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Improving Pricing Accuracy for Various Numerical Methods with the General Control Variate Method

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The control variate method is a popular variance reduction technique used in Monte Carlo methods which are frequently used to price a complex derivative by calculating the expected discounted payoff of that derivative. This method is used in much financial literature to exploit information about the errors in estimates of known quantities – which are usually the prices (or the expected discount payoffs) of derivatives that can be analytically priced – to reduce the error for estimating an unknown quantity, which is usually the price of a complex derivative of interest. This paper generalizes the core idea of the control variate method in two ways: First, the idea of reducing the errors for estimating unknown (discounted) expected values can be generalized extended to a boarder class of operators, the linear operators, like the inverse Fourier transform and the convolution. Second, our method can be separately applied to reduce the error contributed by one or more numerical procedure(s) that are (repeatedly) involved in a numerical pricing method to suppress the overall pricing error. Thus our general control variate method can be applied to reduce the pricing errors of a wide classed of numerical pricing methods, such as the tree method, the characteristic-function-based pricing method, and the convolution-based pricing method. Numerical results shows that our approach can effectively increase the accuracy and the efficiency of many numerical pricing methods.

Keywords: numerical method; pricing; control variate; tree; characteristic function; convolution.

JEL Classifications: C02; G13

1 Introduction

Due to the booming of financial markets, complex derivative products are constructed to meet customers' need. The presences of these complex derivatives do improve the efficiency of financial markets. On the other hand, sophisticated stochastic processes are also investigated to fit the processes of market variables better. But the presence of these sophisticated products and processes also make the derivation of analytical pricing formulae intractable. Thus we must rely on many different numerical methods, such as Monte Carlo simulations, tree methods, characteristic-function-based pricing methods, convolution-based methods, and so on.

When continuous pricing models or equations are hard to be analytically evaluated, they are transferred into discrete counterparts that are suitable for numerical evaluations. Take the CRR tree model proposed by Cox et al. (1979) in Fig. 1 as an example. The time interval $[0, T]$ are discretized into several time steps, each with length Δt. The possible stock prices at each time step are also discretized; for example, there are two stock prices: S_0u and S_0d at the time step 1. The details of this figure will be discussed in later sections. Usually, the pricing results generated by a numerical method converge to the theoretical derivative price as the discretization get finer; for example, the pricing results generated by the CRR tree converge to the theoretical derivative price as Δt gets smaller (see Duffie (1996)). However, increasing the resolution of the discretization would (dramatically) increases the size of the discretization, like the number of tree nodes in Fig. 1, and hence the computational time. Financial practitioners are usually thrown into a dilemma to strike the balance between the pricing accuracy and the computational time.

To address the aforementioned dilemma, finding efficient and accurate numerical pricing methods is an important issue and is widely studied in academic literature. One possible approach is to find an efficient algorithm to speed up computation. For example, evaluating derivatives under the tree model illustrated in Fig. 1 is traditionally performed by the backward induction method. Roughly speaking, we first evaluate the derivative price at each node located in the last time step, say time step 2 in this example. This information is then used to derive the derivative price at each node in time step 1. The above procedure is repeatedly applied by using the derivative prices at time step i to derive the derivative prices at time step $i-1$ until the derivative price at the root node located at time step 0 is obtained. Lyuu (1998) and Dai et al. (2007) suggest that some calculation process of the backward induction method can be saved by taking advantage of combinatorial properties. Thus the pricing performance is improved since the combinatorial method requires less computational time to achieve the same level of accuracy than the backward induction method does.

Another approach to improve a numerical method is to improve the convergence rate of the pricing results. Take the Monte Carlo pricing method (`MC` hereafter) pioneered by Boyle (1977) as an example. It randomly samples the changes of a economic variable, say the underlying asset's price, to evaluate a derivative's price which can be expressed as the discounted expected payoff of that derivative under the so-called risk-neutral probability measure (see Harrison and Pliska (1981)). Note that the pricing result is also a random variable and a large amounts of samples (and hence a large amount of computational time) are required to obtain a satisfactory pricing result. The control variate method can improve the performance of the `MC` by reducing the variances of the pricing results. Instead of directly estimating an unknown quantity which is usually the price of a complex derivative of interest, the control variate method estimates the expected difference between the unknown quantity and the known one – which is usually the value of a simple derivatives that can be analytically evaluated. Thus the unknown quantity can be estimated as the known quantity (evaluated by the analytical formula) plus the estimated difference. The variance of the pricing result can be dramatically reduced if the sample differences are close to zero.

The control variate method is widely adopted in the financial literature. For example, the

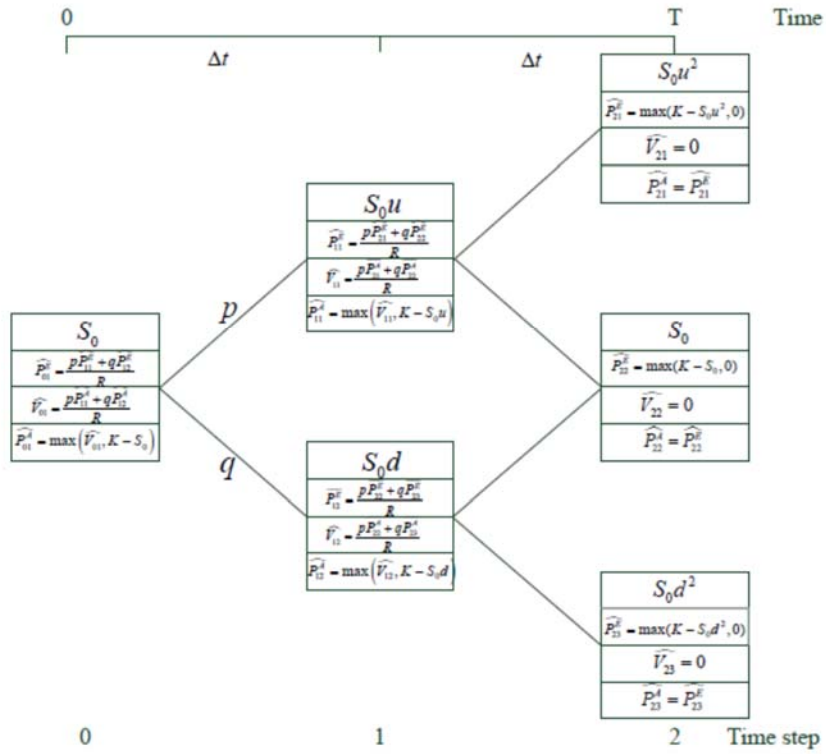


Figure 1: **Pricing American Puts on the Two-time-Step CRR Tree** S_0 denotes the underlying asset's value at time 0, K denotes the strike price, T denotes the time to maturity for the American put, Δt denotes the length of a time step, and R denotes the discount factor. p and q denote the upward and the downward branching probabilities, respectively. u and d denote the upward and the downward multiplication factors, respectively. Each node is represented by a node with four fields, which denote the price of the underlying asset, the price of the European put $\hat{P}^E_{ij}$, the continuation value $\hat{V}_{ij}$, and the price of the American put $\hat{P}^A_{ij}$ of that node. Overhead hat symbols are used to distinguish symbols involved in the traditional backward induction method in this figure from the symbols used in the general control variate method (discussed later). The subscript ij means the j-th node (counted from the uppermost node) at the i-th time step.

payoffs of arithmetic average Asian options (abbreviated to Asian options hereafter) depend on the arithmetic average price of the underlying asset. These options are popular but can not be analytically solved. Kemna and Vorst (1990) derive the analytical pricing formulae for geometric average Asian options whose payoffs depend on the geometric average price of the underlying asset. Since the magnitudes of the differences of the payoffs between these two options are relatively much smaller than the magnitudes of the option payoffs, the variance for estimating the differences of expected payoffs by `MC` is much smaller than the variance for estimating the Asian option value. Thus the pricing accuracy for evaluating an Asian option is improved by summing the value of an otherwise identical geometric average Asian option (evaluated by analytical formulae) plus the expected discounted differences of the payoffs of these two options (evaluated by `MC`). This approach is further improved by Han and Lai (2010) by using an optimal control process as a control variate to gain further variance reduction. Besides, Duan (1995) also applies the control variate method to efficiently evaluate options under the GARCH model. Dingec and Hormann (2012) price path dependent options under Lévy processes by exploiting information about the error to evaluate the same options under geometric Brownian motion.

Hull and White (1988) first generalize the core idea of the control variate method to improve the accuracy for pricing an American put on the CRR tree illustrated in Fig. 1. Specifically, they take advantage of the error for estimating the price of a European put on a CRR tree to reduce the error for estimating the price of an American put. They suggest that the American put can be evaluated as the difference between the estimates of prices of American and European puts on the CRR tree (i.e, $\hat{P}^A_{01} - \hat{P}^E_{01}$)[1] plus the European put price which can be analytically solved by Black and Scholes (1973) formula.

This paper will investigate the property of the control variate method further and examine how useful it could be to improve the performance of various numerical pricing methods. Note that most numerical pricing methods need to evaluate the result for applying a linear operator O on a certain function X. Usually $O(X)$ can not be analytically evaluated and must be estimated numerically. Our core idea is to suppress the error for estimating $O(X)$ in order to improve the overall accuracy of numerical pricing methods. To inherit the spirit of the control variate method, we first pick another function Y as a control variate – call it a control function for simplicity. That is, the control function Y is close to the function X and $O(Y)$ can be analytically solved. Then a more accurate estimation for $O(X)$ is obtained by numerically estimating $O(X - Y)$ plus the analytical result of $O(Y)$. Take pricing American puts with the CRR tree illustrated in Fig. 1 as an example. The American-put-value function of the underlying asset price at an arbitrary positive time step i plays the role of the function X. Finding the continuation-value[2] function (of the underlying asset price) at the time step $i-1$ based on the function X plays the role of the operator O. O can be numerically estimated by a 1-time-step backward induction; in other words, the continuation value of a node (illustrated in the third field) is estimated as the expected discounted option values of its two successor nodes (illustrated in the fourth fields). The European-put-value function at time step i plays the role of control function Y to suppress the error for numerically estimating $O(X)$. This is because the function Y is close to X and each point in the European-put-value function at time step $i-1$ (or $O(Y)$) can be analytically solved by the Black and Scholes (1973) formula. Note that the American put value for each node at time step $i-1$ is then evaluated as the maximum of the continuation value and the exercise value at that node as illustrated in the fourth field of that node. And the aforementioned evaluations are repeated from the last time step to the beginning of the tree to obtain the final pricing result. Note that our approach can repeatedly apply the control variate method to the 1-time-step backward induction, while Hull and White (1988) approach apply once to overall pricing result. Numerical experiments suggest that our approach outperforms their approach.

Two more examples are given to demonstrate how the general control variate method is applied to improve the performance of numerical pricing methods. First, to capture versatile behaviors of the underlying asset price, various processes, such as the jump diffusion process proposed by Merton (1976), the stochastic volatility process proposed by Heston (1993), and so on, are invented to fit real world financial markets better. Since the characteristic functions of most of these processes are simpler to derive analytically than the probability density functions of these processes, Carr and Madan (1999) and Carr and Wu (2004) take advantage of the relation between the Fourier transforms of vanilla option prices and the characteristic functions to price vanilla options. Specifically, the option prices can be evaluated as an inverse Fourier transform (or the operator O) of the function X which can be expressed in terms of the characteristic function. $O(X)$ may not be analytically solved but can be numerically evaluated by the fast Fourier transform (FFT)– which can be viewed as a numerical integration as discussed later. However, the integrand oscillates significantly, which makes a high resolution of discretization (and hence

[1] The pricing results generated by the CRR tree for European and American puts in Fig. 1 are $\hat{P}^E_{01}$ and $\hat{P}^A_{01}$, respectively.

[2] The continuation value means the value to hold an American put without exercising it immediately.

a large amount of computational time) necessary to obtain a satisfactory pricing result. To improve the pricing performance under the general control variate method, we pick a control function Y that is close to X and $O(Y)$ is required to be analytically solved to avoid introducing extra numerical errors. Again, the error for estimating $O(X)$ is significantly suppressed by numerically evaluating $O(X-Y)$ plus the analytical function $O(Y)$. Numerical results suggest that our revised method provide more accurate pricing results and can avoid the negative-price problem for pricing deep-out-of money options.

Next, the general control variate method is used to improve the performance of the convolution-based Asian option pricing method. The payoff of an Asian option depends on the average price of the underlying asset. The pricing problem is intractable since the density function of the average asset price f_A can not be analytically solved. Carverhill and Clewlow (1990) and Benhamou (2002) suggest that f_A can be numerically evaluated by alternatively applying a convolution and a Jacobian transformation[3] on density functions. Numerical errors propagate and accumulate when the aforementioned operators are alternatively applied numerically. To reduce the overall pricing error, we apply the general control variate method alternatively on each operator to suppress the numerical error introduced by that operator. Numerical results show that our revised method is more accurate and more efficient than the original pricing method.

The rest of this paper is organized as follows. In Sec. 2, we will survey the traditional control variate method and introduce the framework of our general version. Then we demonstrate how general control variate method reduce the pricing error of the the tree pricing method, the characteristic-function-based pricing method, and the convolution-based pricing method in Sec. 3, 4, and 5, respectively. A simple survey of each numerical method and the related numerical experiments will also be given in the corresponding section. Sec. 6 concludes the paper.

2 The Control Variate Method

2.1 The Traditional Version

The traditional control variate method is a variance reduction technique used in MC (see Glasserman, 2004). It uses the estimation error of a known quantity, say $\mathrm{E}(Y)$, to improve the estimation of a unknown quantity, say $\mathrm{E}(X)$, where X and Y are random variables. Specifically, $\mathrm{E}(X)$ can be estimated as

$$\begin{aligned} \mathrm{E}(X) &\approx \mathrm{E}^{\mathtt{MC}}(X) && (1)\\ &\approx \mathrm{E}^{\mathtt{MC}}(X-Y)+\mathrm{E}(Y), && (2) \end{aligned}$$

where $\mathrm{E}^{\mathtt{MC}}$ denotes an operation to estimate the expected value with MC, Eq. (1) and Eq. (2) denote that $\mathrm{E}(X)$ is estimated by directly applying MC or by applying the traditional control variate method, respectively. For convenience, let $\mathrm{Var}(X)$ and $\mathrm{Cov}(X,Y)$ denote the variance of X and the covariance of X and Y, respectively. The performances for estimating $\mathrm{E}(X)$ by above two approaches can be measured by the variances of the righthand sides of Eq. (1) and Eq. (2), which are $\mathrm{Var}(X)$ and $\mathrm{Var}(X)+\mathrm{Var}(Y)-2\mathrm{Cov}(X,Y)$, respectively. Thus, the control variate method can dramatically improve the performance for estimating $\mathrm{E}(X)$ (or reduce the variance) if we can find a proper Y that is highly correlated to X. Note that a derivative price can be expressed as the expected present value of its future payoff under the risk neutral probability measure. Thus much literature take advantage of the traditional control variate method to evaluate the value of a complex derivative with a simple derivative that can be analytically priced. For example, Kemna and Vorst (1990) price an Asian option by using a geometric

[3]It is used to find the probability density of one random variable that can be expressed in terms of more fundamental random variable(s).

average Asian option's payoff as the control variate. The pricing performance is dramatically improved since the payoff of the latter (simple) derivative is highly correlated to the former (complex) derivative.

2.2 The General Version

The core idea of traditional control variate method illustrated in Eq. (2) can be further generalized to other linear numerical methods[4] like a numerical integration. Specifically, recall that random variables X and Y can be treated as real-valued functions defined on the sample space Ω. Thus the unknown quantity $\mathrm{E}(X)$ can be estimated by numerically integrating $\int_\Omega X(\omega)dP(\omega)$, where P denotes the probability density function. The linear property of a numerical integration asserts that $\mathrm{E}(X)$ can also be estimated by

$$\mathrm{E}(X) \approx \int_\Omega (X(\omega) - Y(\omega))\, dP(\omega) + \int_\Omega (Y(\omega))\, dP(\omega), \tag{3}$$

which is analogous to Eq. (2). To improve the accuracy for estimating $\mathrm{E}(X)$ in Eq. (3), we mimic the core idea of the traditional control variate method – picking a highly correlated random variable Y to reduce the numerical error of $\mathrm{E}^{MC}(X-Y)$. Analogously, we can properly select a function Y that is close to the function X to reduce the error for numerically evaluating $\int_\Omega (X(\omega) - Y(\omega))\, dP(\omega)$. In addition, $\int_\Omega (Y(\omega))\, dP(\omega)$ (or $\mathrm{E}(Y)$) is required to be exactly solved without introducing extra numerical errors to ruin the accuracy for estimating $\mathrm{E}(X)$ by Eq. (3).

Indeed, the above idea can be further extended to reduce the error for applying any linear operator O to numerically estimate a wide class of unknown quantities, like the density function of the average underlying asset price f_A mentioned in the introduction. Specifically, the linear property assets that applying O on the input X can be evaluated as

$$O(X) \approx O^N(X-Y) + O(Y) \tag{4}$$

instead of $O^N(X)$, where N denotes the numerical evaluation of O. To suppress the error of Eq. (4), we pick a proper input Y that is close to the input X to suppress the numerical error of $O^N(X-Y)$. $O(Y)$ is required to be analytically solved to avoid introducing extra numerical errors. Since many numerical pricing methods may numerically evaluate one or many operator(s) repeatedly, the overall pricing accuracy can be improved by suppressing the numerical error for evaluating each operator with the "general version" of the control variate method. For example, in a characteristic-function-based pricing method like Carr and Madan (1999) and Carr and Wu (2004), the inverse Fourier transform and the characteristic function of the underlying asset's process play the roles of O and X, respectively. A numerical method may numerically evaluate more than one operators that can be improved by the general control variate method. In a convolution-based pricing method like Carverhill and Clewlow (1990) and Benhamou (2002), the convolution and the Jacobian transformation are alternatively applied repeatedly. The general control variate method is applied on each operator to improve the accuracy of an intermediate output rather than directly on the pricing result. In addition, the intermediate output is not necessary a value; it can be a discretized function, say a discretized density function in the convolution-based pricing method. Our numerical experiments suggest that the accumulations of these "partial" improvements would result in overall performance improvement of a numerical pricing method in terms of accuracy and computational time.

[4]Hull and White (1988) improves the pricing accuracy of American puts by generalizing the traditional control variate method to the tree method – which is not a linear numerical method. Note that the linear property (of a numerical method)is a sufficient condition, but not a necessary condition for generalizing the traditional control variate method to that numerical method.

Applying the control variate method to reduce the error for numerically estimating $O(X)$ is similar to the procedure mentioned above. First, we find a proper control function Y that makes $O(Y)$ analytically solvable and that is close to X. Then the error for estimating $O(X)$ is reduced by estimating $O(X-Y)$ numerically plus the analytical value of $O(Y)$. Note that the effectiveness of the general control variate method highly depends on how the control function Y is close to the function X. For pricing American puts on the tree, we use the European-put-price function of the underlying asset as the control function since these two options are almost identical except the right to exercise the option early. For the characteristic-function-based pricing method, we use the characteristic function of the jump diffusion process proposed in Merton (1976) to approximate the characteristic function of the underlying asset's price process. The parameters of the former process is calibrated to make the first five cumulants of the former process match the cumulants of the latter process. For the convolution-based pricing method, we use the normal density function to approximate the density function inputted to the convolution or the Jacobian transformation. Again, the parameters of the former density function are calibrated to make the first two moments of the former function match the estimated moments of the latter one.

3 Pricing American Puts under Tree Methods

3.1 Background Introduction

A put option grants a holder the right to sell the underlying asset for a predetermined strike price K. While a European put only allows the option holder to exercise the right at the maturity date T, an American put allows the holder to exercise the right at any time τ prior to maturity T. Let S_t denote the underlying asset price process at time t for convenience. The payoff of a European put at maturity is $(K-S_T)^+$, and the payoff to exercise an American put at time τ is $(K-S_\tau)$. By taking advantage of the risk neutral valuation method, the value of a European put P^E and an American put P^A can be expressed as the expected discounted payoff

$$\begin{aligned} P^E &= \mathrm{E}_Q\left[e^{-rT}(K-S_T)^+\right] && (5)\\ P^A &= \max_{\tau\in\Upsilon}\mathrm{E}_Q\left[e^{-r\tau}(K-S_\tau)\right], && (6)\end{aligned}$$

where r denotes the risk-free rate, Q denotes the risk neutral measure, and Υ denotes the set of all stopping times. Here we follow Hull and White (1988) by assuming that S_t follow the lognormal diffusion process

$$\ln(S_t/S_0) = \left(r-\sigma^2/2\right)t + \sigma W_t, \tag{7}$$

where σ denotes the volatility of the underlying asset's price, and W_t denotes a standard Brownian motion. Note that Eq. (5) can be analytically evaluated by the Black and Scholes (1973) formula, while Eq. (6) can not be analytically evaluated due to the difficulty to estimate the early exercise premium.

The evolution of a lognormal diffusion process in Eq. (7) can be discretely simulated by a tree, say the CRR tree (see Cox et al., 1979), as illustrated in Fig. 1. It divides the time interval $[0,T]$ into several equal time steps, each with length Δt. For convenience, the number xy in the subscript of $\hat{P}^E$ and $\hat{P}^A$ denote the values of the European put and the American put at node (i,j) – the j-th node (counted from the uppermost node) at the i-th time step. The underlying asset price S at an arbitrary node (i,j) would move to Su (node $(i+1,j)$) with probability p or Sd (node $(i+1,j+1)$) with probability q at the next time step, where multiplication factors u and d are set to $e^{\sigma\sqrt{\Delta t}}$ and $1/u$, respectively, and branching probabilities p and q are set to $\frac{e^{r\Delta t}-d}{u-d}$ and $1-p$, respectively, to match the first two moments of the lognormal diffusion process.

Both European and American puts can be numerically priced on a CRR tree by the backward induction method; that is, we evaluate the option values (of the nodes) from the end of the tree to its beginning. Specifically, the value of a European put for an arbitrary node prior to maturity, say $\hat{P}_{ij}^E$, is evaluated as the expected discounted value of its successor node $\hat{P}_{ij}^E = \frac{p\hat{P}_{i+1,j}^E + q\hat{P}_{i+1,j+1}^E}{R}$, where R denotes the 1-time-step discount factor $e^{-r\Delta t}$. An American put grants holder the right to exercise the put at node (i,j) for the profit $K - S(i,j)$, where $S(i,j)$ denotes the asset value at that node. The holder can also choose not to exercise the option at node (i,j) immediately and the value of the option, called the continuation value for simplicity, can be estimated by

$$\hat{V}_{ij} = \frac{p\hat{P}_{i+1,j}^A + q\hat{P}_{i+1,j+1}^A}{R}. \tag{8}$$

The holder will decide whether he/she exercises the option or not to maximize the benefit; that is, the value of American put at node (i,j) is

$$\max\left(\hat{V}_{ij}, K - S(i,j)\right). \tag{9}$$

The pricing results for European and American puts are $\hat{P}_{01}^E$ and $\hat{P}_{01}^A$, respectively. The accuracy of the pricing results can be improved as the discretization of the tree get finer.

3.2 Applying the Generalized Control Variate Method

The operator that calculates the expected discounted payoff as in Eqs. (5) and (6) can be numerically estimated by the tree method. Hull and White (1988) extend the control variate method by applying it on the tree method instead of `MC`. They take advantage of the error for estimating P^E by the tree method to reduce the error for estimating P^A. The estimation result $\hat{P}_{01}^A - \hat{P}_{01}^E + \mathrm{BS}(S_0, T)$ is much more accurate than $\hat{P}_{01}^A$ given the same discretization level (of the tree), where $\mathrm{BS}(a, b)$ denotes the Black and Scholes (1973) put option pricing formula with the underlying asset price a and the time to maturity b.

We generalize the control variate method further by applying it to improve the accuracy of certain operators in the tree method. Here we detail how the continuous pricing model in Eq. (6) is transferred into its discrete counterpart since similar concepts and notations will be used in the following sections. Recall that a n-time-step tree method discretizes the time interval $[0, T]$ into n equal-distance time steps. Thus, pricing the American put on the tree can be viewed to repeat the operator O_B, to evaluate the continuation value function of the underlying asset's value at time step $i-1$ based on the option-value function at time step i, n times from the last step back to the beginning of the tree. Take Fig. 1 as an example. Let P_i^A, V_i, and P_i^E denote the American put value function, continuation value function, and the European put value functions of the underlying asset at time step i, respectively. P_2^A can be discretely approximated by keeping the option values at certain points, say S_0u^2, S_0, and S_0d^2, in a list $\hat{\mathbb{P}}_2^{\mathbb{A}}$; that is, $\hat{\mathbb{P}}_2^{\mathbb{A}} \equiv \{\hat{P}_{21}^A, \hat{P}_{22}^A, \hat{P}_{23}^A\}$. The operator O_B is numerically evaluated by applying the 1-time-step backward induction formula like Eq. (8) on $\hat{\mathbb{P}}_2^{\mathbb{A}}$ to obtain the discretization of the continuation value function at time step 1, $\hat{\mathbb{V}}_1 \equiv \{\hat{V}_{11}, \hat{V}_{12}\}$. The above numerical estimation can be expressed as $\hat{\mathbb{V}}_1 = O_B^N(\hat{\mathbb{P}}_2^{\mathbb{A}})$, where O_B^N denotes that the operator O_B is evaluated numerically. Then the list of the American put values at time step 1, $\hat{\mathbb{P}}_1^{\mathbb{A}}$ is obtained by judging whether exercising the put is beneficial or not by Eq. (9) at each node in the time step 1. O_B^N and the early exercise judgement can be alternatively applied to obtain the final pricing result $\hat{P}_{01}^A$.

Now we improve the accuracy for estimating the continuation value function and as a consequence the American put value function by the general control variate method as illustrated in Fig. 2. The American and the European-put-value functions play the roles of the function of interest X and the control function Y, respectively. Unlike Eq. (8), the continuation value for a

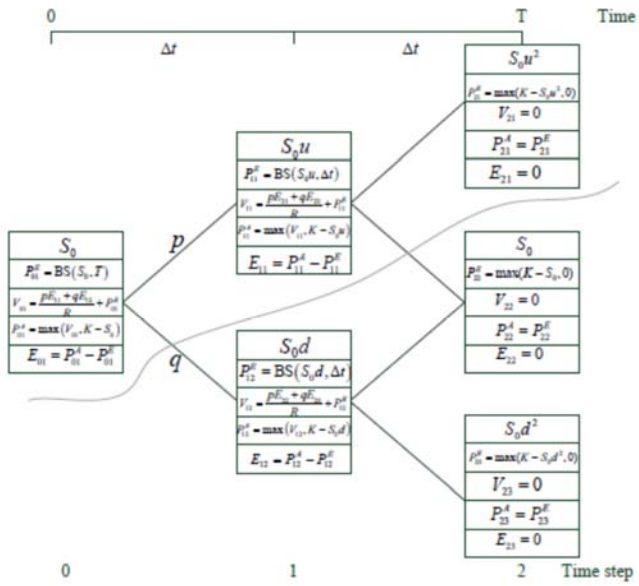


Figure 2: **Pricing American Puts with the General Control Variate Method** The meanings of S_0, u, d, p, q, and K are the same as those in Fig. 1. Each node (i,j) is represented by a rectangle with five fields, which denote the price of the underlying asset, the analytical value of the European put P_{ij}^E, the continuation value V_{ij}, the value of the American put P_{ij}^A, and the early exercise premium E_{ij}.

node (i,j) prior to maturity is now estimated as $V_{ij} \equiv \frac{pE_{i+1,j}+qE_{i+1,j+1}}{R} + P_{ij}^E$, where $E_{i,j}$ denotes the early exercise premium, or the difference of the values of the American and the European puts at node (i,j). P_{ij}^E denotes the European put value at node (i,j) that is analytically evaluated by the Black and Scholes (1973) formula[5]. The above formula for evaluating V_{ij} is applied to evaluate the value of each element in the list $\mathbb{V}_i$ that discretely approximate the function V_i. Indeed, the above approximation can be expressed in terms of the general control variate method as

$$\mathbb{V}_i = O_B^N(\mathbb{P^A}_{i+1} - \mathbb{P^E}_{i+1}) + O_B(P_{i+1}^E), \tag{10}$$

where the difference of two lists $\mathbb{P^A}_{i+1} - \mathbb{P^E}_{i+1}$ is the list of the early exercise premium or the discretization of the difference between the functions X and Y. Note that applying O_B on the European put value function at time step $i+1$, P_{i+1}^E, will obtain the function P_i^E. This can be proved by applying the tower rule on Eq. (5) as follows:

$$\begin{aligned} P_i^E(S_{i\Delta t}) &= \mathrm{E}_Q\left[e^{-r(T-i\Delta t)}(K-S_T)^+|S_{i\Delta t}\right] \\ &= \mathrm{E}_Q\left[e^{-r\Delta t}\mathrm{E}_Q\left[e^{-r(T-(i+1)\Delta t)}(K-S_T)^+|S_{(i+1)\Delta t}\right]|S_{i\Delta t}\right] \\ &= \mathrm{E}_Q\left[e^{-r\Delta t}P_{i+1}^E|S_{i\Delta t}\right]. \end{aligned}$$

By taking advantage of the general control variate method in Eq. (10), we get the list $\mathbb{V}_i$ that is more accurate than the list $\hat{\mathbb{V}}_i$ evaluated by directly applying the backward induction. The list of American put values $\mathbb{P^A}_i$ is then obtained by substituting $\mathbb{V}_i$ into Eq. (9). Note that $\mathbb{P^A}_i$ tends to be more accurate than $\hat{\mathbb{P}}_i^{\mathbb{A}}$ since $\mathbb{V}_i$ is more accurate than $\hat{\mathbb{V}}_i$ Our accurate pricing method for American put is constructed by repeatedly applying the above procedure as

[5]Note that P_{ij}^E and P_i^E are different symbols distinguished by the number of elements in the subscript. The latter symbol denotes the European put value function at the time step i.

described in Algorithm 1. Note that other numerical methods in the following sections will also be described in this format without giving a specificized example like Fig. 2 for brevity.

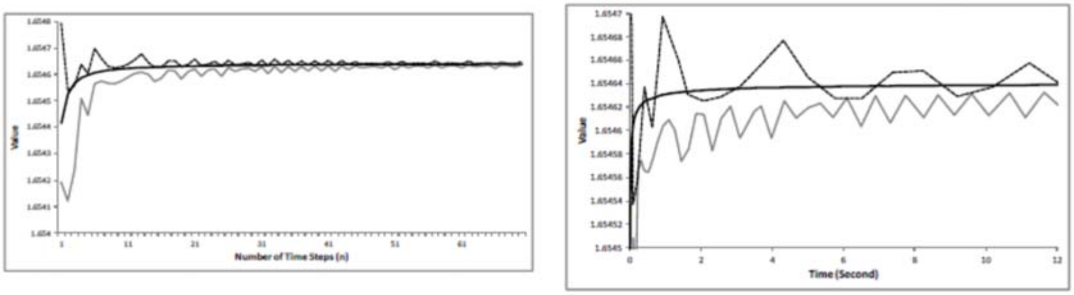
Algorithm 1 The General Control Variate Method for Pricing American Puts on a n-Time-Step Tree.

1: Evaluate the list of the early exercise premium $\mathbb{E}_n(\equiv \mathbb{P}^{\mathbb{A}}{}_n - P_n^E)$.
2: **for** $i = n-1$ down to 0 **do**
3: Evaluate the list of the continuation value $\mathbb{V}_i$ by substituting $\mathbb{E}_{i+1}$ into Eq. (10).
4: Evaluate the list of the American put value $\mathbb{P}^{\mathbb{A}}{}_i$ by substituting $\mathbb{V}_i$ into Eq. (9).
5: Evaluate the list of the early exercise premium $\mathbb{E}_i(\equiv \mathbb{P}^{\mathbb{A}}{}_i - P_i^E)$.
6: **end for**
7: The pricing result is the American put value at the beginning node of the tree; i.e, P_{01}^A.

3.3 Numerical Experiments

Recall that the pricing results of a tree method converge to the theoretical value (about 1.64563 in this example) as the number of time steps n increases. Compared to the results generated by directly applying the backward induction method to the tree model (denoted by the gray dotted line), the Hull and White (1988) method applies the control variate method once on the overall pricing results (denoted by black dashed line) and slightly improve the accuracy for pricing American puts as illustrated in Fig. 3 (a). That is, given the same number of time steps (of the tree method), the pricing result generated by the Hull and White (1988) method tends to be closer to 1.65463 than the result generated by the direct backward induction. In addition, our approach repeatedly applies the general control variate method and the pricing results (denoted by the black solid line) significantly improve the accuracy and reduce the oscillation problem.

Note that a sophisticated pricing method like our approach would require extra computations (like evaluating the Black-Scholes pricing formula many times) and hence long computational time. Thus evaluating the performances among different pricing methods should compare the convergence rates of these methods in terms of computational time as illustrated in Fig. 3 (b). Indeed, most of extra computations in Algorithm 1 can be skipped by taking advantage of the property of the early exercise boundary (see Curran, 1994). For convenience, we call a node (i,j) an "early-exercise node" if the option holder decides to exercise the American put immediately at that node (i.e, $V_{ij} < K - S(i,j)$); otherwise, we call it a "non-early-exercise node". There exists a default boundary, like the gray curve in Fig. 2, that divide the tree nodes into two groups: the group of non-early-exercise nodes in the upper part of the tree and the group of early-exercise nodes in the lower part. We mimic the Curran (1994) method to estimate the default boundary and use the general control variate method to improve the estimation. For each non-early-exercise node (i,j), we directly evaluate the early exercise premium E_{ij} without calculating P_{ij}^A; that is, we evaluate E_{ij} as $\frac{pE_{i+1,j}+qE_{i+1,j+1}}{R}$ without involving the Black-Scholes pricing formula. For early-exercise nodes, we only calculate the values for the node right below the default boundary. The evaluation for other early-exercise nodes can be skipped without influencing the pricing results as mentioned in Curran (1994). Indeed, the above concept can be used to improve all tree-based pricing algorithms analyzed in this numerical experiment. The experiment suggests that our method still converges much faster than the other two methods in terms of the computational time as in Fig. 3 (b).



(a) (b)

Figure 3: Convergence Comparisons for Pricing American Puts

The x axes in panel (a) and (b) denote the number of time steps (in thousands) and the computational time, respectively. The y axes in both panels denote the American put prices generated by different numerical methods. The gray dotted lines denote the results generated by directly applying the backward induction method on the CRR tree. The black dashed lines denote the results generated by Hull and White (1988) method. The black solid lines denote the results generated by our method. The initial underlying asset's price S_0 is 40, the time to maturity T is 3 year, the strike price K is 35, the risk-free rate r is 0.05, and the volatility σ is 0.2.

4 Characteristic-Function-Based Pricing Methods

4.1 Background Introduction

A plenty of empirical studies suggest that many assets' prices have certain features like "high peak" and "heavy tail" that can not be properly modeled by the aforementioned lognormal diffusion process (see e.g. Eberlein et al. (1998) ,Hosking et al. (2000), and Koedijk et al. (1998)). To capture these features better, many financial experts develop complex processes like the variance gamma process (see Madan et al. (1998)) and the stochastic volatility process (see Heston (1993)) to model the evolution of an asset price process. However, pricing derivatives on these complicated processes under the risk neutral variation method could become mathematical intractable. This is because the density of the asset price can not be analytically solved, which make the closed-form pricing formulae for even the simplest vanilla options unavailable. Fortunately, the analytical formulae of return characteristic functions for a vast class of price processes are available, and can be applied to price derivatives as mentioned in Bakshi and Chen (1997), Bates (1996), and Chen and Scott (1992). The following discussions focus on the approach proposed by Carr and Madan (1999) since it seems to be the most efficient one due to the use of FFT to improve the performance. Our general control variate method can be applied to improve the accuracy of their pricing method by finding a proper control function that approximates the target characteristic function. The information about the difference between the control function and the target function is then exploited to reduce the pricing error.

Assume that the underlying asset price process S_t follows a stochastic process G. Carr and Madan (1999) propose that the value of a European call option can be expressed as a function $C_G^{\mathrm{E}}(e^k)$ of the strike price e^k as follows:

$$C_G^{\mathrm{E}}(e^k) = E_Q\left[e^{-rT}(S_T - e^k)^+\right] = \int_k^{\infty} (e^s - e^k) q(s)\, ds = \frac{e^{-dk}}{\pi} \int_0^{\infty} \mathrm{Re}[e^{-ivk}\psi_G(v)]\, dv, \tag{11}$$

where q denotes the density function of $\ln S_T$, and $\mathrm{Re}[x]$ denotes the real part of a complex number x. ψ_G is the Fourier transform of $e^{dk}C_G^{\mathrm{E}}(e^k)$, where $d > 0$ denotes an exogenously given damping constant[6]. Thus ψ_G can be expressed as

$$\psi_G(v) \;=\; \frac{e^{-rT}\,\phi_G(v-(d+1)i)}{d^2+d-v^2+i(2d+1)v},$$

where ϕ_G denotes the characteristic function of q; that is, $\phi_G(v) \equiv \int_{-\infty}^{\infty} e^{ivs}q(s)\,ds$.

The call option value in Eq. (11) can be approximately evaluated by a numerical integration method like the Trapezoid rule as follows:

$$\begin{aligned} C_G^{\mathrm{E}}(e^k) &= \frac{e^{-dk}}{\pi}\int_0^{\infty} \mathrm{Re}[e^{-ivk}\psi_G(v)]\,dv && (12)\\ &= \frac{e^{-dk}}{\pi}\int_0^{\eta N} \mathrm{Re}[e^{-ivk}\psi_G(v)]\,dv + \text{truncation error} && (13)\\ &= \frac{e^{-dk}}{\pi}\sum_{j=0}^{N-1}\frac{\eta}{2}\mathrm{Re}\left[e^{-i\eta jk}\psi_G(j\eta)+e^{-i\eta(j+1)k}\psi_G((j+1)\eta)\right] + \text{truncation error} + \text{sampling error}, && (14) \end{aligned}$$

where η denotes the distance between quadrature points, and N denotes the number of quadrature points. The improper integral in Eq. (12) can be approximated by truncating the upper limit and using the definite integral in Eq. (13) since $|e^{-ivk}\psi_G(v)|$ converges to zero as $v \to \infty$. The error incurred due to the truncation is called the truncation error which is negligible when $N\eta$ becomes larger (see Lee, 2004). The sampling error in Eq. (14) is the error contributed by approximating a definite integral with the Trapezoid rule and is equal to

$$\frac{1}{12}\eta^3\left(\frac{d^2}{dv^2}\mathrm{Re}\left[e^{iv_0k}\psi_G(v_0)\right]\right) \tag{15}$$

for some $v_0 \in [0, N\eta]$.

4.2 Applying the General Control Variate Method to Improve a Characteristic-Function-Based Pricing Method

In the aforementioned characteristic-function-based pricing method, the values of the function ψ_G are discretely sampled to store in a list $\psi_{\mathbb{G}} \equiv \{\psi_G(0), \psi_G(\eta), \cdots, \psi_G(N\eta)\}$, then the inverse Fourier transform is applied numerically on the list $\psi_{\mathbb{G}}$ as in Eq. (14). That is, the call option value $C_G^{\mathrm{E}}(e^k)$ is numerically estimated as

$$C_G^{\mathrm{E}}(e^k) \approx O_{\mathrm{IF}}^N(\psi_{\mathbb{G}}),$$

where the operator O_{IF} denotes the inverse Fourier transform, and the superscript N denotes that the operator is numerically evaluated. To apply our general control variate method to suppress the pricing error contributed by the numerical evaluation, we first find a control price process, say the jump diffusion process in this paper. Let ψ_{CTRL} be the Fourier transform of the call value function $C_{\mathrm{CTRL}}^{\mathrm{E}}(e^k)$ (on the control process) multiplied by e^{dk}, and $\psi_{\mathbb{CTRL}}$ be a list of discrete samples of ψ_{CTRL}: $\{\psi_{\mathrm{CTRL}}(0), \psi_{\mathrm{CTRL}}(\eta), \cdots, \psi_{\mathrm{CTRL}}(N\eta)\}$. Then our general control variate method exploits the information of $\psi_{\mathbb{G}} - \psi_{\mathbb{CTRL}}$ to reduce the numerical error for applying O_{IF}^N and improve the accuracy for estimating $C_G^{\mathrm{E}}(e^k)$ as follows:

$$C_G^{\mathrm{E}}(e^k) = O_{\mathrm{IF}}(\psi_{\mathrm{CTRL}}) + O_{\mathrm{IF}}^N(\psi_{\mathbb{G}} - \psi_{\mathbb{CTRL}}). \tag{16}$$

Obviously, the performance of error reduction depends on how ψ_{CTRL} is close to ψ_G. In addition, $O_{\mathrm{IF}}(\psi_{\mathrm{CTRL}})$ must be analytically solvable to avoid the introduction of other numerical errors.

[6]Note that the Fourier transform of $C_G^{\mathrm{E}}(e^k)$ doesn't exist since it is not a square integrable function– note that it tends to S_0 as k tends to $-\infty$. Carr and Madan (1999) employ a proper damping constant d to make the Fourier transform of $e^{dk}C_G^{\mathrm{E}}(e^k)$ well defined.

Therefore, Eq. (16) entails that the call value function C_G^{E} in Eq. (11) under our general control variate method is evaluated as follows:

$$\begin{aligned} C_G^{\mathrm{E}}(e^k) &= \frac{e^{-dk}}{\pi}\int_0^\infty \mathrm{Re}\left[e^{-ivk}\psi_G(v)\right]\,dv \\ &= \frac{e^{-dk}}{\pi}\int_0^\infty \mathrm{Re}\left[e^{-ivk}[\psi_{\mathrm{CTRL}}(v)+\psi_{\mathrm{RESIDUAL}}(v)]\right]\,dv \\ &\equiv C_{\mathrm{CTRL}}^{\mathrm{E}}(e^k)+C_{\mathrm{RESIDUAL}}^{\mathrm{E}}(e^k), \end{aligned} \tag{17}$$

where $\psi_{\mathrm{RESIDUAL}}(v) \equiv \psi_G(v) - \psi_{\mathrm{CTRL}}(v)$ be the difference between ψ_G and ψ_{CTRL}, $C_{\mathrm{CTRL}}^{\mathrm{E}}(e^k)$ (or $O_{\mathrm{IF}}(\psi_{\mathrm{CTRL}})$) should be analytically evaluated to avoid extra numerical errors.

In this paper, we demonstrate our idea by choosing the jump-diffusion process proposed by Merton (1976) as the control process. Then we tune the parameters of the control process to reduce the amplitude of $\psi_{\mathrm{RESIDUAL}}(v)$ and hence the pricing error. Specifically, a jump-diffusion process follows the stochastic differential equation:

$$dS_t = \left(\mu + \frac{\sigma^2}{2}\right) S_t\,dt + \sigma S_t\,dW_t + (e^{J_t}-1)S_t\,dM_t,$$

where μ and σ^2 denote respectively the drift and the volatility of the diffusion component of the asset price, and W_t denotes a standard Brownian motion. The jump component is governed by a Poisson process M_t with intensity λ, and it is independent of W_t. The jump size is governed by a sequence of independent normal random variables J_t with mean μ_J and standard derivation σ_J. The characteristic function of $\ln S_T$ can be expressed as an infinite series:

$$\phi_{\mathrm{MJD}}(v) = \exp\left(-\lambda T + iv(\mu T + \ln S_0) - \frac{1}{2}\sigma^2 T v^2\right)\sum_{h=0}^{\infty}\frac{(\lambda T \exp(iv\mu_J - \frac{\sigma_J^2 v^2}{2}))^h}{h!}.$$

To avoid the truncation error caused by the truncation of the infinite summation, we consider a modified jump-diffusion process with at most $H-1$ jumps during the option life; that is, the characteristic function of $\ln S_T$ of this modified process, denoted as $\phi_{\mathrm{MJD}_H}(v)$, is the sum of the first H terms of $\phi_{\mathrm{MJD}}(v)$ expressed as follows:

$$\phi_{\mathrm{MJD}_H}(v) \equiv \exp\left(-\lambda T + iv(\mu T + \ln S_0) - \frac{1}{2}\sigma^2 T v^2\right)\sum_{h=0}^{H-1}\frac{(\lambda T \exp(iv\mu_J - \frac{\sigma_J^2 v^2}{2}))^h}{h!}. \tag{18}$$

The call price formula for this modified process will play the role of $C_{\mathrm{CTRL}}^{\mathrm{E}}(e^k)$ in Eq. (17) and can be expressed as a summation of the following finite sequence:

$$C_{\mathrm{CTRL}}^{\mathrm{E}}(e^k) = \sum_{h=0}^{H-1}\frac{e^{-\lambda' T}(\lambda' T)^h}{h!}\mathrm{BS}_C(S_0, e^k, T, \sigma_h, r_h) \quad \text{for} \quad u = 0, 1, \ldots, m-1, \tag{19}$$

where $\lambda' \equiv \lambda e^{\mu_J + \frac{\sigma_J^2}{2}}$. $\mathrm{BS}_C(S_0, e^k, T, \sigma_h, r_h)$ denotes the Black-Scholes call option pricing formula on the lognormal diffusion process (see Black and Scholes, 1973) with the initial underlying asset's price S_0, the strike price e^k, the time to maturity T, the risk-free rate $r_h \equiv \mu + \frac{\sigma^2}{2} + \frac{h(\mu_J + \frac{\sigma_J^2}{2})}{T}$, and the volatility rate $\sigma_h \equiv \sqrt{\sigma^2 + \frac{h\sigma_J^2}{T}}$. The Fourier transform of $e^{dk}C_{\mathrm{CTRL}}^{\mathrm{E}}(e^k)$, denoted as ψ_{CTRL}, can be expressed as

$$\psi_{\mathrm{CTRL}}(v) \equiv \frac{e^{-(\mu + \frac{\sigma^2}{2} + \lambda(e^{\mu_J + \frac{\sigma_J^2}{2}} - 1))T}\,\phi_{\mathrm{MJD}_H}(v - (d+1)i)}{d^2 + d - v^2 + i(2d+1)v}. \tag{20}$$

Thus the residual part call price $C^{\mathrm{E}}_{\mathrm{RESIDUAL}}(e^k)$ in Eq. (17) can be numerically estimated as follows:

$$\begin{aligned} C^{\mathrm{E}}_{\mathrm{RESIDUAL}}(e^k) &= \frac{e^{-dk}}{\pi}\int_0^\infty \mathrm{Re}\left[e^{-ivk}\psi_{\mathrm{RESIDUAL}}(v)\right] dv \\ &\approx \frac{e^{-dk}}{\pi}\sum_{j=0}^{N-1}\frac{\eta}{2}\mathrm{Re}\left[e^{-i\eta jk}\psi_{\mathrm{RESIDUAL}}(j\eta) + e^{-i\eta(j+1)k}\psi_{\mathrm{RESIDUAL}}((j+1)\eta)\right] \\ &= O^N_{\mathrm{IF}}(\psi_{\mathrm{G}} - \psi_{\mathrm{CTRL}}). \end{aligned} \tag{21}$$

Next we calibrate the parameters for the jump diffusion process to make ψ_{CTRL} close to ψ_G through the cumulant matching method. Assume that the first five cumulants of $\ln S_T$ under the process of interest G exist and are equal to m_1, m_2, m_3, m_4, and m_5, respectively. Matching these five cumulants to the first five cumulants of $\ln S_T$ under the jump-diffusion process yields the following equations:

$$(\mu + \lambda\mu_J)\,T + \ln S_0 = m_1, \tag{22}$$
$$\left(\sigma^2 + \lambda\left(\mu_J^2 + \sigma_J^2\right)\right)T = m_2, \tag{23}$$
$$\lambda(\mu_J^3 + 3\mu_J\sigma_J^2)T = m_3, \tag{24}$$
$$\lambda(\mu_J^4 + 6\mu_J^2\sigma_J^2 + 3\sigma_J^4)T = m_4, \tag{25}$$
$$\lambda(\mu_J^5 + 10\mu_J^3\sigma_J^2 + 15\mu_J\sigma_J^4)T = m_5. \tag{26}$$

Note that the left hand sides of the above equations are the first five cumulants of $\ln S_T$ under the jump-diffusion process.[7]

The parameters for jump diffusion process are calibrated by solving Eqs. (22)$\sim$(26). We first rewrite Eq. (24) as

$$\sigma_J^2 = \frac{m_3 - \lambda\mu_J^3 T}{3\lambda\mu_J T}. \tag{27}$$

By substituting Eq. (27) for all σ_J^2 in Eq. (25) and Eq. (26), we have

$$\begin{aligned} &-2\mu_J^6T^2\lambda^2 + (4m_3\mu_J^3T - 3\mu_J^2m_4T)\lambda + m_3^2 = 0, \\ &-2\mu_J^6T^2\lambda^2 - 3\mu_Jm_5T\lambda + 5m_3^2 = 0. \end{aligned}$$

By equating the above two equations, we get

$$\lambda = \frac{4m_3^2}{\left(3m_5\mu_J - 3m_4\mu_J^2 + 4m_3\mu_J^3\right)T}. \tag{28}$$

Substituting σ_J^2 in Eq. (27) and λ in Eq. (28) into Eq. (24) would yield a quartic polynomial equation of μ_J as follows:

$$48m_3^4\mu_J^4 - 120m_3^3m_4\mu_J^3 + 9m_3^2\left(8m_3m_5 + 5m_4^2\right)\mu_J^2 - 54m_3^2m_4m_5\mu_J + 9m_3^2m_5^2 = 0. \tag{29}$$

The above equation can be solved by the root finding method provided by mathematical softwares like Mathematica. If there are multiple real roots for μ_J, we will first substitute each root into Eq. (28) to find its corresponding jump intensity λ. The root with the smallest λ will be chosen to make ϕ_{MJD_H} – constructed based on the the modified jump-diffusion process with finite jumps

[7]Although we use the modified jump-diffusion process (with at most $H-1$ jumps) instead of the jump-diffusion process to calculate the control process ψ_{CTRL} as in Eq. (20), the calibration error will be absorbed by the evaluation of Eq. (21). That is, the use of the modified jump-diffusion process does not generate additional errors.

as in Eq. (18)– more close to ϕ_{MJD_G}. This is because we calibrate the parameters of the jump diffusion with infinite jumps to match the cumulants of the process of interest G by Eqs. (22)$\sim$(26) to make ϕ_{MJD} approximate ϕ_{MJD_G}. Thus we should pick a lowest jump intensity λ to minimize the difference between ϕ_{MJD} and ϕ_{MJD_H}. On the other hand, it is possible that Eq. (29) does not have any real root. Then we simply pick a proper μ_J which minimizes the absolute value of the left hand side of Eq. (29). Once μ_J is determined, the other 4 parameters, λ, σ_J, μ, and σ, can be determined by substituting μ_J into Eqs. (28), (27), (22), and (23), respectively. Algorithm 2 summarizes the core idea for applying our general control variate method to improve Carr and Madan's characteristic-function-based pricing method.

Algorithm 2 Applying the General Control Variate Method to Improve the Characteristic-Function-Based Method.

1: Find ψ_G, the Fourier transform of the call price $c_G^{\mathrm{E}}(e^k)$ on the process G multiplied by e^k.
2: Determine the parameters of the jump diffusion process to make ψ_{CTRL} approximate to ψ_G by Eqs. (22) $\sim$ (29).
3: Evaluate $O_{\mathrm{IF}}^N(\psi_{\mathrm{G}} - \psi_{\mathrm{CTRL}})$ numerically to get $C_{\mathrm{RESIDUAL}}^{\mathrm{E}}(e^k)$ (see Eq. (21)).
4: Evaluate $O_{\mathrm{IF}}(\psi_{\mathrm{CTRL}})$ to get $C_{\mathrm{CTRL}}^{\mathrm{E}}(e^k)$ by the analytical formula in Eq. (19).
5: $C_G^{\mathrm{E}}(e^k)$ is estimated as the sum of $C_{\mathrm{RESIDUAL}}^{\mathrm{E}}(e^k)$ and $C_{\mathrm{CTRL}}^{\mathrm{E}}(e^k)$ as in Eq. (17).

4.3 Numerical Results

The accuracy of the characteristic-function-based pricing methods highly depends on the magnitude of the sampling error introduced by applying the numerical integral like the Trapezoid rule as illustrated in Eq. (15). Under our general control variate method, the sampling error is suppressed by substituting the numerical integral with the integrand ψ_{RESIDUAL} in Eq. (21) for the integral with the integrand ψ_G in Eq. (14). Since a control function ψ_{CTRL} is properly selected to closely approximates ψ_G, the amplitude of ψ_{RESIDUAL} becomes smaller and smoother than ψ_G. Thus the amplitude of the second order derivative of ψ_{RESIDUAL} will have a better chance to be smaller than the derivative of ψ_G as illustrated in Fig. 4. Since the sampling error is bounded above by the supremum of the second order derivative of the integrand as in Eq. (15), a lower amplitude of the second order derivative would imply a lower pricing error as illustrated in Fig. 5. Fig. 4 demonstrates the amplitude of $\frac{d^2}{dv^2}\mathrm{Re}\left[e^{ivk}\psi_G(v)\right]$ (plotted in thin dashed curves) and $\frac{d^2}{dv^2}\mathrm{Re}\left[e^{ivk}\psi_{\mathrm{RESIDUAL}}(v)\right]$ (plotted in thick solid curves) for three popular price processes: the variance gamma model in panel (a) (see Madan et al., 1998), the stochastic volatility model in panel (b) (see Heston, 1993), and the double exponential model in panel (c) (see Kou, 2002). It can be observed that the amplitudes of $\frac{d^2}{dv^2}\mathrm{Re}\left[e^{ivk}\psi_{\mathrm{RESIDUAL}}(v)\right]$ in all three models are significantly smaller than the amplitudes of $\frac{d^2}{dv^2}\mathrm{Re}\left[e^{ivk}\psi_G(v)\right]$. Fig. 5 uses the same numerical settings for the aforementioned three processes as the settings in Fig. 4 and show that our general control variate method (plotted in thick solid curves) is more efficient and more accurate than the characteristic-function-based method studied by Carr and Madan (1999) (plotted in thin dashed curves). Specifically, the upper limit ηN of the integral in Eq. (13) is fixed to be a very large constant 2^{10} to ensure that the truncation error is negligible. Then we can analyze how the change of the distance between the quadrature points η and hence the number of quadrature points N influence the computational efficiency and the accuracy. Note that the y-axes in all six panels denote the logarithm of the absolute pricing error. The x-axes in panel (a), (c), and (e) denote the computational time. It can be observed that our general control variate method is more efficient since the computational time required by our method to achieve any certain precision level is lower than the computational time required by the Carr and Madan (1999) method. On the other hand, the x-axes in panel (b), (d), and (f) denote the logarithm of the distance between the quadrature points η. It can also be observed that our method is more accurate since the pricing error produced by our method is much smaller than the error produced by the Carr and Madan (1999) method given the same η.

5 Convolution-Based Asian Option Pricing Method

5.1 Background Introduction

The payoff of an Asian option depends on the average of discrete samples of the underlying asset price over a pre-specified time interval. Pricing Asian options is an intractable problem since the analytical formula for the average underlying asset's price density does not exist. Let A be the average of the underlying asset's price sampled at times $t_0, t_1, t_2, \ldots, t_n$, where $0 = t_0 < t_1 < t_2 < \cdots < t_n = T$ as follows:

$$A \equiv \frac{1}{n+1}\sum_{i=0}^{n} S_{t_i}. \tag{30}$$

The value of an Asian call option can be expressed as the expectation of the discounted payoff under the risk-neutral variation method (see Harrison and Pliska, 1981) as follows:

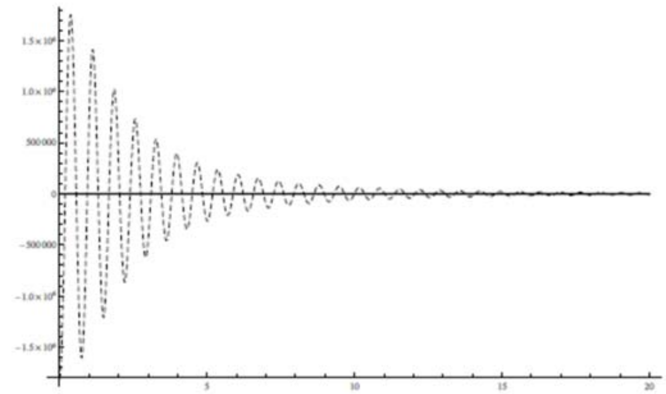
$$C^{\text{Asian}} = E_Q\left[e^{-rT}(A-K)^+\right]. \tag{31}$$

Carverhill and Clewlow (1990) propose a convolution-based pricing method to estimate the probability density of A in order to price C^{Asian}, and their method is then improved by Benhamou (2002). Our general control variate method can improve both pricing methods and the following discussion will focus on the latter one for simplicity. Denote the underlying asset's return from time t_{i-1} to time t_i as $R_i \equiv \ln(S_{t_i}/S_{t_{i-1}})$. Since $S_{t_i} = S_{t_0}e^{R_1+R_2+\cdots R_i}$, Eq. (30) can be rewritten as:

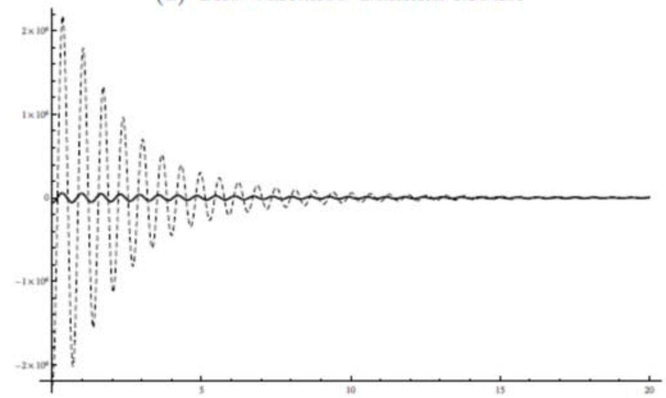
$$\begin{aligned} A &= \frac{1}{n+1}\sum_{i=0}^{n} S_{t_i} = \frac{S_{t_0}}{n+1}\left(1+e^{R_1}+e^{R_1+R_2}+\cdots+e^{R_1+R_2+\cdots R_n}\right) \\ &= \frac{S_{t_0}}{n+1}\left(1+e^{R_1}\left(1+e^{R_2}\left(1+\cdots e^{R_{n-1}}\left(1+e^{R_n}\right)\right)\right)\right) \\ &= \frac{S_{t_0}}{n+1}\left(1+e^{R_1+\ln(1+\exp(R_2+\ln(1+\cdots+\exp(R_{n-2}+\ln(1+\exp(R_{n-1}+\ln(1+\exp(R_n))))))))}\right) \end{aligned} \tag{32}$$

Under the premise that S_t follows a Levy process, the stationary and the independent increment properties entail that the returns $R_1, R_2, R_3, \ldots$ are independent. This useful property allow us to recursively apply the numerical convolution method to evaluate the densities of the exponential terms in Eq. (32). Specifically, Benhamou (2002) expresses the exponential term in Eq. (32) as a recursive sequence $\{D_i\}$ as follows:

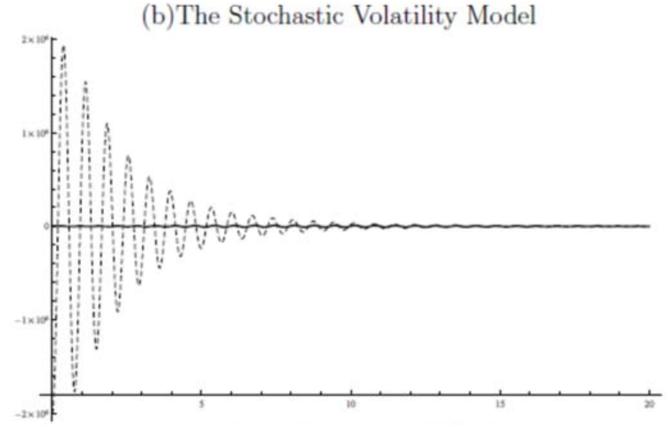
$$\begin{aligned} D_{n-1} &= R_n - E[R_n] = R_n - \mu_{n-1}, \\ D_{n-2} &= R_{n-1} + \ln\left(1+e^{R_n}\right) - E[R_{n-1}] - \ln\left(1+e^{E[R_n]}\right) \\ &= R_{n-1} + \ln\left(1+e^{D_{n-1}+\mu_{n-1}}\right) - \mu_{n-2}, \\ D_{n-3} &= R_{n-2} + \ln\left(1+e^{R_{n-1}+\ln\left(1+e^{R_n}\right)}\right) - E[R_{n-2}] - \ln\left(1+e^{E[R_{n-1}]+\ln\left(1+e^{E[R_n]}\right)}\right) \\ &= R_{n-2} + \ln\left(1+e^{D_{n-2}+\mu_{n-2}}\right) - \mu_{n-3}, \\ &\vdots \\ D_0 &= R_1 + \ln\left(1+e^{R_2\left(\cdots+\ln\left(1+e^{R_n}\right)\right)}\right) - E[R_1] - \ln\left(1+e^{E[R_2]\left(\cdots+\ln\left(1+e^{E[R_n]}\right)\right)}\right) \\ &= R_1 + \ln\left(1+e^{D_1+\mu_1}\right) - \mu_0, \end{aligned} \tag{33}$$



(a) The Variance Gamma Model



(b)The Stochastic Volatility Model



(c) The Double Exponential Model

Figure 4: Comparison of the Second Order Derivatives for Estimating Sampling Errors.

The x-axes denote the variable v, the thin dashed lines denote $\frac{d^2}{dv^2}\mathrm{Re}\left[e^{ivk}\psi_G(v)\right]$, and the thick solid lines denote $\frac{d^2}{dv^2}\mathrm{Re}\left[e^{ivk}\psi_{\mathrm{Residual}}(v)\right]$. Panel (a) is generated from the variance gamma model with $S_0 = 100$, $K = 100$, $r = 0$, T =4 months, the drift rate of the Brownian motion -0.1436, the variance rate of the Brownian motion 0.1213, and the variance rate of the gamma process 0.1686. Panel (b) is generated from the stochastic volatility model with $S_0 = 100$, $K = 100$, $r = 0$, $T = 4$ months, the mean reversion speed 1.49, the long-run variance 0.0671, the volatility of the underlying asset price volatility 0.742, the correlation -0.0571, and the current variance 0.0262. Panel (c) is generated from the double exponential model with $S_0 = 100$, $K = 98$, $r = 0.05$, $T = 6$ months, the rate of upward jumps 10, the rate of downward jumps 5, the upward probability 0.4, the downward probability 0.6, and the intensity of the Poisson process 1.

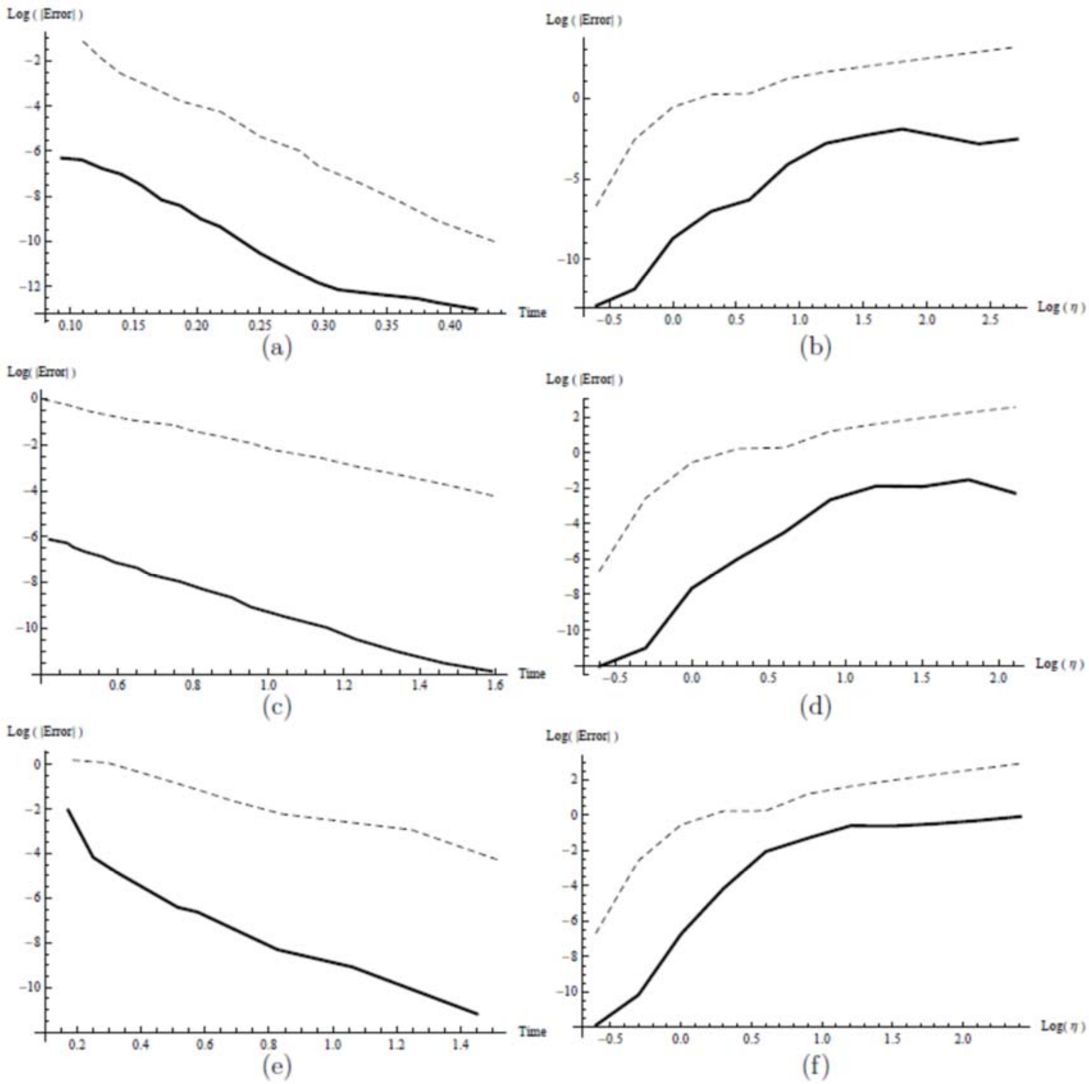


Figure 5: Convergence of pricing results.

The pricing errors for the variance gamma model, the stochastic volatility model, and the double exponential model are shown in panel (a) and (b), (c) and (d), and (e) and (f), respectively. Panels (a), (c), and (e) plot the relations between the computational time and the logarithm of the absolute pricing errors. Panels (b), (d), and (f) plot the relations between the logarithm of the distance between the quadrature points η and the logarithm of the absolute pricing errors. The thin dashed curves and the thick solid curves denote the pricing error generated by the Carr and Madan (1999) method and our general control variate method with $H = 9$, respectively. The damping coefficient d is set as 1.5. We use the pricing results generated by the Carr and Madan (1999) method with $N = 2^{20}$ and $\eta = 2^{-10}$ as the benchmarks. All parameter values for the variance gamma model, the stochastic volatility model, and the double exponential model are the same as those in Fig. 4.

where the sequence $\{\mu_i\}$ denotes the approximately expected values for $\{D_i\}$ as follows:

$$\begin{aligned}
\mu_{n-1} &= E[R_n], \\
\mu_{n-2} &= E[R_{n-1}] + \ln\left(1 + e^{E[R_n]}\right) = E[R_{n-1}] + \ln\left(1 + e^{\mu_{n-1}}\right), \\
\mu_{n-3} &= E[R_{n-2}] + \ln\left(1 + e^{E[R_{n-1}] + \ln\left(1+e^{E[R_n]}\right)}\right) = E[R_{n-2}] + \ln\left(1 + e^{\mu_{n-2}}\right), \\
&\vdots \\
\mu_0 &= E[R_1] + \ln\left(1 + e^{E[R_2] + \ln\left(1 + \cdots + \ln\left(1+e^{E[R_n]}\right)\right)}\right) = E[R_1] + \ln\left(1 + e^{\mu_1}\right).
\end{aligned}$$

Therefore, the average underlying asset's price A can be expressed as $\frac{S_{t_0}}{n+1}\left(1 + e^{D_0+\mu_0}\right)$ and the Asian call option price defined in Eq. (31) can be reexpressed as

$$C^{\text{Asian}} = E_Q\left[e^{-rT}(A-K)^+\right] = E_Q\left[e^{-rT}\left(\frac{S_{t_0}}{n+1}\left(1 + e^{D_0+\mu_0}\right) - K\right)^+\right]. \tag{34}$$

Eq. (34) can be evaluated by the numerical integration method if the density of D_0 is available. For convenience, let f_U represent the density function of a random variable U. Benhamou (2002) numerically evaluates f_{D_0} by repeatedly apply the numerical convolution method and the Jacobian transformation method discussed as follows. First, define Z_i to satisfy the equation $D_{i-1} = R_i + Z_i$. Then $f_{D_{i-1}}$ can be evaluated as the convolution O_{C} of the density functions f_{R_i} and f_{Z_i}, which can be expressed as

$$f_{D_{i-1}} = O_{\text{C}}(f_{R_i}, f_{Z_i}). \tag{35}$$

Substituting the aforementioned equation into Eq. (33) would suggest that Z_i can be expressed as a increasing function of D_i as follows:

$$Z_i = \ln\left(1 + e^{D_i+\mu_i}\right) - \mu_{i-1},$$

This entails that f_{Z_i} can be expressed in terms of f_{D_i} by the Jacobian transformation method as follows:

$$f_{Z_i}(x) = \begin{cases} f_{D_i}(\ln(e^{x+\mu_{i-1}} - 1) - \mu_i)\frac{e^{x+\mu_{i-1}}}{e^{x+\mu_{i-1}}-1} & \text{if } x > -\mu_{n-i-1}, \\ 0 & \text{otherwise.} \end{cases} \tag{36}$$

Thus we can solve $f_{Z_{n-1}}$ by applying Eq. (36) on $f_{D_{n-1}}$. Then apply the convolution method on $f_{Z_{n-1}}$ and $f_{R_{n-1}}$ to solve $f_{D_{n-2}}$. By repeating the procedures, we will eventually obtain f_{D_0} and solve the option value by Eq. (34).

Since the above operators can not be analytically applied, thus each density function involved in above calculations is approximated by a list of density values. Specifically, a window $[-b, b]$ is chosen to contain the bulk of the probability mass of all involved densities. Then $2m+1$ grid points $-b = x_{-m} < \cdots < x_0 = 0 < \cdots < x_m = b$ are selected with equal grid spacing b/m. For example, the density $f_{D_{n-1}}$ is approximated by the grid list $\mathbb{D}_{n-1} = \{f_{D_{n-1}}(x_{-m}), f_{D_{n-1}}(x_{-m+1}), \cdots, f_{D_{n-1}}(x_m)\}$. To estimate $\mathbb{Z}_{n-1}$ – the grid list to approximate the density $f_{Z_{n-1}}$ – with $\mathbb{D}_{n-1}$, we first apply numerical interpolations on the list $\mathbb{D}_{n-1}$ to estimate the list $\{f_{D_{n-1}}(\ln(e^{x+\mu_{n-2}} - 1)) - \mu_{n-1}\}_{x=x_{-m}}^{x_m}$, then apply the Jacobian transformation formula in Eq.(36) on the latter list to evaluate $\mathbb{Z}_{n-1}$. We use the symbol O_{J} to denote the density conversion operator by the Jacobian transformation and the superscript N to denote that the operator is evaluated numerically. Then each grid list $\mathbb{Z}_i$ $(1 \le i \le n-1)$ can be evaluated by applying numerical transformation on $\mathbb{D}_i$ as follows:

$$\mathbb{Z}_i = O_{\text{J}}^N(\mathbb{D}_i). \tag{37}$$

In addition, the convolution mentioned used to evaluate $f_{D_{i-1}}$ in Eq. (35) is numerically approximated by applying the numerical convolution O_{C}^{N} on the grid lists $\mathbb{R}_i$ and $\mathbb{Z}_i$ to obtain the $\mathbb{D}_{i-1}$ as follows:

$$\mathbb{D}_{i-1} = O_{\mathrm{C}}^{N}(\mathbb{R}_i, \mathbb{Z}_i), \tag{38}$$

The Benhamou (2002) pricing method is summarized in Algorithm 3.

Algorithm 3 Benhamou Pricing Method.

1: Evaluate the densities values in the list $\mathbb{D}_{n-1}$.
2: **for** $i = n-1$ down to 1 **do**
3: Calculate $\mathbb{Z}_i$ by applying numerical Jacobian transformation method on $\mathbb{D}_i$ (see Eqs. (36) and (37)).
4: Calculate $\mathbb{D}_{i-1}$ by applying the numerical convolution on $\mathbb{R}_i$ and $\mathbb{Z}_i$ (see Eq. (38)).
5: **end for**
6: The Asian option value C^{Asian} is evaluated as the expectation in Eq.(34) with the grid list $\mathbb{D}_0$.

5.2 Using the General Control Variate Method to Improve the Convolution-Based Pricing Method

In Benhamou (2002) pricing method, the numerical Jacobian transformation (see Eq. (37)) and the numerical convolution (see Eq. (38)) are alternatively applied to construct two series of grid lists $\{\mathbb{Z}_i\}$ and $\{\mathbb{D}_i\}$ in order to estimate the density of the average underlying asset's price A and hence the value of the Asian option as illustrated in Eq. (34). The general control variate method is used to improve the accuracy for estimating $\{\mathbb{Z}_i\}$ and $\{\mathbb{D}_i\}$ and hence the overall pricing result.

To improve the accuracy for estimating the grid list $\mathbb{Z}_i$ by applying the Jacobian transformation on $\mathbb{D}_i$, we first find an analytical control function $f_{D_i}^{\mathrm{ctrl}}$ that closely approximate $\mathbb{D}_i$. Let $\mathbb{D}_i^{\mathrm{ctrl}} \equiv \{f_{D_i}^{\mathrm{ctrl}}(x_{-m+1}),\ f_{D_i}^{\mathrm{ctrl}}(x_{-m}),\ \cdots,\ f_{D_i}^{\mathrm{ctrl}}(x_m)\}$ denote the grid list of $f_{D_i}^{\mathrm{ctrl}}$. Thus, we decompose $\mathbb{D}_i$ into two parts $\mathbb{D}_i = \mathbb{D}_i^{\mathrm{ctrl}} + (\mathbb{D}_i - \mathbb{D}_i^{\mathrm{ctrl}})$, and then apply the Jacobian transformations to these two parts separately. Since $f_{D_i}^{\mathrm{ctrl}}$ is analytically known, $O_{\mathrm{J}}\left(f_{D_i}^{\mathrm{ctrl}}\right)$ can be analytically solved without incurring numerical errors (due to the interpolation). The grid list contributed by this part is

$$\{f_{D_i}^{\mathrm{ctrl}}\left(\ln(e^{x_{-m}+\mu_{i-1}}-1)-\mu_i\right)\frac{e^{x_{-m}+\mu_{i-1}}}{e^{x_{-m}+\mu_{i-1}}-1}, f_{D_i}^{\mathrm{ctrl}}\left(\ln(e^{x_{-m+1}+\mu_{i-1}}-1)-\mu_i\right)\frac{e^{x_{-m+1}+\mu_{i-1}}}{e^{x_{-m+1}+\mu_{i-1}}-1},$$
$$\cdots, f_{D_i}^{\mathrm{ctrl}}\left(\ln(e^{x_m+\mu_{i-1}}-1)-\mu_i\right)\frac{e^{x_m+\mu_{i-1}}}{e^{x_m+\mu_{i-1}}-1}\}.$$

On the other hand, applying the Jacobian transform on $\left(\mathbb{D}_i - \mathbb{D}_i^{\mathrm{ctrl}}\right)$ is estimated numerically. That is, the estimation of $\mathbb{Z}_i$ mentioned in the third step of Algorithm 3 is improved as follows:

$$\mathbb{Z}_i = O_{\mathrm{J}}^{N}\left(\mathbb{D}_i - \mathbb{D}_i^{\mathrm{ctrl}}\right) + O_{\mathrm{J}}\left(f_{D_i}^{\mathrm{ctrl}}\right). \tag{39}$$

The numerical error incurred in Eq. (39) is less than the error incurred in Eq. (37) since the magnitude of the grid list $\mathbb{D}_i - \mathbb{D}_i^{\mathrm{ctrl}}$ would be less than the magnitude of $\mathbb{D}_i$ due to the premise that $f_{D_i}^{\mathrm{ctrl}}$ is close to $\mathbb{D}_i$.

Similarly, the numerical error incurred for estimating the grid list $\mathbb{D}_{i-1}$ mentioned in the fourth step of Algorithm 3 (or Eq. (38)) can also be suppressed by our general control variate method. We find an analytical function $f_{Z_i}^{\mathrm{ctrl}}$ that possesses the following two critical properties to play the role of a control variate for estimating $\mathbb{D}_{i-1}$: First, $f_{Z_i}^{\text{ctrl}}$ should closely approximate f_{Z_i}. Second, the convolution of f_{R_i} and $f_{Z_i}^{\text{ctrl}}$ (i.e, $O_C(f_{R_i}, f_{Z_i}^{\text{ctrl}})$) can be analytically solved to avoid the introduction of numerical errors. Let $\mathbb{Z}_i^{\text{ctrl}}$ denote the grid list $\{f_{Z_i}^{\text{ctrl}}(x_{-m}), f_{Z_i}^{\text{ctrl}}(x_{-m+1}), \cdots, f_{Z_i}^{\text{ctrl}}(x_m)\}$ for the density function $f_{Z_i}^{\text{ctrl}}$. To improve the accuracy for estimating $\mathbb{D}_{i-1}$, we first decompose $\mathbb{Z}_i$ into the following two parts: $\mathbb{Z}_i = \mathbb{Z}_i^{\text{ctrl}} + \left(\mathbb{Z}_i - \mathbb{Z}_i^{\text{ctrl}}\right)$. The linear property of the convolution operator entails that the convolution of $\mathbb{R}_i$ and $\mathbb{Z}_i$ evaluated in Eq. (38) can be decomposed into the convolution of $\mathbb{R}_i$ and $\mathbb{Z}_i - \mathbb{Z}_i^{\text{ctrl}}$ plus the convolution of $\mathbb{R}_i$ and $\mathbb{Z}_i^{\text{ctrl}}$. Note that the latter convolution can be analytically solved to avoid introducing extra numerical errors. Thus the accuracy of the fourth step of Algorithm 3 (or Eq. (38)) can be improved as follows:

$$\mathbb{D}_{i-1} = O_{\mathrm{C}}^{N}\left(\mathbb{R}_i, \mathbb{Z}_i - \mathbb{Z}_i^{\text{ctrl}}\right) + O_{\mathrm{C}}\left(f_{R_i}, f_{Z_i}^{\text{ctrl}}\right). \tag{40}$$

For simplicity, our following discussions and experiments are demonstrated by assuming that the underlying assets price process follows the geometric Brownian motion and that the control functions $f_{Z_i}^{\text{ctrl}}$ and $f_{D_i}^{\text{ctrl}}$ follow the normal distributions. To ensure that $f_{D_i}^{\text{ctrl}}$ and $f_{Z_i}^{\text{ctrl}}$ are close to f_{D_i} and f_{Z_i} respectively, the parameters of $f_{D_i}^{\text{ctrl}}$ and $f_{Z_i}^{\text{ctrl}}$ are calibrated by the moment matching method. Since the first few moments of D_i and Z_i are hard to be derived, we first derive the moments of e^{D_i} and e^{Z_i} instead. Note that e^{D_i} and e^{Z_i} can be expressed as

$$\begin{aligned} e^{D_i} &= e^{R_{i+1}}(1+e^{R_{i+2}}(1+e^{R_{i+3}}(\ldots e^{R_{n-2}}(1+e^{R_{n-1}}(1+e^{R_n})))))e^{-\mu_i}, \\ e^{Z_i} &= 1+e^{R_{i+1}}(1+e^{R_{i+2}}(1+e^{R_{i+3}}(\ldots e^{R_{n-2}}(1+e^{R_{n-1}}(1+e^{R_n})))))e^{-\mu_i}. \end{aligned}$$

The above formulas imply two recursive formulae: $e^{D_{i-1}} = e^{R_i}e^{Z_i}$ and $e^{Z_i} = 1 + e^{D_i}$. Since the random variables R_i and Z_i are independent due to the independent increment property of the Levy process (which is followed by the underlying asset price process), the first two moments of e^{D_i} and e^{Z_i} can be iteratively determined by alternatively applying the following three rules provided in Turnbull and Wakeman (1991): First, if the n^{th} moments (n=1 or 2) of two independent random variables U_1 and U_2 are equal to $m_1(n)$ and $m_2(n)$ respectively, then the n^{th} moment of U_1U_2 equals $m_1(n)m_2(n)$. Second, the first moment of $1+U_1$ is equal to $1+m_1(1)$. Third, the second moment of $1+U_1$ is equal to $1+2m_1(1)+m_2(2)$. Let a normal random variable D_i^{ctrl} follow the density function $f_{D_i}^{\text{ctrl}}$. The first two moments of D_i^{ctrl} can be solved by requiring the first two moments of $e^{D_i^{\text{ctrl}}}$ to match the first two moments of e^{D_i} as follows:

$$\begin{aligned} \mathrm{E}(e^{D_i}) &\equiv \mathrm{E}\left(e^{D_i^{\text{ctrl}}}\right) = e^{\mathrm{E}(D_i^{\text{ctrl}})+\mathrm{Var}(D_i^{\text{ctrl}})/2}, \\ \mathrm{Var}(e^{D_i}) &\equiv \mathrm{Var}(e^{D_i^{\text{ctrl}}}) = \left(e^{\mathrm{Var}(D_i^{\text{ctrl}})}-1\right)e^{2\mathrm{E}(D_i^{\text{ctrl}})+\mathrm{Var}(D_i^{\text{ctrl}})}, \end{aligned}$$

where $\mathrm{E}(U)$ and $\mathrm{Var}(U)$ denote the expected value and the variance of a random variable U, respectively. Therefore, the first two moments of $f_{D_i}^{\text{ctrl}}$ are solved to be

$$\begin{aligned} \mathrm{E}(D_i^{\text{ctrl}}) &= \ln \frac{\left(\mathrm{E}(e^{D_i})\right)^2}{\sqrt{\mathrm{Var}(e^{D_i}) + \left(\mathrm{E}(e^{D_i})\right)^2}}, \\ \mathrm{Var}(D_i^{\text{ctrl}}) &= \ln\left(1 + \frac{\mathrm{Var}(e^{D_i})}{\left(\mathrm{E}(e^{D_i})\right)^2}\right). \end{aligned}$$

Similarly, the first two moments of $f_{Z_i}^{\text{ctrl}}$ can also be determined by the same method as above.

The Asian call option value evaluated in the sixth step of Algorithm 3 (or Eq. (34)) by the numerical integration can also be improved by decomposing f_{D_0} into a normal density $f_{D_0}^{\text{ctrl}}$ plus a residual function $f_{D_0}^{\text{RESIDUAL}}$ as follows:

$$\begin{aligned} C^{\text{Asian}} &= e^{-rT} E\left[\left(\frac{S_{t_0}}{n+1}\left(1+e^{D_0+\mu_0}\right)-K\right)^+\right] \\ &= e^{-rT}\int_{-\infty}^{\infty}\left(\frac{S_{t_0}}{n+1}\left(1+e^{x+\mu_0}\right)-K\right)^+ f_{D_0}(x)dx \\ &= e^{-rT}\int_{-\infty}^{\infty}\left(\frac{S_{t_0}}{n+1}\left(1+e^{x+\mu_0}\right)-K\right)^+ \left(f_{D_0}^{\text{ctrl}}(x)+f_{D_0}^{\text{RESIDUAL}}(x)\right)dx \\ &\equiv C_{\text{ctrl}}^{\text{Asian}}+C_{\text{RESIDUAL}}^{\text{Asian}}, \end{aligned} \tag{41}$$

where $C_{\text{ctrl}}^{\text{Asian}}$ and $C_{\text{RESIDUAL}}^{\text{Asian}}$ denote the option values contributed by $f_{D_0}^{\text{ctrl}}$ and $f_{D_0}^{\text{RESIDUAL}}$, respectively. Since $f_{D_0}^{\text{ctrl}}(x)$ is a normal density function, $C_{\text{ctrl}}^{\text{Asian}}$ can be evaluated analytically by modifying Black and Scholes (1973) option pricing formula as follows:

$$C_{\text{ctrl}}^{\text{Asian}} = \frac{S_{t_0}e^{-rT+\mu_0+\mu_{D_0}+\frac{\sigma_{D_0}^2}{2}}}{(n+1)}\Phi\left(\frac{\mu_{D_0}+\sigma_{D_0}^2-\xi}{\sigma_{D_0}}\right)+\left(\frac{S_{t_0}}{n+1}-K\right)e^{-rT}\Phi\left(\frac{\mu_{D_0}-\xi}{\sigma_{D_0}}\right), \tag{42}$$

where $\Phi(\cdot)$ denotes the standard normal distribution function, and μ_{D_0} and $\sigma_{D_0}^2$ denote the first two moments of the density function $f_{D_0}^{\text{ctrl}}$, respectively. ξ denotes $\ln\left(K(n+1)/(S_{t_0})-1\right)-\mu_0$, which is the solution of $\frac{S_{t_0}}{n+1}\left(1+e^{x+\mu_0}\right)-K=0$. Since only $C_{\text{RESIDUAL}}^{\text{Asian}}$ needs to be evaluated numerically, numerical errors can be further suppressed. Note that Eq. (42) can be viewed as an application of our general control variate method as well. Our revised version for the Benhamou (2002) pricing method is summarized in Algorithm 4.

Algorithm 4 Applying the General Control Variate Method to Improve the Convolution-Based Pricing Algorithm

1: Evaluate the densities values in the list $\mathbb{D}_{n-1}$;
2: **for** $i = n-1$ **downto** 1 **do**
3: Decompose $\mathbb{D}_i$ into two parts: $\mathbb{D}_i = \mathbb{D}_i^{\text{ctrl}} + \left(\mathbb{D}_i - \mathbb{D}_i^{\text{ctrl}}\right)$;
4: Calculate $\mathbb{Z}_i$ by applying the Jacobian transformation to $\mathbb{D}_i - \mathbb{D}_i^{\text{ctrl}}$ and $f_{D_i}^{\text{ctrl}}$ respectively (see Eq. (39));
5: Decompose $\mathbb{Z}_i$ into two parts: $\mathbb{Z}_i = \mathbb{Z}_i^{\text{ctrl}} + \left(\mathbb{Z}_i - \mathbb{Z}_i^{\text{ctrl}}\right)$;
6: Calculate $\mathbb{D}_{i-1}$ by applying the numerical convolution on $\mathbb{Z}_i - \mathbb{Z}_i^{\text{ctrl}}$ and $\mathbb{R}_i$ and the analytical convolution on $f_{Z_i}^{\text{ctrl}}$ and f_{R_i} (see Eq. (40)).
7: **end for**
8: Evaluate the Asian option value C^{Asian} by Eqs. (41) and (42).

5.3 Numerical Results

We demonstrate how our general control variate method (plotted in solid curves) improve the accuracy and the efficiency of the convolution-based Asian option pricing method proposed by Benhamou (2002) (plotted in dashed curves) as illustrated in Fig. 6. Panel (a) denotes the relationship between the logarithm of the absolute pricing error and the grid spacing b/m. Note that the magnitude of the errors introduced by the numerical Jacobian transform and the numerical convolution would reduce with the decrement of the grid spacing. This can be confirmed by observing that the pricing errors decrease with the decrement of grid spacing. It can also be observed that our method does improve the accuracy since the pricing error produced by our method is much smaller than that produced by the Benhamou (2002) method given an

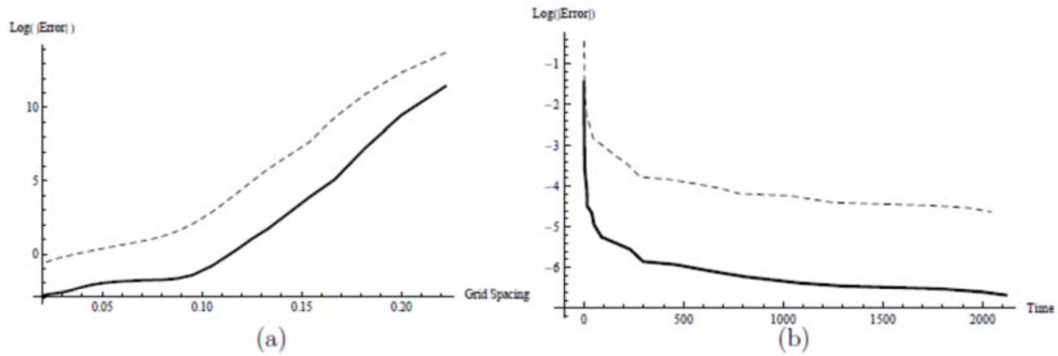


Figure 6: Convergence Comparisons for Pricing Asian Options.

The x-axes in panel (a) and (b) denote the grid spacing b/m and the computational time, respectively. The y-axes in both panels denote the logarithm of the absolute pricing errors. The dashed curves denote pricing errors generated by Benhamou (2002) method illustrated in Algorithm 3. The solid curves denote pricing errors generated by our improvement method illustrated in Algorithm 4. The initial underlying asset's price S_0 and the strike price K are 40, the volatility of the asset price is 0.3, the time to maturity T is 1 year, the risk-free rate r is 0.1, the window size is [-2,2], and the number of samples n (to evaluate the average price A) is 50.

arbitrary level of grid spacing. Note that the decrement of grid spacing would also increase the number of grid points and hence the computational time. In addition, our improvement method requires extra calculations and thus more computational time than the Benhamou (2002) method. To make the comparison fair, we compare the error convergence speeds in terms of computational time for both methods in panel (b). It can be observed that our method is more efficient since the computational time required by our method to achieve any certain precision level is lower than the time required by Benhamou (2002) method.

6 Conclusions

This paper extends the core idea of the control variate method, a popular variance reduction method used in Monte Carlo simulations, to reduce the errors for numerically evaluating linear operators, like the fast Fourier transform and the convolution. These numerical operators usually repeatedly occur in a numerical pricing method so we can drastically reduce the overall pricing error by reducing the error introduced by each operator. Specifically, we find a control function Y that is close to the function X inputted to the operator O and that $O(Y)$ can be analytically evaluated without introducing extra numerical errors. The overall numerical error is greatly suppressed since it is only contributed by numerically evaluating $O(X-Y)$– note that the residual function $X-Y$ is close to a zero function. We show that how our idea can be applied to tree methods, characteristic-function-based pricing methods, and convolution-based pricing methods. Numerical results verify the superiority of our approach.

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Determinants of Corporate Social Responsibility of A Social Enterprise: An Empirical Analysis

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This paper makes an attempt to estimate the corporate social responsibility (CSR) of a social enterprise in Singapore. Following the literature, we measure CSR based on a set of standard questions to gauge how the public values CSR according to these standard questions.

The social enterprise being studied is NTUC Fairprice. NTUC is Singapore's labour movement which is a macro-focused union that works well with the government to achieve growth with equity (see Yao and Chew (2014) for the theory of the macro-focused union). In this study, we also measure the CSR of Giant, another supermarket which is a commercial firm. A comparative analysis of the estimate of the CSR of these two firms is then made.

The main finding is that, based on a field survey, Singaporeans value the CSR of NTUC Fairprice more highly than that of Giant. Our regression analysis reveals that the CSR valuation of NTUC Fairprice is basically determined by how people perceive NTUC Fairprice in terms of their sentiments. On the other hand, the only variable that is statistically significant in explaining changes in the CSR valuation of Giant is Malay respondents.

The study also finds that, based on the second field survey, almost 85% of respondents chose to become members of NTUC because of non-collective bargaining benefits and only 10% joined the union because of sentiment.

The main conclusion is that union members are always supportive of the social effort of NTUC Fairprice and other cooperatives. The main policy implication is that NTUC is far-sighted in making non-collective bargaining benefits available to the general public provided that they become union members.

Keywords:

JEL Classifications:

1. A Selective Literature Review

Corporate Social Responsibility (CSR) has gained much significance in recent years with the increasing awareness of the benefits that CSR brings forth. This section provides an insight into the workings of CSR.

Many different definitions for CSR have been applied in the existing literature, many of which revolve around Carroll‘s pyramid of CSR, which embraces four aspects - economic, legal, ethical and philanthropic - in defining social responsibilities (Carroll, 1991). The definition of CSR becomes more problematic when researchers seek to elucidate whether CSR is a commitment (WBCSD, 1999) or a voluntary investment (Benabout & Tirolet, 2009) made by firms. Since this paper studies CSR from an economic perspective, we define CSR as an investment in line with other studies such as Reinhardt & Stavins (2010). Moreover, in Singapore’s context, CSR is a hand-out as it is not mandatory for companies to engage in CSR.

Empirical research provides strong support for the linkage between CSR and financial performance (Orlitzky et al., 2003; Chong & Tan, 2010). Surveys carried out reveal that branding, value maximization, stakeholdership and profit maximization are the main reasons that motivate managers to engage in CSR (Kan, 2012). Raza et al. (2013) and Naqvi, Ishtiaq, Kanwal, Ali, & Inderyas (2013) show that CSR helps to create a positive image of the company.

In our study we distinguish between the benefits to private firms from engaging in CSR from the benefits to social enterprises. Private firms engage in socially responsible business practices, either in the form of discretionary activities or investments to support social causes in order to improve community well-being and protect the environment. These activities are expected to produce brand preference, build brand positioning, improve product quality, as well as build relationships with external partners and even decrease operating costs and improve employees’ productivity (Biovna, 2010). Leedy (2009) studies how non-profit firms help to address important social issues that contribute to negative externalities by engaging in CSR. This paper focuses on the marginal benefits (MB) attained in acts of CSR.

Investment in CSR is not without costs. The costs involved when engaging in CSR can be categorized into 3 main types – sunk cost, recurrent cost and opportunity cost,[1] according to a report done by the Sino-German Project (giz, 2012). Profits forgone (Carroll & Shabana, 2010), labour and capital maintenance are examples of such costs. Therefore, as with all economic goods, CSR is costly and hence must be justifiable. Hence this paper focuses on determining the marginal costs (MC) of engaging in CSR in a bid to find the optimal level of CSR.

Many studies have been made on the effectiveness of CSR on raising the profitability of companies to determine whether engaging in CSR can be justified. Methods employed include cost and benefit analysis (CBA) (Asatryan, 2013), qualitative evaluation (Aravossis, Panayiotou, & Tsousi, 2006), and linear additive model (Sweeney, 2009).

[1] Sunk costs would include investment in capital such as equipment and infrastructure, while recurrent costs would involve the maintenance of such equipment. The opportunity costs would then be the wealth invested or the labour hours involved in CSR when it could have been used to generate additional revenue for firms.

In quantifying CSR, Sweeney (2009) argues that CSR involves 4 dimensions – (A) Environment, (B) Customer, (C) Community and (D) Employees. CSR essentially implies good externalities enjoyed by the society at large. The public perception and evaluation of these four dimensions by the firm are therefore regarded as external benefits. Sweeney also argues that there are other benefits from engaging in CSR, specifically (i) employee attraction, motivation and retention, (ii) customer attraction and loyalty, (iii) reputation, and (iv) access to capital, which are accrue solely to the firms themselves. These benefits may be referred to as private benefits.

This paper aims to investigate the public perception and evaluation of external benefits and private benefits for NTUC FairPrice and Giant using the Sweeney model.

2. Methodology and Hypotheses

This paper uses Sweeney's model of estimating CSR on the basis of external benefits, private benefits and total benefits,which is the sum of external benefits and private benefits for NTUC FairPrice and Giant. To evaluate the performance of the respective supermarket's CSR, online surveys and face-to-face interviews were conducted from 20 January 2014 to 23 February 2014. The objective of the survey is to capture the subjective personal valuation of total benefits, external benefits, and private benefits for NTUC FairPrice and Giant. Respondents were requested to state whether they agree or disagree with a given statement regarding each organisation on a scale of 1 to 7, with a higher number indicating stronger agreement. (See Appendix A for the survey questionnaire. For a brief background on NTUC FairPrice and Giant, please visit the respective websites:

http://www.fairprice.com.sg/webapp/wcs/stores/servlet/StoreLocatorCmd?langId=1&storeId=90001&catalogId=10051&storesView=ContentView&Corporate=Y&strType=Cheers

http://www.dairyfarmgroup.com/companies/overview.htm)

The survey covers a random sample of 198 observations, with 128 females and 70 males (see Appendix B for the profile of the respondents), with the majority aged between 21 to 25 years. 162 of the respondents are Chinese, 62% are single, and 59% are professionals. 56% of the respondents attained tertiary education. The average household size is 4.2, with 94 respondents having household income of more than $5,000. The average weekly visits to supermarkets stands at 1.82, with FairPrice being the main choice of visit. 41% of the respondents are NTUC members. As NTUCFP is owned by NTUC, the average score for Sentiments towards NTUC is 4.5 among the respondents.

As NTUC FairPrice is a social enterprise and is a co-operative of the labour movement in Singapore, and Giant is a private enterprise, the following hypotheses are proposed:

Hypothesis 1: FairPrice's CSR on the account of total benefits is greater than Giant's CSR.

Hypothesis 2: NTUC FairPrice's external benefits is greater than Giant's external benefits.

Hypothesis 3: NTUC FairPrice's private benefits is smaller than Giant's private benefits.

The total benefits, external benefits and private benefits for NTUC Fairprice and Giant are given in Table 1. Not surprisingly, the total benefits and external benefits are higher for

NTUC Fairprice than for Giant. But it can also be seen that the private benefits for NTUC FairPrice are also higher than for Giant. This goes to show that it pays to be perceived to perform a public good.

Table 1: FairPrice and Giant Performance

	FairPrice (F)	Giant (G)
Total Benefit (TB/CSR)	4.4	4.2
External Benefit (EB)	4.5	4.3
Private Benefit (PB)	4.3	4.2

3. Regression model

The model of regressions is as follow:

$$y = \beta_0 + \beta_1 Gender + \beta_2 Age + \beta_3 Race + \beta_4 Marital + \beta_5 Education + \beta_6 Professionals + \beta_7 Income + \beta_8 Household\ Size + \beta_9 Frequency + \beta_{10} Member + \beta_{11} Choice + \beta_{12} Sentiments$$

Where	Y	=	Total Benefit (NTUC/Giant) or External Benefit (NTUC/Giant) or Private Benefit (NTUC/Giant)
	Gender	=	Dummy variable of gender, with 0=female and 1=male
	Age	=	Age (in years) of respondents
	Race	=	Race, further segregated to 3 dummy variables to represent the three majority races in Singapore – Chinese, Indian, Malay.
	Marital	=	Dummy variable of marital status, with 0=married and 1=single/divorced/widowed
	Education	=	Education level of respondents
	Profession	=	Dummy variable of profession, with 0=non-professionals and 1=professionals
	Income	=	Household income (in dollars) of respondents
	Household size	=	Household size (number of people) of respondents
	Frequency of visit	=	Number of weekly visits to supermarkets
	Member	=	Dummy variable of NTUC membership, with 0=non-member and 1=member
	Choice	=	Dummy variable of frequent choice of supermarket, with 0=Giant and1=NTUC FairPrice
	Sentiments	=	Sentiments for NTUC as a union on a scale of 1-7, with 1being Strongly Negative and 7 being Strongly Positive
	β_0	=	Constant term
	β_1	=	Coefficient of Gender
	β_2	=	Coefficient of Age
	β_3	=	Coefficient of Race
	β_4	=	Coefficient of Marital
	β_5	=	Coefficient of Education
	β_6	=	Coefficient of Profession
	β_7	=	Coefficient of Income
	β_8	=	Coefficient of Household size
	β_9	=	Coefficient of Frequency of visit
	β_{10}	=	Coefficient of NTUC member

β_{11}	=	Coefficient of Choice of supermarket
β_{12}	=	Coefficient of Sentiments for NTUC Union, for NTUC FairPrice analysis only

3.1. *Stage I Analysis*

To test for significance, a regression analysis is done on all three components – CSR/TB, PB and EB. The results are given in Tables 2-5. Table 2 shows that, for NTUCFP, all variables are insignificant except sentiments. In other words, respondents who score high in terms of sentiments also give higher score for total benefits for NTUCFP. All variables for Giant are insignificant except the variable Malay respondents. This shows that respondents who are Malay give a high score for total benefits for Giant.

Table 2: Total Benefit (TB) as the Independent Variable

TB = f(Independent variables)

Dependent Variable	**(1)** **NTUCFP_TB**	**(2)** **Giant_TB**
gender_male	-0.0547 (0.628)	-0.0876 (0.44)
Age	-0.443 (0.271)	-0.187 (0.643)
race_Chinese	.577 (0.126)	0.775 (0.041)
race_Malay	0.712 (0.088)	1.49** (0)
race_Indian	0.640 (0.165)	0.772 (0.097)
maritalstatus_Single	-0.135 (0.426)	0.0539 (0.751)
edu_lvl	0.0572 (0.531)	-0.00324 (0.972)
occupation_professional	0.0822 (0.523)	0.565 (0.66)
income_lvl	-0.0309 (0.410)	-0.0623 (0.097)
household_size	-0.0652 (0.162)	-0.0809 (0.084)
Frequency	0.0222 (0.590)	0.0267 (0.519)
ntuc_member	-0.215 (0.856)	0.0184 (0.876)
choice_visit	-0.142 (0.333)	0.0549 (0.703)
Sentiments	0.241** (0)	-
N	198	198
adj R^2	0.146	0.131

Table 3 shows that all variables for NTUCFP are insignificant except sentiments. In other words, respondents who score high in terms of sentiments also give a higher score for external benefits for NTUCFP. All variables for Giant are insignificant except the variable Malay respondents. This shows that respondents who are Malay give a high score for total benefits for Giant.

Table 3: External Benefit as the Independent Variable for NTUCFP and Giant

EB = f (Independent variables)

Dependent Variable	(1) NTUCFP_EB	(2) Giant_EB
gender_male	-0.0406 (0.681)	-0.0738 (0.462)
Age	-0.0525 (0.136)	-0.0387 (0.28)
race_Chinese	0.0233 (0.944)	0.404 (0.226)
race_Malay	0.0651 (0.858)	1.07** (0.004)
race_Indian	0.369 (0.36)	0.57 (0.164)
maritalstatus _Single	-0.239 (0.108)	0.0308 (0.838)
edu_lvl	0.0287 (0.719)	-0.0629 (0.438)
occupation_professional	0.0866 (0.443)	0.0675 (0.553)
income_lvl	0.00117 (0.971)	-0.021 (0.524)
household_size	-0.0339 (0.406)	-0.022 (0.593)
frequency	-0.0236 (0.513)	-0.0127 (0.728)
ntuc_member	-0.1 (0.335)	-0.00411 (0.969)
choice_visit	0.00646 (0.96)	-0.0674 (0.597)
sentiments	0.328** (0)	-
N	198	198
adj R2	0.257	0.0711

Table 4 shows that, for the private benefit equation for NTUCFP, all variables are insignificant except the dummy variable for Chinese, the dummy for Malay and sentiments. For private benefit for Giant, all variables are insignificant except the three main races in Singapore, Chinese, Malay and Indian respondents.

Table 4: Private Benefit as the Independent Variable
PB = f (Independent variables)

Dependent Variable	(1) NTUCFP_PB	(2) Giant_PB
gender_male	-0.0429 (0.785)	-0.103 (0.505)
Age	-0.0354 (0.527)	-0.00973 (0.859)
race_Chinese	1.22** (0.021)	1.24** (0.016)
race_Malay	1.25** (0.032)	1.95** (0.001)
race_Indian	1.17 (0.068)	1.29** (0.041)
maritalstatus_Single	-0.0636 (0.787)	0.165 (0.475)
edu_lvl	0.126 (0.322)	0.0116 (0.926)
occupation_professional	0.00744 (0.967)	-0.0530 (0.761)
income_lvl	-0.0143 (0.785)	-0.0247 (0.627)
household_size	-0.0593 (0.36)	-0.114 (0.073)
Frequency	0.101 (0.08)	0.101 (0.073)
ntuc_member	-0.0265 (0.872)	-0.0325 (0.839)
choice_visit	0.152 (0.456)	0.120 (0.54)
Sentiments	0.221** (0.001)	-
N	198	198
adj R^2	0.0801	0.0469

Hence for NTUCFP, sentiments is a variable consistently able to explain TB, EB and PB of NTUCFP. This positive ideology towards NTUC would generate a host of benefits for FairPrice as well. Firstly, if consumers generally feel better towards the corporation, they are more likely to be biased. Secondly, consumers are more likely to feel that the supermarket has done more than what is required or has met its objective. Thirdly, the services offered by the supermarket will be better appreciated by consumers as opposed to the same services offered by other supermarkets. All this adds up to imply that good sentiments may lead to an increase in patronage of the supermarket. Subsequently, we will examine the determinants of sentiments towards NTUC.

In the case of Giant, the dummy variable for Malay respondents has been consistently significant in the equations of TB, EB and PB of Giant. Hence, we conducted another survey to ascertain the views of Malay residents regarding the choice of Giant as a supermarket (the profile of the Malay respondents is given in Annex C). As Table 5 shows, on a scale of 1 to 7, the statement that prices at Giant are lower registers a value of 5.31, followed by Giant as a familiar brand among Malay population receiving a value of 5.28. Our findings imply that Giant has been very successful in building a brand loyalty among the Malay residents in Singapore.

Table 5: Reasons for choosing Giant over other supermarkets

Giant has a wider variety of goods	4.72/7.00
Prices of goods in Giant are lower	5.31/7.00
Giant is located near my house	4.83/7.00
Giant is a familiar barnd among the Malay community as Giant is a key sponsor for social events such as concerts for the Malay community	5.28/7.00

Note: 1 = Very Strongly Disagree, 5 = Neither Agree nor Disagree, 7 = Very Strongly Agree

3.2. *Stage II Analysis*

Conceptualising sentiments towards NTUC

The earlier sections reveal a key observation regarding FairPrice and its affiliation to NTUC, as well as how sentiments towards the latter can play a critical role in CSR benefits, alongside both PB and EB. Therefore, this section investigates the factors affecting consumers' sentiments. As seen in the regression results presented below, at the 5% significance level, all variables are insignificant except NTUC Membership and the Choice of visit, as given in Table 6.

The regression model is as follow:

$$y = \beta_0 + \beta_1 Gender + \beta_2 Age + \beta_3 Race + \beta_4 Marital + \beta_5 Education + \beta_6 Professionals + \beta_7 Income + \beta_8 Household\ Size + \beta_9 Frequency + \beta_{10} Member + \beta_{11} Choice$$

where Y = Sentiments towards NTUC.

Table 6 shows that NTUC union membership is the only significant variable in the Sentiments equation. It shows that an increase in choice of visit by 1 would lead to an increase in sentiments by only 0.671.

One of the reasons for consumers' positive attitude towards FairPrice can be understood by the higher level of CSR engaged in by the supermarket, proven by the findings above. This is also consistent with the expected norm as with increased visits to the same supermarket, the consumer is better able to be aware of their CSR activities and services offered. Therefore, this can be translated into a better understanding of the good intention of the supermarket, generating positive feelings towards FairPrice and hence in turn, NTUC.

Table 6: The Sentiments Equation

Dependent Variable	(1) sentiments
gender_male	-0.15826 (0.384)
Age	0.002354 (0.971)
race_Chinese	0.755016 (0.212)
race_Malay	1.045583 (0.117)
race_Indian	0.501306 (0.499)
maritalstatus_Single	0.075762 (0.781)
edu_lvl	-0.08089 (0.582)
occupation_professional	0.346851 (0.093)
income_lvl	-0.11706 (0.051)
household_size	-0.08698 (0.244)
Frequency	0.092097 (0.164)
ntuc_member	0.399247** (0.035)
choice_visit	0.671191** (0.004)
N	198
adj R^2	0.0715

Similarly, there exists a positive relationship between sentiments and NTUC membership, where the latter would offer member consumers exclusive privileges that may increase the good feeling consumers have towards the supermarket. This indirect link between sentiments and membership can be proven through the findings attained from a pilot test[2] conducted, which aims at establishing the rationale for joining NTUC. Out of the 50

NTUC members surveyed, 84% of the respondents joined NTUC because of the benefits offered by being a union member rather than because of sentiments.

Therefore, the empirical results and analysis presented in this section prove a crucial finding – Sentiments are affected by NTUC membership, where the latter is in turn affected by NTUC benefits only.

[2] Refer to Annex D for thesurvey questionnaire and findings of NTUC members.

4. Conclusion

This paper studies the benefits arising from CSR activities engaged by supermarkets in Singapore as perceived by their customers. The private benefits arising from engaging in CSR activities are different for a social enterprise compared to a private firm, and our findings reveal that the private benefits for FairPrice are higher than that for Giant. Given the assumption that both FairPrice and Giant engage in the same CSR level, our study indicates that FairPrice as a social enterprise has achieve higher private benefits than Giant from its CSR activities. Our results imply that is a good strategy to be perceived to be a social enterprise.

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Annex A: Survey Questionnaire

SECTION 1 – RESPONDENT'S PROFILE

(Please ✔ where appropriate)

1.1. What is your gender?

☐ Male ☐ Female

1.2. What is your age?

☐ 21-25 years old ☐ 26-30 years old ☐ 31-35 years old ☐ 36-40 years old
☐ 41-45 years old ☐ 46-50 years old ☐ 51-55 years old ☐ 56-60 years old
☐ 61-65 years old ☐ >65 years old

1.3. What is your race?

☐ Chinese ☐ Malay ☐ Indian ☐ Eurasian ☐ Others, please specify: ________

1.4. Marital status

☐ Single ☐ Married ☐ Divorced ☐ Widowed

1.5. What is your highest attained education level?

☐ 'O' Level & below ☐ 'A' Level/Diploma/IB ☐ Degree ☐ Masters & above

1.6. Which category best classifies your occupation?

☐ Legislators, Senior Officials & Managers
☐ Associate Professionals & Technicians
☐ Agricultural & Fishery Workers
☐ Service & Sales Workers
☐ Plant and Machine Operators & Assemblers
☐ Others
☐ Professionals
☐ Clerical Support Workers
☐ Student
☐ Craftsmen & Related Trades Workers
☐ Cleaners, Laborers & Related Workers
☐ Not working

1.7. How many people are there in your household?

____

1.8. What is your monthly household income level?

☐ \$0 - \$1000 ☐ \$1001 - \$2000 ☐ \$2001 - \$3000
☐ \$3001 - \$4000 ☐ \$4001 - \$5000 ☐ \$5001 & above

1.9. How many times do you visit a supermarket in 1 week?

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ >5

1.10. Are you currently a NTUC member?

☐ Yes ☐ No

1.11. Please rank the supermarkets according to the frequency you visit:

Supermarket	Rank (1=most frequent)
FairPrice Supermarket	
Giant Supermarket	

Page 1

SECTION 2

Scale: 1 = Very Strongly Disagree; 7 = Very Strongly Agree (Please ✔ where appropriate)	FairPrice Supermarket								Giant Supermarket						
	1	2	3	4	5	6	7		1	2	3	4	5	6	7
Section 2.1: Responsible Retailing															
To what extent has the respective supermarket met the objective of:															
1. Promoting a healthy lifestyle of consumers through providing quality products															
2. Taking into account consumers' feedback and act on it promptly															
3. Placing customers concerns and satisfaction above its goal of profit making															
4. Ensuring consistency in its pricing policies (i.e. same price across outlets)															
5. Ensuring that the prices of products are reasonably priced and value-for-money															
Section 2.2: Community Care															
To what extent has the respective supermarket met the objective of:															
1. Creating more employment opportunities for the public															
2. Initiating new and/or support existing training opportunities															
3. Promoting the setting up of local businesses (e.g. by assisting investment programmes)															
4. Being involved in voluntary activities that would benefit society (e.g. distributing daily necessities to the low-privileged/low income groups)															
5. Prioritizing societal issues above profit maximising goals															
Section 2.3: Sustainable Environment															
To what extent has the respective supermarket met the objective of:															
1. Reducing environmental impacts of its business operations (e.g. adopting green technology)															
2. Implementing new green initiatives (e.g. set up eco-friendly outlets)															
3. Actively participating and/or encouraging the public to take part in environmentally – friendly activities (e.g. campaigns and products)															
4. Constantly monitoring and regulating environmental impacts from operations (e.g. set target on waste reduction)															
5. Prioritizing environmental considerations before its profit maximising goal.															
Section 2.4: Workplace															
To what extent has the respective supermarket met the objective of:															
1. Providing a nurturing and safe workplace environment to attract and retain employees.															
2. Minimizing conflicts at work and promote staff bonding (e.g. staff retreat).															
3. Paying employees according to industry standards.															
4. Ensuring welfare of employees (in terms of training, work life balance, flexible employment).															
5. Providing ample equal opportunities to all employees regardless of gender and race.															

Scale: 1 = Very Strongly Disagree; 7 = Very Strongly Agree (Please ✓ where appropriate)	FairPrice Supermarket								Giant Supermarket						
	1	2	3	4	5	6	7		1	2	3	4	5	6	7
Section 2.5: Contribution															
1. I am willing to donate money to the supermarket if they are CSR friendly.															
2. I am willing to donate in-kind (e.g. non-monetary donations) for the respective supermarket if they are CSR friendly.															
3. The respective supermarket should pay fully for their CSR activities.															

SECTION 3

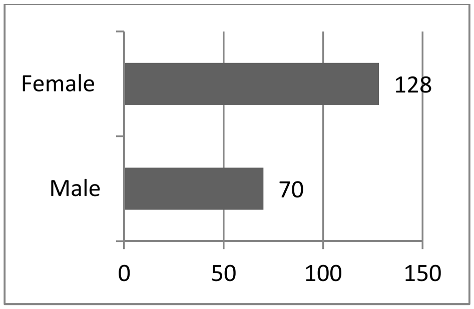
Scale: 1 = Very Strongly Disagree; 7 = Very Strongly Agree (Please ✓ where appropriate)	FairPrice Supermarket								Giant Supermarket						
	1	2	3	4	5	6	7		1	2	3	4	5	6	7
Section 3.1: Customer Attraction & Retention															
1. I will choose to purchase an item from the respective supermarket because it engages in CSR (i.e. more contribution to the community and providing adequate rewards to its employees).															
2. I will encourage my friends to shop at the supermarket which engages in CSR.															
3. I will buy from this supermarket that provides CSR to the society (even at a higher price), even if another supermarket offers a lower price.															
4. I am willing to volunteer my services to the supermarket because it engages in CSR (e.g. willing to help out in the supermarket without receiving a salary)															

SECTION 4

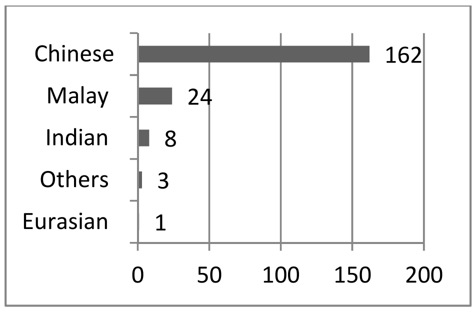
Scale: 1 = Strongly Negative; 7 = Strongly Positive (Please ✓ where appropriate)	1	2	3	4	5	6	7
1. What are your sentiments towards NTUC (as a union)?							

Annex B: General Profile of Respondents of the Main Survey

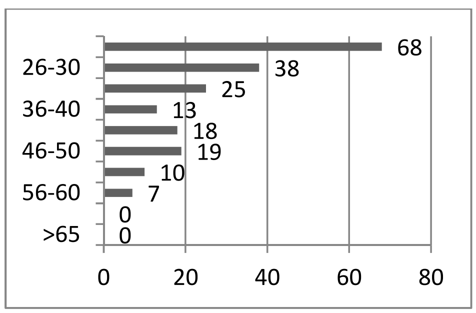
1. *Gender*



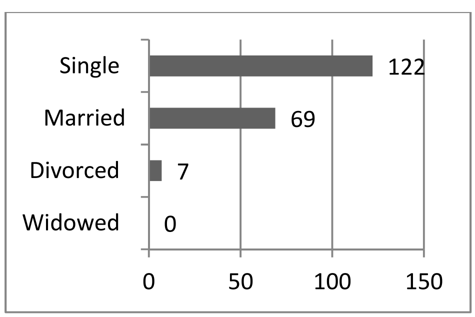
2. *Race*



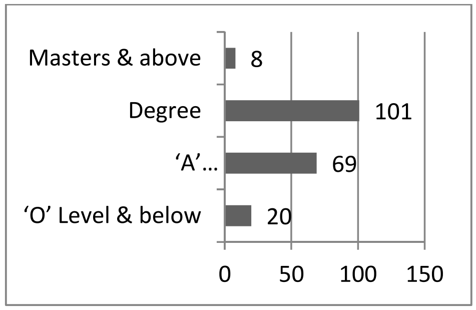
3. *Age*



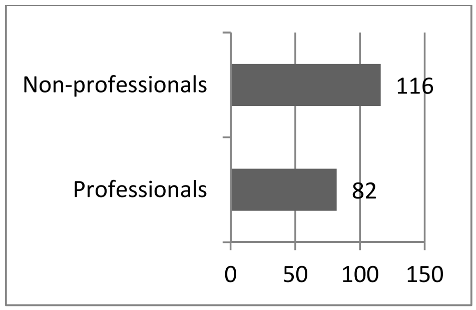
4. *Marital Status*



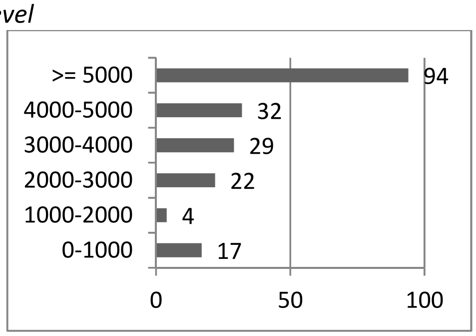
5. *Education Level*



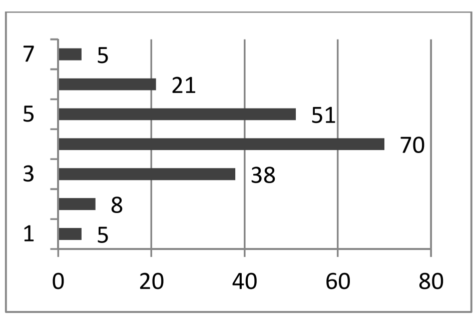
6. *Occupation*



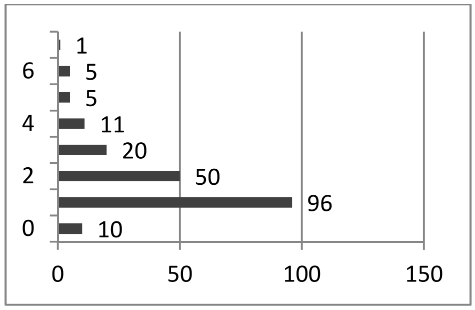
7. *Household Income Level*



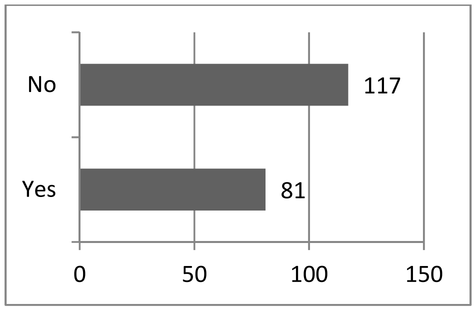
8. *Household Size*



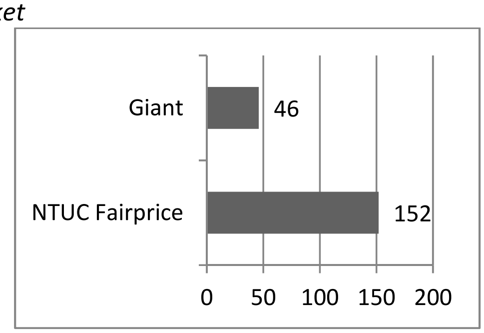
9. *Number of visits to supermarket per week*



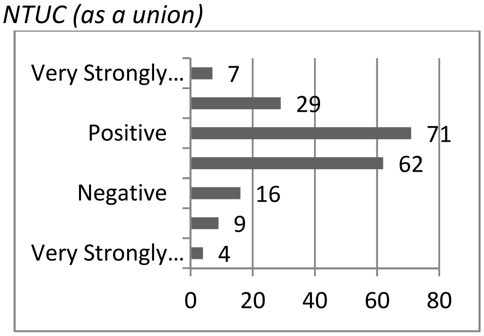
10. NTUC Member



11. Choice of supermarket



12. Sentiments towards NTUC (as a union)



Annex C: Survey Questionnaire for Giant

This pilot survey was conducted from 1 May 2014 to 19 May 2014. The purpose of the survey was to establish the primary reason of Malays choosing Giant as the choice of supermarket. A total of 47 respondents were surveyed but only responses of 36 were taken into consideration because 11 respondents did not choose Giant as the choice of visit.

Questions

(Please ✔ where appropriate)

1.1. Is Giant supermarket the most frequent choice of supermarket?

☐ Yes ☐ No

1.2. Marital status

☐ Single ☐ Married ☐ Divorced ☐ Widowed

1.3. What is your household income level?

☐ $0 - $1000 ☐ $1001 - $2000 ☐ $2001 - $3000 ☐ $1001 - $2000
☐ $3001 - $4000 ☐ $4001 - $5000 ☐ $4001 - $5000 ☐ $5001 & above

1.4. Please rate (from 1 to 7) the following reasons for choosing Giant supermarket over other supermarkets (e.g. FairPrice, Sheng Siong)?

Scale: 1 = Very Strongly Disagree; 7 = Very Strongly Agree (Please ✔ where appropriate)	1	2	3	4	5	6	7
I choose Giant supermarket because:							
1. Giant has a wider variety of goods							
2. Prices of goods in Giant is lower							
3. Giant is located near my house							
4. Giant is a familiar brand among the Malay community as Giant is a key sponsor for social events such as concerts for the Malay community							
5. Other reasons, pls specify: ______________________							

Results of pilot survey

1.1 Is Giant supermarket the most frequent choice of supermarket?

Yes	36	100%
No	0	0%

1.2 What is your marital status?

Single	9	25%
Married	24	67%
Divorced	1	3%
Widowed	2	6%

1.3 What is your household income level?

$0 - 1000	0	0%
$1001 - $2000	6	17%
$20001 - $3000	7	19%
$3001 - $4000	4	11%
$4001 - $5000	15	42%
$5001 & above	4	11%

1.4. Please rate the following reasons for choosing Giant supermarket over other supermarkets (e.g. FairPrice, Sheng Siong)

	Very Strongly Disagree	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree	Very Strongly Agree	Mean
Giant has a wider variety of goods	1	1	5	6	14	5	4	4.72
Prices of goods in Giant is lower	1	0	3	5	9	10	8	5.31
Giant is located near my house	3	1	3	6	8	9	6	4.83
Giant is a familiar brand among the Malay community as Giant is a key sponsor for social events such as concerts for the Malay community	1	0	3	7	7	9	9	5.28
Others, pls specify (if no reasons, select [Neither Agree nor Disagree])	0	0	0	34	0	0	2	4.17

Annex D: Survey Questionnaire for NTUC members

This pilot survey was conducted from 12 March 2014 to 23 March 2014. The purpose of the survey was to establish the primary reason for being a NTUC member. A total of 54 respondents were surveyed but only responses of 50 NTUC members were taken into consideration because 4 respondents were non-NTUC members.

Questions

(Please ✔ where appropriate)

1.1. Are you currently a NTUC member?

☐ Yes ☐ No

1.2. Marital status

☐ Single ☐ Married ☐ Divorced ☐ Widowed

1.3. How many people are there in your household?

____

1.4. What is the primary reason for being an NTUC member?

☐ I feel good towards NTUC

☐ I want to enjoy the benefits of being a member (e.g. discounts, LINKPoints)

☐ Other reasons, please specify: ________________________________

Results of pilot survey

1.1 Are you currently a NTUC member?

Yes	50	100%
No	0	0%

1.2 What is your marital status?

Single	16	32%
Married	33	66%
Divorced	0	0%
Widowed	1	2%

1.3 How many people are there in your household?

	Min Value	Max Value	Average Value	Standard Deviation	Responses
Household size	2.00	8.00	4.60	1.34	50

1.4 What is the primary reason for being a NTUC member?

I feel good towards NTUC.	5	10%
I want to enjoy the benefits of being a member (e.g. discounts, LINKPoints).	43	86%
Others	2	4%

□ □ □ □ □ □ Are Multiple Directorships Beneficial in East Asia?

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We posit that the benefits and costs of multiple directorships are conditional on firm characteristics. We find firm valuation is positively associated with multiple directorships in (i) firms with high advising needs and (ii) firms with high external financing needs. These beneficial effects of multiple directorships are generally stronger in countries with weak shareholder rights and in firms that are widely-held. However, when controlling shareholder hold high voting-rights to cash-flow rights, multiple directorships reduce firm valuation, especially in countries with weak shareholder rights and in closely-held firms. As multiple directorships increases, cash holdings (capital expenditures) contribute less to shareholder value. The negative association between value of cash (capital expenditure) and busy boards is mitigated in firms with (i) high advising needs, (ii) high external financing needs, and (iii) less entrenched ownership structures.

Keywords: Multiple directorships; Ownership structure; Firm performance.

JEL classifications: G30, G32, G34

1. Introduction

Prior studies suggest two competing hypotheses on the association between firm performance and multiple directorships held by outside directors. According to the reputation hypothesis, the market for outside directorships provides incentives for outside directors to develop a reputation as monitoring specialists (Fama and Jensen (1983)). Thus, firm performance is positively associated with external directorships held by outside directors because directors with more outside board seats are likely to be more experienced, provide better advice, and offer better monitoring. Consistent with the reputation hypothesis, prior studies find that the number of outside directorships is related to firm performance for financially distressed firms (Gilson (1990)), for firms that cut dividends (Kaplan and Reishus (1990)), and for firms that opt out of stringent anti-takeover provisions (Coles and Hoi (2003)).

On the other hand, the busyness hypothesis posits that as the number of outside directors sitting on multiple board increases, the directors are likely to be over-stretched. Hence, the busyness hypothesis predicts firm performance is negatively associated with external directorships held by outside directors because of diminished board oversight. Consistent with the busyness hypothesis, prior studies find that firms with busy boards exhibit lower firm valuation ((Fich and Shivdasani (2006)) and lower announcement period abnormal returns in corporate acquisitions (Ahn, Jiraporn and Kim (2010)).

In summary, prior studies provide mixed evidence on the association between multiple external directorships and firm performance. A possible reason for this mixed evidence is that different firms have different optimal board structures (Adams, Hermalin and Weisbach (2010)). Recent governance literature emphasizes the importance of firm characteristics in the design of optimal board structures (Boone, Field, Karpoff and Raheja (2007), Coles, Daniel and Naveen (2008) and Linck, Netter and Yang (2008)). Thus, a one-size fits all recommendation for board structure is not appropriate for all firms because a uniform board structure does not explicitly consider the heterogeneity in firm characteristics. In this study, we posit that the benefits and costs of multiple directorships are conditional on firm characteristics. Our objectives are twofold. First, we examine how the association between multiple directorships and firm performance vary systematically with firm characteristics. This investigation helps to shed light on the conditions under which the benefits of multiple directorships outweigh the costs of having busy directors or vice-versa. Second, we examine specific channels through which multiple directorships affect firm performance.

We examine our research questions on multiple board appointments with a large sample of listed firms in East Asia. We focus on East Asia for several reasons. First, in a survey of the literature on the board of directors, Adams, Hermalin and Weisbach (2010, page 101) find that "the vast majority of the literature focuses on United States firms and comparisons of boards across countries outside United States is, in contrast, an under-explored". Our examination on the board structure in East Asia attempts to fill this void. Second, in emerging economies such as East Asia, higher information asymmetry allows managers and large shareholders to expropriate corporate resources for their personal benefits. These opportunities for expropriation are exacerbated when the legal protection is weak; when enforcement of contracts is poor; and when shareholders have weaker rights (LaPorta, Lopez and Shleifer (1999), Claessens, Djankov, Fan and Lang (2002) and Lee, Lee and Yeo

(2009)). Third, the prevalence of multiple directorships in East Asia is much higher compared to United States. For example, in United States, the percentage of busy outside directors[1] is 21% ((Fich and Shivdasani (2006)) whereas in our sample of East Asia countries, the percentage of busy outside directors is 43%.

In this study, we posit three firm characteristics that affect the association between external board appointments held by outside directors and firm performance: (i) firm's advising needs, (ii) firm's external financing needs, and (iii) corporate ownership structure. Coles, Daniel and Naveen (2008) argue that complex firms such as those that are diversified, those that are large and those with large intangible assets, have greater advising requirements. Prior studies suggest outside directors can provide good advice and expertise to the firm. Hermalin and Weisbach (1988) argue that firms can choose "an outside director who will give good advice and counsel, who can bring valuable experience and expertise to the board.'' Agarwal and Knoeber (2001) find that the proportion of outside directors with political expertise on the board is positively related to firms' need for political advice. Building on these arguments, if outside directors who hold multiple external board seats bring more experience and knowledge and offer better advice, complex firms with high advising requirements can benefit from having such directors. Thus, our first hypothesis is that in firms with high advising needs, firm performance is positively associated with outside directors' external board appointments.

Prior studies find that firms that have stronger external financing needs have stronger corporate governance structures (Durnev and Kim (2005), Fan and Wong (2005), Dahya, Dimitrov and McConnell (2008)). Durnev and Kim (2005) find that corporate governance and disclosure practices are positively associated with the firms' external financing needs, especially in countries with weak investor protection. Fan and Wong (2005) find that firms that frequently raise equity capital are more likely to appoint high-quality auditors. Dahya, Dimitrov and McConnell (2008) find a positive association between the proportion of the board composed of directors not affiliated with the dominant shareholder and the likelihood of the firm issuing equity. Building on these studies, we predict that firms with high external financing needs are likely to benefit from having directors with multiple external board seats. The rationale is as follows. Firms with higher external financing needs are subjected to more scrutiny by capital market participants. Thus, in such firms, there is heightened awareness in outside directors that their reputation is sensitive to the intense monitoring by capital market participants (Fama and Jensen (1983)). Hence, in firms with high external financing needs, outside directors who fail to monitor are more likely to lose their external board seats due to personal reputational losses in the managerial labour market. Thus, our second hypothesis predicts that in firms with high external financing needs, firm performance is positively associated with outside directors' external board appointments.

In East Asia, corporate ownership is concentrated and many firms are controlled by a large dominant shareholder. Prior studies find that firm valuation is negatively associated with the separation of control rights and cash flow rights of the controlling shareholder (LaPorta et al (1998), Claessens et al (2002) and Lins (2003)). Multiple board appointments

[1] Following prior studies (Ferris et, al (2003) and Fich and Shivdasani (2006)), we classify a director as busy if he holds three or more directorships.

by outside directors can be beneficial or detrimental in firms with high separation of control rights and cash flow rights of the controlling shareholder. On one hand, if outside directors with multiple board seats play an effective corporate governance role, then the negative association between firm performance and the separation of control rights and cash flow rights of the controlling shareholders will be reduced by the proportion of outside directors with multiple board appointments. On the other hand, the directors' busyness hypothesis suggests that lower monitoring by busy outside directors increases the potential expropriation of minority shareholders by the controlling shareholders. Thus, our third hypothesis predicts that if busy directors are ineffective (effective) monitors, the negative association between firm performance and the wedge between the control rights and cash flow rights in the controlling shareholder will be more (less) pronounced in firms with higher proportion of outside directors with multiple board appointments.

In our first set of tests, we examine the association between firm performance and outside directors' external directorships. Using a sample of listed firms in East Asia, we find that firms in which outside directors hold multiple directorships have lower firm valuation. Our result suggests that for the average firm in our sample, the directors' busyness hypothesis dominates the reputation hypothesis.

More importantly, we find that the association between multiple directorships and firm valuation is conditional on firm characteristics. First, we find that in firms with high advising needs, firm valuation is positively associated with the proportion of outside directors with multiple external directorships. This result suggests that in firms with high advising needs, there is a net benefit from having directors with multiple external board seats who can provide more experience, advice and expertise to the firms. Second, we find that in firms with high external financing needs, firm valuation is positively associated with outside directors' external board appointments. The intuition is that as firms with high external financing needs are subjected to disciplinary forces when they return to the capital market, outside directors who fail to monitor are more likely to lose their external board seats due to reputational losses. Third, we document that in firms in which the controlling shareholder holds disproportionately high voting rights relative to cash flow rights, the negative association between firm valuation and multiple directorships is more pronounced.

Additional analysis indicates that our results vary systematically with the governance and institutional features of the East Asian countries. First, in developing countries and in countries with weak shareholder rights, we find that the negative association between busy boards and firm value is more pronounced in firms with high separation of control rights and cash flow rights. Thus, in countries with weak investor protection, poor monitoring associated with busy boards combined with agency problems associated with concentrated ownership structure, results in further declines in firm value. Second, in developed countries and countries with strong shareholder rights, the beneficial effect of multiple directorships is more positive in firms with high external financing needs. We conjecture the strong country-level governance institutions improve the effectiveness of board monitoring in firms that frequently raise external finance. Third, we find that combination of high percentage of busy outside directors and high separation of voting rights and cash flow rights in the controlling shareholder increase agency problems in closely held firms relative to widely-held firms.

Fourth, we provide some evidence that the beneficial effect of multiple board appointments in firms with high advising needs is stronger in widely held firms.

In our second set of tests, we examine two possible channels through which busy boards affect firm performance. First, we find that as multiple directorships increases, corporate cash holdings are worth less to outside shareholders. We find that the negative association between the marginal value of cash and busy boards is mitigated in firms with (i) higher advising needs, (ii) higher external financing needs, and (iii) lower separation of voting rights and cash flow rights of the controlling shareholder. Additional analysis suggests that these results are generally stronger in countries with stronger shareholder rights, developed countries and in widely-held firms. Second, in firms with busy boards, corporate capital expenditures contribute more to shareholder value in firms with (i) higher advising needs, (ii) higher external financing needs, and (iii) lower separation of voting rights and cash flow rights of the controlling shareholder. Moreover, these results are more pronounced in countries with stronger shareholder rights, developed countries and in widely-held firms.

Our results contribute to the literature of board structure in at least two ways. First, we contribute to the literature on multiple directorships (Ferris et al (2003), Fich and Shivdasani (2006)) by providing evidence that the association between firm performance and busy boards is conditional on firm characteristics. We shed light on the conditions under which the benefits of multiple directorships outweigh the costs of having busy directors. Our result on the positive association between multiple directorships and firm performance for complex firms with high advising needs is new. Similarly, our finding of the positive association between multiple directorships and firm performance in firms with high external financing needs is novel. Our results cast doubt on the suggestion that busy boards are detrimental for all firms. More broadly, our results add to the recent governance literature that underscores the importance of taking into account the heterogeneity in firm characteristics in the design of optimal board structures (Boone, Field, Karpoff and Raheja (2007), Coles, Daniel and Naveen (2008) and Linck, Netter and Yang (2008)).

Second, we shed light on two channels through which busy boards reduce firm valuation by providing evidence that as multiple directorships increases, corporate cash holdings are worth less to outside shareholders, and capital expenditures contribute less to shareholder value. Our results highlight the contextual nature of the association between multiple directorships and the valuation of cash holdings (capital expenditure) that varies systematically with firm characteristics, country-level shareholder rights and corporate ownership structure.

The rest of the paper is organized as follows. Section 2 describes the sample and method. Section 3 presents our results on the association between multiple directorships and firm performance conditional on firm characteristics. Section 4 presents evidence on the specific channels through which multiple directorships affect firm performance. Section 5 concludes.

2. Sample and Method

2.1. *Sample*

We begin with the Worldscope database to identify listed firms in six East Asian countries comprising Hong Kong, Indonesia, Malaysia, Philippines, Singapore and Thailand and during the period 2001 to 2007. We exclude financial institutions because of their unique financial structure and regulatory requirements. We eliminate observations with extreme values of control variables such as sales growth and firm size. We obtain the annual reports from the Global Report database and company websites. Our final sample consists of 1,482 firms for 6,536 firm-year observations during the period 2001 to 2007 in six East Asian countries (Hong Kong, Indonesia, Malaysia, Philippines, Singapore and Thailand). We collect data on the board characteristics and corporate ownership from the annual report.

2.2. *Code of Corporate Governance*

An important issue is how the corporate governance rules differ across the different countries because these rules may contain guidance on the level of outside (non-executive) directors and the incidence of multiple directorships. We briefly review the Code of Corporate Governance of each country in our sample to better understand the effect of country-specific corporate governance rules on our results, in particular the guidelines on the composition of the level of outside (non-executive) directors and the incidence of multiple directorships.

The Malaysian Code Corporate Governance, the Code of Corporate Governance in Singapore, Hong Kong Code on Corporate Governance Practices and the Principles of Good Corporate Governance For Listed Companies in Thailand recommend that there should be a strong and independent element on the Board, with independent directors making up at least one-third of the Board. The Code of Corporate Governance in these countries typically define an "independent" director as one who has no relationship with the company, its related companies or its officers that could interfere, or be reasonably perceived to interfere, with the exercise of the director's independent business judgment. The Philippines Code Corporate Governance recommends that Public Companies shall have at least two independent directors or such independent directors shall constitute at least twenty percent of the members of such Board, whichever is the lesser. In contrast, the Indonesia Code Corporate Governance recommends that there should be ample board independence without stipulating the minimum number of independent directors or the proportion of board independence.

Under the stock exchange listing rules for the countries in our sample, public companies describe in the annual reports their corporate governance practices with specific reference to the principles of the Code Corporate Governance, as well as disclose and explain any deviation from any guideline of the Code. Companies are also encouraged to make a positive confirmation at the start of the corporate governance section of the annual report that they have adhered to the principles and guidelines of the Code, or specify areas of non-compliance.

In terms on multiple directorships, the code of corporate governance in Hong Kong, Indonesia, Malaysia, Singapore, Philippines and Thailand do not explicitly provide a maximum cap on the number of external board seats per director. The common theme in the code of corporate governance in these countries is that when a director has multiple board representations, he must ensure that sufficient time and attention is given to the affairs of each company. In other words, although the codes of corporate governance in these countries do not explicitly stipulate a formal limit on maximum number of board representations, the guidelines generally recommend that boards should carefully consider the competing time commitments that are faced when directors serve on multiple boards.

2.3. *Measures of Directors' Busyness*

In this study, we employ three measures of directors' busyness. Following prior studies (Fich and Shivdasani (2006) and Ahn, Jiraporn and Kim (2010)), our basic premise is that if outside directors are central to effective board monitoring, a measure of busy director computed only for outside directors will be more relevant. Our first measure of directors' busyness is the average number of external directorships per outside director (DIRCOOUT), which is computed as the total number of external directorships held by outside directors divided by the number of outside directors. Outside directors are directors who directors who are not classified as inside or grey directors, where grey directors include former employees or persons who have related party transactions with the firm. Our second measure of director's busyness is the percentage of busy outside directors (BUSYOUT). As in Ferris et. al (2003) and Fich and Shivdasani (2006), we consider a director as busy if he holds three or more directorships. Our third measure of director's busyness is a dummy variable that equals one if 50% or more of the outside directors are busy, and zero otherwise (D_BUSY) where we classify a director as busy if he holds three or more directorships.

2.4. *Model Specification*

Following Fich and Shivdasani (2006), to test the association between firm valuation and external directorships held by the board, we employ the following firm-fixed effects model[2]:

$$\begin{aligned}\text{TOBINQ}_{i,t} = {} & \beta_0 + \beta_1 \text{BUSYDIR}_{i,t-1} + \beta_2 \text{BUSYDIR}_{i,t-1}{*}\text{ADVICE}_{i,t-1} \\ & + \beta_3 \text{BUSYDIR}_{i,t-1}{*}\text{EXTFIN}_{i,t-1} + \beta 4 \text{ BUSYDIR}_{i,t-1}{*}\text{WEDGE}_{i,t-1} \\ & + \beta_5 \text{ADVICE}_{i,t-1} + \beta_6 \text{EXTFIN}_{i,t-1} + \beta_7 \text{WEDGE}_{i,t-1} + \beta_8 \text{OUTDIR}_{i,t-1} \\ & + \beta_9 \text{BDSIZE}_{i,t-1} + \beta_{10} \text{BDOWN}_{i,t-1} + \beta_{11} \text{INTLOCK}_{i,t-1} + \beta_{12} \text{NOMIN}_{i,t-1} \\ & + \beta_{13} \text{INSTI}_{i,t-1} + \beta_{14} \text{LNASSET}_{i,t-1} + \beta_{15} \text{ROA}_{i,t-1} + \beta_{16} \text{SALECHG}_{i,t-1} \\ & + \beta_{17} \text{DEBT}_{i,t-1} + \beta_{18} \text{GAAPDIF}_{i,t-1} + \text{Firm-fixed effects} + \text{Country Dummies} \\ & + \text{Industry Dummies} + \text{Year Dummies} \qquad (1)\end{aligned}$$

Our proxy for firm valuation is TOBINQ, computed as market value of equity plus book value of total liabilities divided by total assets. Our test variable of interest is BUSYDIR, which is one of the three measures of directors' busyness: (i) average directorships per outside director (DIRCOOUT) (ii) percentage of busy outside directors where a director is classified is busy if he hold three or more directorships (BUSYOUT); and (iii) a dummy variable that equals one if more than 50% of outside directors are busy, and zero otherwise (D_BUSY).

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[2] Fitch and Shivdasani (2006, page 694) explain that "the fixed effects approach is robust to the presence of omitted firm-specific variables that would lead to biased estimates in an ordinary least squares (OLS) framework. Given the high correlation between the market-to-book ratio and corporate governance variables with numerous other company attributes, the fixed effects framework offer more reliable estimates than OLS regressions".

Our first hypothesis predicts that in firms with high advising needs, firm performance is positively associated with outside directors' external board appointments. Coles, Daniel and Naveen (2008) argue that the need for advising increases with organizational complexity. Thus, we use a firm's organizational complexity as a proxy for its advising needs. We measure the firm's intensity of advising needs based on a common factor analysis of three widely-used measures of organizational complexity: (i) number of business segments, (ii) firm size and (iii) proportion of intangible assets to total assets. As expected, this common factor score (i.e. firm's intensity of advising needs) increases with corporate diversification, firm size and intangible assets. We create a dummy variable (ADVICE) that equals one if this common factor score is greater than the median value and zero otherwise. As per Hypothesis 1, both β_2 and $\beta_1 + \beta_2$ should be positive.

The second hypothesis predicts that in firms with high external financing needs, firm performance is positively associated with outside directors' external board appointments. Following Rajan and Zingales (1998), we define a firm's external finance needs as its capital expenditures minus cash flow from operations divided by capital expenditures. Then, we compute the firm's average external finance needs ratio in the prior five years to smooth temporal fluctuations and to remove the effect of outliers. We create a dummy variable (EXTFIN) that equals one if the external finance needs ratio is greater than the median value and zero otherwise. As per Hypothesis 2, both β_3 and $\beta_1 + \beta_3$ should be positive.

The third hypothesis predicts that if the directors busyness hypothesis dominates the reputation hypothesis, then in firms in which the controlling shareholder holds high control rights relative to cash flow rights, firm performance is negatively associated with outside directors' external board appointments. We follow the procedures in La Porta et al. (1999) to compute the separation of control rights and cash flow rights of the controlling shareholder (WEDGE)[3]. To test the incremental effect of the controlling shareholder's ownership on the association between busy boards and firm valuation, we interact busy boards (BUSYDIR) and the control rights minus cash flow rights of the largest controlling shareholder (WEDGE). If the directors' busyness hypothesis dominates the reputation hypothesis, we expect the interaction term between BUSYDIR and WEDGE to be negative. Appendix A contains the variable definitions.

Our control variables are as follows. The governance literature generally suggests that as boards become increasingly independent of managers, their monitoring effectiveness increases, thereby decreasing managerial opportunism and enhancing firm performance (Shivdasani (1993) and Perry and Peyer (2005)). Thus, we include the proportion of outside directors on the board (OUTDIR) in our tests. Yermack (1996) finds that smaller boards are associated with higher firm value because they are more efficient. Hence, we include board size at the end of the preceding fiscal year (BDSIZE). Linck, Netter and Yang (2008) find

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[3] Specifically, we consider the shareholder of Company X to be the controlling shareholder when the shareholder is an individual or a family, a privately held company, a privately held financial firm, or a government. A controlling shareholder is defined as the shareholder who has the determining voting rights of the company and who is not controlled by anyone else. If a company does not have a controlling shareholder, it is classified as widely held. For example, if the controlling shareholder is the family M that owns 50% of the shares in Company B and Company B owns 30% of the shares in Company A, we designate family M as controlling 30% of the control rights of Company A and owning 15% (= 50% x 30%) of the cash flow rights.

that higher common equity ownership by outside directors increases board monitoring incentives. We control for percentage of common shares held by outside directors (BDOWN). Bizjak, Lemmon and Whitby (2009) argue that board interlocks can be beneficial if they facilitate the efficient transfer of information or knowledge, or if they facilitate learning about best corporate practices. Alternatively, board interlocks and close relations between firms through director ties potentially reduce the independence of board members and can exacerbate agency problems. Following Bizjak, Lemmon and Whitby (2009), our measure of board interlock is a dummy variable (INTLOCK) that is set to one if two firms in the sample share a common board member in that year. We also include a dummy variable for the presence of a board nominating committee (NOMIN). We also control for the proportion of common equity held by institutional shareholders (INSTI) because prior studies (Lins (2003) and Durnev and Kim (2005)) find that large institutional shareholders are associated with more effective monitoring of managers.

Following Jian and Lee (2011), we control for firm size by including the natural logarithm of book assets (LNASSET) and profitability (ROA). To control for growth opportunities (Smith and Watts (1992)), we include prior year's sales growth (SALECHG). Jensen (1986) argues that debt can mitigate the agency costs of free cash flow. Thus, we include the ratio of long-term debt to total assets (DEBT).

One concern is that differences in accounting standards across countries will affect the levels of conservatism across countries. To address this concern, we follow the approach in Nobes (2001) and Bae, Tan, Welker (2008) to control for differences between domestic accounting standards (local GAAP) and International Financial Reporting Standards (IFRS). Specifically, for each country, we compute a measure of the number of differences between domestic accounting standards and International Financial Reporting Standards (GAAPDIF)[4]. In our model, we also include country dummy variables to control for country effects, industry dummy variables to control for country effects, and year dummy variables to control for time effects.

3. Results

3.1. *Descriptive statistics*

Table 1 shows the descriptive statistics by country. Several results are noteworthy. There is considerable variation in the sample. Firms in Malaysia have the highest percentage of busy outside directors (mean BUSYOUT is 48%) whereas firms in Indonesia have the lowest percentage of busy outside directors (mean BUSYOUT is 26%). About 29% of the firms in Hong Kong and 18% of the firms in Indonesia have more than 50% of their outside directors

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[4] Nobes (2001) and Bae, Tan, Welker (2008) employ a comprehensive survey to benchmark how domestic accounting standards against International Financial Reporting Standards. In the survey, partners in large accountancy firms from more than 60 countries benchmarked the local accounting standards in their country against International Financial Reporting Standards. The survey contains information on how local GAAP differs from Financial Reporting Standards on 80 key accounting issues, issues incorporating recognition, measurement, and disclosure rules. Some examples of the accounting issues include deferred tax accounting, segment reporting, capitalization of leases, accounting for employee benefit obligations, impairment testing of intangibles, accounting for financial instruments, disclosure of the fair value of financial assets, treatment of discontinued operations, treatment of discontinued operations and consolidation of special purpose entities.

(D_BUSY) classified as busy (i.e. holding three or more directorships). At the other extreme, the proportion firms with more than 50% of their outside directors (D_BUSY) classified as busy are 41% and 43%, in Malaysia and Singapore respectively. Consistent with prior studies (Claessens, Djankov, Fan and Lang (2002), Lins (2003) and Lee (2007)) that documented concentrated ownership in East Asia, our sample average separation of voting rights and cash flow rights in the controlling shareholder (WEDGE) is 21%.

Table 2 presents the Spearman correlation between the variables. Several points are noteworthy. First, firm valuation is negatively associated with multiple directorships, indicating that busy boards are associated with lower firm performance. Second, firms with busy boards have lower operating profitability. Third, consistent with prior studies (Claessens, Djankov and Lang (2002)), firm valuation is negatively associated with the separation of voting rights and cash flow rights of the controlling shareholder. Fourth, firms with higher advising needs are more likely to have boards with multiple directorships. Fifth, firm-level external financing need is positively associated with multiple directorships.

3.2. *Market-to-book ratio tests*

Our first set of tests examines the association between market-to-book ratio (TOBINQ) and busy board. Table 3 presents the following firm-fixed effects regression results of market-to-book ratio (TOBINQ) on busy boards. In all specifications, to alleviate concern about potential cross-sectional and time-series dependence in the data, we report t-values on an adjusted basis using robust standard errors corrected for double (firm and year) clustering (Petersen (2009)). In model (1), the estimated coefficient on DIRCOOUT (average directorships per outside director) is negative and statistically significant. The results indicate that firm valuation is negatively associated with the multiple external directorships held by outside directors. Thus, in our sample, the busyness hypothesis dominates the reputation hypothesis.

The estimated coefficient on the interaction term, DIRCOOUT x ADVICE, is positive and statistically significant. The result suggests that the negative effect of busy board on Tobin's Q for firms with low advising needs is more than offset for firms with high advising needs ($\beta_1 + \beta_2 = 0.028$, $p<0.01$). This result is consistent with our hypothesis that firms with high advising needs benefit from having more outside directors with multiple external board appointments. In terms of economic significance, if the average directorships per outside director increase by one standard deviation, Tobin's Q for firms with external financing needs increases by 2.2% relative to the sample mean.

The estimated coefficient on the interaction term, DIRCOOUT x EXTFIN, is positive and statistically significant at the 1% level. The result suggests that the negative effect of busy board on Tobin's Q for firms with low external financing needs is more than offset for firms with high external financing needs ($\beta_1 + \beta_3 = 0.013$, $p<0.01$). Thus, in firms with high external financing needs, firm value is positively associated with outside directors' external board appointments. In terms of economic significance, if the average directorships per outside director increase by one standard deviation, Tobin's Q for firms with external financing needs increases by 1.1% relative to the sample mean.

The estimated coefficient on the interaction term, DIRCOOUT*WEDGE, is negative and statistically significant at the 1% level. This result suggests that in firms with higher separation of voting rights and cash flow rights of the controlling shareholder, the negative association between firm valuation and multiple directorships is more pronounced. In terms of economic significance, holding constant the wedge between control rights and cash flow rights at the sample median, a standard deviation increase in the average directorships per outside director reduces Tobin's Q by 3.9% relative to the sample mean.

In model (2), we measure directors' busyness with the percentage of busy outside directors (BUSYOUT). Following Fich and Shivdasani (2006), we classify director as busy if he holds three or more directorships. In model (3), we measure directors' busyness with a dummy variable (D_BUSY) that equals one if more than 50% of outside directors are busy, and zero otherwise. Our inferences are qualitatively similar. Specifically, we continue to document the positive association between firm valuation and multiple directorships is more pronounced in firms with (i) high external financing, (ii) high advising needs and (iii) low wedge of voting rights and cash flow rights of the controlling shareholder[5].

It is possible that differences in accounting conservatism across countries affect the dependent variable which is the market-to-book ratio. Following the approach in Claessens, Djankov, Fan and Lang (2002), we perform the market-to-book test at the country level to examine the sensitivity of our results to accounting differences. The intuition is that if country-level accounting conservatism is related to country-level accounting rules, then all firms in the same country (subjected to the same country-level accounting rules) should have the same country-level accounting conservatism. Table 4 presents the regression analysis for each country in our sample. There is no evidence that results are driven by specific countries.

3.3. *Developed countries versus developing countries*

This section examines how our results differ between developed countries and developing countries. Following La Porta, Lopez, Shleifer and Vishny (2002), we classify Hong Kong, and Singapore as developed countries, and Indonesia, Malaysia, Philippines and Thailand as developing countries. Table 5 presents the results for developed countries (column 1) and developing countries (column 2). Although the results are directionally similar in both developed countries and developing countries, there are two main differences. First, the coefficient on BUSYOUT*WEDGE is more negative in developing countries[6]. Thus, in firms with high separation of control rights and cash flow rights, the negative association between busy boards and firm value is more pronounced in developing countries. Second, the coefficient on BUSYOUT*EXTFIN is more positive and statistically significant in the

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[5] As an alternative measure of firm performance, we examine the association between busy boards and return-on-assets (ROA). Our results (not tabulated) are qualitatively similar. Firms with higher proportion of busy outside directors have lower ROA. The negative association between ROA and busy boards is stronger in firms with higher wedge of voting rights and cash flow rights of the controlling shareholder. In firms with high advising needs and those with high external financing needs, ROA is positively associated with outside directors' external board appointments.

[6] The F-statistic of the difference between developed countries and developing countries for the coefficient on BUSYOUT*WEDGE is significant at the 5% level.

developed countries[7]. Thus, in firms with high external financing needs, outside director perform more effective monitoring in developed countries.

3.4. *Strong versus weak shareholder right*

Our sample consists of countries with different country-level shareholder protection. Hence, we examine whether board composition has a differential effect in countries with strong versus weak levels of legal shareholder protection. On one hand, if strong board monitoring substitutes weak country-level shareholder protection, a strong board is likely to be more valuable in a country with weak shareholder protection. On the other hand, it is possible that a strong board would have little effect in a country with weak shareholder protection because the board may be dominated by entrenched managers without a protective legal environment.

Based on La Porta, Lopez, Shleifer and Vishny (1998) measure of country-level shareholder right, we partition our sample into countries with strong and weak shareholder right based on the sample median. Specifically, we classify Hong Kong, Malaysia and Singapore as countries with strong shareholder right and Indonesia, Phillipines and Thailand as countries with weak shareholder right. Table 5 presents the results for countries with strong shareholder right (column 3) and countries with weak shareholder right (column 4). There are several interesting results. First, the coefficient on BUSYOUT*WEDGE is more negative in countries with weak shareholder right[8]. Thus, in firms with high separation of control rights and cash flow rights, the negative association between busy boards and firm value is more pronounced in countries with weak shareholder right. This result indicates that in countries with weak shareholder right, poor monitoring associated with busy boards combined with agency problems associated with concentrated ownership structure, results in further declines in firm value. Second, the coefficient on BUSYOUT*EXTFIN is more positive and statistically significant in the countries with strong shareholder right. Thus, in firms with high external financing needs, outside director perform more effective monitoring in countries with strong shareholder right[9] This result is consistent with notion that stronger country-level investor protection facilitates corporate monitoring by outside directors whose reputational capital is tied to external board appointments.

Another important aspect of shareholder protection is whether shareholder rights are effectively enforced. To measure the degree of enforcement, we employ quantitative assessments of the rule of law (the extent to which agents have confidence in the law and abide by the rules of the society), regulatory quality (the ability of government to formulate and implement effective policies for the regulation of business) and the control of corruption from Kaufmann, Kraay and Mastruzzi (2003). The results (not tabulated) based on partitioning the sample by enforcement of the rule of law are qualitatively similar to the results based on partitioning the sample by shareholder rights.

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[7] The F-statistic of the difference between developed countries and developing countries for the coefficient on BUSYOUT*EXTFIN is significant at the 5% level.

[8] The F-test of the difference in BUSYOUT*WEDGE between into countries with strong and weak shareholder right is significant at the 5% level.

[9] The F-test of the difference in BUSYOUT*EXTFIN between into countries with strong and weak shareholder right is significant at the 5% level.

3.5. *Closely-held versus widely-held firms*

Outside United States, corporate ownership is concentrated with many firms being controlled by a large shareholder (La Porta, Lopez, Shleifer and Vishny (1998, 2002). Thus, we investigate whether our results differ between closely-held firms and widely-held firms. Following Claessens, Djankov, Fan and Lang (2002), we classify a firm as closely held if it is controlled by a single largest shareholder at the 20% ownership cut-off level. Otherwise, we classify the firm as widely held. Table 5 presents the results for closely-held firms (column 5) and widely-held firms (column 6). There are two main differences between closely-held firms and widely-held firms. First, the coefficient on the interaction term BUSYOUT*WEDGE is negative and statistically significant in closely held firms. The result suggests that the combination of high percentage of busy outside directors and high separation of voting rights and cash flow rights in the controlling shareholder increase agency problems in closely held firms. Our result is consistent with the finding in Claessens, Djankov, Fan and Lang (2002) that managers at closely-held firms are more likely than widely-held firms to divert private benefits of control for themselves[10]. Second, the coefficient on the interaction term BUSYOUT*ADVICE is positive and statistically significant (at the 5% significance level) in widely held firms but it is positive and marginally significant (at the 10% significance level) in closely-held firms. This result suggests that the beneficial effect of multiple board appointments in firms with high advising needs is stronger in widely-held firms. Further analysis (not tabulated) indicates that in our sample, the widely-held firms have more business segments and higher intangibles than do closely-held firms. In other words, the widely-held firms have higher organizational complexity (and hence higher advising needs) than closely-held firms.

4. Channels Through Which Multiple Directorships Affect Firm Performance

This section provides evidence on the channels through which busy boards affect shareholder value. Specifically, we examine how busy boards affect the market valuation of corporate cash holdings and market valuation of corporate capital expenditures[11].

4.1. *Market Valuation of Corporate Cash Holdings*

To examine how busy boards affect the contribution of cash to firm value, we extend the framework developed by Faulkender and Wang (2006), who study the relation between the marginal value of cash and corporate financial policies. We augment their model by introducing the busy board measure. Specifically, our regression equation is specified as follows:

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[10] By construction, WEDGE measures the control rights minus cash flow rights of the largest controlling shareholder. Thus, WEDGE equals zero for widely-held firms.

[11] Prior studies provide evidence on the association between busy boards and specific corporate outcomes. Fich and Shivdasani (2006) find that firms with busy boards exhibit lower sensitivity of CEO turnover to firm performance. Ahn, Jiraporn and Kim (2010) find that acquiring firms, where directors hold more outside board seats, are more likely to undertake value-destroying mergers. We extend these studies by examining other channels (corporate cash holdings and capital expenditures) thorough which busy boards can affect firm valuation.

$$R_{it} - R^{B}_{it} = \beta_0 + \beta_1 \Delta CASH_{it} + \beta_2 \Delta CASH_{it}*BUSYOUT_{it-1} + \beta_3 \Delta CASH_{it}*BUSYOUT_{it-1}*ADVICE_{it-1} + \beta_4 \Delta CASH_{it}*BUSYOUT_{it-1}*EXTFIN_{it-1} + \beta_5 \Delta CASH_{it}*BUSYOUT_{it-1}*WEDGE_{it-1} + \text{control variables} \quad (2)$$

The dependent variable in equation (2) is the industry-adjusted returns of the firm's common stock over fiscal year t. On the right-hand side of equation (2), $\Delta CASH_{it}$ is a firm's unexpected change in cash from year t-1 to t, with the firm's cash position at the end of year t-1 taken to be its expected cash level in year t. Since $\Delta CASH_{it}$ is scaled by the market value of equity at the end of year t-1, its coefficient β_1 measures the dollar change in shareholder wealth for a one-dollar change in corporate cash holdings. Following Faulkender and Wang (2006), the control variables are net financing over year t-1 to t, changes in net income after tax, changes in total assets net of cash, changes in research and development, changes in interest expense, and changes in dividends. Similar to the change in cash, these variables are also scaled by the firm's market capitalization at the start of the fiscal year. All variables are defined in Appendix A.

We merge the sample of firms with board information with Datastream to obtain daily stock return information. The final sample consists of 4,723 firm-year observations from 2001 to 2007 with the necessary variables to construct the variables in equation (2)[12]. Table 5 presents the market valuation of corporate cash holdings.

In column (1), the interaction between the unexpected change in cash and the proportion of busy directors on the board, $\Delta CASH_{it}*BUSYOUT_{it-1}$, is negative and significant at the 1% level. This result suggests that in firms with higher proportion of busy directors on the board, there are fewer constraints on managers over the diversion of corporate cash holdings for personal benefit and thus results in lower valuation of cash holdings. The interaction term, $\Delta CASH_{it}*BUSYOUT_{it-1}*ADVICE_{it-1}$, is positive and significant at the 1% level, suggesting that in firms with busy boards, cash is worth more in the sub-sample of firms with high advising needs. The interaction term, $\Delta CASH_{it}*BUSYOUT_{it-1}*EXTFIN_{it-1}$, is positive and significant at the 5% level. Simply put, in firms with busy boards, cash is worth more in the sub-sample of firms with high external financing needs. We find the interaction term, $\Delta CASH_{it}*BUSYOUT_{it-1}*WEDGE_{it-1}$, to be negative, suggesting that the negative valuation of cash in firms with more busy boards is more pronounced in those firms with higher ratio of voting rights to cash flow rights in the hands of the controlling shareholder.

Columns (2) and (3) present the analysis for developed countries and developing countries respectively. Columns (4) and (5) present the analysis for countries with strong shareholder rights and weak shareholder rights, respectively. In developing countries and countries with weak shareholder rights, cash is worth less in firms with busy board. However, in developed countries and countries with strong shareholder rights, cash is worth more in firms with busy boards, especially in the sub-sample of firms with high external financing needs. Columns (6) and (7) present the analysis for closely-held firms and widely-held firms, respectively. In closely-held firms, cash is worth less in firms with busy boards and high wedge between voting and cash-flow rights.

[12] The additional requirement of stock returns data in the analysis of the market valuation of corporate cash holdings reduces the sample size.

4.2. *Market Valuation of Corporate Capital Expenditures*

To examine how the contribution of capital expenditures to shareholder value depends on the proportion of busy outside directors on the board, we employ the same general framework we used for the analysis of the market value of cash holdings. We employ the following regression equation:

$$R_{it} - R^B_{it} = \beta_0 + \beta_1\, \Delta CAPEX_{it} + \beta_2\, \Delta CAPEX_{it}{*}BUSYOUT_{it-1} + \beta_3\, \Delta CAPEX_{it}{*}BUSYOUT_{it-1}{*}ADVICE_{it-1} + \beta_4\, \Delta CAPEX_{it}{*}BUSYOUT_{it-1}{*}EXTFIN_{it-1} + \beta_5\, \Delta CAPEX_{it}{*}BUSYOUT_{it-1}{*}WEDGE_{it-1} + \text{control variables} \quad (3)$$

The only difference between this model (equation 3) and that used in the value-of-cash analysis (equation 2) is that we replace $\Delta CASH_{it}$ with $\Delta CAPEX_{it}$, the change in a firm's capital expenditures from fiscal year t-1 to fiscal year t. Since $\Delta CAPEX_{it}$ is scaled by the market value of equity at the end of year t-1, its coefficient β_1 measures the dollar change in shareholder wealth for a one-dollar increase in capital expenditures.

Table 7 presents the regression results of the capital expenditures analysis. In column (1), we find that the scaled change in capital expenditures has a significantly positive effect on excess stock returns, indicating that on average capital investments add to shareholder value. The coefficient of the interaction term between busy boards and the change in capital expenditures ($CAPEX_{it}{*}BUSYOUT_{it-1}$) is negative and significant, indicating that busy boards reduce the contribution of capital expenditures to shareholder value. The interaction term, $\Delta CAPEX_{it}{*}\ BUSYOUT_{it-1}{*}ADVICE_{it-1}$, is positive and significant, indicating in firms with busy boards, capital investments are worth more in the sub-sample of firms with high advising needs. The interaction term, $\Delta CAPEX_{it}{*}BUSYOUT_{it-1}{*}EXTFIN_{it-1}$, is positive and significant, suggesting that in firms with busy boards, corporate capital investments are worth more in the sub-sample of firms with high external financing needs. We find that the interaction term, $\Delta CAPEX_{it}{*}BUSYOUT_{it-1}{*}WEDGE_{it-1}$, is negative and significant, suggesting that in firms with busy boards, corporate capital expenditures are less valuable in the sub-sample of firms with high ratio of voting rights to cash flow rights in the hands of the controlling shareholder.

Columns (2) and (3) present the analysis for developed countries and developing countries respectively. Columns (4) and (5) present the analysis for countries with strong shareholder rights and weak shareholder rights, respectively. In developed countries and countries with strong shareholder rights, capital expenditure is worth more in firms with busy boards, especially in the sub-sample of firms with high external financing needs. Columns (6) and (7) present the analysis for closely-held firms and widely-held firms, respectively. In closely-held firms, capital expenditure is worth less in firms with busy boards and high wedge between voting and cash-flow rights.

4.3. *Additional Tests*

4.3.1. *Endogeneity*

It is possible that firm valuation, the proportion of busy outside directors on the board and corporate ownership are jointly determined. To correct for this potential endogeneity problem, we estimate a simultaneous equation model similar to Harvey, Lins and Roper (2004). In this approach, we simultaneously estimate a three-stage least squares regression model, with three structural equations consisting of a (i) firm valuation equation, (ii) a busy board equation and (iii) a corporate ownership equation.

Table 8 reports the results of the three-stage least squares regressions. In model (1), the estimated coefficient on BUSYOUT is negative and significant, indicating that an increase in the proportion of busy outside directors on the board is negatively associated with firm valuation. The interaction term BUSYOUT*ADVICE is positive and significant, indicating that firms with high advising needs benefit from having more outside directors with multiple board appointments. The interaction term BUSYOUT*EXTFIN is positive and significant, indicating that if the proportion of busy outside directors on the board in firms increases, the valuation of firms with high external financing needs also increases. The interaction term BUSYOUT*WEDGE is negative and significant, indicating that the monitoring problems associated with busy boards coupled with entrenched ownership structure reduces firm value.

In model (2), we find that firm size, the stock's market risk (beta) and stock return volatility are negatively associated with the wedge between voting rights and cash flow rights. Consistent with Harvey, Lins and Roper (2004), we also find that the separation between voting rights and cash flow rights is positively associated with leverage. However, Tobin's Q, percentage of tangible assets and sales growth rate are not significant in this equation.

In model (3), we find that the proportion of busy directors on the board is positively associated with firm size and firm age. The industry-adjusted stock return of the firm is not significantly associated with proportion of busy directors on the board. This result casts doubt that poor firm performance makes the appointment of busy boards more likely, consistent with the results in Fich and Shivdasani (2006). Furthermore, there is no association between the wedge of voting rights and cash flow rights in the hands of the controlling shareholder and the proportion of busy directors on the board. Thus, there is little evidence that controlling shareholders appoint busy outside directors to reduce monitoring of corporate insiders.

As an additional test, following prior studies (Laeven and Levine (2007) and John, Litov, and Yeung (2008)), we use the average proportion of busy outside directors in the firm's industry based on two-digit securities industry classification (SIC) codes as instruments for the proportion of busy board of a given firm. Similarly, we employ the average wedge of voting rights and cash flow rights of the firm's industry based on two-digit SIC codes as instruments for a given firm's wedge of voting rights and cash flow rights. The economic assumption behind this model is that the industry's average proportion of busy outside directors on the board (average wedge of voting rights and cash flow rights) affects the firm valuation only through its effect on that firm's busy board (wedge of voting rights and cash flow rights) and not otherwise. Our three-stage estimation results based on this instrument (not tabulated) are qualitatively similar. Taken together with the results in Table 8, it is unlikely that our results are driven by endogeneity issues[13].

4.3.2. *Other Robustness Tests*

As a sensitivity test, we also repeat our tests year by year. The year-by-year analysis is qualitatively similar to our main results. Thus, there is no evidence that our results are clustered in specific years. As a robustness test, we exclude firms with board interlock to address the concern that interlocks could reduce the perceived independence of outside directors. In this sub-sample that exclude firms with board interlock, our results (not tabulated) are qualitatively similar.

5. Conclusions

This paper examines the benefits and costs associated with multiple directorships held by outside directors. Using a sample of listed firms in East Asia, we find that firms in which outside directors hold multiple directorships have lower firm valuation. Our result suggests that for the average firm in our sample, the directors' busyness hypothesis dominates the reputation hypothesis. More importantly, we find that the association between multiple directorships and firm performance is conditional on firm characteristics. Firm valuation is positively associated with the proportion of outside directors with multiple external directorships in firms with high advising needs and those with high external financing needs. These beneficial effects of multiple directorships are generally stronger in developed countries, countries with stronger shareholder rights and widely-held firms. In firms in which the controlling shareholder hold disproportionately high voting rights relative to cash flow rights, the negative association between firm valuation and multiple directorships by outside directors is more pronounced. The detrimental effects of busy boards are stronger in countries with weaker shareholder rights and closely-held firms.

As multiple directorships increases, corporate cash holdings (capital expenditures) are worth less to outside shareholders. We find that the negative association between the marginal value of cash (capital expenditures) and busy boards is mitigated in firms with (i) higher advising needs, (ii) higher external financing needs, and (iii) lower separation of voting rights and cash flow rights of the controlling shareholder. Additional analysis suggests that these results are generally stronger in countries with stronger shareholder rights, developed countries and in widely-held firms.

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[13] We acknowledge that it is difficult to identify ideal exogenous variables that affect firm value or board structure or ownership, but not all three. At the minimum, to the extent that our three-stage least squares estimation method controls for endogeneity among corporate valuation, busy boards and corporate ownership structure, our results are consistent with the notion that the association between multiple directorships and firm valuation is conditional on firm characteristics.

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Table 1

Descriptive statistics

This table presents the descriptive statistics by country for the sample of 6,536 firm-year observations during the period 2001 to 2007 in six East Asian countries (Hong Kong, Indonesia, Malaysia, Philippines, Singapore and Thailand). Variables are defined in Appendix A.

	Hong Kong		Indonesia		Malaysia		Philippines		Singapore		Thailand		Total	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
TOBINQ	2.73	2.25	1.59	1.37	2.51	1.95	1.67	1.73	2.59	1.74	2.32	1.81	2.46	1.85
DIRCOOUT	3.16	2	2.25	2	4.38	3	4.02	3	4.11	2	3.37	3	3.79	3
BUSYOUT	39	35	26	21	48	41	45	39	46	40	42	39	43	36
D_BUSY	0.29	0	0.18	0	0.41	0	0.37	0	0.43	0	0.38	0	0.35	0
ADVICE	0.4	0	0.47	0	0.58	1	0.51	1	0.48	0	0.52	1	0.5	1
EXTFIN	0.51	1	0.39	0	0.42	0	0.57	1	0.52	1	0.47	0	0.5	1
WEDGE	25	17	18	12	23	20	19	10	22	17	28	22	21	18
BDSIZE	10.3	8	7.1	6	8.2	6	8.7	7	9.5	8	8.9	8	8.43	8
OUTDIR	0.53	0.44	0.31	0.25	0.52	0.43	0.39	0.32	0.57	0.44	0.42	0.37	0.41	0.38
BDOWN	2.71	1.05	2.12	1.14	3.02	2.18	1.73	0.85	2.47	1.31	3.42	2.29	2.61	1.74
INTLOCK	0.28	0	0.17	0	0.35	0	0.21	0	0.34	0	0.30	0	0.31	0
NOMIN	0.83	1	0.51	1	0.72	1	0.65	1	0.86	1	0.69	1	0.71	1
INSTI	10.72	7.53	7.13	4.22	9.82	5.17	10.13	8.02	13.25	7.81	8.27	6.53	9.71	6.82
LNASSET	4.17	3.12	3.41	2.77	3.91	3.27	2.92	2.51	4.02	3.52	3.91	2.82	3.87	3.01
ROA	0.089	0.052	0.073	0.062	0.087	0.069	0.075	0.053	0.091	0.072	0.088	0.059	0.083	0.065
SALECHG	0.216	0.182	0.192	0.151	0.182	0.117	0.172	0.155	0.161	0.130	0.198	0.185	0.174	0.153
DEBT	0.272	0.203	0.411	0.326	0.351	0.293	0.279	0.241	0.242	0.192	0.352	0.297	0.328	0.305

Table 2

Spearman correlations

This table presents the Spearman correlations between the variables. The parenthesis contains the p-values.

	TOBINQ	DIRCOOUT	BUSYOUT	D_BUSY	ADVICE	EXTFIN	WEDGE	BDSIZE	OUTDIR	BDOWN
TOBINQ	1									
DIRCOOUT	-0.27 (0.03)	1								
BUSYOUT	-0.41 (0.02)	0.48 (0.02)	1							
D_BUSY	-0.47 (<0.01)	0.53 (0.01)	0.62 (<0.01)	1						
ADVICE	0.19 (0.04)	0.46 (0.03)	0.49 (<0.01)	0.47 (<0.01)	1					
EXTFIN	0.22 (0.03)	0.39 (0.04)	0.53 (0.02)	0.55 (<0.01)	0.27 (0.04)	1				
WEDGE	-0.38 (0.02)	0.24 (0.08)	0.19 (0.05)	0.22 (0.06)	0.15 (0.18)	0.22 (0.07)	1			
BDSIZE	0.15 (0.18)	0.28 (0.11)	0.31 (0.09)	0.25 (0.07)	0.32 (0.04)	0.16 (0.39)	0.09 (0.42)	1		
OUTDIR	0.22 (0.07)	0.32 (0.17)	0.27 (0.13)	0.34 (0.11)	-0.22 (0.03)	0.19 (0.08)	0.22 (0.05)	0.29 (0.06)	1	
BDOWN	0.08 (0.13)	0.05 (0.27)	0.08 (0.22)	0.12 (0.16)	0.09 (0.22)	0.02 (0.63)	0.11 (0.18)	0.27 (0.08)	0.12 (0.17)	1
INTLOCK	-0.07 (0.04)	0.11 (0.18)	0.14 (0.23)	0.19 (0.32)	0.21 (0.03)	0.14 (0.19)	0.09 (0.28)	0.35 (0.10)	0.23 (0.08)	0.06 (0.27)
NOMIN	0.12 (0.18)	0.04 (0.23)	0.12 (0.15)	0.08 (0.23)	0.09 (0.35)	0.16 (0.09)	0.11 (0.23)	0.08 (0.31)	0.27 (0.04)	0.14 (0.22)
INSTI	0.27 (0.02)	0.16 (0.11)	0.09 (0.22)	0.11 (0.28)	0.17 (0.39)	0.22 (0.05)	0.28 (0.04)	0.11 (0.20)	0.15 (0.12)	0.09 (0.17)
LNASSET	0.45 (0.02)	0.31 (0.03)	0.35 (0.02)	0.17 (0.04)	0.59 (<0.01)	0.16 (0.07)	0.10 (0.14)	0.35 (0.03)	0.26 (0.08)	-0.19 (0.07)
ROA	0.41 (<0.01)	-0.29 (0.06)	-0.27 (0.03)	-0.33 (0.02)	0.31 (0.04)	0.29 (0.15)	-0.35 (0.02)	0.16 (0.19)	0.23 (0.11)	0.15 (0.19)
SALECHG	0.23 (0.06)	0.03 (0.22)	0.07 (0.19)	0.08 (0.24)	0.17 (0.09)	0.38 (0.02)	-0.24 (0.06)	0.12 (0.13)	0.19 (0.09)	0.06 (0.21)
DEBT	-0.19 (0.17)	0.09 (0.34)	0.04 (0.39)	0.17 (0.31)	0.06 (0.29)	0.36 (0.03)	0.09 (0.26)	0.17 (0.22)	0.07 (0.38)	0.15 (0.23)

Table 2 (continued)

Spearman correlations

	INTLOCK	NOMIN	INSTI	LNASSET	ROA	SALECHG	DEBT
INTLOCK	1						
NOMIN	-0.11 (0.04)	1					
INSTI	-0.19 (0.08)	0.22 (0.09)	1				
LNASSET	0.26 (0.06)	0.34 (0.03)	0.44 (<0.01)	1			
ROA	0.13 (0.25)	0.16 (0.19)	0.37 (0.05)	0.21 (0.03)	1		
SALECHG	0.08 (0.31)	0.09 (0.35)	0.19 (0.22)	0.19 (0.15)	0.23 (0.06)	1	
DEBT	0.05 (0.41)	0.12 (0.23)	0.06 (0.15)	0.29 (0.04)	0.15 (0.11)	-0.21 (0.04)	1

Table 3

Firm valuation and busy outside directors

This table presents the firm-fixed effects regression results of firm valuation. The sample consists of 6,536 firm-year observations during the period 2001 to 2007 in six East Asian countries (Hong Kong, Indonesia, Malaysia, Philippines, Singapore and Thailand). The dependent variable is market value of equity plus book value of total liabilities divided by total assets (TOBINQ). All variables are defined in Appendix A. All models include firm fixed effects and dummy variables for country effects, industry effects and years effects (not tabulated). The parentheses contain the t-statistics on an adjusted basis using robust standard errors corrected for double (firm and year) clustering (Petersen (2009)). ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	1	2	3
Intercept	0.135 (2.03)**	0.283 (3.25)***	0.215 (3.22)***
DIRCOOUT	-0.045 (-3.11)***		
DIRCOOUT *ADVICE	0.073 (3.22)***		
DIRCOOUT * EXTFIN	0.058 (2.95)***		
DIRCOOUT * WEDGE	-0.064 (-2.52)***		
BUSYOUT		-0.114 (-3.02)***	
BUSYOUT * ADVICE		0.216 (3.32)***	
BUSYOUT * EXTFIN		0.233 (2.67)***	
BUSYOUT * WEDGE		-0.109 (-2.53)***	
D_BUSY			-0.081 (-3.22)***
D_BUSY * ADVICE			0.117 (2.89)***
D_BUSY * EXTFIN			0.108 (3.04)***
D_BUSY* WEDGE			-0.062 (-2.09)**

Table 3 (continued)

ADVICE	0.063 (2.41)***	0.136 (2.37)***	0.097 (2.03)**
EXTFIN	0.048 (2.11)**	0.067 (2.06)**	0.069 (2.05)**
WEDGE	-0.162 (-2.09)**	-0.185 (-2.11)**	-0.131 (-2.84)***
BDSIZE	-0.037 (-1.15)	-0.011 (-1.04)	-0.023 (-1.12)
OUTDIR	0.036 (1.98)**	0.059 (2.14)**	0.065 (2.09)**
BDOWN	0.025 (1.03)	0.106 (1.17)	0.073 (1.40)
INTLOCK	-0.071 (-1.52)	-0.098 (-1.47)	-0.102 (-1.39)
NOMIN	0.113 (1.29)	0.088 (1.81)*	0.143 (1.25)
INSTI	0.287 (2.01)**	0.197 (2.05)**	0.216 (2.11)**
LNASSET	0.492 (3.56)***	0.591 (4.15)***	0.523 (4.01)***
ROA	0.205 (2.01)**	0.294 (2.08)**	0.214 (1.72)*
SALECHG	0.072 (1.43)	0.114 (1.25)	0.129 (1.31)
DEBT	-0.115 (-1.29)	-0.087 (-1.14)	-0.091 (-0.82)
N	6,536	6,536	6,536
Adjusted R^2	33.04%	35.61%	34.92%

Table 4

Regression Results of Firm Valuation and Busy Outside Directors by Country

This table presents the firm-fixed effects regression results of firm valuation. The sample consists of 6,536 firm-year observations during the period 2001 to 2007 in six East Asian countries (Hong Kong, Indonesia, Malaysia, Philippines, Singapore and Thailand). The dependent variable is market value of equity plus book value of total liabilities divided by total assets (TOBINQ). All variables are defined in Appendix A. All models include dummy variables for industry effects and years effects (not tabulated). The parentheses contain the t-statistics on an adjusted basis using robust standard errors corrected for double (firm and year) clustering (Petersen (2009)). ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Hong Kong	Indonesia	Malaysia	Philippines	Singapore	Thailand
Intercept	0.271 (2.92)***	0.502 (3.17)***	0.173 (2.85)***	0.479 (3.52)***	0.306 (2.70)***	0.139 (4.05)***
BUSYOUT	-0.105 (-2.11)**	-0.082 (-1.79)*	-0.129 (-3.41)***	-0.078 (-2.76)***	-0.152 (-2.03)**	-0.164 (-2.08)**
BUSYOUT * ADVICE	0.138 (2.71)***	0.092 (2.25)***	0.252 (1.83)*	0.284 (2.33)***	0.173 (1.92)*	0.275 (2.61)***
BUSYOUT * EXTFIN	0.251 (2.49)***	0.102 (1.88)*	0.268 (2.45)***	0.095 (2.01)**	0.311 (2.80)***	0.140 (2.05)**
BUSYOUT * WEDGE	-0.073 (-2.11)**	-0.251 (-2.82)***	-0.102 (-2.03)**	-0.165 (-2.67)**	-0.086 (-2.07)**	-0.203 (-2.71)***
ADVICE	0.125 (2.41)***	0.079 (1.93)*	0.182 (2.40)***	0.172 (3.13)***	0.106 (1.88)*	0.152 (2.10)**
EXTFIN	0.029 (2.08)**	0.085 (2.62)***	0.103 (1.88)*	0.085 (2.92)***	0.091 (1.86)*	0.101 (2.04)**
WEDGE	-0.203 (-2.54)***	-0.117 (-2.04)**	-0.225 (-3.01)***	-0.211 (-2.47)***	-0.142 (-2.01)**	-0.128 (-2.03)**
BDSIZE	-0.052 (-0.86)	-0.029 (-0.78)	0.073 (1.19)	0.042 (0.63)	-0.019 (0.41)	0.094 (1.02)

Table 4 (continued)

OUTDIR	0.070 (2.02)**	0.039 (1.05)	0.082 (2.01)**	0.074 (2.38)***	0.065 (2.12)**	0.041 (1.03)
BDOWN	0.085 (0.94)	0.092 (1.01)	0.211 (0.92)	0.085 (0.26)	0.004 (1.28)	0.077 (0.43)
INTLOCK	-0.071 (-1.28)	0.012 (0.64)	-0.172 (-1.89)*	-0.054 (-1.93)*	-0.062 (-1.30)	0.062 (1.39)
NOMIN	0.052 (1.91)*	0.175 (2.02)**	0.074 (0.59)	0.105 (1.23)	0.139 (1.82)*	0.064 (1.51)
INSTI	0.134 (2.12)**	0.062 (1.47)	0.231 (2.29)***	0.132 (1.51)	0.143 (2.31)***	0.173 (2.02)**
LNASSET	0.631 (3.80)***	0.304 (2.92)***	0.415 (3.02)***	0.252 (2.08)**	0.0482 (2.77)***	0.392 (3.43)***
ROA	0.213 (2.45)***	0.116 (1.87)*	0.130 (2.02)**	0.217 (2.62)***	0.302 (2.89)***	0.106 (1.57)
SALECHG	0.109 (0.62)	0.152 (1.34)	0.087 (0.53)	-0.083 (-0.27)	0.035 (0.76)	0.103 (0.85)
DEBT	-0.061 (-1.37)	0.019 (0.35)	0.073 (1.12)	-0.105 (-2.11)**	-0.119 (-1.86)*	0.125 (1.79)*
N	1,497	834	1,343	537	1,566	759
Adjusted R^2	25.32%	18.09%	39.18%	28.75%	38.92%	23.06%

Table 5

Additional Analysis - Regression Results of Firm Valuation and Busy Outside Directors

This table presents the firm-fixed effects regression results of firm valuation. The sample consists of 6,536 firm-year observations during the period 2001 to 2007 in six East Asian countries (Hong Kong, Indonesia, Malaysia, Philippines, Singapore and Thailand). The dependent variable is market value of equity plus book value of total liabilities divided by total assets (TOBINQ). All variables are defined in Appendix A. All models include dummy variables for country effects, industry effects and years effects (not tabulated). The parentheses contain the t-statistics on an adjusted basis using robust standard errors corrected for double (firm and year) clustering (Petersen (2009)). ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1) Developed countries	(2) Developing countries	(3) Strong shareholder right	(4) Weak shareholder right	(5) Closely held firms	(6) Widely held firms
Intercept	-0.815 (-2.83)***	0.392 (2.64)***	0.471 (2.92)***	-0.152 (-2.01)**	0.276 (3.12)***	0.513 (2.84)***
BUSYOUT	-0.122 (-2.51)***	-0.193 (-3.27)**	-0.136 (-2.60)***	-0.125 (-2.47)***	-0.129 (-2.42)***	-0.118 (-2.57)***
BUSYOUT * ADVICE	0.223 (2.90)***	0.194 (2.72)***	0.205 (2.41)***	0.223 (2.12)**	0.107 (1.97)*	0.265 (3.18)***
BUSYOUT * EXTFIN	0.283 (2.85)***	0.156 (2.03)**	0.317 (2.72)**	0.204 (2.55)***	0.215 (2.42)***	0.253 (2.60)***
BUSYOUT * WEDGE	-0.091 (-2.42)***	-0.162 (-2.98)***	-0.115 (-2.59)***	-0.213 (-3.02)***	-0.225 (-3.29)***	-
ADVICE	0.103 (2.07)**	0.129 (2.38)***	0.097 (2.03)**	0.112 (2.42)***	0.073 (2.02)**	0.128 (2.11)**
EXTFIN	0.089 (2.46)***	0.045 (1.88)*	0.103 (2.69)***	0.078 (2.90)***	0.062 (2.05)**	0.094 (2.48)***
WEDGE	-0.147 (-2.03)**	-0.213 (-2.52)***	-0.118 (-2.29)***	-0.251 (-2.67)***	-0.195 (-3.16)***	-

Table 5 (continued)

BDSIZE	-0.032 (-0.98)	-0.005 (1.14)	-0.103 (-1.22)	-0.724 (-1.40)	-0.021 (-1.33)	-0.065 (-0.67)
OUTDIR	0.076 (2.01)**	0.098 (2.29)***	0.081 (2.29)***	0.113 (2.56)***	0.104 (2.07)**	0.084 (2.61)***
BDOWN	0.028 (1.15)	0.013 (0.87)	0.051 (0.83)	0.071 (1.19)	0.052 (1.03)	0.019 (0.76)
INTLOCK	-0.062 (-1.46)	-0.085 (-1.51)	-0.041 (-0.92)	-0.103 (-1.28)	-0.073 (-1.40)	-0.052 (-1.03)
NOMIN	0.117 (1.62)	0.402 (1.39)	0.208 (1.35)	0.365 (0.74)	0.264 (0.82)	0.311 (1.20)
INSTI	0.129 (2.38)***	0.082 (2.01)**	0.107 (2.02)**	0.085 (2.49)***	0.174 (2.56)***	0.092 (1.86)*
LNASSET	0.431 (3.86)***	0.529 (4.01)***	0.602 (4.17)***	0.582 (3.70)**	0.417 (3.28)***	0.569 (3.42)***
ROA	0.264 (2.10)**	0.217 (2.03)**	0.162 (2.26)**	0.139 (2.08)**	0.121 (2.03)**	0.133 (2.12)**
SALECHG	0.138 (1.67)	0.159 (1.82)*	0.078 (1.59)	0.113 (1.50)	0.105 (1.41)	0.127 (1.86)*
DEBT	-0.042 (-0.83)	-0.056 (-1.04)	-0.081 (-1.20)	-0.105 (-0.72)	0.163 (1.09)	-0.095 (-1.17)
N	3,063	3,473	4,406	2,130	4,052	2,130
Adjusted R^2	28.6%	26.1%	29.5%	27.2%	30.7%	27.9%

Table 6

Regression results of the market valuation of corporate cash holdings.

This table presents the regression results of the market valuation of corporate cash holdings. The sample consists of 4,723 firm-year observations during the period 2001 to 2007 in six East Asian countries (Hong Kong, Indonesia, Malaysia, Philippines, Singapore and Thailand). The dependent variable is the industry-adjusted excess returns of the firms during the fiscal year. All variables are defined in Appendix A. All models include dummy variables for country effects, industry effects and years effects (not tabulated). The parentheses contain the t-statistics based standard errors corrected for heteroscedasticity and firm-level clustering. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1) Pooled sample	(2) Developed countries	(3) Developing countries	(4) Strong shareholder right	(5) Weak shareholder right	(6) Closely held firms	(7) Widely held firms
Δ CASH$_t$	0.317 (2.75)***	0.492 (2.81)***	0.304 (3.25)***	0.352 (3.13)***	0.528 (3.81)***	0.427 (3.92)***	0.281 (2.76)***
Δ CASH$_t$ * BUSYOUT$_{t-1}$	-0.235 (-3.15)***	-0.197 (-2.78)***	-0.271 (-2.90)***	-0.202 (-2.98)***	-0.267 (-3.02)***	-0.263 (-3.01)***	-0.255 (2.15)**
Δ CASH$_t$ * BUSYOUT$_{t-1}$ *ADVICE$_{t-1}$	0.403 (2.72)***	0.387 (2.65)***	0.425 (2.79)***	0.362 (2.42)***	0.374 (2.61)***	0.272 (2.04)**	0.324 (2.70)***
Δ CASH$_t$ * BUSYOUT$_{t-1}$ * EXTFIN$_{t-1}$	0.304 (2.16)**	0.465 (2.66)***	0.252 (2.04)**	0.449 (2.70)***	0.283 (2.11)**	0.217 (1.89)*	0.218 (2.09)**
Δ CASH$_t$ * BUSYOUT$_{t-1}$ * WEDGE$_{t-1}$	-0.473 (-2.62)***	-0.376 (-2.50)***	-0.582 (-3.17)***	-0.341 (-2.72)***	-0.579 (-3.23)***	-0.604 (-2.91)***	-
ΔCASH$_t$ * CASH$_{t-1*}$	-0.229 (-3.01)***	-0.203 (-2.81)***	-0.217 (-2.60)***	-0.182 (-2.55)***	-0.217 (-2.60)***	-0.275 (-2.91)***	-0.202 (-2.01)**
ΔCASH$_t$ * DEBT$_t$	-0.051 (0.72)	-0.040 (1.01)	-0.059 (0.52)	-0.022 (1.23)	-0.072 (1.03)	-0.033 (1.28)	-0.027 (0.44)

Table 6 (continued)

CASH $_{t-1}$	0.075 (1.29)	0.091 (1.18)	0.070 (1.05)	0.048 (0.74)	0.065 (1.22)	0.062 (1.21)	0.013 (1.28)
DEBT $_{t}$	-0.311 (-1.15)	-0.294 (-1.09)	-0.083 (-0.74)	-0.211 (-1.15)	-0.072 (-1.34)	-0.071 (-0.72)	-0.281 (-1.05)
ΔEARN $_{t}$	0.372 (2.04)**	0.315 (2.39)***	0.072 (1.83)*	0.292 (2.11)**	0.103 (1.88)*	0.071 (1.23)	0.221 (0.39)
ΔNETASSET $_{t}$	0.009 (0.83)	0.004 (0.72)	0.015 (1.06)	0.0015 (0.34)	0.023 (1.19)	0.019 (1.33)	0.023 (1.22)
ΔRD$_{t}$	0.711 (0.68)	0.723 (0.92)	0.592 (1.10)	0.613 (0.45)	0.518 (0.67)	0.513 (0.72)	0.457 (0.89)
ΔINTEREST$_{t}$	-0.027 (-0.24)	0.015 (1.29)	-0.042 (-0.75)	0.011 (1.02)	-0.027 (-0.62)	0.055 (0.70)	0.011 (0.32)
ΔDIV$_{t}$	-0.066 (-0.81)	-0.071 (-1.16)	-0.041 (-1.02)	-0.052 (-1.23)	-0.057 (-1.18)	-0.039 (-1.14)	-0.067 (-1.29)
NETFIN$_{t}$	0.002 (0.85)	0.001 (0.39)	0.004 (0.51)	0.001 (0.02)	0.022 (0.73)	0.001 (0.09)	0.001 (0.322)
WEDGE	-0.213 (-2.02)**	-0.162 (-1.79)*	-0.248 (-2.11)**	-0.103 (-2.04)**	-0.248 (-2.13)**	-0.183 (-2.02)**	-
BDSIZE	0.015 (0.72)	0.027 (0.40)	0.030 (0.19)	0.005 (0.46)	0.024 (0.22)	0.019 (0.22)	0.043 (0.71)
OUTDIR	0.049 (0.52)	0.105 (0.46)	0.041 (0.59)	0.119 (0.83)	0.093 (0.70)	0.019 (0.24)	0.162 (1.09)
BDOWN	0.002 (0.13)	0.017 (0.28)	0.001 (0.19)	0.021 (0.35)	0.001 (0.28)	0.001 (0.11)	0.001 (0.18)
INTLOCK	0.001 (0.17)	0.004 (0.28)	0.001 (0.13)	0.015 (0.83)	0.011 (0.29)	0.023 (0.18)	0.029 (0.32)
NOMIN	0.025 (1.04)	0.037 (0.72)	0.014 (0.99)	0.029 (0.38)	0.005 (1.14)	0.043 (1.29)	0.029 (0.70)
INSTI	0.107 (2.01)**	0.096 (2.09)**	0.072 (1.15)	0.064 (2.02)**	0.061 (1.33)	0.052 (1.03)	0.083 (2.10)**
N	4,723	1,888	2,835	2,760	1,963	2,881	1,842
Adjusted R^2	16.8%	12.7%	14.3%	14.1%	15.2%	12.2%	14.9%

Table 7

Regression results of the market valuation of large capital expenditure increases.

This table presents the regression results of the market valuation of corporate capital expenditure. The sample consists of 2,106 firm-year observations during the period 2001 to 2007 in six East Asian countries (Hong Kong, Indonesia, Malaysia, Philippines, Singapore and Thailand). The dependent variable is the industry-adjusted excess returns of the firms during the fiscal year. All variables are defined in Appendix A. All models include dummy variables for country effects, industry effects and years effects (not tabulated). The parentheses contain the t-statistics based standard errors corrected for heteroscedasticity and firm-level clustering. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1) Pooled sample	(2) Developed countries	(3) Developing countries	(4) Strong shareholder right	(5) Weak shareholder right	(6) Closely held firms	(7) Widely held firms
Δ CAPEX$_t$	0.292 (2.15)**	0.316 (2.53)***	0.262 (3.11)***	0.319 (2.84)***	0.172 (2.11)**	0.215 (3.13)***	0.329 (2.70)***
Δ CAPEX$_t$ * BUSYOUT$_{t-1}$	-0.217 (-2.98)***	-0.173 (-2.70)***	-0.262 (-2.81)***	-0.197 (-2.62)***	-0.235 (-2.10)**	-0.284 (-2.09)**	-0.251 (2.10)**
Δ CAPEX$_t$ * BUSYOUT$_{t-1}$ * ADVICE$_{t-1}$	0.319 (2.08)**	0.203 (2.32)***	0.228 (2.10)**	0.302 (2.31)***	0.275 (2.02)**	0.203 (1.88)*	0.349 (2.09)**
Δ CAPEX$_t$ * BUSYOUT$_{t-1}$ * EXTFIN$_{t-1}$	0.352 (2.12)**	0.411 (2.05)**	0.203 (2.01)**	0.412 (2.57)***	0.290 (1.81)*	0.193 (2.05)**	0.221 (2.10)**
Δ CAPEX$_t$ * BUSYOUT$_{t-1}$ * WEDGE$_{t-1}$	-0.401 (-2.53)***	-0.452 (-2.71)***	-0.513 (-3.01)***	-0.338 (-2.80)***	-0.472 (-2.11)**	-0.579 (-2.83)***	-
CAPEX$_t$	0.189 (1.05)	0.170 (0.98)	0.163 (1.04)	0.192 (0.72)	0.153 (1.01)	0.115 (1.24)	0.130 (1.41)
DEBT$_t$	-0.615 (-1.52)	-0.512 (-1.19)	-0.631 (-1.37)	-0.531 (-1.33)	-0.642 (-1.50)	-0.481 (-0.90)	-0.623 (-1.02)
ΔEARN$_t$	0.415 (2.10)**	0.438 (2.34)***	0.217 (1.52)	0.372 (2.52)***	0.229 (1.41)	0.302 (1.45)	0.463 (2.13)**

Table 7 (continued)

$\Delta NETASSET_t$	0.023 (0.87)	0.035 (0.92)	0.19 (0.23)	0.040 (0.87)	0.21 (0.35)	0.029 (0.11)	0.031 (0.57)
ΔRD_t	0.022 (1.13)	0.014 (0.81)	0.059 (0.80)	0.072 (1.11)	0.054 (0.73)	0.017 (0.55)	0.011 (0.42)
$\Delta INTEREST_t$	-0.061 (-1.40)	-0.082 (-1.09)	-0.031 (-0.42)	-0.117 (-1.05)	-0.071 (-1.31)	-0.032 (-1.22)	-0.078 (-1.19)
ΔDIV_t	-0.022 (-0.53)	-0.036 (-1.05)	-0.071 (-1.30)	-0.025 (-0.88)	-0.016 (1.16)	-0.011 (-1.18)	-0.036 (-0.97)
$NETFIN_t$	0.701 (0.98)	0.735 (0.86)	0.571 (1.13)	0.643 (0.47)	0.529 (0.78)	0.318 (0.75)	0.413 (0.90)
WEDGE	-0.119 (-2.01)**	-0.103 (-1.52)	-0.217 (-2.04)**	-0.115 (-1.30)	-0.226 (-2.10)**	-0.178 (-2.04)**	-
BDSIZE	0.001 (0.17)	0.027 (0.38)	0.001 (0.33)	0.022 (0.37)	0.021 (0.20)	0.017 (0.15)	0.001 (0.19)
OUTDIR	0.115 (1.23)	0.414 (1.35)	0.215 (1.27)	0.317 (0.88)	0.215 (0.73)	0.307 (1.15)	0.37 (0.22)
BDOWN	0.137 (1.03)	0.151 (1.24)	0.082 (1.19)	0.1223 (1.53)	0.109 (1.45)	0.129 (1.03)	0.001 (0.33)
INTLOCK	0.016 (0.84)	0.005 (0.76)	0.023 (1.07)	0.002 (0.54)	0.031 (1.22)	0.005 (1.02)	0.022 (1.50)
NOMIN	0.029 (1.05)	0.017 (0.97)	0.052 (0.88)	0.076 (1.03)	0.042 (1.22)	0.017 (0.80)	0.027 (0.38)
INSTI	0.166 (1.89)*	0.213 (1.92)*	0.151 (1.25)	0.341 (1.88)*	0.028 (0.81)	0.201 (1.91)*	0.126 (0.82)
N	2,106	839	1,267	1,261	845	1,243	863
Adjusted R^2	12.7%	13.1%	11.2%	13.9%	10.8%	13.9%	10.5%

Table 8

Joint determination of firm valuation, corporate ownership and busy boards

This table presents the three-stage least squares regression results of firm valuation, corporate ownership and busy boards. The sample consists of 6,536 firm-year observations during the period 2001 to 2007 in six East Asian countries (Hong Kong, Indonesia, Malaysia, Philippines, Singapore and Thailand). In model (1), the dependent variable is market value of equity plus book value of total liabilities divided by book value of total assets (TOBINQ). In model (2), the dependent variable is the separation of voting rights and cash flow rights of the controlling shareholder (WEDGE). In model (3), the dependent variable is the percentage of busy outside directors on the board where a director is classified is busy if he holds three or more directorships (BUSYOUT). All models include dummy variables for country effects, industry effects and years effects (not tabulated). The parentheses contain the t-statistics based standard errors corrected for heteroscedasticity and firm-level clustering. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	1	2	3
Dependent variable	TOBINQ	WEDGE	BUSYOUT
Intercept	0.029 (3.15)***	0.418 (2.71)***	0.255 (3.03)***
BUSYOUT	-0.119 (-2.57)***	0.072 (1.09)	
BUSYOUT * ADVICE	0.141 (2.56)***		
BUSYOUT * EXTFIN	0.129 (2.41)***		
BUSYOUT * WEDGE	-0.102 (2.86)**		
ADVICE	0.049 (1.24)		
EXTFIN	0.066 (1.91)*		
WEDGE	-0.153 (-2.12)**		0.022 (0.73)
BETA		-0.084 (-1.89)*	

Table 8 (continued)

SIGMA		-0.117 (-2.05)**	
FIRMAGE			0.119 (2.02)**
INDRET			0.090 (1.16)
TOBINQ		0.117 (1.28)	0.203 (1.37)
TANGIBLE	0.061 (1.29)	-0.214 (-1.01)	
BDSIZE	-0.029 (-0.77)		
OUTDIR	0.057 (2.03)**		
LNASSET	0.502 (2.72)***	-0.316 (-2.61)***	0.201 (2.10)**
ROA	0.186 (2.01)**		
SALECHG	0.030 (1.12)	0.029 (1.02)	0.105 (0.67)
DEBT	-0.0465 (-1.39)	0.813 (2.04)**	0.019 (0.74)
N	6,536	6,536	6,536

Appendix A - Variable definitions

Variable	Definition
Analysis of firm performance	
TOBINQ	Market value of equity plus book value of total liabilities divided by total assets.
DIRCOOUT	Average directorships per outside directors.
BUSYOUT	Percentage of busy outside directors where a director is classified is busy if he holds three or more directorships.
D_BUSY	A dummy variable that equals one if more than 50% of outside directors are busy, and zero otherwise. We consider a director as busy if he holds three or more directorships.
ADVICE	The firm's intensity of advising needs based on a common factor analysis of three widely-used measures of organizational complexity: (i) number of business segments, (ii) firm size and (iii) proportion of intangible assets to total assets. ADVICE is a dummy variable that equals one if this common factor score is greater than the median value and zero otherwise.
EXTFIN	We define a firm's external finance needs as its capital expenditures minus cash flow from operations divided by capital expenditures. Then, we compute the firm's average external finance needs ratio in the prior five years to smooth temporal fluctuations. EXTFIN is a dummy variable that equals one if the external finance needs ratio is greater than the median value and zero otherwise.
WEDGE	Control rights minus cash flow rights of the largest controlling shareholder.
OUTDIR	Proportion of outside directors on the board. Outside directors are directors who directors who are not classified as inside or grey directors, where grey directors include former employees or persons who have related party transactions with the firm.
BDSIZE	Number of directors on the board.
BDOWN	The percentage of common shares held by outside directors.
INTLOCK	a board interlock dummy variable that equals one if two firms in the sample share a common director in that year and zero otherwise.
NOMIN	A dummy variable that equals one if a board nominating committee is present and zero otherwise.
INSTI	The proportion of common equity held by institutional shareholders.
LNASSET	Natural logarithm of book value of total assets.
ROA	Net income divided by total assets.

SALECHG Prior year sales growth.

DEBT Long term debt divided by book value of total assets.

Analysis of market valuation of corporate cash holdings

R_{it} Raw returns of the stock during the fiscal year.

R^{B}_{it} Benchmark return proxied by industry value weighted returns.

Δ $CASH_t$ Change in cash divided by market value of equity at start of the year.

$DEBT_t$ Total liabilities divided by market value of equity at start of the year.

$\Delta EARN_t$ Change in net income after tax divided by market value of equity at start of the year.

$\Delta NETASSET_t$ Change in net assets divided by market value of equity at start of the year.

ΔRD_t Change in research and development expenditures divided by market value of equity at start of the year.

$\Delta INTEREST_t$ Change in interest divided by market value of equity at start of the year.

ΔDIV_t Change in common dividends divided by market value of equity at start of the year.

$NETFIN_t$ New equity issues and new debt issues divided by market value of equity at start of the year.

CONSTRAIN A dummy variable that equals one if the firm's total payout ratio (dividends and stock repurchases divided by assets) is below the sample median and zero otherwise.

Analysis of market valuation of corporate cash holdings

Δ $CAPEX_t$ Change in capital expenditures incurred during the year divided by market value of equity at start of the year.

Analysis of joint determination of firm valuation, corporate ownership and busy boards

BETA The beta from a regression of firm's monthly stock return on its local market Morgan Stanley Capital International index in the prior 36-months period.

SIGMA Standard deviation of firm's stock return in the prior 36-months period.

TANGIBLE Net property, plant and equipment divided by total assets.

FIRMAGE Age of the firm since incorporation date.

INDRET Industry adjusted stock return in the last fiscal year.

□ □ □ □ □ □ Has BRICS Countries Decoupled from the Effect of Contagion during the 2008 Financial Crisis? Comparison of VECM Model and DCC GARCH Model

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In the light of the recent financial crisis, this paper investigates the contagion effect of the 2008 financial crisis shedding light on the decoupling recoupling theory. This paper investigates 5 BRICS countries (Brazil, Russia, India, China and South Africa) and the contagion effect from the US and UK indices. This paper compares DCC GARCH model and VECM model to conduct the investigation. This paper has found that with the exception of China, BRICS countries generally have been effected by the contagion effect.

1. Introduction

The current financial crisis has done considerable global damage in the period between 2008 and 2010, and therefore it is particularly interesting to understand the impact of the crisis. It originated from Anglo-Saxon economies, the US particularly, and to a lesser extent the UK. Much of the literature has done extensive research into the reasons behind the crisis but there is a lack of research into the impact of the crisis upon other countries such as the BRICS.

The BRICS (Brazil, Russia, India, China and South Africa) was a term for these countries coined by Goldman Sachs in 2002 and consists of five of the highest GDP growth countries in the world. It is also forecasted that the BRICS will become the dominant economies by 2050, representing half of the global GDP (Chittedi 2014). Currently, the BRICS are all in the G20 organisation and already representing a significant proportion of the world's population and economic activities.

The economic activities of BRICS are not only significant globally, they are also significant in their respective regions as they are the regional hubs in their own right, such as Brazil in Latin America and China in East Asia. The macro-economics and the climate for financial markets are very different from the traditional Anglo-Saxon countries, such that many scholars have thought that these countries have already decoupled from the US and UK economies (Leduc, Spiegel 2013, Liang 2010). The reason is that the economic model for the BRICS is predominately export-led, whereas the growth of the Anglo-Saxon economies has been reliant on domestic consumption for many years. The export-led economies have resulted in a significant amount of foreign reserves in the current accounts of the BRICS countries and, leading the above-average economic growth, regionally driving global economies.

Investors invest in these countries for a number of reasons. First the growth rate of the assets tends to be in the region of double figures, meaning that it can satisfy some risk-taking investment strategies. Investors investing into these assets are usually seeking a better return than mature markets. Secondly, most scholars thought that because of the decoupling effect mentioned earlier, it satisfies the primary principle of the portfolio theory that traders would diversify internationally to reduce the risk of the portfolio from the extreme sudden volatility of a shock in one particular country.

Because of this reason, it is particularly interesting to study the co-movement and the contagion of these emerging markets so that the effect of one of the most damaging financial crises can be understood. It is important to study the performance of the markets in the BRICS countries during the recent financial crisis so that the decoupling–recoupling theory can be investigated, as there is currently a lack of literature in this area. Studying this area will enable the academic world to gain an understanding of the behaviour of the financial markets, assisting the fiscal policy-making of emerging countries and also the formulation of crisis-prevention regulation. Secondly, diversification is an important area for investment and the study of contagion will enable us to understand how a crisis may transmit from one country to another. This will enable investors to gain an understanding of the underlying contagion that is hidden in regions and countries, enabling them to make informed decisions when undertaking investment activities. This will provide more insight for them to make better decisions in terms of diversification into emerging countries.

2. Literature Review

A great deal of the literature has focused on finding out the presence of the contagion effect in emerging markets in a given period of time (Morales, Andreosso-O'Callaghan 2014, Ahmad, Sehgal et al. 2013, Dimitriou, Kenourgios et al. 2013, Kotkatvuori-Ornberg, Nikkinen et al. 2013, Didier, Love et al. 2012, Junior, Franca 2012, Aloui, Aissa et al. 2011, Kenourgios, Samitas et al. 2011, Guo, Chen et al. 2011, Naous, Khemiri et al. 2010). Most of the literature lacks cohesion when analysing the presence of the contagion effect in a collection of countries. It is therefore the intention of the researcher that a focused analysis be undertaken in the form of a select few emerging countries, and the BRICS bloc has been chosen for this purpose.

2.1 Contagion channels

Some of the literature argues that the only way BRICS countries would be able to weather the next financial crisis would be by undertaking trade (Kim, Lee et al. 2011). Through trade and collection, and a large amount of foreign reserves together with fiscal reform, emerging countries would be able to isolate themselves from the external shocks that may negatively impact on the financial markets and economies. These studies explain the reason behind this as trade eventually leading to export-led growth of economies, ensuring above-average growth year on year.

However, it is trade that led the emerging countries into lowered growth from mid-2008. The falling demand of consumption led to a fall in exports. This has hit the export-led countries hard and resulted in the below average performance of macro-economic figures in 2008 and 2009. Combined with the pull of the currency contagion, channel presence in the traditional dollar-trading markets and those artificially pegged to the dollar, the financial markets experienced a decrease in market capitalisation and liquidity, the performance of which was found to be affected by the intensive bad news from the West.

This thesis will provide a comprehensive study of the contagion channels by comparing two mathematical econometric models, the VECM and the Dynamic Conditional Correlation (DCC) GARCH models. It will explain how contagion happened and the delay of its occurrence.

2.2 Decoupling–recoupling theory

Prior to the beginning of the 2008 sub-prime mortgage financial crisis, some of the literature argued that the BRICS economies had decoupled from the traditional Anglo-Saxon economies (Kizys, Pierdzioch 2013, Kim, Lee et al. 2011, Dooley, Hutchison 2009). This is because the BRICS have been employing export-led growth strategies, whereas Anglo-Saxon economies favour domestic consumption. The differences in these strategies led to a global imbalance and the trade deficit between these countries widened. Countries like China, Russia and India were hence able to collect a large amount of foreign reserves. Therefore, some of the literature was arguing that the emerging countries may be able to weather the next financial crisis prior to the 2008 crisis. This argument led into a debate over the strength of the linkage between emerging countries and the industrialised countries.

However, the 2008 financial crisis revealed to us that the BRICS economies were at best recoupled to the world economies, despite the fact that they outperformed the US and the UK in 2007 in many areas, such as outperforming by 40% in the financial markets. Since the collapse of Lehman Brothers and other financial institutions, the contagion of the bad news resulted in the co-movement of financial markets. Financial markets in emerging countries experienced a decline in liquidity and an increase in volatility following the intense bad news in the West. This has led to the consistent findings of many studies that the linkage between the economies has been greatly enchanted since the occurrence of 2008 financial crisis. Some even argued that they did not decouple in the calm period as the emerging countries could not weather the financial crisis technically.

This thesis will continue to shed light on this area and will use two mathematical models to contribute to the debate that the decoupling theory was at best weakly supported during the tranquil period.

2.3 Contagion in BRICS

Much of the literature focuses on examining contagion in a group of emerging countries and there is a lack of a focus on a group of similar economies such as the BRICS (Kotkatvuori-Ornberg, Nikkinen et al. 2013, Samarakoon 2011). Consistently, the literature has found that the correlation of financial contagion has increased since the collapse of Lehman Brothers and the later stage of the 2008 financial crisis. Some of the literature divided the contagion into two phases: the difference in the correlation level in the tranquil and the crisis period, providing an in-depth analysis that the intensive bad news since the collapse of Lehman Brothers has greatly affected the financial markets of the BRICS countries.

Few elements within the literature rejected the presence of contagion from the US to the BRICS and this thesis will provide further information and the reasons behind the delay of the contagion from mid-2008 onwards. In Section 3, the methodologies section, I will explain the testing of the contagion of the BRICS. Section 4 presents the data describing the performance of the financial markets in the BRICS during the financial crisis. Section 5 provides a discussion comparing the VECM and the DCC GARCH model. It provides explanations of the presence of contagion. Section 6 concludes the paper.

3. Methodology

3.1 Data Collection

The sample was taken from January 2007 to December 2010, during the peak of the financial crisis. Closing share prices of each of the BRICS countries were collected on Yahoo Finance. The sample was analysed using Microsoft Excel and EVIEWS software. Many studies have defined contagion as the sudden increase of co-movement of stock markets after a shock (Dimitriou, Simos 2013, Samarakoon 2011). Traditionally, the literature a number of different kinds of models to test the co-movement: the Chow test, the co-integration test, the causality test, a DCC GARCH model and a direct estimation of specific transmission mechanisms. Since most of the literature that employed the last methods was not especially tested for contagion, I have proposed to use the three most objective methods in EVIEWS so that the co-movement can be tested.

3.2 Johansen co-integration test

The co-integration test is a common tool since it was introduced by measuring the present and the changes in the co-integrating vector in a long-run sample. It is particularly good for a sample with a long period of observations explaining the linkages of the financial markets and the variables for testing.

Its advantage being with an assumption of unit root such that it is excellent in testing variables that often modelled as unit root such as interest rates, inflation, real exchange rates and unemployment rates. Hence it is very useful to test the impact of the current financial crisis in terms of the macro-economic determinates on the financial markets in the BRICS. In the Johansen framework, all the variables are near-integrated, testing the H0 $r \leq 0$ in trace test and the H0 $r=0$ in eigenvalue test.

Johansen's methodology takes its starting point in the vector autoregression (VAR) of order p given by:

$$y_t = \mu + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \varepsilon_t \qquad 1$$

where y_t is an n x 1 vector of variables that are integrated of order one – commonly denoted as I(1), and ε_t is an n x 1 vector of innovations. This VAR can be re-written as:

$$y_t = \mu + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-1} + \varepsilon_t \qquad 2$$

Where:

$$\Pi = \sum_{i=1}^{p} A_i - I \text{ and } \Gamma_i = -\sum_{j=i+1}^{p} A_j \qquad 3$$

Johansen proposed two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of the Π atrix; the trace test and the maximum eigenvalue test, shown in equations 4 and 5.

$$J_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i) \qquad 4$$

$$J_{max} = -T\ln(1 - \lambda_{r+1}) \qquad 5$$

One disadvantage of this model is that because it is particularly good at long-running relationships, it risks missing the periods of co-movement in the short-term relationships of markets for a short period of time after a crisis. But this can be addressed using a causality test that is designed to test short-run relationships.

3.3 VECM

Granger and Lee (1989) formulated the non-linearity in the adjustment mechanism or Error Correction Model (ECM). This representation was then developed by (Escribano, Pfann 1998) who considered that the linear ECM models are based on restrictive conditions as follows.

The uniqueness of the long-term equilibrium and adjustment with respect to the equilibrium is symmetrical. Yet according to (Masson 1999), during periods of crisis, financial markets may give rise to situations of multiple equilibrium, reflecting sudden changes in investor expectations with respect to the risk.

These carry out operations of re-adjustment and the reallocation of portfolios that thus move the market from a steady state to another. Also, and as has been suggested by several studies, the adjustment with respect to the equilibrium is asymmetric. The markets' reaction to the shock differs according to its positive or negative nature. (Escribano, Pfann 1998) shared the error correction term in the ECM model in two positive and negative parts such as:

$$z_{t-1}^{+} = \begin{cases} z_{t-1} \; si \; \Delta z_{t-1} > 0 \\ 0 \; \sin on \end{cases} \qquad 6$$

$$z_{t-1}^{-} = \begin{cases} z_{t-1} \; \sin \Delta z_{t-1} < 0 \\ 0 \; \sin on \end{cases} \qquad 7$$

This transformation allows for the creation of two situations of equilibrium, each characterised by a specific speed of adjustment. The first equilibrium of stability is captured by the term: z_{t-1}^{-}. Therefore, the new representation of the ECM is:

$$\Delta y_t = \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + \sum_{i=1}^{q} \beta_i \Delta x_{t-i} + \delta_1 z_{t-1}^{+} + \delta_2 z_{t-1}^{-} + \varepsilon_t \qquad 8$$

By testing the beta coefficient of the granger term $\sum_{i=1}^{q} \beta_i \Delta x_{t-1}$by Wald Test: H0: $\beta_1 = \beta_2 = \cdots = \beta_n = 0$, we will be able to know if the granger term has caused significant external induction to the indices of the BRICS.

Because there is structural break in all of the indices as illustrated on graphs in Appendix B, it is proposed to include a control variable to estimate the structural break that occurred during the last quarter of 2008, approximately when Lehman Brothers collapsed. It is proposed that a control variable of the announcement date of the recession in the UK is used representing the pre crisis period and post crisis period. The UK government announced the reality of recession in October 2008 and the control variable is set to 0 before the announcement date and equals to 1 after the announcement date.

3.3 Dynamic Conditional Correlation (DCC) GARCH model

The DCC GARCH model enables researchers to estimate the co-variance transmission mechanism between the sample countries. This type of model allows practitioners to construct a portfolio that can be forecasted using a set of co-variance based variables of asset returns. It is particularly important as the hedge ratio often changes according to the assets' co-variance and volatilities. Hence, this type of GARCH model is commonly employed by sophisticated traders and researchers.

We can specify a multivariate conditional variance as:

$$H_t = D_t R_t D_t \qquad 9$$

Where D_t is the (n x n) diagonal matrix of time-varying standard deviations from univariate GARCH models with $\sqrt{h_{ii,t}}$ on the ith diagonal, i = 1,2....,n. $R_t$is the (n x n) time-varying correlation matrix. The DCC model proposed by Engle (2002) involves a two-stage estimation of the conditional co-variance matrix H_t. In the first stage, univariate volatility models are fitted for each of the stock returns and estimates of $\sqrt{h_{ii,t}}$ are obtained. In the second stage, stock-return residuals are transformed by their estimated standard deviations from the first stage. That is: $u_{i,t} = {\varepsilon_{i,t}}/{\sqrt{h_{ii,t}}}$, where $u_{i,t}$ is then used to estimate the parameters of the conditional correlations. The evolution of the correlation in the DCC model is given by:

$$Q_t = (1 - \alpha - \beta)\bar{Q} + \alpha u_{t-1}u'_{t-1} + \beta A_{t-1} \qquad 10$$

Where $Q_t = (q_{ij,t})$ is the n x n time-varying co-variance matrix of u_t, $\bar{Q} = E[u_t u'_t]$ is the n x n unconditional variance matrix of u_t, and α and β are non-negative scalar parameters satisfying $(\alpha + \beta) < 1$. Since Q_t does not generally have ones on the diagonal, we scale it to obtain a proper correlation matrix R_t. Thus:

$$R_t = (diag(Q_t))^{\frac{-1}{2}} Q_t (diag(Q_t))^{-\frac{1}{2}} \qquad 11$$

Where $(diag(Q_t))^{-\frac{1}{2}} = diag\left(\frac{1}{\sqrt{q_{11,t}}}, \dots, \frac{1}{\sqrt{q_{nn,t}}}\right)$

Now R_t in Eq (11) is a correlation matrix with ones on the diagonal and off diagonal elements less than one in absolute value, as long as Q_t is definitely positive. A typical element of $R_t$is of the form:

$$\rho_{ij,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t}q_{jj,t}}}, i,j = 1,2,\dots,n \text{ } and \text{ } i \neq j \qquad 12$$

Expressing the correlation coefficient in a bivariate case, we have:

$$\rho_{12,t} = \frac{(1-\alpha-\beta)\bar{q}_{12}+\alpha u_{1,t-1}u_{2,t-1}+\beta q_{12,t-1}}{\sqrt{[(1-\alpha-\beta)\bar{q}_{11}+\alpha u_{1,t-1}^2+\beta q_{11,t-1}]}\sqrt{[(1-\alpha-\beta)\bar{q}_{22}+\alpha u_{2,t-1}^2+\beta q_{22,t-1}]}} \qquad 13$$

As proposed by (Engle 2002), the DCC model can be estimated using a two-stage approach to maximise the log-likelihood function. Let θ denote the parameters in D_t and ϕ the parameters in R_t, then the log-likelihood fund is:

$$I_t(\theta,\phi) = [-\frac{1}{2}\sum_{t=1}^{T}(nlog(2\pi) + log|D_t|^2 + \varepsilon_t' D_t^{-2}\varepsilon_t)]$$
$$+ [-\frac{1}{2}\sum_{t=1}^{T}(log|R_t| + u_t' R_t^{-1} u_t - u_t' u_t)]$$

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The first part of the likelihood function in Eq. 14 is volatility, which is the sum of individual GARCH likelihoods. The log-likelihood function can be maximised in the first stage over the parameters in D_t. Given the estimated parameters in the first stage, the correlation component of the likelihood function in the second stage (the second part of Eq. 14) can be maximised to estimate correlation coefficients.

This DCC GARCH model has a number of advantages over the multivariate GARCH model. Firstly, it can potentially analyse a larger sample of matrices. Secondly, it has been tested that it is often more accurate for its estimation compared to the multivariate GARCH model and superior to other estimation models such as moving average methods.

4. Data

4.1 Descriptive statistics

Appendix A shows the descriptive statistics of the natural log value of the financial markets of the BRICS and the Anglo-Saxon financial centres. It is illustrated that Brazil has the highest mean value in the BRICS with 10.9326, while South Africa has the lowest mean value of 4.257997. South Africa in the meantime has the highest standard deviation, meaning that it has the highest risk of all five BRICS countries, with a value of 0.489503. In contrast, Brazil has the lowest standard deviation with a value of 0.197598. The number of observations was 972.

Appendix B shows the graphs illustrating the performance of the indices of all countries during 2007 to 2010.

Appendix C shows the DCC GARCH correlation graphs. It shows that in most countries, the DCC correlation was in high volatility in 2008 when Lehman Brothers collapsed. It also shows that South Africa in general has the highest correlation with the US market, while India appeared to have the lowest correlation with the US market. Apart from Russia, it appears that all five countries experienced an increase or no change of correlation since the credit crunch. South Africa experienced the highest increase of correlation with the UK market since the credit crunch.

Appendix D shows the DCC GARCH statistical model result and it shows that, apart from China, the correlation coefficients for the other four BRICS countries are mostly found to be significant. It means that there is an underlying financial linkage between the Anglo-Saxon financial markets and the BRICS.

Appendix E shows the VECM coefficient result and also the corresponding Wald Test and the announcement date dummy result. The VECM result shows that China, India and South Africa has significant result with the UK share index. Furthermore, Russia shows a slight contagion result in lag one with the US share index. This means that contagion was presence during the pre crisis period in most countries. It is also found that the dummy variable was found significant in South Africa and Brazil meaning that during post crisis period, contagion was presence from the US and UK for these countries.

5. Results

5.1 BRICS countries

Interestingly, apart from China, the other four countries in the BRICS have shown significant results in both the DCC GARCH and VECM models. This means that the null hypothesis for both models can be statistically rejected for the BRICS. The result means that the BRICS did not decouple from the Anglo-Saxon economies during the 2008 sub-prime financial crisis and, in fact, were fundamentally influenced by the developed financial markets.

The 2008 financial crisis presents the perfect environment to study the contagion because it is rare that financial crisis originates in the developed world. The nature and cause of financial crisis also fit into the theory of contagion that the financial crisis spread from the US to the rest of the world as a result of asset-backed securities being traded all over the world. The results of this research show that the underlying linkage between the US financial markets and the BRICS financial markets is particularly strong and might have become even stronger during this financial crisis. This can be seen from the DCC GARCH model: the correlation is generally high in the study period. The high level of correlation in the study period presented in the correlation graphs is no coincidence and they were the induced external shock that was caused by the financial crisis in the US. The shockwaves of the failing of the large financial institutions during 2007 and 2008, especially Lehman Brothers, were felt throughout the world and primarily resulted in the contagion of the sub-prime financial crisis.

The DCC GARCH models also noticed similar patterns between the UK and all five BRICS bloc countries. This could mean that the health of the banking industry in the UK was also a concern affecting the rest of the world, resulting in some form of contagion in the BRICS. The banking industry of the UK was also seriously damaged and a number of financial institutions were financially rescued by the government, affecting the confidence of the markets. This study has since confirmed that the linkage between the UK and the BRICS countries is also strong, particularly India and South Africa as they are part of the Commonwealth. Their business and financial linkages towards the UK are comparatively higher for historical reasons.

Although insignificant results were found in China, the DCC GARCH model shows that the collapse of the US and UK financial institutions had a negative impact on the Chinese financial markets. Data show a slight increase in correlations in both the US and UK graphs, meaning that in general there were negative impacts of the sub-prime financial markets but they were found not to be statistically significant.

Prior to undertaking the VECM model, all five countries were tested using the Johansen co-integration model and co-integrations were found in all five countries. This further corroborates the GARCH results that contagion was present during the financial crisis. Co-integration models are used to test the long-term equilibrium of data so that its presence means that the tested financial markets were all in long-run contagion during the study period. This is consistent with the literature that found evidence against the decoupling theory for the BRICS countries. This means that the BRICS bloc countries are strongly linked to the Anglo-Saxon economies and the recent financial crisis only made the underlying linkage stronger, as the DCC GARCH model has shown.

The VECM models show statistically significant results between the UK and the four BRICS countries China, Russia and India and South Africa. Compared to the DCC GARCH model, the VECM model did not show significant linkage between the BRICS and the US initially but has shown a significant result on the interest rate dummy variable meaning that the BRICS countries has shown some degree of contagion to both of the US and the UK market. The shockwaves of the collapse of major financial institutions affected global financial markets and resulted in the contagion of the financial crisis.

The resulting global recession has affected demand for imports in the developed world. This has caused a slowdown of growth in the export-led economies of the BRICS countries. This is particularly true to natural resources export countries like Russia, Brazil and South Africa where the contagion was found during the post crisis period. There was some insulation of contagion for manufactured and service export countries like China and India as these countries experienced a delay of slow down of economic growth that only occurred in the late stage of 2009. Hence the control variable that was set in 2008 did not manage to measure this. This resulted in the decreased level of investment and the outflow of liquidity in the financial markets of the BRICS countries. Therefore, the financial markets in the emerging economies faced significantly increased volatility, which resulted in slowdown and partial collapse in some regions. As a result, the capitalisation of the financial markets in the BRICS decreased and they also experienced a crisis directly caused by the sub-prime mortgage crisis in the US.

Secondly, the decreased price of commodities from mid-2008 also affected the confidence of the financial markets. This significantly affected the resource export-led countries like Russia, South Africa and Brazil. Hence the financial performance of the major enterprises that are listed in their respected financial markets decreased. Thus the performance of the index was affected, and confidence for the future was dented during 2008 and 2009 within the BRICS.

Thirdly, apart from China, the value of all four currencies depreciated against the dollar from 2008 as a result of low confidence in the midst of the recession. This somehow did not augment exportation for the BRICS; hence it caused major concern regarding the capacity to earn foreign currencies in the emerging countries. Furthermore, the depreciation of local currencies is one of the pieces of evidence of the outflow of liquidity of financial markets. This further caused the decreased value of capitalisation of the financial markets in the BRICS.

5.2 Comparison of models

This section will compare the findings for both the DCC GARCH model and the VECM model. VECM, instead of a conventional vector auto regressive model, is used when the model detects the existence of co-integration. In econometrics, it measures the internal shocks of lagged financial variables and also the causality of the external shocks. This thesis seeks to identify the external causalities that caused the contagion of the financial markets. Thus, as presented in the methodology section, the mathematical model of this VECM measures the impact of the lagged index data of the US and UK financial markets. This part of the VECM model can be compared to the granger causality model as it essentially measures the identical factors that might have caused the contagion. The VECM model is good at measuring the short-run equilibrium in the already identified long-run co-integration. The short-run equilibrium can be seen as the adjustment that might be needed for financial markets to stay in contagion. In this thesis, these identified short-run adjustments might be the decreased demand for exports, the decreased price of commodities and the depreciation of local currencies. These factors have all played a part in lowering the growth of the export-led economies of the BRICS countries, resulting in contagion from the Anglo-Saxon countries of the US and the UK. The collapse of the banking institutions in the US and the UK probably only had a limited impact on the BRICS countries as most of the literature reported that only limited exposure to the asset-backed securities was found in the banking systems within the BRICS.

In comparison, the DCC GARCH model predicts the correlations, measuring the strength of the underlying co-movement linkage between the financial markets of the US, the UK and the BRICS countries. In theory, the correlation of the financial markets can be argued to be background contagion as these are usually caused by the natural characteristics and the behaviour of the financial markets rather than significant external forces that can be measured by VAR and VECM models. It is also arguable that this underlying co-movement tends to be passive, hence the DCC GARCH model is an excellent tool to analyse and measure this underlying co-movement behaviour. Furthermore, most of the literature suggests that this co-movement can be developed through three traditional channels: financial, trade and competitive devaluation of local currency. In this thesis, these three channels will be analysed so that the results of the DCC GARCH model can be explained.

Financial linkage is the underlying co-movement behaviour due to historical and geographical reasons. Trade refers to the trading partnership and relationship that the financial markets may have, therefore affecting the performance of the organisations at the same time. The trade linkage can also be reflected through economic indicators and the relationship between the examined countries in their respective financial markets. This is particularly interesting as the economies of the export-led BRICS countries severely slowed during the recession as a result of the lowered demand for imports from developed countries. Competitive devaluation of currencies relates to the behaviour of emerging countries in which they may aggressively lower the foreign exchange rate in order to stimulate the export industry. During the study period, four of the five countries experienced the depreciation of local currencies. This has arguably had an impact on the correlation of financial markets through the reduction of liquidity mechanisms.

5.2.1 VECM

This sub-section will discuss the finding of the VECM model. As previously mentioned, VECM discovers and quantifies the external shocks by investigating the granger causality term in the equation. This thesis has identified a number of external forces that have dramatically increased the level of contagion between the US, the UK and the BRICS financial markets. These factors include the exposure of the toxic assets, the reduction of demand for imports from developed countries, the collapse of commodities prices and the depreciation of local currencies. This sub-section will discuss these findings that were generated through the VECM model.

Lehman Brothers and other financial institutions

The initial shock of the global financial crisis was the collapse of the major financial institutions in the US and the UK. This sent a shockwave through the world such that many large multinational financial institutions required governmental rescue. Many other lesser affected institutions also needed significant investment injection to either repair the balance sheet or re-capitalise. Although most of the literature suggested that the exposure of toxic assets for the banks within the BRICS was limited, the indirect effect of the trading of CDOs and other securities means that they were also under significant pressure to re-capitalise balance sheets. Asian banks, like India's, came out of the crisis in better shape compared to other geographical regions because they had implemented measures during the Asian Financial Crisis in the early 2000s and these measures limited exposure to toxic foreign investment. In China, the trading of asset-backed securities was only recently introduced and this further insulated it from the crisis. Indeed, according to The Economists, four of the top ten most capitalised banks are Chinese.

In Brazil, due to historical and inheritance reasons, banks are strongly linked to Spanish institutions and exposure to the crisis for Brazilian financial institutions was very indirectly coming from continental Europe. Countries such as Russia are also more traditionally closely linked with Europe than with the Anglo-Saxon economies. Hence, the finding of this thesis is consistent with the literature; there was only a limited exposure to toxic assets for the financial institutions located within the BRICS. Therefore, the causality of the collapse of the US and UK institutions, although found to be significant, was considered to be small in the VECM model.

Reduction of demand of import from industrialised countries

The success story of the export-led countries employed by BRICS in the early 2000s to the present has raised questions about whether the emerging countries have decoupled from the industrialised countries. Many of the smaller countries and to some extent the western countries were looking at the secret of the BRICS because the export-led economies had been delivering near double figures of growth for BRICS members. Export-led growth countries were also able to turn a budget deficit into budget surplus, particularly in Brazil and Russia. In China the sheer size of the exports accumulated a significant sum of foreign reserves.

However, the answer to this question has been provided during this financial crisis: manufactured goods have to be consumed and if developed countries cannot do so, the economies of these export-led countries will suffer. The resulting recession in the developed countries has impacted the confidence of the consumption. This affected the desire of the western countries, which directly resulted in the decline in demand for the manufactured goods and services provided by the BRICS. As a result, the service industry in India recorded an export decline of 60% to the US and a sharp decline of growth for China also was recorded.

This affected the performance of export-led companies and the confidence of the financial markets as the recession in the West slowed the economies of the BRICS substantially. In China, the government resorted to increasing domestic consumption by using a stimulus package. This created a cushion for the manufacturing sector in China, hence reducing the decline of employment opportunities and utilising the reserve capacity in the factories.

Collapse of commodities prices in mid-2008

While China and India are manufactured goods and service export economies, Russia, Brazil and South Africa are natural resources export countries. In these countries, over a quarter of the GDP is related to the export industry of natural resources and this sector is the major earner of foreign currencies. The financial markets in these countries are dominated by petroleum and multinational mining companies, which also have significant influence upon the national interests as well as respective indices.

Hence the BRICS not only suffered a major setback with the decline in demand for exported manufactured goods; Brazil, Russia and South Africa also suffered significantly during mid-2008 when the price of most of the commodities collapsed. This directly resulted in a decline in the performance of the indices, affecting the confidence of investors investing in the long term in these multinational companies. The indirect impact of lowered employment and investment opportunities spread among the export sector, resulting in a lowered growth of the national GDP and affecting the respective indices. This resulted in a prolonged period of high volatility, low growth opportunities and ultimately the contagion effect from the US and UK financial markets.

Outflow of liquidity

During the early part of the financial crisis, the financial markets in the developed world were suffering a liquidity crisis as a result of sub-prime mortgage events. Financial institutions in the US and the UK were instructed to rebuild their balance sheet by recapitalising. Hence, they were selling assets to replace the toxic assets on the balance sheets. The emerging markets became a very attractive region for recapitalising as this region represents some of the most liquid markets, like China and Brazil. The assets within the BRICS are also very attractive to investors for a number of reasons. First of all, they are also very liquid and can turn back to cash easily. This is very important for struggling banks as time was crucial to regain the confidence of investors. Secondly, and maybe most importantly, these assets are insulated from the toxic assets in the US and the UK. Due to local fiscal regulations, the exposure to toxic assets was found to be limited by most of the literature. Thirdly, the risk premium in the emerging markets has become lower compared to the US and the UK markets. This ensures that the assets in the emerging markets are very attractive for opportunistic investors. As a result, financial markets in the BRICS experienced a drain in liquidity, and hence an increase in volatility and decrease in value. Furthermore, some of the literature has found that individual and institutional investors may sell off BRICS assets to repay the margin that they might have lost when the US market collapsed in 2008. This affected the financial markets and increased the contagion effect.

5.2.2 DCC GARCH

The DCC GARCH model predicts the correlation of two financial markets over a period of time. As previously mentioned, the contagion that the DCC GARCH estimates consists of three channels and this sub-section will discuss these channels.

Underlying financial linkage

This channel measures the passive linkage between two financial markets depending on the characteristics and the behaviour of investors in the local region. The DCC GARCH model is useful to estimate this passive contagion channel as it uses the historical return and correlation to predict the time series' present correlation. It can take into account the relatively unknown and hard-to-quantify historical characteristics of local markets. These historical and present characteristics can be factors like cultural inheritance, fiscal policies, governmental regulations, the behaviour of local and foreign investors, political position within the geographical region and other hidden / passive relationships between financial markets such as treaties.

Governmental regulations is a popular topic to be discussed in literature that result in a contagion effect to a particular financial market. In emerging countries, there is often regulation restricting the outflow of investment, such that profits may be reinvested back to local regions or communities. In Asian countries like China and India, governmental regulations have been amended since the Asian Financial Crisis in the early 2000s such that there is insulation to this channel of contagion. Financial markets and fiscal are also heavily regulated in Russia to prevent an outward flow of investment. There are similar governmental policies, to a lesser extent, in Brazil such that there is a restriction of the outflow of liquidity in respective financial markets. However, in South Africa regulations are relatively weaker; hence, the contagion effect is relatively strong compared to the other four countries. The regulations are not adequate enough to prevent a withdrawal from investing countries. Thus, South Africa experienced a stronger decline of market capitalisation compared to the other four countries and a much stronger contagion effect.

Trade linkage

This channel is particularly important to the BRICS as an export-led growth strategy has been employed. All five countries are in the G20, showing the significance of the trade for global importance too. There is a positive relationship between trade and correlation of financial markets because the performance of trade will affect both markets. The healthy growth of trade for both markets will also increase the confidence and the capitalisation of financial markets. This will ensure that the financial markets will grow together, resulting in a higher correlation and contagion effect at the end.

For example, Russia has a lower correlation with the UK compared to India because of the traditional heritage and business partnership environment. India belongs to the Commonwealth and has been the beneficiary of the outsourcing exercise that the UK has been doing since the 1990s. Hence businesses in India are highly integrated with the UK economy compared to Russia. In contrast, Russia's economy depends on the exportation of natural resources to Holland, Germany and Eastern Europe and only 6% of natural gas is delivered to the UK. Similarly, the business relationship between the UK and Brazil is relatively immature compared to India and South Africa. The majority of the oil products from Brazil would be delivered to the US and China. Hence the correlations of Russia and Brazil found by the DCC GARCH model are insignificant and low when compared to India and South Africa.

Currency devaluation

In mid-2008, four of the BRICS currencies apart from the Chinese Yuan experienced a sharp depreciation against the dollar. Although this was not intentional and not enough to start the devaluation war against each other, this effectively became a competitive devaluation of local currencies to boost export. On the other hand, the Chinese government employed a strict policy of not allowing the Yuan to appreciate despite pressure from the US. This has further weakened the demand for Chinese exports and the growth of the Chinese GDP has fallen below a single percentage digit for a decade. As a result, the trade link between the Chinese and the world weakened when exports became less competitive compared to the rest of the BRICS.

Because of this, most of the literature has argued that Chinese contagion through this channel has been weakened. This is due to the fact that the Yuan became less competitive compared to the other four BRICS countries, affecting the trade channel as discussed previously. Together with the strict government policy for foreign investment and relatively limited exposure to the toxic assets, this has formed a further insulation layer for China to move with the US and UK markets. Therefore, the contagion effect experienced by the Chinese markets was small and insignificant.

6. Conclusion

Contagion has been an interesting subject to study during the recent 2008 sub-prime financial crisis as it is rare that a crisis originated from a developed country. From this paper, we have gained an understanding that the contagion effect was present and has affected most of the BRICS countries apart from China. Therefore, the decoupling theory that some of the literature maintained was not conclusive, as the economies of the emerging countries possessed underlying links to the US and the UK markets. This paper has found that, although the model of the BRICS economies is different from that of Anglo-Saxon countries, the underlying financial linkages are too strong for economies to have decoupled.

This paper has studied two models of common econometrics to analyse the contagion effect. The researcher has made a comparison between what the models measure and what they mean in the contagion study as well as the decoupling–recoupling theory. The correlation found by the DCC GARCH model is that the linkages between these countries are still very high and became even higher during the financial crisis. This is because the negative impacts of the turmoil that occurred in the western economies filtered into the BRICS bloc and resulted in a significant downturn in the financial markets. This has been confirmed in the discussion section: the trade linkage and currencies linkage are also very closely related across the studied countries. The external shock that was analysed in the VECM model enabled us to conclude that the fall in demand from industrialised countries dented the growth of the export-led economies of the BRICS. This analysis concluded that the global economies are strongly linked as the export-led economies must find countries to buy their goods and if demand for these goods falls, so does growth in the economies of the BRICS.

Appendix A – Descriptive Statistics

Date: 08/09/14 Time: 10:27
Sample: 1/02/2007 12/31/2010

	LBRAZIL	LCHINA	LINDIA	LRUSSIA	LSOUTHAFRI	LUK	LUS
Mean	10.93264	8.032194	9.622944	7.186497	4.257997	7.935586	7.060964
Median	10.99369	8.000702	9.662419	7.266234	4.083789	7.955204	7.062324
Maximum	11.20527	8.714742	9.952514	7.585743	5.032397	8.171283	7.355737
Minimum	10.28994	7.442317	9.007048	6.241484	3.253084	7.509565	6.516977
Std. Dev.	0.197598	0.283519	0.218853	0.320492	0.489503	0.158832	0.194466
Skewness	-0.797179	0.412044	-1.012102	-1.232610	0.060471	-0.604748	-0.387493
Kurtosis	2.657747	2.720942	3.443455	3.625262	1.653458	2.452025	2.286192
Jarque-Bera	107.6941	30.65823	173.9091	261.9645	74.02600	71.40780	44.96000
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	10626.52	7807.292	9353.501	6985.275	4138.773	7713.390	6863.257
Sum Sq. Dev.	37.91260	78.05179	46.50780	99.73664	232.6646	24.49593	36.72040
Observations	972	972	972	972	972	972	972

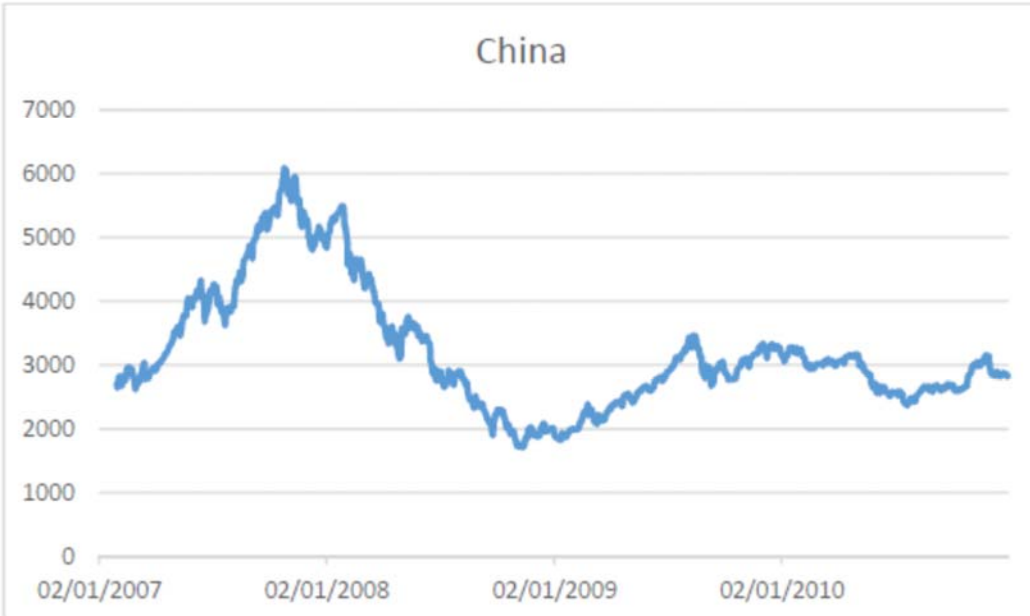
Appendix B – Performance of indices

Graph A – Brazil

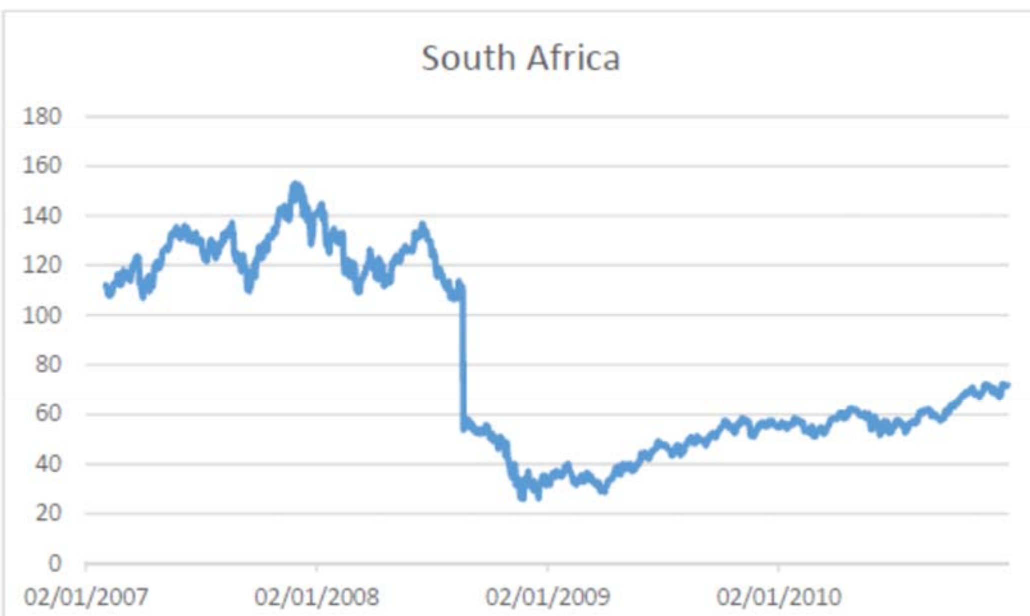
Graph B – Russia

Graph C – India

Graph D – China



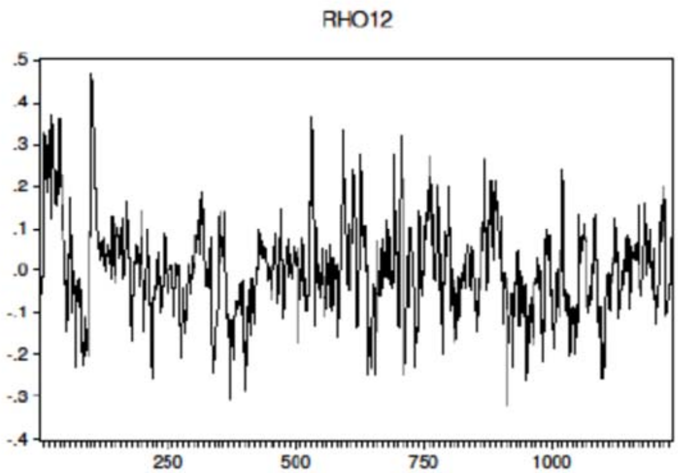
Graph E – South Africa



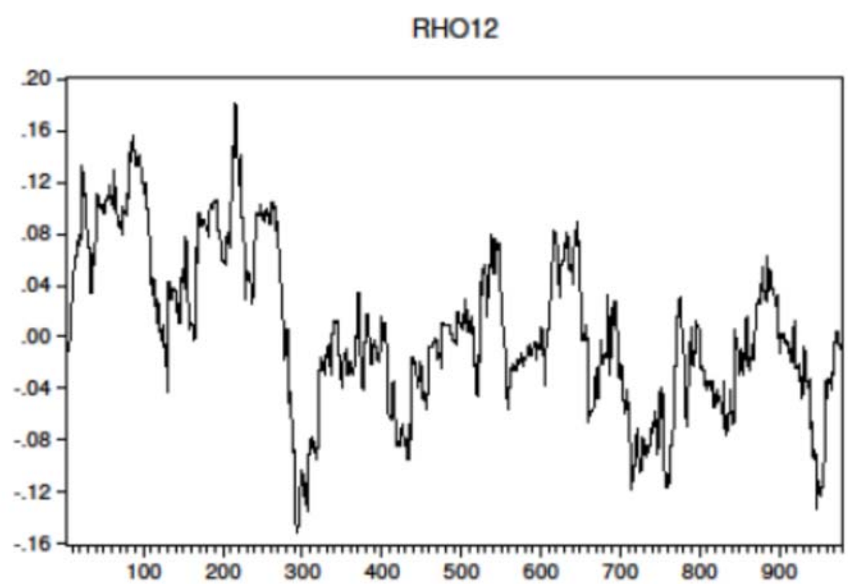
Appendix C – DCC GARCH correlation graphs

Correlation with the US

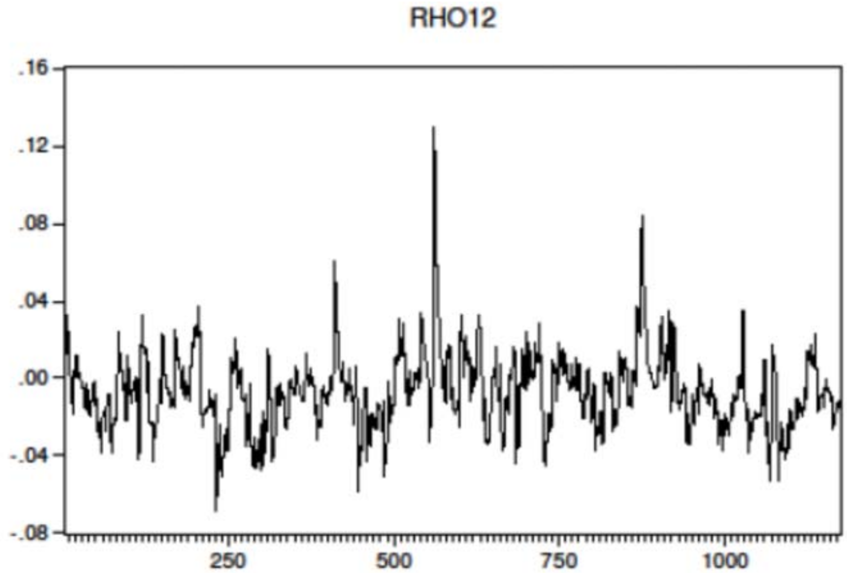
Graph 1: Brazil



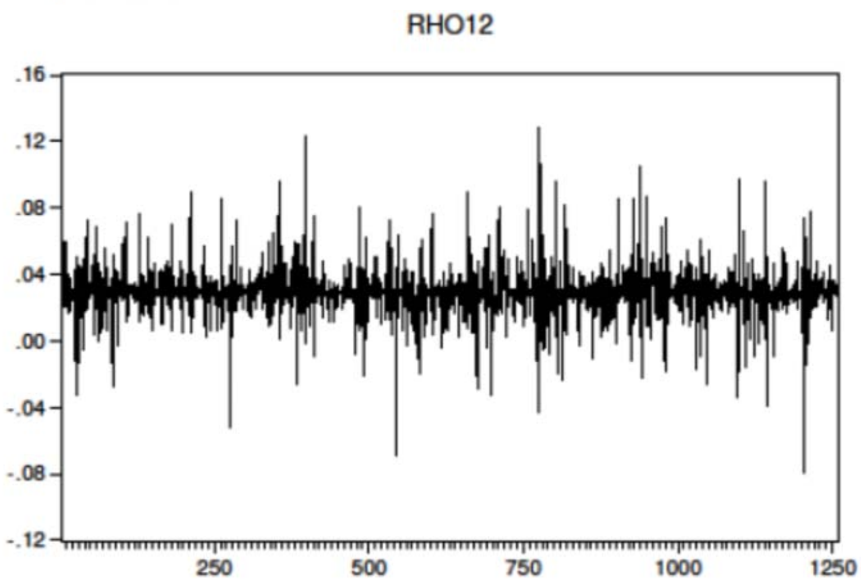
Graph 2: Russia



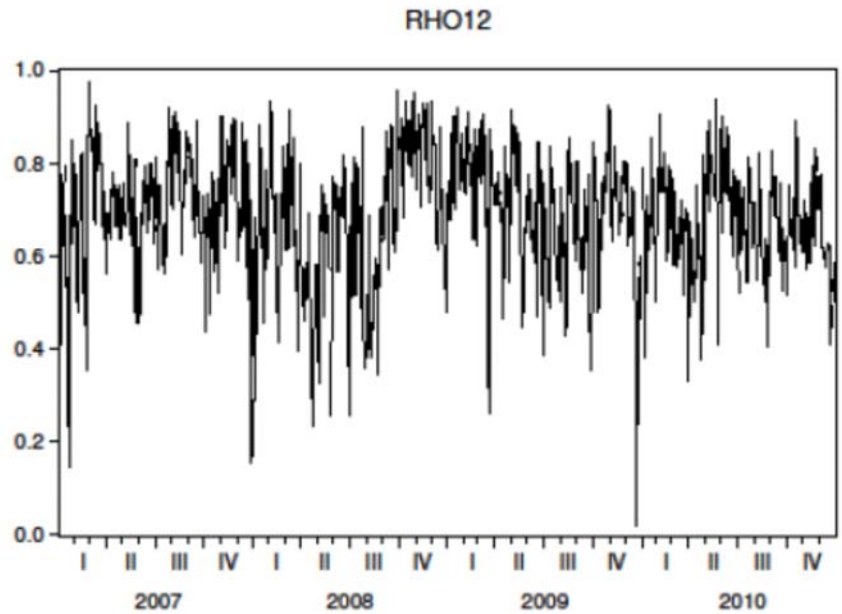
Graph 3: India



Graph 4: China

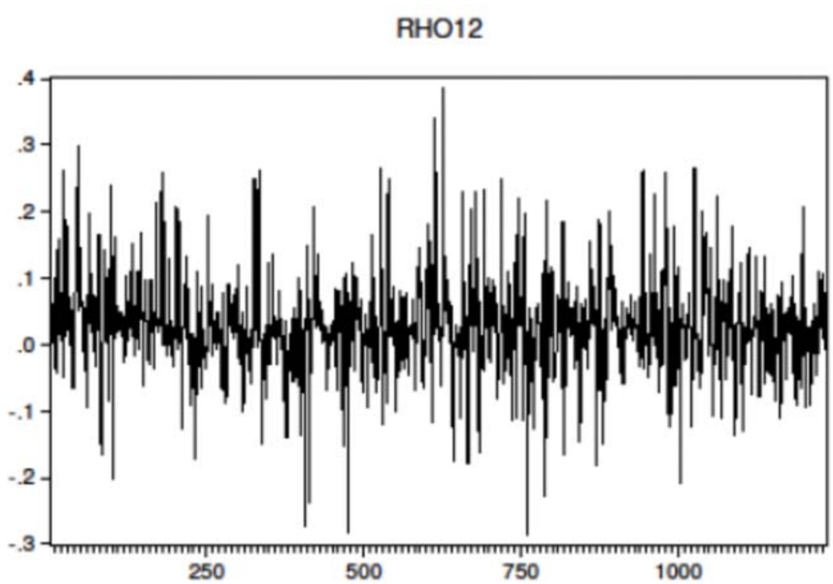


Graph 5: South Africa

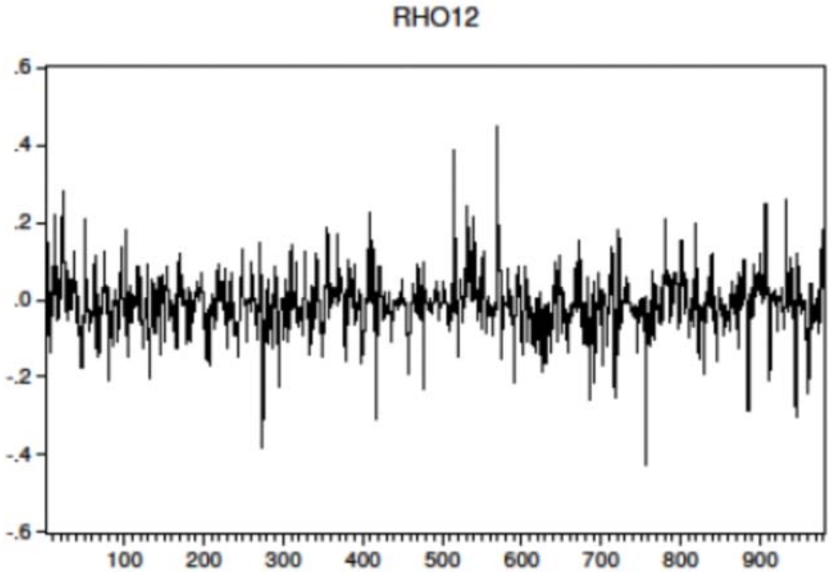


Correlation with the UK

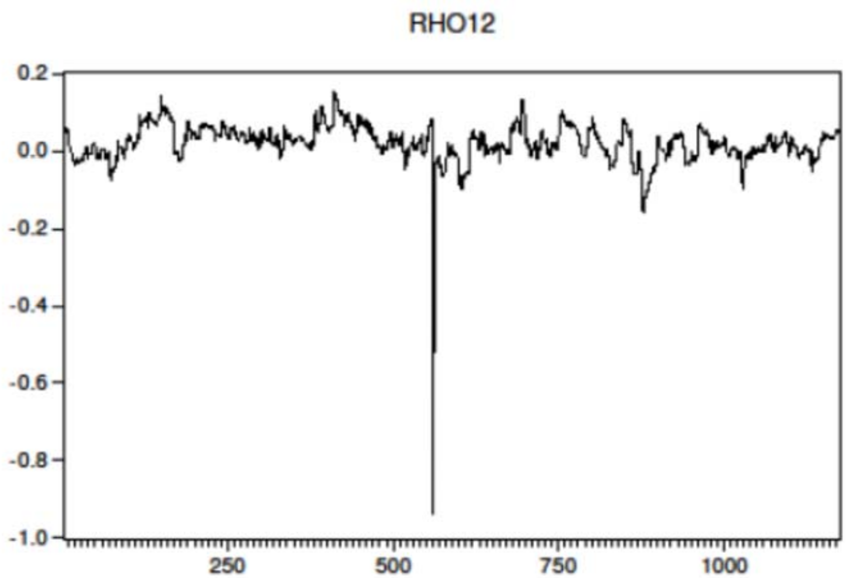
Graph 6: Brazil



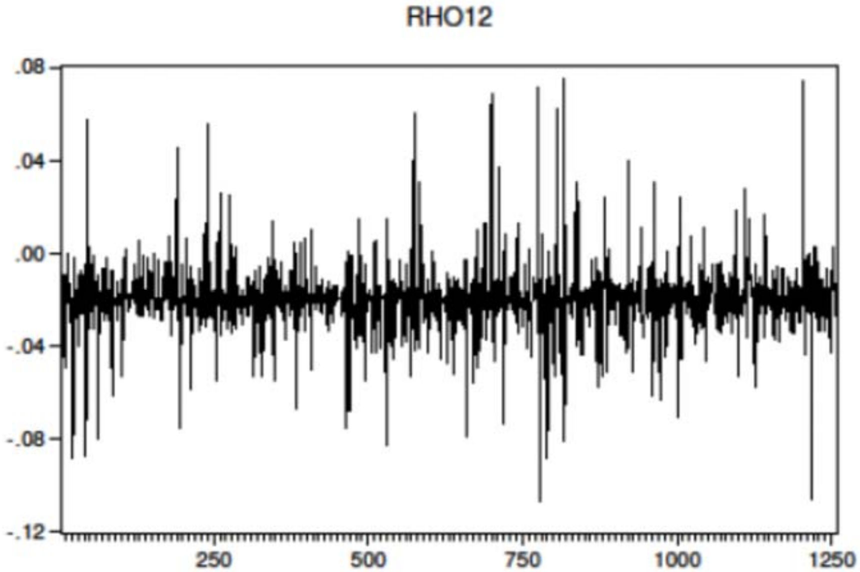
Graph 7: Russia



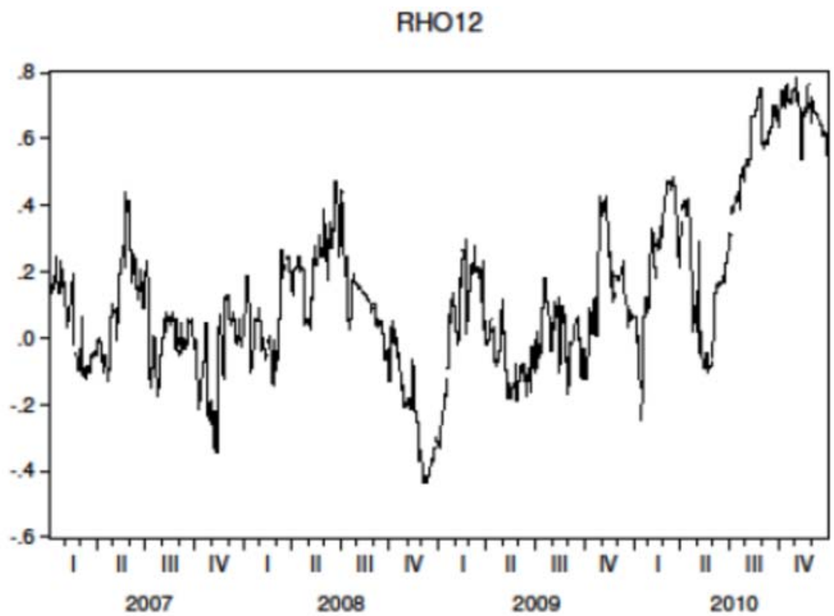
Graph 8: India



Graph 9: China



Graph 10: South Africa



Appendix D – DCC GARCH statistic results

Correlation Table

	T1	T2
Brazil - US	0.08*	0.65*
Brazil - UK	0.08**	0.15
Russia - US	0.03	0.92*
Russia -UK	0.11	0.29
India- US	-0.01	0.87**
India - UK	-0.01*	0.95*
China - US	-0.02	0.40
China- UK	-0.01	-0.31
South Africa - US	0.36*	0.48*
South Africa - UK	0.56*	0.95*

Table 3: DCC GARCH Results

T1 initial value = 0.2

T2 initial value = 0.7

*1% significant

**5% significant

Appendix E – VECM statistic results

VECM

	β1	β2	β⁺	Dummy
Brazil - US	0.72	0.27	0.52	0.03**
Brazil - UK	0.26	0.90	0.51	
Russia - US	0.30	0.08***	0.15	0.80
Russia -UK	0.18	0.43	0.34	
India- US	0.79	0.13	0.33	0.48
India - UK	0.58	0.04**	0.09***	
China - US	0.87	0.93	0.98	0.19
China- UK	0.01*	0.55	0.02*	
South Africa - US	0.74	0.74	0.91	0.00*
South Africa - UK	0.16	0.03**	0.05**	

Table 2: VECM Results

β⁺ : Wald Test β1=β2=0

*1% significant

**5% significant

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Are Disasters the Matters for the Japanese Exchange Rate Market?

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This paper investigates the links between the performances of Japanese Yen (JPY) and disasters through the insights of the event study framework and several econometrics methodologies. We further examine the transmission channels among several finance and macroeconomics activity variables during the post-disaster period. Empirical findings demonstrate the duration of the impact of disasters on the JPY and indicate the suitable timing for hedging JPY. In addition, a guideline for speculators and investors to construct a long-short term portfolio setting is suggested by our procedure and resulting evidences.

1. Introduction

Japan experienced the catastrophic Tohoku earthquake and its resulting tsunami in March, 2011. This disaster broke out in the northeastern part of Japan, which area makes up 7 % of the GDP of Japan. According to the report investigated by World Bank, this disaster results in the loss of Japan as high as $235 billion dollars while the Japanese government assessed that it would be close to $300 billion dollars and requires at least 5 years to rebuild. Besides, the dangerous reactors of nuclear power plant Fukushima also exist as a threat to the health of most Japanese. In other words, this disaster played a destroyable role for Japanese Economy.

In fact, Japan is a country suffering many natural disasters, including earthquakes and tsunamis. These facts, in general, easily infer a pessimistic forecast for the future economy of Japan. Furthermore, since the patterns of financial markets are strongly correlated to the economic activities, thus, most investors would like to know what the currency or stock market will act like for the following days after this disaster.

Taking New Zealand as an example, this pacific country lost the advantage of its exchange rate when it was rocked by a heavy earthquake, owing to its exportation dominated economy. Nevertheless, when we observe the reaction of Japanese Yen (JPY) to Tohoku earthquake, an interesting fact could be noted as follows: JPY dropped sharply as much as 0.4 per cent on average against the top counterparts initially, then it rebounded and rose up even more quickly, which once climbed to 76 against the US dollar, approaching to the peak where the currency ever achieved after the World War II. Hence, we look back to historical Japanese nature disasters in the past 20 more years and report the links between the performances of JPY and those disasters in Figure 1.

As a matter of fact, the literature investigating the impact of the disaster on JPY has been so far rather limited, even though financial practitioners have observed that the appreciation of JPY in the aftermath of the disaster recently. Some recent contributions analyze the impacts of risks of rare natural or economics disaster on asset prices, economics development and economic growth. Toya and Skidmore (2007) use disaster impact data over time to examine the degree to which the human and economic losses from natural disasters are reduced as economies develop.

Arnason (2011) investigates the paradox of nature disasters leading to economics growth by the case of the Touhoku earthquake and find that Japan is likely to experience growth following the earthquake. More importantly, Wang (2013) examines the impact of Japanese natural disasters on stock market by GARCH and GARCH-in-the mean models and indicates that natural disasters do not have a linear impact on Japanese stock return.

Thus, based on those evidences, we put our interest in explaining the seemingly paradox of natural disasters effects on JPY. Meanwhile, two further issues are also arisen here: (i)on average, how many days after the occurrence of the disaster does the disaster start to affect JPY significantly? (ii)what do the transmission channels display among several finance and macroeconomics variables , such as Japanese central bank (BOJ) intervention, Japanese risk free rate, Japanese stock market index and the interest rate differential between the Japan and U.S., etc. during the post-disaster period?

To address the above issues, in this paper, we employ PROBIT, LOGIT models widely used in literature and COAR-MLE estimation proposed by Wang et al. (2014 b) using the event study analysis. Perhaps the first published event study is Dolley (1933), which examines the price effects of stock splits by studying normal price changes at the specific time of the split. Afterwards, the event-study approach has been applied to a variety of firm-specific and economy-wide events in the academic accounting and finance field (e.g., Campbell et al., 1997; Mackinlay, 1997; Bernanke and Kuttner, 2005). The usefulness of such an approach comes from the two facts: (i) the effect of an event will be reflected immediately in asset prices; (ii) the event's economic impact can be measured using asset prices observed over a relatively short time period. Because the disasters considered in this paper, including earthquakes, typhoons and storms, are special shocks which impacts on asset prices would be expected to die out as time goes on, using the event study approach is able to explain the effects of such specific shocks on financial markets or economy more accurately. Briefly speaking, the event study approach could not only capture more accurate effects causing by specific shocks, which usually are easily ignored and missed when considering the general regression research or direct measures on whole samples of historical data, but also filter the effect and shock-unrelated noises arisen by whole samples. In addition, the selection of estimation window size is the key point for the event study approach. Since in general the impact of disaster on asset prices is the short run effect and lasts for around one month long, the estimation window size we consider in this paper is set by from 1 to 22.Furthermore, by adjusting the event estimation window size, we could conclude that around which day after the disaster, the disaster starts to affect the financial market and economy or how long such effect of disaster last for intuitively.

The literature focusing on the issues of finance and monetary policies using PRO BIT and LOGIT models has grown up rapidly for recent years. Nyberg (2008 a) predicts the direction of monthly excess stock returns using the binary dependent dynamic PROBIT model as wells as Nyberg (2008 b) examines various financial variables as predictors in new dynamic PROBIT models to predict the probability of a recession in the United States and Germany. Xiong (2012) considers an ordered PROBIT analysis to measure the monetary policy stance of the People's Bank of China.

One important issue that is pervasive in the time series literature is the danger of obtaining spurious correlation findings proposed by Granger and Newbold (1974) and Granger et al. (2001). A spurious correlation occurs when a pair of independent series, each of them non-stationary or strongly autoregressive, are found apparently to be related according to standard inference in an OLS regression. Wang et al. (2014a) develops a new estimator, CO-AR estimator, to solve spurious regressions by applying a two stage generalized Cochrane-Orcutt transformation based on an autoregressive approximation framework, even though the exact forms of error terms are unknown in practice. However, GARCH effect is not taken into account in this work. Without the loss of generality, based on the framework of CO-AR estimation, Wang et al. (2014 b) suggest COAR-MLE estimation for spurious regression with GARCH effect. Since many finance and economics variables displaying I(1) or near I(I) processes where the AR/MA coefficients is closer to 1 (see Ferson et al. , 2003) could result in spurious correlations , thus we employ COAR-MLE estimation to analyze the relationship between JPY and other finance and economics variables during the post-disaster period.

The main findings of this paper can be summarized as follows. First, we suggest the transmission channels among several important finance and economics variables during the post-disaster period, because these channels can guide the investors to build up a portfolio after the disasters. Furthermore, on the basis of event study analysis, empirical results show that on average, several variables begin to affect the JPY significantly at around the 10th day after the disaster whereas the BOJ intervention occurs earlier, i.e. at the second or third day after the disaster. This finding is consistent with the observable fact that the BOJ usually intervenes JPY after the disaster to rebuild the economy. Most importantly, during the post-disaster period, the performance of Japanese stock index is negatively correlated to that of JPY. The possible explanation of this phenomenon is to sell oversea assets to obtain more JPYs for the sake of rebuilding economy. Moreover, this result overturns the finding of Wang (2012), since we could discover the direct link between the disaster and exchange rate return based on our econometrics analysis.

Second, the impacts of disasters on financial markets and economy are short run effects, thus those empirical findings and behaviors of assets would be formed as the trading or heading guideline for speculators and investors, because the duration of the disaster effect implies the timings of entering and leaving financial markets and the varying coefficients representing the relationship between the JPY and several variables provide the information for portfolio selections. Third, compared to the analysis of the event study approach, we further consider the convention regression scheme on whole samples where we denote the earthquake as the dummy variable. We set it equal to 1 when an earthquake occurs, otherwise we set it equal to 0. Similar to the spirit of the event study approach, the event estimation window size of this dummy variable is adjusted from 1 to 22, i.e., from the first day on which the disaster happens until the 22th business day after the disaster. That is to say, when an earthquake occurs, we denote this variable as 1 and adjust it until 22 days after the disaster. Through this methodology, we could explain the appreciation of JPY in the aftermath of the disaster in a long run framework. More importantly, the most patterns of the relationship between JPY and those considered variables are different from those for event study approach which indicate the short run performance for the relationship among those variables. For example, the coefficient of the stock index in the relation to JPY becomes positive in most cases when we use dummy variable analysis on whole samples. That implies that in the long run, even the issue of earthquake is considered, the stronger the Japanese stock market, the stronger the Japanese Yen. In other words, our empirical findings provide the short and long term information for the correlation between JPY and those considered variables during the post-disaster period. Moreover, these results indicate the insights of hedging and portfolio selections and by which we could form a long-short portfolio setting.

The follow-up of this paper is organized as follows. Section 2 illustrates the event study approach and econometrics methodologies considered in this paper. Section 3 presents the data summary and variable selection. Empirical findings are reported in Section 4. Concluding remarks are in Section 5.

2. Models and Econometrics Methods.

2.1. *Event Study Analysis*

In this paper, natural disasters are treated as events and its unexpected occurrence is believed to cause exchange rate market to fluctuate in the aftermath. So here we introduce the event study framework, which has been widely used in economics and finance studies. Event study is used to measure the impact of events that usually take very short time on economy, assuming market rationality would absorb information of events in enough time. Applications of it includes acquisitions and mergers, announcements of macroeconomic variables and other short effect issue caused by all kinds of events. Natural disasters treated as events are easily to be quantized, and it works under the assumption that these disasters' shock on finance market is of same magnitude, namely nationally here though those disasters counted in this paper may strike Japan in different regions. Such disasters are surely unexpected, and its information should not be included in prices of market ahead of its occurrence.

After the disasters happen, what is more interesting is how long the market of exchange rate takes to absorb information of effects of disasters on economy. Therefore our event study framework should deal with two issues: what effects are responsible for fluctuations of exchange rate in the post-disaster period and the durations of these effects.

The first issue is normal as in general event study and we are looking to event window directly, ignoring special abnormal returns during the post-disaster period. However, for the second issue we denote the duration problem by a special way. To be specific, we don't fix the size of event window but vary it in a range from 1 to 21. That remarks a period which begins just on the date when the natural disaster occur but ends in different days as long as 21. So for each models we have 21 different cases concerning the window size, and a comparison between these cases is able to give us a hint on the duration process. Firstly, by implementing the event study with different event window sizes, we are able to uncover the possible time varying features of coefficients in the model, thus deducing dynamic effects of natural disasters on the exchange rate models as time goes on. Secondly, the significance inferred by p value is an indication of the duration of the disasters' effects, equivalently as how long coefficients in the models keep influences. Indeed an intuitive finding is p values of coefficients in models, with a guideline that coefficients changing from significantly to insignificantly or other way around.

2.2. *Econometrics Methods*

According to the Figure 1, we could find in most cases, the JPY appreciates following the disaster. It implies the power of buying the JPY is stronger than it of selling the JPY during the post-disaster period. To address this issue, we need to examine how likely several factors caused the change of the JPY. We first employ two commonly used binary dependent variable methodologies, PROBIT and LOGIT methods, to test for the relationship between the probability of positive JPY returns and those factors. These methods can give us hints on the conditional probabilities of specific events. In this study, we take the sign of JPY returns as binary dependent variables. We denote the positive and negative returns of JPY as 1 and 0, respectively. Therefore, the general model for the two methods can be written as,

$$y_t^* = X_t'\beta + \varepsilon_t$$

$$y_t = \begin{cases} 1, & if\ y_t^* < 0 \\ 0, & if\ y_t^* \geq 0 \end{cases}$$

Where we denote y^*_t as the return of JPY/USD, the negative part of which corresponds to the appreciation of Japanese yen, and its resultingyt as 1 .In addition, which of them we should use depends on the distribution of error term ε_t. Under this condition, our focus becomes what sign and magnitude of β can fit the likelihood of value of y_t.

Here what distribution ε satisfies decides whether we use PROBIT or LOGIT models, since the former indicates ε is of normal distribution and the latter of logistic distribution. Usually maximized likelihood estimation is employed for estimation and test for PROBIT and LOGIT models, and though coefficients of the two models for same data sample may be different, the marginal effects inferred by the estimation of coefficients should be similar.

In this case of modeling time series data, there may exist some problems in econometrics. A more accurate measurement of the post-disaster effect is by regression on returns. The data collected from financial market are well known to be highly persistent, and in this case as an example, the Box–Jenkins tests of data of exchange rate, bond and stock markets all indicate they are auto-correlated and may still have features of I(1) though differencing has already changed the nonstationary to the stationary. Based on Granger (1974), the serial correlation is therefore likely to cause the spurious regression problem under the traditional OLS, as a result of which the regression statistics can over reject null hypothesis. To cope with this kind of problem, Wang et al. (2013) propose an estimation using two stage Cochrane-Orcutt Autoregressive (CO-AR) methods, which fit data of AR(p,q) and ARIMA(p,1,q) both well. Another contribution of Wang et al. (2013) is that their estimation can also keep valid convergence rate after modifications referring to heterogeneity feature of data that is usually modeled by GARCH(m,n). Therefore they further advise to include GARCH effect in modeling financial data and estimate it by maximum likelihood estimation with their COAR method, thereby COAR-MLE. Here to avoid the wrong conclusion by spurious regression problem, we follow Wang et al. (2013) in the usage of COAR-MLE. For the linear models we are discussing, the two-stage CO-AR method is conducted like this: the first step is to estimate the standard OLS coefficients to obtain the OLS residuals $\hat{u}t = yt - xt'\beta$ And to remove the serial correlations, we fit an AR(k) process to the OLS residuals $\hat{u}_t$, where the order of k is selected by AIC. In this sense,

$$u_t = \sum_{j=1}^{k} \hat{b}_j \, u_{t-j} + \hat{e}_{tk} + o_p(1)$$

After estimating coefficients in AR(k) for OLS residuals $\hat{u}_t$, we similarly filter y_t and

x_t and get,

$$y_t^* = y_t - \sum_{j=1}^{k} \hat{b}_j \, y_{t-j} \text{ and } x_t^* = x_t - \sum_{j=1}^{k} \hat{b}_j \, x_{t-j}$$

Our next step is to estimate the new models of y_t^* and x_t^*, and as we discussed given the GARCH effect MLE should be employed to obtain the consistent estimator $\hat{\beta}_{COAR-MLE}$. Wang et al. (2013) proves that this new estimator is consistent at rate $T^{1/2}$ and asymptotically normally distributed without having to estimate the long run variance. So we can build convergent t statistic t_β as

$$t_\beta = \frac{\hat{\beta}_{COAR-MLE}}{S_{\hat{\beta}}} \xrightarrow[d]{} N(0,1)$$

Where $S_{\hat{\beta}}$ denotes standard errors for estimators. It is believed that with this new estimation, the duration process can be reflected relatively accurate.

3. Data, Key Variables, and Summary Statistics

3.1 Data Description

The frequency of data is daily and following the traditional wisdom in research of exchange rates, our models employ variables in the model form: $s_t = s_{t-1} + c'Z_t + u_t$, where$s_t$ denotes the exchange rate of U.S. dollar against Japanese yen, Z_t is the information set investors can obtain currently and u_t is the white noise. Our analysis indicates in the aftermath of natural disasters, Japanese yen would appreciate and therefore to verify this hypothesis we are more interested in situations when $s_t - s_{t-1} < 0$, which is equivalently as U.S. dollar depreciates in the value of Japanese yen. As a result, in our framework of PROBIT and LOGIT models we set the dependent variables equal to 1 if Japanese yen appreciates otherwise zero.

In financial market, mean reversion is believed to exist generally, which indicates price has the trend to come back to the moving average level though with some fluctuations. Thereby it is believed that in the FX market, how far prices are from the average level would cause influence on the price next period. An aim of this paper is to explore the market efficiency, which can be tested by whether historical prices are taken into the change of current exchange rate. So we include deviation of exchange price from the moving average level in the information set Z_t. Indeed the average level of exchange rate is usually referred to as targeted price level by which central banks decide whether to intervene in market. There is a large amount of literature discussing how to compute the moving average by choosing the window size to average. LeBaron (1999) justifies a term of 150 days as a very common choice among market traders, which is verified by Kim and Sheen (2002) again. While Ito and Yabu (2007) suppose that the long-run target can be only useful if approaching as long as five-year moving average. But Chen, Chang and Yu (2012) point that the short-term deviation is highly correlated to the three-year-term and five-year-term deviations. To circumvent the possible multicollinearity problem, here we follow Chen, Chang and Yu (2012) to set up three types of targets, in which the short-term is defined as target for the previous day's exchange rate, the medium-term target for the previous month's moving average rate, and the long-term target for the previous150-days' moving average rate. The exchange rate deviation on date t is then defined as the exchange rate difference between the previous-day rate and any potential target rate. Namely we have the following dependent variables, Short-term deviation: $\mathbf{SDEV}_t \equiv s_{t-1} - s_{t-2}$

Medium-term deviation: $\mathbf{MDEV}_t \equiv s_{t-1} - \frac{1}{21}\sum_{i=1}^{21} s_{t-1-i}$

Long-term deviation: $\mathbf{LDEV}_t \equiv s_{t-1} - \frac{1}{150}\sum_{i=1}^{150} s_{t-1-i}$

We categorize our models in three kinds by dependent variables included in the information set Z_t concerning these three types of deviations. To be specific, from the view point of investors, other dependent variables being fixed inZ_t, the models can have three types: (1) without historical information of FX price, (2) with the price information of last day's exchange rate as $\mathbf{SDEV}_t$,(3) with short, medium and long term price information together and that is to include $\mathbf{SDEV}_t$,$\mathbf{MDEV}_t$and $\mathbf{LDEV}_t$simultaneously. This methodology of categorizing is able to test investors' dependence on historical prices. In case of type (1), no historical price information is included suggesting investors in the market don't look back in the past exchange rate level; while in type (2), it is assumed that investors would account on historical price but only in short term which requires the past information would quickly die out; at last in type (3) the market considers complete information of historical prices and thinks its effect would last.

The rest of information set Z_t are the same for all models, including intervention by the central bank, Japanese risk free rate and its difference from U.S. risk free rate, Japan stock market index. The variable (INT) denoting amount of currencies central bank transacts in the market, which is triggered when the degree of deviation of exchange rate price the central bank think is too far from the target. In the short term after natural disasters, it is normal that market would develop fears about the local economy and thus follows the fluctuation in FX market. And to stabilize the market, government usually responses by selling or buying assets. On one side, Japan ranks the second in the amount as holder of U.S. treasury bonds and that enables the government to have strong power to provide liquidity to markets. On the other side, measures from the government are also indicators of serious deviation in market. It can thus be inferred behaviors of central banks are to some degree responsible for the change of exchange rate. Such intervention by the central bank is generally not often, yet they happen frequently around those natural disasters so that they should have power on the post-disaster price of exchange rate. So we put that in the information set as an independent variable. The information set also includes Japanese call money interest rates in addition to its difference with the U.S. Federal Funds rate, and we denote them by JPI and SPR respectively. The former is to measure the actions of domestic bond market while the latter compares that with overseas bond market. The two variables measure how finance investing environment changes in the special post-disaster period influence investors' attitudes to hold yen financial assets. Normally investors in Japan's market should be sensitive to rise of Japan's interest rate since it has been touched the bottom, and speculation motivation also warns them against violation of interest parity of Japan with other countries. However, such facts are more likely to hold in the long run, while for some short periods, for example in the disaster case, those natural disasters may lead investors to ignore the difference in bond markets since those related to Japan are usually relatively steady. Therefore it is interesting to check if relatively steady interest markets can calm the fear in the market of exchange rate. Another factor often related to the change of currency value is stock index representing development of domestic economy. Economic fundamentals of Japan are the final attractions of capital flow and the core dynamics to produce profits of yen assets, so if natural disasters cause big changes in the economy, disrupting the production of local industry and declining exports, such turbulence should also fluctuate the exchange rate market. Stock markets are proved to correlate highly with economy in Japan. So testing on stock index acts as a representation of tests of economy's correlation with exchange rate. Hence we use performance of Nikkei 225 stock index to measure the effect of disasters on economy and define $\mathbf{NIK=100 \times \Delta Ln(Nikkei_t)}$ as an independent variable. Indeed by JPI, SPR and NIK we are able to present capital inflow in finance and industry of Japan, and since they support the profits of yen assets, they must be prior considerations of the currency investors.

Besides, we treat dates when disasters break out as a dummy variable which also determines size of event window. These disasters contain earthquakes and typhoons, most of which produce effects obstructing the district or whole country's economy development. What's more, we count the sarin attack on the Tokyo subway, which is the most serious social accidents during the latest decades. It somehow causes the national fear of terrorist attack from the heresy, and disrupts the people's life as well as the economy. To give us a hint on duration of effects on exchange rate of natural disasters, the dummy standard is varying. Generally we set dummy valued at 1 only in the duration period which begins at the date when disasters break out. The durations can last from 1 day to 21 days and thereby provide 21 different window sizes for each model. In event study, the dummy is not in the model but it determines the event window while in our common case it is taken in. In addition to the advantage of excluding the possible weak effects of financial data, we can assess how long the information of unexpected disasters can keep in the financial markets. The intervention data are from Ministry of Finance of Japan, and we collect other financial data from DATASTREAM. We count the disasters by dates they happen, which is listed on what. The sample consists of daily observations of 5964 business days from 1991/04/01 to 2014/02/06.

3.2 Summary Statistics

We compute the returns of the raw price data of exchange rate market and equity market due to their generally accepted unit root features, by which we get new variables "Return=100 ×ΔLnSt" and "NIK=100 ×ΔLn(Nikkei$_t$)". This process gives us advantage of explaining appreciation of currency. For the price of exchange rate of U.S. dollars against Japanese yen, a negative return should match our interest that is the appreciation of yen. Similarly, we difference the logarithm of Japan's daily call money rate to smooth the domestic risk free interest rate as usually processed.

A brief description of data corresponding to variables is provided in the table 1. A note that should be noticed is that we diversify the central bank's intervention in models by setting INVS, INVB and INVT. The first variable denotes the intervention amount by selling Japanese yen while the second variable that by buying Japanese yen. In this sense, they are all positive values. Yet in the third variable, INVT, we construct it by the combination if INVS and INVB, however, where selling corresponds to negative value and INVB to positive value. Such further step is necessary since no INVB happens in the shortly aftermath of natural disasters as we search the data, thus giving us convenience to focus on INVS. While in treating the whole data sample, we should still deal with both selling and buying measures that are responsible for changes of currency values. Table 1 shows historically INVS works in more amount as far as 8072.2 billion yen, which reflects the recent stimulations led by government to the economy. Interest rate of Japan bond (RJPI) stays in a low level, and that makes the difference of it between U.S. interest rate keeps negative almost. Disasters happen in a frequency of 0.006. Considering those natural disasters are almost all national, it supports the aim of this paper that disaster issue should be cared about in investing in Japan's market.

We also need to impress here that in part of price deviations, we increase the magnitudes of SDEV denoting the short term price deviation to make it comparable to middle and long term price deviation in effects on yen's appreciation. To copy with nonstationary feature in financial time series, we firstly apply unit root test to the data to decide if further steps to transform stationary to nonstationary. Now we test the existence of unit root in the data by ADF and Phillips-Perron tests, with the latter robustly checking the former's results in case of autocorrelations of regressors in models. The results are as following.

Variable	Test	
	ADF	Phillips-Perron
return	-77.12694***	-77.15662***
SDEV	-76.52645***	-76.53559***
MDEV	-15.32467***	-15.86783***
LDEV	-5.415275***	-5.523307***
SPR	-1.049913	-3.28208
JPI	-7.376933***	-7.318696***
NIK	-79.42736***	-79.60225***

The results shows that all variables except SPR reject null hypothesis of having unit roots. To match the integration order, we need to first difference SPR, namely the spread of Japan's and U.S. interest rates.

4. Empirical Findings

We estimate the effect of Bank of Japan's intervention (INVT), the spread of Japan's call money interest rate minus US Federal fund interest rate (SPR), Japan's call money interest rate (JPI) , the growth rate of the Nikkei 225 stock index (NIK), the short term deviation from previous one day moving average (SDEV), the medium term deviation from previous one month moving average (MDEV), the long term deviation from previous half-year moving average (LDEV) on day t-1 on the change of the Japanese Yen/U.S. Dollar (JPY/USD) foreign exchange market on day t by the PROBIT, LOGIT, OLS, and COAR models for the sample from the event period chosen as the event window [0, 1], [0, 2],...,[0, 22]. During the event periods for 35 events, the volatilities of the JPY/USD foreign exchange market is not significant different from each other. We thus use OLS and COAR without considering the GARCH error terms. But for the whole sample period from 1991/04/01 to 2014/02/06, we include an additional dummy variable DISASTER to indicate the event periods in the regression and employ GARCH and COAR-GARCH to consider the possible different volatilities of the event periods and the non-event periods in the JPY/USD foreign exchange market. We report the results for event window [0, 10] only Table 2 and for all the event windows from [0,1] to [0,22] in Fig. 2.1 - Fig. 2.6 for the short term and Fig. 2.7 depicts time varying feature of DISASTER variable for the long term.[1] We estimate three models as described in previous section: The first model is Model A which is without historical information of FX price. The second is Model B with the price information of last day's exchange rate as $\mathbf{SDEV}_t$,. The last model is Model C is with short, medium and long term price information together and that is to include $\mathbf{SDEV}_t$, $\mathbf{MDEV}_t$ and $\mathbf{LDEV}_t$ simultaneously. The results are quite similar. Therefore, we just report the estimated results for Model C which includes all the historical price information.

4.1 Short run vs. long run for event window [0, 10]

In Table 2, we report the results from the short run and long run data based on the event window [0, 10]. They are significantly different based on the same econometric methods. For example, INVT is insignificant for all econometric models in the short run dataset, but it is very significant in the long run dataset. Another example is JPI. JPI are very significant for both cases, but it has positive sign for the short run dataset, while it has negative sign for the long run dataset. For S_DEV, it is significant for all econometric models for the short run data, but S_DEV becomes insignificant when the econometric models are GARCH and COAR-GARCH. Therefore, it is interesting to note that the short run reactions from INVT, JPI, NIK, and S_DEV is different those of the same variables. The results from GARCH and COAR-GARCH are

[1] Here for the long term we just show the figure of time varying coefficient for the DISASTER variable because other variables have not significant variations as event window become large. However, the figures for these variables are on request..

quite similar in the long run effects because all of the independent variables are stationary, In other words, the independent variables of GARCH model are stationary checked by the unit root test. For COAR-GARCH models, the AR(k) process to the dependent variable and the independent variables is to obtain the fitted values of the dependent variable and the independent variables stationary. Basically, they are the same econometric approach.

The estimated coefficients of NIK in Table 2 are all negative and significant at 1%, 5%, or 10% for short-run effects and long-run-effects. This findings show that an increase in the growth of stock price causes the depreciation of the JPY/USD foreign exchange rate. A possible explanation for these findings is that an increase in the stock market is generally an indicator of an expanding economy and expects a higher inflation (Ajayi and Mougoue, 1996). This may cause the outflows of capital and lead to the depreciation of the JPY/USD exchange rate.

The coefficients of DISASTER are all positive and significant at 1% for long-run effects. This result shows that, during the periods of natural disaster, the value of the yen in the JPY/USD foreign exchange rate market increases because the Japanese government and corporations might have to liquidate some of their U.S Treasuries for reconstruction from property damage.

The coefficients of INVT are all negative and only for OLS significant at 10% for the short-run effects. But for the long-run effects they become positive and significant at 5% for PROBIT and LOGIT and 1% for GARCH and COAR-GARCH. This results show that, after natural disasters happened, while the market would develop fears about the local economy and thus causes the fluctuation in FX market, the BOJ intervention has little effect on the exchange rate return. But in the long term, the BOJ intervention by buying JPY will increase the value of the yen in the JPY/USD foreign exchange rate.

The coefficients of S_DEV are all positive for all models and statistically significant for OLS and COAR in the short term and PROBIT and LOGIT in the long term. They are statistically insignificant for GARCH and COAR-GARCH in the long run. The positive coefficients are consistent to the policy of leaning against the wind and reflects the mean reversions of Japanese yen as the assets. In the long run, the findings that the coefficients of S_DEV, M_DEV, and L_DEV are all statistically insignificant for GARCH and COAR-GARCH demonstrates that the historical price information have no effects on the exchange rate return of U.S. dollar against Japanese yen.

4.2 Short run vs. long run for all event window

In Table 3 and Table 4, we report the results from the short run and long run data, respectively, based on different event window. We increase the length of event window from [0, 2] to [0, 20]. In Table 3, with the change of the length of event window, we obtain the different results. For example, the coefficients of S_DEV, L_DEV, INVT, and JPI are most likely statistically significant at a great length of event window. The coefficient of INVT is statistically significant when the event window is greater than 15. In Table 4, we include the DISASTER variable in the regression and increase its length of the event window, the coefficient of DISASTER are only statistically significant at some specific event window such as [0, 10]. Most coefficients of independent variables are stable in term of the magnitude of the coefficient and statistical significance level as an increase in the event window except NIK. From Table 4, we know the length of event window plays an important role for the DISASTER dummy variable.

5. Concluding Remarks

Japan's exchange market has been researched in this paper for its post-disaster performance because of the relatively highly frequent disasters there. In specific, we explore how much and how long natural disaster's effects can keep in the currency market. We employ event study methods here to measure the duration feature of disasters, and therefore locate the duration boundary by test if coefficients in models are significant. The models include information from bond and stock markets in addition to historical prices of exchange rate, which we introduce to exclude the possible endogenous bias in error terms. Besides, we divide our models into three types by including different historical prices of exchange rate, and this shows us how far back investors consider for their yen asset's value when disasters happen.

Our findings indicate disaster's effects die out as time goes on after it broke out, yet a post-disaster period ranging from 10 to 15 days proves significant in causing changing values of Japanese yen. Closely after the disaster, historical price information may be the main indicator for investors' portfolio decision, while other variables about bond and stock markets stand out in the long run. Generally disasters cause an increasing value of Japanese yen, and so does government's intervention, which matches our hypothesis. In the aftermath of disasters, the spread of interest rates in U.S. and Japan is insignificant, while Japan's overnight interest rate and NIKKEI stock returns affect exchange return of dollar against yen negatively and positively respectively. This may indicate investors care more about the conditions of Japan's economy than its comparison between other countries, and we suppose the positive stock return effect here is due to the integration of global financial markets.

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Table 1
Description of Variables
(sample size: 5,964)

Variable	Description	Mean	Std. Dev.	Min.	Max.
S	Daily prices of U.S. dollar's exchange rate against Japanese yen.	108.7306	15.34742	75.76	147.14
INVT	Japan intervention in absolute values measured by billions of yen, including both selling and buying overseas assets.	15.6021	153.8283	0	8072.2
SPR	The difference between the Japan call money interest rate and the U.S. Federal Fund interest rate, namely JPI_t-USF_t.	-2.2963	2.3560	-7.3	2.858
RJPI	Japan's daily call money interest rate, the risk free rate employed in bond market of Japan.	0.8572	1.6545	-0.012	8.4375
NIKKEI	Daily historical Nikkei 225 index	14654.508	4352.7647	7054.98	26980.37
DISASTER	The first dates of natural disasters which hit Japan in the history in addition to the 1995's Sarin attack on the Tokyo subway. All of these disasters do harms to domestic economy, and cause national fears.	0.0059	0.0764	0	1
SDEV	short term deviation from previous one day moving average, $\mathrm{SDEV}_t \equiv s_{t-1} - s_{t-2}$.	-0.0066	0.7486	-8.4050	4.8050
MDEV	Medium term deviation from previous one month moving average,	-0.0651	2.0022	-15.8300	7.9190

	$\text{MDEV}_t \equiv s_{t-1} - \frac{1}{21}\sum_{i=1}^{21} s_{t-1-i}$				
LDEV	Long term deviation from previous half-year moving average, $\text{LDEV}_t \equiv s_{t-1} - \frac{1}{150}\sum_{i=1}^{150} s_{t-1-i}$	-0.4030	5.4634	-21.6850	15.7173

Notation: This table describes the raw data, yet for our aim, we also need daily log returns of U.S. dollar's exchange rate against Japanese yen, denoting by "Return", which is indeed $100 \times \Delta LnSt$. By the similar way, we also obtain daily log returns of stock index as $NIK=100 \times \Delta Ln(Nikkei)$. Also, to smooth off Japan's interest rate, we modify it by differencing the logarithm of RJPI and denote it as JPI to be used in our models. SDEV is too small compared to MDEV and LDEV, so we employ $100 \times SDEV$ in our model to make the comparison more clear

Table 2

Estimation results from the PROBIT, LOGIT, OLS, COAR, GARCH, COAR-GARCH models based on event window [0, 10]. The regression models are based on $EXR_t = \beta_0 + \beta_1 S\_DEV_t + \beta_2 M\_DEV_t + \beta_3 L\_DEV_t + \beta_4 INVT_t + \beta_5 SPR_{t-1} + \beta_6 JPI_{t-1} + \beta_7 NIK_{t-1} + \beta_8 DISADTER_{t-1} + \varepsilon_t$
The error terms for COAR, GARCH and COAR-GARCH are specified as $\sigma_t^2 = \alpha_0 + \alpha_1 \times \sigma_{t-1}^2 + a_2 \times \varepsilon_{t-1}^2 + e_{t.}$

Independent variables	Exp. sign	Short Run				Long Run			
		PROBIT	LOGIT	OLS	COAR	PROBIT	LOGIT	GARCH	COAR -GARCH
Intercept		0.1302**	0.2085*	0.1026***	0.9719*	-0.0542***	-0.0868***	0.0015	0.0016
S_DEV		0.0029	0.0048**	0.0021***	0.0032***	0.0007***	0.0011***	5.53E-05	2.23E-05
M_DEV		0.0525*	0.0829	0.0323	0.2769*	0.0055	0.0087	0.0035	0.0053
L_DEVI		-0.0394	-0.0624*	-0.0131*	-0.0609***	-0.0041	-0.0066	-0.0022	-0.0020
INVT		-0.0008	-0.0012	-0.0005*	-0.0008**	0.0003**	0.0005**	0.0004***	0.0004***
SPR		0.8169**	1.3384	0.4950**	0.3343*	-0.1353	-0.2167	-0.0482	-0.0522
JPI		-0.0850**	-0.1358**	-0.0457***	-0.0382***	0.0050*	0.0079**	0.0025**	0.0027**
NIK		-0.1079*	-0.1757*	-0.0826***	-0.0819***	-0.0458***	-0.0734***	-0.0397***	-0.0404***
DISASTER						0.1681***	0.2685***	0.0629**	0.0641**
R^2				0.1464	0.3132			0.0219	0.0063
Pseudo-R^2		0.0403	0.0399			0.0051	0.0051		
Log-likelihood		-217.0394	-217.0304	-280.9985	-237.66	-4108.5335	-4108.5836	-5769.416	-5734.815
N		328	328	328	328	5964	5964	5964	5964

Note:*, **, and *** stand for statistically significant at 0.1, 0.05, and 0.01 levels, respectively.

Table 3

Estimation results from the COAR model based on different event window. The regression models is based on

$$EXR_t = \beta_0 + \beta_1 S\_DEV_t + \beta_2 M\_DEV_t + \beta_3 L\_DEV_t + \beta_4 INVT_t + \beta_5 SPR_{t-1} + \beta_6 JPI_{t-1} + \beta_7 NIK_{t-1} + \varepsilon_t$$

Independent variables	Short Run							
	[0, 2]	[0, 5]	[0, 7]	[0, 10]	[0, 12]	[0, 15]	[0, 17]	[0, 20]
Intercept	0.9420	0.7939	0.8022	0.9719*	0.8026	0.8159*	0.7268	0.6378
S_DEV	0.0010	0.0025***	0.0032***	0.0032***	0.0036***	0.0032***	0.0030***	0.0025***
M_DEV	0.1873***	0.0698	0.2003***	0.02769***	0.2742***	0.3171***	0.3177***	0.3393***
L_DEVI	-0.0630**	-0.0244	-0.0260	-0.0609***	-0.0406*	-0.0563***	-0.0221	-0.0229
INVT	0.0048	-0.0005	-0.0014***	-0.0008**	-0.0003	-0.0006***	-0.0006***	-0.0006***
SPR	0.3490	0.1958	0.3041	0.3343*	0.1970	0.1293	0.1689	0.2110
JPI	-0.0634	-0.0274	-0.0168	-0.0382***	-0.0235***	-0..0218***	-0.0167***	-0.0139**
NIK	-0.1379**	-0.0518**	-0.0602***	-0.0819***	-0.0870***	-0.0936***	-0.0918***	-0.0830***
N	70	168	232	328	390	480	536	619

Note:*, **, and *** stand for statistically significant at 0.1, 0.05, and 0.01 levels, respectively.

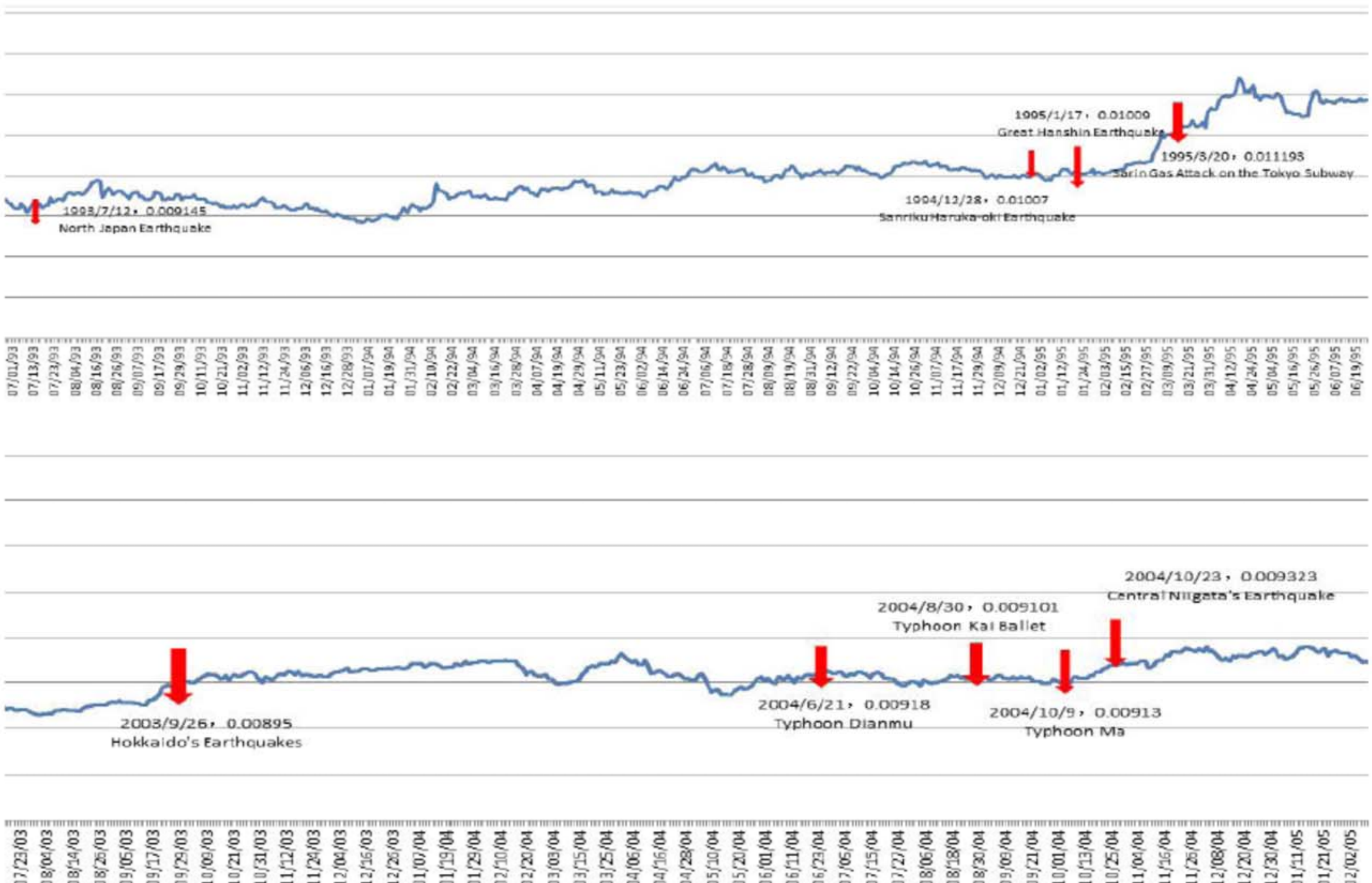
Table 4

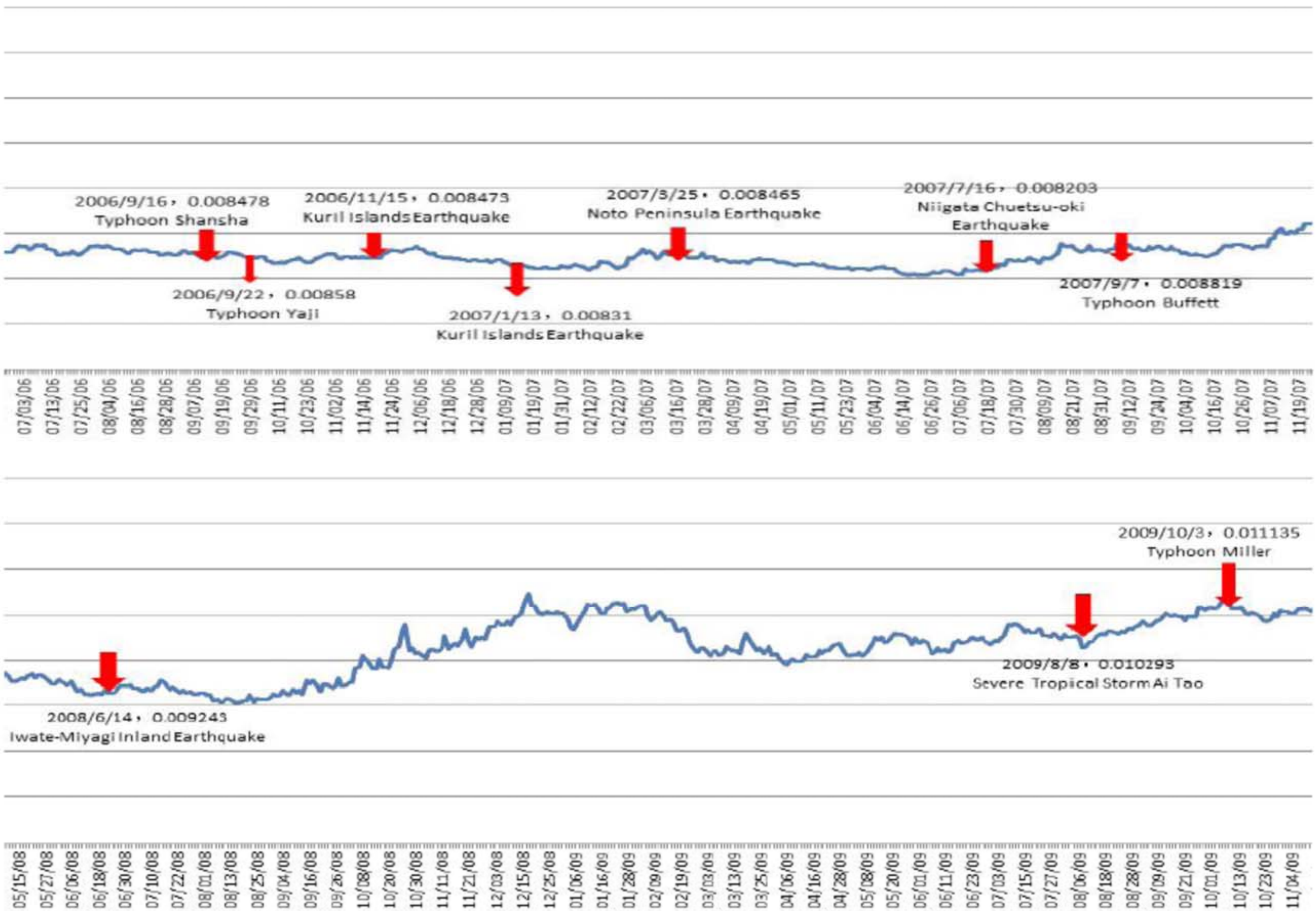
Estimation results from the COAR-GARCH models based on different event window. The regression models is based on $EXR_t = \beta_0 + \beta_1 S\_DEV_t + \beta_2 M\_DEV_t + \beta_3 L\_DEV_t + \beta_4 INVT_t + \beta_5 SPR_{t-1} + \beta_6 JPI_{t-1} + \beta_7 NIK_{t-1} + \beta_8 DISADTER_{t-1} + \varepsilon_t$. The error terms for COAR-GARCH is specified as $\sigma_t^2 = \alpha_0 + \alpha_1 \times \sigma_{t-1}^2 + a_2 \times \varepsilon_{t-1}^2 + e_t$.

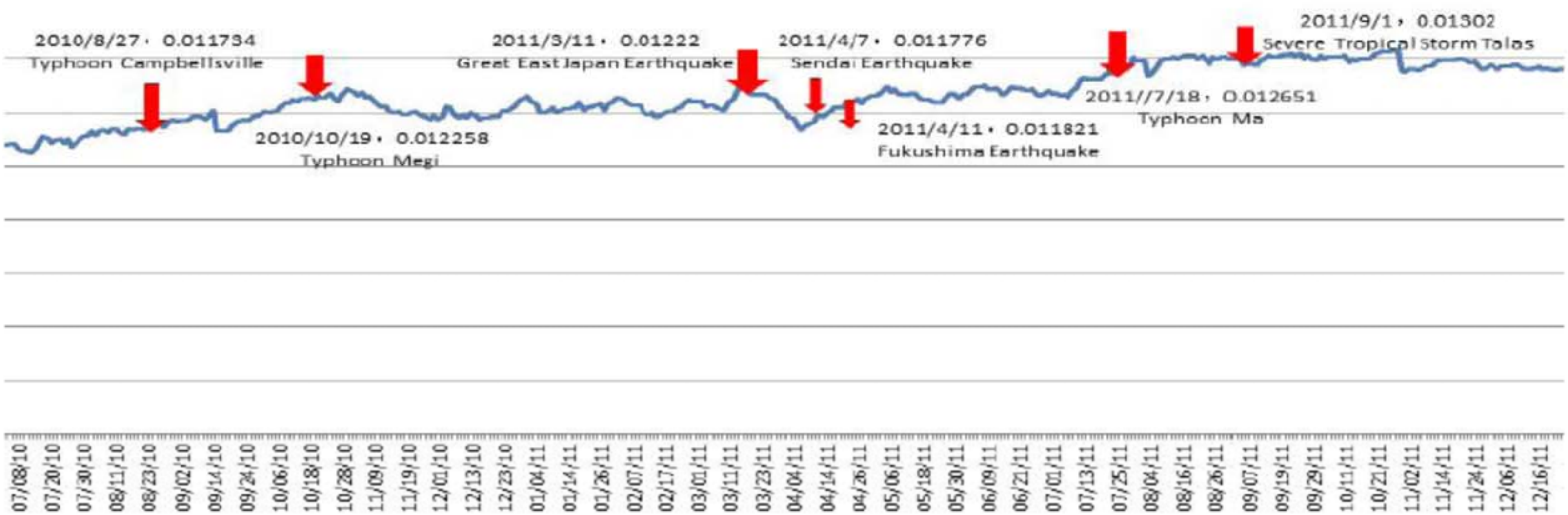
Independent variables	Long Run							
	[0, 2]	[0, 5]	[0, 7]	[0, 10]	[0, 12]	[0, 15]	[0, 17]	[0, 20]
Intercept	0.0051	0.0046	0.0043	0.0016	0.0018	0.0013	0.0015	0.0007
S_DEV	2.00E-05	2.21E-05	1.94E-05	2.23E-05	1.91E-05	1.60E-05	1.71E-05	1.74E-05
M_DEV	0.0050	0.0050	0.0050	0.0053	0.0053	0.0056	0.0055	0.0056
L_DEVI	-0.0021	-0.0021	-0.0021	-0.0020	-0.0020	-0.0020	-0.0020	-0.0020
INVT	0.0004***	0.0004***	0.0004***	0.0004***	0.0004***	0.0004***	0.0004***	0.0004***
SPR	-0.0525	-0.0524	-0.0524	-0.0522	-0.0522	-0.0519	-0.0520	-0.0520
JPI	0.0027**	0.0027**	0.0027**	0.0027**	0.0027**	0.0027**	0.0027**	0.0027**
NIK	-0.0404***	-0.0404	-0.0404	-0.0404***	-0.0405	-0.0405	-0.0405	-0.0404
DISASTER	0.0432	0.0320	0.0307	0.0641**	0.0513*	0.0465*	0.0407	0.0420*
N	5964	5964	5964	5964	5964	5964	5964	5964

Note:*, **, and *** stand for statistically significant at 0.1, 0.05, and 0.01 levels, respectively.

Figure 1. Historical national disasters in Japan and JPY/USD exchange rate




2006/9/16, 0.008478
Typhoon Shansha
2006/11/15, 0.008473
Kuril Islands Earthquake
2007/3/25, 0.008465
Noto Peninsula Earthquake
2007/7/16, 0.008203
Niigata Chuetsu-oki
Earthquake
2006/9/22, 0.00858
Typhoon Yaji
2007/1/13, 0.00831
Kuril Islands Earthquake
2007/9/7, 0.008819
Typhoon Buffett
2009/10/3, 0.011135
Typhoon Miller
2009/8/8, 0.010293
Severe Tropical Storm Ai Tao
2008/6/14, 0.009243
Iwate-Miyagi Inland Earthquake


2010/8/27 · 0.011734
Typhoon Campbellsville
2010/10/19 · 0.012258
Typhoon Megi
2011/3/11 · 0.01222
Great East Japan Earthquake
2011/4/7 · 0.011776
Sendai Earthquake
2011/4/11 · 0.011821
Fukushima Earthquake
2011//7/18 · 0.012651
Typhoon Ma
2011/9/1 · 0.01302
Severe Tropical Storm Talas
07/08/10 07/20/10 07/30/10 08/11/10 08/23/10 09/02/10 09/14/10 09/24/10 10/06/10 10/18/10 10/28/10 11/09/10 11/19/10 12/01/10 12/13/10 12/23/10 01/04/11 01/14/11 01/26/11 02/07/11 02/17/11 03/01/11 03/11/11 03/23/11 04/04/11 04/14/11 04/26/11 05/06/11 05/18/11 05/30/11 06/09/11 06/21/11 07/01/11 07/13/11 07/25/11 08/04/11 08/16/11 08/26/11 09/07/11 09/19/11 09/29/11 10/11/11 10/21/11 11/02/11 11/14/11 11/24/11 12/06/11 12/16/11

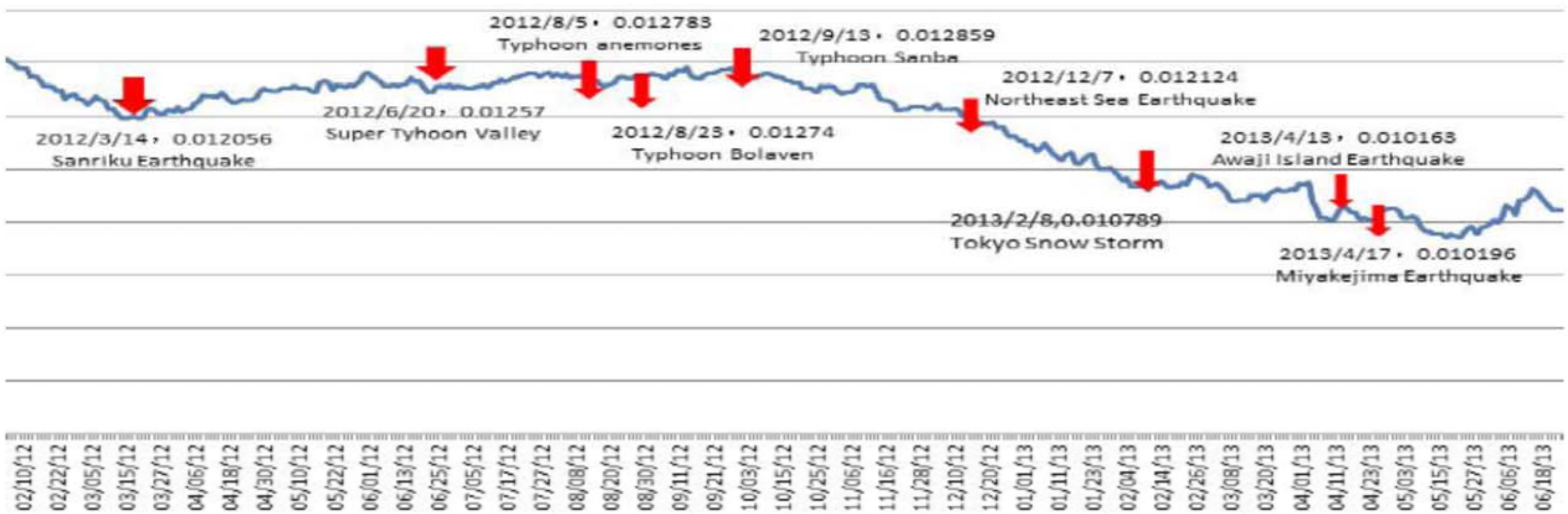

2012/3/14 · 0.012056
Sanriku Earthquake
2012/6/20 · 0.01257
Super Tyhoon Valley
2012/8/5 · 0.012783
Typhoon anemones
2012/8/23 · 0.01274
Typhoon Bolaven
2012/9/13 · 0.012859
Typhoon Sanba
2012/12/7 · 0.012124
Northeast Sea Earthquake
2013/2/8,0.010789
Tokyo Snow Storm
2013/4/13 · 0.010163
Awaji Island Earthquake
2013/4/17 · 0.010196
Miyakejima Earthquake
02/10/12 02/22/12 03/05/12 03/15/12 03/27/12 04/06/12 04/18/12 04/30/12 05/10/12 05/22/12 06/01/12 06/13/12 06/25/12 07/05/12 07/17/12 07/27/12 08/08/12 08/20/12 08/30/12 09/11/12 09/21/12 10/03/12 10/15/12 10/25/12 11/06/12 11/16/12 11/28/12 12/10/12 12/20/12 01/01/13 01/11/13 01/23/13 02/04/13 02/14/13 02/26/13 03/08/13 03/20/13 04/01/13 04/11/13 04/23/13 05/03/13 05/15/13 05/27/13 06/06/13 06/18/13

Figure 2-1: The estimated coefficients of S_LEV on EXR across all event windows in the short run: COAR estimates with 95% confidence intervals vs. Probit estimates.

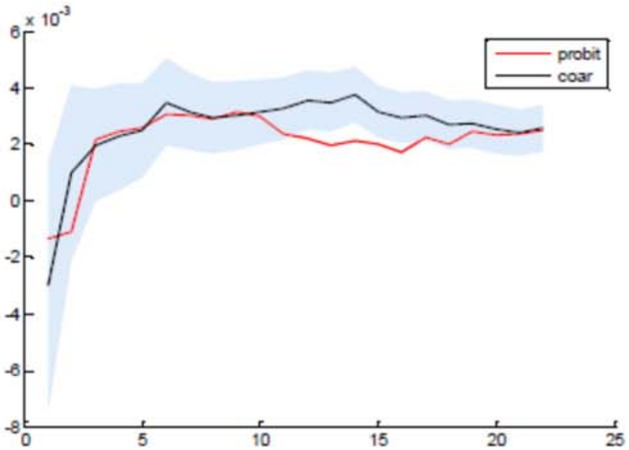


Figure 2-2: The estimated coefficients of M_LEV on EXR across all event windows in the short run: COAR estimates with 95% confidence intervals vs. Probit estimates.

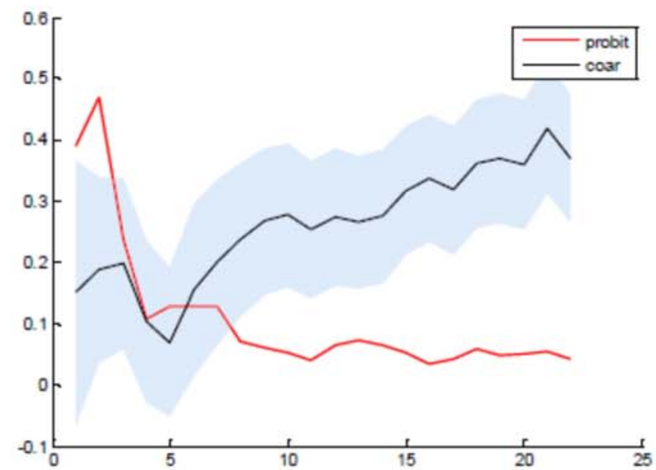


Figure 2-3: The estimated coefficients of INVT on EXR across all event windows in the short run: COAR estimates with 95% confidence intervals vs. Probit estimates.

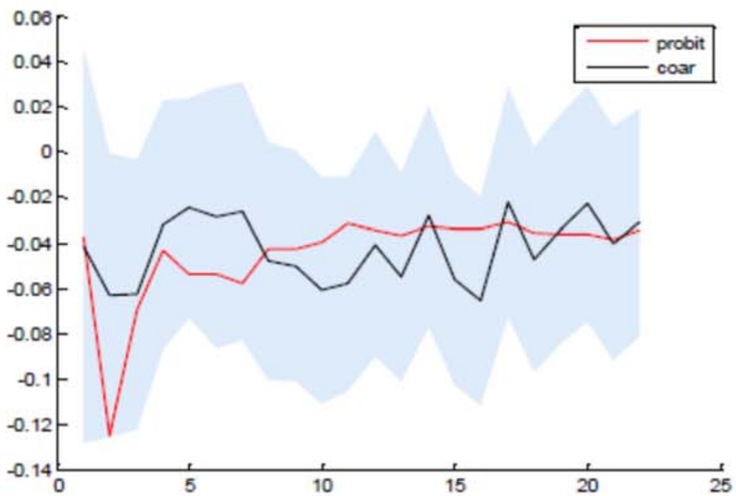


Figure 2-4: The estimated coefficients of SPR on EXR across all event windows in the short run: COAR estimates with 95% confidence intervals vs. Probit estimates

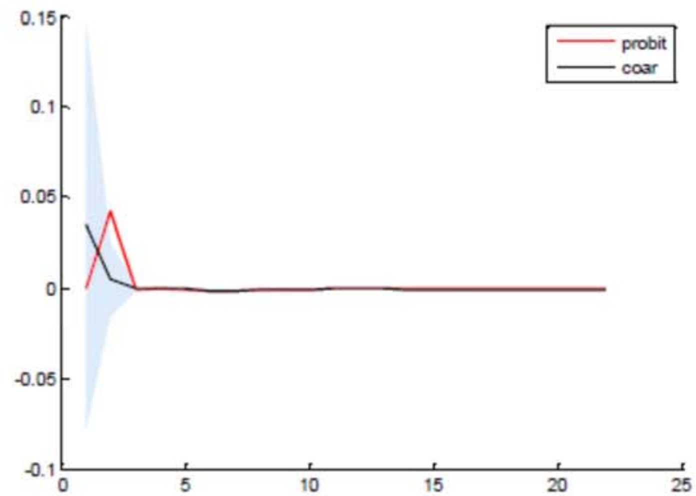


Figure 2-5: The estimated coefficients of JPI on EXR across all event windows in the short run: COAR estimates with 95% confidence intervals vs. Probit estimates.

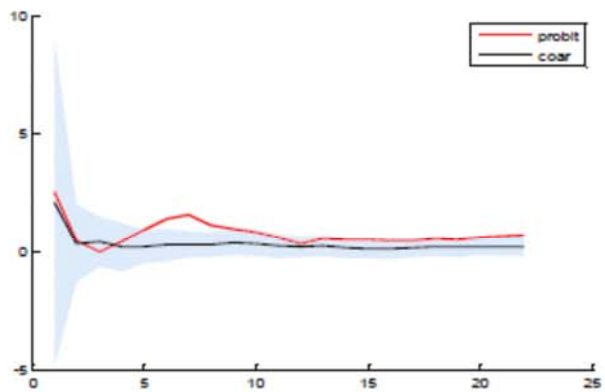


Figure 2-6: The estimated coefficients of NIK on EXR across all event windows in the short run: COAR estimates with 95% confidence intervals vs. Probit estimates.

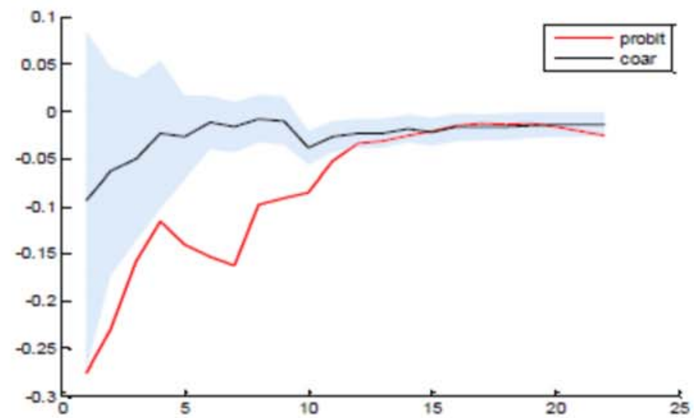
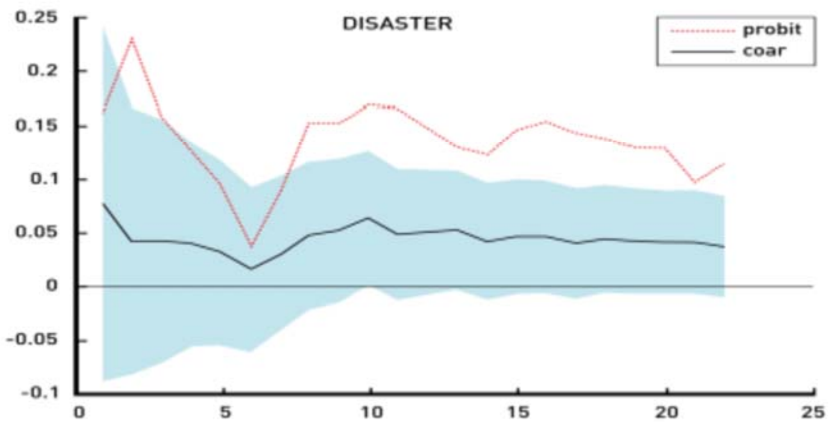


Figure 2-7: The estmated coefficients of DISASTER on EXR across all event windows in the long run: COAR-GARCH estimates with 95% confidence intervals vs. Probit estimates.



Methodological Proposal for the Study of the Impact of Globalization on Business Strategy of Mexican International Enterprises

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The aim of this paper is to support a methodology proposal for the analysis of the impact on commercial globalization trend in relation to the internationalization of Mexicans firms. Also this paper analyzes the advantage the Mexican firms took in the liberalization agenda of the Mexican government with the multilateralism and regionalism policies. For this purpose, the statistic descriptive modeling methodology is used to relate grow of the internationalization of the Mexican firms and the impact in the foreign investment of the main multinationals in Mexico, forcing them to centering in competitive productive processes and improving their internal organization, innovation and development.

Keywords: Globalization, internationalization, multilateralism, multinationals, regionalism.

JEL Classifications: F62, F21, F13, F23, F15

1. Introduction

Mexico has experienced a steady increase in the internationalization of Mexican companies, which increased largely due to the openness trade policy adopted by the country. Following the entry of Mexico to the General Agreement on Tariffs Trade (GATT for its acronym in English) in 1986 and to adopt business trends on multilateralism and regionalism, has led to an increase in the internationalization of Mexican companies. In light of the foregoing, Mexico, from the late 90's, has experienced an increase in investment abroad of large Mexican companies that have survived the market reforms and structural adjustment policies (Vargas-Hernández, 2011). From this, it follows that the support of the Mexican government to Mexican companies as well as the impact of trade globalization, results in a sustained increase in the internationalization of Mexican companies.

This paper analyzes the impact of trade globalization in the internationalization of Mexican companies, same as, taking advantage of Mexico's trade policy openness, through multilateralism and regionalism have increased their presence in international markets.

Through descriptive statistical method of investigation, it is analyzed and developed the increased internationalization of Mexican companies and the impact of foreign investors and major multinationals in the competition, which forces Mexican companies to focus on innovation and development and to adopt more competitive production processes and improved internal organization.

2. Background of the problem

Following the entry of Mexico to the General Agreement on Tariffs Trade (GATT for its acronym in English) in 1986 and to take business trends multilateralism and regionalism, has led to an increase in the internationalization of Mexican companies, situation that has caused an increase in investment abroad of large Mexican companies that have survived the market reforms and structural adjustment policies (Vargas Hernández, 2011). From this, it follows that the support of the Mexican government to Mexican companies as well as the impact of trade globalization, results in a sustained increase in the internationalization of Mexican companies increased, and in the decisions of these to select an internationalization strategy to a specific market.

3. Definition of the problem

Currently, it is observed an increase in the internationalization of Mexican companies, derivative from trade openness policy adopted by Mexico and the globalization of trade out of which it is part. This trend can be divided into two branches: First observed multilateralism, same as is understood as trade openness of a country through the conclusion of free trade, and on the other, regionalism, which is understood as the trade openness of a country through regional integration (Arango Quintero and Cardona Montoya, 2008).
Therefore, the research questions are:

a. What is the degree of increase in the internationalization of Mexican companies, from Mexico's entry into the General Agreement on Tariffs Trade (GATT for its acronym in English) in 1986 to date, derived from the globalization of trade which is part of the country?

b. What is the degree of increase in the internationalization of Mexican companies, since the adoption of trade policy openness of the country, because of multilateralism?
c. What is the rate of increase in the internationalization of Mexican companies, since the adoption of trade policy openness of the country, because of regionalism?
d. What is the impact of multilateralism and regionalism in the selection of a destination country at the time of the internationalization of a company?

4. Justification

The importance on the world stage of globalization of markets, societies and cultures, is resulting in a direct impact on the internationalization of Mexican companies, same as, taking advantage of Mexico's trade policy openness, through multilateralism and regionalism have increased their presence in international markets. Similarly, to attract foreign investors and major multinationals to the country, it has impacted directly on free competition, which forces Mexican companies to focus on innovation and development, to adopt more competitive production processes and as an improvement in its internal organization.

5. Assumptions

a. The trade globalization has an impact on the internationalization strategies of companies.
b. Multilateralism adopted by a country has an impact on the internationalization of its companies.
c. Regionalism adopted by a country has an impact on the internationalization of its companies.
d. Multilateralism and regionalism adopted by a country have an impact on the selection of a country at the time of the internationalization of a company.

6. The trade globalization

6.1. *Conceptual framework*

The last 25 years the world economy has been characterized by numerous scientific and technological progresses, which has changed the pattern of production throughout the world, creating a growing interdependence that encompasses the total activities of an industrial economic sector, either regional or global level. This process is known as globalization and its main feature is that it has generated a significant increase in the flow of trade and investment; in such a way that globalization is seen as a struggle to participate in a greater number of markets and better capture larger volume of foreign direct investment (Gómez 2006).

An integration of the different concepts of trade globalization is poured in the following table:

Table 1: Commercial globalization.

Terms	Meanings and authors
Products at low cost.	Set of economic, technological and social factors that allowed multinational companies to sell their products almost there are no differences in various countries (Levitt, 1984).
Increased volume of FDI flows.	A fight for participating in a greater number of markets and achieve to capture higher volume flows of foreign direct investment (Gómez, 2006).
Operates without a country on a global scale.	Global company is one that has abandoned its national identity and operates as a non-country on a global scale (Ohmae, 1991).
Accelerated global integration of economies.	Worldwide accelerated integration of economies through trade, production, financial flows, technology diffusion, information networks and cultural flows (IMF, 1996).
Dynamic global market integration.	Dynamic process of increasing freedom and global integration of markets for labor, goods, services, technology and capital (De la Dehesa, 2000).

Source: Prepared.

The process of economic globalization is to operate with relatively low costs as if the whole world or the most important regions of the cities were a single entity.

An approach to the definition of globalization would be to integrate it from its characteristics. Globalization is an economic, technological, social and cultural scale process, which involves increased communication and interdependence among countries, unifying its markets, societies and cultures, through a series of social, economic and political transformations that give them global.

6.2. *Theoretical framework*

6.2.1. *Globalization of markets*

Pineda (1998) takes in his work an approach to the definition of globalization, analyzing seven approaches that try to explain globalization as theory. Among them, the presence of capitalism as a driving force of change worldwide in recent decades largely explains the emergence of the phenomenon of globalization. With countless multidisciplinary impacts as capitalism involves other than strictly economic, sociological, cultural, political, religious, technological, environmental, among others, none of which able to explain the complexity of the phenomenon of globalization.

The main beneficiaries of this process of globalization are multinational corporations that benefit from huge economies of scale, whether in production, distribution and administration to scale and product standardization, as stated by Levitt (1984). The most effective global competitors incorporate a higher quality and profitability to their cost structures, selling in all national markets the same products they sell in their home market, fully standardized products without any differentiation.

In light of the foregoing, Mexican companies not only face fierce competition in international markets but facing international competitors in the domestic market, with standardized products, with improved technology and above all more economical. Consumers initially had local preferences, but today they are seduced by the low price. Currently, it can be observed an increase in the internationalization of Mexican companies, derivative trade openness policy adopted by Mexico and the globalization of trade of which it is part, trend that can be divided into two branches, first multilateralism and on the other part the regionalism.

6.2.2. *Adoption of trade policy openness*

In the eighties, the economic and political framework was created for the United States and agencies like the World Bank and the International Monetary Fund actively promote implementation of neoliberal policies in developing countries, including Latin American (Ruiz Naples, 2004). Undoubtedly one of the most important neoliberal policies of that time was the adoption by Mexico of the General Agreement on Tariffs Trade (GATT for its acronym in English) in 1986-now World Trade Organization (WTO) - which had resulted in the adoption of trade policy openness.

Among the main commitments assumed by Mexico, was the gradual reduction of tariffs on trade as well as the adoption of trade policies of non-discrimination, among which are included national treatment and treatment of the most favored nation, generating with this the greater trade openness in Mexico. Derived from the developments described above, the Mexican government, in compliance with the economic policies of former President Carlos Salinas de Gortari (1988-1994), conducted a series of privatizations of state enterprises and later opened a new concept of growth national economic production that oriented outward to export.

In the context of trade liberalization and tariff scale deregulation, Mexico opted for free trade area with Canada and the United States, leading to the signature of the Free Trade with North America (NAFTA or NAFTA for its acronym in English) by Salinas de Gortari on December 17, 1992. Trade liberalization could be the start of a successful integration if it achieved positive effects on the dynamics of innovation and technological process. Any strategy to improve the local economy should be aware of the social dimension that contains the expanded vision of development on the limited size reflected only in quantitative terms of growth, as it could be understood the scope of NAFTA (Hernandez Soto Vázquez, 2008) .

a) Mexico and multilateralism

Arango Cardona Quintero and Montoya (2008) define multilateralism as trade openness of a country through the conclusion of trade agreements with a country, taking advantage of the liberalizing trade policies of both countries, in order to increase international trade protecting investors and creating trade policies that benefit both countries.

"In the area of international trade relations, the fundamental and distinctive feature of the strategy promoted by the United States to ensure stability and prosperity has been multilateralism," sustained Renato Ruggiero, Director General of the WTO on October 16, 1995. Ruggiero established the importance of vision and leadership of the United States, first under the GATT and now the WTO. The core of the international trading system is constituted by the principles of non-discrimination and the nation most favored (NMF). Ruggiero gave six reasons why governments have adhered to the principle of MFN and why it is "essential to resist the lure of the apparent short-term benefits of bilateralism" (Ruggiero, 1995).

As it asserts Jimenez Martinez (2007), the free trade agreements that Mexico has, is one of the most important elements in the process of internationalization. Thus, companies in the region should take full advantage of trade liberalization and to ensure their presence in other countries. The establishment of various treaties can serve as a trigger for the company's operations in foreign markets, and is a clear factor that directly affects the continued development of the internationalization process. After signing the Free Trade Agreement with North America, which includes tariff preferences for signers' countries, support for foreign investment, alternative means of dispute resolution against unfair trade practices, regulations, and intellectual property rights, among others.

Mexico began a race to sign trade agreements with other countries, with the sole aim to diversify exports and build tariff preferences with other countries. Currently, Mexico has a network of 10 FTAs with 45 countries (TLC's), according to the Ministry of Economy (2014). In these trade agreements, is now including the new TLC Mexico-Central America, which entered into effect on July 1, 2013. In the Mexico-Central America FTA are included Mexico, Costa Rica, Nicaragua, El Salvador, Guatemala and Honduras. This treaty, replaced the three existing trade agreements that Mexico had with Central America (FTA Mexico - Costa Rica 1995, Mexico-Nicaragua in 1998 and TLC's Triangle Northern Mexico in 2001), resulting with this, a total of 10 FTAs with 45 countries. It will be pending to attach to this trade agreements list the recent Free Trade Agreement Mexico-Panama, as in April 2014 was signed by the presidents of both countries.

Similarly, Mexico has 9 limited agreements, Economic Complementation Agreements and partial scope agreements, as part of the Latin American Integration Association (LAIA) and 30 Agreements for the Reciprocal Promotion and Protection of Investments (BITs).

b) Mexico and regionalism

Arango Cardona Quintero and Montoya (2008) explain regionalism, such as trade openness of a country through regional integration with two or more countries, through the holding of regional trade agreements. In fact, the authors argue that regional integration agreements, initially conceived as exceptions to the multilateral trading system, have become the guiding principles of global business dynamics. Regional agreements emerged as a scheme which recognizes exceptions recognizing that multilateralism is a system that is built between countries at different levels of development and seeks to create the conditions for a global free trade.

In recent years, it has been observed the establishment of economic blocs, through which various nations celebrate regional agreements that allow them to join forces to get the most out of its exchange trade (Jiménez Martínez, 2007). This situation has led to a significant increase in trade between regions of neighboring countries, as prime examples are the European Union, NAFTA, the Central American bloc Mercosur and the latest Pacific Partnership (Mexico, Peru, Colombia and Chile). According to the Ministry of Economy

(2014), Mexico participates in the Latin American Integration Association (LAIA). Also, México actively participates in multilateral and regional organizations and forums such as the World Trade Organization (WTO), the Asian-Pacific Economic Cooperation (APEC), the Organization for Economic Cooperation and Development (OECD), among others.

The flagship in the process of regionalization organisms is undoubtedly the Forum Asia Pacific Economic Cooperation (APEC for its acronym in English), of which Mexico is a party. The APEC moves on three pillars: trade liberalization, promotion of investment and technical cooperation. Unlike the European Union, the Asia Pacific region did not seek to form a community, but a forum for cooperation to achieve common goals. According to Martínez Lagorreta (2002), interest in creating an organization of this type born after World War II in a region where economic growth forced an economic and political interaction expeditiously. In this way, regional forums and organizations and industry forums and government groups were formed.

Another body, undoubtedly important, is the Pacific Alliance, led by Mexico has achieved regional integration between Mexico, Colombia, Peru and Chile, precisely those South American countries that do not belong to block of the Southern Common Market, having completely different trade and economic policies. Such regional bloc, the Pacific Alliance, aims to build a participatory and consensual membership, an area of deep integration to move progressively towards the free movement of goods, services, capital and people, i.e., a common market. Similarly, Pacific Alliances aims to promote higher growth, development and competitiveness of economies throughout, with a view to achieving greater well-being and overcome socioeconomic inequality. It intends becoming a platform of political articulation, economic and trade integration and projection to the world, with special emphasis on Asia-Pacific.

Cooperation and regional integration in Latin America are growing. In recent years, progress has been more on the real integration of Latin American economies that during the past three decades. A series of regional, sub regional and bilateral agreements is achieving increasing liberalization of mutual trade and economic and growing political (Van Klaveren, 1990) cooperation. One of the main advantages in signing FTAs with trading blocs, is not only to have a greater presence in other markets, but the power to reduce both tariff and non-tariff barriers in international trade, standardizing requirements among member countries of the block. This situation happens for example with the European Union, representing 28 countries, or the Southern Common Market (MERCOSUR), composed of five countries.

The integration then becomes an ideal geostrategic mechanism to achieve favorable positions in key areas by countries with greater bargaining power (Arango Cardona Quintero and Montoya, 2008). It will be under investigation, analyzing the mechanism that openness has impacted more Mexican companies, still the case or multilateralism or regionalism. Regionalism offers advantages for foreign investment and exports as they are counting on a single integrated market by several countries with similar market characteristics. This would represent a strategy of international expansion for the company or, standardization and reduction of regulations and tariff and nontariff restrictions. Among these nontariff restrictions can be mentioned the phytosanitary regulations, health, previous permits and export licenses, which would result in greater ease for businesses when exporting their products.

7. Internationalization of companies

7.1. *Conceptual framework*

In order to make an integration of the different concepts of internationalization, they are poured in the following table:

Table 2: Internationalization

Terms	Meanings and authors
Formulas and commitment levels subject to change.	Sequential process consisting of several stages that require progressive international nature of the company and a growing involvement of outside resources. Internationalization has to be seen as a complex process, which supports various institutional formulas depending on the level of commitment of the company in international markets. These formulas and levels of engagement are subject to change as the company consolidates its presence in the international arena (Duarte Lopez, 1996).
Evolutionary and long-term dynamic process that gradually affects the value chain.	Corporate growth strategy for international geographic diversification through an evolutionary and dynamic long-term process that gradually affects the different activities of the value chain. Also, the organizational company structure with a growing commitment and increasing involvement of its resources and capabilities to the international environment, and knowledge based (Larrinaga Villarreal, 2006).
Economic activity in other countries.	The development of the economic activity of the company in other countries (Good, 1996, 2006).
Adopt rules for transaction	The process of adapting exchange transaction modalities in international markets (Andersen, 1993).
Opening new markets, low production costs.	The objectives of internationalizing a business are opening new markets, lower production costs and structure of production and distribution of the company more efficient (Canals, 1994).
Resources or customers outside the borders.	Internationalize the company is managing any area of business or customers using resources beyond the borders of the country where the company is (Zaldo, 1997).
Gradual commitment to international markets.	It argues that the internationalization of a company is a gradual commitment of management to international markets (Johanson and Wiedershein, 1975, Johanson and Vahlne, 1977, 1990; Nordsrrom and Vahlne, 1993).

Source: Prepared

7.1.1. *Multinational companies*

The rapid emergence of developing economies is characterized by a wave of economic growth and the rise of national companies to become global competitors themselves. These companies are globalizing their businesses and competing with the traditional American model of modern multinational corporations (Vargas-Hernández, 2010).

Table 3: Multinational company

Terms	**Meanings and authors**
Multiplant company	The company that has one of its revenue-generating plants located outside the home country (Dunning, 1981).
Export company	The export company concentrates its production in the country and sells its goods or services in at least one foreign market (Pla and Leon, 2004).
Global company Multidomestic company Transnational company	They refer to the specific strategic approaches that can be adopted by multinational companies, and specify the basic strategies of multinationalization described by Bartlett and Ghoshal (1991).
Global company.	Multinational company with significant worldwide presence (Pla and Leon, 2004)
Multinational corporation	The multinational corporation is one that concentrates its productive activity in l home country and sells its goods or services in at least one foreign market (Jarillo and Martinez, 1991).
Global companies.	Such multinational companies have a significant presence worldwide, assimilates acceptance of global companies (Ohmae, 1991).
Business companies born international.	Business companies born international arise as a unit in the new currents that try to explain the accelerated internationalization (McDougall et al, 1994).

Source: Trujillo Davila, et al, 2006

The theory of monopolistic advantage is associated with the interpretations of the emergence of multinational firms proposed by Hymer (1976). He finds that for firms with production facilities abroad, they must have some kind of unique competitive advantage. This competitive advantage may originate in the production, technology, organization, management style or marketing, which means that these companies can compete with foreign companies in their own markets. Although national firms can be found more established and have greater knowledge of the market, they may be forced to bear the cost of developing such an advantage, and therefore, are incapacitated to compete with foreign companies.

7.1.2. *Foreign direct investment*

A concept intrinsically linked to the internationalization of companies and multinational corporations is the direct investment abroad. The legislation currently in force, on foreign investments respects, with some exceptions, the definitions of direct investment from organizations such as the International Monetary Fund (5.º Manual de Balanza de Pagos) and the OECD (Benchmark Definition).

The ways in which such investment occurs are: Investment for the creation of new companies, acquisition of part or all of the share capital of an existing company, reinvested earnings and intercompany loans and related stock companies (Fernandez-Otheo, 2005). Hymer (1976) also considers the cause of FDI the elimination of conflict between competing companies when the markets in which they operate are imperfect. Scepter (1999) states that

Table 4: Foreign Direct Investment

Terms	**Meanings and authors.**
Lasting relationship between a resident and a nonresident of an economy.	Lasting relationship between a resident in one economy (subsidiary) and a non-resident (holding company), with the intention of influencing their management, which is required for the latter owns at least 10% of the share capital of the first (OECD Benchmark Definition).
Flow of resources	Investments in a country other than the country of origin for the investor, which draws resources flow (Dunnign, 1988).
Strategy in the internationalization process	It establishes that foreign direct investment is an option of international presence, a mode strategy in the internationalization process of the firm (Duarte Lopez, 1996).
Multinational enterprise	Concept closely linked to multinational corporations as defined and determined (Dunnign, 1979, 1980, 1988).

Source: Prepared

rather than independent companies exist, or if they produce agreements between different market participants.

7.2. *Theoretical framework*

7.2.1. *Theory of internalization*

The internalization theory of multinational companies has its origin in the theory of transaction costs. The latter assumes that when markets are perfectly competitive, no need any control mechanism, since the threat of being replaced by another company, eliminates the possibility of developing opportunistic behavior and force companies to act efficiently (Whitelock, 2002). When reducing the number of suppliers, then the company is less likely to replace and, therefore, the transaction costs are increased due to the need of a rigorous bargaining and to assume and take some monitoring costs to ensure that the contract is fulfilled in conditions that had been established (Dwyer and Oh, 1988). The analysis of the transaction costs predicts that the company internationalizes markets, when asset specificity is high.

The theory of internationalization, as indicated, considers that experiential knowledge is the key to explain the process of internationalization of the company. It is particularly important because it allows linking its internal resources with market opportunities (Ericsson et al. 2000, 2001, Luo, 1999). In the field of exports the theory of internationalization is identified with knowledge concerning consumers, competitors, channels, environment, as a key element of the knowledge base of the firm (Morgan et al., 2003) is identified.

From the microeconomic approach, taking as its starting point the company, the called the International Development Stages Paradigm, proposed by various authors from Uppsala School (Johanson and Wiedershein, 1975, Johanson and Vahlne, 1977, 1990; Vahlne and Nordsrrom, 1993) who suggests that the process of internationalization of a company is a gradual engagement thereof with international markets.

As the main hypothesis, the model states that firms start their international operations when their size is still small, but expand following the stages of business growth strategy to the nearest markets (Johanson and Vahlne, 1990). According Canals (1997), it can be distinguished four main types of international companies, which in turn, reflect the same stages of internationalization. These stages are the exporting company, a multinational company, global company and transnational company.

There are many theories concerning the process of internationalizing and its determinants, each focusing on one or several partial aspects. This set of theories can be grouped into seven blocks of doctrinal trends: the classical theory, the theory of product life cycle, the Uppsala model, the paradigm of Porter, the strategic theory, the theory of internationalization and Dunning paradigm.

Table 5: Main theories on internationalization

School	Contribution	Authors
Theory of absolute advantage.	Ability to produce a good using less inputs than another producer (Smith, 1776)	Smith (1776)
Theory of comparative advantage.	Countries tend to specialize in the production and export of those goods manufactured with a relatively lower cost compared to the rest of the world. Where these countries are comparatively more efficient than others tend to export and tend to import goods those who are ineffective, and therefore goods are produced at comparatively higher than the rest of the world costs (Ricardo, 1817)	Ricardo (1817)
The Heckscher-Ohlin theory	If a country has relatively an abundant factor (labor or capital), it will have a comparative and competitive advantage in those goods that require a greater amount of that factor. Heckscher (1919), Ohlin (1933)	Heckscher (1919), Ohlin (1933)
Theory of product life cycle.	Analysis of the interdependence between the stage of product life and internationalization (Vernon, 1966)	Vernon (1966)
Uppsala model.	Study of the internationalization process of firms (Johanson and Vahlne, 1977, 1990)	Johanson y Vahlne (1977, 1990)
Porter paradigm	analysis location advantage in the home country. (Porter, 1990)	Porter (1990)
Strategic theory.	Analysis of strategic interdependence between the stage of product life and internationalization (Bartlett and Ghoshal, 2002)	Bartlett y Ghoshal (2002)
Internationalization theory.	Applying the approach of transaction costs at the mode of internationalization of the company. (Buckley and Casson,1976).	Buckley y Casson (1976)
Paradigm of Dunning	Ranking factors of internationalization in ownership advantages and location internationalization (Dunning, 1981, 1985, 1993, 1998)	Dunning (1981, 1985, 1993, 1998)

Source: Own calculations based on Galán, Galande, Gonzalez (2000).

7.2.2. *Business growth*

It cannot be analyzed the internationalization without studying the growth of businesses. According to Penrose (1959), company's growth is a cumulative process resulting from the interaction between external inducers such as market opportunities and productive services available in the company, derived from its own resources. The impact that foreign competition has in the country, has resulted in growth in Mexican companies while adapting to the needs of international markets. Chandler (1992) and Penrose highlight the existence of internal factors and external factors in the process of business expansion. External forces come from changes in markets, technology and population. A remarkable increase of Mexican companies is a result of regional integration which has been part of Mexico.

Integration can also help in the short term to the transmission of knowledge and technology transfer to domestic producers brings new products and processes generated by trading partners (Grossman and Helpman, 1990). The competition from foreign companies and the transfer of technology and innovative production processes results in an increase in the internationalization of Mexican companies. Having a technological breakthrough opportunities and long-term growth, it would be advantageous for a country to be able to compete successfully in an industry, field or product whose markets offer good prospects for development that rely on key technologies (Arjona, 1995). The internationalization strategy is a growing commitment and involvement of its resources and capabilities to international markets requiring different levels of investment, risk and control.

According to Johanson and Vahlne (1977), internationalization as an evolutionary dynamics nature´s phenomenon implies an increasing commitment of companies to human and financial resources in foreign markets. There are illustrative cases in the recent literature showing the importance that in the development of SMEs has had its participation as suppliers of large global companies with foreign capital. Issues such as geographic proximity or cognitive close relations established between local suppliers and global manufacturing companies (Asheim and Isaksen, 2003). Another view of the impacts of foreign direct investment (FDI) has to do with the role that transnational corporations can exert through direct operation on local businesses via its ownership of the latter (Blomström and Kokko, 1996).

It is for this reason that most Mexican companies with foreign capital comes mainly from trading partners with which Mexico has signed trade agreements. Torres and Jasso (2009) state that business growth is related not only to the use of its initial resources, but with the development of skills and abilities that accumulates during productive operations and daily management, facing a number of adverse forces arising from the conditions of the economic context in which they operate. The authors note that there are factors that cause expansion or contraction of business, such as the decline in demand for products or the opportunity to create new markets, changes in demographics and the development of technological innovations.

There has been in recent years a growth in companies in various sectors. Some large national companies have partnered with transnational counterparts to face international competition in domestic field, but also to expand into foreign markets, as it happens especially in cases of the cement, the brewing, chemical, glass and automotive industries (Vidal, 2000).

8. Research methods

Table 6: Methodological congruence

Variable	Description	Concept	Indicators	Research instruments	Operationalization of variables(ítems)	Data analysis.
X	Trade globalization	Economic, technological, social and cultural scale process,which involves increased communication and interdependence among countries in the world, unifying its markets, societies and cultures, through a series of social, economic transformations and policies that give them a global (concept of the author).	(X1) Multilateralism (X2) Regionalism	Databases	Trade agreements signed by Mexico. Blocks and commercial international trade associations to which Mexico belongs.	Descriptive statistics that provide graphic Analysis of average Medium Media Inferential statistics Correlation of variables
Y	Business Internationalization	Internationalization strategy of Mexican companies. Corporate strategy By growth by international geographic diversification through an evolutionary and dynamic long-term process that gradually affects the different activities of the value chain and the organizational structure of the company with a growing commitment and involvement of its resources and capabilities to the international environment, and based on an augmentative knowledge "Villarreal Larrinaga O. (2006).	Expansion in the global market. Growth rate companies abroad document analysis.	Documental analysis Data base IQOM		It is used APSS system to make graphs Descriptive statistics Research is longitudinal.

Source: Prepared

9. Final thoughts

Through the method of descriptive statistical research is to analyze the increasing internationalization of Mexican companies and the impact of foreign investors and major multinational derivative trade globalization, same as taking advantage of the openness trade policy in Mexico, through multilateralism and regionalism have increased their presence in international markets. Similarly, how globalization impacts the business, strategies for internationalization of Mexican companies when deciding to internationalize to a specific market.

In light of the foregoing, Mexican companies not only face fierce competition in international markets but facing international competitors in the domestic market, with standardized products, with better technology and above all, more economical; consumers initially had local preferences, today, are seduced by the low price.

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□□ □ □ □ □ Bond Yield and Credit Rating: Evidence of Chinese Local Government Financing Vehicles

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Excessive borrowing of local governments in China sparked concerns that the debt may threaten the financial stability of the economy and ultimately cause economic collapse. It becomes critically important to understand the credit rating of China's Local Government Financing Vehicle (LGFV) bonds and the association between the yields, credit ratings, and bond characteristics under this circumstance.

We use a complete pooled data set of 771 LGFV bond issues from 1999 to 2011 and OLS and two-stage-least-squares (2SLS) regressions to examine how credit ratings might affect LGFV bond yields and an ordered probit model to study the determinants of credit ratings. The main findings are: (1) bond characteristic variables, such as duration and guarantee, matter in determining yields though credit rating plays a major role in determining yields of LGFV bond issues; (2) bond issue size and bond type are the main determinants of LGFV bond credit ratings, while the bond issuer characteristics have little explanatory power; (3) at least in Eastern China, smaller credit rating agency tend to give better ratings after controlling for bond issuer and issue characteristics.

Keywords: yield, credit rating, Local Government Financing Vehicle (LGFV), China

JEL Classification: G20, G24, G28

1 Introduction

Much of China's recent growth has been driven by infrastructure projects financed by the central and local governments. China's tax reform in 1994 provided a framework for the "tax-separation" fiscal system. But problems remain in deepening the reforms and in improving financial relations among different levels of government. Besides the existing channels for raising funds, local governments need bond financing for economic development. However, institutional impediments prevent formal operations via this channel. Provision 28 of the Budgetary Law stipulates the following: "All Local government budgets should be planned strictly to assign expenditures by income and match the two. Without permission from the law or the State Council, no local government should issue bonds."

In 2009, to counter the effects of the Global Financial Crisis, China embarked on a massive 4 trillion RMB economic stimulus program. In addition, local governments were told to spend. In order to implement much of the infrastructure investment, local governments get around the restrictions by setting up Local Government Financing Vehicles (LGFVs) and use them as the platforms to borrow from banks or issue bonds. They invested in infrastructure and real estate projects to keep GDP ticking along. The heightened activity of LGFVs along with reduced lending standards helped fuel a massive investment bubble and credit boom in 2009 and 2010. Chinese banks grew their loans by 65% since the beginning of 2009 as credit expansion was the centre piece of China's stimulus package during the global financial crisis. Much of these loans were channeled to LGFVs as well as the property sector.

China's chief auditor warns of mounting debt on the 26th June 2010, "The scale is large, and the burden is quite heavy" when referring to the local government debts. A recent report released by the National Audit Office (NAO) shows that local governments in China had incurred about 10.7 trillion RMB ($1.65 trillion) in debt as of the end of 2010, about half of which was held by LGFVs. Provincial, municipal and county-level governments had 6,576 financing vehicles. Three provinces, 29 municipal cities and 44 counties had more than 10 LGFVs each. Of the total, debt among financing vehicles operated by local governments amounted to 4.97 trillion RMB.

Excessive borrowing of local government, however, sparked concerns that the debt may threaten the financial stability of the economy and ultimately cause economic collapse. By the end of 2010, there were 78 cities and 99 counties whose governments were on the verge of bankruptcy. This means that they had a debt ratio of more than 100 percent, debt exceeded revenue, according to the NAO report. Though the local government debt problem in China raises a lot of concerns, the bonds issued by the LGFV issuers are rated very high, some of them even hold a AAA rating. Many people doubt the credibility of China's domestic rating agencies. Bottelier (2003) finds that most listed corporate bonds in China received AAA ratings from the major domestic rating agencies and argues that the four major domestic rating agencies are not truly independent and their ratings are irrelevant in the market. Kennedy (2003) suggests that these domestic rating agencies have no apparent impact on the decisions of corporate bond buyers in China.

As far as we know, the credit rating of the local government debt has not been touched. The major reason is that the LGFV bonds emerged in the past few years and they differ from general corporate bonds in many ways. First, the board members and senior management are the local government officials rather than businessmen. Second, the main objective of LGFV platform is to support urban infrastructure projects and other public utilities services, not to pursue maximum profit. Last but not least, one of the most important sources of revenue is the financial subsidies or other types of transfer payment provided by the local government. Tu (2010) argues that the LGFV bonds in China could be considered as equivalent to the municipal government bonds, though these two are not exactly the same. Therefore, the LFGV bonds are exposed to not only the credit risk, but also the macroeconomic risk, industry risk, policy risk, and even a unique risk related to the local government fiscal position. It becomes critically important to understand the association between yields, credit ratings, and bond characteristics of China's LFGV bonds under this circumstance.

Due to the lack of data on China's LGFV bonds, no research has been undertaken to directly examine the relationship between bond yields and credit ratings for the LGFV bond issues. We believe our paper is the first to use a complete pooled data set of 771 LFGV bond issues from 1999 to 2011 to study this topic. We use both OLS and 2SLS regressions to examine how credit ratings might affect LGFV bond yields and an ordered probit model to study the determinants of credit ratings. The main findings are: (1) bond characteristic variables, such as duration and guarantee, matter in determining yields though credit rating plays a major role in determining yields of LGFV bond issues; (2) bond issue size and bond type are the main determinants of LGFV bond credit ratings, while the bond issuer characteristics have little explanatory power; (3) at least in Eastern China, smaller credit rating agency tends to give higher ratings after controlling for bond issuer and issue characteristics.

In addition to contributing to the literature on the local government debt and bond markets in China, this paper adds to the yield-rating nexus in the literature. The rest of paper is organized as follows. Section 2 reviews the related literature on credit rating. Section 3 presents the institutional background the local government debt and LGFV bonds. Section 4 describes the sample and variables. Section 5 provides empirical analysis on the association between yields and ratings and the determinants of credit ratings. Section 6 offers concluding remarks.

2 Related Literature on Credit Rating

Credit risk and credit ratings have been one of the most active areas of recent financial research, driven by advances in portfolio risk measurement and management techniques, growth in credit derivatives trading, and the adoption of the Basel II Accord. Within this broader literature, a growing body of research analyzes the credit ratings.

Altman, Avery, Eisenbeis and Sinkey (1981) review the early evolution and application of statistical techniques to bond ratings and other financial analyses. Moon and Stotsky (1993), Cantor and Packer (1997), and Pottier and Sommer (1999) find that rating scales, rating determinants, or weights attached to rating determinants differ across rating agencies after accounting for self-selection bias. Moon and Stotsky (1993) demonstrat that there is a significant difference between Moody's and S&P's in rating determinants. Their results indicate that split ratings reveal differences in both the degree of importance that is assigned to the specific determinants of the ratings and in the way that the bonds are classified. Amato and Furfine (2004)'s analysis is based on a model of ratings determination that takes into account factor that measure the business and financial risk of firms, in addition to indicators of macroeconomic conditions. Cantor (2004) summarizes six streams of the research around credit rating. These six streams include understanding rating transitions, rating determinants and stability, understanding the role of credit ratings as tools for portfolio governance, relating bond prices and spreads to credit ratings, relating changes in market prices to changes in credit ratings, and relating sovereign risk and sovereign ratings. Our paper is closely linked with two out of six streams mentioned in Cantor (2004) – rating determinants and relating bond yields to credit ratings.

In the study of credit ratings, the ordered probit model and panel framework are usually used by empirical analysis. Cheung (1996) estimates the relationship between the provincial credit ratings, as assessed by Standard & Poor's, and a number of economic variables, using the ordered probit methodology. All the variables in her estimation prove to be significant. In particular, she finds that downgrades take place at almost the same speed at different levels of the debt-to-GDP ratio, based on a pooled sample of nine provinces. Based on smaller pools of provinces with similar economic characteristics, she finds that downgrades take place at different speeds at different levels of the debt-to-GDP ratio. Becker and Milbourn (2011) use both OLS and ordered probit models to examine how increased competition affects the credit rates market. They conclude that ordered probit regression allows the effect of dependent variables to vary across different parts of the ratings scale. The ordered probit regression, therefore, uses data more efficiently. They find that the entry of a third major rating agency coincides with lower overall quality, as measured by both the levels and informational content of incumbents' ratings.

There is also a growing interest on the emerging bond markets and topics related to local government debt. Mizen and Tsoukas (2013) investigate the determinants of the firm's decision to issue corporate bonds in emerging Asian economies, using a novel database covering the period 1995 to 2004. Mendoza-Velázquez (2009) investigates the impact of rating changes to State and Municipal governments on bond returns in Mexico.

3 Institutional Background and Development

3.1 Institutional background

Up to the early 1970s, China's government finance planning was highly centralized. All revenues and expenditures of local governments were under the state budget, in accordance with the principles of the centrally planned economy. The sharing of annual revenue and expenditure was settled by bargaining between the central and local governments. There was little room for regional autonomy or for local governments to expand revenue sources.

The fiscal decentralization reforms at the beginning of the 1980s brought changes, such as a contract system for revenues, and division of expenditure responsibility between the central and local governments. However, this system retained many of the characteristics of bargaining. Although they had 5-year fiscal contracts, the central and local governments were always negotiating for their shares, which varied frequently, in aggregate fiscal revenue. If local governments increased their revenue collection, then they might get a higher share. Eventually, local governments received more incentives to develop the local economy under this overall rationing system, but it had serious consequences. The ratio of central government fiscal revenue to total fiscal revenue declined between 1984 and 1993. The contract system also lacked stability. Since the formula for revenue sharing between central and local governments was renegotiated only every 5 years, it induced many negative short-term activities, such as predatory exploitation of resources, duplication of economic structures, and distortion of government-enterprise relations. These acted against the tenets of sustainable development and market-oriented reform.

Chinese government thus introduced the tax-separation system in 1994, establishing a rudimentary framework for power division in fiscal administration. The central and local governments have separate powers to collect certain categories of taxes. The tax reform of 1994 simplified the tax code by specifying revenue assignments to 3 broad categories: taxes exclusive to the central government, shared taxes between central and provincial governments, and taxes exclusive to provincial governments. The scheme fundamentally shifted the focus of the revenue system away from negotiations to a more standardized tax regime. The result has been a dramatic improvement in revenue collection for the central government since 1994.

While the Chinese fiscal system appears centralized on the revenue side, its expenditure assignments are among the most decentralized in the world. Spending on education, health care, pensions, and unemployment insurance are assigned to governments in city, county, and township levels. Local governments are also responsible for investment in infrastructure that supports national economic and social development goals. Therefore, the central government is responsible for about 20% of public expenditures while 80% are assigned to and implemented by provincial, municipal, and local governments (see Table 1). The gap between local revenue and expenditure is expanding. By comparison, average sub-national government spending accounts for only 32% of total expenditure for developed countries and 16% for developing countries (Dabla-Norris, 2005).

In theory, decentralization should help governments customize public services more suitably to local needs. However, in practice, decentralized public service provision often yields substandard public services for the populace in underdeveloped regions. Moreover, this unusual degree of expenditure decentralization combined with a dearth of clearly defined legal responsibilities for each level of government make the Chinese fiscal system rather chaotic. Spending responsibilities tend to be "pushed" downward from higher levels while revenues are "grabbed" by the top. As a result, local governments often suffer from a mismatch between income and expenses. This mismatch has become particularly severe in recent years as local governments' share of total expenditure beyond 80% after the aggressive 4000 billion RMB fiscal stimulus launched in 2008. The local fiscal deficit reached a historical high of 4.14 trillion RMB at the end of 2011. A substantial part of local fiscal deficit was financed in the form of LGFVs.

Table 1. Fiscal Revenue and Expenditure at Local Level (100 million RMB)

	Local Fiscal Revenue	*Annual Change (%)*	*Share in State Total (%)*	*Local Fiscal Expenditure*	*Annual Change (%)*	*Share in State Total (%)*	*Surplus/ (Deficit)*
1993	3391.4	-	78.0%	3330.2	-	71.7%	61.2
1994	2311.6	-31.8%	44.3%	4038.2	21.3%	69.7%	(1726.6)
1995	2985.6	29.2%	47.8%	4828.3	19.6%	7080.0%	(1842.8)
1996	3746.9	25.5%	50.6%	5786.3	19.8%	72.9%	(2039.4)
1997	4424.2	18.1%	51.1%	6701.1	15.8%	72.6%	(2276.8)
1998	4984	12.7%	50.5%	7672.6	14.5%	71.1%	(2688.6)
1999	5594.9	12.3%	48.9%	9035.3	17.8%	68.5%	(3440.5)
2000	6394	14.3%	47.8%	10365.1	14.7%	65.3%	(3971.1)
2001	7793	21.9%	47.6%	13090	26.3%	69.5%	(5297.0)
2002	8515	9.1%	45.0%	15281.5	16.3%	69.3%	(6766.5)
2003	9850	15.7%	45.4%	17229.9	12.8%	69.9%	(7379.9)
2004	11893.4	20.7%	45.1%	20592.8	19.5%	72.3%	(8699.4)
2005	15100.8	27.0%	47.7%	25154.3	22.2%	74.1%	(10053.6)
2006	18303.6	21.2%	47.2%	30431.3	21.0%	75.3%	(12127.8)
2007	23572.6	28.8%	45.9%	38339.3	26.0%	77.0%	(14766.7)
2008	28649.8	21.5%	46.7%	49248.5	28.5%	78.7%	(20598.7)
2009	32602.6	13.8%	47.6%	61044.1	24.0%	80.0%	(28441.6)
2010	40610	24.6%	48.9%	73884	21.0%	82.8%	(33274.0)
2011	51327.3	26.4%	50.6%	92733.7	25.5%	84.9%	(41406.4)

Source：NBS（National Bureau of Statistics of China）

3.2 The development of bond market and LGFV bonds

The bond market in China has undergone a major development in recent years. By the end of 2010, the balance of bonds under custody (not including Central Bank Bills) had reached 16.3 trillion RMB, a seven-fold increase compared to the end of 2000. The rapid development of the bond market has raised the proportion of direct financing in the total amount of financing in society, thereby having the effect of improving the financing structure. The proportion of direct financing in corporates' external financing rose from 7% at the end of 2004 to 25% at the end of 2010, while the proportion of bond financing in direct financing rose from 18% to 66%, presenting a continuous growth trend.

At present, the bond market in China has become mainly an over-the-counter (OTC) market for institutional investors. Such market formation corresponds to the regular pattern for the international development of a bond market. The OTC-driven interbank market constitutes over 95% of the overall bond market. In 2010, China's interbank market (not including Central Bank Bills) issued 4.69 trillion RMB of bonds and held 15.8 trillion RMB in custody; cash bond transactions reached 64.0 trillion RMB and repo transactions reached 87.6 trillion RMB; the number of institutional investors that invested or traded in the interbank bond market increased from 650 in 2000, to close to 10,235 at the end of 2010.

Within China's bond market, the corporate bond market is the submarket that has grown the most and the fastest in recent years. The variety of the market increases all the time and its scale keeps expanding. At present, China's corporate bond market has grown from bond for single project into varied structures that includes enterprise bonds, MTNs, short-term notes, corporate bonds, convertible bonds and asset-backed securities. The scale of the market has increased from 79.7 billion RMB in 1999 to 3.5 trillion RMB at the end of 2010. The promotions of short-term notes and MTNs in particular have fostered the development of China's corporate bond market. Prior to 2005, China's corporate bond market approximately grew a mere 30 billion RMB per year. Following the promotion in 2005 of short-term notes, it rapidly increased to around 200 billion RMB. After the promotion in 2008 of MTNs, the market made another great leap forward in scale, reaching 600 billion RMB in the same year, and over 1353.6 billion RMB by the end of 2010. At present, the short-term notes and the MTNs are mainly self-regulated by the National Association of Financial Market Institutional Investors (NAFMII), which uses a registration system to handle issuance. It has to be said that the marketized development model has been a main factor in promoting the rapid development of the bond market in China.

LGFVs normally issue bonds in the form of Enterprise Bonds (EBs) and MTNs. Table 2 reports the issurance information of LGFV bonds between 1999 and 2011. The first LGFV bond hit the market in 1999. Only 4 EBs were issued in 2002 with a total amount of 6 billion RMB. The number of issues increased dramatically to 210 and the total amount reached 356.5 billion RMB in 2011. The pooled data shows that 40% of LGFV bonds issued by municipal government and almost all LGFV bonds issued by county government entered the market after 2008, while the 4 trillion economic stimulus plan was introduced by the central government.

Table 2. The Issues and Size of LGFV Bonds by year (100 million RMB)

	Issues			*Size*		
Year	Total	MTN	Enterprise Bond	Total	MTN	Enterprise Bond
1999	1	0	1	8	0	8
2002	4	0	4	60	0	60
2003	8	0	8	166	0	166
2004	2	0	2	40	0	40
2005	25	0	25	308	0	308
2006	15	0	15	183	0	183
2007	25	0	25	289	0	289
2008	33	1	32	563	30	533
2009	196	20	176	3270	761	2509
2010	196	30	166	2646	540	2106
2011	266	56	210	3565	800	2765
Total	771	107	664	11098	2131	8967

Source: Wind

Table 3 shows us the amount of the LGFV bonds and the share in the enterprise bonds from 1999 to 2011. Before 2008, the growth of LGFV bonds was relative stable. In November 2008, the central government introduced a 4 trillion economic stimulus plan. Central government invested nearly 1/3, around 1.18 trillion, and the rest came from local matching funds and private sources. LGFVs such as urban construction investment companies became one of the most important financing platforms for local government. The growth has become rather explosive since then.

The number of LGFV bonds issued in the form of enterprise bond was 210 in 2011, twice of the total volume between 2002 and 2008. The share of LGFV bonds in enterprise bonds also rose sharply from 22.5% in 2008 to the history high of 63.2% in 2011. The only LGFV bond issued in 1999 is not included in Table 3 because the issuance of LGFV was stopped from 2000 to 2001.

Table 3. The Amount of LGFV Bonds and Share in the Enterprise Bonds (100 Million RMB)

Year	LGFV bonds		Enterprise Bonds	Share
	Issuing volume	Amount	Amount	
2002	4	60	325	18.5%
2003	8	166	358	46.4%
2004	2	40	322	12.4%
2005	25	308	654	47.1%
2006	15	183	1015	18.0%
2007	25	289	1696	17.0%
2008	32	533	2367	22.5%
2009	176	2509	4247	59.1%
2010	166	2106	3621	58.2%
2011	210	2765	4375	63.2%
Total	663	8959	18980	47.2%

Source: Wind

The distribution of LFGV issues by credit ratings is presented in Table 4. It is obvious that the weight of AAA rated bonds decreased from 100% in 2007 to less than 15% in 2011. The median of ratings has been moving downward. The weights of

AA+ rated bonds, AA rated bonds, and AA- rated bonds were 35%, 47%, and 3%, in 2011, respectively. This downward trend may indicate that the credit quality of LGFV bond issues is deteriorating over time.

Table 4. Distribution by LGFV Issue Credit Ratings

	2007		*2008*		*2009*		*2010*		*2011*	
AAA	25	100%	11	33%	55	28%	26	13%	37	14%
AA+	0	0%	16	64%	94	48%	92	47%	94	35%
AA	0	0%	6	24%	44	22%	76	39%	126	47%
AA-	0	0%	0	0%	2	1%	2	1%	9	3%
A+	0	0%	0	0%	1	1%	0	0%	0	0%
A	0	0%	0	0%	0	0%	0	0%	0	0%
A-	0	0%	0	0%	0	0%	0	0%	0	0%
Total	25	100%	33	100%	196	100%	196	100%	266	100%

Source: Wind

The distribution of LFGV issuers by credit ratings reported in Table 5 shows a slightly different pattern. The average rating of LGFV issuers is worse than that of LGFV issues. The main reason is that many platform companies issue bonds with a guarantee or other forms of support from the local government.

Table 5. Distribution by LGFV Issuer Credit Ratings

	2007		2008		2009		2010		2011	
AAA	9	36%	7	21%	35	18%	13	7%	31	12%
AA+	5	20%	10	40%	35	18%	50	26%	42	16%
AA	7	28%	12	48%	80	41%	97	49%	118	44%
AA-	3	12%	4	16%	38	19%	34	17%	72	27%
A+	0	0%	0	0%	7	4%	2	1%	3	1%
A	1	4%	0	0%	1	1%	0	0%	0	0%
A-	0	0%	0	0%	0	0%	0	0%	0	0%
Total	25	100%	33	100%	196	100%	196	100%	266	100%

Source: Wind

4 Sample and Variables

Data on all LGFV bond issues during 1999-2011 were collected from Wind Database. This database provides detailed information on yields, credit ratings and bond characteristics of 771 LGFV bond issues. To determine the association between bond yields, credit ratings and bond characteristics, we pick up the variables listed in Table 6. Apart from bond yield and credit rating, we also select a number of additional explanatory variables based on a survey of prior research on the determinants of bond ratings and yields (e.g., Sorensen, 1979; Boardman and McEnally, 1981; Kidwell, Marr, and Thompson, 1984; Fung and Rudd, 1986; Lamy and Thompson, 1988; and Ziebart and Reiter, 1992). These studies typically explain bond yields and ratings in terms of issuer characteristics and issue characteristics.

Some prior researches have used a number of financial ratios to capture issuer characteristics or used bond ratings to capture the overall measure of the default risk of a firm. In this study, however, we argue that LGFVs in China differ from other corporate issuers in many ways. First, the board members and senior management are the local government officials rather than businessmen. Second, the main objective of local government financing platform is to support urban infrastructure projects and other public utilities services, not to pursue maximum profit. Last but not least, one of the most important sources of revenue is the financial subsidies or other types of transfer payment provided by the local government. To deal with this issue, we use a unique set of local government fiscal variables as the issuer characteristics to capture the default risk related to the local government.

Table 6 defines the variables used in the empirical analysis. YIELD is the yield to maturity of LGFV bond issues. RATING is an ordinal variable taking on values from 1 to 7 representing A-, A, A+, AA-, AA, AA+, and AAA, respectively. High quality ratings should be informative about bond values, and therefore bond yield (Beck and Milbourn, 2011). RATING is expected to have a positive relation with YIELD.

Table 6. Variable Description

Variables	Description
LGFV yields and ratings	
YIELD	Yield to maturity of LGFV bond issues
RATING	Ordinal variable taking on values from 1 to 7 representing A-, A, A+, AA-, AA, AA+, and AAA, respectively.
Issue characteristics	
LSIZE	Log of the size of issue (in millions of RMB). Economies of scale in underwriting suggest that the LSIZE would be inversely related to bond yields and positively associated with credit ratings.
DR	Bond duration. Bonds with longer duration are expected to have a higher yield and a worse rating because its greater interest risk exposure.
TY	TY is a bond type dummy variable, 1 if the LGFV bond is issued in the form of Enterprise Bond, 0 otherwise. EBs are expected to be associated with higher yields and worse bond ratings.
Issuer characteristics	
LRG	Total local LGFV debt over local GDP. LRG is expected to be associated with higher yields and worse bond ratings.
FDGDP	Fiscal dividend per GDP. FDGDP is expected to be associated with higher yields and worse bond ratings.
GR	Guarantee is a dummy variable. It equals to 1 if the LGFV bond issuer is backed by the local government, 0 otherwise. Guarantee reduces default risk so that this should be negatively associated with yields and positively associated with bond ratings.
Other control variable	
RA	Ordinal variable taking on values from 1 to 6 representing the six largest rating agencies, from the largest to the smallest.
Other dummy variables	
Time dummy	$DYear_i$ =1 if LGFV bonds issued in year i; and 0 otherwise.
Regional dummy	$DArea_2$ =1 if LFGV bonds issued by local governments in North-Eastern China; and 0 otherwise; $DArea_3$ =1 if LFGV bonds issued by local governments in Central China; and 0 otherwise;

	$DArea_4$=1 if LFGV bonds issued by local governments in Western China; and 0 otherwise.

LSIZE is the log of the size of issue (in millions of RMB). Many studies, including Altman (1968), test the size effect on prediction of default. They argue that larger firms are less likely to default and they tend to issue larger amount of debt. We expect LSIZE to be negatively related to bond yields and positively associated with credit ratings. DR is the duration of LGFV bond issue. Bonds with longer duration are expected to have a higher yield and a worse rating because its greater interest risk exposure. TY is a bond type dummy variable. It equals to 1 if the LGFV bond is issued in the form of Enterprise Bond, 0 otherwise.

LRG is computed by dividing the total LGFV debt of a province by this province's GDP. FDGDP is the absolute value of a province's fiscal balance over GDP. These two fiscal variables should be positively related with the dependent variable (Cheung, 1996; Mizen and Tsoukas, 2013). GR is a dummy variable. It equals to 1 if the LGFV bond issue is backed by the local government, 0 otherwise. Guarantee reduces default risk so that this should be negatively associated with yields and positively associated with bond ratings. We also want to test if the credit rating quality is significantly different among rating agencies. RA is an ordinal variable taking on values from 1 to 6 representing the six largest rating agencies, from the largest to the smallest, namely, China Chengxin International Credit Rating Co Ltd., China Lianhe Credit Rating Co Ltd., Dagong Global Credit Rating Co Ltd., Shanghai Brilliance Credit Rating & Investors Service Co Ltd., Pengyuan Credit Rating Co Ltd., and Shanghai Fareast Credit Rating Co Ltd.

In order to preserve the numbers of observations and the relevant degrees of freedom, we also include the time and regional dummies for the comparison purposes. Time dummy $DYear_i$=1 if LGFV bonds issued in year i; and 0 otherwise. Regional dummy $DArea_2$=1 if LFGV bonds issued by local governments in North-Eastern

China; and 0 otherwise; $DArea_3$=1 if LFGV bonds issued by local governments in Central China; and 0 otherwise; $DArea_4$ =1 if LFGV bonds issued by local governments in Western China; and 0 otherwise.[1] Table 7 provides summary statistics for the sample of 771 LGFV bond issues and Table 8 presents the statistics of LGFV bond issues of four sub-regions.

Table 7. Summary Statistics

Panel A: Total					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
YI	771	6.044	1.219	2.62	8.6
LSIZE	771	14.393	9.946	3	100
RATING	771	5.316	1.041	2	7
DR	771	5.038	2.143	0.090	13.896
LRG	771	0.083	0.029	0.049	0.151
FDGDP	771	0.059	0.047	0.015	0.295
RA	771	2.713	1.309	1	6
GR	771	0.523	0.500	0	1
TY	771	0.861	0.346	0	1
Panel B: Time dummies					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
$DYear_{2002}$	771	0.005	0.072	0	1
$DYear_{2003}$	771	0.010	0.101	0	1
$DYear_{2004}$	771	0.003	0.051	0	1
$DYear_{2005}$	771	0.032	0.177	0	1
$DYear_{2006}$	771	0.019	0.138	0	1

[1] The four sub-regions are classified according to the different economic and financial development levels, namely, Eastern, North-Eastern, Central and Western. Eastern region consists of Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan. Northeastern region includes Liaoning, Jilin, Heilongjiang. Central consists of Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan. Western includes Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Shanxi, Gansu, Qinghai, Ningxia, Xinjiang. Our study covers all provinces except Tibet.

$DYear_{2007}$	771	0.032	0.177	0	1
$DYear_{2008}$	771	0.043	0.203	0	1
$DYear_{2009}$	771	0.254	0.436	0	1
$DYear_{2010}$	771	0.254	0.436	0	1
$DYear_{2011}$	771	0.345	0.476	0	1
Panel C: Regional dummies					
Variable	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
$DArea_2$	771	0.0687	0.253	0	1
$DArea_3$	771	0.182	0.386	0	1
$DArea_4$	771	0.184	0.388	0	1

Note: This table provides summary statistics of the test variables for a sample of 771 LGFV bond issues over the period 1999–2011. The variables are defined as follows: YIELD is the yield to maturity of LGFV bond issues; LSIZE is the natural log of size of the issue (in millions of dollars); RATING is an ordinal variable taking on values from 1 to 7 representing A-, A, A+, AA-, AA, AA+, and AAA, respectively; DR is the duration; LRG is the local LGFV debt over local GDP; FDGDP is the absolute value of a province's fiscal balance over GDP; RA is an ordinal variable taking on values from 1 to 6 representing the six largest rating agencies, from the largest to the smallest; GR equals to 1 if the LGFV bond issue is backed by the local government, 0 otherwise; TY equals to 1 if the LGFV bond is issued in the form of Enterprise Bond, 0 otherwise. $DYear_i$ and $DArea_i$ are the time and regional dummies, respectively.

Table 7 shows that the mean yield is about 6%, while the mean rating of LGFV bond issues is somewhere between AA- and AA. LGFV bond issues' duration varies from 0.09 to 13.896 years, with the mean slightly over 5 years. The local LGFV debt over local GDP ratio ranges from 4.9% to 15.1%, while the fiscal dividend over GDP ratio varies from 1.5% to 29.5%. The mean of guarantee dummy is slightly higher than 0.5, showing that nearly half of the bond issuers are backed by the local government. The bond type dummy reports a mean of 0.861, indicating that the most issuers prefer to issue the LGFV bonds in the form of Enterprise Bonds.

Table 8. Summary Statistics of Sub-Regions

Panel A: Eastern China					
Variable	Obs	Mean	Std. ev.	Min	Max
YI	436	5.739	1.243	2.62	8.6
LSIZE	436	15.561	11.547	3	100
RATING	436	5.585	1.118	2	7
DR	436	4.780	2.373	0.090	13.896
LRG	436	0.093	0.033	0.053	0.151
FDGDP	436	0.024	0.010	0.015	0.063
RA	436	2.589	1.309	1	6
GR	436	0.502	0.501	0	1
TY	436	0.810	0.393	0	1
Panel B: North-Eastern China					
Variable	Obs	Mean	Std. ev.	Min	Max
YI	53	7.258	0.983	4.35	8.54
LSIZE	53	13.660	4.341	6	20
RATING	53	4.736	0.711	3	7
DR	53	6.127	1.643	3.288	9.630
LRG	53	0.075	0.014	0.057	0.087
FDGDP	53	0.086	0.030	0.06	0.121
RA	53	2.830	1.326	1	5
GR	53	0.453	0.503	0	1
TY	53	1.000	0.000	1	1
Panel C: Central China					
Variable	Obs	Mean	Std. ev.	Min	Max
YI	140	6.437	1.052	4.15	8.4
LSIZE	140	12.251	5.012	3	25
RATING	140	4.793	0.773	2	7
DR	140	5.467	1.712	2.167	10.143
LRG	140	0.062	0.010	0.049	0.089
FDGDP	140	0.094	0.011	0.078	0.104
RA	140	3.186	1.142	1	5
GR	140	0.529	0.501	0	1
TY	140	0.971	0.167	0	1
Panel D: Western China					
Variable	Obs	Mean	Std. Dev.	Min	Max
YI	142	6.139	0.949	3.8	8.6
LSIZE	142	13.194	9.314	3	100
RATING	142	5.225	0.811	3	7
DR	142	4.998	1.733	0.589	8.819
LRG	142	0.078	0.010	0.065	0.097
FDGDP	142	0.123	0.047	0.081	0.295

RA	142	2.585	1.359	1	5
GR	142	0.606	0.490	0	1
TY	142	0.859	0.349	0	1

Note: This table provides summary statistics for a sample of 771 LGFV bond issues of four sub-regions. The variables are defined as follows: YIELD is the yield to maturity of LGFV bond issues; LSIZE is the natural log of size of the issue (in millions of dollars); RATING is an ordinal variable taking on values from 1 to 7 representing A-, A, A+, AA-, AA, AA+, and AAA, respectively; DR is the duration; LRG is the local LGFV debt over local GDP; FDGDP is the absolute value of a province's fiscal balance over GDP; RA is an ordinal variable taking on values from 1 to 6 representing the six largest rating agencies, from the largest to the smallest; GR equals to 1 if the LGFV bond issue is backed by the local government, 0 otherwise; TY equals to 1 if the LGFV bond is issued in the form of Enterprise Bond, 0 otherwise.

Table 8 shows that the mean yield is about 6%, while the mean yield of LGFV bond issues in the Eastern China is the lowest and mean yield in the Northeastern region is the highest. The 10 provinces in the Eastern region are the most developed areas in China. There is no doubt that this region's LGFV bond issues are associated with larger size and higher rating. This region also dominates the LGFV bond market with a total issues of 274 and total amount of 412.5 billion RMB (see Table 9).

Table 9. The issuance information of four regions

	Total Issues	Total Amount (100 mil)	MTNs	Amount of MTNs (100 mil)	EBs	Amount of EBs (100 mil)
Eastern	436	6784.6	83	1765.9	353	5018.7
North-Eastern	53	724	0	0	53	724
Central	140	1715.1	4	45	136	1670.1
Western	142	1873.6	20	319.6	122	1554
Total	771	11097.3	107	2130.5	664	8966.8

Source: Wind

5. Empirical Analysis

5.1 Does credit rating capture it all?

The relationships between bond yield, credit rating and bond characteristics have been the focus of many researchers (Fisher, 1959; Cohen, 1962; Horrigan, 1966; West, 1970; Kaplan and Urwitz, 1979; and Weinstein, 1981). It is commonly believed that a bond with a worse credit rating carries a higher risk of default and a correspondingly higher risk to the investor. As a result, investors require lower-rated bonds to pay a higher rate of interest to compensate them for the additional risk. Bhojraj and Sengupta (2003) argue that bond yields and ratings are essentially determined by the probability that the firm will not be able to meet its debt obligations and by the degree of protection afforded to the lenders in such an event. Therefore, the financial risk characteristics of the firm and the characteristics of the debt issuance are the factors influencing yields and ratings.

We examine the association between yields, ratings, and bond characteristics of LGFV bonds following Bhojraj and Sengupta (2003). Bond yields are regressed against ratings and control variables capturing the issuer characteristics and the specific features of the LGFV bond issues to examine the explanatory power of these variables.

$$\begin{aligned} YIELD_i &= \beta_0 + \beta_1 RATING_i + \beta_2 LSIZE_i + \beta_3 DR_i + \beta_4 LRG_i + \beta_5 FDGDP_i \\ &+ \beta_6 RA_i + \beta_7 GR_i + \beta_8 TY_I + \sum_{i=1}^{n} \beta^{'} DArea_i + \sum_{i=1}^{n} \beta^{''} DYear_i + \varepsilon_i \end{aligned} \tag{1}$$

In order to mitigate the biases caused by endogeneity of the predictor variables, we run a 2SLS regression by applying instrumental variables consisting of appropriately lagged levels of the variables. The OLS and 2SLS results obtained from the regression of the bond yields on ratings and control variables are presented in Table 10. The reported t-statistics are based White's (1980) heteroscedasticity-corrected covariance matrix. The regression results are based on bond characteristics variables in addition to bond ratings. The objective here is to examine if LGFV bond characteristics variables help to explain bond yields beyond what is captured by the ratings.

Table 10. The association between yield and credit rating

	OLS		2SLS	
	Coef	t-Stat	Coef	t-Stat
Ratings				
RATING	-0.5203***	(-15.4891)	-0.7199***	(-7.4343)
Issue characteristics				
LSIZE	-0.0070*	(-2.4442)	-0.0059	(-1.9882)
DR	0.0828***	(5.5947)	0.0921***	(5.7109)
TY	0.3511***	(3.7887)	0.1561	(1.1200)
Issuer characteristics				
LRG	-3.8267***	(-3.4432)	-1.6898	(-1.0347)
FDGDP	1.5513	(1.4889)	1.6973	(1.5835)
GR	-0.2603***	(-5.2725)	-0.2835***	(-6.2084)
Other control variable				
RA	0.0360	(1.8576)	0.0288	(1.4380)
Other dummy variables				
DArea2	0.7835***	(6.6643)	0.7378***	(5.9541)
DArea3	0.2040*	(2.0212)	0.1917	(1.8403)
DArea4	0.2988*	(2.4676)	0.2797*	(2.2482)
DYear2002	-0.5014	(-0.6726)	-0.6560	(-0.8569)
DYear2003	0.0362	(0.0514)	-0.0955	(-0.1321)
DYear2004	0.8629	(1.0609)	0.6156	(0.7369)
DYear2005	0.1263	(0.1864)	-0.0202	(-0.0290)
DYear2006	-0.9843	(-1.4269)	-1.2218	(-1.7247)
DYear2007	-0.3112	(-0.4554)	-0.7316	(-1.0338)
DYear2008	1.0472	(1.5454)	0.6501	(0.9313)
DYear2009	0.2526	(0.3765)	-0.2161	(-0.3103)
DYear2010	-0.0141	(-0.0209)	-0.4909	(-0.7003)
DYear2011	0.9350	(1.3885)	0.4882	(0.6926)
Constant				
_cons	8.0915***	(11.2206)	9.3336***	(10.0195)
Adj R-squared	0.714		0.689	

Note: This table gives the OLS and 2SLS estimates of equation (1). The dependent variable for YIELD is the yield to maturity of LGFV bond issues. The independent variables are defined as follows: LSIZE is the natural log of size of the issue (in millions of dollars); RATING is an ordinal variable taking on values from 1 to 7 representing A-, A, A+, AA-, AA, AA+, and AAA, respectively; DR is the duration; LRG is the local LGFV debt over local GDP; FDGDP is the absolute value of a province's fiscal balance over GDP; RA is an ordinal variable taking on values from 1 to 6 representing the six largest rating agencies, from the largest to the smallest; GR equals to 1 if the LGFV bond issue is backed by the local government, 0 otherwise; TY equals to 1 if the LGFV bond is issued in the form of Enterprise Bond, 0 otherwise. $DYear_t$ and $DArea_i$ are the time and regional dummies, respectively.

The *t*-ratios are computed using White heteroskedasticity corrected standard errors (White, 1980). The significance levels of 1%, 5% and 10% are noted by ***, ** and *.

We find that credit ratings do indeed play a very major role in determining yields of LGFV bond issues in both OLS and 2SLS regressions. This result is in line with Crabbe and Post (1993), Gande et al. (1997), and John et al. (2003). The coefficients of RATING have negative sign and significant at 1% level, indicating that the better the credit rating, the lower the yields (and the better the prices). An interesting finding, however, is that other variables matter in determining yields, even after controlling for credit rating. Table 10 shows us that out of the three variables representing issue characteristics, the coefficients of DR are positive and significant at 1% level in both OLS and 2SLS regressions, while the coefficients of LSIZE and TY are significant in OLS but insignificant in 2SLS results. It supports our hypothesis that the LGFV bonds with longer duration have a higher yield because they have greater interest risk exposure. GR is the only issuer characteristic variable that has proper sign and significant at 1% level in both regressions. This result shows that the local government guarantee is an important variable in affecting the LGFV bond's yield. The average yield of LGFV bonds with local government guarantee is significantly lower than the yield of those without such kind of support from the local government.

In that occasion, we argue that credit rating alone is not a sufficient statistic for determining the LGFV bond yield. This is an interesting but puzzling result. There is little in the prior theoretical or empirical literature to guide us on this finding. One possible explanation that we present is that there are imperfections in the rating process. These imperfections impart biases in ratings whose magnitudes depend on bond issue characteristics like the duration or issuer characteristics like the guarantee.

An alternative explanation is that the credit ratings offered by Chinese credit rating agencies do not have sufficient information content. Bottelier (2003) finds that most listed corporate bonds in China received AAA ratings from the major domestic rating agencies and argues that the four major domestic rating agencies are not truly independent and their ratings are irrelevant in the market. Kennedy (2003) suggests that these domestic rating agencies have no apparent impact on the decisions of corporate bond buyers in China. However, Poon and Chan (2008) examine the asymmetric certification effect of initial rating announcements and the signaling effect of rating downgrade announcements in China using a pooled time-series cross-sectional issuer rating data from 2002 to 2006. Their empirical evidence supports the hypothesis of an asymmetric certification effect.

To better understand this interesting but puzzling result, we examine the determinants of LGFV bond issue credit ratings using an ordered probit model in the next section.

5.2 The determinants of credit rating

We follow Altman and Rijken (2004) and Amato and Furfine (2004) to establish an ordered probit model[2] to predict LGFV bonds credit rating conditional on financial, debt-related, and local government related characteristics. There are five explanatory variables and three dummy variables in our model. Explanatory variables include size (*LSIZE*), duration (DR), leverage (LRG), fiscal balance to GDP ratio ($FDGDP$), rating agency (RA), guarantee (GR) and bond type (TY). The empirical specification obtained for 771 bonds pooled together is:

$$
\begin{aligned}
RATING_i &= \beta_0 + \beta_1 LSIZE_i + \beta_2 DR_i + \beta_3 LRG_i + \beta_4 FDGDP_i \\
&+ \beta_5 RA_i + \beta_6 GR_i + \beta_7 TY_i + \sum_{i=1}^{n} \beta' DArea_i + \sum_{i=1}^{n} \beta^{*} DYear_i + \varepsilon_i
\end{aligned}
\tag{2}
$$

Where i is an index for the bond issues.

Table 11 reports maximum likelihood estimation results of an ordered probit model using the entire sample that pools four sub-regions together. To allow for heterogeneity across observations, we estimate the ordered probit model with the robust standard errors option. Consistent with our hypothesis, the size of bond issue

[2] The ordered probit model for credit rating is presented in the Appendix.

has a positive impact on the rating determination. The sign of the coefficient of LSIZE is positive and is significant at 1% level. The coefficient of TY is also significant and with negative sign which is consistent with our hypothesis.

Table 11. The result of ordered probit regression on ratings (whole sample with time and regional dummies)

	Dependent variable: RATING	
	Coef	z-Stat
LSIZE	0.0906***	(11.3428)
DR	0.0518	(1.9136)
TY	-1.6557***	(-9.9187)
LRG	16.7739***	(7.9735)
GR	-0.0856	(-0.9977)
FDGDP	-0.3801	(-0.2134)
RA	-0.0360	(-1.0628)
DArea2	-0.5728**	(-2.8744)
DArea3	-0.2412	(-1.4094)
DArea4	-0.1395	(-0.6781)
DYear2002	-4.5856	(-0.0074)
DYear2003	0.6238	(0.0010)
DYear2004	-1.1933	(-0.0016)
DYear2005	-4.1561	(-0.0067)
DYear2006	-4.4992	(-0.0073)
DYear2007	-5.9168	(-0.0096)
DYear2008	-6.1905	(-0.0100)
DYear2009	-6.6289	(-0.0108)
DYear2010	-6.7083	(-0.0109)
DYear2011	-6.9568	(-0.0113)
Cutoff point 1	-8.9818	(-0.0146)
Cutoff point 2	-8.2537	(-0.0134)
Cutoff point 3	-6.6734	(-0.0108)
Cutoff point 4	-5.0054	(-0.0081)
Cutoff point 5	-3.7199	(-0.0060)
No. of obs.	771	
LR chi2(20)	659.05	
Prob>Chi2	0.0000	
Pseudo R-sq	0.3069	
Log Like.	-774.2689	

Note: This table gives the ordered probit estimates of equation (2) for the whole sample with time and regional dummies. The dependent variable for RATING is an ordinal variable taking on values from 1 to 7 representing A-, A, A+, AA-, AA, AA+, and AAA, respectively. The independent variables are defined as follows: LSIZE is the natural log of size of the issue (in millions of dollars); DR is the duration; LRG is the local LGFV debt over local GDP; FDGDP is the absolute value of a province's fiscal balance over GDP; RA is an ordinal variable taking on values from 1 to 6 representing the six largest rating agencies, from the largest to the smallest; GR equals to 1 if the LGFV bond issue is backed by the local government, 0 otherwise; TY equals to 1 if the LGFV bond is issued in the form of Enterprise Bond, 0 otherwise. The significance levels of 1%, 5% and 10% are noted by ***, ** and *.

Table 12 presents the ordered probit regression results for four sub-regions in China. The coefficients of LSIZE are positive and significant for Eastern, Central and Western regions, which support our expectation that larger issues will be rated higher. The coefficients of TY are significant at 1% level in two regions, Eastern and Western China, and 5% in one region, Central China. It shows that the LGFV bonds issued in the form of enterprise bonds are rated lower. The coefficients of DR are negative and significant in only two sub-regions, Eastern and Western China. Two fiscal variables, LRG and FDGDP, do not have favorable impact on the determination of credit ratings. An interest finding is that the coefficient of RA is negatively significant in Eastern China alone. It indicates that smaller credit rating agency tend to give higher ratings after controlling for bond issuer and issue characteristics, at least in Eastern China. This finding supports Lee (2006)'s argument in some extent. Lee (2006) claims that major Chinese credit-rating agencies have put too much emphasis on winning business by giving top ratings to most issuers, whether top ratings were deserved or not.

Table 12. The result of ordered probit regression on ratings (four sub-regions)

	Dependent variable: RATING			
	Eastern China	Northeastern China	Central China	Western China
LSIZE	0.0865***	0.0499	0.0722***	0.1025***
z	(8.8311)	(1.1062)	(3.5032)	(5.4214)
p>|z|	(0.0000)	(0.2686)	(0.0005)	(0.0000)
DR	-0.0763**	-0.1812	0.1191	-0.2207***
z	(-2.5976)	(-1.5030)	(1.9306)	(-3.5702)
p>|z|	(0.0094)	(0.1328)	(0.0535)	(0.0004)

TY	-0.7728***	-	-1.7861**	-1.4407***
z	(-4.3514)	-	(-2.9307)	(-4.2484)
p>lzl	(0.0000)	-	(0.0034)	0.0000
LRG	22.8013***	-137.0766*	-7.6799	12.8319
z	(10.3420)	(-2.2900)	(-0.6430)	(1.2005)
p>lzl	(0.0000)	(0.0220)	(0.5202)	(0.2299)
GR	-0.1389	-0.0003	0.1685	0.2326
z	(-1.2310)	(-0.0008)	(0.8736)	(1.1561)
p>lzl	(0.2183)	(0.9993)	(0.3823)	(0.2476)
FDGDP	-43.7210***	72.1649**	13.583	5.4427*
z	(-6.8292)	(2.5830)	(1.1465)	(2.5362)
p>lzl	(0.0000)	(0.0098)	(0.2516)	(0.0112)
RA	-0.1448**	-0.1928	0.082	0.1033
z	(-3.2363)	(-1.3815)	(0.9328)	(1.3402)
p>lzl	(0.0012)	(0.1671)	(0.3509)	(0.1802)
No. of obs.	436	53	140	142
LR chi2(7)	357.7900	12.84	33.09	77.17
Prob>Chi2	0.0000	0.0456	0.0000	0.0000
Pseudo R-sq	0.2920	0.1247	0.1038	0.2257
Log Like.	-433.8299	-45.0668	-142.8511	-132.3690

Note: This table gives the ordered probit estimates of equation (2) for four sub-regions. The dependent variable for RATING is an ordinal variable taking on values from 1 to 7 representing A-, A, A+, AA-, AA, AA+, and AAA, respectively. The independent variables are defined as follows: LSIZE is the natural log of size of the issue (in millions of dollars); DR is the duration; LRG is the local LGFV debt over local GDP; FDGDP is the absolute value of a province's fiscal balance over GDP; RA is an ordinal variable taking on values from 1 to 6 representing the six largest rating agencies, from the largest to the smallest; GR equals to 1 if the LGFV bond issue is backed by the local government, 0 otherwise; TY equals to 1 if the LGFV bond is issued in the form of Enterprise Bond, 0 otherwise. The significance levels of 1%, 5% and 10% are noted by ***, ** and *.

6 Conclusion

Excessive borrowing of local governments in China sparked concerns that the debt may threaten the financial stability of the economy and ultimately cause economic collapse. It becomes critically important to understand the credit rating of China's LFGV bonds and the association between the credit rating, yield and bond characteristics under this circumstance.

We use a complete pooled data set of 771 LFGV bond issues from 1999 to 2011 and OLS and 2SLS regressions to examine how credit ratings might affect LGFV bond yields and an ordered probit model to study the determinants of credit ratings.

The OLS and 2SLS regression results show that other variables, such as bond issue size, duration, and guarantee, matter in determining yields though credit rating plays a major role in determining yields of LGFV bond issues. This is an interesting but puzzling result. In this occasion, we argue that credit rating is not a sufficient indicator on which the LGFV bond investors can rely. The two possible explanations are rating process imperfections and insufficient informational content of the rating offered by Chinese credit rating agencies.

We then employ an ordered probit model to examine the determinants of LGFV bond issues' credit ratings. The coefficients of bond issue size and bond type are significant and with proper sign. This finding supports our expectation that larger issues are rated higher and the LGFV bonds issued in the form of enterprise bonds are rated lower. Two bond issuer variables, LRG and FDGDP, do not have favorable impact on the determination of credit ratings. An interest finding is that the coefficient of RA is negatively significant in Eastern China alone. It indicates that smaller credit rating agency tend to give higher ratings after controlling for bond issuer and issue characteristics, at least in Eastern China. The implication is that, in a less developed bond market, smaller rating agencies probably give credit ratings with less informational content.

Appendix: The ordered probit model for credit rating

Credit ratings are often viewed as important assessments of firms' underlying credit risk as certified by rating agencies such as Moody's and Standard & Poor's. Without such certification, firms who want to borrow from the public debt and loan markets may not be able to do so, and investors would be reluctant to lend money to the firm (Sufi, 2009). Credit ratings may also contain information on firms' credit quality beyond other publicly available information. For instance, firms may be

reluctant to release information to the market that would compromise their strategic programs, in particular with regard to competitors. Credit ratings in comparison allow them to incorporate inside information without disclosing specific details to the public at large. Credit ratings can be viewed as resulting from a continuous, unobserved creditworthiness index. Each credit rating corresponds to a specific range of the creditworthiness index, with higher ratings corresponding to a higher range of creditworthiness values. Since the credit rating representation of creditworthiness is a qualitative ordinal variable, the estimation of a model for such a dependent variable necessitates the use of a special technique.

Consider the simple case of a qualitative unordered dichotomous dependent variable, i.e., a variable that can take only two values (such as yes or no, on or off). Assume that this variable, represented as a 0-1 binary variable, is modeled as a linear function of a set of explanatory variables and of an error term. The predicted values from the estimation of this model should fall mainly within the 0-1 interval, suggesting that they could be interpreted as probabilities that the dependent variable takes the value 0 (or 1), given the values of the explanatory variables. However, such estimated probabilities can fall outside the 0-1 range. Various distribution functions are available to constrain the estimated probabilities to lie in the range (0,1), the most frequently used being the cumulative standard normal probability function and the logistic function. The probit model makes use of the former, while the logit model makes use of the latter. If the qualitative dependent variable can be classified into more than two categories (i.e., if it is a polychotomous variable), estimation can be undertaken by means of the multinomial probit or the multinomial logit models, which are generalizations of the binary probit and logit models. However, the credit rating representation of creditworthiness is not only a polychotomous qualitative variable; it is also an ordinal variable, i.e., a variable with an inherent order (unlike a polychotomous variable representing, say, choices of colors or travel destinations). An ordinal polychotomous dependent variable would usually be coded as 0, 1, 2, 3, and so on. This representation reflects only a ranking; it is not known to what extent going from 0 to 1 is different from (or equivalent to) going from 2 to 3. For such an ordinal dependent variable, using multinomial probit or logit would not be efficient, because these models would misspecify the data-generating process in assuming that there is no order in the different categories that the dependent variable can take.

The ordered multinomial probit (OMP) is used for estimation in the context of an ordinal polychotomous dependent variable. While taking into account the existence of a ranking, the OMP also assumes that the size of the difference between any two adjacent ratings is not known but does not matter to the carrying out of the analysis, unlike, for example, the usual regression techniques, where the size of the difference between adjacent elements is known and matters to the carrying out of the analysis.

Assume that the unobserved continuous measure, creditworthiness, is a linear function of a set of explanatory variables x, with parameter vector β, and an error term ε:

$$\tilde{y} = \beta' x + \varepsilon \tag{3}$$

As usual, $\tilde{y}$ is unobserved. What is observed are the credit ratings assigned to the bonds, which range from AAA to A-.

$$y = AAA \quad if\, \tilde{y} \le \mu_1 \tag{4}$$

$$y = AA+ \quad if\, \mu_1 < \tilde{y} \le \mu_2$$

$$\ldots\ldots$$

$$y = A+ \quad if\, \mu_5 \le \tilde{y}$$

This is a form of censoring. The μ s are unknown partition boundaries (or cut points) that define the ranges of the creditworthiness index (i.e., AAA, AA+, AA, AA-, A+, A, A-); these parameters must be estimated in conjunction with the vector. Estimation proceeds by maximum likelihood.

It is assumed that ε is normally distributed across observations, and the mean and variance of are normalized to zero and one. With the normal distribution, the following probabilities result (for simplicity, AAA, AA+, AA, AA-, A+, A and A- are denoted as 7, 6, 5, 4, 3, 2 and 1respectively), where is the cumulative function of a normal distribution:

$$prob(y = AAA) = \phi(\mu_1 - \beta' x) \tag{5}$$

$$prob(y = AA+) = \phi(\mu_2 - \beta' x) - \phi(u_1 - \beta' x)$$

$$\cdots\cdots$$

$$prob(y = A+) = 1 - \phi(\mu_5 - \beta' x)$$

A likelihood function can be formed as follows:

$$L(y/x) = \sum_{k=1}^{n} \left\{ Y_{1k} \times \ln \phi(\mu_1 - x_k{}' \beta) + \sum_{i=2}^{5} Y_{ik} \times \ln \left[\phi(\mu_i - x_k{}' \beta) - \phi(\mu_{i-1} - x_k{}' \beta) \right] + Y_{5k} \times \ln \phi(\mu_4 - x_k{}' \beta) \right\} \tag{6}$$

where Y_{ik} is an indicator variable that takes on the value one if the realization of the k th observation Y_k is the i th rating, and zero otherwise. Once the likelihood function is formed, the estimation of the unknown parameter μ's and β's can be undertaken. The estimated cutoff points, μ's, along with the estimated β's, maximize the log-likelihood function stated above.

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Capital Investment in Logistics Technology: Lessons Learned from Song Than ICD Co. Ltd

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Capital investment made by logistics companies in technology aims to enable their customers achieve competitive advantage through cost leadership and value-added services. The paper reviews different perspectives on appraising an investment in a new technology. A case study of Song Than ICD Co., Ltd., a third-party logistics (3PL) company shows that a strategic investment in warehouse management system (WMS) is a right decision in order to achieve investment success. The study findings provide valuable lessons learned in relation to decisions on investment on a state-of-art logistics technology in the context of regional and global integration being undergone by Vietnam's logistics companies.

Keywords: warehouse management system, logistics, technology

Introduction

Logistics market

Full-service logistics functions provided by a third-party logistics (3PL) company should include warehousing, transportation and distribution. Logistics market in the Asia Pacific region has been growing in recent years when companies are outsourcing logistics services but the customers are expecting better, faster and cheaper logistics services. Table 1 shows the relevant economic data on the logistics industry in the world. Especially, the 3PL revenue in the Asia Pacific accounts for the biggest cut of the total global 3PL revenue (31%).

Table 1 - Global 3PL market size estimates (in billions of US dollars)

Region	2011 GDP	Logistics (as % of GDP)	2011 logistics cost	3PL (as % of logistics cost)	2011 3PL revenue	% of total 3PL revenue
North America	$18,004	8.9%	$1,598	10.0%	$160	26.0%
Europe	$17,690	8.9%	$1,567	10.2%	$160	26.0%
Asia Pacific	$19,208	12.8%	$2,458	7.8%	$191	31.0%
South America	$4,178	12.3%	$ 514	7.7%	$40	6.4%
Remaining	$11,081	11.3%	$1,762	3.7%	$65	10.6%
Total	$ 70,161	11.3%	$ 7,899	7.8%	$616	100.0%

Source: (Armstrong&Associates 2013)

Nevertheless, the logistics industry is facing a number of complaints from customers. Table 2 summarized the findings on what logistics customers want and it is found that information technology (IT) capabilities received the second worst evaluation score on continuing problem (35%). Noticeably, the IT capabilities in the Asia Pacific region is the lowest in comparison with other regions.

Problems facing Vietnam's logistics industry

The logistics industry in Vietnam is still on the nascent stage. Logistics costs in Vietnam are estimated to be between 15 and 20 percent (Frost and Sullivan Report). The demand for logistics services provided by third-party logistics (3PL) companies is on the rise but Vietnam's logistics companies are reported to be struggling to be third-party logistics (3PL) companies as they lack capabilities to provide full-range logistics services to customers. Vietnam's logistics industry is very highly fragmented. A large number of domestic companies provide only discrete distribution services, mainly as shipping, trucking and customs clearance. Very few domestic companies are truly 3PL company. Foreign logistics companies, with their capability to provide integrated full-service logistics have been dominating logistics market in Vietnam.

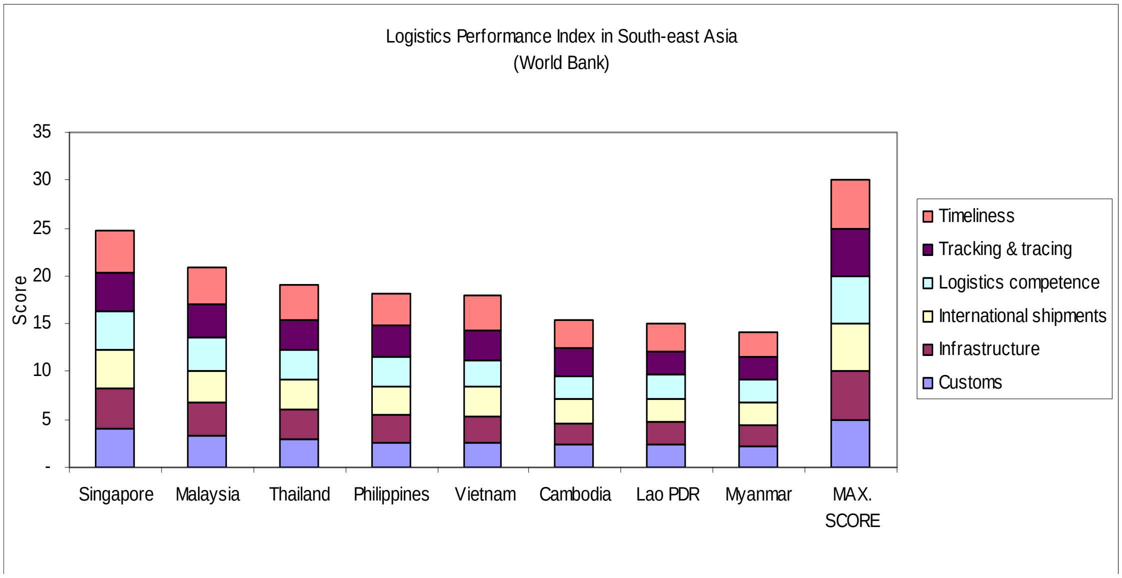
Table 2 - Continuing problems with 3PL providers as reported by customers

	All regions	**North America**	**Europe**	**Asia Pacific**	**Latin America**
Service level commitment not realized	46%	43%	46%	46%	50%
Lack of continuous, ongoing improvements and achievements in offerings	40	37	41	41	43
Cost reductions have not been realized	35	37	37	34	32
Information technology capabilities not sufficient	35	38	31	38	33
Lack of project management skills	33	31	35	36	31
Unsatisfactory transition during implementation stage	30	34	28	33	21
Ineffective key performance indicators (KPIs)	30	28	27	31	39
Too many human conditions related problems	29	30	24	32	34
Lack of consultative/knowledge-based skills	26	22	23	34	27
Lack of business process integration across regions and supply chain services	20	21	16	28	12
Lack of global capabilities	19	16	19	20	21
Inability to form meaningful and trusting relationships	13	15	13	13	12
Poor post-merger integration of acquired companies	13	12	13	21	3
No problems	13	17	16	6	15

Source: (Langley 2007)

Table 3 shows that Vietanm is placed number five out of eight Asean countries in logistics performance index (LPI) scores. Among the evaluation criteria, timeliness, tracking and tracing problems can be handled by improving information quality. Investments in information communication technology (ICT) specialized in logistics operations can help improve the LPI indicator results. There are a number of trends that put downward pressure on investment in ICT for domestic logistics companies. First, regional and global integration, especially with 2015 Asean Economic Community (AEC) realization and looming Trans-pacific Partnership (TPP), more strong global 3PL companies enter Vietnam's logistics market, making competition more intense in this field. Also, companies tend to operate globally, demanding a higher level of logistics management, which can be met by a higher level of ICT. Second, rapid technology change creates opportunities for logistics to apply advanced ICT to improve their customer service. Third, e-logistics services are on the trend. E-logistics is defined to be "the mechanism of automating logistics processes and providing an integrated, end-to-end fulfillment and supply chain management services to the players of logistics processes. Those logistics processes that are automated by e-logistics provide supply chain visibility and can be part of existing e-Commerce or Workflow systems in an enterprise"

Table 3 – Logistics Performance Index in Southeast Asia



(Watson Research Center, 2007). If a domestic company is behind in adopting e-logistics, it will left behind in competition for logistics markets.

Warehouse Management System

One of the software and solutions for running 3PL services is Warehouse Management System (WMS). The WMS acts as the hub of a company's supply chain solution, integrating accounting/order and shipping software systems, electronic data interchange (EDI) systems, radio frequency and barcode hardware, and warehouse automation equipment. This inventory-control system would link customers, distributors, drivers, warehouses and retailers. The system would help reduce the time of ordering and order fulfilling, better control inventory, reduce inventory shrinkage and pilferage and faster recognize changes in demand at the customer level. The costs may range from 10 to 16 million US$ to include about 15 million USD for the system. For example, WMS investment in WMS by DHL Vietnam cost about 15 million US$. Vinafco, a domestic logistics company spent 16 million US$ for this system in 2013. Normally, some time after installation of the system, another phase of investment with several additional million US$ is needed for ancillary equipment.

The benefits of WMS

WMS is a must for effective and efficient operation of a distribution center. It covers all functions involved in physically distributing and handling goods at a distribution center (DC). These functions include inventory management operations (maintaining items, groups, orders) and order flow (retrieving orders, storing orders, tracking and tracing). Together, distribution and warehouse management system (WMS) aim to improve customer service. The benefits to customers are real-time enterprising in material management, improved operations in terms of accuracy, reduced paperwork, integration to automated warehouses. WMS providers claim its benefits as inventory control, stocking, cross-docking, quality control, returns management, task management, yard management, locating and picking (Fig. 1).

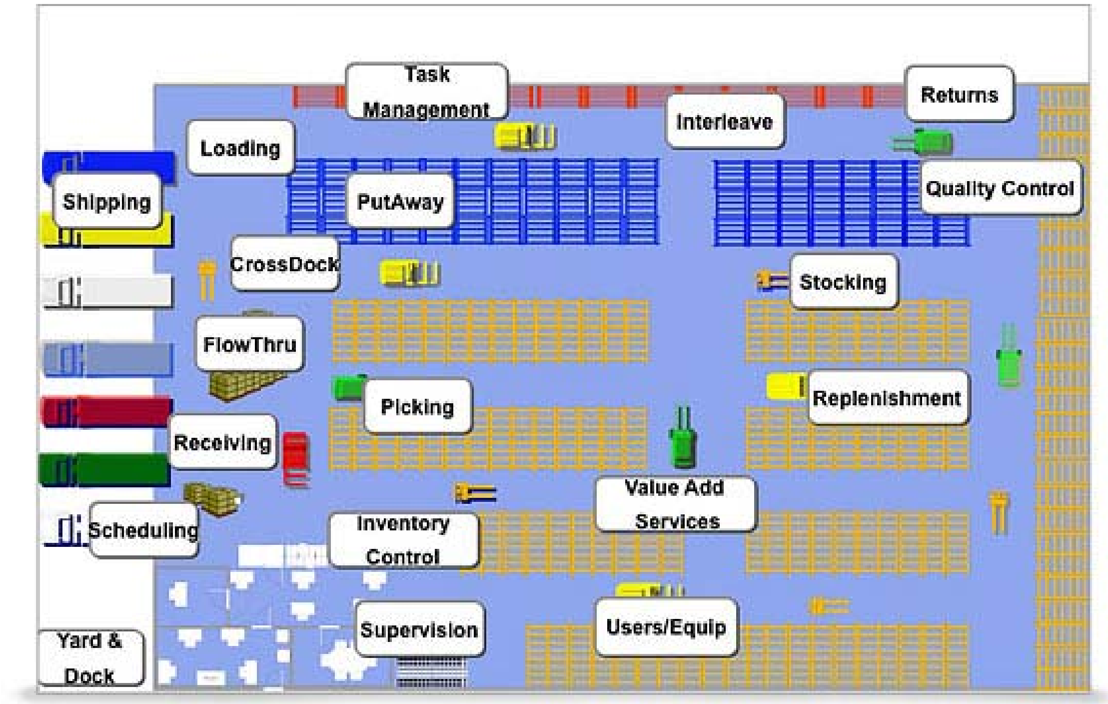


Figure 1 – Claimed benefits of warehouse management system (source: Oracle Corporation)

Some key providers of WMS are Marc Global Services, PeopleSoft, SSA Global, Microsoft Business Solution, Oracle Corporation, JD Edwards, Pulse Logistics System.

A company with advanced technology would be a first mover, occupying markets ahead of competitors hence increase revenues. A typical example is UPS or FedEx, who entered Vietnam's market in 2000s and occupied a large portion of Vietnam's logistics markets because their service quality is much more compelling than that of domestic ones. For example, they deliver packages fast and very accurately, thanks to their modern information technology application. Warehouse management system helps customer businesses boost productivity, reduce inventory-carrying costs, shorten order fulfillment times, and deliver a rapid return on investment (ROI).

Study Objective

The purpose of this study is to investigate why Song Than ICD Co. Ltd., a state-owned logistics company invested in warehouse management system and examine its performance outcomes as a results of the system installation. The proposition is that a company with investments in an advanced information system can be justified by its business strategy, operational, tangible, intangible benefits. The study results would identify critical lessons learned from the company in making decisions on technology investments.

Methodology

Qualitative approach is applied for this study. The purpose is to determine critical success factors to the phenomena of an investment in an advanced warehouse management system to serve the business model of distribution center. The study process began from personal contact with executives of Song Than ICD Co. Ltd., firstly via email and then an in-depth interview. Semi-structured interview has been conducted in July 2014. For the quality and validity of interviewed, the interviewee was business and planning manager of Song Than ICD, Co. Ltd. The advantages of the important people in the organization is that the researcher can gather valuable and correct information such as company policies, history and plans. In addition, the researcher collected relevant information from different sources such as company records, websites and related reports.

Relevant Literature

Justifications for logistics technology

A great deal of literature wrote about the relationship between information technology and business performance. (Porter 1998) postulated that information technology is one of the sources for sustained competitive advantage and profit. However, in order for the IT to contribute to business performance, some conditions are that the resources, including IT resources should be are firm specific, valuable, rare, imperfectly imitable, and not strategically substitutable by other resources (Barney 1991) There have been many efforts to link financial ratio with IT capability. Some noticeable revelations are that the average profit ratios of firms that have superior IT capability are higher than the average profit ratios of all other firms in the industry (Santhanam and Hartono 2003) and the financial performance of IT leader firms is significantly better than those of the matched firms on several measures of financial performance Bharadwaj (Bharadwaj 2000).

A classical approach used to appraise a capital investment is from the neoclassical theory (Jorgenson 1963) and the Q theory (Tobin, 1969) as follows.(Tobin 1969), as follows.

$$\Delta_j = \int_{t=0}^{\infty} e^{-rt} E\left\{\left[\mathrm{MR}_t\left(\frac{1}{\varepsilon_t}+1\right)\right] - g_I - q\right\} \mathrm{d}t,$$

in which $g(I_t) = dG(I_t)/dK_t$ *and* $G(I_t)$ is the adjustment cost of investment as defined by Tobin (1969). The equation above poses that the factors influential to the investment decisions are: marginal adjustment cost $g(I_t)$, which is internal to the firm; (ii) marginal revenue MR)and demand elasticity *(є)*, which represent the characteristics as well as changes in demand in response to the firm’s adoption of technology; (iii) the cost of investment, including funds ® and equipment (*q*); and (iv) firm’s business expectation indicated by the operator E[…]. According to the neoclassical investment theory, investment objective is to maximize its net worth or profit and the investment decision is determined by the costs of equipment and labor.

Nevertheless, business performance should not only be measured by financial returns but also other performance outcomes. Kaplan and Norton (1992) added financial model with customer service, internal business measures and learning measures through the balanced scorecard framework for an IT-company (Kaplan and Norton 2005). A general framework of factors justifying an investment in a IT project covers strategy fit, tactic and operational considerations, tangibles and intangibles (Gunasekaran, D. et al. 2001). Tangibles can be measured by return on investment (ROI), lead time, inventory cost reduction while intangible benefits include better competitiveness, improved customer service and even risk of not investing in a technology (ibid). In his survey, Kirkpatrick found that only 30% of the Chief Information Officers said that monetary metrics are sufficient to justify substantial benefits from an IT investment, implying that intangibles are very important (Kirkpatrick). In terms of strategic fit, technology investment should be aligned with the company's long-term growth strategy. Although a ROI is not ascertained for an investment, a strategy reason can dominate an investment decision. At the tactical and operational level, integration with existing system, satisfied evaluation indicators are among the items required for consideration prior to an investment (ibid). Besides, mandates from big customers force a logistics service provider to install an management information system if the provider wants to maintain service contracts with them. For example, large retailers such as Wal-Mart and Target issued mandates to logistics service providers to install advanced information systems for better inventory control, meaning that the providers have no choice but invest in the systems (Vijayaraman and Osyk 2006). Firm characteristics such as firm size, diversification, sector, structure also affect IT investment (Yap 1990).

Technology Transfer in Vietnam

Most of technology investments in Vietnam have been implemented through technology transfer contracts between a foreign company as a transferring partner and a Vietnamese company as a recipient. However, due to the reasons given as above, the number of such contracts is not numerous. Vietnamese companies not only lack capital for investment, information for seeking and acquisition, but also are limited in appraising an investment in technology. Some large corporations have spent a lot of money buying equipment which are underutilized or wasted. The most recent study on 8,010 Vietnamese firms in many industries was conducted to assess their technology and competitiveness (2014). The results found that only about 8% had some form of R&D expenditure. More than a half of this expenditure was used to develop technology new to the market the firm operates in. The firms preferred adaptation of existing technologies for use within the firm. This finding is consistent with the results of a previous study that "investments in existing technologies providing a better return for firms compared to the costly innovative R&D" (Basant and Fikkert 1996). The critical reasons for technology adaption included that the firms wanted to improve quality for improved competitiveness, increased productivity, enriched product variety, capacity expansion, outdated technology replacement (Newman, Rand et al. 2014). This reflects the fact that Vietnamese firms are conscious of importance of technology investments in operations and competitiveness. The biggest obstacle for the surveyed firms to adapt a technology is the lack of access to financial capital or credit, similarly to other emerging economies (Basant & Fikkert, 1996).

Findings

Vietnam logistics industry overview

Among about 1,200 logistics companies operating in Vietnam market, about 18% are state-owned, 70% privately owned and 10% non-registered and about 2% foreign logistics companies (Sullivan 2007). Multinational and joint venture companies (foreign-invested) target global customers in Vietnam by offering logistic packages (such as 3PL package – Third Party Logistics). State owned companies/corporations dominate local market on freight transportation and delivery. Joint Stock and private companies targets customers who are in private sector in Vietnam and are competing with players in the first group to offer 3PL package to multinational customers in Vietnam. The demand for warehousing, transportation and freight forwarding services has steadily increased for recent years due to the high volumes of materials and finished goods. Table 3 shows the increase trend of container volumes.

In addition, revenues from logistics services in Vietnam's market is steadily increasing, at a rate of around 25% per year (Vietnam's General Statistics Office).

The Case of Song Than ICD Co. Ltd

Company Profile

Vision: "to be one of the five (5) top professional logistics service providers among Vietnam's domestic logistics companies (excluding foreign logistics companies) in 5 years; to be one of the top ten logistics services providers in Vietnam market" (Source: Company Document).

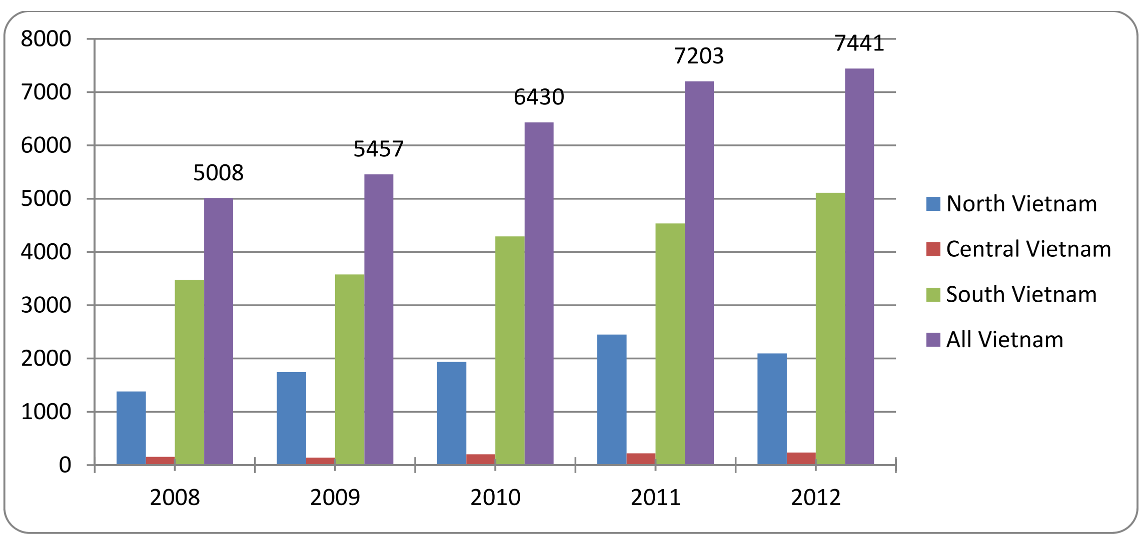


Figure 2 – Vietnam Container Throughput in million TEUs (Source: Vietnam Seaports Association)

History of the company

The company is based in Binh Duong Province. Established December 2000, the company was subsidiary to Tan Cang New Port Corporation, headquartered in Ho Chi Minh City. Originally, the company provided a limited number of logistics services such as warehouse lease, transportation, customs brokerage, container loading and unloading. With these basic services, at that time Song Than ICD was regarded as two-party logistic company. Later, the company had taken dramatic transformation steps. It expanded logistics services as a true three-party logistics (3PL) provider, running a distribution center for a multinational corporation Kimberly Clark. It had capability to integrate many logistics and supply chain processes such as production, distribution and retailing. Now its business activities include container yard and warehousing service, terminal service, customs clearance, bonded warehouses, cold warehouses, container handling, storage and haulage, commodity classification and packing, container sanitation and repairing, domestic commodity distribution, shipping agent. Its logistics capabilities include container yard of 95,000 m^2, warehouse of 164,500 m^2 (domestic warehouse: 123.458 m^2, CFS warehouse: 17.614m^2, bonded warehouse: 23.428m^2), 4 depots (Depot 1: 49.500m^2, Depot 2: 23.500 m^2, Depot 3: 10.000 m^2, Depot 4: 12.000m^2). The company invested in hardware and software for logistics activities. The purchased advanced equipment includes rail mounted gantry crane (3), reach-stacker (02), empty reach-stacker (01), forklift (06), prime mover (12). The software includes Warehouse Management System.

Business Performance

The annual revenue growth has been 15% on average over the last 14 years. In 2012, its total revenue was VND 186,685 billion (or 8.6 million $US), equivalent to 109.27% of the planned one; total profit was VND 32,250 billion (or 1.5 million $US), equivalent to 104.85% of those planned. With its business achievements, in Mar 6, 2015 Song Than ICD Co. Ltd, a subsidiary company to Saigon New Port Corporation, was honored with the "2nd-rank Labor Medal" presented by the President of Vietnam. In 2015, the company has total assets of 280 billion VNDs or about 13 million $US.

Strategy Change and Technology

The remarkable strategy change made by the company was that the company decided to shift from a single-function business model of freight forwarding to a multi-function model of distribution center, including all logistics services such as warehousing, distribution and shipment. Song Than ICD Co. constructed its vision to be a top domestic 3PL. This shift came from its investigation and analysis of opportunities from external environmental factors as well as internal strengths. To run a distribution center effectively, an advanced warehouse management system (WMS) was purchased. With its advantages from strong logistics infrastructure such as ports, warehouses, advanced management software, it is the first domestic logistics company that won an international 3PL service contract with a big US multinational corporation, Kimberly Clark.

"Originally, its function was to exploit (the use) of the port (Tan Cang Port). In recent years, (we) recognized intense competition trend. The potential for logistics is very big but logistics logistics companies are occupying the market. Therefore, Tan Cang Corporation identified the second pillar, in addition to the pillar of port exploitation, is logistics services. The company was established in 2000 from an enterprise under Tan Cang Corporation. Since 2007 the company has been financially independent. Its functions include warehousing, container transportation, customs brokerage service. In 2009, Song Than ICD won a logistics service contract for Kimberly Clark, a U.S. corporation. In this bid, Song Than ICD was the only domestic participating company, together with other seven foreign logistics companies. The contract services include provision f service solutions for a distribution center for Kimberly Clark. These services are really third-party logistics ones. This opened a new direction, i.e. third-party logistics services." (Tran Tri Dung, Business and Planning Manager, Song Than ICD).

Lessons learned

What drove Song Than ICD adopt the model of distribution center and the acquisition of warehouse management system (WMS) to run the center should be examined for lessons that would be learned from Vietnamese logistics enterprises prior to following it.

Technology investment as an organizational strategy, not departmental interests

Their top-level managers studied opportunities from external environment and strengths from inside to prepare this strategy. Externally, facilitating environmental factors include its easy access to logistics infrastructure (ports, etc), growing demand for 3PL services. Internally, centralized organizational structure, as a military-originated organization, created a unity of command culture, top-down approach to implement any strategic decision. Once senior management issues a strategic decision, all lower-level personnel must abide by it. This organizational structure is ideal in managing expensive investments. The decision on buying a management information system should be due to necessity for competition and long-term plan, not short-term benefits based on a specific discipline. If the appraisal of technology investment is made by lower-level managers, different perspectives can cause lack of consensus. Financial department manager will prefer profit ratios, e.g. payback period, return-on-investment (ROI), internal rate of return (IRR). The financial people may be concerned that new huge investment in technology may dilute return on investment if the current ROI has been high from current operations. Chief information officer (CIO) or the head of IT Solutions Company, another sister company of Saigon Newport Corporation, may belittle profit considerations. Rather he will highly appreciate non-profit criteria such as system integration, data migration. Managers in charge of customer relationship may consider intangible benefits such as improve customer relationship, risk of not investing in technology. Senior manager at Song Than ICD used top-down approach to make strategic decision in this case.

Intangible vs. tangible benefits

Investors should not focus too much on tangible benefits such as profit indictors. Intangibles such as improved staff skills, customer service, process effectiveness should be considered for investment decision. These suggested measures are consistent with the balanced scorecard of a company (Kaplan and Norton, 2005). Managers at Song Than ICD recognized that the new WMS improved computer skills for its staff.

> *"In terms of project efficiency, initially there was difficulty due to personnel quality. But after one year, staff's capability improved. They changed their working attitude and styles. Previously, warehouse staff used to be responsible for opening and closing the gate for warehouses only, but now they should know to process orders accurately". (Tran Tri Dung, Business and Planning Manager, Song Than ICD).*

Strong support from top management for investment implementation

The investment success depends on management support, commitment, policies, organizational culture for innovation, strategic points. Two organizational elements that inspire technology adoption at Song Than ICD are obviously seen to be strong commitment from management and strategic goal to be top 3PL company.

> *"We as military side are disciplinary. When a plan is started, there is project management board, steering board and experts' team. When the project is right, it must be implemented. Nobody may obstruct it. It is our advantage to be well-organized and highly disciplined" (Tran Tri Dung, Business and Planning Manager, Song Than ICD).*

Besides, a sister company Tan Cang IT Solutions Co., assisted in appraising the investment proposal and monitoring the investment process. With its expertise and experience in evaluation IT projects, Song Than ICD feels less concerned on technological issues but focus more on its logistics operations.

Future Studies

As follow-up to these findings, future studies should include quantitative research that covers a robust sample of logistics companies in Vietnam. Hypotheses should be tested on the impact of the factors such as strategy, tangible and intangibles on the decisions on technology investments and how the business performance is predicted by technology investments. Furthermore, the issues on risks should be explored. The investment as above was based on the assumption that 3PL logistics customers, such as Kimberly Clark, are increasing its outputs in line with economic growth in Vietnam hence maintain supply relations in a long term, e.g. more than 5 years. Nevertheless, there are some risks. The fact is now that the contract between the company with Kimberly Clark is 5 years. The possible risk to the success of this investment is that changes in the customer's business performance can influence the continued service contract with the company. These changes may be classified in three scenarios: 1) after some years of using the company services, the customer may begin to use services from other 3PL services providers; 2) the business performance of the customer in Vietnam is not going well. For example, Kimberly Clark will lose some market because of more and more competitors to Kimberly Clark in producing the same products in Vietnam's market and worse, its competitors save a lot of logistics costs. This may require Kimberly Clark to reevaluate its contract with Song Than ICD logistics. Another proposed research topic is to investigate which factors make a company self-develop an inhouse management system rather than purchase expensive management software developed by big IT solutions corporations. A comparative study of buying and making cases would draw useful conclusions for companies to make a suitable choice.

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Corporation Diversification and Firm Performance: Evidence from Vietnamese Listed Firms

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We examine the effect of corporate diversification on firm performance, for firms listed on Vietnamese stock exchanges, using 2744 firm year observations over the period from 2007 to 2012. We find that corporate diversification has negative impact on firm performance. Our results are robust to various econometric estimation techniques including fixed effect, instrumental fixed effect, Heckman Selection model and System Generalized Method of Moments. In the Vietnamese context, lack of efficient corporate governance system may encourage firms to take corporate diversification strategy, which impairs firm performance.

Keywords: Corporate Diversification, Firm performance, Heckman selection model, System GMM

1. Introduction

In the past, Vietnam was a centrally planned economy; however in 1986 there was an important economic reform (named as Doi Moi) wherein a market economy was adopted. Following the economic reforms, the privatization process of state owned enterprises, also called "equitization" in Vietnam, was proposed in 1991 and was launched in 1992. The Vietnamese government encouraged firms to diversify[1] their businesses in late of 1990s[2]. Thus many firms began operating in multi segments, particularly state-owned enterprises. These firms then were privatized and listed on stock market.

There are many studies on relationship between corporate diversification and firm performance in developed markets and developing markets[3]. The research on impact of corporate diversification on firm performance is still unexplored in Vietnamese context. This paper fills in the gap in existing literature by investigating the impact of corporate diversification on firm performance for Vietnamese listed firms over the period from 2002 to 2012. We employ fixed effect, Heckman selection and system generalized method of moments econometric estimation to investigate the relationship between corporate diversification and firm performance. We find that in Vietnamese context, corporate diversification has negative impact on firm performance.

This paper is structured as below: Section 2 discusses various theories, benefits and costs related to corporate diversification. Section 4 discusses literature review and develops hypotheses. Section 5 discusses methodology. Section 6 discusses data and variables. Section 7 illustrates classification of diversified firms. Section 8 discusses summary statistics and correlation matrix. Section 9 discussed empirical results and finally, section 10 concludes.

2. Corporate diversification: Theoretical perspective, Benefits and Costs

When a firm expands, it tends to diversify its operations because of the existence of surplus resources in current businesses. Corporate diversification is often considered as a strategy for

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[1] Corporate diversification is an expansion strategy adopted by many enterprises around the globe (Lin and Su, 2008).

[2] The Law On Domestic Investment Promotion signed by Chairman of National Assembly on 20/05/1998 (http://www.moj.gov.vn/vbpq/en/Lists/Vn%20bn%20php%20lut/View_Detail.aspx?ItemID=1543)

[3] Lang and Stulz (1994), Berger and Ofek (1995), Claessens et al. (1999), Chen and Ho (2000), Khanna and Palepu (2000), Schoar (2002), Lu and Beamish (2004), Villalonga (2004a), Mishra and Akbar (2007), Boubaker et al. (2008), Li and Rwegasira (2008), Bae et al. (2011), La Rocca and Staglianò (2012), George and Kabir (2012), Lien and Li (2013), Choe et al. (2014)

firms in order to expand their operations and reach the goal of profit maximization. Further, corporate diversification refers to an expansion of a firm into "related and unrelated" investments (Kim et al., 2009)[4]. It is suggested that firms tend to diversify because of changes in economic or industry conditions (Campa and Kedia, 2002). There are three main theories (agency theory, resource-based view and internal capital market) that examine corporate diversification. These theories are discussed in the following subsections.

2.1 Agency theory

Agency theory is developed by Jensen and Meckling (1976). The theory reflects the relations, goals and conflicts arising in corporations between agents (the managers) and owners (the entrepreneurs). Aggarwal and Samwick (2003) state that there are two main agency arguments which can be used to explain why managers tend to diversify their firms' businesses. The first agency explanation is risk reduction. Senior managers in corporations typically have their own equity in their own firms. Therefore, they tend to face idiosyncratic risk when firms do not diversify. As a result, managers have more incentive to diversify their firms' business. They argue further that the higher equity ownership the managers have; the higher idiosyncratic risk they face and therefore they try to diversify their firms in order to lower that risk. The second explanation of diversification activities is private benefits of managers. Although new investments may not be valuable, managers may obtain a better reputation when they manage a more diversified firm. Thus, managers become more valuable to firms and they can demand more compensation.

A recent explanation that arises to justify the diversification propensity is the nature of corporate governance system of firms. Corporate governance can refer to the ways that the board of directors and managers control a company, and make decisions, especially decisions that have an important effect on shareholders. It is revealed that firms with weak corporate governance may motivate managers to diversify the firms because they can exploit the inadequate corporate governance in order to obtain benefit from corporate diversification. Jiraporn et al. (2006) states

[4] Related diversification refers to the diversification strategy employed to set up new products or new businesses that are related to current business of firms. Unrelated diversification is a diversification activity that introduces new products or new areas that are not related to firms' existing business.

that managers can take advantage of the weak shareholder rights, associated with restrictive corporate governance mechanisms, and diversify the firm unwisely.

2.2 Resource-based view theory

The resource-based view is discussed by Wernerfelt (1984). He argues that firms can become bigger with a strategy of conducting a balance between exploiting existing resources of the firms and also developing the new ones. Furthermore, Chatterjee and Wernerfelt (1991) explain that most resources of firms are not simply used for one product, and therefore it is an incentive for firms to diversify.

From the resource-based perspective, it is observed that diversification would occur in firms if the firms' resources and capabilities are in surplus and these resources can be transferred across industries (Mishra and Akbar, 2007). Thus, if firms can exploit their unused resources, they are willing to expand. Based on the idea of resource-based view, Matsusaka (2001) suggests a theoretical model of diversification strategy of firms. He contends that diversified firms tend to have lower performance compared to undiversified firms because these firms do not appropriately match their organizational capabilities to the new businesses. However, if the firms that have organizational capabilities[5] find businesses matching their capabilities, they would diversify their businesses. Hence, this is the reason that firms try to find new products or enter new industry.

2.3 Internal capital market theory

This theory suggests that if a firm has the ability to allocate capital generating from its business unit to another business unit, the firm can operate efficiently. This action can be explained by informational advantages of the firm in raising capital compared with the external capital market. It means that the firm can avoid the cost of capital financing from outside. Indeed, Matsusaka and Nanda (2002) argue that cost of external financing is greater than the cost of internal funds. They also state that internal capital allocation may provide the firm the benefit of selecting internal capital instead of raising funds from external capital market. This feature cannot be found in a stand-alone firm. Moreover, in an environment of agency problems and asymmetric information, the internal capital market is beneficial because it eliminates costs of capital from the external market. Lins and Servaes (2002) study corporate diversification in emerging

[5] Senior managers' capabilities are also considered as organizational capabilities.

markets. They contend that internal capital market can be an attractive motivation for corporate diversification because of imperfections in external capital market in emerging economies.

2.4 Benefits and costs of corporate diversification

Berger and Ofek (1995) propose that corporate diversification has "value-enhancing and value-reducing effects". They state that corporate diversification helps firms operate different businesses with larger debt capacity and lower taxes i.e. increasing tax shields, and tax savings by offsetting losses in several divisions against profit in other divisions. Firms in emerging markets may gain benefits from corporate diversification due to high reputation, easy access to foreign capital and advanced technology (Khanna and Palepu, 2000). Diversification of product and geography may encourage firms take advantages of multiple markets (David et al., 2010).

Diversified firms can easily transfer capital from one segment to another segment while stand-alone firms have difficulty in doing so (Matsusaka and Nanda, 2002). They also propose the coinsurance effect of diversification. The coinsurance effect occurs when firms with diversification can reduce the variation of cash flow and then lower the likelihood of insolvency compared with focused firms. Coinsurance thus can make diversification more attractive by allowing diversified firms to have access to loan with lower cost than non-diversified firms. Hann et al. (2013) add that the coinsurance effect in diversified firms may decrease systematic risk and therefore lower their cost of capital. Wan et al. (2011) state that from the perspective of resource-based view theory, high firm performance can be contributed by related diversification activities. They argue that firms can benefit from diversification by maximization of resource transfer among business divisions in firms.

Berger and Ofek (1995) argue that potential costs of diversification include the investment in bad projects which lead to poor divisions and thus exhaust resources from better performing divisions. Sharing the same view of the investment activities of firms, Lamont and Polk (2002) state that diversified firms may invest inefficiently, as they spend too little on their good business units while they spend too much on their bad business units. From the perspective of internal capital market, diversification destroys value of firms because diversified firms allocate capital inefficiently across their different units. Stowe and Xing (2006) reveal that diversified firms may have fewer growth opportunities than non-diversified firms. This can be explained by the restricted ability of expansion in the future.

3 Vietnam's Stock Market and Classification of diversified firms by industry

3.1 Vietnam's Stock Market

The Vietnamese stock exchange was established in 2000[6]. There are currently two stock exchanges in Vietnam i.e. Ho Chi Minh Stock Exchange (HSX) and Hanoi Stock Exchange (HNX)[7] (Viet Capital Securities, 2011). In 2000, there were only 5 firms listed on the Ho Chi Minh Stock Exchange and in 2006, the number of listed firms rose to 106. The number of listed firms in Hanoi Stock Exchange increased, from 9 in 2005 to 364 in 2010. In 2013, the number of listed enterprises were 301 in Ho Chi Minh Stock Exchange and 377 in Hanoi Stock Exchange[8]. The market capitalization value has also increased significantly, along with the increase in number of listed firms. The value of market capitalization increased significantly, from only 0.154 U.S billion dollars in 2003 to 20.385 U.S billion dollars in 2010, and reached 32.933 U.S billion dollars in 2012. Moreover, while the market capitalization of listed firms as percentage of GDP was only 0.36 percent in 2003; this figure increased to 21.14 percent in 2012[9]. This implies that the stock market in Vietnam plays an important role in the development of Vietnam's economy.

[Table 1]

Table 1 illustrates number of diversified firms and their market capitalization by industry in 2012. Column (1) illustrates number of listed firms by industry in both Ho Chi Minh stock exchange and Hanoi stock exchange in 2012. Column (2) shows market capitalization value of listed firms by industry in 2012. Column (3) illustrates number of diversified firms in industry. Construction industry has a highest number of diversified firms (63), followed by Real Estate (37), Wholesales Trade (18) and others. Column (4) illustrates market capitalization of diversified firms in industry. Real Estate has a highest market capitalization (86000 billion

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[6] The appearance of Vietnam stock market is originated from Decree No. 48/1998/ND-CP of July 11, 1998 On Securities And Securities Market (http://moj.gov.vn/vbpq/en/Lists/Vn%20bn%20php%20lut/View_Detail.aspx?ItemID=1502).

[7] HSX was formerly Ho Chi Minh City Securities Trading Center (HOSTC) established in 2000, and HOSTC was transferred to HSX in 2007. HNX was formerly Hanoi Securities Trading Center (HASTC) established in 2005, and HASTC was transferred to HNX in 2009.

[8] Refer to Hochiminh Stock Exchange (2008); Hochiminh Stock Exchange (2009); Hochiminh Stock Exchange (2010); Hochiminh Stock Exchange (2011); Hochiminh Stock Exchange (2012); Hochiminh Stock Exchange (2013); Hanoi Securities Trading Center (2006); Hanoi Securities Trading Center (2007); Hanoi Stock Exchange (2009); Hanoi Stock Exchange (2012); Hanoi Stock Exchange (2013).

[9] See World Bank (2014).

Vietnam dongs), followed by Construction (18000 billion Vietnam dongs), and Support Activities for Mining and Wholesale Trade (12000 billion Vietnam dongs). In 2012, there are 233 diversified firms which account for 37.3 percent and their total market capitalization accounts for 32.7 percent.

4 Literature review

There are many research papers that provide empirical evidence of the link between corporate diversification and firm performance. While most of the research is on the U.S. market, there are some studies about emerging markets. While examining the effect of corporate diversification on firm performance, it is found that the relationship between corporate diversification and firm performance is mixed.

Lang and Stulz (1994) use the U.S. data from the late 1970s and the 1980s to analyse corporate diversification and find that diversified firms have lower market value than single segment firms. Specifically, their study demonstrates that highly diversified firms have a mean and median Tobin's Q below the average figure of the sample. Besides, Berger and Ofek (1995) posit that the loss of value is around 13% to 15% with a sample of U.S. firms over the period from 1986 to 1991. Their results suggest that unrelated diversification creates a larger decrease in firm value than related diversification.

A study of East Asian firms by Claessens et al. (1999) find that corporate diversification is associated with a five percent discount of firm value. However, the study also cites that losses are less prominent in the case of diversified firms in poor economies. Moreover, they observe that group-affiliated firms (firms that are related through common ownership – for example, a parent company) are more likely to diversify compared with independent firms, especially in less developed economies. Likewise, Chen and Ho (2000) conduct a study on corporate diversification in Singapore and show that diversification has a negative impact on firm value, which implies that corporate diversification leads to a diversification discount. Their study also shows that large firms tend to diversify more.

Stowe and Xing (2006) study the growth opportunities of diversified firms and find that on average, diversified firms have fewer growth opportunities than do single-segment firms. They find that excess value of firms becomes significantly lower after diversification. Using annual data from twenty five non-banking firms listed on the Tunis stock exchange, Boubaker et al.

(2008) find strong evidence of a discount value on diversified firms i.e. corporate diversification decreases firm value. Singh et al. (2007) analyse the relationship between corporate diversification and performance for 889 Indian firms and find that diversified firms perform significantly worse than focused firms. Furthermore, they also find that there is a significant negative relation between the degree of diversification and firm performance. They conclude that this is due to the cost inefficiencies of diversified firms.

Bae et al. (2011) investigate the relationship between corporate diversification and firm value in Korea and find that while unrelated corporate diversification decreases firm value, related corporate diversification has no effect on firm value. Besides, they also state that this negative effect is exacerbated if firm is affiliated to a large business group. By using a sample of 607 listed companies on the Bombay stock exchange in 1999 – 2000, George and Kabir (2012) also indicate a negative effect of corporate diversification on firm performance in India.

Villalonga (2004a) examines the effect of diversification and states that diversified firms are traded at a premium compared to undiversified firms within the same industries. Villalonga (2004b) use three treatment effects estimators (Dehejia and Wahba, 2002; Dehejia and Wahba, 1999; Abadie and Imbens, 2002; Heckman, 1979) with 1978-1997 Compustat database to investigate the corporate diversification effect and posits that diversification does not destroy value. Similarly, Çolak (2010) use data of 6233 companies from Compustat between 1989 and 1998 and finds that corporate diversification does not increase or decrease firm value. He argues that corporate diversification itself does not affect firm value. The firm value may be affected by other factors such as lack of innovation or economic conditions.

In researching the relation between diversification and firm performance in India, Mishra and Akbar (2007) (through the perspective of resource-based view) suggest that group affiliation (diversification) is beneficial. Moreover, Lin and Su (2008) point out that diversified firms have higher Tobin's Q than focused firms. They also state that non-government controlled multi-division firms have better performance than government controlled diversified firms. La Rocca and Staglianò (2012) find that unrelated corporate diversification has positive effect on firm performance in Italian firms over the period from 1980 to 2007. This positive effect is explained by the fact that Italian firms diversify to lessen information asymmetry and achieve benefits from internal capital market.

Based on coinsurance arguments, for US firms over the period from 1998 to 2006, Hann et al. (2013) state that diversified firms can lower cost of capital (thus can improve firm value). By using a sample of Australian listed firms over the period from 2004 to 2008, Choe et al. (2014) find that diversified firms enhance firm value compared to that of undiversified firms and this positive effect is accelerated when firms' managers receive incentives such as stock or stock options. In studying the impact of corporate diversification on firm performance in recession period, Volkov and Smith (2014) find a significant increase in firm value of diversified firms, but this positive effect is temporary.

There are papers which indicate a nonlinear relationship between corporate diversification and firm performance. Khanna and Palepu (2000) conduct a study on 1309 Indian listed firms and show a nonlinear relationship between corporate diversification and firm performance. Corporate diversification initially decreases firm performance, and then improves firm performance when it reaches a certain level. In the case of Japanese companies, Lu and Beamish (2004) reveal a horizontal S shaped link between geographic diversification and firm performance. Li and Rwegasira (2008) report a U shaped relationship between corporate diversification and firm performance when investigating 300 listed firms in China over the period from 2003 to 2004. For Taiwanese firms, Lien and Li (2013) contend that corporate diversification has a concave effect on firm performance.

Jiraporn et al. (2006) find evidence that firms with weak shareholder rights tend to be industrially diversified. Firms' managers try to exploit the weakness of shareholder rights by unwise diversification activities. Indeed, the imperfection of market together with ineffective law in emerging countries make the agency problem associated with corporate diversification more severe (Lins and Servaes, 2002). The weak and inefficient environment can encourage firms' managers diversify businesses for their power, benefits, or ensuring their current job. Thus, diversification could lead to a discount value and firms with weak shareholder rights may experience a large diversification discount.

Vietnam began to transform from a centrally planned economy to market based economy in the mid of 1980s, and legislative reform was engaged in 2006[10] (Lobet, 2008). However, Vietnam

[10] Before 2006, there are a law for domestic companies (Law on Enterprises 2000), a law for state-owned enterprises (Law on State Owned Enterprises 2003), a law for foreign-owned companies (Law on Foreign Investment 2000), and a law for

has weak and inefficient system of economic law (Lobet, 2008; The Heritage Foundation, 2015), and low investor protection (Export Entreprises SA, 2014). Stock market in Vietnam is also characterized by low information disclosure (Nguyen et al., 2014), that creates an environment for firms' managers to exploit shareholders. Hence, it can be argued that listed firms in Vietnam do not have strong shareholder protection, and therefore the firms' managers tend to undertake discount value diversification strategy. We test the following hypothesis:

Corporate diversification has negative impact on firm performance of listed firms in Vietnam.

5 Research methodology

The following empirical model will be used to test the hypothesis:

$$FP_{it} = \alpha + \beta_1 DIV_{it} + \beta_2 X_{it} + \varepsilon_{it} \tag{1}$$

where FP_{it} is firm performance of firm i at time t, DIV_{it} is corporate diversification level of firm i at time t, X_{it}s are control variables of firm i at time t, and ε_{it} is error term.

5.1 Fixed effect estimation

There may be problem related to endogeneity, which leads to potential bias in estimations (Greenbaum, 2007). In the empirical model (1), corporate diversification may be endogenous (Campa and Kedia, 2002; Choe et al., 2014; Dastidar, 2009; Hann et al., 2013; Bae et al., 2011; Lin and Su, 2008; Villalonga, 2004b). Therefore, it is necessary to control for endogeneity of corporate diversification variable in the empirical model. The paper firstly uses fixed effect approach to deal with endogeneity caused by unobserved variables as in previous studies (Campa and Kedia, 2002; Shyu and Chen, 2009; David et al., 2010; Jiraporn et al., 2008; Choe et al., 2014). The fixed effect method uses within transformation to eliminate individual time invariant effect and then obtain the estimators through OLS estimation (Wooldridge, 2011).

5.2 Instrumental variable fixed effect estimation

The fixed effect method, however, cannot control for endogeneity when explanatory variables are correlated with error terms. Therefore, instrumental variable (IV) estimation with fixed effect method is used. Instrumental variables need to be correlated to endogenous variable (corporate diversification) and uncorrelated to dependent variable (firm performance). David et al. (2010)

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agricultural companies (Law on Cooperatives 2003). New Law on Enterprise 2005 unified 4 laws above and was implemented in 2006.

argue that industry level variables can serve as valid instruments. The industry level instrument variables are the following: fraction of diversified firms within industry, fraction of sales of diversified firms within industry (Campa and Kedia, 2002), capital expenditure over sales within industry (He, 2009), and industry median of corporate diversification measures. For testing the validity of these instruments, Hansen J test is used in the case of heteroskedasticity (Baum, 2006; Baum et al., 2003).

5.3 Heckman self-selection model

When examining effect of corporate diversification on firm performance, corporate diversification decision may be endogenous (Dastidar, 2009) because firms are likely to diversify if they obtain benefits from diversification (He, 2012) and factors impacting corporate diversification propensity may also affect firm performance (Campa and Kedia, 2002; Choe et al., 2014). Besides, corporate diversification decision of firms may be based on firm characteristics (such as profitability, firm size, and growth opportunities) that are not a random sample but selected by firms themselves (Dastidar, 2009). Therefore, a Heckman self-selection model (Heckman, 1979) should be employed to examine effect of corporate diversification on firm performance (Dastidar, 2009; Campa and Kedia, 2002; Lin and Su, 2008; Jiraporn et al., 2008).

Based on Heckman selection approach, firm performance model is as follow:

$$y_{it} = \alpha + \beta_1 D_{it} + \beta_2 x_{it} + \varepsilon_{it} \tag{2}$$

where y_{it} is dependent variable (firm performance), D_{it} is a binary independent variable ($D_{it} = 1$ if diversified otherwise $D_{it} = 0$ if undiversified), x_{it} is a set of control variables that affect firm performance, and ε_{it} is error term.

Corporate diversification decision (selection equation) is as below:

$$D_{it}^* = \delta z_{it} + u_{it}, \tag{3}$$

$D_{it} = 1$ if $D_{it}^* > 0$ and $D_{it} = 0$ otherwise. z_{it} is a set of factors that affect diversification decision of firm, u_{it} is error term.

Then, by substituting D_{it} in equation (2); firm performance model is as follow:

$$y_{it} = \alpha + \beta_1(\delta z_{it} + u_{it}) + \beta_2 x_{it} + \varepsilon_{it} \quad (4)$$

when $D_{it}^* > 0, D_{it} = 1$

$$y_{it} = \alpha + \beta_2 x_{it} + \varepsilon_{it} \quad (5)$$

when $D_{it}^* \leq 0, D_{it} = 0$

In order to estimate regression coefficients of equation (4) and (5), Heckman's two – step procedure or maximum likelihood estimation is used (Guo, 2015). The first step of Heckman procedure is to estimate the probability of taking corporate diversification by probit or logit model, and obtain estimates of selection correction – called lambda or inverse mills ratio[11]. The second step is to include the lambda estimates from the first step in the regression model of firm performance. The two – step approach is simpler but the maximum likelihood is more efficient (Guo, 2015). The paper examines both estimation approaches.

5.4 System GMM estimation

Firm performance may be dynamic in nature (Mishra, 2014) and the econometric treatment of dynamic nature of firm performance includes lagged values of firm performance among the explanatory variables.

$$y_{it} = \delta y_{i,t-1} + x_{it}^{'}\beta + u_{it} \qquad i = 1,........,N \qquad t = 2,............T \quad (6)$$

where δ is a scalar, $x_{it}^{'}$ is a $1 \times K$ vector of explanatory variables and β is a $K \times 1$ vector of parameters to be estimated. The error term u_{it} is composed of an unobserved effect and time-invariant effect μ_i and random disturbance term ν_{it}.

$$u_{it} = \mu_i + \nu_{it} \quad (7)$$

where $\mu_i \sim IID(0, \sigma_\mu^2)$ and $\nu_{it} \sim IID(0, \sigma_\nu^2)$ independent of each other and among themselves. The dynamic panel data regressions described in above equations (6) and (7) are characterized by

[11] See Greene (2012, p. 876) for a discussion on inverse mills ratio.

two sources of persistence over time i.e. autocorrelation due to the presence of a lagged dependent variable among the regressors and individual effects characterizing the heterogeneity among the individuals. Since y_{it} is a function of μ_i, this implies that $y_{i,t-1}$ is also a function of μ_i. Therefore, $y_{i,t-1}$ is correlated with the error term through the presence of μ_i. The OLS estimator for equation (6) is biased and inconsistent even if the v_{it} are not serially correlated. The fixed effect estimator of (7), which eliminates the individual effects μ_i, produces biased and inconsistent estimates (Nickell, 1981; Kiviet, 1995). Anderson and Hsiao (1982) suggested first differencing the model to get rid of the μ_i and then using $\Delta y_{i,t-2} = (y_{i,t-2} - y_{i,t-3})$ as an instrument for $\Delta y_{i,t-1} = (y_{i,t-1} - y_{i,t-2})$. These instruments will not be correlated with $\Delta v_{it} = v_{i,t} - v_{i,t-1}$, so far as the v_{it} themselves are not serially correlated. This instrumental variable (IV) estimation method leads to consistent but not necessarily efficient estimates of the parameters in the model because it does not make use of all available moment conditions (Ahn and Schmidt, 1995) and it does not take into account the differenced structure on residual disturbances (Δv_{it}). Arellano (1989) states that for simple dynamic error components models, the estimator that uses differences $\Delta y_{i,t-2}$ rather than levels $y_{i,t-2}$ for instruments has a singularity point and very large variances over a significant range of parameter values. On the other hand, the estimator that uses $y_{i,t-2}$ has no singularities and much smaller variances. Arellano and Bond (1991) proposed a generalized method of moments (GMM) estimator of the first differenced model that brings about significant efficiency gains as compared to the estimator by Anderson and Hsiao (1982) through exploiting additional orthogonality conditions associated with higher lags of the endogenous variable in the set of instruments. Blundell and Bond (1998) show that the lagged-level instruments in the Arellano-Bond estimator become weak as the autoregressive process becomes too persistent or the ratio of the variance of the panel-level effect to the variance of the idiosyncratic error becomes too large. Linear dynamic panel data models include p lags of the dependent variable on covariates and contain unobserved panel level effects, fixed or random. Arellano and Bover (1995) develop a framework for efficient instrumental variable estimators of random effects models with information in levels which can accommodate predetermined variables. Building on the work of Arellano and Bover (1995), Blundell and Bond (1998) proposed a system estimator that uses moment conditions in which lagged differences are used as instruments for the level equation in addition to the moment conditions of lagged levels as instruments for the differenced equation. This estimator is designed for datasets with many panels and few periods. The method assumes that there is no autocorrelation in the idiosyncratic errors and requires the initial condition that the panel-level effects be uncorrelated with the first difference of the first observation of the dependent variable. The system GMM model introduces more instruments and therefore may increase efficiency (Roodman, 2009). This study employs system GMM approach to examine the relationship between diversification and firm performance.

The system GMM model requires test serial correlation in differenced residuals. The Arellano – Bond test for autocorrelation is used to identify autocorrelation of the differenced errors. The null hypothesis of this test is that there is no autocorrelation. In addition, Sargan or Hansen test of overidentifying restrictions is performed to test a null hypothesis that instruments are exogenous, meaning no correlation between the instruments and the disturbances.

6 Data and variables

6.1 Data

The data used to examine the effect of corporate diversification on firm performance is by Vietstock[12] which provides data of all listed firms in Ho Chi Minh Stock Exchange and Hanoi Stock Exchange. We exclude financial firms such as banks, security companies, insurance companies in accordance with earlier studies (Dastidar, 2009; Lien and Li, 2013; Hann et al., 2013; Chen and Yu, 2012; Jiraporn et al., 2008; Lin and Su, 2008; Lins and Servaes, 2002). The financial firms are subject to regulation and financial information that are different to other firms (Jiraporn et al., 2008).

The information of sales segments is collected from annual explanations of financial statement and annual reports of listed companies. In the case of Vietnam stock market, there are no standard requirements for information disclosures. For example, Vietnamese listed firms do not require reporting the segments' sales in industry classification codes. Hence, the information of corporate diversification is only collected from annual explanations of financial statements and annual reports of firms that disclose this information. The sales segments of each company are classified into industries based on Vietnam Standard Industrial Classification 2007 (VSIC 2007).

[12] http://vietstock.vn/

Because of availability of data, this study only focuses on unrelated diversification for which information is available. The data covers financial information of listed firms from 2007 to 2012.

6.2 Variables

Corporate diversification is measured by three approaches: dummy variable, Herfindahl index, and entropy index. Dummy variable equals one if a firm diversifies otherwise it is zero. Chen and Ho (2000) indicate assets-based Herfindahl and sales-based Herfindahl as measures of diversification. Fukui and Ushijima (2007) and Lin and Su (2008) use revenue-based Herfindahl index in their study. Martin and Sayrak (2003) state that entropy measure can capture three aspects of firm's diversification activities i.e. number of industries, distribution of firm revenues/assets over industry segment, and relatedness's degree among industries. Singh et al. (2007) and Lien and Li (2013) use sales-based entropy measure as a measure of corporate diversification.

The Herfindahl index is as follow:

$$H = \sum_{i=1}^{n} S_i^2 \tag{8}$$

where S_i is the i^{th} segment's revenue proportion of the firm's total revenues, and n is the number of segments of the firm.

The entropy index is as follow:

$$E = \sum_{i=1}^{n} S_i \times \ln\left(\frac{1}{S_i}\right) \tag{9}$$

where S_i is the i^{th} segment's revenue proportion of the firm's total revenues, and n is the number of segments of the firm.

Firms are considered as diversified if they have at least one segment's sales that account for at least 90% of total sales (Lin and Su, 2008; Lins and Servaes, 2002).

Firm performance is often measured by Tobin's Q in studies on the relationship between corporate diversification and firm performance (Choe et al., 2014; Lang and Stulz, 1994; Chen and Ho, 2000; Khanna and Palepu, 2000; Fukui and Ushijima, 2007; Lin and Su, 2008). We use Tobin's Q as a proxy for firm performance.

$$Tobin's\ Q = \frac{Share's\ market\ price \times Number\ of\ outstanding\ share + Book\ value\ of\ debt}{Book\ value\ of\ total\ assets} \quad (10)$$

$$Tobin's\ Q = \frac{Share's\ market\ price \times Number\ of\ outstanding\ share + Book\ value\ of\ debt}{Replacement\ value\ of\ assets} \quad (11)$$

In equation (11) of Tobin's Q, replacement value of assets is calculated as in studies of Alberto de et al. (2004) and De Miguel and Pindado (2001). The replacement value of firm's assets (K) is defined as follow:

$$K = KF + KI + (BA - BF - BI) \quad (12)$$

where KF is the replacement value of tangible assets, KI is the replacement value of inventories, BA is the book value of firm's total assets, BF is the book value of tangible assets, and BI is the book value of inventories.

$$KF = KF_{t-1} \times (1 + a)/(1 + b) + I \quad (13)$$

where a is the ratio of depreciation over book value of tangible assets, b is the annual growth of capital good prices (this data is collected from annual Vietnam yearbook of statistics), KF_{t-1} is the lagged value of replacement value of tangible assets and $KF_0 = BF_0$. I is investment which is defined as change in book value of tangible assets plus depreciation.

$$KI = BI \times 2P_t / (P_t + P_{t-1}) \quad (14)$$

where P is the wholesale price (obtained from annual Vietnam yearbook of statistics).

In accordance with previous studies, we use various control variables to investigate the impact of corporate diversification on firm performance i.e. firm size, profitability, leverage, investment, and dividend yield. Firm characteristics such as firm size, profitability, firm leverage, investment, dividend yield, book to market ratio, firm age and industry and economy characteristics such as fraction of diversified firms in industry and GDP growth rate are included to examine the likelihood of taking corporate diversification in the Heckman selection model.

Firm size is a factor that impacts corporate diversification. It can be argued that when firm size increases, firm tends to diversify its business because it has more resources for expanding. Singh et al. (2004) indicate that firm size and corporate diversification (measured by Herfindahl index) have a positive relationship. Firm size may have positive impact on firm performance (Chen and

Yu, 2012). However, Mansi and Reeb (2002) and Choe et al. (2014) find that firm size and firm performance has a negative relationship. Lang and Stulz (1994) state mixed relationship between firm size and firm performance. In this study, firm size is measured by taking logarithm of total assets (Çolak, 2010; Dastidar, 2009; Chen and Ho, 2000; Berger and Ofek, 1995).

Firm leverage refers to financial leverage used by the firm, which shows to what extent the firm's assets are financed by debt. Firms with high debt ratio may have ability to access more funds for business expansion (Chen et al., 2009). Firm leverage affects firm performance in the context of corporate diversification. He (2009) shows that diversified firms are likely to have higher firm leverage. Mishra and Akbar (2007) contend that it is easier for diversified firms to raise funds from debt. Besides, ability of raising debt funds also help firms to invest more into new industries. However, there are empirical evidence showing a negative effect of firm leverage on firm performance (Chen and Yu, 2012). Firm leverage is ratio of total debt over total assets (Chen et al., 2009; Chen and Yu, 2012; David et al., 2010).

Book to market ratio is a proxy for growth opportunity (Singh et al., 2004). Firms with low growth opportunities tend to expand their operations through diversification and firms with high growth opportunities have low level of corporate diversification. The book to market ratio is calculated by taking book value of firm's equity (or book value per share) divided by market value of firm's equity (or market value per share) (Hann et al., 2013).

Firm age represents the number of years that a firm exists. It can be argued that firms with long history may have capacity to do business in new industries. Besides, old firms may have less growth opportunities, and then they tend to diversify their businesses. There is evidence that shows a positive effect of firm age on corporate diversification in developed market (Denis et al., 1997) and emerging market (Chen and Yu, 2012; Lien and Li, 2013). In this study, firm age is measured by the number of years since a firm registered as corporation (Choi et al., 2012).

Profitability is a firm characteristic that affects corporate diversification decision. It is argued that firms with low profitability tend to expand their businesses through corporate diversification in order to find profitable opportunities (Campa and Kedia, 2002). Profitability influences the way that firms with high profitability tend to be less diversified (Campa and Kedia, 2002). It is also found that multi-segments firms are likely to have poor profitability (Claessens et al., 1999).

In this paper, profitability is measured by the ratio of earnings before tax and interest to sales (Dastidar, 2009; Campa and Kedia, 2002).

Industry characteristic is a factor that influences firm's corporate diversification decision (Maksimovic and Phillips, 2002). Fraction of diversified firms in industry represents for industry characteristic as it shows corporate diversification's trend in industry where firms operate. This variable indicates attractiveness of an industry which implies that a firm which operates in an industry that has a high fraction of diversified firms is likely to diversify (Campa and Kedia, 2002). GDP growth rate indicates macro-economic situation of market. It is argued that high GDP growth encourages firms to diversify businesses (Campa and Kedia, 2002).

Investment is ratio of capital expenditure to total sales (Berger and Ofek, 1995; Campa and Kedia, 2002) or capital expenditure to total assets (Mansi and Reeb, 2002). They indicate that investment has a significant positive effect on firm performance. Campa and Kedia (2002) contend that firms with high level of investment tend to be less diversified.

Dividend yield represents for dividend policy of the firm. Dividend yield is ratio of dividend per share to market price per share (Mishra, 2014; Aggarwal and Samwick, 2003). Manos et al. (2012) argue that compared to single firms, multi segment firms may get benefit from internal capital market and then easily maintain a high dividend policy for investors. Aggarwal and Samwick (2003) document a negative link between dividend yield and firm performance.

7 Summary statistics and correlation matrix

[Table 2]

Table 2 illustrates summary statistics of variables used in this study over the period from 2007 to 2012. The mean value of Tobin's Q of sample firms is 1.083, which is relatively lower than Tobin's Q value of 1.453 in Japan (Fukui and Ushijima, 2007), 1.52 in Singapore (Chen and Ho, 2000) and 2.1725 in China (Lin and Su, 2008). The standard deviation of Tobin's Q is 0.413 which is lower than 0.482 in Japan (Fukui and Ushijima, 2007), and 1.0471 in China (Lin and Su, 2008). The average value of Tobin's Q calculated on the basis of replacement value of assets is 1.041 and standard deviation is 0.407.

The average value of Herfindahl index is 0.841 with standard deviation of 0.208. The mean value of Herfindahl index of listed firms in Vietnam is higher than those of 0.700 in the U.S. (Denis et al., 1997), 0.730 in Singapore (Chen and Ho, 2000), and 0.589 in China (Chen, 2010). The value of standard deviation (0.208) of Herfindahl index in Vietnam is lower than those of 0.253 in China (Chen, 2010), and 0.246 in Japan (Fukui and Ushijima, 2007). The mean value of entropy index of listed firms in Vietnam is 0.271 with standard deviation of 0.343. The mean value of entropy index in Vietnam (0.271) is similar to the value of 0.22 in Taiwan (Chen and Yu, 2012), but lower than those of 0.76 in Spain (Del Brio et al., 2011), and 0.4922 in China (Lu and Yao, 2006). The values of Herfindahl index and entropy reveal that the level of corporate diversification in Vietnam is not as high as in developed markets or other emerging markets[13].

The average value of firm size (natural log of assets) is 26.715 and its standard deviation is 1.291. Profitability of listed firms in Vietnam has an average value of 9.7 percent, with a standard deviation of 0.096. The mean value of profitability is slightly higher than that of 6 percent in the U.S. (Çolak, 2010). Leverage variable shows a mean value of 52.2 percent and a standard deviation of 0.212. The mean value of 52.2 percent is higher than those of 33.2 percent in Japan (Fukui and Ushijima, 2007), and 48 percent in Australia (Chen et al., 2009), but similar to value of 52.1 percent in China (Chen, 2010). The mean value of investment is 0.053 and its standard deviation is 0.094. This average value of investment is lower than that of 0.09 in the U.S. (Çolak, 2010), which implies a low level of investment of listed firms in Vietnam. The dividend yield variable shows a mean value of 7 percent, with a standard deviation of 0.062. This mean value is higher than those of 1.4928 percent in the U.S. (Aggarwal and Samwick, 2003), and 4.8 percent in Hong Kong (Chen et al., 2005). The average firm age of Vietnamese listed firms is 6.352, which is considerably lower than that of 21.63 in the U.S. (Çolak, 2010). The mean value of book to market ratio is 1.366, with a standard deviation of 0.906. The mean value of book to market ratio implies a market to book ratio of 0.732 which is relatively lower than that of the U.S. (2.933) (Franco et al., 2010). The average value of fraction of diversified firms in industry is 33.086 percent. This value is lower than that of 59.48 percent in China (Lin and Su, 2008), and 68 percent in Singapore (Chen and Ho, 2000). The average GDP growth rate of Vietnam over the period from 2007 to 2012 is 5.924 percent.

[Table 3]

[13] A lower value of Herfindahl index means a higher level of corporate diversification, and a higher value of entropy index means a higher level of corporate diversification

Table 3 illustrates correlation matrix of variables. Firm performance (TOB and TOBK) is positively correlated with Herfindahl index corporate diversification variable (DIVH). Firm performance (TOB and TOBK) is negatively correlated with entropy index corporate diversification variable (DIVE). Firm performance is positively correlated with firm size (SIZE), profitability (PROF), investment (INV), and GDP growth rate (GDP) and negatively correlated with firm's leverage (LEV), dividend yield (DIVYIELD), firm age (AGE), book to market ratio (BM), and fraction of diversified firms in industry (NDIV). Level of corporate diversification is positively correlated with firm size, firm's leverage, investment, firm age, book to market ratio, and fraction of diversified firms in industry and negatively correlated with profitability, dividend yield, and GDP growth rate.

8 Empirical results

This section presents empirical results of models investigating effect of corporate diversification on firm performance. Table 4 illustrates results of fixed effect estimation. Table 5 illustrates results of fixed effect with instrumental variable estimation. Table 6 illustrates results of Heckman selection method. Table 7 illustrates results of system GMM estimation. For robustness, two measures for Tobin's Q are used in each estimation approach: (1) total market value of firm divided by book value of total assets as per equation (10), and (2) total market value of firm divided by replacement value of total assets as per equation (11).

[Table 4]

Table 4 presents results of impact of corporate diversification on firm performance after controlling for unobserved heterogeneity. Tobin's Q (TOB), measured by total market value of firm divided by book value of total assets, is dependent variable in columns (1), (2), and (3). Tobin's Q (TOBK), measured by total market value of firm divided by replacement value of total assets, is dependent variable in columns (4), (5), and (6). Herfindahl index is used in columns (1) and (4), entropy index is used in columns (2) and (5), and dummy variable is used in columns (3) and (6) as corporate diversification variables. Corporate diversification significantly shows a negative impact on firm performance i.e. increase in level of corporate diversification leads to a decrease in firm performance. In columns (2) and (4), as Herfindahl index increases (decrease in level of corporate diversification), there is an increase in Tobin's Q. Entropy index in columns (2) and (5) is negative and significant which implies that as corporate diversification increases, Tobin's Q decreases. Dummy variable in columns (3) and (6) is negative and significant which indicates that when firms diversify, Tobin's Q is lower. The result implies that diversified firms inefficiently conduct corporate diversification strategy (Berger and Ofek, 1995), and firms' managers do not operate these firms with best interest of shareholders, especially in markets with weak shareholder protection (Lins and Servaes, 2002).

[Table 5]

Table 5 illustrates results of effect of corporate diversification on firm performance after controlling for unobserved heterogeneity and endogeneity caused by correlation between diversification variable and error terms. The sign and significance of corporate diversification variable is similar as in Table 4. However, the magnitude of effect of corporate diversification level on firm performance in instrumental variable fixed effect estimation is higher. The instruments for corporate diversification variable are fraction of diversified firms in industry and fraction of sales of diversified firms in industry. The Hansen J test of over identification is provided to show that these instruments are valid.

[Table 6]

Table 6 illustrates result of firm performance on corporate diversification by using Heckman selection estimation. This table provides results from both two steps and maximum likelihood estimations using two measures of Tobin's Q as per equation (10) and (11). The table also reports first step of Heckman selection estimation (probit model of corporate diversification propensity). As shown in the table, after controlling for endogenous self-selection; corporate diversification dummy variable is negative and significant, indicating that corporate diversification impair firm performance. Lambda values from models are positive and significant, implying that features affecting corporate diversification decision are positive correlated with firm performance and relationship between corporate diversification and firm performance suffers from selection bias (Dastidar, 2009). This implies that coefficient of corporate diversification variable is corrected for selection.

[Table 7]

Table 7 illustrates results of system GMM estimation of firm performance on corporate diversification. In this table, corporate diversification measured by Herfindahl index, entropy index, and dummy variable shows negative and significant impact on firm performance. Arellano – Bond tests for serial correlation at second order and Sargan or Hansen tests for over identification of the models are satisfied, indicating that the models are appropriately specified.

In Table 4, Table 5, Table 6, and Table 7, firm size variable shows mixed results. Fukui and Ushijima (2007) find firm size as negative and insignificant. Campa and Kedia (2002), Lins and Servaes (2002) and Chen and Yu (2012) find firm size as positive. Profitability variable is positive and significant in accordance with Campa and Kedia (2002), Çolak (2010) and Choe et al. (2014). Leverage variable shows mixed results. This contradicts with Fukui and Ushijima (2007), George and Kabir (2012), and Chen and Yu (2012) who find a negative relationship between leverage and firm performance. Firms can lower cost of capital and agency problem with high debt ratio (Bae et al., 2008). Investment variable is negative and significant, which contradicts positive and significant result of investment as per Campa and Kedia (2002), Mansi and Reeb (2002), and Lins and Servaes (2002). This result may imply that that diversified firms in Vietnam may invest efficiently and hence decrease firm performance. Dividend yield variable is negative and significant, implying that listed diversified firms in Vietnam are likely to pay more dividend (Manos et al., 2012), which may have a negative impact on firm performance (Aggarwal and Samwick, 2003).

9 Conclusion

The paper investigates impact of corporate diversification level on firm performance of listed firms in Vietnam over the period from 2007 to 2012. We find that that corporate diversification impairs firm performance in listed firms in Vietnam.

Findings are as per previous studies in developed markets (Lang and Stulz, 1994; Berger and Ofek, 1995; Bae et al., 2011) and developing markets (Claessens et al., 1999; Singh et al., 2007; Boubaker et al., 2008; George and Kabir, 2012). Corporate diversification decreases firm performance because diversified firms invest inefficiently into new segments (Berger and Ofek, 1995), and have to financially support these unprofitable segments (Lins and Servaes, 2002). Weak protection mechanism in emerging markets also encourage firms' managers engage in corporate diversification in order to benefit themselves, warranting their jobs (Jiraporn et al., 2006).

The negative impact of corporate diversification on firm performance implies that Vietnamese government should pay attention to expansion operations of firms, especially in firms which have high level of state ownership. Lack of efficient corporate governance system and law enforcement may encourage firms to take corporate diversification strategy, which leads to value discount of firms. This implies that the state may conduct diversification through a portfolio investment instead of letting firms engage in corporate diversification strategy.

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Table 1: Listed diversified firms in Vietnam, by industry (2012)

Industry	Number of firms	MCAP of firms (billion VND)	Number of diversified firms	MCAP of diversified firms (billion VND)	MCAP of diversified firms (%)
	(1)	(2)	(3)	(4)	(5)
Administrative and Support Services	4	378.6	2	85.6	22.6
Apparel - Leather and Allied Products	8	1800.0	1	96.9	5.4
Architectural, Engineering, Specialized Design Services and Related Services	7	520.7	2	219.2	42.1
Arts, Entertainment, and Recreation	2	765.9	1	394.1	51.5
Chemical - Pharmaceutical	21	25000.0	1	16.6	0.1
Construction	116	24000.0	63	18000.0	75.0
Construction and Real Estate	8	410.5	6	333.7	81.3
Crop Production	7	7600.0	1	300.3	4.0
Educational Services	1	22.1	1	22.1	100.0
Electric Power Generation, Transmission and Distribution	16	10000.0	1	74.4	0.7
Electrical Equipment & Telecommunications	19	4700.0	8	3300.0	70.2
Financial services and Related Activities	2	6400.0	1	3000.0	46.9
Food - Beverage - Tobacco	50	150000.0	8	3100.0	2.1
Furniture and Related Products	7	1000.0	3	549.8	55.0
Hotel and Accomodation	5	770.2	3	242.3	31.5
Machinery - Transportation Equipment	8	384.1	2	76.2	19.8

Industry	Number of firms	MCAP of firms (billion VND)	Number of diversified firms	MCAP of diversified firms (billion VND)	MCAP of diversified firms (%)
	(1)	(2)	(3)	(4)	(5)
Management, Scientific, Technical Consulting	1	8.2	0	0.0	0.0
Metal - Nonmetallic Mineral - Fabricated	61	21000.0	15	10000.0	47.6
Mining (except Oil and Gas)	28	14000.0	4	441.0	3.1
Natural Gas Distribution	8	76000.0	0	0.0	0.0
Other Products	4	2900.0	1	5.9	0.2
Other Services	1	107.0	0	0.0	0.0
Paper Manufacturing	17	1200.0	2	173.8	14.5
Petroleum and Coal Products	2	1000.0	1	993.9	99.4
Plastics and Rubber	19	8300.0	6	467.4	5.6
Publishing Industries	18	612.6	11	421.3	68.8
Real Estate	56	94000.0	37	86000.0	91.5
Repair and Maintenance	1	199.5	0	0.0	0.0
Retail Trade	19	3100.0	6	423.0	13.6
Scenic and Sightseeing Transportation	1	271.4	0	0.0	0.0
Scientific Research and Other Related Services	1	111.3	0	0.0	0.0
Support Activities for Agriculture and Forestry	1	116.7	0	0.0	0.0
Support Activities for Mining	4	12000.0	2	12000.0	100.0
Support Activities for Transportation	12	3100.0	3	461.6	14.9
Telecommunications	13	2000.0	8	1900.0	95.0
Transit and Ground Passenger Transportation	6	953.8	3	136.3	14.3
Truck Transportation	6	273.4	2	22.5	8.2
Warehousing and Storage	1	558.4	0	0.0	0.0
Water Transportation	17	5000.0	10	4200.0	84.0
Water, Sewage and Other Systems	2	289.2	0	0.0	0.0
Wholesale Trade	44	17000.0	18	12000.0	70.6
Wood Products	1	70.8	0	0.0	0.0
All	625	490000.0	233	160000.0	32.7

Note: The table illustrates listed diversified firms by industry in Vietnam at the end of 2012. Column (1) shows the number of listed firms within industry. Column (2) indicates the total market capitalization (MCAP) of listed firms, in billions of Vietnam dongs. Column (3) presents the number of diversified firms. Column (4) illustrates market capitalization of diversified firms. Column (5) presents the percentage of market capitalization of diversified firms relative to market capitalization of industry. Diversified firms are firms that have at least one segment's sales account for equal or less than 90% of total sales.

Table 2: Descriptive statistics of variables

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
TOB	2677	1.083	0.413	0.602	2.252
TOBK	2672	1.041	0.407	0.568	2.208
DIVH	2696	0.841	0.208	0.349	1.000
DIVE	2696	0.271	0.343	0.000	1.136
DDIV	2696	0.331	0.471	0.000	1.000
SIZE	2678	26.715	1.291	24.353	29.191
PROF	2678	0.097	0.096	-0.052	0.345
LEV	2678	0.522	0.212	0.134	0.845
INV	2676	0.053	0.094	-0.036	0.351
DIVYIELD	2669	0.070	0.062	0.000	0.205
AGE	2696	6.352	2.952	0.000	19.000
BM	2684	1.366	0.906	0.272	3.491
NDIV	2696	33.086	20.515	0.000	100.000
GDP	2696	5.924	0.577	5.250	7.130

Note: The table reports summary statistics of variables over the period from 2007 to 2012 for Vietnamese listed firms. TOB is Tobin's Q, measured as ratio of total market value of firm divided by book value of total assets. TOBK is Tobin's Q calculated as the ratio of total market value of firm over replacement value of assets. DIVH is sales-based Herfindahl index. DIVE is sales-based entropy index. DDIV is dummy variable of corporate diversification. Dummy equals one if a firm diversifies otherwise it is zero. SIZE is firm size i.e. natural log of assets. PROF is firm profitability i.e. ratio of operating income and sales. LEV is firm leverage, measured as ratio of total debt over total assets. INV is firm investment, computed as ratio of capital expenditure over sales. DIVYIELD is dividend yield ratio. AGE is firm age, the natural log of number of year since firm registered as corporation. BM is book to market ratio. NDIV is fraction of diversified firms in industry. GDP is GDP growth rate.

Table 3: Correlation matrix of variables

	TOB	TOBK	DIVH	DIVE	DDIV	SIZE	PROF	LEV	INV	DIVYIELD	AGE	BM	NDIV	GDP
TOB	1.00													
TOBK	0.99	1.00												
DIVH	0.09	0.09	1.00											
DIVE	-0.09	-0.09	-0.99	1.00										
DDIV	-0.10	-0.10	-0.91	0.90	1.00									
SIZE	0.08	0.07	-0.06	0.06	0.03	1.00								
PROF	0.35	0.34	0.05	-0.04	-0.05	0.16	1.00							
LEV	-0.10	-0.11	-0.07	0.09	0.06	0.32	-0.21	1.00						
INV	0.07	0.04	-0.01	0.01	0.01	0.11	0.17	0.04	1.00					
DIVYIELD	-0.22	-0.22	0.07	-0.06	-0.05	-0.08	0.13	-0.01	-0.07	1.00				
AGE	-0.24	-0.22	-0.09	0.10	0.08	-0.07	-0.07	-0.16	-0.10	0.05	1.00			
BM	-0.71	-0.70	-0.09	0.09	0.11	-0.01	-0.29	0.08	-0.11	0.05	0.24	1.00		
NDIV	-0.15	-0.14	-0.45	0.45	0.44	0.07	-0.08	0.18	-0.03	-0.08	0.04	0.20	1.00	
GDP	0.32	0.31	0.01	-0.01	-0.01	-0.03	0.10	-0.02	0.05	-0.05	-0.19	-0.23	-0.03	1.00

Note: The table reports correlation matrix over the period from 2007 to 2012 for Vietnamese listed firms. TOB is Tobin's Q, measured as ratio of total market value of firm divided by book value of total assets. TOBK is Tobin's Q calculated as the ratio of total market value of firm over replacement value of assets. DIVH is sales-based Herfindahl index. DIVE is sales-based entropy index. DDIV is dummy variable of corporate diversification. Dummy equals one if a firm diversifies otherwise it is zero. SIZE is firm size i.e. natural log of assets. PROF is firm profitability i.e. ratio of operating income and sales. LEV is firm leverage, measured as ratio of total debt over total assets. INV is firm investment, computed as ratio of capital expenditure over sales. DIVYIELD is dividend yield ratio. AGE is firm age, the natural log of number of year since firm registered as corporation. BM is book to market ratio. NDIV is fraction of diversified firms in industry. GDP is GDP growth rate.

Table 4: Fixed effect estimation results of effect of corporate diversification on firm performance

	(1) TOB	(2) TOB	(3) TOB	(4) TOBK	(5) TOBK	(6) TOBK
DIV	0.233***	-0.157***	-0.051**	0.268***	-0.178***	-0.063***
	(0.001)	(0.001)	(0.025)	(0.000)	(0.000)	(0.006)
SIZE	-0.045	-0.044	-0.046*	-0.034	-0.032	-0.035
	(0.109)	(0.119)	(0.099)	(0.215)	(0.232)	(0.195)
PROF	1.129***	1.126***	1.144***	1.077***	1.075***	1.094***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEV	0.334***	0.337***	0.328***	0.310***	0.312***	0.303***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
INV	-0.091	-0.090	-0.088	-0.166***	-0.165***	-0.163**
	(0.131)	(0.135)	(0.149)	(0.009)	(0.009)	(0.012)
DIVYIELD	-0.616***	-0.613***	-0.609***	-0.584***	-0.581***	-0.576***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	2.639***	2.845***	2.891***	2.280***	2.518***	2.569***
	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Year controlled	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2658	2658	2658	2655	2655	2655
R-squared	0.700	0.700	0.698	0.690	0.690	0.688
F statistic	209.224	209.450	207.406	200.220	200.481	198.925
	0.000	0.000	0.000	0.000	0.000	0.000

Note: The table presents the results of fixed effect estimation of panel data (2007 to 2012). Tobin's Q (TOB), proxy for firm performance, is dependent variable and measured by total market value of firm divided by book value of total assets. Tobin's Q (TOBK), proxy for firm performance, is dependent variable and measured by total market value of firm divided by replacement value of total assets. Herfindahl index is used as corporate diversification measure (DIV) in column (1) and (4). Entropy index is used as corporate diversification measure (DIV) in column (2) and (5). Dummy variable is used as corporate diversification measure (DIV) in column (3) and (6). SIZE is firm size, calculated as the natural log of assets. PROF is firm profitability, equals operating income over sales. LEV is firm leverage, measured by the ratio of total debt over total assets. INV is firm investment, computed by the ratio of capital expenditure over sales. DIVYIELD is dividend yield ratio. p-value in parentheses, standard error in bracket. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

Table 5: Fixed effect with instrumental variable estimation results of effect of corporate diversification on firm performance

	(1) TOB	(2) TOB	(3) TOB	(4) TOBK	(5) TOBK	(6) TOBK
DIV	1.359***	-0.879***	-0.286***	1.461***	-0.940***	-0.324***
	(0.006)	(0.006)	(0.008)	(0.004)	(0.005)	(0.004)
SIZE	-0.032	-0.027	-0.041	-0.020	-0.014	-0.029
	(0.276)	(0.385)	(0.136)	(0.502)	(0.650)	(0.302)
PROF	0.985***	0.977***	1.078***	0.925***	0.918***	1.020***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEV	0.363***	0.374***	0.326***	0.340***	0.352***	0.300***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
INV	-0.073	-0.066	-0.059	-0.147**	-0.140**	-0.130**
	(0.252)	(0.306)	(0.333)	(0.028)	(0.038)	(0.040)
DIVYIELD	-0.649***	-0.633***	-0.611***	-0.619***	-0.602***	-0.578***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year controlled	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2633	2633	2633	2630	2630	2630
R-squared	0.638	0.639	0.676	0.619	0.620	0.660
F statistic	225.531	225.082	247.572	214.114	213.912	233.585
	0.000	0.000	0.000	0.000	0.000	0.000
Hansen J statistic	0.126	0.199	0.255	0.792	0.978	0.001
	0.722	0.655	0.613	0.373	0.323	0.973

Note: The table presents the results of fixed effect with instrumental variable of panel data (2007 to 2012). Tobin's Q (TOB), proxy for firm performance, is dependent variable and measured by total market value of firm divided by book value of total assets. Tobin's Q (TOBK), proxy for firm performance, is dependent variable and measured by total market value of firm divided by replacement value of total assets. Herfindahl index is used as corporate diversification measure (DIV) in column (1) and (4). Entropy index is used as corporate diversification measure (DIV) in column (2) and (5). Dummy variable is used as corporate diversification measure (DIV) in column (3) and (6). SIZE is firm size, calculated as the natural log of assets. PROF is firm profitability, equals operating income over sales. LEV is firm leverage, measured by the ratio of total debt over total assets. INV is firm investment, computed by the ratio of capital expenditure over sales. DIVYIELD is dividend yield ratio. Constants are not reported. p-value in parentheses, standard error in bracket. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

Table 6: Heckman selection regression results of effect of corporate diversification on firm performance

	Maximum likelihood estimation		Two steps estimation		Maximum likelihood estimation		Two steps estimation	
	(1) TOB	(2) TOB	(3) TOB	(4) TOB	(5) TOBK	(6) TOBK	(7) TOBK	(8) TOBK
Second step								
DDIV	-0.432***	-0.432***	-0.515***	-0.515***	-0.429***	-0.429***	-0.501***	-0.501***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SIZE	0.025***	0.025***	0.029***	0.029***	0.022***	0.022***	0.025***	0.025***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
PROF	1.209***	1.209***	1.171***	1.171***	1.176***	1.176***	1.142***	1.142***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEV	-0.050	-0.050	-0.066*	-0.066*	-0.070*	-0.070*	-0.084**	-0.084**
	(0.214)	(0.214)	(0.098)	(0.098)	(0.086)	(0.086)	(0.034)	(0.034)
INV	-0.136**	-0.136**	-0.131**	-0.131**	-0.236***	-0.236***	-0.233***	-0.233***
	(0.014)	(0.014)	(0.024)	(0.024)	(0.000)	(0.000)	(0.000)	(0.000)
DIVYIELD	-0.803***	-0.803***	-0.708***	-0.708***	-0.801***	-0.801***	-0.709***	-0.709***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	1.497***	1.497***	1.449***	1.449***	1.542***	1.542***	1.500***	1.500***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year controlled	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry controlled	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First step								
SIZE	0.099***	0.099***	0.125***	0.125***	0.099***	0.099***	0.124***	0.124***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
LEV	-0.277*	-0.277*	-0.420**	-0.420**	-0.290*	-0.290*	-0.427**	-0.427**
	(0.090)	(0.090)	(0.012)	(0.012)	(0.075)	(0.075)	(0.011)	(0.011)
AGE	0.038***	0.038***	0.046***	0.046***	0.035***	0.035***	0.046***	0.046***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
BM	0.605***	0.605***	0.060	0.060	0.589***	0.589***	0.058	0.058
	(0.000)	(0.000)	(0.163)	(0.163)	(0.000)	(0.000)	(0.179)	(0.179)
PROF	0.244	0.244	-0.593*	-0.593*	0.202	0.202	-0.594*	-0.594*
	(0.484)	(0.484)	(0.096)	(0.096)	(0.562)	(0.562)	(0.095)	(0.095)
NDIV	0.022***	0.022***	0.034***	0.034***	0.024***	0.024***	0.034***	0.034***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
GDP	0.563***	0.563***	0.157**	0.157**	0.542***	0.542***	0.153*	0.153*
	(0.000)	(0.000)	(0.047)	(0.047)	(0.000)	(0.000)	(0.054)	(0.054)
Constant	-7.620***	-7.620***	-5.950***	-5.950***	-7.541***	-7.541***	-5.900***	-5.900***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Athrho	1.125***	1.125***			1.113***	1.113***		
	(0.000)	(0.000)			(0.000)	(0.000)		
Lnsigma	-1.172***	-1.173***			-1.179***	-1.178***		
	(0.000)	(0.000)			(0.000)	(0.000)		
Lambda			0.243***	0.269***			0.239***	0.258***
			(0.000)	(0.000)			(0.000)	(0.000)
Wald chi-squared	3281.406	3281.406	2524.680	2524.680	3219.765	3219.765	2507.990	2507.990
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Rho	0.809	0.809	0.884	0.884	0.805	0.805	0.869	0.869
Sigma	0.312	0.312	0.333	0.333	0.311	0.311	0.328	0.328
Lambda	0.253	0.253	0.294	0.294	0.250	0.250	0.285	0.285
Wald test of Rho=0	574.678	574.678			538.442	538.442		
	(0.000)	(0.000)			(0.000)	(0.000)		

Note: TOB is Tobin's Q, measured as ratio of total market value of firm divided by book value of total assets. TOBK is Tobin's Q calculated as the ratio of total market value of firm over replacement value of assets. DDIV is dummy variable of corporate diversification. DDIV is dependent variable in first step. SIZE is firm size, calculated as the natural log of assets. PROF is firm profitability, equals operating income over sales. LEV is firm leverage, measured by the ratio of total debt over total assets. INV is firm investment, computed by the ratio of capital expenditure over sales. DIVYIELD is dividend yield ratio. AGE is firm age, the natural log of number of year since firm registered as corporation. BM is book to market ratio. NDIV if fraction of diversified firms in industry. GDP is GDP growth rate. p-value in parentheses, standard error in bracket. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

Table 7: System GMM results of effect of corporate diversification on firm performance

	(1) TOB	(2) TOB	(3) TOB	(4) TOBK	(5) TOBK	(6) TOBK
L.TOB	0.099	0.094	0.217***			
	(0.451)	(0.476)	(0.000)			
L.TOBK				0.075	0.064	0.200***
				(0.565)	(0.627)	(0.001)
DIV	0.373*	-0.263*	-0.099*	0.482**	-0.330**	-0.154**
	(0.091)	(0.066)	(0.084)	(0.048)	(0.035)	(0.034)
SIZE	0.044	0.051	-0.007	0.056	0.065	0.004
	(0.373)	(0.324)	(0.846)	(0.290)	(0.245)	(0.921)
PROF	2.063***	2.047***	1.949***	2.138***	2.131***	2.052***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
LEV	0.162	0.154	0.403***	0.098	0.091	0.351**
	(0.537)	(0.566)	(0.007)	(0.733)	(0.757)	(0.040)
INV	-0.486	-0.473	-0.790**	-0.655*	-0.618	-1.030***
	(0.191)	(0.201)	(0.029)	(0.099)	(0.116)	(0.007)
DIVYIELD	-0.706	-0.701	-0.418	-0.711	-0.723	-0.501
	(0.125)	(0.132)	(0.197)	(0.131)	(0.127)	(0.132)
Constant	-0.490	-0.278	0.929	-0.873	-0.575	0.705
	(0.697)	(0.820)	(0.300)	(0.519)	(0.657)	(0.470)
Year controlled	Yes	Yes	Yes	Yes	Yes	Yes
Industry controlled	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1392	1392	1392	1388	1388	1388
Wald chi-squared	3049.429	2855.668	3523.015	2631.947	996.190	3116.540
	0.000	0.000	0.000	0.000	0.000	0.000
AR1	-2.721	-2.691	-5.120	-2.983	-2.927	-5.033
	0.007	0.007	0.000	0.003	0.003	0.000
AR2	-1.562	-1.496	-1.586	-1.270	-1.203	-1.255
	0.118	0.135	0.113	0.204	0.229	0.210
Sargan test	25.962	25.651	37.470	22.850	22.676	41.114
	0.355	0.371	0.271	0.529	0.539	0.157
Hansen test	16.273	17.523	23.981	15.044	15.708	26.963
	0.878	0.826	0.874	0.919	0.898	0.761

Note: The table presents the results of system GMM estimation of panel data (2007 to 2012). All results are robust to heteroskedasticity. Tobin's Q (TOB), proxy for firm performance, is dependent variable and measured by total market value of firm divided by book value of total assets. Tobin's Q (TOBK), proxy for firm performance, is dependent variable and measured by total market value of firm divided by replacement value of total assets. Herfindahl index is used as corporate diversification measure (DIV) in column (1) and (4). Entropy index is used as corporate diversification measure (DIV) in column (2) and (5). Dummy variable is used as corporate diversification measure (DIV) in column (3) and (6). SIZE is firm size, calculated as the natural log of assets. PROF is firm profitability, equals operating income over sales. LEV is firm leverage, measured by the ratio of total debt over total assets. INV is firm investment, computed by the ratio of capital expenditure over sales. DIVYIELD is dividend yield ratio. p-value in parentheses, standard error in bracket. *, ** and *** represent significance at 10%, 5% and 1% levels respectively.

The Effect of the Clawback Provision on the Asymmetric Sensitivity of CEO Bonus to Earnings

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Section 304 of the Sarbanes-Oxley Act of 2002 (SOX) sets forth a clawback provision that enables a publicly traded company to recover bonuses and other performance-based compensation from the chief executive officers (CEOs) if their company is required to restate financial statements due to material noncomplicances, as a result of misconduct, with financial reporting requirements under the security laws. In this paper we examine the effect of regulatory changes on the sensitivity of CEO bonus to earnings in the cases of good news and bad news in the periods before and after SOX. We find that asymmetric sensitivity of bonus to earnings exists before SOX but disappears in the post-SOX period. This is consistent with the reduced impact of settling up problems due to the clawback provision. This finding shows that regulatory changes affect compensation contracts and has implications for regulators, managers, politicians, investors, and academics in their assessment of the equitable relationship between executive efforts and executive bonus compensation.
Keywords: Executive Compensation, Sarbanes-Oxley, Ex Post Settling Up, Clawback Provision, Asymmetric Sensitivity

Data Availability: Data used in this study are available from public sources identified in the paper

JEL classification: J33; L2; M41

1. Introduction

A line of research examines the sensitivity of executive compensation to performance, which is usually measured by accounting and stock return. Examining the sensitivity of pay to performance around the 1993 enactment of Section 162(m) that limits the corporate tax deduction for executive compensation to $1 million per individual for the top five executives but provides an exception for compensation in excess of $1 million if it qualifies as "performance-based," Johnson et al. (2001), Perry and Zenner (2001), and Balsam and Ryan (2001) find some evidence of an increased sensitivity of compensation to performance after 1993. Carter et al. (2009) examines the relation between earnings and bonuses changes after Sarbanes-Oxley finding firms placing more weight on earnings.

Leone et al. (2006) document that CEO cash compensation is twice as sensitive to negative stock returns as it is to positive stock returns. They attribute this difference in sensitivity to boards of directors structuring cash compensation to mitigate the *ex post* settling up problem so that CEOs are rewarded less for unrealized gains than they are penalized for unrealized losses.[1] They do not, however, pursue similar predictions on the potential asymmetric association between CEO cash pay and accounting earnings for two reasons. First, earnings-based bonus contracts are often piece-wise linear plans containing lower and upper bounds, implying reduced sensitivity of executive bonus pay to earnings when earnings are either very high or very low. Second, conservative accounting constrains managerial opportunistic behavior, offsets managerial biases with its asymmetrical verifiability requirement, and generally excludes unrealized gains from earnings and recognizes unrealized losses in a timely manner (Watts 2003). Therefore, if the accounting system were designed solely for use in executive compensation contracts, there would be no asymmetry in the relationship between bonus pay and accounting earnings, as in the case of stock returns.[2]

In the past two decades, investors, analysts, and other market participants have increasingly been monitoring the extent to which a firm's earnings met or exceeded analyst forecasts. Missing the analysts' forecasts can result in a large decline in stock prices (Barth, Elliott, and Finn 1999; Skinner and Sloan 2002), while firms that meet forecasts enjoy a return premium, even when they meet forecasts through earnings management (Bartov, Givoly, and Hayn 2002). Skinner and Sloan (2002) demonstrate that the market penalizes firms that fall short of expectations by more than it rewards firms that exceed them. More specifically, they find that the negative share returns for firms that failed to meet earnings expectations were significantly greater in magnitude than the positive returns for firms that exceeded market expectations. Since the decrease in a firm's market value with bad earnings news is greater than the increase in the firm's market value due to good earnings news, the compensation committee of a firm should map this asymmetry in compensating CEOs so we predict that the compensation committee penalizes executives' bad performance when the firm's earnings expectations are not met more than it rewards executives' good performance through the payments of executive bonuses.

When earnings expectations are not met, the compensation committee is also likely to penalize the manager more severely under the financial reporting environment that supports greater financial reporting flexibility and offers greater managerial discretions than under the environment that permits less financial reporting flexibility because the manager with greater financial reporting flexibility and managerial discretion is expected to have more means to avoid missing his/her firm's earnings

[1] Leone et al. (2006) further note that the *ex post* settling up problem also exists in other types of CEO compensation, although it is likely to be more severe when payments are made in cash. This is because the unrealized gain may evaporate before equity claims vest when payments are made in the form of stock options.

[2] Of course the degree of accounting conservatism can be also affected by debt contracts, litigation concerns, tax strategies, as well as executive compensation contracts (Watts 2003, Leone et al. 2006).

expectations. Failing to meet earnings expectations leads the compensation committee to believe that the firm's earnings outlook is indeed bleak and thus it has more justifications to penalize the manager with lower bonus pay.

Section 304 of SOX includes a clawback provision that requires reimbursement by CEOs and CFOs of bonuses and other incentive compensation if their company is required to restate financial statements due to material noncompliances, as a result of misconduct, with any financial reporting requirement under the securities laws. Because of this provision, the impact of ex post settling up problem is reduced, i.e., the probability of shareholders incurring costs because future cash flow do not materialize is reduced. Therefore, we expect to see that the sensitivity of executive bonus pay to negative changes in earnings is greater in the pre-SOX period than in the post-SOX period.

CEOs have the greatest level of influence on the firm's financial reporting decisions, and we use CEO compensation data from ExecuComp for the period from 1993 to 2005 to investigate pay-for-performance sensitivity. We find that: first, the sensitivity of executive bonus compensation to accounting earnings is greater for bad news (market-adjusted returns are negative) than for good news (market-adjusted returns are zero or positive).[3] Second, accounting conservatism is positively associated with changes in bonus compensation. Third, the asymmetric sensitivity of executive bonus compensation to accounting earnings in the cases of good news and bad news exists in the period before SOX but disappears after SOX.

These findings are based on both pooled and Fama-Macbeth regression tests using White's (1980) heteroskedasticity-consistent covariance estimator, rather than the ordinary least squares (OLS) estimator that tends to overstate standard errors and thus understate t-statistics in the existence of heteroskedasticity. The findings are also obtained after controlling for most of the variables that have been identified, in prior executive compensation studies, to influence the sensitivity of executive bonus compensation to earnings and stock returns. They remain robust after extreme values of all the variables in the regression tests are eliminated.

This study is expected to make the following contributions to the literature on compensation, earnings management, and conservatism. First, the evidence of a greater sensitivity of executive bonus compensation to changes in earnings with bad news than to changes in earnings with good news further refines the argument of Healy (1985) and Murphy (1999) that earnings-based bonus contracts often contain lower (bogey) and upper (cap) bounds, which suggests reduced sensitivity of cash pay to earnings when earnings are either very high or very low. In other words, this paper's evidence that a more significant increase in the sensitivity of executive bonus compensation to changes in earnings with bad news relative to changes in earnings with good news is consistent with the following argument: when earnings expectations are not met, the manager of a firm suffers a decrease in not only share price but also bonus pay by more than the manager enjoys an increase in share price and bonus pay when earnings expectations are met.

Second, a strong, positive association between the level of conservatism and the change in bonus pay implies the need to control for levels of conservatism in all the regression tests that examine the sensitivity of executive compensation to earnings.

Third, significant reductions in the asymmetric sensitivity of executive bonus compensation to earnings changes after the Sarbanes-Oxley Act of 2002 implies that the less flexible financial reporting environment in the post-SOX period resulted in lower levels of earnings management and conservatism, and the compensation committee of a firm penalizes its manager less in the post-SOX period than in the

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[3] As in Leone et al. (2006), negative (positive) market-adjusted stock returns are used as a proxy for unrealized losses (gains) or bad (good) news. Therefore, market earnings expectations are assumed not to be met when there exist negative market-adjusted stock returns.

pre-SOX period when earnings expectations are not met. In particular, the evidence of the effects of Sarbanes-Oxley and other concurrent reforms on the sensitivity of executive bonus compensation to earnings changes is likely to be useful information for regulators, managers, politicians, investors, and academics in their assessment of the equitable relationship between executive efforts and executive compensation for the firms affected by the Act.

Fourth, very recently, Shaw and Zhang (2010) demonstrate using a three-way performance partition that an *ex post* settling up in CEO cash compensation based on poor firms performance does not systematically occur.[4] This is in stark contrast to the empirical evidence documented in Leone et al. (2006). The results of this paper also support the Shaw and Zhang's finding, even using the same two-way performance partition as the one used in Leone et al. (2006), because when more control variables are added in the regressions that examine the relation between executive bonus compensation and firm performance, executive bonus compensation is not more sensitive to negative stock returns than to positive stock returns, throwing doubt on the *ex post* settling up claim made in Leone et al. (2006).

The remainder of this study is organized into six sections. The second section develops the hypotheses by exploring and discussing previous relevant research. The third section describes sample selection procedures and research design. Section four presents the results of empirical tests on the sensitivity of executive compensation to earnings and stock returns. The fifth section describes the sensitivity tests and alternative specifications. Concluding comments are provided in the final section.

2. Hypothesis Development

Leone et al. (2006) note that managers, like shareholders, have limited tenure and limited liability, which creates a situation of costly *ex post* settling up when managers are paid for unrealized gains that evaporate. Recovery of excess compensation payments and reparation for excess investments is difficult when the manager leaves the firm before the cash flows materialize (Watts 2003).[5] On the other hand, CEO pay should be reduced for unrealized losses, so the CEO cannot avoid the consequences of poor performance. A higher sensitivity of cash compensation to negative stock returns than to positive stock returns reflects a more severe punishment for poor performance.

Leone et al. (2006), however, do not make similar predictions on the potential asymmetric relationship between CEO cash pay and accounting earnings for the following two reasons. First, the reduced sensitivity of CEO cash compensation to accounting earnings when earnings are either very high or very low has been suggested in prior research (Murphy 1999, Healy 1985, Leone et al. 2006). As reported in Murphy (1999), earnings-based bonus contracts usually contain bogeys and caps, and most bonus plans use accounting earnings in a piecewise linear fashion. Second, conservative accounting generally excludes unrealized gains from earnings and recognizes unrealized losses in a timely manner. Therefore, there would be no asymmetry in the relationship between bonus compensation and accounting earnings, as in the case of stock returns. The above discussions imply that if we can control extreme values of accounting earnings and the levels of accounting conservatism, executive bonus compensation should be more sensitive to negative earnings changes than it is to

[4] Dechow (2006) also suggests that what appears to be *ex post* settling up enforced by compensation committees upon pooly performing executives could in fact reflect the result of compensation committees mechanically applying bonus contract formulas to earnings.

[5] Leone et al. (2006) also indicate that if the firm pays the executive a cash bonus for an unrealized gain, but that gain does not later materialize, the executive can quit the firm and the shareholders will have difficulty recovering the cash paid for that unrealized gain.

positive earnings changes, consistent with the positive correlation between unexpected earnings and abnormal stock returns documented in the famous 1968 Ball and Brown study.

In recent years, investors, analysts, and other market participants have been closely monitoring the extent to which a firm's earnings meet or exceed analyst forecasts. Executives have incentives to use discretionary accruals to achieve the earnings benchmark, since significant economic benefits potentially accrue to firms when earnings meet or beat analysts' forecasts. Missing the analysts' forecasts can result in a large decline in stock prices (Barth, Elliott, and Finn 1999; Skinner and Sloan 2002), while firms that meet forecasts enjoy a return premium, even when they meet forecasts through earnings management (Bartov, Givoly, and Hayn 2002). Skinner and Sloan (2002), in a study that covers a sample period of 1984-1996, demonstrate that the negative share returns for firms that failed to meet earnings expectations were significantly greater in magnitude than the positive returns for firms that exceeded expectations. As Scott (2006) observes, the market penalizes firms that fall short of expectations by more than it rewards firms that exceed them. The compensation committee of a firm is expected to penalize its executives' bad performance by more than it rewards its executives' good performance when a cash bonus is paid. Therefore, this paper's first hypothesis in its alternate form is constructed as follows:

H1: Ceteris paribus, the sensitivity of CEO bonus compensation to accounting earnings is greater for bad news than for good news.

Watts (2003) defined conservatism as "the asymmetrical verification requirements for gains and losses." The greater the difference in the degree of verification required for gains versus losses, the greater the conservatism that exists.

Watts (2003) also observes that in practice, conservatism more than offsets managerial bias, and on average defers earnings and understates cumulative earnings and net assets. In contracts, such as debt, executive compensation, and employment contracts, these conservative effects increase firm value because they constrain management's opportunistic payments to themselves and other parties, such as shareholders. The increased firm value is shared among all corporate stakeholders, increasing everyone's welfare.

Specifically, in debt covenants, conservative accounting reduces the likelihood of management paying excessive dividends by introducing a persistent downward bias into retained earnings [Scott (2006)]. In compensation contracts, conservatism reduces the likelihood of overpayments to managers by constraining premature revenue recognition and asset overvaluation. In sum, conservative accounting can contribute to efficient contracting, which leads to lower cost of capital for the firm and an increase in firm value.

As Watts (2003) indicates, in the bonus compensation case, without verifiable earnings measures, the manager receives overpayments that leave shareholders with a lower share value, even after adjusting for the value increase through the efforts of the manager. Furthermore, the shareholders are unable to recover the overpayment because of the manager's limited liability. The compensation committee of a firm is expected to reward managers through an incentive compensation instrument (e.g., bonus pay) if managers adopt more conservative accounting policies because it will significantly reduce such overpayments to managers. We expect, therefore, a positive correlation between conservatism and bonus pay. Based on the above arguments, this paper's second hypothesis in its alternate form is constructed as follows:

H2: Ceteris paribus, accounting conservatism is positively associated with changes in bonus compensation.

Cohen et al. (2008), Lobo and Zhou (2006), Li et al. (2006), and Carter et al. (2009) demonstrate that the reforms associated with the Sarbanes-Oxley Act (SOX) of 2002 have considerably altered the financial reporting environment in which managers operate, and find an increase in accounting conservatism, a decrease in financial flexibility in financial reporting, and an ensuing decrease in earnings management after the implementation of Sarbanes-Oxley.

As we discussed in the development of hypothesis 1, the results of prior research generally suggest that the capital market penalizes firms that fall short of investors' earnings expectations by more than it rewards firms that exceed them. As a result, managers have a strong incentive to ensure that earnings expectations are met. One way to do this is to manage earnings upwards. Scott (2006) notes, "Rational investors will be aware of this incentive, of course. This makes meeting expectations all the more important for managers. If these are not met, the market will reason that if the manager could not find enough earnings management to avoid the shortfall, the firm's earnings outlook must be bleak indeed, and/or the firm is not well managed since it cannot predict its own future. Consequently, the manager's reputation suffers as well as share price."

Accordingly, when earnings expectations are not met, the compensation committee of a firm has more incentives to penalize the manager in a financial reporting environment that supports less conservative financial reporting, more flexible financial reporting, or higher levels of earnings management than in an environment that mandates more conservative financial reporting, less flexible financial reporting, or lower levels of earnings management, because the manager who has greater flexibility in financial reporting and more earnings management instruments is expected to do better at avoiding missing his/her firm's earnings expectations. In other words, the sensitivity of executive bonus pay to changes in earnings with bad news is less in the post-SOX period than the sensitivity of executive bonus pay to changes in earnings with bad news in the pre-SOX period.

More importantly, Section 304 of the SOX includes a clawback provision that requires reimbursement by CEOs and CFOs of bonuses and other incentive compensation if their company is required to restate financial statements due to material noncompliances, as a result of misconduct, with any financial reporting requirement under the securities laws. Because of this provision, the impact of ex post settling up problem is reduced, i.e., the probability of shareholders incurring costs because future cash flow do not materialize is reduced. This discussion leads to the formation of this paper's third hypothesis as follows:

H3: Ceteris paribus, the level of asymmetric sensitivity of CEO bonus compensation to accounting earnings decreases after SOX.

3. Sample Selection and Methodology

3.1. *Sample Selection*

Table 1 provides the sample selection process. Financial data are obtained from COMPUSTAT, stock return data from CRSP, and executive compensation data from ExecuComp. The sample period begins in 1992 because that is the first year for which detailed compensation information is available from ExecuComp. The initial sample consists of 25,653 firm-year observations with available CEO bonus and stock compensation data. From this initial sample we delete data lost when computing the change form of compensation, missing CRSP, COMPUSTAT and institutional ownership data. We also delete financial institutions (SICs between 6000-6999) and utilities (SICs between 4400 and 5000).[6] The final sample includes 5,332 firm-year observations. Of these, 3,557 (1,775) observations are good (bad) news firms when we measure good/bad news using annual raw return. When we use annual abnormal return to classify good/bad news firms, the sample consists of 2,766 (2,566) good news (bad news) firms.

[Insert Table 1 here]

3.2. *Methodology*

3.2.1. *Performance Measures*

Different measures of accounting performance are used in prior research, including Sloan (1993), Baber, Janakiraman, and Kang (1996), Gaver and Gaver (1998), Baber, Kang, and Kumar (1998), Baber, Kang, and Kumar (1999), and Leone, Wu, and Zimmerman (2006). We adopt four different measures of accounting performance – changes in return on assets (ΔROA), changes in return on equity (ΔROE), changes in earnings per share excluding extraordinary items & discontinued operations (ΔEPSP), and changes in earnings per share including extraordinary items & discontinued operations (ΔEPSEIP), in order to add generality to the analysis.

<u>*Change in Return on Assets (ΔROA)*</u>

$\Delta ROA_t = ROA_t - ROA_{t-1}$

where ROA = Net Income before extraordinary items (EI) and discontinued operations (DO) / Total Assets;

<u>*Change in Return on Equity (ΔROE)*</u>

$\Delta ROE_t = ROE_t - ROE_{t-1}$

where ROE =Net Income before EI and DO / Average Common Equity;

<u>*Change in Earnings per Share, excluding EI and DO (ΔEPSP)*</u>

$$\Delta EPSP_t = \frac{\Delta\left(\text{Earnings per share excluding EI and DO}\right)_t}{\left(\text{Stock Price}\right)_{t-1}}$$

<u>*Change in Earnings per Share, including EI and DO (ΔEPSEIP)*</u>

$$\Delta EPSEIP_t = \frac{\Delta\left(\text{Earnings per share including EI and DO}\right)_t}{\left(\text{Stock Price}\right)_{t-1}}$$

We use two measures of stock performance: Annual market-adjusted returns (Leone, Wu, and Zimmerman 2006) and annual raw returns as used in most prior compensation studies:

<u>*Annual Market-Adjusted Return (ANNMAR)*</u>

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[6] These firms are excluded because Cheng and Warfield (2005) and Burgstahler and Eames (2003) show that managers in these regulated industries may have different incentives to manage earnings.

ANNMAR is cumulative monthly returns for the fiscal year t, where monthly return is computed by subtracting value-weighted market index from monthly return obtained from the CRSP monthly returns file.

$$\text{ANNMAR}_t = \prod_{\tau=1}^{12}(\text{ARET}\,\tau + 1) - 1$$

where ARET = monthly raw return – value-weighted market index.

<u>*Annual Raw Return (ANNMRR)*</u>

Annual Raw Return (ANNMRR) is cumulative monthly returns for the fiscal year t obtained from the CRSP monthly returns file.

$$\text{ANNMRR}_t = \prod_{\tau=1}^{12}(\text{RET}\,\tau + 1) - 1$$

where RET = monthly raw return

3.2.2. *Regression Models*

We investigate the effect of conservatism on compensation, as well as difference in the relationship between earnings and compensation between good news firms and bad news firms using the following pooled regression model:

$$\begin{aligned}\Delta BON_{i,t} = {} & \beta_0 + \beta_1 D_{i,t} + \beta_2\, ANNMRR_{i,t} + \beta_3\, D_{i,t}*ANNMRR_{i,t} + \beta_4\, \Delta EPS_{i,t} + \\ & \beta_5\, D_{i,t}*\Delta EPS_{i,t} + \beta_6\, SALE_{i,t} + \beta_7\, SALE^2_{i,t} + \beta_8\, FAGE_{it} + \beta_9\, LEVERAGE_{i,t} + \\ & \beta_{10}\, MTB_{i,t} + \beta_{11}\, PERS_{it} + \beta_{12}\, LOSSDUM_{i,t} + \beta_{13}\, EQUITYINC_{it} + \\ & \beta_{14}\, LMVE_{,it} + \beta_{15}\, EPSSTD_{i,t} + \beta_{16} RETSTD_{i,t} + \beta_{17}\, INST_{i,t} + \\ & \beta_{18}\, EAGE_{it} + \beta_{19}\, IOS_{it} + \beta_{20}\, NOAA_{it} + \Sigma\gamma_j YEAR_j + \varepsilon_{i,t} \qquad (1)\end{aligned}$$

$$\begin{aligned}\Delta STOCK_{i,t} = {} & \beta_0 + \beta_1 D_{i,t} + \beta_2\, ANNMRR_{i,t} + \beta_3\, D_{i,t}*ANNMRR_{i,t} + \beta_4\, \Delta EPS_{i,t} + \\ & \beta_5\, D_{i,t}*\Delta EPS_{i,t} + \beta_6\, SALE_{i,t} + \beta_7\, SALE^2_{i,t} + \beta_8\, FAGE_{it} + \beta_9\, LEVERAGE_{i,t} + \\ & \beta_{10}\, MTB_{i,t} + \beta_{11}\, PERS_{it} + \beta_{12}\, LOSSDUM_{i,t} + \beta_{13}\, EQUITYINC_{it} + \\ & \beta_{14}\, LMVE_{,it} + \beta_{15}\, EPSSTD_{i,t} + \beta_{16} RETSTD_{i,t} + \beta_{17}\, INST_{i,t} + \\ & \beta_{18}\, EAGE_{it} + \beta_{19}\, IOS_{it} + \beta_{20}\, NOAA_{it} + \Sigma\gamma_j YEAR_j + \varepsilon_{i,t} \qquad (2)\end{aligned}$$

where for firm i in year t,

BON=BONUS$_t$/SALARY$_{t-1}$;

STOCK= (Restricted stock grants$_t$ + Black-Scholes value of option grantss$_t$)/ SALARY$_{t-1}$;

ΔBON=BON$_t$ – BON$_{t-1}$;

ΔSTOCK = STOCK$_t$ – STOCK$_{t-1}$;

ANNMRR = Annual raw returns for fiscal year t from CRSP;

D = 1 if the annual market-adjusted return (ANNMAR) is negative, and 0 otherwise;

EPS = alternatively measured as ROA, ROE, EPSP, or EPSEIP;

ROA = Net income before EI and DO$_t$ /Total Assets$_t$;

ROE = Net income before EI and DO_t /average common equity for year t and t-1;

EPSP = EPS excluding EI and $DO)_t$/(Stock $Price)_{t-1}$;

EPSEIP = (EPS including EI and $DO)_t$/(Stock $Price)_{t-1}$;

ΔROA = $ROA_t – ROA_{t-1}$;

ΔROE= $ROE_t – ROE_{t-1}$;

ΔEPSEIP = $EPSEIP_t – EPSEIP_{t-1}$;

ΔEPSP = $EPSP_t – EPSP_{t-1}$;

SALE = Net $Sales_t$ (Compustat item SALE);

FAGE= Firm age, calculated as year t minus the first year the firm appeared on CRSP;

LEVERAGE = (Long-term $debt_t$ + the current portion of long-term $debt_t$) / total $assets_t$

MTB = Market value of $equity_t$ /book value of common $equity_t$

PERS = Persistence proxies such as IMA or ARI;

IMA = Persistence measure calculated based on the Integrated Moving Average model;

ARI = Persistence measure based on the Integrated Autoregressive model;

LOSSDUM = 1 if net income including EI and $DO_t < 0$ and 0 otherwise;

EQUITYINC = ($RSHN_t$ + $OPTIONN_t$ + $EOPN_t$ + $UEOPN_t$ + $SHOWN_t$)/($SHOUT_t$ *1,000), where RSHN = Restricted stock holdings (thousands of shares), OPTIONN = Options granted (thousands of shares), EOPN=Exercisable options (thousands of shares), UEOPN = Unexercisable options (thousands of shares), SHOWN = Shares owned with options excluded (thousands of shares), and SHOUT = Common Shares Outstanding (millions of shares);

LMVE = Log(market value of equity from ExecuComp);

EPSSTD = Earnings volatility in year t, measured by standard deviation of annual basic earnings per share over the past 7 years;

RETSTD = Stock return volatility in fiscal year t, measured by standard deviation of monthly returns over the prior 60 months;

INST = % of Institutional Ownership in fiscal year t from the TFSD Ownership Database;

EAGE = Age of the CEO in fiscal year t;

IOS = Investment Opportunity Set composite, computed by performing principal component analysis on the four IOS measures (Kwon and Yin 2006), from all available observations for the period from 1993 to 2005;

NOAA = nonoperating accruals / total assets; and

YEAR = 1 if fiscal year t and 0 otherwise.

We deflate year t change in executive compensation by prior year (t-1) base salary to control for size-related factors that vary cross-sectionally and to minimize the effect of year t-1 performance on compensation metrics (Baber et al. 1996). Control variables including sales (SALE), the square of sales ($SALE^2$), firm age (FAGE), leverage (LEVERAGE), and market-to-book (MTB) are identified in Leone et al. (2006) as those that are potentially correlated with the pay-performance sensitivity. Francis and Schipper (1999, p. 342) indicate that market-to-book ratios have been used in prior research as a proxy for unrecognized intangible assets. Givoly and Hayn (2000) demonstrate that to the extent that equity valuation by investors is based on the present value of future cash flows, the market-to-book ratio as well as earnings multiples would tend to be higher when the accounting measurement is more conservative.[7] This suggests that the market-to-book ratio (MTB), measured by the value of the equity divided by the book value of the equity, can also be used as a proxy for accounting conservatism, and may affect the sensitivity of CEO compensation to market and accounting performance.

Baber et al. (1998) demonstrate that the sensitivity of compensation to earnings varies directly with earnings persistence. Therefore, a proxy for earnings persistence (IMA), measured by MA1 based on an IMA(1,1) time-series characterization of earnings, is also included as a control variable in the regression analysis. A detailed description of the computation of earnings persistence measures is made in section 3.2.3. *LOSSDUM*, which takes a value of 1 if net income with EI and DO is less than 0 and 0 otherwise, is included to control for earnings persistence when earnings are negative.

Cheng and Warfield (2005) find that managers with high equity incentives are more likely to sell shares in the future, and this motivates these managers to engage in earnings management to increase the value of the shares to be sold. Earning management can affect the level of earnings persistence and quality, which in turn can affect the sensitivity of compensation to earnings. We thus include *EQUITYINC* to proxy for the effect of equity incentives for earnings management. The log of the market value of equity (*LMVE*) is included to control for the firm size effect (Dikolli et al. 2005; Garvey and Milbourn 2006).

Banker and Datar (1989), Lambert and Larcker (1987), Sloan (1993), and Leone et al. (2006) demonstrate that earnings volatility and stock return volatility influence the sensitivity of executive cash compensation to market and accounting performance. We measure earnings volatility by the standard deviation of annual basic earnings per share over the last 7 years and stock return volatility by the standard deviation of monthly returns over the prior 60 months, similar to those used in Dikolli et al. (2005).

Other control variables that are expected to influence the sensitivity of executive compensation to executive performance measures include institutional ownership (INST) (Dikolli et al. 2005, 2006) and the age of the executive (*EAGE*) (Garvey and Milbourn 2006, Dikolli et al. 2006), Finally, year dummies (YEAR) are included to capture time-specific factors. We run the two models separately using both pooled and Fama-MacBeth regressions.

Baber et al. (1996) show that there are stronger associations between compensation and performance measures for firms with greater investment opportunities. Following Baber et al. (1996) and Kwon and Yin (2006), we include the investment opportunity set variable (IOS), measured by the principal component of four IOS proxies – Investment Intensity, Geometric Mean Annual Growth Rate of Market Value of Total Assets, Market-to-Book Value of Total Assets, and Research and Development Expenditure to Total Assets, as defined in Table 3 of Kwon and Yin (2006), as a control variable for the regression analysis.

Leone et al. (2006) assert that if the accounting system were designed solely for use in compensation contracts (unrealized gains are excluded from income and unrealized losses are recognized immediately), there would be no asymmetry in the relationship between cash compensation and accounting earnings, as in the case of stock returns. Their claim implies that accounting conservatism can affect the sensitivity of executive compensation to earnings. Therefore, we include two conservatism proxies into the regression analysis: the aforementioned market-to-book value of equity (MTB) and non-operating accruals (NOAA). Khan and Watts (2009), Kwon et al. (2006), and

[7] Also see Feltham and Ohlson (1995) and Ohlson and Zhang (1998).

Givoly and Hayn (2000) document that conservative firms have more negative periodic non-operating accruals (NOAA). Since Khan and Watts (2009) warn that the direct positive relationship between MTB and conservatism is not observed due to the "buffer problem" (Roychowdhury and Watts 2007), we rely more on NOAA as a proxy for conservatism.[8]

Fama-MacBeth Regression Model

We also estimate regression equations (1) and (2) using the Fama-MacBeth (1973) procedure, which has the advantage of controlling for cross-sectional correlation in the residuals by assuming independence through time.[9] The presence of a positive cross-sectional correlation in the residuals in the pooled regression would understate standard errors and overstate the t-statistics. Reported coefficients, adjusted R^2s, and number of observations will be the means of 13 annual regressions from 1993-2005. In addition, the standard errors will be the time-series standard deviations of the coefficients divided by the square root of 13. T-statistics will be accordingly computed as follows:

$$t(Y_j) = \frac{Y_j}{s(Y_j)\big/\sqrt{n}} \tag{3}$$

where Y_j = the mean coefficient of 13 annual cross-sectional regressions from 1993 through 2005 for variable j;

$s(Y_j)$ = the time-series standard deviations of the 13 coefficients divided by the square root of 13; and

n = the number of years tested.

3.2.3. *Earnings Persistence Measures*

A recent study by Baber et al. (1998) demonstrates that the sensitivity of executive cash compensation to earnings varies directly with earnings persistence. Earnings persistence is defined as the degree to which future earnings are induced by a $1.00 increase in current earnings. Valuation theory suggests that analysts and investors should put greater emphasis on forecasting high-persistence earnings than low-persistence earnings, because a given amount of the former has a greater valuation impact than the same amount of the latter. This time series property of earnings (earnings persistence) is positively related to ERC, the magnitude of the relationship between earnings and returns (Kormendi and Lipe 1987, Easton and Zmijewski 1989, Collins and Kothari 1989).

The role of persistence can be explained by comparing the values of an unexpected dollar of permanent earnings and transitory earnings. Prior empirical studies predict that transitory earnings surprises have an empirical ERC of one, while the ERC of permanent earnings is one plus the inverse of the discount rate, so that analysts and investors are relatively uninterested in transitory earnings because the trading profits that could be earned from private foreknowledge of a dollar of transitory earnings are smaller than the profits from private foreknowledge of a dollar of permanent earnings (Freeman and Tse 1992).

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[8] Khan and Watts (2009) note, "The buffer problem is that over a short horizon beginning MTB is negatively correlated with conservatism flows due to prior unrecognized increases in asset values reducing the necessity to recognize asset value losses. Since ending MTB is a function of beginning MTB, this induces a negative relation between ending MTB and conservatism at the annual horizon. Over longer horizons (three years or more), the beginning MTB effect is reduced and ending MTB (in year t) is positively correlated with conservatism over years t-3 to t as shown in Roychowdhury and Watts (2007)."

[9] Leone et al. (2006) and Herrmann et al. (2001), among others, used the Fama-MacBeth procedure in their empirical analyses. Theil (1971, p. 160) discusses a theoretical aspect of correlated residuals (disturbances) in a panel data regression.

Since earnings follow a non-stationary process, the persistence can be better measured with a first differenced time-series model. In order to estimate firm-specific persistence levels, we adopt an *ARIMA (1, 1, 0*) *or ARI (1,1,0)* (Kormendi and Lipe 1987), Easton and Zmijewski 1989) and an *IMAMA (0, 1 1) or IMA (0,1,1)* (Beaver 1970, Beaver et al. 1980, Collins and Kothari 1989, Ali and Zarowin 1992, and Baber et al. 1998) time-series characterization of quarterly earnings, each of which considers seasonality of quarterly earnings and facilitates parsimonious empirical specifications of both earnings innovations and earnings persistence.

The *ARI (1, 1, 0*) model or the first differenced AR (1) model with seasonality can be expressed as follows:

$$(1-\phi B)(1-B^4)X_t = a_t$$

X is quarterly actual earnings, ϕ is the persistence parameter, B is the backshift operator and a_t is white noise. This can also be represented as

$$X_t = X_{t-4} + \phi(X_{t-1} - X_{t-5}) + a_t$$

$$\Delta X_t - \phi \Delta X_{t-1} = a_t$$

ϕ is a firm-specific persistence level estimate similar to the autocorrelation of seasonally differenced earnings over the 32 quarters that end in each year of the sample period 1993-2005.

We can easily see that if ϕ is low, then current-earnings innovation would be more transitory. On the other hand, if ϕ is high, then current-earnings innovation would be more permanent. Thus, parameter ϕ measures the extent to which earnings innovations are permanent rather than transitory and quantifies the notion of earnings persistence.

The *IMA (0, 1, 1*) model with seasonality can also be expressed as follows:

$$(1 - B^4)X_t = (1 - \theta B^4)a_t,$$ where $(1 - \theta)$ is the persistence parameter.

$$X_t = X_{t-4} - \theta a_{t-4} + a_t$$

If θ=1, then earnings follow a mean reverting process, and all earnings innovations are expected to be transitory. In contrast, when θ=0, earnings follow a random walk process, and all earnings innovations are expected to be permanent. Thus, parameter $(1 - \theta)$ measures the persistence level.

3.2.4. *Modified Jones Model and Performance-matched Discretionary Accruals*

We compute discretionary accruals using the cross-sectional modified Jones model estimated by industry and year. The cross-sectional approach has the advantage of controlling for the effects of industry-wide economic changes on total accruals and allowing the coefficients to change across years due to possible structural changes.[10]

$$TACCR_{i,t} / A_{i,t-1} = a_t (1/A_{i,t-1}) + b_{1t} (\Delta REV_{i,t} - \Delta REC_{i,t}) / A_{i,t-1} + b_{2t} (PPE_{i,t} / A_{i,t-1}) + \varepsilon_{i,t}$$

where for firm i at time t,

[10] Guay, Kothari, and Watts (1996) investigate the relative merits of various discretionary accrual models and conclude that the cross-sectional Jones and cross-sectional modified Jones models are the most effective in identifying discretionary accruals. DeFond and Jiambalvo (1994), Subramanyam (1996), Bartov, Gul, and Tsui (2000), and Gul, Leung, and Srinidhi (2000) further support the adoption of the cross-sectional modified Jones model.

$TACCR_{i,t}$ = total accruals, see footnote[11];

$A_{i,t-1}$ = lagged total assets (item #6);

$\Delta REV_{i,t}$ = change in sales (item #12);

$\Delta REC_{i,t}$ = change in accounts receivable (item #2);

$PPE_{i,t}$ = gross property, plant and equipment (item #7); and

$\varepsilon_{i,t}$ = error term.

Discretionary accruals are estimated as the difference between reported total accruals and fitted values of total accruals (nondiscretionary accruals) using coefficient estimates from equation (3) for the period 1993-2005:

$$DA_{i,t} = TACCR_{i,t}/A_{i,t-1} - [a_t\,(1/A_{i,t-1}) + b_{1t}\,(\Delta REV_{i,t} - \Delta REC_{i,t}) / A_{i,t-1} + b_{2t}\,(PPE_{i,t} / A_{i,t-1})]$$

where $DA_{i,t}$ is discretionary accruals and $\Delta REC_{i,t}$ is the change in accounts receivable (item #2). We adjust discretionary accruals for performance and industry effects, as suggested by Kothari, Leone, and Wasley (2005), because potential measurement errors in discretionary accruals may correlate with industry membership, growth, or performance. We calculate performance-matched discretionary accruals for firm i as discretionary accruals of firm i minus discretionary accruals of the firm j that exhibits the closest ROA in the same industry.

4. Empirical Results

4.1. *Descriptive Statistics*

Table 2 shows means, medians, and standard deviations of compensation variables, performance measure variables, other financial variables, time-series variables, an investment opportunity set proxy variable, conservatism proxy variables, and earnings management proxy variables for all firm-year-observations. The financial and time-series variables are assumed to influence the sensitivity of executive incentive compensation to earnings and stock prices, as documented in prior research.

As in Leone et al. (2006), we compare descriptive statistics between bad news firms and good news firms using parametric (two sample t) and nonparametric (Wilcoxon rank-sum) tests. Table 2 shows that all incentive compensation variables are different between the bad and good news sub-samples at the statistically significance levels of 5% or 1%, with the exception of equity-based compensation (STOCK), which is not significant in the parametric test; changes in equity-based compensation (ΔSTOCK), which is positive but insignificant in the parametric test; and changes in total compensation (ΔTCOG), which is insignificant in the parametric test. As expected, good news firms outperform bad news firms in all performance measures except for ROE, which is not statistically different in parametric tests.

As indicated in Table 2, in general, bad news firms show higher leverage, lower market-to-book value of equity, higher earnings persistence, smaller firm size, lower earnings and stock variability,

[11] $TACCR_{i,t} = \Delta CA_{i,t} - \Delta CL_{i,t} - \Delta Cash_{i,t} + \Delta STD_{i,t} - Dep_{i,t}$, where, for firm i at time t, $\Delta CA_{i,t}$= change in current assets (item #4); $\Delta CL_{i,t}$ = change in current liabilities (item #5); $\Delta Cash_{i,t}$ = change in cash and cash equivalents (item #1); $\Delta STD_{i,t}$ = change in debt included in current liabilities (item #34); and $Dep_{i,t}$ = depreciation and amortization expense (item #14).

lower institutional ownership, older CEOs, less accounting conservatism, and lower cash flows from operations than good news firms.

[Insert Table 2 here]

Panel A of Table 3 reports Spearman correlations among the variables used in the multiple regression tests. Performance metrics (ANNMRR, ΔROA, and ΔEPSP) are significantly and positively correlated with changes in bonus compensation (ΔBON).[12] The correlations between the performance metrics and changes in equity-based compensation (ΔSTOCK) are not statistically significant. The insignificant correlations may imply that equity grants are awarded for reasons other than rewarding managers for past performance, e.g., incentives for future performance [Core and Guay (1999)].

Firm-year observations (5,332) are split into bad news and good news groups based on negative and non-negative values of ANNMAR. Panels B (bad news) and C (good news) of Table 3 reveal Spearman correlations between the two compensation variables (ΔBON and ΔSTOCK) and the performance metrics (ANNMRR, ΔROA, ΔROE, ΔEPSP, and ΔEPSEIP), along with a proxy for conservatism (NOAA). Consistent with the results of Panel A, ΔBON is positively and significantly associated with all performance variables. The correlations are statistically significant at the 1% level without exception. In addition, the negative correlation for the conservatism proxy (NOAA) is significant at the 5% level, which suggests that accounting conservatism increases executive bonus pay. As expected from the results of Panel A and prior research, ΔSTOCK is not significantly associated with any of the performance variables, with the exception of ANNMRR in the case of good news. Unlike the case of ΔBON, the conservatism proxy (NOAA) is significantly and positively correlated with ΔSTOCK in both Panels. This implies that when a firm adopts more conservative financial reporting, the compensation committee penalizes its manager with less equity-based pay.

[Insert Table 3 here]

4.2. *Regression results*

Table 4 reports results from estimating equation (1) for bonus compensation using pooled regressions (Panel A) and Fama-MacBeth regressions (Panel B). In column (1) of Panel A, the sensitivity of bonus compensation to stock returns (ANNMRR) and to change in ROA (ΔROA) are both significant at the 1% level. The coefficient on D*ANNMRR is positive and significant, indicating that bonus compensation is more sensitive to stock returns when returns contain unrealized losses (ANNMAR< 0) than when returns contain unrealized gains (ANNMAR $\geq$ 0), consistent with Leone et al. (2006) conclusion that boards of directors exercising discretion to reduce costly *ex post* settling up in cash compensation paid to executives. The coefficients on D*ΔROA, SALE and $SALE^2$, are statistically insignificant, similar to what Leone et al. (2006) reported. In general, the results presented in the second column of Panel A or Panel B (a short version of ΔROA regression without various control variables) are consistent with those of the third column in Table 4 in Leone et al. (2006).

When we include a comprehensive set of control variables that have been identified in prior research in estimating equation (1), we find the following results. First, the coefficients on stock returns (ANNMRR) and four different types of accounting performance variables — ΔROA, ΔROE, ΔEPSP,

[12] Although not shown in the table, other performance variables, such as ANNMAR, ΔROE, and ΔEPSEIP, are also significantly and positively correlated with ΔBON.

are ΔEPSEIP — are statistically significant at the 1% level in both Panel A and Panel B. Second, the coefficient for D*ANNMRR becomes either insignificant in Columns (2) and (5) or significant at the 10% level at best in Columns (3) and (4). This coefficient is insignificant across board in Penal B using the Fama-MacBeth regression tests.[13] When more control variables are included in equation (1), the asymmetric sensitivity of executive cash compensation to stock returns almost disappears. Note that when Leone et al. include CEO horizon, a proxy for the severity of the *ex post* settling up problem in the model, they failed to document cross-sectional variations in the asymmetric relationship between cash compensation and stock returns. Along with Shaw and Zhang (2010), we failed to find evidence of an asymmetric sensitivity of bonus to stock returns.

This paper's first hypothesis, that the sensitivity of executive bonus compensation to changes in accounting earnings is greater for bad news (market-adjusted returns are negative)

than for good news (market-adjusted returns are zero or positive), is supported by Table 4 when proxies for changes in accounting earnings are ΔROE, ΔEPSP, and ΔEPSEIP in pooled regression tests (Panel A) and ΔEPSP and ΔEPSEIP in Fama-MacBeth regression tests (Panel B). Their coefficients are all statistically significant at the 5% or higher levels. The results imply that, as is done by the capital market, the compensation committee of a firm penalizes its executives' bad performance by more than it rewards its executives' good performance through executive cash bonus pay when the executive performance is measured by changes in earnings.

The regression results of Table 4 are also consistent with this paper's second hypothesis that accounting conservatism is positively associated with changes in bonus compensation.

The proxy for accounting conservatism (NOAA) has significant negative coefficients across all different measures of changes in earnings (ΔROA, ΔROE, ΔEPSP, and ΔEPSEIP). Specifically, t-statistics for the NOAA variable in regressions that include ΔROA, ΔROE, ΔEPSP, and ΔEPSEIP are -4.71 (-4.96), -4.44 (-4.16), -4.40 (-3.55), and -4.16 (-3.34), respectively in pooled (Fama-MacBeth) regression tests and are statistically significant at the 1% level without exception.[14] The compensation committee indeed rewards managers through an incentive compensation instrument (e.g., bonus pay) if managers adopt more conservative accounting policies because it significantly increases contract efficiency and, thus, firm value by reducing unnecessary overpayments to managers.

Other significant coefficients in both pooled and Fama-MacBeth regression tests in Table 4 are those of LOSSDUM, EQUITYINC, and INST. Specifically, when a firm reports a net loss (LOSSDUM = 1), the manager of the firm is penalized with a significant reduction of his or her bonus pay. Executives with higher equity incentives (EQUITYINC) are rewarded with higher bonus pay. Cheng and Warfield (2005) document that managers with high equity incentives are more likely to sell shares in the future, and this motivates these managers to engage in earnings management to increase the value of the shares to be sold. If the compensation committee of such a firm cannot completely see through this earnings management behavior, executives of the firm are likely to receive higher bonus pay based on the increased share value. Executives of firms with higher levels of institutional ownership (INST) are rewarded with higher bonus pay than executives of firms with lower levels of institutional ownership. This evidence of higher executive compensation associated with higher levels of institutional ownership is consistent with the results of Smith and Swan (2008).

[Insert Table 4 here]

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[13] Leone et al.(2006) present their empirical results based only on Fama-MacBeth regression tests.

[14] Since NOAA becomes more negative with more conservative financial reporting, the negative coefficient of the NOAA variable means more cash bonus pay.

Table 5 reports results from estimating equation (2) for equity-based compensation using pooled regressions (Panel A) and Fama-MacBeth regressions (Panel B). As in Leone et al. (2006), all of the coefficients on stock return variables (ANNMRR and D*ANNMRR) are statistically insignificant when a more comprehensive set of control variables is included. In addition, a weaker association exists between changes in accounting earnings and equity-based executive compensation. There are also no signs of asymmetric sensitivity of executive equity-based compensation to accounting earnings, as in the case of executive bonus compensation.

Other significant coefficients in both pooled and Fama-MacBeth regression tests in Table 5 are those of FAGE, MTB, IMA, LMVE, EPSSTD, RETSTD, INST, EAGE, and IOS. Specifically, as firm age (FAGE) and executive age (EAGE) increase, the level of executive equity-based compensation increases. As market-to-book value of equity (MTB), earnings persistence (IMA), firm size (LMVE), earnings volatility (EPSSTD), stock returns volatility (RETSTD), the level of institutional ownership (INST), and the level of investment opportunities (IOS) increase, the level of executive equity-based compensation decreases.

Interestingly, the MTB variable, which is a proxy for either unrecognized intangible assets or accounting conservatism, is significantly and negatively correlated with changes in executive equity-based compensation in Table 5, whereas the variable is insignificantly associated with changes in executive bonus compensation in Table 4. This implies that accounting conservatism leads to lower equity-based pay.

[Insert Table 5 here]

In order to confirm evidence in prior research that a change took place in the financial reporting environment in the post-SOX period, we test whether conservatism increases (Table 6) and earnings management decreases (Table 7) after the Sarbanes-Oxley Act of 2002 and other concurrent reforms.[15] Lobo and Zhou (2006) examine the change in managerial discretion over financial reporting following the Sarbanes-Oxley Act and document an increase in conservatism in financial reporting following SOX and the resulting requirement by the SEC that financial statements be certified by firms' CEOs and CFOs. They find that firms report lower discretionary accruals after SOX than in the period preceding SOX. In addition, based on the Basu (1997) measure of conservatism, they demonstrate that firms incorporate losses more quickly than gains when they report income in the post-SOX period. Lobo and Zhou's (2006) empirical evidence suggests that SOX and the resultant SEC certification requirement may have altered management's discretionary reporting behavior towards greater conservatism.

In Table 6, the results show that conservatism, measured by cumulative nonoperating accruals, increases after SOX. In the full (constant) sample, the t-statistics are 2.46 (2.01) and 4.87 (2.60) in parametric and non-parametric tests, respectively. They are significant at least at the 5% level. Since the association between the market-to-book value of equity (MTB) variable, another proxy for conservatism, and the changes in bonus pay (ΔBON) is not strong in both pooled and Fama-MacBeth regression tests, we do not include it in the analysis of the change in the level of conservatism following SOX.

[Insert Table 6 here]

[15] For example, as shown in Carters et al. (2009), the NYSE proposed significant rule changes in its listing standards aimed at ensuring independence of directors and strengthening corporate governance practices of listed companies. In October 2002, the NASDAQ followed suit with a similar proposal to strengthen board independence and committee independence (SEC 2003a).

In Table 7, absolute values of modified Jones discretionary accruals and performance-matched discretionary accruals in the pre-SOX period from 1997 through 2000 are compared to those in the post-SOX period from 2002 through 2005.[16] In this comparison, we implicitly assume, as in prior research, that the higher the absolute value of these accruals, the higher the magnitude of earnings management. Although three of the two t-statistics and two Wilcoxon Z statistics are not sufficiently statistically significant, all four statistics are positive. Moreover, the non-parametric Wilcoxon Z statistic (2.57) in the case of modified Jones discretionary accruals is significant even at the 1% level. Therefore, we conclude that there is some evidence that earnings management in the post-SOX period is smaller in magnitude than earnings management in the pre-SOX period.

[Insert Table 7 here]

The results of Table 8 show that the asymmetric sensitivity of executive bonus compensation to changes in earnings is significantly reduced in the post-SOX period relative to the pre-SOX period. The coefficients on ΔROA, ΔROE, ΔEPSP, and ΔEPSEIP when there is bad news (market-adjusted stock returns are negative) are generally significant in the pre-SOX period, but become insignificant in the post-SOX period. The t-statistics of the coefficients on ΔROA, ΔROE, ΔEPSP, and ΔEPSEIP are 0.62 (-0.46), 2.33 (0.31), 1.98 (1.49), and 1.69 (1.18), respectively in the pre-SOX (post-SOX) period in the pooled regression tests, whereas those on ΔROA, ΔROE, ΔEPSP, and ΔEPSEIP are 0.65 (-0.49), 3.89 (-1.24), 3.99 (1.77), and 1.86 (1.05), respectively in the pre-SOX (post-SOX) period in the Fama-MacBeth regression tests. The empirical evidence of Table 8 is consistent with this paper's third hypothesis that the sensitivity of executive bonus pay to changes in earnings when market-adjusted stock returns are negative (bad news) is less under the post-SOX period than in the pre-SOX period.

This reduced asymmetry implies that when earnings expectations are not met (bad news), the compensation committee has greater incentive to penalize its executive under the financial reporting environment that allows for less conservative accounting, more flexible financial reporting or greater earnings management than under the environment that requires more conservative accounting, less flexible financial reporting or less earnings management, because the executive who has greater flexibility of financial reporting and with more earnings management instruments is expected to do better at avoiding missing his/her firm's earnings expectations. When the executive fails to do this, he or she deserves more of a decrease in bonus pay in the more flexible financial reporting environment vis-à-vis the less flexible financial reporting environment.

Cohen et al. (2008), Lobo and Zhou (2006), Li et al. (2006), and Carter et al. (2009) observe that the Sarbanes-Oxley Act of 2002 and other concurrent reforms decreased the flexibility executives had in financial reporting and increased the risk that CEOs and CFOs assume for the accuracy of the reported numbers. Therefore, the degree of asymmetric sensitivity of executive bonus pay to earnings could be less in the post-SOX period, compared to the pre-SOX period.

[Insert Table 8 here]

5. Sensitivity Tests and Alternative Specifications

[16] Since the accounting scandal involving Enron that prompted the US Senate to enact the Sarbales-Oxley Act in 2002 took place in 2001, we intentionally omit 2001 in order to mitigate any noise problem in the comparison analysis as a result of the inclusion of 2001 in the pre-SOX period.

5.1. *Annual Raw Returns (ANNMRR) replaces Annual Market-Adjusted Returns (ANNMAR)*

We replace annual market-adjusted returns (ANNMAR) with annual raw returns (ANNMRR) to proxy for unrecognized losses (ANNMRR < 0) or unrecognized gains (ANNMRR ≥ 0) in both the pooled and Fama-MacBeth regression tests. The results were qualitatively the same as before.

5.2. *Integrated Autoregressive Model (ARI) vs. Integrated Moving Average (IMA)*

We replace the Integrated Moving Average time series model with the Integrated Autoregressive Model to measure earnings persistence. The results are similar to those based on IMA.

5.3. *Extreme Values*

For all regression analyses in this study, we use several methods of truncation: deletions of observations outside mean ± 3 std, mean ± 4 std, and mean ± 5 std; deletion of extreme 1% of variable distributions; and deletion of extreme 2% of variable distributions. The results presented in Tables 4, 5, and 7 are robust to such alternative treatments.

6. Concluding Remarks

This paper examines the asymmetric sensitivity of the CEO bonus to earnings, the association between conservatism and bonus pay, asymmetric sensitivity of CEO bonus compensation to earnings before and after SOX. In line with recent developments in theoretical models and empirical findings, we posit that the sensitivity of executive bonus compensation to earnings with bad news (market-adjusted stock returns are negative) will be larger than the sensitivity of executive bonus compensation to changes in earnings with good news (market-adjusted stock returns are either positive or zero). We also posit that accounting conservatism will be positively correlated with changes in executive bonus pay. Based on the results of prior research that documents an increase in conservatism, a decrease in flexibility in financial reporting, and an ensuing decrease in earnings management following the Sarbanes-Oxley Act of 2002, this paper further posits that the asymmetry of the sensitivity of executive bonus compensation to changes in earnings will be reduced in the post-SOX period.

We find empirical evidence consistent with the above hypotheses. Specifically, first, the sensitivity of CEO bonus compensation to earnings with bad news is greater than the sensitivity to earnings with good news. Following prior research, negative (nonnegative) market-adjusted stock returns are used as proxies for bad (good) news. Second, the accounting conservatism, measured in cumulative nonoperating accruals, indeed increases bonus pay. Third, a significant reduction in the asymmetry of the sensitivity of executive bonus compensation to changes in earnings is found in the post-SOX period. We attribute this to the clawback provision set forth by SOX. Fourth, this paper's primary findings are based on both pooled and Fama-Macbeth regression tests using White's (1980) heteroskedasticity-consistent covariance estimator, rather than the ordinary least squares (OLS) estimator that tends to overstate standard errors and thus understate t-statistics in the presence of heteroskedasticity. Fifth, the empirical results are also robust to a variety of extreme value treatments and alternative specifications of bad news. Finally, this paper attempts to incorporate the effects of most, if not all, of the control variables (19 independent variables) that have been identified in the executive compensation literature.

Given that the issue of executive compensation has been a longstanding one in the United States and Canada because many feel that executives are excessively paid, this paper's evidence of asymmetric sensitivity of executive compensation to earnings and a positive role of accounting conservatism in connection with executive bonus pay, along with a significant reduction of the asymmetry in the relationship between executive bonus compensation and earnings in the post-SOX period is likely to be useful information for managers, politicians, investors, and academics in their assessment of the equitable relationship between executive efforts and executive bonus compensation.

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TABLE 1

Sample Selection

Firm-Year Observations with available CEO Bonus and Stock Compensation Data in ExecuComp (1992 to 2005)		25,653
Less:		
Observations with insufficient data to compute the change form of Compensation and Missing Non-Compensation Data (ExecuComp)		(8,314)
Observations with insufficient CRSP data		(2,995)
Observations with insufficient COMPUSTAT and institutional ownership data		(2,690)
Financial institutions (SICs between 6000 and 6999) and utilities (SICs between 4400 and 5000)		(6,322)
Total Firm-Year Observations		5,332
Annual Abnormal Return (ANNMAR):		
Positive (Good News)	2,766	
Negative (Bad News)	2,566	5,332

Table 2
Descriptive Statistics

Variables	All Firms *N = 5,332* Mean	Median	Std	Bad News (ANNMAR<0) N = 2,566 Mean	Median	Std	Good News (ANNMAR≥0) N = 2,766 Mean	Median	Std	Student's t	Wilcoxon z
BON	1.14	0.79	2.10	0.99	0.67	1.57	1.28	0.90	2.48	-5.14***	-9.44***
STOCK	3.07	1.13	8.99	2.98	1.05	9.61	3.15	1.24	8.37	-0.70	-2.43**
ΔBON	0.05	0.00	2.21	-0.12	0.00	2.24	0.22	0.07	2.17	-5.66***	-11.81***
ΔSTOCK	-3.08	-1.12	9.04	-3.00	-1.05	9.67	-3.15	-1.22	8.41	0.58	2.16**
ΔTCOG	0.59	0.20	15.86	0.27	0.10	19.90	0.90	0.31	10.83	-1.44	-4.95***
ANNMRR	0.18	0.13	0.43	-0.08	-0.06	0.22	0.43	0.36	0.43	-53.98***	-51.48***
ANNMAR	0.08	0.01	0.41	-0.20	-0.17	0.15	0.34	0.23	0.40	-65.68***	-63.19***
ROA	0.08	0.07	0.05	0.08	0.07	0.06	0.08	0.07	0.05	-2.32**	-2.89***
ROE	0.19	0.16	0.31	0.19	0.15	0.26	0.20	0.16	0.35	-1.09	-3.96***
EPSP	0.06	0.05	0.04	0.05	0.05	0.03	0.07	0.06	0.05	-10.21***	-9.89***
EPSEIP	0.06	0.05	0.05	0.05	0.05	0.04	0.07	0.06	0.06	-8.69***	-8.94***
ΔROA	0.001	0.002	0.04	-0.004	-0.001	0.04	0.004	0.004	0.04	-8.71***	-10.18***
ΔROE	0.004	0.002	0.30	-0.006	-0.003	0.25	0.014	0.007	0.34	-2.51**	-9.28***
ΔEPSP	0.004	0.004	0.04	0.001	0.002	0.03	0.008	0.006	0.04	-7.06***	-8.13***
ΔEPSEIP	0.005	0.004	0.06	0.002	0.002	0.05	0.009	0.006	0.07	-4.16***	-7.48***
SALE	6318	1660	18172	6231	1628	17864	6398	1695	18456	-0.33	-1.22
FAGE	31	28	18	31	27	18	32	28	19	-1.31	-1.23
LEVERAGE	0.21	0.20	0.15	0.21	0.21	0.15	0.20	0.12	0.15	2.11**	2.25**
MTB	3.85	2.61	13.54	3.42	2.41	4.69	4.25	2.81	18.23	-2.22**	-8.42***
IMA	0.94	0.95	0.53	0.96	0.97	0.68	0.92	0.94	0.34	2.48**	2.45**
ARI	0.44	0.49	0.27	0.46	0.50	0.27	0.43	0.48	0.28	2.76***	2.50**
EQUITYINC	0.04	0.02	0.07	0.04	0.02	0.07	0.04	0.02	0.07	-0.43	-0.45
LMVE	7.70	7.52	1.60	7.57	7.44	1.62	7.76	7.61	1.57	-4.41***	-4.54***
EPSSTD	0.92	0.62	1.17	0.91	0.60	1.27	0.93	0.65	1.08	-0.54	-3.12***
RETSTD	0.10	0.10	0.04	0.10	0.09	0.04	0.11	0.10	0.04	-6.63***	-8.86***
INST	0.64	0.66	0.20	0.62	0.64	0.20	0.66	0.68	0.19	-7.78***	-7.77***
EAGE	73	75	11	73	75	11	73	75	10	1.68*	2.46**
IOS	0.02	-0.55	2.41	0.03	-0.53	2.48	0.01	-0.56	2.33	0.20	0.39
NOAA	-0.01	-0.01	0.05	-0.01	-0.01	0.05	-0.02	-0.01	0.05	2.95***	4.15***
CFOA	0.14	0.12	0.09	0.13	0.12	0.09	0.14	0.13	0.10	-6.03***	-6.53***
TAA	0.01	0.00	0.06	0.01	0.01	0.06	0.001	-0.004	0.07	4.91***	7.20***

[a] BON=$BONUS_t/SALARY_{t-1}$; STOCK=(Restricted Stock $Grants_t$ + Black-Scholes Option $Awards_t$)/ $SALARY_{t-1}$; ΔBON=$BON_t - BON_{t-1}$; ΔSTOCK = $STOCK_t - STOCK_{t-1}$; ΔSALBON = $SALBON_t - SALBON_{t-1}$,where SALBON = SALARY + BON and SALARY= $SALARY_t/SALARY_{t-1}$; ΔTCOG = $TCOG_t - TCOG_{t-1}$, where TCOG = Total Compensation including Option Grants deflated by $SALARY_{t-1}$; ANNMRR = Cumulative Monthly Raw Returns for Fiscal Year t from CRSP; ANNMAR= Cumulative Monthly Market-Adjusted Returns for Fiscal Year t from CRSP where Market-Adjusted Returns = Raw Returns – Value-Weighted Market Returns; ROA = Net Income before Extraordinary Items and Discontinued Operations/Total Assets; ROE=Net Income before Extraordinary Items and Discontinued Operations/Average Common Equity; EPSP = EPS excluding Extraordinary Items and Discontinued $\text{Operations})_t/(\text{Stock Price})_{t-1}$; EPSEIP = (EPS including Extraordinary Items and Discontinued $\text{Operations})_t/(\text{Stock Price})_{t-1}$; ΔROA = $ROA_t - ROA_{t-1}$; ΔROE= $ROE_t - ROE_{t-1}$; ΔEPSP = $EPSP_t - EPSP_{t-1}$; ΔEPSEIP = $EPSEIP_t - EPSEIP_{t-1}$; Sale = Net Sales (compustat #12); FAGE= fiscal year t of the observation minus the year the firm first appeared on CRSP; LEVERAGE = Long-Term Debt plus The Current Portion of Long-term Debt (compustat # 9 + compustat #34)/Total Assets (compustat #6); MTB = Market Value of Equity/Book Value of Common Equity from ExecuComp; IMA=Persistence Measure based on the Integrated Moving Average model; ARI=Persistence Measure based on the Integrated Autoregressive model; EQUITYINC = (RSHN + OPTIONN + EOPN + UEOPN +

Table 2 (continued)

SHOWN)/(SHOUT * 1,000), where RSHN = Restricted Stock Holdings (in Thousand Shares), OPTIONN = Options Granted (in Thousand Shares), EOPN=Exercisable Options (in Thousand Shares), UEOPN = Unexercisable Options (in Thousand Shares), SHOWN = Shares Owned with Options Excluded (in Thousand Shares), and SHOUT=Common Shares Outstanding (in Million Shares); LMVE=Log(Market Value of Equity from ExecuComp); EPSSTD = Earnings Volatility measured by Standard Deviation of Annual Basic Earnings per Share over the past 7 years; RETSTD = Stock Return Volatility measured by Standard Deviation of Monthly Returns over the Prior 60 months; INST = Institutional Ownership in % from the TFSD Ownership Database x 100; EAGE= CEO age; EQUITYINT = (RSG + OPTION)/TCOG, where RSG= Restricted Stock Grants ($), OPTION=Option Grants ($), and TCOG=Total Compensation ($); IOS = the investment opportunity set composite, which is computed by performing the principal component analysis on the four IOS measures (Kwon and Yin 2006), from the all available observations for the period from 1993 to 2005; NOAA = nonoperating accruals deflated by total assets; CFOA = cash flow from operations deflated by total assets; and TAA = total accruals deflated by total assets.

Table 3

Spearman Correlation Coefficients[a]

Panel A: All Firms (N=5,332)

	ΔBON	ΔSTOCK	ANNMRR	ΔROA	ΔEPSP	SALE	FAGE	LEVERAGE	MTB	IMA	EQUITYINC	LMVE	EPSSTD	RETSTD	INST	EAGE	IOS	NOAA
		***	***	***	***	***						***	***		***		*	***
ΔBON	1.00	-0.09	0.19	0.33	0.31	0.04	0.02	0.01	0.07	0.01	-0.01	0.06	0.04	0.01	0.05	-0.02	-0.03	-0.05
						***	***	***	***	***	***	***	***	***	***	***	***	***
ΔSTOCK		1.00	0.01	-0.01	0.00	-0.33	-0.15	-0.10	-0.23	0.04	0.09	-0.41	-0.17	-0.05	-0.22	0.20	-0.17	0.07
				***	***		*	***	***			***	***		***		**	***
ANNMRR			1.00	0.18	0.14	0.01	-0.02	-0.05	0.17	-0.02	0.02	0.07	0.04	-0.01	0.06	-0.00	-0.03	-0.06
					***	***		***	***			***	***	**	***		*	***
ΔROA				1.00	0.73	0.04	0.01	-0.08	0.12	-0.01	-0.02	0.07	0.10	0.03	0.06	-0.01	-0.03	0.05
						*							***	***	***	*	***	***
ΔEPSP					1.00	0.02	-0.01	0.00	0.01	-0.01	0.01	0.00	0.07	0.05	0.06	-0.02	-0.06	0.04
							***	***	***	***	***	***	***	***	***	***	***	**
SALE						1.00	0.48	0.28	0.16	-0.08	-0.40	0.81	0.34	-0.25	0.16	-0.04	-0.05	-0.03
								***		***	***	***	***	***	***	***	***	***
FAGE							1.00	0.21	-0.00	-0.09	-0.38	0.37	0.28	-0.28	0.11	-0.07	-0.12	0.08
									***	***	***	***	***	***	***		***	***
LEVERAGE								1.00	-0.19	-0.08	-0.12	0.08	0.18	-0.16	0.06	-0.01	-0.13	0.07
										***	***	***	***	***	*	***	***	***
MTB									1.00	-0.05	-0.12	0.53	-0.09	-0.06	-0.02	-0.04	0.35	-0.13
											***	***	***		**	***	**	
IMA										1.00	0.04	-0.07	-0.10	0.02	-0.03	0.06	-0.03	0.01
												***	***	***	***	***		
EQUITYINC											1.00	-0.42	-0.16	0.21	-0.12	0.18	0.01	-0.02
													***	***	***	***	***	***
LMVE												1.00	0.24	-0.20	0.18	-0.06	0.20	-0.09
														***	***	***	***	
EPSSTD													1.00	-0.04	0.18	-0.07	-0.11	0.00
															***	***	***	***
RETSTD														1.00	0.19	-0.20	0.14	-0.11
																***		***
INST															1.00	-0.16	0.02	-0.09
																	***	***
CEOAGE																1.00	-0.06	0.06
																		***
IOS																	1.00	-0.10
NOAA																		1.00

[a] The variables are defined in Table 2. The symbols of *, **, and *** indicate statistical significance levels of 10%, 5%, and 1%, respectively, in two-tailed tests.

[b] See Table 2 for variable definitions.

Table 3 (continued)

Panel B: Bad News (ANNMAR < 0), N = 2,566

	ΔBON	ΔSTOCK	ANNMRR	ΔROA	ΔROE	ΔEPSP	ΔEPSEIP	NOAA
ΔBON	1.00	-0.05***	0.14***	0.33***	0.36***	0.32***	0.30***	-0.04**
ΔSTOCK		1.00	0.03	-0.02	-0.02	0.01	-0.01	0.08***
ANNMRR			1.00	0.13	0.12***	0.10***	0.13***	-0.01***
ΔROA				1.00	0.87***	0.76***	0.65***	0.06***
ΔROE					1.00	0.77***	0.66***	0.06***
ΔEPSP						1.00	0.86***	0.05***
ΔEPSEIP							1.00	0.04**
NOAA								1.00

Panel C: Good News (ANNMAR ≥ 0), N = 2,766

	ΔBON	ΔSTOCK	ANNMRR	ΔROA	ΔROE	ΔEPSP	ΔEPSEIP	NOAA
ΔBON	1.00	-0.11**	0.11***	0.29***	0.31***	0.27***	0.24***	-0.05***
ΔSTOCK		1.00	0.05***	0.01	0.02	0.01	0.03	0.06***
ANNMRR			1.00	0.14***	0.13***	0.11***	0.12***	-0.04**
ΔROA				1.00	0.86***	0.71***	0.62***	0.05***
ΔROE					1.00	0.70***	0.61***	0.03
ΔEPSP						1.00	0.87***	0.04*
ΔEPSEIP							1.00	0.02
NOAA								1.00

TABLE 4

Relationship between Changes in Bonus Compensation (ΔBON) and Independent Variables, including Changes in Accounting Earnings, Annual Raw Returns, and Other Control Variables 1993 through 2005 (t-statistics in parentheses)[a]

Panel A : Pooled Regression Results

Model:
$$\begin{aligned}\Delta BON_{i,t} = {} & \beta_0 + \beta_1 D_{it} + \beta_2 ANNMRR_{it} + \beta_3 D_{it} * ANNMRR_{it} + \beta_4 \Delta EPS_{it} + \\ & \beta_5 D_{it} * \Delta EPS_{it} + \beta_6 SALE_{it} + \beta_7 SALE^2_{it} + \beta_8 FAGE_{it} + \beta_9 LEVERAGE_{it} + \\ & \beta_{10} MTB_{it} + \beta_{11} PERS_{it} + \beta_{12} LOSSDUM_{it} + \beta_{13} EQUITYINC_{it} + \\ & \beta_{14} LMVE_{,it} + \beta_{15} EPSSTD_{i,t} + \beta_{16} RETSTD_{i,t} + \beta_{17} INST_{it} + \\ & \beta_{18} EAGE_{it} + \beta_{19} IOS_{it} + \beta_{20} NOAA_{it} + \Sigma\gamma_j YEAR_j + \varepsilon_{it} \qquad (1)\end{aligned}$$

			ΔE		
	ΔROA	ΔROA	ΔROE	ΔEPSP	ΔEPSEIP
	(1)	(2)	(3)	(4)	(5)
β_0 (intercept)	-0.004(-0.47)	0.010(1.01)	0.012(1.22)	0.010(1.06)	0.010(1.00)
β_1 (D)	-0.006(-0.64)	-0.003(-0.29)	-0.005(-0.48)	-0.006(-0.57)	-0.006(-0.56)
β_2 (ANNMRR)	0.051(4.18)***	0.055(4.39)***	0.057(4.59)***	0.056(4.53)***	0.062(4.96)***
β_3 (D*ANNMRR)	0.019(2.12)**	0.014(1.52)	0.016(1.71)*	0.016(1.73)*	0.015(1.61)
β_4 (ΔE)	0.080(6.88)***	0.088(7.75)***	0.205(6.44)***	0.103(9.06)***	0.100(6.56)***
β_5 (D*ΔE)	0.015(1.18)	0.015(1.27)	0.064(2.30)**	0.026(2.19)**	0.052(3.82)***
β_6 (SALE)	0.002(0.00)	-0.040(-0.93)	-0.038(-0.90)	-0.043(-1.02)	-0.038(-0.90)
β_7 ($SALE^2$)	0.010(0.00)	0.102(0.82)	0.093(0.74)	0.105(0.85)	0.096(0.76)
β_8 (FAGE)		0.007(0.80)	0.005(0.53)	0.007(0.81)	0.004(0.50)
β_9 (LEVERAGE)		0.018(2.38)**	0.013(1.66)*	0.012(1.64)	0.010(1.36)
β_{10} (MTB)		0.004(0.15)	-0.014(-0.47)	0.019(0.75)	0.021(0.81)
β_{11} (IMA)		0.025(2.22)**	0.023(2.02)**	0.021(1.90)*	0.022(1.99)**
β_{12} (LOSSDUM)		-0.067(-8.63)**	-0.065(-8.35)***	-0.065(-8.51)***	-0.068(-8.70)***
β_{13} (EQUITYINC)		0.019(2.20)*	0.020(2.34)**	0.018(2.13)**	0.020(2.36)**
β_{14} (LMVE)		0.015(1.22)	0.020(1.53)	0.019(1.52)	0.018(1.44)
β_{15} (EPSSTD)		0.005(0.45)	0.012(1.10)	-0.002(-0.17)	0.004(0.39)
β_{16} (RETSTD)		-0.004(-0.37)	-0.002(-0.15)	-0.011(-1.11)	-0.010(-1.03)
β_{17} (INST)		0.013(1.59)	0.014(1.73)*	0.017(2.09)**	0.018(2.24)**
β_{18} (EAGE)		-0.009(-1.24)	-0.009(-1.19)	-0.009(-1.21)	-0.008(-1.05)
β_{19} (IOS)		0.001(0.15)	0.003(0.28)	-0.002(-0.23)	-0.004(-0.41)
β_{20} (NOAA)		-0.042(-4.71)***	-0.039(-4.44)***	-0.038(-4.40)***	-0.036(-4.16)***
F-Value:	16.13***	12.45***	11.84***	13.90***	12.71***
Adj. R^2:	0.052	0.073	0.069	0.082	0.075
White's Heteroskedasticity test: Chi-square Value (p-value)[b]	198.03 (0.00)***	434.65 (0.96)	463.18(0.77)	430.70(0.96)	452.03(0.83)
No. of Observations	5,332	5,332	5,332	5,332	5,332

TABLE 4 (continued)

Panel B: Fama-MacBeth Regression Results

Model: $$\Delta BON_{i,t} = \beta_0 + \beta_1 D_{it} + \beta_2 ANNMRR_{it} + \beta_3 D_{it} * ANNMRR_{it} + \beta_4 \Delta EPS_{it} + \beta_5 D_{it} * \Delta EPS_{it} + \beta_6 SALE_{it} + \beta_7 SALE^2_{it} + \beta_8 FAGE_{it} + \beta_9 LEVERAGE_{it} + \beta_{10} MTB_{it} + \beta_{11} PERS_{it} + \beta_{12} LOSSDUM_{it} + \beta_{13} EQUITYINC_{it} + \beta_{14} LMVE_{,it} + \beta_{15} EPSSTD_{i,t} + \beta_{16} RETSTD_{i,t} + \beta_{17} INST_{it} + \beta_{18} EAGE_{it} + \beta_{19} IOS_{it} + \beta_{20} NOAA_{it} + \Sigma\gamma_j YEAR_j + \varepsilon_{it} \quad (1)$$

			ΔE		
	ΔROA (1)	ΔROA (2)	ΔROE (3)	ΔEPSP (4)	ΔEPSEIP (5)
β_0 (intercept)	-0.014(-0.63)	-0.006(-0.22)	-0.007(-0.23)	-0.006(-0.22)	-0.010(-0.38)
β_1 (D)	0.001(0.09)	-0.006(-0.36)	-0.010(-0.54)	-0.006(-0.35)	-0.007(-0.41)
β_2 (ANNMRR)	0.061(2.78)***	0.068(2.94)***	0.070(2.70)***	0.077(3.40)***	0.082(3.66)***
β_3 (D*ANNMRR)	0.043(1.98)**	0.025(1.09)	0.025(1.00)	0.031(1.55)	0.032(1.44)
β_4 (ΔE)	0.124(6.45)**	0.129(4.09)***	0.336(5.11)***	0.125(5.62)***	0.112(4.92)***
β_5 (D*ΔE)	0.012(0.69)	0.011(0.40)	0.014(0.27)	0.064(4.93)***	0.052(3.28)***
β_6 (SALE)	0.023(0.50)	-0.045(-0.50)	-0.034(-0.39)	-0.022(-0.29)	-0.024(-0.30)
β_7 ($SALE^2$)	-0.080(-0.30)	-0.025(-0.07)	-0.075(-0.21)	-0.071(-0.21)	-0.077(-0.22)
β_8 (FAGE)		-0.002(-0.14)	-0.007(-0.46)	-0.006(-0.37)	-0.007(-0.45)
β_9 (LEVERAGE)		0.013(1.41)	0.004(0.34)	0.008(0.74)	0.007(0.66)
β_{10} (MTB)		0.010(0.73)	-0.037(-2.09)**	0.012(0.98)	0.019(1.44)
β_{11} (IMA)		0.013(0.83)	0.013(0.94)	0.014(0.95)	0.015(1.02)
β_{12} (LOSSDUM)		-0.084(-5.11)***	-0.083(-5.02)***	-0.084(-5.08)***	-0.086(-5.60)***
β_{13} (EQUITYINC)		0.023(1.50)	0.025(1.76)*	0.028(1.99)**	0.032(2.27)**
β_{14} (LMVE)		0.041(2.02)**	0.046(2.36)**	0.038(1.99)**	0.043(2.33)**
β_{15} (EPSSTD)		-0.007(-0.87)	-0.001(-0.21)	-0.005(-0.49)	-0.003(-0.31)
β_{16} (RETSTD)		-0.011(-0.84)	-0.005(-0.35)	-0.016(-1.06)	-0.013(-0.81)
β_{17} (INST)		0.015(1.70)*	0.012(1.37)	0.016(1.77)*	0.018(1.92)*
β_{18} (EAGE)		-0.010(-0.96)	-0.010(-1.16)	-0.010(-1.04)	-0.009(-1.06)
β_{19} (IOS)		0.002(0.16)	0.008(0.58)	0.004(0.25)	0.002(0.16)
β_{20} (NOAA)		-0.054(-4.96)***	-0.053(-4.16)***	-0.043(-3.55)***	-0.039(-3.34)***
Adj. R^2:	0.080	0.105	0.109	0.118	0.104

Average No. of Observations per Year: 410

[a] The variables are defined in Table 2. The symbols *, **, and *** indicate statistical significance levels of 10%, 5%, and 1%, respectively, in two-tailed tests.
[b] White's (1980) heteroskedasticity tests for violations of assumptions of homoskedastic errors and independence between the errors and regressors. Whenever violations occur at 10% or higher levels, White's t values replace Student's t values.
[c] See Table 2 for variable definitions.

TABLE 5
Relationship between Changes in Equity-Based Compensation (ΔSTOCK) and Independent Variables, including Changes in Accounting Earnings, Annual Raw Returns, and Other Control Variables
1993 through 2005 (t-statistics in parentheses)[a]

Panel A: Pooled Regression Results

Model: $$\Delta STOCK_{i,t} = \beta_0 + \beta_1 D_{it} + \beta_2 ANNMRR_{it} + \beta_3 D_{it} * ANNMRR_{it} + \beta_4 \Delta EPS_{it} + \beta_5 D_{it} * \Delta EPS_{it} + \beta_6 SALE_{it} + \beta_7 SALE^2_{it} + \beta_8 FAGE_{it} + \beta_9 LEVERAGE_{it} + \beta_{10} MTB_{it} + \beta_{11} PERS_{it} + \beta_{12} LOSSDUM_{it} + \beta_{13} EQUITYINC_{it} + \beta_{14} LMVE_{,it} + \beta_{15} EPSSTD_{i,t} + \beta_{16} RETSTD_{i,t} + \beta_{17} INST_{it} + \beta_{18} EAGE_{it} + \beta_{19} IOS_{it} + \beta_{20} NOAA_{it} + \Sigma\gamma_j YEAR_j + \varepsilon_{it} \quad (1)$$

	ΔEPS			
	ΔROA	ΔROE	ΔEPSP	ΔEPSEIP
β_0 (intercept)	0.037(3.93)***	0.039(4.14)***	0.039(4.09)***	0.039(4.06)***
β_1 (D)	-0.005(-0.52)	-0.006(-0.66)	-0.005(-0.48)	-0.005(-0.49)
β_2 (ANNMRR)	0.002(0.14)	0.001(0.00)	0.002(0.14)	0.002(0.14)
β_3 (D*ANNMRR)	0.005(0.48)	0.006(0.59)	0.005(0.47)	0.005(0.48)
β_4 (ΔEPS)	0.026(1.81)*	0.075(2.33)**	0.019(1.54)	0.031(2.10)**
β_5 (D*ΔEPS)	-0.010(-0.73)	-0.046(-1.63)	-0.005(-0.45)	-0.013(-1.12)
β_6 (SALE)	-0.001(-0.00)	-0.005(-0.10)	-0.001(-0.00)	0.001(0.00)
β_7 ($SALE^2$)	0.036(0.28)	0.044(0.35)	0.038(0.30)	0.036(0.28)
β_8 (FAGE)	0.032(3.35)***	0.032(3.34)***	0.032(3.31)***	0.030(3.19)***
β_9 (LEVERAGE)	-0.009(-1.13)	-0.009(-1.17)	-0.009(-1.14)	-0.009(-1.15)
β_{10} (MTB)	-0.053(-2.11)**	-0.055(-1.87)*	-0.034(-1.45)	-0.033(-1.43)
β_{11} (IMA)	-0.029(-2.58)***	-0.030(-2.71)***	-0.028(-2.49)**	-0.029(-2.61)***
β_{12} (LOSSDUM)	0.001(0.00)	0.001(0.17)	0.001(0.00)	0.001(0.14)
β_{13} (EQUITYINC)	-0.002(-0.33)	-0.001(-0.20)	-0.002(-0.25)	-0.001(-0.17)
β_{14} (LMVE)	-0.182(-13.42)***	-0.179(-13.07)***	-0.183(-13.34)***	-0.182(-13.27)***
β_{15} (EPSSTD)	-0.036(-2.87)***	-0.034(-2.77)***	-0.037(-2.91)***	-0.035(-2.77)***
β_{16} (RETSTD)	-0.058(-6.62)***	-0.056(-6.44)***	-0.059(-6.66)***	-0.058(-6.61)***
β_{17} (INST)	-0.036(-4.20)***	-0.036(-4.18)***	-0.036(-4.12)***	-0.036(-4.15)***
β_{18} (EAGE)	0.020(3.23)***	0.021(3.24)***	0.021(3.30)***	0.021(3.29)***
β_{19} (IOS)	-0.048(-3.59)***	-0.048(-3.60)***	-0.049(-3.57)***	-0.049(-3.59)***
β_{20} (NOAA)	0.017(1.77)*	0.017(1.80)*	0.018(1.87)*	0.019(1.94)*
F-Value:	30.79***	30.75***	30.63***	30.49***
Adj. R^2:	0.170	0.170	0.170	0.169
White's Heteroskedasticity test: Chi-square Value (p-value)[b]	609.96 (0.01)***	608.03(0.00)***	601.03(0.00)***	597.31(0.00)***
No. of Observations	5,332	5,332	5,332	5,332

Panel B: Fama-MacBeth Regression Results

$$\text{Model: } \Delta STOCK_{i,t} = \beta_0 + \beta_1 D_{it} + \beta_2 ANNMRR_{it} + \beta_3 D_{it} * ANNMRR_{it} + \beta_4 \Delta EPS_{it} + \beta_5 D_{it} * \Delta EPS_{it} + \beta_6 SALE_{it} + \beta_7 SALE^2_{it} + \beta_8 FAGE_{it} + \beta_9 LEVERAGE_{it} + \beta_{10} MTB_{it} + \beta_{11} PERS_{it} + \beta_{12} LOSSDUM_{it} + \beta_{13} EQUITYINC_{it} + \beta_{14} LMVE_{,it} + \beta_{15} EPSSTD_{i,t} + \beta_{16} RETSTD_{i,t} + \beta_{17} INST_{it} + \beta_{18} EAGE_{it} + \beta_{19} IOS_{it} + \beta_{20} NOAA_{it} + \Sigma\gamma_j YEAR_j + \varepsilon_{it} \quad (1)$$

	ΔEPS			
	ΔROA	ΔROE	ΔEPSP	ΔEPSEIP
β_0 (intercept)	0.051(2.88)***	0.050(2.80)***	0.052(2.92)***	0.053(2.99)***
β_1 (D)	0.008(0.66)	0.010(0.90)	0.009(0.76)	0.012(1.02)
β_2 (ANNMRR)	0.004(0.22)	0.002(0.14)	0.002(0.08)	0.002(0.12)
β_3 (D*ANNMRR)	0.016(1.02)	0.017(1.12)	0.016(1.01)	0.017(1.07)
β_4 (ΔEPS)	0.018(0.87)	0.084(2.17)**	0.006(0.64)	0.029(2.35)**
β_5 (D*ΔEPS)	-0.001(-0.02)	-0.082(-1.48)	-0.002(-0.15)	-0.026(-2.32)**
β_6 (SALE)	-0.044(-0.49)	-0.051(-0.55)	-0.047(-0.52)	-0.049(-0.54)
β_7 ($SALE^2$)	0.199(0.72)	0.214(0.77)	0.213(0.77)	0.217(0.79)
β_8 (FAGE)	0.053(4.49)***	0.053(4.52)***	0.054(4.88)***	0.053(4.70)***
β_9 (LEVERAGE)	-0.025(-2.83)***	-0.026(-2.79)***	-0.027(-2.93)***	-0.026(-2.94)***
β_{10} (MTB)	-0.106(-2.13)**	-0.110(-2.45)**	-0.099(-2.02)**	-0.099(-2.00)**
β_{11} (IMA)	-0.044(-2.75)***	-0.045(-2.57)**	-0.045(-2.64)***	-0.045(-2.71)***
β_{12} (LOSSDUM)	-0.007(-0.60)	-0.008(-0.72)	-0.007(-0.57)	-0.007(-0.56)
β_{13} (EQUITYINC)	0.009(1.42)	0.008(1.15)	0.009(1.47)	0.009(1.62)
β_{14} (LMVE)	-0.194(-9.00)***	-0.189(-8.36)***	-0.193(-8.59)***	-0.191(-8.47)***
β_{15} (EPSSTD)	-0.047(-3.57)***	-0.047(-3.52)***	-0.049(-3.79)***	-0.051(-3.99)***
β_{16} (RETSTD)	-0.050(-4.64)**	-0.052(-4.94)***	-0.053(-5.00)***	-0.054(-4.98)***
β_{17} (INST)	-0.045(-7.12)***	-0.046(-6.86)***	-0.045(-6.92)***	-0.045(-7.07)***
β_{18} (EAGE)	0.018(2.43)**	0.020(2.82)***	0.021(2.84)***	0.021(2.93)***
β_{19} (IOS)	-0.080(-4.49)***	-0.077(-4.54)***	-0.079(-4.39)***	-0.078(-4.39)***
β_{20} (NOAA)	0.002(0.14)	0.001(0.01)	0.003(0.21)	0.005(0.36)
Adj. R^2:	0.161	0.157	0.154	0.155
Average No. of Observations per Year:	410			

[a] The variables are defined in Table 2. The symbols *, **, and *** indicate statistical significance levels of 10%, 5%, and 1%, respectively, in two-tailed tests.

[b] White's (1980) heteroskedasticity tests for violations of assumptions of homoskedastic errors and independence between the errors and regressors. Whenever violations occur at 10% or higher levels, White's t values replace Student's t values.

[c] See Table 2 for variable definitions.

Table 6
Comparison of Cumulative Nonoperating Accruals as a Proxy for Conservatism (NOAA)
Between two sub-periods

Panel A: Full Sample

NOAA				Comparison	
Mean	*Median*	*Mean*	*Median*	*Student's t*	*Wilcoxon Rank-Sum Z*
1997-2000 (n=1730)		vs. **2002-2005** (n=1813)			
-0.012	**-0.007**	**-0.016**	**-0.012**	**2.46****	**4.87*****

Panel B: Constant Sample (115 firms per year)

NOAA				Comparison	
Mean	*Median*	*Mean*	*Median*	*Sign Z*	*Wilcoxon Signed-Rank Z*
1997-2000 (n=460)		vs. **2002-2005** (n=460)			
-0.011	**-0.006**	**-0.015**	**-0.012**	**2.01****	**2.60****

[a] **Wilcoxon rank-sum, Two Sample t tests, Sign tests, and Wilcoxon signed-rank tests are performed between two different periods. The symbols of * and ** indicate statistical significance levels of 5% and 1%, respectively, in two-tailed tests. Many observations are lost in constructing constant firms across all sample years.**
[b] **See Table 2 for variable definitions.**

Table 7
Comparisons of Modified Jones Discretionary Accruals (DA) and Performance-Matched Discretionary Accruals (PMDA)
Pre-SOX period vs. Post-SOX period

1997-2000 (Pre-SOX period) vs. 2002-2005 (Post-SOX period)

1997-2000 (N=1514)		2002-2005 (N=1401)		Comparison	
Mean	*Median*	*Mean*	*Median*	*Student's t (P-Value)*	*Wilcoxon Z (P-Value)*
Modified Jones Discretionary Accruals (│DA│)					
18.262	**0.434**	**15.070**	**0.296**	**0.61 (0.54)**	**2.57 (0.01)*****
Performance-Matched Discretionary Accruals (│PMDA│)					
25.761	**0.815**	**24.177**	**0.739**	**0.26 (0.79)**	**1.43 (0.15)**

[a] Wilcoxon rank-sum and Two Sample t tests are performed between two different periods. The symbols of * and ** indicate statistical significance levels of 5% and 1%, respectively, in two-tailed tests. │DA│ = the absolute value of modified Jones discretionary accruals, and │PMDA│ = the absolute value of performance-matched discretionary accruals.
[b] See Table 2 for variable definitions.

Table 8
Relationship between Changes in Bonus Compensation and Changes in Accounting Earnings, Annual Raw Returns, and the Conservatism Proxy Variable (Coefficients with t-statistics in parentheses[a])

	Pooled				Fama-MacBeth			
	ΔE				ΔE			
	ΔROA	ΔROE	ΔEPSP	ΔEPSEIP	ΔROA	ΔROE	ΔEPSP	ΔEPSEIP
Panel A: 1997-2000 (Pre-SOX Period)								
ANNMRR	0.111	0.113	0.108	0.111	0.095	0.097	0.102	0.096
	(2.92)***	(2.98)***	(2.87)***	(2.93)***	(1.99)**	(1.69)*	(2.04)**	(2.38)**
ANNMRR*D	0.023	0.027	0.026	0.033	0.034	0.036	0.030	0.038
	(0.86)	(1.03)	(1.01)	(1.25)	(0.79)	(0.79)	(0.74)	(1.02)
ΔEPS	0.140	0.153	0.151	0.157	0.124	0.220	0.136	0.162
	(4.61)***	(3.32)***	(4.71)***	(4.01)***	(3.33)***	(2.32)**	(3.97)**	(3.80)***
ΔEPS*D	0.019	0.118	0.066	0.071	0.032	0.099	0.087	0.065
	(0.62)	(2.33)**	(1.98)**	(1.69)*	(0.65)	(3.89)***	(3.99)***	(1.86)*
NOAA	-0.045	-0.047	-0.039	-0.032	-0.037	-0.040	-0.026	-0.023
	(-1.80)*	(-1.90)*	(-1.62)	(-1.30)	(-2.42)**	(-3.27)***	(-2.16) **	(-2.12)**
Other control variables are included but not reported.								
Panel B: 2002-2005 (Post-SOX Period)								
ANNMRR	0.065	0.073	0.067	0.070	0.067	0.071	0.068	0.073
	(3.07)***	(3.46)***	(3.16)***	(3.26)***	(1.49)	(1.59)	(1.63)	(1.74)*
ANNMRR*D	0.009	0.011	0.011	0.009	0.037	0.044	0.036	0.045
	(0.63)	(0.78)	(0.74)	(0.60)	(0.89)	(1.02)	(0.81)	(0.91)
ΔEPS	0.099	0.265	0.085	0.064	0.112	0.503	0.104	0.057
	(5.04)***	(3.83)***	(4.50)***	(2.84)***	(3.63)***	(4.69)***	(2.23)**	(3.18)***
ΔEPS*D	-0.010	0.019	0.033	0.030	-0.013	-0.144	0.037	0.025
	(-0.46)	(0.31)	(1.49)	(1.18)	(-0.49)	(-1.24)	(1.77)*	(1.05)
NOAA	-0.042	-0.038	-0.039	-0.037	-0.061	-0.057	-0.057	-0.054
	(-2.86)***	(-2.67)***	(-2.67)***	(-2.57)***	(-3.73)***	(-3.73)***	(-3.45)***	(-3.49)***
Other control variables are included but not reported.								

[a] The variables are defined in Table 2. The symbols of *, **, and *** indicate statistical significance levels of 10%, 5%, and 1%, respectively, in two-tailed tests.
[b] See Table 2 for variable definitions.

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□ □ □ □ □ □ The Impact of Financial Leverage on Financial Performance: Empirical Evidence of Listed Sugar Companies in Vietnam

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Influence of financial decisions on financial performance is critical issue for academic researcher and investors since past few decades in developing economic. The purpose of this paper is to examine the impact financial leverage on financial performance from sugar manufacturing section in Vietnam. Sugar manufacturing companies have listed on Ho Chi Minh City Stock Exchange (HOSE) and Hanoi Stock Exchange (HNX). For measuring the performance of the firms Return on Assets (ROA), Return on Equity (ROE), Net Profit Margin (NPM) and Earning per Share Growth (EPSG) are used as proxies. Debt to Equity Ratio (DER) is variables for the capital structure. Controlled variables installed in the research as firm's age (AGE), size (SIZE) impact on relationship between financial leverage and financial performance. Surveyed companies are six. Data is taken from period 2009 to 2013. The panel data is analysed by using the Pooled regression model, Fixed Effect Model (FEM), Random Effect Model (REM) and Generalized Least Square (GLS). The result shows the negative impact and significant of financial leverage on financial performance as Earnings Per Share Growth, Net Profit Margin and Return On Assets. Firm's age negatively impacts and significant on financial performance as Earnings Per Share Growth, Net Profit Margin. Firm size negatively impacts and significant on financial performance as Return on Equity. The conclusion, limitation and recommendation area of research are also discussed at the end of the research. The research provides useful recommendations for policy direction and management of Vietnamese listed sugar companies.

Keywords: Financial leverage, financial performance, sugar companies, Vietnam, panel data, firm's age, firm size, FEM, REM, GLS.

1. Introduction

Financial leverage plays an important role in corporate finance. Financial leverage is a measure of how much firms use equity and debt to finance its assets. Firm finances its operation and investment by multiple financing resources. The financing resources classify into two main categories. First, the internal financing includes common stock issuance, reserves, retained earnings, and preferred stocks. Second, resource identify the external financing which consisting the short-term, long-term debt and the issuance of bonds. Firm often likes to finance by debt because firm can deduct interest expenses when calculating taxable income. The financial leverage employs by a firm is intended to earn more on the fixed charges funds than their costs. Moreover, stockholders can maintain control of a firm without increasing their investment. When debt increases, the financial risk of the company also increases, make firm bankruptcy. But, it increases the opportunity for the firm to earn more by efficiently utilization of these resources. Balancing between benefit and cost associated with debt financing are right decision, avoid affecting shareholder's benefit. Due to purpose of financial management is to maximum shareholder's wealth. Therefore, the capital of any organization is a significant dynamic for firm's existence and growth as well as it has key roles in the financial performance of the firm to achieve the long-term goals and objects of the organization.

Vietnam's sugar industry really takes shape in southern Vietnam in the early 20th century, and concentrates in the central and Mekong river delta regions. Products of sugar industry mainly supply to the domestic demand. But, most of Vietnamese listed sugar firms' after – tax profit declines in 2013. Losses resulted is mentioned is the low sugar price and high interest rates (Hung, 2014). Vietnamese firm's financial leverage increases high. According to Son (2012) in recent years, the debt to equity ratio of local firms is 120%, higher than regional average is 45%. High leverage affects how firm's financial performance ratio? When financial performance is decreased, it is signal for shareholder, investor and creditor. And the market will reflect stock price on the stock exchange. Their price/earnings ratios based on 2013 numbers are between 5X and 10X. Some of the companies are trading 20% below their book values and the dividend yields are around 8-12% (AFC, 2014). Therefore, the importance of financial leverage for Vietnamese listed sugar companies is necessary. The companies needs the optimal financing resources towards reaching the optimal capital structure intended for to consistency with firm's requirements towards making suitable financing decisions and followed by return significantly on their financial performance as firms output.

The objective of the research is empirically investigate the main role of financial leverage, firm's age, firm size on the firm's financial performance of Vietnamese listed sugar companies for the period 2009 – 2013 in Ho Chi Minh City Stock Exchange (HOSE) and Hanoi Stock Exchange (HNX).

This research aims to answer the question is: what is the impact of financial leverage on financial performance of listed sugar companies in Vietnam?

This research has important decision-making implications for the manager, academic researchers, shareholders with reason that the quality accounting information has become very important in current situation, with the purpose of such benefits it is very important in

Vietnam. Now, financial leverage, firm's age, firm size, and financial performance have to be converted into important decisions. They are assumed that there is strong and critical relationship among financial leverage, firm's age, firm size, and financial performance. In this research examines new evidences on the linkages among financial leverage firm's age, firm size, and financial performance.

Content of this paper is structured as follows: introduction, literature review and hypothesis, research methodology, data analysis and discussion, conclusion and future research.

2. Literature review and hypotheses

Structure of this section consists of seven parts. The first and second sections are popular definitions of financial leverage and financial performance. The third one presents the relationship between financial leverage and financial performance. The fourth one presents the empirical evidences. The fifth one presents the relationship among financial leverage, firm's age, firm size and financial performance. The sixth one is hypothesis development. The last is conceptual model.

The concept of financial leverage

Financial leverage shows the amount of debts representing in capital structure of the company (Mehta, 2014). Firm uses debt financing due to some benefits as 1) By raising funds through debt, stockholders can maintain control of a firm without increasing their investment, 2) If the firm earns more on investments financed with borrowed funds than it pays in interest, then its shareholders' returns are magnified (Brigham et al., 2011). Besides, financial leverage increases with the increase in the percentage of debts which causes to increase the risk as liquidation and even bankruptcy.

There are many measures of financial leverage as total debt ratio, debt to equity ratio and market debt ratio. Total debt ratio measure the percentage of funds provided by current liabilities and long-term debt. Debt to equity ratio indicates what proportion of equity and debt in firm is using to finance its assets. Market debt ratio reflects a source of risk that is not captured by the conventional book debt ratio (Brigham et al., 2011). Among them, debt to equity ratio is an important tool of financial analysis to evaluate the financial structure of firm. It basically indicates the relative proportion of debt and equity in financing the assets of the firms.

The choice of financial leverage measurement depends on research objective. Financial leverage in this analysis is assumed to arise as firms venture to borrow capital when they expect to earn more than the cost of debt capital. So, the research uses debt to equity ratio.

The concept of financial performance

Financial performance generally measures of a firm's overall financial health over a given period of time (Gweyi et al., 2014). Financial performance provides a subjective measure of how well a company can use assets from its primary mode of business and generate revenues. A number of different accounting measures for calculating firm performance. Financial performance indicators in the form of ratios include profitability, utilization financial structure and investment – shareholder ratio (Brigham et al., 2011). Measure of profitability is by Net Profit Margin (NPM), Earnings Per Share Growth (EPSG). Net Profit Margin shows how much each sales dollar shows up as net income after all expenses are paid. This ratio might be the most important for shareholders and investors, as it give them a tough view of how well their businesses are at the last. EPS Growth is defined as the percentage change in normalised earnings per share over the previous 12 month period to the latest year end. It gives a good picture of the rate at which a company has grown its profitability per unit of equity. The performance of the sugar companies will be measured by Return On Assets (ROA). ROA is defined as net income divided by total assets. ROA shows the efficiency with the company is managing its investment in assets and using them to generate profit. Another measure of profitability is the Return On Equity (ROE). Return On Equity measures the rate of return on the ownership interest of the common stock owners. ROE shows how well a company uses investment funds to generate earnings growth.

These indicators are the most popular to measure financial performances and used in many researches such as Pratheepkanth (2007), Rehman (2013). So, these financial performance indicators are focused in this research.

Theory about financial leverage and financial performance

Many researchers have focused on the relationship between financial leverage and financial performance. Some of these researches are:

Modigliani and Miller (1958) published a paper about capital structure. They concluded capital structure had no influence on firm value. It was irrelevance and argument result, but it contributed important for developing capital structure theory.

Modigliani Miller (1963) found that in the presence of corporate income taxes but in the absence of the bankruptcy risk, there was a linear relationship between the value of the levered firm and that of its debt. This implied that a firm should maximize it used of debt in order to enjoy the benefit of tax subsidy on interest payments.

Kraus and Litzenberger (1973) suggested that trade-off theory. The theory referred to the optimal capital structure was determined by balancing benefits and cost associated with debt financing. Debt financing benefits included tax savings, reducing agency cost and the financial distress cost, and the cost associated to debt financing was direct and indirect bankruptcy costs.

According to Myers (1977), the cost of high leverage could lead to a negative relationship between leverage and firm performance. Debt overhang problems created underinvestment problems and cause poor firm performance. Even if firms with high leverage had new investment projects that generated positive net present values, they couldn’t issue new junior debt. Because the earnings generated by new investment projects were used to pay off debts to existing debt holders, new junior debtors did not obtain adequate payments from the earnings of new projects. Therefore, banks and other creditors did not offer credit for new projects with positive net present values. As highly leveraged firms couldn’t obtain enough credit, they could lose potential profits from profitable investment opportunities of which they were unable to take advantage.

Myers and Majluf in (1984) suggested pecking order theory. This theory stated that because of information asymmetry between firms managers and investors it was probable that investors would under value the new issued stock, so to avoid this problem the company first priority was to use its internal sources “retained earnings” to finance its investments, if they were not sufficient then debt was issue and when it was not useful to issue any more debt, then equity is issue. So they could conclude that if firm was profitable its retained earnings would be high and it would use its retained earnings for its financial needs, so it employed that there is negative relationship between leverage and firms profitability

Jensen (1986) argued the threat of defaulting on debt payments makes firms more efficient. As highly leveraged firms that had large amounts of debt have to pay off debts and make interest payments, they had an incentive to earn more cash from efficient investments and to enhance their performance. Furthermore, because of the threat of default on debt payments, they did not increase their debts and finance profitable investment opportunities without using debt.

To sum it up, theoretical literature provides opposite arguments on the relationship between leverage and corporate performance. Therefore, has empirical literature decided between theories?

The empirical evidences

The empirical studies have been performed to analyse the relationship between leverage and corporate performance.

Pratheepkanth (2007) researched the impact capital structure and financial performance of business firm listed at Colombo Stock Exchange during the study period (2005 - 2009). The result of study showed that the leverage finance impacted negatively on financial performance of small business. The capital structure indicator was measured by debt equity ratio. The financial performance indicators were used in the study such as Return On Assets, Return On Investment, Net Profit Margin, Gross Profit. The sample size consisted of 30 business companies listed at Colombo Stock Exchange. They used descriptive statistics to describe and summarize the behaviour of the variables in a study. And correlation analysis was used to find out the relationship between capital structure and financial performance. And regression mode was used to analyse the impact of financial leverage. Business firm depended on debt capital.

Singapurwoko et al. (2011) studied the impact of financial leverage to profitability study of non-financial companies listed in Indonesia Stock Exchange during the study period (2003 - 2008). The results of the study showed debt, firm size, and operational decision affected positively significant, and macroeconomics affected insignificantly towards profitability. And, industry factor was found to affect companies’ profitability. They used debt and combined other factors such as operational decision, macroeconomics, firm size, and industry to understand the effect of debt to profitability. The profit indicator was Return On Equity. The financial leverage was measured by using Equity Multiplier. The operational decision was measured by Total Assets Turnover. The macroeconomics indicator was measured by Bank Indonesia rate. Firm size was measured by the value of asset. The industrial indicator was qualitative measures. The sample size consisted of 48 listed non-financial companies in

Indonesian Stock Exchange. Regression and chi square analysis were used to find out the impact of financial leverage to profitability.

Ojo (2012) examined the effect of financial leverage on corporate performance in Nigeria. Data consisted of 17 firms were randomly selected and studied for a period ranging from 1993 to 2005. Financial leverage on Earnings Per Share indirectly affected the Net Assets Per Share of firms as the bulk of the shocks on the Net Assets Per Share was received from Earnings Per Share of the firms. Financial leverage indicator was Debt Equity Ratio. The corporate performance indicators were used in the study such as Earnings Per Share, Net Assets Per Share. He employed econometric technique of Vector Auto Regression (VAR) model. Financial leverage had substantial effect on corporate performance especially when the Net Assets Per Share was used as an indicator of corporate performance in Nigeria over the period covered by the study.

Rehman (2013) investigated relationship between financial leverage and financial performance of listed sugar companies in Pakistan during the study period. The results of the study showed that positive relationship of Debt Equity Ratio with Return On Assets and Sales Growth, and negative relationship of Debt Equity Ratio with Earnings Per Share, Net Profit Margin and Return On Equity. Financial leverage was measured by using Debt to Equity Ratio. Financial performance was measured by using five indicators including Return On Assets, Return On Equity, Earnings Per Share After Tax, Net Profit Margin, Sales Growth. The sample size consisted of 35 listed companies from sugar companies of Karachi Stock Exchange in period from 2006 to 2011. Descriptive statistics are used to describe and summarize the behaviour of the variables in a study. Correlation analysis was also used to find out the relationship between financial leverage and financial performance. The use of debt might make a positive or negative impact on financial performance.

Wabwile et al. (2014) researched the effect of financial leverage and financial performance of Tier 1 Commercial Banks Listed on Nairobi Security Exchange Kenya. The result of study showed that total debt to equity, debt to asset, have a negative effect on return on assets and return on capital employed, but none of them are significant. There was a positive correlation between financial leverage and EPS. Financial leverage was measured by using Debt to Equity Ratio, Debt to Asset ratio, Times interest earned ratio. Financial performance was by using four indicators including Return On Assets, Return on capital employed (ROCE), growth of the firm Earnings per share (EPS) and Dividend yield (DY) and value of the firm Price book value (PBV). The sample data was 6 commercial banks listed on Nairobi Security Exchange from the period 2007-2011. They collected data from financial statement of companies (2010-2012). Person correlation analysis and regression analysis were used to test correlation of data were used to find out the relationship between financial leverage and financial performance.

Gweyi et al. (2014) tested the effect of financial leverage and financial performance of Deposit Taking Savings and Credit Co-operative in Kenya. Financial leverage was measured by using Debt to Equity Ratio. The result of study showed that strong positive correlation between Debt Equity Ratio with Return On Equity and Net Profit Margin and a weak positive correlation between Debt Equity Ratio with Return On Assets and Income Growth. Financial performance was by using four indicators including Return On Assets, Return On Equity, Net Profit Margin, Income Growth. The sample data was 40 Savings and Credit Co-operative

Societies from the period 2010 to 2012. They collected data from financial statement of companies (2010-2012). Descriptive statistics and correlation analysis were used to find out the relationship between financial leverage and financial performance. They concluded that a strong correlation between financial leverage and financial performance of Deposit Taking Savings and Credit Co-operative in Kenya.

Akeem et al (2014) examined the effect of capital structure on firm's performance with a case study of manufacturing companies in Nigeria from 2003 to 2012. Capital structure measured by total debt and debt to equity ratio. Firm's performance measured by Returns on asset (ROA), Returns on equity (ROE). Panel data for the firms were generated and analysed using fixed effects, random effects and Hausman Chi Square estimations to test the relationship between the firm leverage and firm performance. The result of study showed that capital structure measures are negatively related to firm performance. The study recommended that firms should use more of equity than debt in financing their business activities, in as much as the value of a business could be enhanced using debt capital.

In summary, the results of empirical research are mixed relationship between of financial leverage and financial performance: positive and negative. As the portion of debts is increased the financial leverage and financial risk are also increased. If the economic condition is good, financial leverage can increase financial performance. If the economic condition is bad, financial leverage can decrease financial performance. Vietnam economy declines in recent years and firms' debt ratio is high, alarm lever (Son, 2012).

So, the research is expected a negative impact of financial leverage on financial performance.

The relationship among financial leverage, firm's age, firm size and financial performance

Firm's age is an important determinant which contributes into relationship between financial leverage and financial performance. Firm age can be defined in terms of years of formation, incorporation or listing. Bulan and Yan (2009) concluded that older firms are more leveraged than younger firms. They argued that mature firms are older, more stable and more highly profitable, with fewer growth opportunities and good credit histories. Due to these characteristics, mature firms are able to borrow more easily and at a lower cost. But, younger firms are more dynamic and more volatile in their growth experience than older firms (Evan 1987). Maturity bright stability in growth as firms learn more precisely their market positioning, cost structures and efficiency levels, are less frequently surprised by profit outcomes, and consequently are less likely to revise their investment plans. Warusawitharana (2011) studied documented firms' average profitability changes systematically with age. He regarded that between 5 and 10 years, the firm's profitability stabilised. After 10 years, the profit started to decline slowly. So, firm's age affects to relationship between financial leverage and financial performance is negative.

Firm size plays important role in defining the capital structure of a firm. Natural log of total sales or natural log of total assets can be used as proxy for size of the firm. As larger firms have an advantageous position in capital markets to raise external funds, they are less dependent on internal funds. Larger firms are more diversified and hence have lower variance of earnings, making them able to tolerate high debt ratios (Wald, 1999). Larger firms are less asymmetrical information. On the other hand, smaller firms may find it relatively more costly to resolve information asymmetries with lenders, may present lower debt ratios (Castanias, 1983). But, Audia et al (2000) highly structured that the large size firms had to encounter with the greater difficulty for highly sensitive organizational structure towards maintain resourcefulness, entrepreneurship and innovativeness to overcome an impediment to growth, good quality performance be supposed to accordingly leads to a reducing in leverage ratios. Intended for large size firms the effects of performance on leverage is negative. Ezeoha (2008) explained that the pecking order theory has an imperious consequence in the financing patterns of the Nigerian listed firms by considering some other variables constant. The result of study illustrated a highly significant negative relationship between financial leverage and profitability indicators.

Thus, firms' age and size have an important influence on capital structure decisions and choices of debt and equity. For firm's age and firm size, the effect of leverage on performance is expected negatively in this research.

Hypothesis development

According to pecking order hypothesis firms tend to use internally generated funds first and then resort to external financing. This shows that profitable firms will have less amount of leverage. There is negative relation between financial leverage and financial performance. Based on the literature review, there are hypothesis that are needed to be proved. Since the main reason of this research is to find out the impact of financial leverage on financial performance, then:

H1: A firm‘s Debt to Equity Ratio has a negative impact on its Earnings Per Share Growth.

H2: A firm‘s Debt to Equity Ratio has a negative impact on its Net Profit Margin.

H3: A firm‘s Debt to Equity Ratio has a negative impact on its Return On Assets.

H4: A firm‘s Debt to Equity Ratio has a negative impact on its Return On Equity.

Conceptual model

Based on literature review and hypothesises the conceptual model is formulated and presented in Figure 1 and consisted of four hypothesises from H1 to H4.

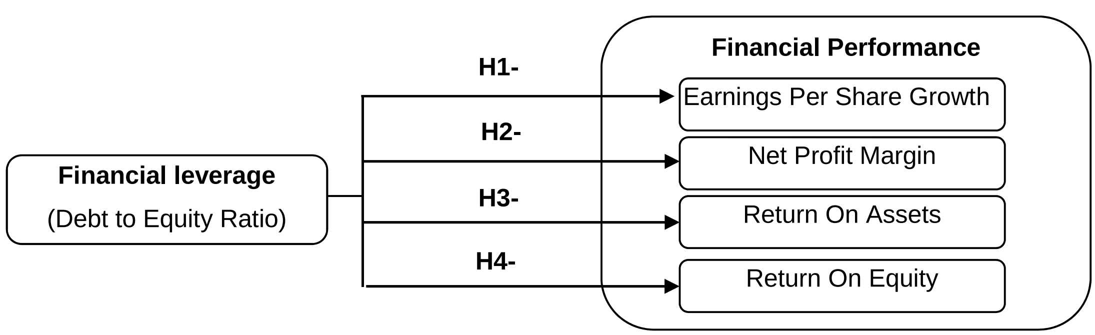

Figure 1: Conceptual model

The research is based on a standard multiple linear regression analysis with the following specification:

$Y_{it} = \beta_0 + \beta_1 DER_{it} + \beta_2 Z_{it} + \varepsilon_{it}$

With: Y is Financial performance variable as mentioned.

DER is Financial leverage (Debt to Equity Ratio)

Z is controlled variables.

β_i are the coefficients of the explanatory and controllable variable.

ε is the error term

3. Research methodology

Data collection

The research collects data from annual audited financial statement of listed sugar companies in HOSE and HNX. This publication provides useful information on key accounts of the financial statements of all listed firms of HOSE and HNX. The sample size consists of 6 listed sugar companies from food producer sector of HOSE and HNX from the period 2009 – 2013 and before Dec 31, 2007. Type of data structure used in this research is panel data.

Variable of Interest

Financial performance (Dependence variable)

Performance of the firms can be calculated by using accounting measure using firm's financial statements. According to Rehman (2013), Wabwile et al. (2014), financial performance indicators are Return On Assets (ROA), Return On Equity (ROE), Earnings Per Share Growth (EPSG), Net Profit Margin (NPM). So, this research uses most commonly used accounting based proxy for performance that is Return On Assets (ROA), Return On Equity (ROE), Earnings Per Share Growth (EPSG), Net Profit Margin (NPM) to evaluate the financial performance as dependent variable.

Financial performance indicators are calculated as:

Return On Assets = Net Income to common stockholders/ Total Assets

Return On Equity = Net Income common stockholders / Total equity

Net Profit Margin = Net Income common stockholders / Sales

Earnings Per Share Growth = (Current year EPS - last year EPS) / last year EPS

Financial leverage (Independence variable)

This research uses accounting measure for financial leverage as independent variable. Gweyi et al. (2014) used debt to equity ratio to measure financial leverage in their research on the relationship between financial leverage and financial performance. It has important implication from the viewpoint of creditors, and owner of business and the firm itself.

Financial leverage as calculated: Financial leverage (DER) = Total debt/ Total equity.

Control variables

The research examines the impact of two control variables impact on relationship between financial leverage and financial performance: firm's age and firm size:

Firm's age (AGE): The number of years since the inception of the firm to the observation date.

Firm size (SIZE): Natural logarithm of total assets.

Method of data analysis

The study uses panel estimation technique in analysing independent variables to the dependent variables. The panel data analysis uses the effect of time as much as it uses the effect of the cross sections (Wooldridge, 2002). The technique helps to control the covert effects which may be related the parameters within the set-up capital structure model. Furthermore, it is expected that modelling the financial data set such that it will have both the time dimension and the cross section dimension will lead more accurate results (Bayrakdaroğlu, 2013). The most common models of this kind are the Pooled regression model, Fixed effects model (FEM) and Random Effects mode (REM) (Gwatidzo et al, 2009).

Pooled regression model approach is to disregard the space and time of the pooled data and estimate the usual OLS regression. In particular, a pooled regression assumes that the estimated coefficients are the same for each cross-section (firms) and over the years.

Fixed Effect method is used to control all the stable characteristics of the companies included in the study over a fixed period of time (Yaffee, 2003). This method provides statistically better results by removing the biases from the data and explains only within the sample variations.

The random effects model (REM) was developed to overcome the loss of the degree of significance in the fixed effects model (Bayrakdaroğlu, 2013). Random Effect method is applied when characteristics of sample differs. As the characteristics of companies are different in terms of size, age etc. so this method is suitable to explain variations between the companies.

The most common way to decide choosing FEM or REM are used Hausman Test. The choice of the model is supported by Hausman test results which indicated a p-value of less than 0.05 hence supported the use of fixed regression model as against random effect model (Hausman and Taylor, 1981).

Finally, the financial performance should vary across firms and over time. Since capital structure itself may also change move over time for the same firm. These models can supply statistical information among groups of variables and among time periods.

4. Data analysis and discussion

This section includes the statistical analysis of financial leverage and the financial performance in listed sugar and companies of HOSE and HNX in Vietnam.

Data analysis technique includes five steps. Firstly, descriptive statistics are used to describe and summarize the behaviour of the variables in the research. Secondly, Person correlation analysis is also used to find out the relationship between financial leverage and financial performance. Thirdly, Pooled regression model, Fixed effects model (FEM) and Random effects model (REM) are used to examine find out the impact of financial leverage on financial performance. Since the study is cross- sectional across the Vietnamese listed firms, hence the FEM and REM' specifications to differ significantly. And Hausman test will be run to test whether model is FEM or REM (Greene, 2008). Fourthly, testing multi-collinearity, heteroskedasticity, autocorrelation violation. Finally, Generalized Least Square which is used by Gill et al. (2010) is fixed heteroskedasticity, autocorrelation. STATA is used software to describe and correlation and regression analysis the impact of financial leverage on financial performance of the listed companies.

Descriptive Statistics

Descriptive statistic is used to describe the nature of data. Table 1 presents the descriptive statistics for all variables, which are used in this research. The total number of observations is 30 firm-years.

DER has a standard deviation of 0.591 lesser than its mean of 0.903, maximum one is 2.68, minimum one is 0.93.

EPSG has a mean of about 0.306 and a standard deviation of 0.986 in which the lowest number is -0.921 and the highest one is 3.649.

The average Net Profit margin is 0.138 and bigger than a standard deviation of 0.084, maximum one is 0.031, minimum one is 0.012.

ROA has a standard deviation of 0.086 lesser than its mean of 0.140, maximum one is 0.379, minimum one is 0.013.

ROE has a mean of about 0.246 and a standard deviation of 0.135 in which the lowest number is 0.028 and the highest one is 0.606.

The average firm's age is 14.5 and a standard deviation of 2.861, maximum one is 20, minimum one is 8.

Table 1: Descriptive Statistics

	Observation	Mean	Std. Dev.	Min	Max
DER	30	0.903	0.591	0.93	2.68
EPSG	30	0.306	0.986	-0.921	3.649
NPM	30	0.138	0.084	0.012	0.031
ROA	30	0.140	0.086	0.013	0.379
ROE	30	0.246	0.135	0.028	0.606
AGE	30	14.5	2.861	8	20
SIZE	30	13.597	1.005	11.486	14.994

The average firm size is 13.597 and a standard deviation of 1.005, maximum one is 14.994, minimum one is 11.486. The mean value for size is high which shows that companies are growing according to total assets.

Correlation analysis

Table 2 shows Pearson correlation between variables. The correlation matrix result shows that there is negative correlation between performance and leverage.

The result shows negative relationship of Debt to Equity Ratio with Net Profit Margin, firm's age at high significance at α =1% level and Return On Assets margin at high significance at α =5%. The result shows the relationship of Debt to Equity ratio with Earnings Per Share Growth, Return On Equity and firm size at no significance. This shows that if performance of the firm is decreasing, its profitability will also increase.

The result shows negative relationship of firm's age and Earnings Per Share Growing, Return On Equity at high significance at α = 5% level. There is negative correlation between size and performance this means that old companies don't have a competitive advantage and get experience new things with the passage of time. So, companies' performances are declined.

The result shows negative relationship of firm size and Return On Asset, Return On Equity at high significance at α = 1% level. There is negative correlation between size and performance this means that larger firms, invest their assets, but old companies' performances aren't improved and decreased.

Table 2: Correlation Analysis

	DER	EPSG	NPM	ROA	ROE	AGE	SIZE
DER	1						
EPSG	-0.2021	1					
NPM	-0.5644 ***	0.4208 **	1				
ROA	-0.4216 **	0.4326 **	0.7246 ***	1			
ROE	-0.0157	0.4150 **	0.5294 ***	0.8878 ***	1		
AGE	-0.3512 ***	-0.4426 **	0.0111	-0.2008	-0.3864 **	1	
SIZE	0.0815	-0.2713	-0.1179	-0.5019 ***	-0.5690 ***	0.3446 *	1

Note: *, **, and *** denote significance at 10%, 5% and 1% levels

Pooled regression model, Fixed Effects Model (FEM) and Random Effects Model (REM)

As the results of Hausman test, the Random Effects Model will choose to regress the relationship of Debt to Equity Ratio and financial performance indictors as Return On Assets, Return On Equity because Prob> chi2 is 0.324; 0.24 which is higher than 0.05 in Table 4. While the Fixed Effects Model is better with Earnings Per Share Growth and Net Profit Margin because Prob> chi2= 0 in Table 3.

Table 3: Pooled regression model, Fixed Effects Model (FEM) and Random Effects Model (REM) of EPSG, NPM and DER, AGE, SIZE

	EPSG			NPM		
	Pooled	REM	FEM	Pooled	REM	FEM
DER	-0.663 **	-0.663 **	0.143	-0.091 ***	-0.061 ***	-0.039
AGE	-0.195 ***	-0.195 ***	-0.592 ***	-0.006	-0.021 ***	-0.047 ***
SIZE	-0.040	-0.040	0.247	0.000	0.000	.062
R-square	0.343	0.343	0.159	0.358	0.108	0.0009
Heteroskedasticity	0.008			0.223		
Autocorrelation	0.006			0.024		
Hausman test	0.002			0.000		

Note: *, **, and *** denote significance at 10%, 5% and 1% levels

Table 4: Pooled regression model, Fixed Effects Model (FEM) and Random Effects Model (REM) of ROA, ROE and DER, AGE, SIZE

	ROA			ROE		
	Pooled	REM	FEM	Pooled	REM	FEM
DER	-0.068 ***	-0.068 ***	-0.027	-0.014	-0.014	047
AGE	-0.000	-0.007	-0.026	-0.011	-0.011	-0.051 **
SIZE	-.031 **	-.031 **	-0.013	-0.061 ***	-0.061 ***	-0.012
R-square	0.438	0.438	0.138	0.368	0.368	0.152
Heteroskedasticity	0.16			0.210		
Autocorrelation	0.001			0.011		
Hausman test	0.324			0.24		

Note: *, **, and *** denote significance at 10%, 5% and 1% levels

Multi-collinearity test result:

All of factors in Table 5 are smaller than 10, so all Independence variables aren't be multi-collinearity.

Table 5: Multi-collinearity test result

	VIF	1/VIF
DER	1.20	0.830
AGE	1.36	0.736
SIZE	1.20	0.834
Mean VIF	1.25	

Heteroskedasticity Test Results

The study tests for panel level heteroskedasticity using White's test .The null hypothesis of this test is homoskedasticity. The p-value of NPM, ROA, ROE and DER, AGE, SIZE is 0.223; 0.16; 0.21 is statistically significant at 5 percent level in Table 3, 4. Hence, the null hypothesis of NPM, ROA, ROE and DER, AGE, SIZE is rejected existence of heteroskedasticity.

The p-value of EPSG and DER, AGE, SIZE of 0.008 is not statistically significant at 5 percent level in Table 3 and hence the null hypothesis of EPSG and DER, AGE, SIZE is accepted of existence of heteroskedasticity. The study consequently employs the GLS estimation technique to take care of this problem.

Autocorrelation Test Results

The study uses the Wooldridge test to test the presence of autocorrelation. The null hypothesis of this test is that there is no first order autocorrelation in the data. The p-value of the F test between EPSG, NPM, ROA, ROE and DER, AGE, SIZE is 0.006; 0.024; 0.001; 0.011 in Table 3, 4. They implies that the F test is not statistically significant at 5 percent level. Hence, the null hypothesis of EPSG, NPM, ROA, ROE and DER, AGE, SIZE is not rejected autocorrelation in the data. Subsequently, the study employs the GLS estimation technique to take care of this problem.

Generalized Least Square Regression Result

The results for GLS method between EPSG and DER -0.693 at significant levels 1% in Table 6.

So, financial leverage (Debt to Equity Ratio) has a negative and significant impact on its Earnings Per Share Growth of Hypothesis 1 is accepted.

The results for GLS method between NPM and DER is -0.064 at significant levels 1% in Table 6. So, financial leverage (Debt to Equity Ratio) has a negative and significant impact on its Net Profit Margin of Hypothesis 2 is accepted.

Table 6: Generalized Least Square Regression Result

	EPSG	NPM	ROA	ROE
DER	-0.693 ***	-0.064 ***	-0.057 ***	-0.020
AGE	-0.255 ***	-0.012 *	-0.004	-0.008
SIZE	-0.255	0.003	-0.039	-0.079 ***

Note: *, and *** denote significance at 10% and 1% levels

The results for GLS method between ROA and DER is -0.057 at significant levels 1% in Table 6. So, financial leverage (Debt to Equity Ratio) has a negative and significant impact on its Return on Assets of Hypothesis 3 is accepted.

Besides, the result for GLS method between ROE and DER is -0.020 at no significant level in Table 6. So, financial leverage (Debt to Equity Ratio) has a negative and no significant impact on its Return on Equity of Hypothesis 4 is rejected.

Overall two control variables show result of relationship with firm's performance. The firm's age shows a negative and significant levels 1%, 10% in relationship between AGE and EPSG and NPM is -0.255, -0.012. The firm's age shows a negative and insignificant in relationship between AGE and ROA, ROE.

The firm size shows a negative and significant level 1% with Return on Equity is -0.079. The firm size shows negative and insignificant levels in relationship between SIZE and EPSG, NPM, ROA.

All of hypotheses are summarized in Table 7.

Table 7: Hypotheses result

	Hypotheses	
H1	A firm's Debt to Equity Ratio has a negative impact on its Earnings Per Share Growth	Accepted
H2	A firm's Debt to Equity Ratio has a negative impact on its Net Profit Margin	Accepted
H3	A firm's Debt to Equity Ratio has a negative impact on its Return On Assets	Accepted
H4	A firm's Debt to Equity Ratio has a negative impact on its Return On Equity	Rejected

5. Conclusion

Findings

The objective of this research is an attempt to examine the impact of financial leverage on financial performance of listed sugar companies in HOSE and HNX and explores the impact of firm's age, firm size in the period 2009 – 2013. The research uses four measures which are used as the proxies for firm's age, firm size, leverage and firm performance on behalf of emerging economy conditions.

The study affirms that leverage has a significant negative effect on financial performance such as financial leverage (DER) negatively impacts and significant of on financial performance as Earnings Per Share Growth, Net Profit Margin and Return On Assets. The results are compatible with Pratheepkanth (2007) as they found a negative impact as well. On other hand, the result is matched with concluding of Wabwile et al. (2014) and consistent with trade-off theory (Kraus and Litzenberger, 1973), pecking order theory (Myers and Majluf, 1984). Based on the trade-off theory for capital structure, an optimal level of leverage can enable a firm to improve its financial performance as it can accrue tax advantage (tax shield) associated with optimum level of debt. The finding is clear evidence to conclude that as the firm increases debt beyond the optimum level. Vietnam economy is recession in recent years. Food manufacture industry is affected in economic condition, and sugar companies' output decrease. Sugar firms rely on borrowing extreme, they will not achieve tax shields and then it lead to increase borrowing cost of which the firm exposes to the bankruptcy risks and reduce the return. This research result shows that use of debt decrease EPSG, NPM, ROA and the results were consistent with the pecking order theory that firm prefer internal financing on external financing and thus enhance performance.

The finding shows that Return On Equity (ROE) is not insignificantly affected by financial leverage (DER). The result is same with result of Abdullah (2012). It can explain that shareholder of sugar company would have no concerned with the debt levels and sources which are used to raise more capital.

Based research finding, the firm's age negatively impacts and significant on financial performance as Earnings Per Share Growth (EPSG), Net Profit Margin (NPM). Sugar firm's age has shown a negative relation with financial performance in the research. The negative of age is due to the fact that firms don't learn with the passage of time and don't get experienced and they can't tackle the problems easily as compared to the new firms. As the age of the sugar firm increases, it doesn't lead to lower debt ratios. As the age of the sugar firm increases, it doesn't increase experience of the firm due to which over the time managers don't learn that what should be done to improve its performance.

And, the firm's size negatively impacts and significant on financial performance as Return on Equity (ROE). Large sugar companies aren't found to have a competitive advantage over small firms as large firms have a wide array of resources and also enjoy economies of scale, hence aren't in a better position to compete in the market.

Managerial implications

The manager should ensure that financial decisions made by them are in consonance with shareholder's wealth maximization objective which encompasses the profit maximization objective of the firm.

Firstly, based on the trade-off theory for capital structure, firm can take advantage of debt to make a better return on equity which ultimately influences firms' profitability. Manager should determine an optimal debt level that balances the benefits of debt against the costs of debt. Manager should avoid situations where they are highly leveraged since this may lead to bankruptcy if they are unable to make payment on their debt.

Secondly, the pecking order theory states that firms' managers prefer to finance new investments first internally with retained earnings, second with debt, and last by issuing new equity. The finding of study, listed sugar used high leverage, so financial performance decreased. Therefore, the order of preferred finance methods for listed sugar firms could first be internal funds, second issuing equity, and last by using debt, enhances firm's performance. Thus, firms' manager of Vietnamese listed sugar follow the Pecking Order Theory.

Thirdly, the management should monitor the interest charged on debt financing to avoid liquidation of the company. It helps the firm avoids the bankruptcy risks, which effect inversely on firm performance.

Fourthly, the manager should employ financial leverage in a way that enhances value for their company owners leading to an increase in returns to equity holders. The debt creates for the managers an incentive to work hardly and actively in spite of the decrease the increments that may make it, but this will encourage them to utilize the best invested opportunities. And a firm will achieve tax shields, and then reflect positively on their performance such as increase EPSG, NPM, ROA.

Fifthly, the result is found that using debt affect the performance in case of ROA in a negative direction which means that listed sugar firms in Vietnam inefficiently use their assets. Manager should invest and manage the company's asset efficiently. The company uses them to generate profit, as a measure of performance.

Sixthly, old companies stabilize on performance whereas new firms should have strategies in place to market and stabilize in order to have a competitive advantage over old companies. The manager should learn and get experience new things with the passage of time. The manager shouldn't carry heavy burdens from the past and are thus more flexible in adjusting to dynamic market trends.

Finally, a firm expands beyond the optimum size diseconomies of scale will set in and this can result in a decline in the financial performance of the firm. Manager should expand in a controlled way with the aim of achieving an optimum size so as to enjoy economies of scale which will ultimately result in higher level of financial performance.

6. Limitation and further research

Although this study produced some interesting and meaningful findings, there are some limitations as well. This study investigates 6 listed sugar companies in the HOSE and HNX for period (2009 – 2013). This is restricted research. The future research will take unlisted companies to increase the sample size and enlarge the time period (2006 – 2013).

Moreover, the study is only limited to three factors that affect the financial performance of the listed sugar companies in the stock market. Thus, more research should be carried out to determine other factors that affect financial performance such as market indicator.

And the research can be conducted comparative study by taking data from different sectors to check the relationship between financial leverage and financial performance.

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APPENDIX 1: LISTED OF SUGAR COMPANIES ON HOSE AND HNX

No	Code	Name	Date of establishment	Date of listing	Province	Stock exchange
1	BHS	Bien Hoa Sugar Joint Stock Company	05/16/2001	12/20/2006	Dong Nai	HOSE
2	LSS	Lam Son Sugar Joint Stock Corporation	09/23/1999	09/1/2008	Thanh Hoa	HOSE
3	NHS	Ninh Hoa Sugar Joint Stock Company	01/06/1996	02/07/2010	Khanh Hoa	HOSE
4	SBT	Thanh Thanh Cong Joint Stock Company	07/15/1995	02/25/2008	Tay Ninh	HOSE
5	SEC	Gia Lai Cane Sugar Thermoelectricity Joint Stock Company	07/18/1997	01/06/2010	Gia lai	HOSE
6	KTS	Kon Tum Sugar Joint Stock Company	07/10/1997	12/31/2010	Kon Tum	HNX

□ □ □ □ □ □ Willingness to Pay for Urban Flooding Control in Ho Chi Minh City

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Despite the implementation of many large scale projects (project 1547 and project 752) involving in controlling urban flooding in Ho Chi Minh City, the issue of urban flooding has been a long-lasting issue for inhabitants in HCMC. There are many causes for the problem, both objective and man-made. This study conducts a contingent valuation (CV) study to find out the willingness to pay (WTP) for the controlling of urban flooding issue. The CV survey was done with the direct survey instrument on 180 households in HCMC. The hypothetical scenario of elicitation was the project 1547 and project 752 upon completion. Double-bounded dichotomous choice question was also employed. The results found some disparities in the tendency of voting for the scenario between some areas in HCMC. Non-parametric and parametric estimates for mean WTP are VND 464,654 and VND 380,000 per each household respectively. Bootstrapping procedure further solidifies these results.

Keywords: Contingent valuation method, WTP, bootstrap, urban flooding.

1. INTRODUCTION

Ho Chi Minh City (HCMC) is one of the largest city and an important economic center in Viet Nam. With the population of 7.8 million people and density of 3,721 people per kilometer square (Wikipedia, 2011), the development of infrastructure cannot catch up with the rapid urbanization rate of HCMC. The inconsistency in the urban development in HCMC caused various problems, one of which is the exceedance in capacity of the urban sewer and drainage system, one of the causes for major urban flooding (Hoc, 2008). Moreover, the instability of the weather also further aggravates the flooding issue through the heavy rainfall and high rainfall level.

In the effort to address the flooding circumstance, the Government has approved two major plans. The first one is the plan of urban drainage improvement and sewer development of HCMC, which was approved by Decision 752 in 2002. The second is the MARD[1] construction plan, which was approved by Decision 1547 in 2008. Both projects have the same goal to help alleviate the flooding in HCMC, but they solve in different approaches. While the former focuses on rehabilitating and developing the inner urban drainage system, the latter seeks to build large scale hydraulic constructs around the city. However, due to the diversity in causes of flooding in HCMC, in order to completely solve the problem, the combination of both projects is required.

Research problem and objectives

In summary, to deal with the urban flooding issue, not to mention other smaller projects, there are two main projects have been approved and in the process of implementing, which are urban drainage improvement and sewer development of HCMC (project 752) and hydraulic construction plan (project 1547). However, project 1547 is facing difficulties in appealing investment and cost underestimating, which may delay the project until 2025. Although a specific number of expected

[1] MARD stands for Ministry of Agriculture and Rural Development.

outcomes of the two projects were not given, CBA of these projects expected to relieve all the tangible damage caused by flood in 50 years, which means no heavy flooding will be occurring in the next 50 years (Steering Centre for Urban Flood Control Program, 2013).

Are all the aforementioned measures effective or not? Inspection of the all the projects upon completion will be required to answer the question in the future. Although a CBA analysis for project 1547 has already been conducted. However, the estimating of the benefit of the project in the CBA is based on the 'flood risk approach' which did not consider the demand and willingness to pay (WTP) of the inhabitants in HCMC. In addition, the results of the study may serve as a guide for making decisions involving potential urban flooding project implementation and fee collection in HCMC as well as in other areas. Furthermore, potential projects involving flood control in HCMC may also require WTP as an important indicator to estimate the benefit of the project. Therefore, this study intents to:

- Evaluate inhabitants' level of awareness about flood risks in HCMC
- Determine the aggregate WTP for a hypothetical anti-flooding project
- Find out the factors governing the WTP of HCMC inhabitants.

In order to answer these questions, Contingent Valuation Method (CVM) will be applied in conjunction with the direct interview survey instrument to measure the willingness to pay for the elimination of urban flooding in HCMC. The result in the study may be used in policy making for deciding whether or not a project would be feasible to be conducted in the future. It may be also helpful for the process of inspecting the effectiveness of the project 1547 and 752.

2. LITERATURE REVIEW

Benefits and costs of a public good or an environmental good are difficult to determine since public goods or environmental goods usually do not have a price. Moreover, the costs and benefits are mostly dependent on individuals' preferences. Given a public good is provided, the individual's benefit can be measured by measuring how much that individual is willing to give up to obtain that public good. On the contrary, the individual's cost when a public good is lost is measured by the value of something else that individual would accept to compensate for the loss.

In terms of welfare, money is usually used as a standard measure. In that case, the measure of benefit is the willingness to pay (WTP) to obtain the benefit or willingness to accept (WTA) to compensate for the lost. The measure of cost is WTP to avoid the cost and WTA to tolerate the same.

2.1 Willingness to pay and willingness to accept

Pearce (1997) defined willingness to pay is the monetary valuation that was placed by an individual for a good or service. WTP is constrained by ability to pay so that any people with higher income will value goods or services more highly than that with lower income.

According to Bateman et al. (2002), the concept of WTP and WTA can be graphically illustrated using indifferent curve. The vertical axis represents the expenditure in money unit of an individual on the private good (y). The horizontal axis represents the quantity of a public good (x). The indifferent curve I and I' represent two linked combinations which have the same level of utility of two distinct individuals, with I has a lower level of utility than I'.

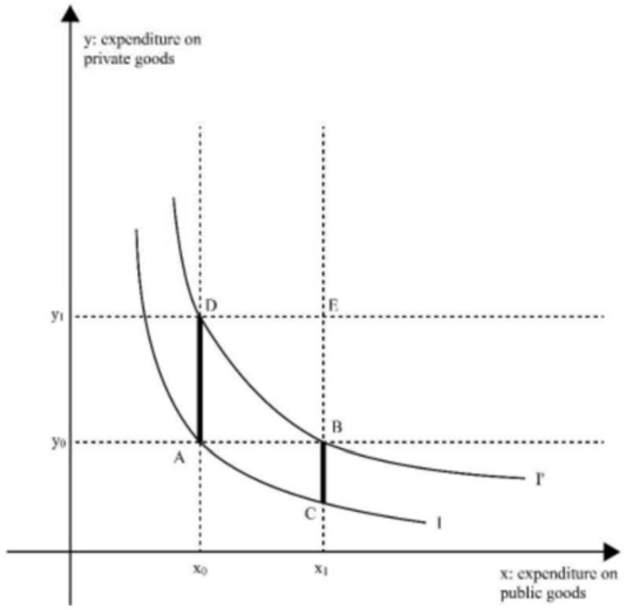

Figure 1 Measure of change in human welfare
Source: Bateman et al., 2002

With the increase in the quantity of public good, the individual can enjoy x_1 of the public good, but the private consumption is reduced by BC, in other words, the new consumption point is now C. The amount BC is defined as the WTP for the increase in the public good (or the compensating variation for the increase in the public good).

If the initial consumption of the individual is at B and there is a *decrease* in quantity of public goods from x_1 to x_0, but the individual enjoys a higher level of private consumption, y1, moving the consumption point from B to D. The amount DA is the amount of private consumption needs to be compensated for the loss in the public good, specifically in this case, the WTA for the reduction in the public good is DA (or the compensating variation for the reduction in the public good).

2.2 Total Economic Value

The net sum of all relevant WTAs and WTPs is defined as the total economic value (TEV) of any change in welfare from a policy or a project. The TEV is commonly classified into use and non-use value. Use value is classified into actual value and option value, non-use value can be disaggregated into existence value, bequest value and altruism value. The following figure demonstrates TEV and its categories.

First, use value consists of two components. Actual use relates to the actual use of the good or service (for example, a visit to a park, the prevention of potential damage of an urban flooding prevention project). Option value refers to the willingness to pay to preserve the good for using it in the future. Amongst stated and revealed preference techniques, there are two commonly used techniques to value the use value of an environmental good, Travel cost method and Hedonic pricing method.

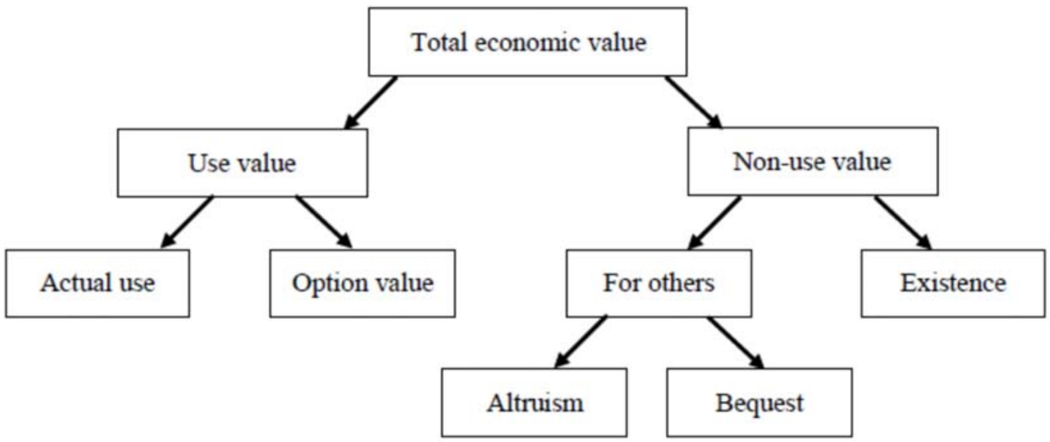

Figure 2 Total economic value
Source: Bateman et al., 2002

Second, the non - use value relates to WTP to keep some good exists, though there is no actual or possible use. The non - use value consists of existence, altruism and bequest value. Existence value refers to the WTP to have a good exists and the individual eliciting WTP has no use for himself or for someone else. The reasons for maintaining the good could be the 'feeling of responsibility' for the good or the 'concern' for the existence of a good (for instance, a rare species of animal). Altruistic value relates to the WTP to keep the good maintained to others in the current generation. Similarly, bequest value may come when the person concerns that the good should be available to others in future generations.

Covering TCM and HPM weakness of not being able to measure non-use value, Contingent Valuation Method (CVM) is one of the methods used to value the non-use value. According to Mitchell and Carson (1989), CVM has many advantages over other methods, one of which is the ability to capture the existence value. CVM involves in describing a hypothetical scenario for the respondent to state their WTP for it. Therefore, it is suitable for the valuation of environmental goods with an easy-to-perceive aspect, such as the cleansing of a river or the provision of electricity in a remote area. Due to the difficulty in capturing the actual use value of such goods, plus respondents of a CVM study rely on their own preferences, which is 'contingent' upon the hypothetical good, to give out their WTP, CVM is unable to capture the use value of the good. However, CVM can be used to measure the non-use value effectively.

2.3 Utility Theory and the Utility Difference Approach

Following economic theory, Bateman et al. (2002) defined the general form of indirect utility function as:

$$V(Y, P, S, Q)$$

The function V(.) can be described as the utility a household can acquire from the income (Y) with the prices of goods (P) (Higher or lower prices enable households to have more goods and thus, raise the utility) and the level of non-market good (Q) (Higher or lower level of non-market good represent an improvement or a decline). The utility is also assumed to be dependent on other socioeconomic factors (S).

Assuming there is a provision of non-market good that raise the level of non-market good from initial Q_0 to Q_1. The household's utility will be pushed up to a higher level:

$$V(Y, P, S, Q) < V(Y, P, S, Q_1)$$

With a higher level of non-market good, the household has to pay an amount to achieve a better well-being, but the higher the amount, the less utility the household will enjoy due to the reduction in dispensable income. So the maximum amount the household willing to pay for the improvement can be described as the amount that will bring the household's utility back to the state without the improvement, or mathematically:

$$V(Y, P, S, Q_0) = V(Y - C, P, S, Q_1)$$

With C is the household's maximum WTP, or in other words, the compensating variation for the change in the well-being. C can be written as a function of other parameters in the model. Moreover, C is constrained by the income, which means the maximum WTP cannot exceed income:

$$C = C(Q_0, Q_1, Y, P, S) = WTP \leq Y$$

Assuming a household indirect utility function has the linear form. With the assumption of the price of market goods and socioeconomic factors of that household fixed. The function of the household utility before the change (status quo) in the non-market good can be written as follows:

$$v_0 = \alpha_0 + \beta y + \gamma p + \gamma s + \gamma q_0 + \mu_0$$

μ_0 represents the unobservable factors that may influence the utility of the household. With the provision of the non-market good, the new indirect utility function will be:

$$v_1 = \alpha_1 + \beta y + \gamma p + \gamma s + \gamma q_0 + \mu_1$$

Note that the change in the utility in the latter equation due to the change in q will be captured in α_1. As mentioned, with the improved welfare, the household is expected to pay a monetary amount from their income that solves:

$$v_0 = v_1$$

$$\beta y + \alpha_0 + \mu_0 = \beta(y - C) + \alpha_1 + \mu_1$$

$$C = \frac{\alpha_1 - \alpha_0 + \mu_1 - \mu_0}{\beta}$$

The amount $\alpha_1 - \alpha_0 + \mu_1 - \mu_0$ can be interpreted as the utility difference that comes from the provision of the non-market goods. This observable portion of the utility difference can be further parameterized as a function of household other socioeconomic characteristics ($X_1, X_2, \ldots, X_k$) in a simple linear form:

$$\alpha_1 - \alpha_0 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k$$

3. METHODOLOGY

Based on the referred literature, this chapter will present the context in which the study is conducted, the application of CVM in the context of valuing the WTP for controlling urban flooding, some justifications about selecting the appropriate elements in CVM, the main contents of the questionnaire, description of the hypothetical scenario, and lastly, the estimation and bootstrap techniques used in the study will also be introduced.

3.1 Survey procedure of the study

Although there are many methods to evaluate public good, such as hedonic pricing and travel cost, CVM is especially suitable in the case of studies involved in non-marketed goods and services, which exists in this study (Bateman et al., 2002). Moreover, the CVM is more feasible when implementing in developing countries, where the response rate is high compared to developed countries (Grosh & Glewwe, 2001). According to Mitchell and Carson (1989), CVM has many advantages over other methods, one of which is the ability to capture the existence value, which mean the individual willingness to pay to preserve the good or service. In addition, there has not been any study measuring the WTP for urban flooding prevention in Vietnam yet. Therefore, the CVM will be used to measure the WTP for HCMC flooding prevention.

The actual survey will be in face-to-face interview format. After providing information about the flooding situation in HCMC, question about characteristics of the respondent and the house, household expectation about flood situation will be asked, then a hypothetical project will be set up. The proposed hypothetical project will be the project 1547 upon completion, which was approved in 2008 by the HCMC People's Committee and the Government plus some brief explanation of the project 752 involving rehabilitating the urban sewer and drainage system will also be given. Although these projects have actually been implemented already, but due to their slow progress, the completed projects are still chosen for the hypothetical scenario. The hypothetical scenario will be described as having the capabilities of alleviating the urban flooding completely when finished. After describing the hypothetical project, the respondents will be given an opportunity to question about the project. Then the bid question is given, in which respondents will be asked how much he/she willing to pay if the project need contributions from HCMC residents.

Regarding the survey mode, the study applied was the direct in-home face-to-face interview mode. Bateman et al. (2002) introduced seven advantages of the face-to-face mode over other modes of survey, which are (i) the assurance of the household members stated, (ii) the order of information unfolding to the respondent, (iii) the assistance of the interviewer to the respondent, (iv) the correction of interviewer with misunderstanding to the questionnaire, (v) the motivation of the interviewer, (vi) the recording of verbatim comments made by the respondents and finally, (vii) the interviewer can monitor the respondents' confidence to the important questions, this is especially useful in question regarding attitude of the respondent to a specific disaster in this study. In addition, computer-assisted personal interviewing (CAPI) was also implemented. Specifically, an electronic tablet with the built-in questionnaire will be brought to each household and will be used by the interviewer to record the answer. This will help cutting down the time spent on data entering and minimize the possibility of error due to entering mistake if the survey was done by traditional paper-survey mode.

For the bid question, the study uses double-bounded dichotomous contingent valuation to ask for the amount that the respondents are willing to pay for the hypothetical project. Then from the data, the WTP for the HCMC flooding prevention is inferred. The double-bounded dichotomous bid question is chosen due to the high statistical efficiency could be achieved compared to open-ended or single-bounded dichotomous-choice method according to Bateman et al. (1999). This type of bid question requires each respondent to identify two pre-specified amount that bound their maximum WTP (one amount is higher and one amount is lower than their maximum WTP). Specifically, each respondent will be asked an initial amount (initial bid), if the answer 'yes' / 'no' is given, a higher/lower amount (higher/lower bid) will be asked. From the answers (yes-no, yes-yes, no-yes, no-no) and corresponding bounds, the WTP interval from each individual is inferred in the data analysis.

The payment vehicle of choice is also crucial to a CVM study (Morrison, Blamey, & Bennett, 2000). Payment vehicle is the method by which the money will be hypothetically collected from the respondents. Two payment vehicles were put into consideration, one-time voluntary payment and one-time mandatory payment in electricity bill of the household. Although a mandatory increase in electricity bills seems to be a more convenient method than a voluntary donation for urban households, Morrison, Blamey & Bennett (2000) pointed out that one of the reasons for the occurrence of vehicle bias is respondents' doubts about payment being one-off. The request for an increase electricity bill may raise doubts to the respondent that, although being clearly stated, that increase will not be charged one time. Furthermore, Ryan (2006) also stated collective payment mechanism usually results in a somewhat higher estimate of WTP compare to voluntary mechanism. To avoid bias, one time voluntary payment vehicle was chosen in this study.

To address hypothetical bias. In the context of the study, three solutions were chosen. The first remedy used was giving the respondents the certainty that the hypothetical project has actually been implemented by project 1547 and project 752 (Cummings et al., 1995; Landry and List, 2007; Mitani and Flores, 2010), the survey will give some information regarding the year of starting, the scale of these actual projects.

However, due to the actual slow progress of these projects, the current progress of these projects was not given the respondents to avoid protest bids. The second solution was the use of vocal confirmation message after the respondents have completed the bid question. More specific, the respondents will be asked whether they are certain about the bid or not, if they are not, they will be required to rethink and change their bid answers. And finally, several emphasis will be made by the interviewer throughout the survey reminding the respondents to answer the questions honestly.

At the beginning of the study, a focus group discussion is conducted, the main purpose of the focus group discussion is to gain insights about the issue of urban flooding, what has to be considered in the questionnaire and basic bid range suggestions. The focus group consists of 6 people who have resided in HCMC for more than 10 years. Participants are asked to give an opinion on the understandability of the proposed scenario and decide whether a specific question is appropriate or not.

After the questions in the questionnaire have been constructed and revised by the focus group. To pre-test the questionnaire, a pilot survey whose main purpose is to determine the bid levels and check the validity of the questions was initiated. 20 random households were selected and surveyed, they were asked to give the specific bid (open bid) on the scenario instead of choosing dichotomous yes-no. According to the collected pilot-survey data, 18 sets of bid were designed, these sets of bids would be used in the final survey.

Table 1 Details of 18 sets of bid used in the survey

Set #	Initial bid (VND)	Lower bid (VND)	Higher bid (VND)	Number of households
1	50,000	20,000	250,000	10
2	50,000	20,000	450,000	10
3	50,000	20,000	1,000,000	10
4	50,000	20,000	3,000,000	10

5	250,000	50,000	450,000	10
6	250,000	50,000	1,000,000	10
7	250,000	50,000	3,000,000	10
8	450,000	50,000	1,000,000	10
9	450,000	50,000	3,000,000	10
10	450,000	250,000	1,000,000	10
11	450,000	250,000	3,000,000	10
12	1,000,000	50,000	3,000,000	10
13	1,000,000	250,000	3,000,000	10
14	1,000,000	450,000	3,000,000	10
15	3,000,000	50,000	5,000,000	10
16	3,000,000	250,000	5,000,000	10
17	3,000,000	450,000	5,000,000	10
18	3,000,000	1,000,000	5,000,000	10

Finally, the sample is chosen based on the two-stage sampling design. More specifically, four districts were chosen at random (District 6, Thu Duc District, Binh Tan District and Binh Thanh District), then in every district, one area was chosen to survey. In each area, the survey process will be accompanied with one area-leader person, the leader will assist in the survey process and ensure the honesty of the responses. Households are notified in advance by telephone by the leader and the family member who takes the survey will have their age to be restricted in working age (18 or older). The total sample size is 180 (not counting pilot observations) which is distributed across areas as following.

Table 2 Distribution of observations across areas

District	Area	Number of observations
District 6	An Duong Vuong Street	30
Binh Tan District	An Duong Vuong, Kinh Duong Vuong Street	45
Binh Thanh District	Nguyen Huu Canh, Nguyen Xi Street	53
Thu Duc District	Kha Van Can Street	52

After the survey has been conducted, the mean and the WTP would be computed using two methods, non-parametric estimation and parametric estimation. For non-parametric estimation, Bateman et al. (2002) proposed a method to deal with double-bounded data, Turnbull Self Consistency Algorithm (TSCA), which is the method will be used in this study. While parametric estimation will conduct a logistic regression to estimate mean WTP.

3.2 Non-parametric estimation technique

An advantage of non-parametric estimation over parametric regression models is that the former do not make any model assumption. Parametric estimation relies solely on the data on the bid levels offered and households' choices. The double-bounded dichotomous question produces interval data with overlapping interval. Bateman et al. (2002) proposed a solution to deal with this type of data, which is Turnbull Self-Consistency Algorithm (TSCA). The procedure for TSCA is described as follows.

Firstly, interval data from the study will be classified into basic intervals, which are smallest interval division units of WTP data and overlapping intervals, which are intervals that encompass two or more basic intervals. In details, data from the study will be classified as follows, in which 8 first intervals are basic intervals.

Table 3 Interval distribution of WTP responses

Interval code	Lower bound	Higher bound	Number of HHs in interval
A	0	20,000	9
B	20,000	50,000	13
C	50,000	250,000	11
D	250,000	450,000	10
E	450,000	1,000,000	12
F	1,000,000	3,000,000	4
G	3,000,000	5,000,000	3
H	5,000,000	∞	0
CD	50,000	450,000	9
CDE	50,000	1,000,000	11
CDEF	50,000	3,000,000	15
DE	250,000	1,000,000	7
DEF	250,000	3,000,000	10
DEFGH	250,000	∞	1
EF	450,000	3,000,000	8
EFGH	450,000	∞	4
FGH	1,000,000	∞	3
GH	3,000,000	∞	1
AB	0	50,000	17
ABC	0	250,000	14
ABCD	0	450,000	9
ABCDE	0	1,000,000	9
	Total number of households		180

TSCA attempts to calculate the survivor function at each of the boundary values B_j (which are 0; 20,000; 50,000; 250,000; 450,000; 1,000,000; 3,000,000; 5,000,000) by dividing the number of households who have WTP higher than B_j by the total sample size (which is 180). However, that number of households is not certain since some households have their intervals spanned in many basic intervals.

The second step is to calculate probabilities for each basic interval that a household WTP will fall into that interval by subtracting the probability of lower bound to the probability of lower bound of the next higher interval.

For each of overlapping intervals, the number of households in that overlapping interval will be allocated into number of households in basic intervals it spans, according to the calculated probability of lying in each basic interval.

Lastly, with the new set of households which are only lying in basic intervals, the survivor function can now be constructed. Multiple iteration of the whole process may be initiated to get the mean WTP to converge.

3.3 Parametric estimation technique

From the framework of utility difference, clearly:

$$\mathrm{z} = \alpha_1 - \alpha_0 = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_k X_k + \beta C - (\mu_1 - \mu_0)$$

The utility difference model yields a logit specification when the probability of a yes response is assumed as the cumulative distribution function of a logistic covariate with the assumption of zero mean error term. The probability of responding a 'yes' answer will be

$$\Pr(yes) = \frac{1}{1 + e^{-z}}$$

Whose coefficients will be estimated by maximizing the likelihood function in a logit model.

In this study, the data on WTP question will be treated as discrete choice data. Specifically, 180 double bounded responses will be treated as 360 binary responses, additionally, a bid variable will be added to the model indicating the bid level that household is faced when elicit the choice.

After estimating the coefficients of the logit model. Then the mean and median of WTP under the assumption of logistic distribution will be computed as follows, according to Haab and McConnell (2002):

$$\text{Mean (median) WTP} = \frac{-\overline{X}\beta'}{\beta_0}$$

In which:

$\overline{X}$ is the row vector of sample mean, including 1 for the constant

β' is the column vector of estimated coefficients excluding the coefficient of bid

β_0 is the coefficient of 'bid' variable.

3.4 Confidence intervals of mean WTP

The estimated WTPs are only estimates of the entire population's WTP based on the sample of households. Different samples could possibly produce different WTPs. Thus, after estimating mean WTP in non-parametric and parametric method in this study, it is required to have an indication of the accuracy of these WTP.

Bateman et al. (2002) generalized two main approaches, which are analytical approach and numerical approach. The latter, is also known as bootstrapping, is proved to be able to achieve a very high degree of robustness and can be applied in many types of estimation techniques and data. Bootstrapping involved in the process of iterated estimation of WTP from a large number of randomly generated datasets whose observations are also randomly drawn from the initial dataset. From the produced WTPs, the confidence interval is then inferred (Krinsky & Robb, 1986).

This study will also apply bootstrapping to produce the 95% confidence interval of the mean WTP. Parametric estimation will bootstrapped with a certain STATA command and non-parametric estimation will be bootstrapped with the Crystal Ball software.

4. ANALYSIS RESULTS

After the survey procedure has been developed. Then actual survey is conducted to gather data. In a CVM study, the crucial requirement is the assurance of data reliability and representativeness because of the complete dependence of WTP estimates on the data. In addition, objective factors such as intentional dishonesty of the respondents, unpatterned responding behaviors or uncontrollable hypothetical bias could also obliquely alter the data. Nevertheless, only with 180 observations compare to the population of over 2 million households in HCMC, the data barely meet the strict requirements of a CVM data quantity. This section holds the purpose of presenting some descriptive statistics of survey data, WTP estimation results with both non-parametric and parametric techniques along with some main findings from the parametric estimation.

4.1 Non-parametric estimation result

After applying TSCA for the sample data, the resulting survivor function is then constructed as follows:

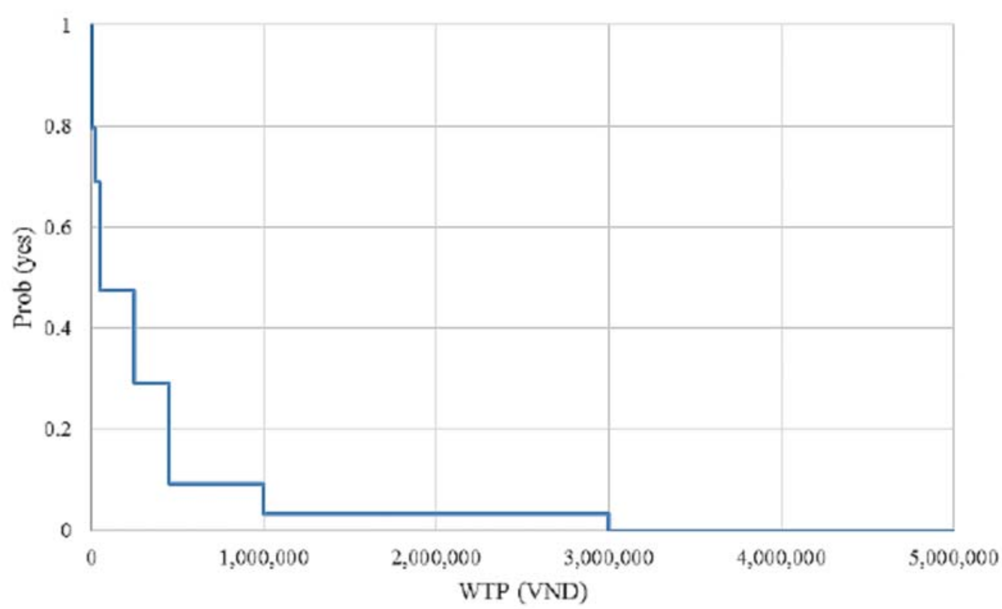

Figure 3 Survivor function of non-parametric estimation

The mean WTP is VND 484,654 while the median of WTP is 250,000. Bootstrapped 95% confidence interval ranges from VND 348,499 to VND 631,757 (for more details on calculating and bootstrapping, see the Appendix). The median WTP in TSCA non-parametric estimation is the value of bid that take the prob(yes) of 0.5, which means it only takes the value of boundary values. Thus, the significant difference between mean and median WTP in this estimator can be explained by the low probability allocation into higher interval and the varied interval distances.

4.2 Parametric estimation results

Parametric estimation in this study involves in logistic regression with the dependent variable of choice (yes/no) with a bid variable indicate the bid offered to the respondents. Since each respondent are asked two times with a double-bounded dichotomous valuation question, the dataset will also be replicated to 360 observations. More specifically, each household will be treated as two different households with the same characteristics but the bid responses.

First, the initial logit model was conducted with all 48 variables included (unrestricted model). However, the unrestricted model failed to give significant result at the 5 % level for 40 variables. Then, by using a stepwise procedure with clustering[2] at 5% level with the unrestricted model, a second logit model with 8 variables was produced (restricted model). A likelihood ratio contrast test between two models also failed to reject the null hypothesis of variables inclusion un-necessity. The result of the restricted model is presented as follows (see the Appendix for the full results of both models):

Table 4 Logistic regression result[3]

Dependent variable: choice	Coef.	Odds ratio	z	p-value
bid_in_million	-3.057	0.047	-6.65	0.00
gender_male	0.098	0.975	0.25	0.80
edu_highschool	-0.926	0.394	-0.98	0.32
edu_vocational	-0.625	0.531	-0.58	0.56
edu_college	-2.394	0.092	-2.40	0.01
edu_university	-1.178	0.307	-1.27	0.20
age	-0.029	0.971	-2.15	0.03
street_anduongvuong	-2.124	0.119	-4.12	0.00
street_kinhduongvuong	-1.273	0.280	-2.86	0.00
income_in_million	0.347	1.415	7.87	0.00
distance_river_100m_500m	-0.400	0.670	-0.60	0.55
distance_river _1km_2km	0.637	1.891	0.79	0.43
distance_river _500m_1km	0.779	2.179	1.30	0.19
_cons	-0.708	0.492	-0.92	0.36

The distance to the river and canal category, although is not significant in the restricted model, the LR individual test failed to remove it from the model, suggesting that these variables still have significant predicting power in the model. In this category, the sign of the dummy indicating a distance from 100m to 500m is negative while others are positive, this possibly implies that the shorter the distance, the less the respondents are willing to pay. Other variables are statistically significant at the 5 % level.

Bid and income variables have negative and positive signs respectively. This implies a monetary increase in bid/income will lead to a decreased/increased probability of

[3] Bid and income are measured in million VND. Dummy variables are italicized. gender_male and 4 education dummies are in unrestricted model only. Other variables are in the restricted model

voting for the project. This is consistent with common sense and economic theory. Moreover, the effect of each VND increase in bid is eight times stronger than income's, suggesting a greater sensitivity of WTP of respondents to the bid faced than the income sensitivity. The age variable has the negative sign, which means respondents who are older has a lower probability of responding with a 'yes' response, suggesting that people who are younger have a higher tendency to vote for the project than who are older.

However, the surprising discovery is the disparities in the tendency of voting between areas in HCMC. More specifically, negative signs on street_kinhduongvuong and street_anduongvuong dummies imply that households residing on An Duong Vuong Street and Kinh Duong Vuong Street are more reluctant to pay for the project than people residing in other 3 streets. A possible explanation for such low preferring in these streets could be the high frequency of flooding in these areas, leading to the increased level of respondents' uncertainty of the outcome of the hypothetical project when asked. According to Urban Flooding Control Centre (2013), Ward 6, which consists An Duong Vuong Street and Kinh Duong Vuong Street, is one of the areas in HCMC which has been suffering from long-lasting flooding since 2008.

The mean and median WTP calculated by the result of the restricted model with 8 variables is VND 380,000, which is fitted in bootstrapped 95% confidence interval of VND 268,822 to VND 480,079. A further comparison between unrestricted and restricted model is illustrated as follows.

Table 5 Unrestricted model and Restricted model comparison

	Unrestricted model	**Restricted model**
Number of observations	360	360
Included variables	48	8
Number of significant variables at 5%	8	5
Count R-squared	0.85	0.83
Number of variables with VIF >10	6	0
Likelihood Ratio contrast test	Not preferred	Preferred
Mean (median) WTP	400,000	380,000
Bootstrapped 95% conf. interval	290,418 – 499,367	268,822 - 480,079

With the count R^2 of 0.83 compared to 0.85 with the unrestricted model and the advocate from the LR contrast test, it can be said that the restricted model achieves a reasonably equivalent predicting power, which is important to WTP estimating compare to the unrestricted one. Moreover, the unrestricted model is also impaired with serious collinearity issue and there is no significant difference in WTP between two models. Therefore, mean WTP of 380,000 is considered as a consistent parametric estimate for the valuation in the study.

In comparison with non-parametric estimate (VND 484,654), parametric technique produces a more conservative number. Possibly due to the significant drag-down of the variables of the restricted model shown by numerous negatives on the coefficients. However, the non-parametric approach does not take into account the other characteristics, especially income, but WTP choice and bid amount. Although there is no clear evidence supporting the use of either method, conservative principle prefers the use of the approach that produce the lower result (Daniel & Jouni, 2002).

There are also some gaps in WTP between male and female. Recalculation of WTP for male and female group results in the estimate of VND 360,000 and VND 400,000 respectively. This is contrary to the common belief that male tends to pay more than female because of being the main earner in households. However, the gap is not very significant and the phenomena can be explained by the housewives' greater level of concern toward their houses.

5. CONCLUSION

Urban flooding has been risen as a serious problem in HCMC in recent years. Despite efforts of the Government to eradicate the situation through large-scale projects, urban flooding still impairs residents in HCMC. Moreover, due to the economic value diversity of such anti-flooding measures, assessing the value of urban flooding controlling has been challenging for economists not only in HCMC, but also in other metropolises in the world. This study applied Contingent valuation method to find out the WTP for the complete elimination of urban flooding in HCMC. The estimated WTP values may be potentially used in cost-benefits assessments of future projects, or inspection upon completion of current projects. Although the survey has been conducted carefully by direct interview method, there are still potential limitations that may alter the results.

The results show the WTP estimates of VND 484,654 and VND 380,000 for non-parametric TSCA technique and parametric estimation respectively. Further justification has been made between figures and the latter was considered as a consistent estimate for mean WTP for the urban flood control. With the approximated total households of 2 million, the aggregated WTP for the whole city is 760 billion VND. Obviously, this figure is extraordinarily low compared to the enormous scale of the hypothetical project and the actual expected investment cost for project 752 and project 1547. However, despite the results, it is still uncertain to conclude about the feasibility of these projects due to the fact that total economic value may not be fully captured by the contingent valuation method, only the non-use value. Thus, further studies using various methods are required in order to fully give out a best estimate for the evaluation of use value of these plans.

The study also points out that, the level of flooding impact, which is reflected through location variable in the study, possibly plays an important role for the respondents to decide whether or not they should accept the bid. More specifically, this suggests that people living in An Duong Vuong and Kinh Duong Vuong streets are less willing to pay for the flood prevention than people living in other 3 streets in the study. Even though another study which encompasses a greater number of streets and districts in HCMC may be required to further solidify this point, this finding still gives some insights for policy makers about the seriousness of flooding in these two areas and the priority of controlling the flooding situation in HCMC.

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APPENDIX

APPENDIX 1: The questionnaire

Question 1. Year of birth

Question 2. Gender

Question 3. Number of family members

Question 4. Monthly income of household

Question 5. How many members in your household is currently working?

Question 6. How long have your family been in HCMC?

Question 7. Education level

- ◯ High School
- ◯ Vocational training
- ◯ College
- ◯ University
- ◯ Post-graduate

Question 8. House condition:	Total square (m2)	No. of floors
◯ Semi-concrete house		
◯ Concrete house		
◯ Temporary house		
◯ Villa		

Question 9. House ownership

- ◯ Rent house
- ◯ Private house
- ◯ State-provided house

Question 10. Distance to the nearest canal or river:

- ◯ Under 100m
- ◯ From 100m to 500m
- ◯ From 500m to 1km
- ◯ From 1km to 2km
- ◯ Higher than 2 km

Question 11. House address

	Yes	No
Question 12. Have your family been affected by urban flooding before?	◯	◯
Question 13. In your opinion, would the urban flooding controlling be improved in the future?	◯	◯
Question 14. Do you concern about the current urban flooding consequences?	◯	◯

Question 15. On average, how many times have your house been affected with urban flooding?

Question 16. In your opinion, what natural disaster do you concern the most? (From 1 to 4 scale)

Hurricane	①	②	③	④
Flooding	①	②	③	④
Earthquake	①	②	③	④
Thunderstorm	①	②	③	④

Question 17. In your opinion, what environmental issue do you concern the most? (From 1 to 4 scale)

Air pollution	①	②	③	④
Water pollution	①	②	③	④
Noise pollution	①	②	③	④
Soil erosion	①	②	③	④
Greenhouse effect	①	②	③	④
Extinction of rare species	①	②	③	④
Illegal logging	①	②	③	④
Natural resources exhaustion	①	②	③	④

Question 18. In your opinion, what urban issue do you concern the most? (From 1 to 4 scale)

Robbery	①	②	③	④
Traffic accident	①	②	③	④
Fire hazard	①	②	③	④
Urban flooding	①	②	③	④
Traffic congestion	①	②	③	④

Question 19. Is your family currently using any private anti-flooding measures?

- ◯ No measures taken
- ◯ Floor elevation

HCMC has been facing with the urban flooding for a long time, especially in the rain season from May to November. Moreover, in October, the situation will be further aggravated by the river tide.

There are three main causes for urban flooding in HCMC: flooding from upstream, high tide and heavy rain. Moreover, the rapid urbanization also pushes canals, rivers and urban drainage system into overload condition.

According to Steering Centre for Urban flooding, In 2013 and 2014, it is expected to have 11 impaired street routes in the city suburban areas remains and there will be no flooding in the city center. Most significant flooding points are:

- Around Phu Lam Circus (District 6) in the city western gateway. Specifically, Hau Giang Street, Hung Vuong Street, Kinh Duong Vuong Street, Minh Phung Street.
- In Binh Tan District, which has the fast urbanization and unorganized city planning, leads to the exceedance in drainage system.
- Some other areas such as Thanh Da (Binh Thanh district), Kha Van Can Street (Thu Duc district) is also affected heavily with flooding.

With the flooding situation. I would like to propose a project which will help alleviating the flooding problem in HCMC. This project is actually approved and implemented in 2008 by the Government but it has not been completed yet. First, the HCMC will be divided into 3 zones (see figure).

- Zone I (yellow zone): contains all of the left-hand side of Saigon river plus Nha Be District (central HCMC districts and a part of Long An Province)
- Zone II (red zone): contains the area around Saigon river – Dong Nai river tri-fork (District 2, 9 and Thu Duc District)
- Zone III (blue zone): contains Can Gio district only.

The project focuses on protecting zone I and zone II, zone III is consider to be an important ecological and vulnerable area. So no measures is implemented in zone III in the project.

Second, the protection for zone I consists of 172 km of dykes and 12 sluice gates, protecting urban and rural areas of HCMC, more specific, zone I, against tidal flooding and river discharges. It also serves the role of controlling the water level in the protected area by enhancing the outer drainage system. Furthermore, the inner urban drainage will also be enhanced by rehabilitate 186 urban drainage routes.

Third, the protection for zone II focuses on the raising of the embankment of lowlands and building smaller dykes to enclose ecological and tourism areas. Canals and main rivers will also be dredged to improve drainage capacity.

Upon completion, this project is expected to eliminate completely the urban flooding in HCMC. Do you have any questions regarding this project?

Question 20. Assuming if there is a call for contribution to the implementation of this project. Each household in HCMC will be requested to contribute an amount of <initial_bid> as voluntary donation. Will you accept to contribute?

◯ Accept	→	If the amount is now <*higher_bid*>, will you accept?	◯ Accept ◯ Reject
◯ Reject	→	If the amount is now <*lower_bid*>, will you accept?	◯ Accept ◯ Reject

Questions regarding belief	Yes	No
Question 21. Do you think this project can effectively reduce the urban flooding problem?	◯	◯
Question 22. Do you think this project may contaminate the surroundings in the implementation process?	◯	◯
Question 23. Do you believe the Government will make a good use of your contribution?	◯	◯

APPENDIX 2: Non-parametric WTP calculation and bootstrap

At the beginning, the number of households will be distributed into intervals. First, TSCA will calculate the probability of having WTP greater than boundary values by dividing the number of households who have WTP higher than boundary values by the total sample size (180) the results are presented in column 5 in the table below

Second, the probability for having WTP range from an interval's lower bound and higher bound is then calculated for basic intervals by subtracting aforementioned figures. For overlapping intervals, the probability is calculated by adding corresponding basic interval probability. Detailed calculation is presented in column 6 in the table below.

Interval code	Lower bound	Higher bound	Number of HHs in interval	Probability WTP > lower bound	Probability lower b < WTP < higher b
A	0	20,000	9	180/180 = 1.00	1.00 – 0.67 = 0.33
B	20,000	50,000	13	122/180 = 0.67	0.67 – 0.60 = 0.07
C	50,000	250,000	11	109/180 = 0.60	0.60 – 0.35 = 0.25
D	250,000	450,000	10	63/180 = 0.35	0.35 – 0.19 = 0.16
E	450,000	1,000,000	12	35/180 = 0.19	0.19 – 0.06 = 0.13
F	1,000,000	3,000,000	4	11/180 = 0.06	0.06 – 0.02 = 0.04
G	3,000,000	5,000,000	3	4/180 = 0.02	0.02 – 0.00 = 0.02
H	5,000,000	∞	0	0/180 = 0.00	0.00 – 0.00 = 0.00
CD	50,000	450,000	9		0.25+0.16
CDE	50,000	1,000,000	11		0.25+0.16+0.13
CDEF	50,000	3,000,000	15		0.25+0.16+0.13+0.04
DE	250,000	1,000,000	7		0.16+0.13
DEF	250,000	3,000,000	10		0.16+0.13+0.04
DEFGH	250,000	∞	1		0.16+0.13+0.04+0.02+0.00
EF	450,000	3,000,000	8		0.13+0.04
EFGH	450,000	∞	4		0.13+0.04+0.02+0.00
FGH	1,000,000	∞	3		0.04+0.02+0.00
GH	3,000,000	∞	1		0.02+0.00
AB	0	50,000	17		0.33+0.07
ABC	0	250,000	14		0.33+0.07+0.25
ABCD	0	450,000	9		0.33+0.07+0.25+0.16
ABCDE	0	1,000,000	9		0.33+0.07+0.25+0.16+0.13

Third, the number of households in each basic interval will be recalculated by adding the initial number of households with the probability-weighted number of households in overlapping intervals. The result is shown in the column 4 at the table below

Interval code	Lower bound	Higher bound	Number of HHs in interval (Recalculated)	Probability WTP > lower bound (Recalculated)
A	0	20,000	36.52	1.00
B	20,000	50,000	19.17	0.80
C	50,000	250,000	39.14	0.69
D	250,000	450,000	32.74	0.47
E	450,000	1,000,000	36.02	0.29
F	1,000,000	3,000,000	10.81	0.09
G	3,000,000	5,000,000	5.61	0.03
H	5,000,000	∞	0.00	0.00
			Mean WTP	484,654

Lastly, the probability of having WTP higher than boundary values will be recalculated with the new numbers of households. The Mean WTP will now be the sum product of newly calculated probabilities with the boundary values (lower bounds).

To calculate the confidence interval, the bootstrapping procedure is applied. More specifically, using Crystal Ball software, multiple randomly generated data sets will be used to calculate different WTPs. The result for the confidence interval of this mean WTP is shown below.

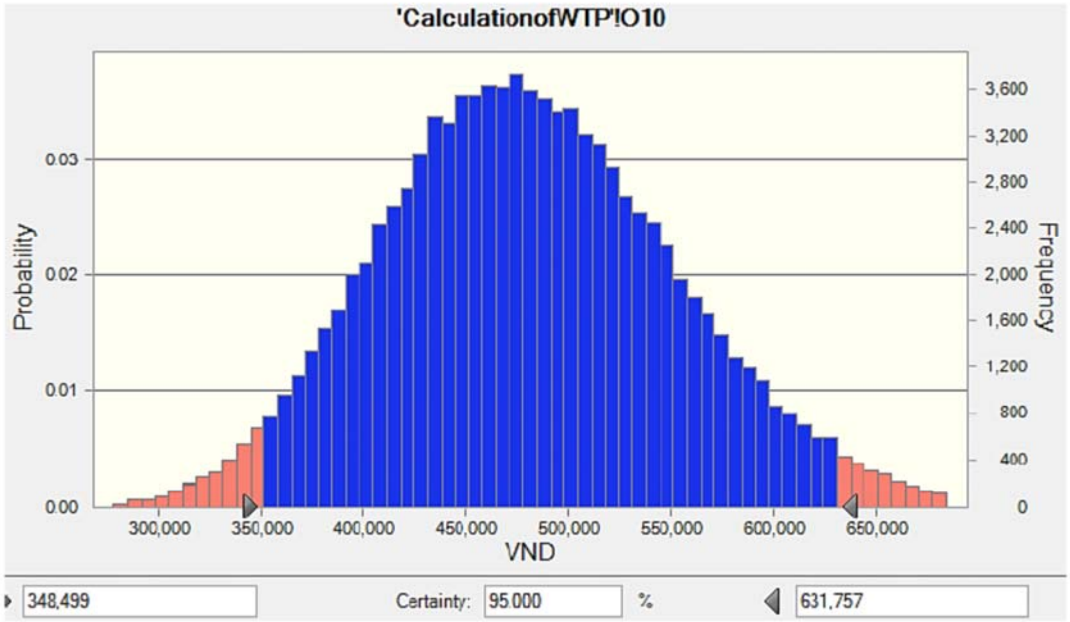

Figure 4 Crystal Ball bootstrapping result for non-parametric WTP
(For even more detailed calculations and bootstrapping instruction, see the Excel file).

APPENDIX 3: Unrestricted model STATA results and bootstrap

Logistic regression Number of obs = 360
LR chi2(47) = 230.21
Prob > chi2 = 0.0000
Log likelihood = -120.92096 Pseudo R2 = 0.4877

choice	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
bid_inmil	-3.768358	.5834935	-6.46	0.000	-4.911984	-2.624732
age	-.0245201	.0173724	-1.41	0.158	-.0585694	.0095292
no_of_dependent	.4663285	.256356	1.82	0.069	-.03612	.9687769
gender_male	.0989271	.3949432	0.25	0.802	-.6751474	.8730015
income_inmil	.4199499	.0774706	5.42	0.000	.2681103	.5717894
no_floors	-.1430356	.302022	-0.47	0.636	-.7349878	.4489166
khavancan	.3610017	.6463254	0.56	0.576	-.9057729	1.627776
anduongvuong	-3.505577	.900945	-3.89	0.000	-5.271397	-1.739757
kinhduongvuong	-1.877452	.7343452	-2.56	0.011	-3.316743	-.4381624
nguyenhuucanh	-.440789	.7830333	-0.56	0.573	-1.975506	1.093928
flood_affect	.6096581	1.27954	0.48	0.634	-1.898194	3.11751
flood_improve	1.058125	.4463937	2.37	0.018	.1832095	1.933041
flood_consequences	-1.314471	.5455949	-2.41	0.016	-2.383817	-.2451247
belief_project	.3818523	.4500268	0.85	0.396	-.500184	1.263889
belief_pollution	.2956996	.6009737	0.49	0.623	-.8821871	1.473586
belief_government	-.9069781	.5409955	-1.68	0.094	-1.96731	.1533535
res_period_under5	1.033324	.5738275	1.80	0.072	-.0913568	2.158006
res_period_under10	-.1490424	.5650193	-0.26	0.792	-1.25646	.958375
edu_highschool	-.9260158	.9460629	-0.98	0.328	-2.780265	.9282334
edu_vocational	-.6251548	1.081205	-0.58	0.563	-2.744277	1.493968
edu_college	-2.394677	.9987266	-2.40	0.016	-4.352146	-.4372093
edu_university	-1.17833	.92941	-1.27	0.205	-2.99994	.6432799
house_semi_concrete	-.0185201	.7538696	-0.02	0.980	-1.496077	1.459037
ownership_rent	-.2690481	.6011	-0.45	0.654	-1.447182	.9090862
distance_100m_500m	-1.148421	.8553328	-1.34	0.179	-2.824842	.5280004
distance_1km_2km	1.417869	1.153721	1.23	0.219	-.8433825	3.679121
distance_500m_1km	.8956122	.8600779	1.04	0.298	-.7901096	2.581334
flood_times_under5	-.060428	.4941573	-0.12	0.903	-1.028958	.9081024
flood_times_above10	-.1774402	.4657231	-0.38	0.703	-1.090241	.7353603
self_anti_flooding	-.6536278	3.444295	-0.19	0.849	-7.404321	6.097066
concern_hurricane	.1111465	.4235304	0.26	0.793	-.7189577	.9412508
concern_flood	-.0124173	.4803627	-0.03	0.979	-.953911	.9290764
concern_earthquake	.622374	.7676667	0.81	0.418	-.8822251	2.126973
concern_thunderstorm	.6659196	.4434418	1.50	0.133	-.2032102	1.535049
concern_air_pollution	-.2308682	.5029651	-0.46	0.646	-1.216662	.7549253
concern_water_pollution	-.4482941	.3846488	-1.17	0.244	-1.202192	.3056037
concern_noise_pollution	.3958451	.4837591	0.82	0.413	-.5523053	1.343996
concern_soil_erosion	1.463726	.5531172	2.65	0.008	.3796367	2.547816
concern_greenhouse	.1436706	.4564686	0.31	0.753	-.7509913	1.038333
concern_extinction	.901053	.5287251	1.70	0.088	-.1352292	1.937335
concern_logging	.3970874	.6177997	0.64	0.520	-.8137777	1.607952
concern_res_exhaustion	.7723069	.5094352	1.52	0.130	-.2261678	1.770782
concern_robbery	.7268556	.4757019	1.53	0.127	-.205503	1.659214
concern_traff_accident	.2819275	.4858891	0.58	0.562	-.6703976	1.234253
concern_fire	-.35244	.4204741	-0.84	0.402	-1.176554	.4716741
concern_urflooding	.8218355	.7144666	1.15	0.250	-.5784932	2.222164
concern_congest	.4266145	.4105365	1.04	0.299	-.3780223	1.231251
_cons	-2.538461	2.228521	-1.14	0.255	-6.906281	1.829359

Krinsky and Robb (95 %) Confidence Interval for WTP measures (Nb of reps: 5000)

MEASURE	WTP	LB	UB	ASL*	CI/MEAN
MEAN/MEDIAN	0.40	0.29	0.50	0.0000	0.51

*: Achieved Significance Level for testing H0: WTP<=0 vs. H1: WTP>0
LB: Lower bound; UB: Upper bound

Measures of Fit for logit of choice

Log-Lik Intercept Only:	-236.024	Log-Lik Full Model:	-120.921
D(312):	241.842	LR(47):	230.207
		Prob > LR:	0.000
McFadden's R2:	0.488	McFadden's Adj R2:	0.284
ML (Cox-Snell) R2:	0.472	Cragg-Uhler(Nagelkerke) R2:	0.647
McKelvey & Zavoina's R2:	0.844	Efron's R2:	0.549
Variance of y*:	21.103	Variance of error:	3.290
Count R2:	0.861	Adj Count R2:	0.618
AIC:	0.938	AIC*n:	337.842
BIC:	-1594.623	BIC':	46.440
BIC used by Stata:	524.375	AIC used by Stata:	337.842

VIF result

Variable	VIF	1/VIF
flood_affect	27.33	0.036584
distance_5~m	20.00	0.050003
concern_ur~g	14.30	0.069915
no_floors	11.35	0.088109
edu_highsc~l	11.33	0.088288
age	11.30	0.088490
flood_cons~s	9.15	0.109271
edu_univer~y	8.19	0.122100
income_inmil	7.75	0.129002
edu_college	7.19	0.139023
distanc~500m	5.59	0.179011
concern_tr~t	5.47	0.182869
no_of_depe~t	4.72	0.211899
anduongvuong	4.44	0.225211
res_perio~10	4.42	0.226474
concern_ro~y	4.24	0.235582
res_period~5	4.15	0.241168
khavancan	3.99	0.250370
edu_vocati~l	3.95	0.253188
concern_co~t	3.62	0.276038
distanc~_2km	3.28	0.304685
gender_male	3.26	0.306687
kinhduongv~g	3.18	0.314825
concern_fl~d	3.13	0.319346
concern_th~m	2.84	0.352726
concern_fire	2.75	0.363180
concern_re~n	2.63	0.379520
house_semi~e	2.63	0.379818
nguyenhuuc~h	2.57	0.388595
flood_tim~10	2.57	0.389299
belief_pro~t	2.56	0.391133
belief_gov~t	2.50	0.400751
flood_impr~e	2.48	0.402447
flood_tim~r5	2.48	0.402512
concern_wa~n	2.42	0.412616
bid_inmil	2.41	0.414638
concern_ai~n	2.39	0.417829
concern_hu~e	2.33	0.429058
concern_no~n	2.19	0.456214
ownership_~t	2.05	0.487842
concern_gr~e	1.92	0.519813
concern_so~n	1.89	0.528191
concern_lo~g	1.72	0.581078
belief_pol~n	1.68	0.594123
self_anti_~g	1.65	0.604361
concern_ex~n	1.62	0.618032
concern_ea~e	1.47	0.679724
Mean VIF	5.05	

APPENDIX 4: Restricted model STATA results, bootstrap and LR contrast test

```
Logistic regression                             Number of obs   =        360
                                                LR chi2(8)      =     187.28
                                                Prob > chi2     =     0.0000
Log likelihood = -142.38521                     Pseudo R2       =     0.3967

------------------------------------------------------------------------------------
            choice |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------------+----------------------------------------------------------------
         bid_inmil |  -3.057467   .4594746    -6.65   0.000    -3.958021   -2.156913
               age |  -.0292945   .0135986    -2.15   0.031    -.0559473   -.0026417
distance_100m_500m |  -.4002655   .6649611    -0.60   0.547    -1.703565    .9030343
  distance_1km_2km |   .6371651   .8084036     0.79   0.431    -.9472769    2.221607
 distance_500m_1km |   .7792256   .5998251     1.30   0.194    -.3964099    1.954861
    kinhduongvuong |  -1.273006   .4446715    -2.86   0.004    -2.144546   -.4014654
      income_inmil |   .3471769   .0441237     7.87   0.000      .260696    .4336579
      anduongvuong |  -2.124322   .5150738    -4.12   0.000    -3.133848   -1.114796
             _cons |  -.7082265   .7698011    -0.92   0.358    -2.217009     .800556
------------------------------------------------------------------------------------
```

Krinsky and Robb (95 %) Confidence Interval for WTP measures (Nb of reps: 5000)

MEASURE	WTP	LB	UB	ASL*	CI/MEAN
MEAN/MEDIAN	0.38	0.27	0.48	0.0000	0.56

*: Achieved Significance Level for testing H0: WTP<=0 vs. H1: WTP>0
LB: Lower bound; UB: Upper bound

Measures of Fit for logit of choice

```
Log-Lik Intercept Only:       -236.024   Log-Lik Full Model:           -142.385
D(351):                        284.770   LR(8):                         187.278
                                         Prob > LR:                       0.000
McFadden's R2:                   0.397   McFadden's Adj R2:               0.359
ML (Cox-Snell) R2:               0.406   Cragg-Uhler(Nagelkerke) R2:      0.555
McKelvey & Zavoina's R2:         0.782   Efron's R2:                      0.471
Variance of y*:                 15.115   Variance of error:               3.290
Count R2:                        0.833   Adj Count R2:                    0.542
AIC:                             0.841   AIC*n:                         302.770
BIC:                         -1781.252   BIC':                         -140.189
BIC used by Stata:             337.745   AIC used by Stata:             302.770
```

VIF results

```
    Variable |       VIF       1/VIF
-------------+----------------------
         age |      7.31    0.136749
distance_5~m |      5.44    0.183855
income_inmil |      3.25    0.308110
anduongvuong |      2.13    0.468563
distanc~500m |      2.06    0.484694
   bid_inmil |      2.01    0.497408
kinhduongv~g |      1.67    0.598646
distanc~_2km |      1.29    0.777012
-------------+----------------------
    Mean VIF |      3.15
```

LR contrast test

```
Likelihood-ratio test                                 LR chi2(39) =     42.93
(Assumption: restricted nested in unrestricted)       Prob > chi2 =    0.3065
```

APPENDIX 5: Related materials, data and calculation files

Data and related materials can be downloaded at one of the following links:

http://goo.gl/4AwHtC

http://goo.gl/ivQoJb

http://goo.gl/2eY10M

http://goo.gl/14AM4Q

Conceptual Framework of Virtual-Team Effectiveness in Vietnam

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With outstanding advantages, teamwork have been increasingly popular in enterprise environment. Improving the effectiveness of team is a solution to help improve the quality of human resources, and thereby promote the general efficiency of companies. In recent days, advances in information systems and communication technology have provided companies with new options for organizing: virtual-team. This is a burgeoning form of organization that allows teams to be composed according to qualifications and expertise, without the limitations of time, space, and the costs and disruptions of relocation.

In Vietnam, companies are more and more investing in virtual-teams to enhance their performance and competitiveness. However, in fact, research on virtual-teams is still in its nascent stages (Badrinarayanan & Arnett, 2008, Prasad & Akhilesh, 2002) and because of the relative newness of virtual-teams, many areas of research have not been examined (Badrinarayanan & Arnett, 2008). Besides, some recent studies also showed that teamwork in Vietnamese companies is not as professional and effective as expected because most managers can't access reliable theoretical framework of team effectiveness (Chau & Anh, 2013).

What are the inputs that influence virtual-team effectiveness? What are the process factors that occur during virtual-teamwork? How can virtual-team effectiveness be measured? To answer these questions, firstly, a review of literature is conducted on background theories and recent studies of teamwork to identify relevant elements in a team effectiveness framework. Once the elements are identified, a qualitative research is carried out on 9 virtual-team managers to indicate which elements are suitable to virtual-team. The number of elements is reduced from 56 to 47. Some elements are removed or classified into other level or divided into specific elements. Some new elements are composed of available elements or brand-new added. After that, a quantitative survey is conducted by using questionnaires via email, Google Docs and hard copies to 259 virtual-team members whose working locations are in the territory of Vietnam.

The research findings help propose a conceptual framework that is particularly suitable to virtual-team effectiveness in Vietnamese enterprise environment. In this framework, (1) **Inputs** include four dimensions: *(i) Team characteristics* (9 factors), *(ii) Individual characteristics* (5 factors), *(iii) Organization characteristics* (5 factors), *(iv) Task characteristics* (4 factors); (2) **Processes** include seven factors: *(i) Coordination, (ii) Connection, (iii) Communication, (iv) Commitment, (v) Flexibility, (vi) Synergy, (vii) Conflict managing*; (3) **Outcomes** include two dimensions: *(i) Performance outcomes* (3 factors), *(ii) Attitude and behavior outcomes* (2 factors) (see Figure 3).

Keywords: Conceptual, effectiveness, framework, team, Vietnam, virtual

1. Introduction

The pressure of global competition, the need to consolidate business models in dynamic, uncertain and complex settings and the need for innovation demand the modification of the structure of work traditionally based around individuals, and the adoption of organizational designs oriented to change and based on teams (West *et al.*, 2004). Teams bring the diversity of knowledge, skills and experience that permits rapid, flexible and innovatory responses to the problems and challenges faced. Hence, the success of organizations and the global production of knowledge depend to a large extent on the effectiveness of teams (Wuchty *et al.*, 2007).

Teamwork goes by many labels, including work teams, work groups, task groups, parallel teams, quality circles, project teams, project groups, cross-functional teams, management teams, etc. With the growth of telework - increasingly called virtual work - is the inevitable growth of virtual-teams, which are teams of people who are geographically dispersed but work together virtually through the use of technology such as teleconferencing and videoconferencing, e-mails, text messages and telephone. Today, we would be hard pressed to find an organization that doesn't have one or more virtual workers and virtual-teams. Virtual-teams are growing in popularity (Cascio, 2000). In the competitive market, virtual-teams represent a growing response to the need for fasting time-to-market, low-cost and rapid solutions to complex organizational problems. Virtual-teams enable organizations to pool the talents and expertise of employees and non-employees by eliminating time and space barriers. Virtual-teams are not only attractive to employers but also green. According to the Telework Research Network, the existing 2.9 million U.S. telecommuters save 390 million gallons of gas and prevent the release of 3.6 million tons of greenhouse gases annually (Lister & Harnish, 2011). In Vietnam, there are many companies which have been using virtual-teams as a modern working form of teamwork. The more companies use virtual-teams, the more knowledge of team effectiveness should be supplied to managers.

However, a representative of General Department of Vocational Training (Ministry of Labor, Invalids and Social Affairs) claimed that one of the most weakness of Vietnamese employees is teamwork (Phuong, 9/2014). Recently, citing from the International Labor Organization, some newspapers reported that the labor productivity of Vietnam belongs to the lowest area, only 1 part 15 of Singaporean, 1 part 5 of Malaysian, 2 part 5 of Thai (Hieu, 9/2014). Performance of Vietnamese employees declines in geometric progression as the number of team members increased in arithmetic progression (Anh, 4/2013). There is a paradox in many Vietnamese companies is the more talented and young the employees are, the easier they lose in activities which require teamwork (Nhat, 6/2011). The experiments suggest that more research is needed to explore the ways to enhance the performance of virtual-teams (El-Tayeh *et al.*, 2008).

Aiming to provide more references for those interested in improving team effectiveness, especially virtual-team effectiveness in Vietnam, this study is carried out in three steps: *(1)* Systematizing background theories and recent studies of teamwork to identify relevant elements in a team effectiveness framework. *(2)* Carrying out a qualitative research on 9 virtual-team managers to indicate which elements are suitable to virtual-team. *(3)* Conducting a quantitative survey among 259 virtual-team members whose working locations are in the territory of Vietnam. These respondents have got themselves involved in virtual-teams with different positions and working locations. The research findings help propose a conceptual framework that is particularly suitable to virtual-team effectiveness in Vietnamese enterprise environment.

2. Literature review

2.1. *Group and team*

A group is two or more individuals who are connected by and within social relationships (Forsyth, 2006). Groups can be classified into two types: *(1)* Informal groups; *(2)* Formal groups (Hiriyapa, 2009; Luthans, 2011; Newstrom, 2007; Schermerhorn *et al.*, 2004). A team is a formal group. It's a group of people holding themselves collectively accountable for using complimentary skills to achieve a common purpose. Teamwork occurs when team members live up to their collective accountability for goal accomplishment (Schermerhorn *et al.*, 2010). Results of teamwork consist of both individual results and what we call "collective work-products" (Katzenback & Smith, 1993). In team, there's no social loafing as group.

Although teamwork is preferred to groupwork, two terms "team" and "group" are used interchangeably in the literature (Guzzo & Dickson, 1996). It is not always beneficial to form groups or teams, under some circumstances one has no alternative (Wagner & Hollenbeck, 2014). In this study, the literature review was carried out on the background theories and recent studies of both "team" and "group", and the term "team" was used for all of the concepts related to "team" or "group".

2.2. *Virtual-team*

Now, due to communication technology improvements and continued globalization, virtual-teams have increased rapidly worldwide (Kirkman *et al.*, 2002). Although virtual-teamwork is a current topic in the literature on global organizations, it has been problematic to define what "virtual" means across multiple institutional contexts (Chudoba *et al.*, 2005). Virtual-teams work across boundaries of time and space by utilizing modern computer driven technologies. The term "virtual-team" is used to cover a wide range of activities and forms of technology-supported working (Anderson *et al.*, 2007). Virtual-teams are comprised of members who are located in more than one physical location. This team trait has fostered extensive use of a variety of forms of computer-mediated communication that enable geographically dispersed members to coordinate their individual efforts and inputs (Peters & Manz, 2007).

Generally, we can differentiate various forms of "virtual" work depending on the number of persons involved, the degree of interaction between them or number of managers, etc. Cascio & Shurygailo (2003) have clarified the difference form of virtual-teams by classifying it with respect to two primary variables namely, the number of location and the number of managers illustrates this graphically. Therefore there are four categories of virtual-teams: *(1)* Teleworkers: A single manager of a team at one location; *(2)* Remote team: A single manager of a team distributed across multiple location; *(3)* Matrixed teleworkers: Multiple manager of a team at one location; *(4)* Matrixed remote teams: Multiple managers across multiple locations.

2.3. *Team effectiveness frameworks*

The success of organizations and the overall production of knowledge depend to a large extent on the effectiveness of teams (Wuchty *et al.*, 2007). Teams are often conceptualized as complex performance systems (Forsyth, 2006). Assuming that variables in the system are linked to one another in simple, one-to-one relationships, systems theory recognizes factors that set the stage for teamwork (*inputs*), that facilitate or inhibit the nature of the teamwork (*processes*), and a variety of consequences that result from the team's activities (*outcomes*). This assumption is the basis of the well-known Input-Process-Output framework of team effectiveness.

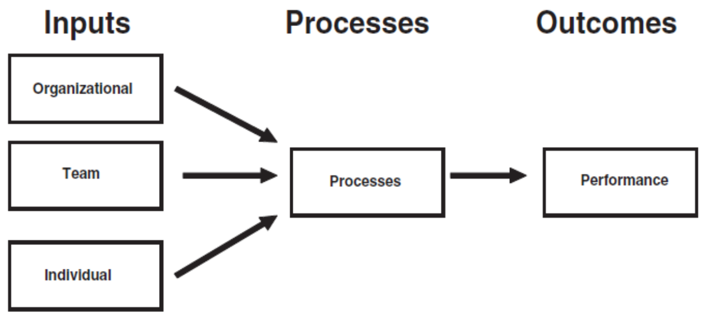
More than 50 years ago, McGrath (1964) developed the first Inputs-Processes-Outcomes (IPO) framework for studying team effectiveness. Since then, the IPO team effectiveness framework has served as a valuable guide for researchers over the years, but it has also been modified and extended in several ways (Cohen & Bailey, 1997; Hackman, 1983; Ilgen *et al.*, 2005; McGrath *et al.*, 2000; Salas *et al.*, 1992). According to Mathieu *et al.* (2008), there are two usual team effectiveness frameworks: *(1)* IPO team effectiveness framework; *(2)* IMO team effectiveness framework.

2.3.1. *IPO team effectiveness framework*

Blendell *et al.* (2001), Driskell *et al.* (1987), Klimoski & Jones (1995), McGrath (1964), Tannenbaum *et al.* (1992), etc., used IPO team effectiveness framework to describe team effectiveness as a system of three stages: Inputs -> Processes -> Outcomes. *(1)* Inputs describe antecedent factors that enable and constrain members' interactions. These include individual team member characteristics (e.g., competencies, personalities), team-level factors (e.g., task structure, external leader influences), organizational and contextual factors (e.g., organizational design features, environmental complexity). *(2)* These various antecedents combine to drive team processes, which describe members' interactions directed toward task accomplishment. Processes are important because they describe how team inputs are transformed into outcomes. *(3)* Outcomes are results and by-products of team activity that are valued by one or more constituencies (Mathieu *et al.*, 2000). Broadly speaking, these may include performance (e.g., quality and quantity) and members' affective reactions (e.g., satisfaction, commitment, viability).

Being considered popular in study, but the IPO team effectiveness framework has been often criticized and modified. Most of the adaptations to the IPO team effectiveness framework have either placed it in a larger context, emphasized a temporal element, or rediscovered more subtle aspects of the model that have gone overlooked. Ilgen *et al.* (2005) noted that many of the meditational factors that intervene and transmit the influence of team inputs to outcomes are not processes. Several other studies showed that during the processes, many mediating factors were formed, such as cognition, motivation, emotion, power, psychological safety, crowd effects, etc. (Cohen & Bailey, 1997; Marks *et al.*, 2001).

Figure 1. Inputs-Processes-Outcomes (IPO) Team Effectiveness Framework



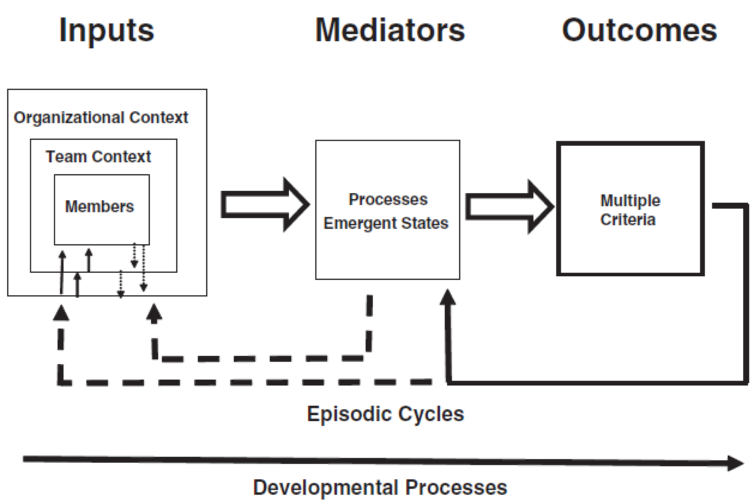
2.3.2. *IMO team effectiveness framework*

In recent years, IMO (inputs-mediators-outcomes) was another outstanding framework of team effectiveness, typically Rasker & Essens (2001), Salas *et al.* (1992), Shanahan (2001), Urban *et al.* (1995), etc. The differences between IMO and IPO team effectiveness frameworks are: *(1)* Inputs are classified into layers, outer layers (higher level factors) and inside layers (lower level factors) influence mutually; *(2)* In teamwork, there appear meaningful mediators that team managers should pay attention to in order to increase the chances of improving team effectiveness. Identifying these mediators also help researchers partly explain the reason why the same inputs make different outcomes; *(3)* Developmental processes of teams unfold over time as teams mature with cyclic loops; *(4)* In a cycle, mediators and outcomes can influence on inputs; *(5)* Feedback loops are episodic processes, while the results of previous cycle affect the inputs of following cycle. Therefore, IMO team effectiveness framework can be displayed as IMOI (Inputs-Mediators-Outcomes-Inputs).

2.4. *Relevant elements in team effectiveness framework*

Not many IMO models were published because of the complexity of relationships between

Figure 2. Inputs-Mediators-Outcomes (IMO) Team Effectiveness Framework



elements in this kind of framework. Hence, by reviewing outstanding studies of teamwork published since the beginning of 20th century, the authors identify relevant elements which probably exist in an IPO framework (not an IMO framework) of team effectiveness.

2.4.1. *Input factors*

Inputs describe antecedent factors that enable and constrain members' interactions. These usually include three main components: individual team member characteristics (e.g., competencies, personalities), team-level factors (e.g., task structure, external leader influences), and organizational and contextual factors (e.g., organizational design features, environmental complexity). According to McGrath (1964), inputs include: *(1)* individual-level factors, *(2)* group-level factors, *(3)* environment-level factors. Gladstein (1984) classified two kinds of inputs: *(1)* group level, *(2)* organizational level. Cohen & Bailey (1997) pointed out four types: *(1)* organization, *(2)* team, *(3)* task, *(4)* individual. According to Rasker & Essens (2001) inputs include: *(1)* environment factors, *(2)* situation factors, *(3)* team factors, *(4)* individual factors, *(5)* task factors.

Analyzing recent studies of teamwork, the authors identify 26 input factors. Cohen & Bailey's review of the work teams literature (1997) has proven to be one of the most influential Journal of Management articles, with more than 545 citations as of 2007 (Harzing, 2007). Referring to Cohen & Bailey (1997), the authors classify these inputs into four kinds (see Appendix 1):

(a) Organization level, including: *(a.1)* Purposes or Goals, *(a.2)* Reward structure, *(a.3)* Resources, *(a.4)* Organizational culture), *(a.5)* Availability of environment, *(a.6)* Work stress, *(a.7)* Climate, *(a.8)* Mutual trust and shared value.

(b) Team level, including: *(b.1)* Leadership, *(b.2)* Norm and procedure*, (b.3)* Team structure or Team design, *(b.4)* Team building, *(b.5)* Relevant members, *(b.6)* Roles and responsibility, *(b.7)* Team size, *(b.8)* Information system, *(b.9)* Relationship.

(c) Task level, including: *(c.1)* Task design or Task structure , *(c.2)* Task strategy, *(c.3)* Task complexity or Work load, *(c.4)* Task characteristic

(d) Individual level, including: *(d.1)* Knowledge, *(d.2)* Attitude, *(d.3)* Skill, *(d.4)* Personality, *(d.5)* Training or Educating

2.4.2. *Process factors*

Team processes have played a central role in most team effectiveness models (Gist *et al.*, 1987; Guzzo & Shea, 1992; Hackman, 1983). Historically, team processes were categorized as either "taskwork" or "teamwork" (McIntyre & Salas, 1995; Oser *et al.*, 1989; Stout *et al.*, 1999). At its essence, taskwork describes functions that individuals must perform to accomplish the team's task, whereas teamwork describes the interaction between team members (McIntyre & Salas, 1995). Marks *et al.* (2001) developed a taxonomy of processes that included three categories: transition, action, and interpersonal.

Analyzing previous studies of teamwork, the authors identify 13 factors that exist or emerge in team processes, notably coordination and communication (see Appendix 2): *(e.1)* Connection, *(e.2)* Flexibility, *(e.3)* Motivation, *(e.4)* Effort, *(e.5)* Synergy, *(e.6)*

Compatibility, *(e.7)* Interdependence, *(e.8)* Commitment, *(e.9)* Coordination, *(e.10)* Assessment – feedback – audit – monitoring, *(e.11)* Decision making, *(e.12)* Communication, *(e.13)* Conflict solving or Problem managing.

2.4.3. *Outcome factors*

Most studies of teamwork concentrate on "who" are team members, "how" they work together, "what" they do to complete tasks. This lead to the obvious bias: many models help clarify the inputs and processes of teamwork, but too few models mentioned outcomes (Beal *et al.*, 2003; Ilgen, 1999). Besides, team effectiveness is often confused with team performance. Although team performance is the most widely criterion in the field of organizational behavior (Bommer *et al.*, 1995), studies of teamwork mostly focuse on human behaviors. Therefore, team performance can not be fully alternative to team effectiveness.

Team effectiveness can be measured in two ways: *(1)* Team effectiveness is an *one-dimensional construct* directly measured by a single variable, usually the team performance (Kolodny & Kiggundu, 1980; Shea & Guzzo, 1987) or the real productivity of team (Steiner, 1972); *(2)* More popularly, team effectiveness is a *multidimensional construct* measured by various criteria (Hackman, 1983; Hackman *et al.*, 1986; Hackman, 2002). For example, according to McGrath (1984) and Sundstrom *et al.* (1990), team effectiveness includes *(i)* team performance and *(ii)* team viability; according to Tannenbaum *et al.* (1992), team effectiveness is viewed as a combination of performance in terms of outcomes and the team's ability to grow and regenerate itself; according to Mohrman *et al.* (1995), team effectiveness is based on three aspects *(i)* team performance, *(ii)* interdependent functioning, *(iii)* team satisfaction; according to Cohen *et al.* (1996), team effectiveness is *(i)* high performance and *(ii)* employee quality of work life; according to Newstrom (2007), team effectiveness includes *(i)* performance or productivity improvements, *(ii)* member behaviors, *(iii)* member attitudes.

Analyzing previous studies of teamwork, the authors identify 17 outcome factors or 17 criteria to measure team effectiveness. Referring to Newstrom (2007), the authors classify these criteria into three kinds (see Appendix 3):

(f) Performance, including: *(f.1)* Productivity, *(f.2)* Cost, *(f.3)* Production, *(f.4)* Quality, *(f.5)* Services , *(f.6)* Safe, *(f.7)* On-time, *(f.8)* Sales, *(f.9)* Plan.

(g) Attitude, including: *(g.1)* Satisfaction, *(g.2)* Satisfaction about job, *(g.3)* Commitment, *(g.4)* Change, *(g.5)* Trust

(h) Behavior, including: *(h.1)* Turnover, *(h.2)* Absence, *(h.3)* Viability

3. Qualitative research

Basing on theoretical basis, a qualitative research is carried on virtual-team managers to indicate which elements are suitable to virtual-team. In order to increase the representation of sample, the authors use *types of virtual-team* as a criterion to choose interviewees: *(i)* teleworkers, *(ii)* remote team, *(iii)* matrixed teleworkers, *(iv)* matrixed remote teams. Sample size is 9 determined by saturation (See Table 1).

Table 1. Information of interviewees

Position – Company	Type of virtual-team
1. Assistant to Project Manager – The Siam Cement Group (SCG)	Teleworkers
2. Operation Specialist – Royal HaskoningDHV	Remote team
3. Exporting Manager – Duytan Plastics Manufacturing Corporation	Matrixed teleworkers
4. Vice Manager of Engineering Department – Southern Vietnam Power Project Management Board	Matrixed remote teams
5. Planning Specialist – Management Board of HCMC Urban Railway	Teleworkers
6. Chief Executive Officer – NMKH Co., Ltd.	Remote team
7. Head of Transaction Banking – Saigon Thuong Tin Commercial Joint Stock Bank (Sacombank)	Matrixed teleworkers
8. Director of Training Center – Viet Capital Bank	Matrixed remote teams
9. Former Associate Creative Director – Chuo Senko Vietnam	Teleworkers

In-depth interview technique (face to face or via telephone) is used. The average time per interview is 60 minutes. Interview protocol is composed of two parts: *(1)* Introduction part: presents the research purposes and questions which help select correct interviewees; *(2)* Discussion part: presents questions which help collect data. Results:

- Not all elements are believed suitable to virtual-team. Because of particular characteristics of virtual-team, especially different working locations, six elements are suggested to be removed: *(a.7*) Climate, *(b.4)* Team building, *(e.6)* Compatibility, *(f.6)* Safe, *(g.3)* Commitment, *(g.5)* Trust.
- One element is suggested to be classified into other level: *(a.1)* Purposes or goals is moved from *(a)* Organization level to *(c)* Task level.
- Two elements are divided into specific elements: *(a.2)* Reward structure = *(OL2)* Reward structure of company & (*TeL8)* Reward structure of team, *(b.1)* Leadership = (*OL7)* Leadership of company & *(TeL7)* Team leadership.
- New elements are composed of available elements: *(OL3)* Resources = *(a.3)* Resources & *(a.5)* Availability of environment, *(TeL2)* Team structure = *(b.3)* Team structure or Team design & *(b.5)* Relevant members, *(PF1)* Connection = *(e.1)* Connection & *(e.7)* Interdependence, *(PF6)* Coordination = *(e.6)* Compatibility & *(e.9)* Coordination, *(Pe4)* Quality = *(f.4)* Quality & *(f.5)* Services, *(Pe5)* On-time = *(f.7)* On-time & *(f.9)* Plan, *(A1)* Satisfaction = *(g.1)* Satisfaction & *(g.2)* Satisfaction about job.
- One brand-new element is added: *(OL1)* Vision and mission.

Besides, in the context of virtual-team, the descriptions of each element are also recorded (see Table 2).

Table 2. Some results of qualitative research

Kinds of factors	Factors	Origin	Descriptions
Input factors			
Organization level	(OL1) Vision and mission	Brand-new factor	Company has clear vision and mission, which are concurred and advocated by virtual-team members.
	(OL2) Reward structure of company	(a.2)	Company applies clear and fair reward structure on virtual-team members.
	(OL3) Resources	(a.3) & (a.5)	Company supplies virtual-team members with sufficient and stable resources, which include anything necessary for virtual-teamwork, such as office equipment, computers, internet, telephone, software, human resources, finance resources, etc.
	(OL4) Organizational culture	(a.4)	Company has strong culture which is suitable to virtual-teamwork.
	(OL5) Work stress	(a.6)	Company puts reasonable work stress to virtual-team members.
	(OL6) Mutual trust	(a.8)	Company successfully builds mutual trust between to virtual-team members and company.
	(OL7) Leadership of company	(b.1)	Leaders of company care about and support virtual-teamwork.
Team level	(TeL1) Norm and procedure	(b.2)	Virtual-team successfully builds internal common rules, norms and procedures.
	(TeL2) Team structure	(b.3) & (b.5)	Virtual-team has relevant members who can minimize weaknesses and maximize strengths of each other.
	(TeL3) Roles and responsibility	(b.6)	In virtual-team, each member is assigned specific and rational roles and responsibilities. All virtual-team members understand, agree and perform their roles and responsibilities.
	(TeL4) Team size	(b.7)	Virtual-team has stable number of members which is suitable to task.
	(TeL5) Information system	(b.8)	Virtual-team has good information system which help team members more efficient in transferring information.
	(TeL6) Relationship	(b.9)	In virtual-team, members have positive relationships.
	(TeL7) Team leadership	(b.1)	Leaders of virtual-team accomplish their tasks in team.
	(TeL8) Reward structure of team	(a.2)	Virtual-team has an internal reward structure which is clear and fair.
Task level	(TaL1) Task goals	(a.1)	Virtual-team's goals are in proportion to tasks. They must be clear and consistent with company's vision and mission.
	(TaL2) Task design	(c.1)	Virtual-team's tasks are scientific.
	(TaL3) Task strategy	(c.2)	Virtual-team has logical strategy to solve particular tasks.
	(TaL4) Work load	(c.3)	Virtual-team is put under suitable and fair work load.
	(TaL5) Task characteristic	(c.4)	Virtual-team's tasks (e.g., types of tasks, requirement of time, skill, ability, etc.) are reasonable.
Individual level	(IL1) Knowledge	(d.1)	Virtual-team members have suitable knowledge (e.g., technical knowledge, specialized knowledge, etc.)
	(IL2) Attitude	(d.2)	Virtual-team members have positive attitudes (e.g., ready to work with distant partners, etc.)
	(IL3) Skill	(d.3)	Virtual-team members have requisite skills, especially teamwork skill (e.g., internet skill, intranet skill, computer skill, stenography skill, etc.)
	(IL4) Personality	(d.4)	Virtual-team members have suitable and reciprocal personalities (e.g., open-minded, flexible, self-aware, self-motivated, active, etc.)

	(IL5) Training	(d.5)	Virtual-team members train themselves to work together effectively (e.g., learning in classes, participating in seminars, etc.)
Process factors			
	(PF1) Connection	(e.1) & (e.7)	Virtual-team members have close connection and interdependence. Virtual-team is a solidary and durable unity.
	(PF2) Flexibility	(e.2)	Virtual-team members respond quickly and flexibly to change.
	(PF3) Motivation	(e.3)	Virtual-team members are motivated by team and company.
	(PF4) Effort	(e.4)	Virtual-team members spend their physical and spiritual efforts on common tasks.
	(PF5) Synergy	(e.5)	Resources in virtual-team are reasonable assigned to tasks.
	(PF6) Coordination	(e.6) & (e.9)	Virtual-team members coordinate closely in order to take full advantage of collective strength. They adjust themselves to become more suitable to each other and to common tasks.
	(PF7) Commitment	(e.8)	Virtual-team members agree and commit to common internal rules.
	(PF8) Assessment – feedback – audit – monitoring	(e.10)	Virtual-team members continuously do the jobs of assessment – feedback – audit – monitoring
	(PF9) Decision making	(e.11)	Virtual-team members join in common decision making processes.
	(PF10) Communication	(e.12)	Virtual-team members communicate effectively. Information is preserved while transferring.
	(PF11) Conflict managing	(e.13)	Virtual-team members proactively plan solutions to conflict.
Outcome factors			
Performance	(Pe1) Productivity	(f.1)	Virtual-team's outcomes are appropriate to inputs.
	(Pe2) Cost	(f.2)	Virtual-team's cost is reasonable and acceptable.
	(Pe3) Production	(f.3)	Virtual-team's production (e.g., products, contracts, projects, etc.) meets the target.
	(Pe4) Quality	(f.4) & (f.5)	Quality of virtual-team's outcomes is acceptable. Quality is increased by plus services (e.g., consulting, promotion, maintenance, warranty, etc.)
	(Pe5) On-time	(f.7) & (f.9)	Virtual-team's outcomes are on-time and conform to plan.
	(Pe6) Sales	(f.8)	Virtual-team's sales and profits meet requirements.
Attitude	(A1) Satisfaction	(g.1) & (g.2)	Virtual-team members have positive thought about each other. Internal conflict is controlled. Virtual-team members are satisfied with work load and results.
	(A2) Change	(g.4)	Virtual-team members positively change. They accept new things and pay attention to team improvement.
Behavior	(B1) Turnover	(h.1)	Virtual-team members don't leave team or stop working because of negative reasons. The number of turnover is within managers' control.
	(B2) Absence	(h.2)	Virtual-team members take part in common working time. They also participate in team-building activities outside working hours. The number of unpermitted absence is decreased.
	(B3) Viability	(h. 3)	Virtual-team is maintained.

4. Quantitative survey

Basing on the results of qualitative research, 47 relevant elements are identified. In order to propose a conceptual framework of virtual-team effectiveness that is particularly suitable to Vietnamese enterprise environment, a quantitative survey using convenient sampling is carried out. The respondents are working in companies in the territory of Vietnam and have participated in virtual-teams with different positions and working locations. Data is collected by questionnaires delivered via email, Google Docs and hard copies. In the first part of questionnaire, some demographic information is collected. In the second part, all scales are scored on a 5-point Likert-scale anchored with strongly disagree = 1 to strongly agree = 5, with 47 indicators. The questionnaire is piloted with a group of virtual-team members before the actual survey. The audit tool is later conducted with a total of 281 respondents, 259 was finally usable (22 invalid respondents). The data is then analyzed by SPSS.

4.1. *Demographic information:*

Gender: 52.9% respondents are woman, 47.1% respondents are man.

Current working location: 68% respondents are in Hochiminh City, 20% respondents are in Hanoi City, 12% are in other places.

The number of virtual-team: 55.1% respondents are participating in 1 virtual-team, 21.5% respondents are participating in 2 virtual-teams, 12% respondents are participating in 3 virtual-teams, 5.8% respondents are participating more than 3 virtual-teams.

Types of virtual-team: 37% respondents have participated in teleworkers, 67.6% respondents have participated in remote team, 36.7% respondents have participated in matrixed teleworkers, 25.9% respondents have participated in matrixed remote teams.

Tools for virtual-teams: 98.8% virtual-teams have used Email, 91.9% virtual-teams have used Telephone, 78.8% virtual-teams have used Instant Messaging and Chat, 59.5% virtual-teams have used Web Conferencing, 50.2% virtual-teams have used File Transfer, 47.5% virtual-teams have used Remote Access and Control, 38.2% virtual-teams have used Groupware.

Positions in current virtual-teams: 24.3% respondents are managers of at least one virtual-team.

The average size of virtual-teams: 17.8% virtual-teams have 2 members, 57.5% virtual-teams have from 3 to 7 members, 24.7% virtual-teams have more than 7 members.

4.2. *Virtual-team effectiveness framework:*

Exploratory Factor Analysis (EFA) using *principal component factor analysis* with *varimax rotation* and *Kaiser normalization* is conducted on observed variables. Firstly, when EFA is conducted on 25 observed variables encoded from 25 input factors, KMO = 0.785 (p = 0.000) and the variable *(TaL3) Task strategy* is removed. Then, EFA is conducted on 24 remaining observed variables, KMO = 0.847 (p = 0.000), two variables *(IL5) Training* and *(TaL5) Task characteristic* are removed. There are four dimensions formed (see Table 3).

Table 3. Results of EFA on input factors

Dimensions	Factors	Factor loadings			
		(1)	(2)	(3)	(4)
Team characteristics	(TeL2) Team structure	0.822			
	(TeL4) Team size	0.804			
	(TeL1) Norm and procedure	0.774			
	(OL6) Mutual trust	0.731			
	(TeL7) Team leadership	0.725			
	(TeL5) Information system	0.674			
	(TeL6) Relationship	0.662			
	(TeL8) Reward structure of team	0.514			
	(PF11) Conflict managing	0.505			
Individual characteristics	(IL2) Attitude		0.804		
	(IL3) Skill		0.703		
	(IL1) Knowledge		0.632		
	(IL4) Personality		0.620		
	(TeL3) Roles and responsibility		0.597		
Organization characteristics	(OL3) Resources			0.787	
	(OL2) Reward structure of company			0.743	
	(OL7) Leadership of company			0.651	
	(OL4) Organizational culture			0.612	
	(OL1) Vision and mission			0.505	
Task characteristics	(TaL2) Task design				0.785
	(TaL4) Work load				0.707
	(OL5) Work stress				0.692
	(TaL1) Task goals				0.650
	Eigenvalue	6.771	2.345	1.692	1.602
	% of Total Variance	29.284	17.552	6.264	5.933
	Cronbach Alpha	0.863	0.754	0.777	0.654

All new constructs are tested by Cronbach's α coefficient (Cronbach's α range is between 0.654 to 0.863). Another EFA is conducted on 11 observed variables which are encoded from 11 process factors, KMO = 0.680 (p = 0.000), 4 variables *(PF3) Motivation*, (*PF4) Effort, (PF8) Assessment – feedback – audit – monitoring , (PF9) Decision making* are removed, and only one dimension is formed (see Table 4).

Table 4. Results of EFA on process factors

Dimensions	Factors	Factor loadings
		(1)
Processes	(PF6) Coordination	0.717
	(PF1) Connection	0.699
	(PF10) Communication	0.689
	(PF7) Commitment	0.621
	(PF2) Flexibility	0.607
	(PF5) Synergy	0.599
	(PF11) Conflict managing	0.555
Eigenvalue		5.332
% of Total Variance		23.764
Cronbach Alpha		0.609

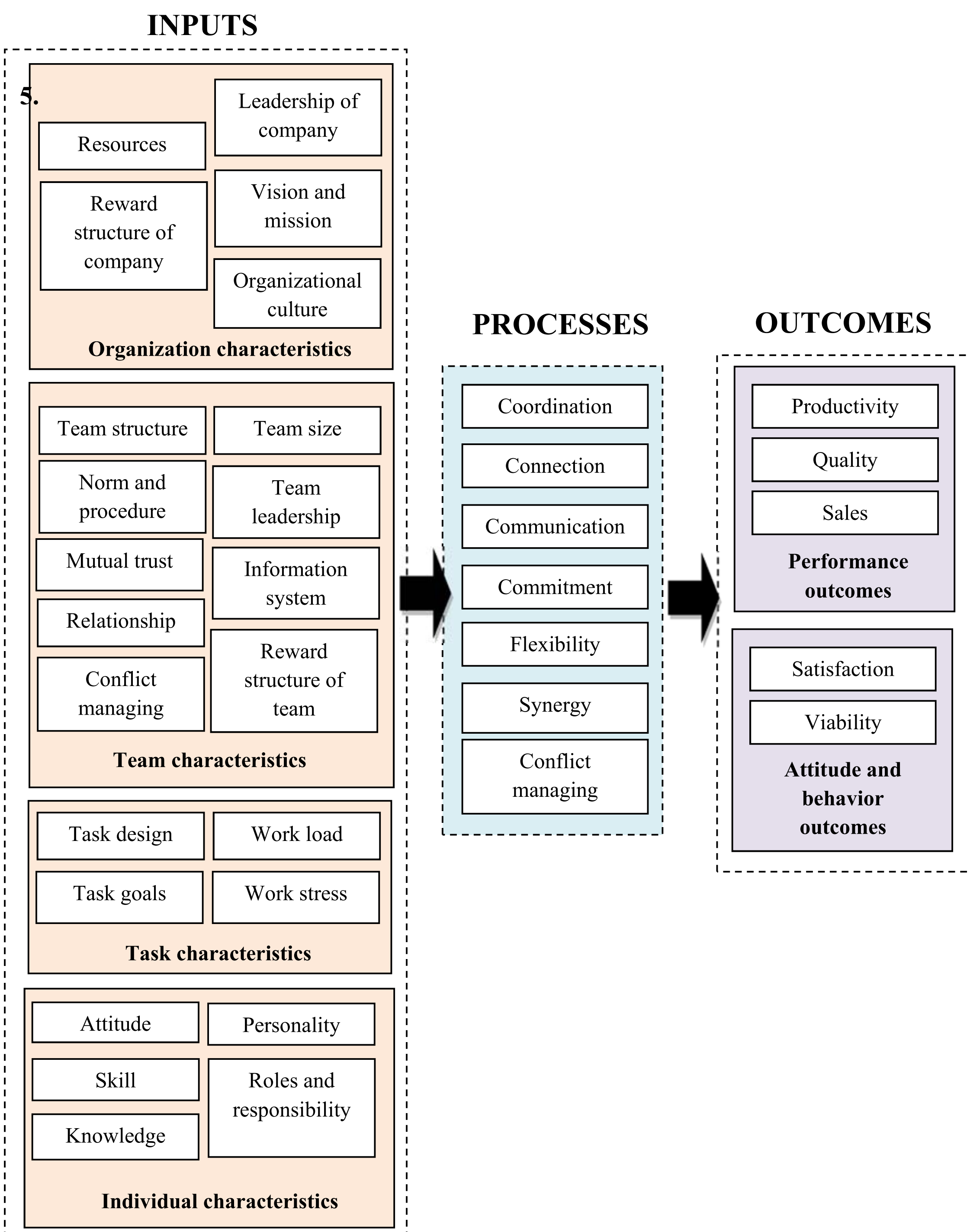
EFA is then conducted on 11 observed variables which are encoded from 11 outcome factors, KMO = 0.740 (p = 0.000), 6 variables (*Pe2) Cost, (Pe3) Production, (Pe5) On-time, (A2) Change, (B1) Turnover, (B2) Absence* are removed, and two dimensions are formed (see Table 5). All new constructs are tested by Cronbach's α coefficient.

Table 5. Results of EFA on outcome factors

Dimensions	Factors	Factor loadings	
		(1)	(2)
Performance outcomes	(Pe1) Productivity	0.767	
	(Pe4) Quality	0.721	
	(Pe6) Sales	0.620	
Attitude and behavior outcomes	(A1) Satisfaction		0.586
	(B3) Viability		0.554
Eigenvalue		2.657	1.369
% of Total Variance		44.281	22.811
Cronbach Alpha		0.623	0.611

The research findings help propose a conceptual framework of virtual-team effectiveness that is particularly suitable to Vietnamese enterprise environment (see Figure 3).

Figure 3. Conceptual framework of virtual-team effectiveness in Vietnam



6. Conclusion

This study is conducted to answer three questions: (1) What are the inputs that influence virtual-team effectiveness? (2) What are the process factors that occur during virtual-teamwork? (3) How can virtual-team effectiveness be measured? To answer these questions, firstly, a review of literature is conducted on background theories and recent studies of teamwork to identify relevant elements in a team effectiveness framework. Once the elements are identified, a qualitative research is carried out on 9 virtual-team managers to indicate which elements are suitable to virtual-team. The number of elements is reduced from 56 to 47. Some elements are removed or classified into other level or divided into specific elements. Some new elements are composed of available elements or brand-new added. After that, a quantitative survey is conducted by using questionnaires via email, Google Docs and hard copies to 259 virtual-team members whose working locations are in the territory of Vietnam.

The research findings help propose a conceptual framework that is particularly suitable to virtual-team effectiveness in Vietnamese enterprise environment. In this framework, (1) **Inputs** include four dimensions: *(i) Team characteristics* (9 factors), *(ii) Individual characteristics* (5 factors), *(iii) Organization characteristics* (5 factors), *(iv) Task characteristics* (4 factors); (2) **Processes** include seven factors: *(i) Coordination, (ii) Connection, (iii) Communication, (iv) Commitment, (v) Flexibility, (vi) Synergy, (vii) Conflict managing*; (3) **Outcomes** include two dimensions: *(i) Performance outcomes* (3 factors), *(ii) Attitude and behavior outcomes* (2 factors) (see Figure 3).

This study contributes to the body of knowledge on virtual-teams, as well as teams, in general. The survey development process used in this study can be utilized by researchers interested in other constructs related to different aspects of team within organization. However, because of convenience sampling method, most respondents are in Hochiminh City, so the results may not highly generalize virtual-team in Vietnam. This study can be pursued by systematizing more theories and studies, extending the scales, carrying out quantitative survey on bigger sample, analyzing data by other techniques.

APPENDIX

Appendix 1. Input factors

Kinds of factors	Factors	References
a. Organization level	a.1 Purposes or Goals	(Adam *et al.*, 2002; Biech, 2007; Hackman, 1983; Hackman, 2002; Klimoski & Jones, 1995; LaFasto & Larson, 2001; Lencioni, 2002; Mickan & Rodger, 2005; Rasker & Essens, 2001; Rubin *et al.*, 1978; Shanahan, 2001; Sharif & Nahas, 2013; Spatz, 2000; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995; West, 2004)
	a.2 Reward structure	(Driskel *et al.*, 1987; Hackman, 2002; LaFasto & Larson, 2001; Lombardo & Eichiger, 1995; Mealiea & Baltazar, 2005; Parker, 2011; Rasker & Essens, 2001; Salas *et al.*, 1992; Shanahan, 2001; Sharif & Nahas, 2013; Sundstrom *et al.*, 1990; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995; Van Roosmalen, 2012; West, 2004)
	a.3 Resources	(Hackman, 1983; Hackman, 2002; LaFasto & Larson, 2001; Mealiea & Baltazar, 2005; Mickan & Rodger, 2005; Parker, 2011; Salas *et al.*, 1992; Shanahan, 2001; Sharif & Nahas, 2013; Spatz, 2000; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995)
	a.4 Organizational culture	(Hackman, 2002; LaFasto & Larson, 2001; Lencioni, 2002; Mealiea & Baltazar, 2005; Mickan & Rodger, 2005; Sharif & Nahas, 2013; Sundstrom *et al.*, 1990; West, 2004)
	a.5 Availability of environment	(Driskel *et al.*, 1987; Hackman, 1983; Katzenbach & Smith, 1993; Shanahan, 2001; Sundstrom *et al.*, 1990; Urban *et al.*, 1995)
	a.6 Work stress	(Driskel *et al.*, 1987; Hackman, 1983; Rasker & Essens, 2001; Shanahan, 2001; Tannenbaum *et al.*, 1992)
	a.7 Climate	(Adam *et al.*, 2002; Biech, 2007; Blendell *et al.*, 2001; Hackman, 1983; Klimoski & Jones, 1995; LaFasto & Larson, 2001; Lombardo & Eichiger, 1995; Parker, 2011; Rasker & Essens, 2001; Shanahan, 2001; Tannenbaum *et al.*, 1992)
	a.8 Mutual trust and shared value	(Adam *et al.*, 2002; Blendell *et al.*, 2001; Hackman, 2002; LaFasto & Larson, 2001; Lencioni, 2002; Lombardo & Eichiger, 1995; Mickan & Rodger, 2005; Parker, 2011; Shanahan, 2001; Sharif & Nahas, 2013; Spatz, 2000; West, 2004)
b. Team level	b.1 Leadership	(Rubin *et al.*, 1978; Klimoski & Jones, 1995; Lombardo & Eichiger, 1995; Spatz, 2000; Shanahan, 2001; Rasker & Essens, 2001; Blendell *et al.*, 2001; LaFasto & Larson, 2001; Biech, 2007; Hackman, 2002; West, 2004; Mickan & Rodger, 2005; Mealiea & Baltazar, 2005; Parker, 2011; Van Roosmalen, 2012; Sharif & Nahas, 2013)
	b.2 Norm and procedure	(Blendell *et al.*, 2001; Driskel *et al.*, 1987; Hackman, 1983; Klimoski & Jones, 1995; LaFasto & Larson, 2001; Rubin *et al.*, 1978; Salas *et al.*, 1992; Shanahan, 2001; Sundstrom *et al.*, 1990; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995)
	b.3 Team structure or Team design	(Blendell *et al.*, 2001; Driskel *et al.*, 1987; Hackman, 1983; Klimoski & Jones, 1995; Parker, 2011; Rasker & Essens, 2001; Salas *et al.*, 1992; Shanahan, 2001; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995)
	b.4 Team building	(Hackman, 2002; Mealiea & Baltazar, 2005; Salas *et al.*, 1992; Shanahan, 2001; Sharif & Nahas, 2013; Sundstrom *et al.*, 1990; Tannenbaum *et al.*, 1992; West, 2004)
	b.5 Relevant members	(Hackman, 2002; LaFasto & Larson, 2001; Lencioni, 2002; Mickan & Rodger, 2005; West, 2004)
	b.6 Roles and responsibility	(Adam *et al.*, 2002; Biech, 2007; Blendell *et al.*, 2001; Hackman, 2002; Katzenbach & Smith, 1993; Klimoski & Jones, 1995; LaFasto & Larson, 2001; Lencioni, 2002; Mealiea & Baltazar, 2005; Mickan & Rodger, 2005; Parker, 2011; Rubin *et al.*, 1978; Shanahan, 2001; Sharif & Nahas, 2013; Spatz, 2000; Sundstrom *et al.*, 1990; Tannenbaum *et al.*, 1992; West, 2004)
	b.7 Team size	(Driskel *et al.*, 1987; Katzenbach & Smith, 1993; Klimoski & Jones, 1995; LaFasto & Larson, 2001; Rasker & Essens, 2001; West, 2004)
	b.8 Information system	(Hackman, 1983; LaFasto & Larson, 2001; Salas *et al.*, 1992; Spatz, 2000)
	b.9 Relationship	(Biech, 2007; Hackman, 1983; Hackman, 2002; LaFasto & Larson, 2001; Lencioni, 2002; Mealiea & Baltazar, 2005; Mickan & Rodger, 2005; Parker, 2011; Rubin *et al.*, 1978; Sharif & Nahas, 2013; West, 2004)

c. Task level	c.1 Task design or Task structure	(Hackman, 1983; Hackman, 2002; Parker, 2011; Rasker & Essens, 2001; Salas *et al.*, 1992; Sundstrom *et al.*, 1990; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995)
	c.2 Task strategy	(Hackman, 1983; Katzenbach & Smith, 1993; Klimoski & Jones, 1995; Lencioni, 2002; Salas *et al.*, 1992; Spatz, 2000; Van Roosmalen, 2012)
	c.3 Task complexity or Work load	(Rasker & Essens, 2001; Shanahan, 2001; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995)
	c.4 Task characteristic	(Driskel *et al.*, 1987; Rubin *et al.*, 1978; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995)
d. Individual level	d.1 Knowledge	(Blendell *et al.*, 2001; Hackman, 1983; Klimoski & Jones, 1995; Lombardo & Eichiger, 1995; Mickan & Rodger, 2005; Rasker & Essens, 2001; Salas *et al.*, 1992; Shanahan, 2001; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995)
	d.2 Attitude	(Klimoski & Jones, 1995; LaFasto & Larson, 2001; Parker, 2011; Rasker & Essens, 2001; Shanahan, 2001; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995)
	d.3 Skill	(Driskel *et al.*, 1987; Hackman, 1983; Katzenbach & Smith, 1993; Klimoski & Jones, 1995; LaFasto & Larson, 2001; Lombardo & Eichiger, 1995; Mealiea & Baltazar, 2005; Rasker & Essens, 2001; Salas *et al.*, 1992; Shanahan, 2001; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995; West, 2004)
	d.4 Personality	(Blendell *et al.*, 2001; Driskel *et al.*, 1987; LaFasto & Larson, 2001; Tannenbaum *et al.*, 1992)
	d.5 Training or Educating	(Shanahan, 2001; Tannenbaum *et al.*, 1992)

Appendix 2. Process factors

Factors	**References**
e.1 Connection	(Hackman, 2002; LaFasto & Larson, 2001; Lencioni, 2002; Mickan & Rodger, 2005; Rasker & Essens, 2001; Spatz, 2000; Sundstrom *et al.*, 1990; Tannenbaum *et al.*, 1992; West, 2004)
e.2 Flexibility	(Lombardo & Eichiger, 1995; Mickan & Rodger, 2005; Rubin *et al.*, 1978; Sharif & Nahas, 2013; West, 2004)
e.3 Motivation	(Blendell *et al.*, 2001; Hackman, 1983; Rasker & Essens, 2001; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995)
e.4 Effort	(Hackman, 1983; Klimoski & Jones, 1995; Salas *et al.*, 1992)
e.5 Synergy	(Biech, 2007; Salas *et al.*, 1992; Shanahan, 2001)
e.6 Compatibility	(Klimoski & Jones, 1995; Shanahan, 2001; Spatz, 2000)
e.7 Interdependence	(Adam *et al.*, 2002; Rasker & Essens, 2001)
e.8 Commitment	(Adam *et al.*, 2002; Katzenbach & Smith, 1993; LaFasto & Larson, 2001; Lencioni, 2002; Mickan & Rodger, 2005; Sharif & Nahas, 2013; Spatz, 2000; West, 2004)
e.9 Coordination	(Adam *et al.*, 2002; Biech, 2007; Hackman, 1983; Hackman, 2002; Klimoski & Jones, 1995; LaFasto & Larson, 2001; Lencioni, 2002; Mickan & Rodger, 2005; Rasker & Essens, 2001; Rubin *et al.*, 1978; Shanahan, 2001; Sharif & Nahas, 2013; Spatz, 2000; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995; West, 2004)
e.10 Assessment – feedback – audit – monitoring	(Adam *et al.*, 2002; Blendell *et al.*, 2001; Hackman, 1983; Mealiea & Baltazar, 2005; Mickan & Rodger, 2005; Parker, 2011; Rasker & Essens, 2001; Sharif & Nahas, 2013; Spatz, 2000; Sundstrom *et al.*, 1990; Tannenbaum *et al.*, 1992; Van Roosmalen, 2012; West, 2004)
e.11 Decision making	(Biech, 2007; Hackman, 2002; LaFasto & Larson, 2001; Lencioni, 2002; Lombardo & Eichiger, 1995; Mealiea & Baltazar, 2005; Mickan & Rodger, 2005; Parker, 2011; Rubin *et al.*, 1978; Sharif & Nahas, 2013; Tannenbaum *et al.*, 1992; West, 2004)
e.12 Communication	(Adam *et al.*, 2002; Biech, 2007; Blendell *et al.*, 2001; Hackman, 2002; Klimoski & Jones, 1995; LaFasto & Larson, 2001; Lencioni, 2002; Mealiea & Baltazar, 2005; Mickan & Rodger, 2005; Parker, 2011; Rubin *et al.*, 1978; Shanahan, 2001; Sharif & Nahas, 2013; Tannenbaum *et al.*, 1992; Urban *et al.*, 1995; West, 2004)
e.13 Conflict solving or Problem managing	(Adam *et al.*, 2002; Biech, 2007; Katzenbach & Smith, 1993; LaFasto & Larson, 2001; Lencioni, 2002; Lombardo & Eichiger, 1995; Mealiea & Baltazar, 2005; Mickan & Rodger, 2005; Parker, 2011; Rubin *et al.*, 1978; Sharif & Nahas, 2013; Tannenbaum *et al.*, 1992; West, 2004)

Appendix 3. Outcome factors

Kinds of factors	Factors	References
f. Performance	f.1 Productivity	(Campion *et al.*, 1993; Campion *et al.*, 1996; Cohen *et al.*, 1996; Cohen & Bailey, 1997; Gibson *et al.*, 2003)
	f.2 Cost	(Cohen *et al.*, 1996)
	f.3 Production	(Drach-Zahavy & Somech, 2002)
	f.4 Quality	(Campion *et al.*, 1993; Campion *et al.*, 1996; Cohen *et al.*, 1996; Cohen & Bailey, 1997; Doolen *et al.*, 2003; Gibson *et al.*, 2003)
	f.5 Services	(Gladstein, 1984; Shea & Guzzo, 1987; Campion *et al.*, 1993; Campion *et al.*, 1996; Hyatt & Ruddy, 1997; Gibson *et al.*, 2003)
	f.6 Safe	(Cohen & Ledford, 1994; 1996; Doolen *et al.*, 2003)
	f.7 On-time	(Gibson *et al.*, 2003)
	f.8 Sales	(Gladstein, 1984; Shea & Guzzo, 1987)
	f.9 Plan	(Doolen *et al.*, 2003)
g. Attitude	g.1 Satisfaction	(Gladstein, 1984; Hackman, 1987; Tannenbaum *et al.*, 1992; Campion *et al.*, 1993; Cohen & Ledford, 1994; Jehn, 1995; Klimoski & Jones, 1995; Campion *et al.*, 1996; Cohen *et al.*, 1996; Cohen & Bailey, 1997; Shanahan, 2001; Blendell *et al.*, 2001; Doolen *et al.*, 2003)
	g.2 Satisfaction about job	(Gladstein, 1984; Cohen & Ledford, 1994; Cohen *et al.*, 1996; Cohen & Bailey, 1997; Wageman, 1995)
	g.3 Commitment	(Fry & Slocum, 1984; Cohen & Ledford, 1994; Cohen *et al.*, 1996; Cohen & Bailey, 1997)
	g.4 Change	(Cohen & Ledford, 1994; Cohen *et al.*, 1996; Cohen & Bailey, 1997)
	g.5 Trust	(Cohen *et al.*, 1996; Cohen & Bailey, 1997)
h. Behavior	h.1 Turnover	(O'Reilly *et al.*, 1989)
	h.2 Absence	(Cohen & Ledford, 1994; Cohen *et al.*, 1996)
	h.3 Viability	(Hackman & Walton, 1986)

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Trade Balance and Exchange Rate in Thailand & the Implications for Vietnam: An Application using Instrumental Variable and the Heterogeneous Panel Cointegration Methods

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This paper is conducted to examine the effects of a currency's devaluation on trade balance for the case of Thailand. In this study, these effects are considered in different aspects such as the determinants of a trade balance of Thailand; and the long run relationship between bilateral exchange rate and Thailand's trade balance.

Empirical findings indicate that the exchange rate policy and relative growth rate of incomes play a central role in explaining Thailand's trade balance, and fiscal and monetary policies are beneficial in some cases. Moreover, the panel fully modified OLS (FMOLS) estimations illustrate that a devaluation of Thailand Baht could provide positive effects on its trade balance in the long run, especially for the groups of country with high income, upper middle income, and countries in the America, and Europe. The individual FMOLS regressions between Thailand and each of her 62 trading partners indicate that the devaluation of Thailand's currency would stimulate Thailand's trade performance with over 20 trading partners, but hurt its performance with the other 10 countries and inconclusive conclusion for the others.

Keywords: Exchange rate, trade balance, currency depreciation, instrumental variable (IV), fully modified ordinary least square (FMOLS)

1. Introduction

Exchange rate has always been one of the most attractive subjects among academics, exporters, importers, investors as well as policy-makers because its vitally important roles played in the international economics. While academics have concerned and developed theories of disequilibrium and equilibrium real exchange rate, the policy-makers concentrate more on exchange rate adjustment in order to examine its effects on the economy. Additionally, exchange rate risk is a key element related directly to the costs and profits for importers, exporters as well as foreign investors. Furthermore, it is argued that developing countries have tendency to devaluate their currency in order to gain the relative competition.

The paper aims to consider a link between Thailand Baht depreciation and Thailand's trade balance. According to Bahmani-Oskooee and Kantipong (2001), after Asian currency crisis, Thailand was one of the most suffered countries in comparison with other nations in the Asian region. Consequently, the country lost market shares of many export products and services to China and other ASEAN countries, and it suffered a severe deficit in its trade of balance. The strategy of devaluation would allow Thailand to increase her regional competitiveness, to recover her lost market shares, and to improve her trade balance. Therefore, Thailand is opted as a typical case to study such a link of effects of depreciation on trade balance.

This paper provides key advantages compared to previous studies. *First*, our analysis exploits panel data rather than individual data, which allows to obtain an individual country's behaviors by observing other countries' performance. *Second*, to control the fact that exchange rates are endogenous to trade balances mention in early research, the current study exploits the fully modified ordinary least squares (FMOLS) method and instrumental variable (IV) estimation to re-examine the link between currency devaluations and trade balances. *Third*, the disaggregated data of trade and exchange rate are utilized to cope with the aggregated bias problem (Rose & Yellen, 1989)

The paper is constructed as follow. The next part reviews theory and empirical evidence related to exchange rate and trade balance, whereas the following present research methodology in term of econometric technique and empirical model. Displayed in two last sections are research findings and conclusions.

2. Literature review

2.1. *Theoretical grounds*

The effect of a currency's devaluation bases on three approaches, including elasticity, income-absorption, and monetary. *Firstly*, the elasticity approach puts an emphasis on the elasticity of demand and supply both of domestic and of foreign country. The key issue of this method is Marshall-Lerner (ML) condition, providing that when the current account begins at an equilibrium position, the devaluation will increase trade flows in the case of the total of (i) price elasticity of domestic demands for imports and (ii) that of foreign demand for exports in absolute terms exceeds unity. After depreciation, it is observed that the balance of trade initially worsens before achieving an improvement. This is known as the so-called J-curve phenomenon. This phenomenon happens because of time lags in recognition, decision, delivery, replacement, and production (Junz & Rhomberg, 1973). The mathematical model showing effects of devaluation on the trade balance was be modelled byJohnson(1975) and Salvartore (2012 p.524). *Secondly*, the absorption approach is proposed by Alexander (1952) and further developed in Alexander (1959). This approach emphasizes how the devaluation affects expenditure behaviors of domestic nation, and thus affects trade balances. The trade balance is calculated by taking the difference between total aggregate demands and domestic absorption measured by consumption, investment, and government purchases. *Thirdly*, the monetary approach studies a broaden concept of balance of payment and considers it as an essentially monetary phenomenon on the view of international economics (Salvatore, 2012 p.509). It is supposed that devaluation may lead to a temporary increase in balance of payment rather than a permanent improvement, but in the long run, balance of payment returns to its initial level.

2.2. *Empirical Reviews*

2.2.1. *Determinants of a Trade Balance*

Furstenberg (1983) had an attempt to examine such domestic factors that significantly influenced the US current account and to suggest policies associated with the national saving and internal investment rates. Miles (1979) established direct relationship between exchange rate and trade balance, in addition to income, monetary supply, and the ratio of government consumption to output. The author investigated the experience of 14 nations using annual data over 1956-1972 periods and concluded that exchange rate devaluations did not improve trade balance of most cases but they increased balance of payments through the capital account. Although Himarios (1985) based on Miles' framework, the author provided critiques of Miles' findings, asserting that *(i)* the findings have problems of unit measurement, *(ii)* the effects of foreign variables and the real terms on trade balance may be differential from that of domestic and nominal ones, and *(iii)* the longer lagged structure of exchange rate plays a significant role. Himarios (1985, 1989) illustrated that devaluations had been a helpful tool for adjusting trade balance.

2.2.2. *Devaluation and Trade Balance*

The empirical studies of investigating the relationship between devaluation and the trade balance are mainly using aggregated and bilateral trade data. On account of aggregated trade data, Bahmani-Oskooee (1985), Himarior (1985, 1989) and Miles (1979) are representative authors using this type of data. However, Bahmani-Oskooee and Alse (1994) pointed out that the first differenced data in Miles (1979) research was stationary. Committedly, the data used in previous studies (Bahmani-Oskooee 1985; Himarios 1985, 1989) was not stationary. With the appliance of cointegration technique by Engle-Granger (1987) and developed by Johansen and Juselius (1990), Bahmani-Oskooee and Alse (1994) indicated that devaluation provided mixed results and found the J-curve phenomenon for some cases. Bahmani-Oskooee (1998) revealed that the devaluation could stimulate the trade balance of most surveyed nations, and found the evidence of the Marshall-Lerner (ML) condition for the case of Korea, South Africa, and Greece. Boyd et al (2001) and Lowinger (2002) provided a support for the J-curve phenomenon and the Marshall-Lerner (ML) condition. Singh (2002) concluded that real exchange rate was statistically related to the balance of trade in India.

According to Bahmani-Oskooee and Brooks (1999), using the effective exchange rate as an aggregate proxy for exchange rate is highly likely to face a serious problem that a nation's currency might appreciate with some currencies, but depreciate with other currencies. Additionally, taking weighted averaging estimate of the exchange rate would smooth out the fluctuation of real effective exchange rate, leading to an unsustainable connection between the effective exchange rate and total trade balance. In order to cope with the problem of effective exchange rate, a large body of studies have employed the disaggregate data or bilateral exchange rate. The list comprises Arora et al (2003), Bahmani-Oskooee & Brooks (1999), Bahmani-Oskooee & Harvery (2010), Bahmani-Oskooee et al (2006), Bahmani-Oskooee et al (2005), Bahmani-Oskooee & Wang (2007), Halicioglu (2008), Rose and Yellen (1989), Thorbecke (2006).

The results of earlier research may suffer the bias and ineffectiveness due to the problems of simultaneity and endogeneity among each variable. Rose and Yellen (1989) indicated that the trade balance model, containing output and exchange rate, may raise the problem of potential simultaneity bias and thus, instrumental variable (IV) method is more appropriate than ordinary least square (OLS). Yol and Baharumshah (2007) indicated that it is highly likely to be a direct and indirect causal relationship between trade balances and such macroeconomic as output, exchange rate, and money supply and some other indicators. To cope with the problem of endogenity, some studies use the IV method (Brissimis & Leventankis 1989; Rose and Yellen 1989, Rose 1990), whereas other utilize the fully modified ordinary least squares (FMOLS) approach (Yol and Baharumshah 2007, Chiu et al 2010). According to Gujarati & Porter (2009), panel data estimations allow taking such heterogeneity explicitly into account by controlling individual variances and provides more informative and less collinearity among the variables, more degree of freedom, and more efficiency.

As far as Thailand is concerned, the link between Thailand's trade balance and bilateral exchange rates has been investigated. For example, Bahmani-Oskooee and Kantipong (2001) revealed that there was at least existence of J-curve phenomenon for two cases of Japan and America out of five major trading partners. In contrast, Baharumshah (2001) indicated that there was no J-curve phenomenon in the short run and the real exchange rate devaluation would affect the trade balance after eight or nine quarters. Onafowara (2003) showed that while the J-curve exists for Thailand's bilateral trade balance with the US in the short run, Thailand's bilateral trade balance with Japan is more consistent with S-curve than J-curve. On one hand, Bahmani-Oskooee and Harvery (2010) pointed out that the real exchange rate changes have no effects on Malaysia's bilateral trade balance to Thailand. On the other hand, Chiu et al (2010) presented that the devaluation of the US dollar would improve her trade balance to Thailand.

3. Research methodology

3.1. *Econometric techniques*

3.1.1. *Panel Unit Root Test*

To avoid spurious regressions associated with time series data, the panel data is examined whether it is stationary or not with the use of Breitung's (2001) panel-based unit root test. It is argued that this test's performance is more powerful than unit root tests employed in individual time series data. Unlike panel-based unit root tests provided by Im et al (2003) and Maddala and Wu (1999), the approach of Breitung (2001) allows individual process to have a common unit root, which is similar to that of Levin et al. (2002). A common unit root assumes that the tests have a common autoregressive (AR) structure for all the series. The prime function form of Breitung (2001) test could be expressed in regressions:

$$\Delta y_{it} = \alpha_i + \beta y_{it-1} + \sum_{j=1}^{p_i} \theta_{ij}\, \Delta y_{i,t-j} + \varepsilon_{it}\ ; i = 1,2,\dots,n; t = 1,2,\dots,T \qquad (1)$$

where Δ represents the first difference variable, i=1,2,…, n individuals in the panel, and t=1,2,…,T time periods. The error term, ε_{it}, is independently distributed normal for all *i* and *t*, and have heterogeneous variances across individuals.

Under Breitung (2001) panel-based unit root test, the null hypothesis is that all panels contain a unit root, meaning that H_0: β=0. The alternative hypothesis is that not all of the individual series have a unit root; that is H_A: β < 0.

3.1.2. *Panel Cointegration Test*

3.1.2.1. Kao's Cointegration Test

Kao (1999) constructed the residual-based cointegration test on the basis of DF and ADF test. The estimation model is as follows:

$$y_{it} = \alpha_i + \beta_i y_{it} + e_{it};\ i = 1,\dots,N; t = 1,\dots,T \qquad \text{where error term } e_{it} \text{ is I(1).}$$

The DF test could be applied to the residuals with a function $\widehat{e_{it}} = p\,\widehat{e_{it-1}} + v_{it}$,
The ADF test uses an extension of above equation with an added lag changes in the regression to correct serial correlation. $\widehat{e_{it}} = p\,\widehat{e_{it-1}} + \sum_{j=1}^{k} \varphi_j\, \Delta\hat{e}_{it-j} + v_{itp}$

The null hypothesis of no co-integration is tested with p=1, and the alternative hypothesis is co-integrated with p<1. The function of the t-statistic calculation is presented in Kao (1999) (pp 8-9).

3.1.2.2. Pedroni Cointegration Test

The general estimation for Pedroni cointegration test is expressed as follow

$$y_{it} = \alpha_i + \sum_{m=1}^{M} \beta_{mi}\, x_{m\,i\,t} + \varepsilon_{it}\ ; i = 1,2,\dots,N; t = 1,2,\dots,T$$

where M, N, and T respectively represent the number of independent variables, the number of individuals, and the time periods. The parameter α_i denotes the unit-specific fixed effects. Pedroni (1999, 2001, 2004) proposed seven test statistics[1] for cointegration, which could be classified into two categories. These test statistics are calculated as follows.

Panel □-statistic:

$$\left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ \hat{\varepsilon}_{i,t-1}^{2}\right)^{-1}$$

Panel rho statistic:

$$\left(\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ \hat{\varepsilon}_{i,t-1}^{2}\right)^{-1}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ (\hat{\varepsilon}_{i,t-1}^{2}\ \Delta\hat{\varepsilon}_{it}-\hat{\lambda}_{i})$$

Panel PP statistic:

$$\left(\tilde{\sigma}_{NT}^{2}\ \sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ \hat{\varepsilon}_{i,t-1}^{2}\right)^{\frac{-1}{2}}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ (\hat{\varepsilon}_{i,t-1}^{2}\ \Delta\hat{\varepsilon}_{it}-\hat{\lambda}_{i})$$

Panel ADF statistic:

$$\left(\tilde{s}_{NT}^{*2}\ \sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ \hat{\varepsilon}_{i,t-1}^{*2}\right)^{\frac{-1}{2}}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}_{11i}^{-2}\ \hat{\varepsilon}_{i,t-1}^{*2}\ \Delta\hat{\varepsilon}_{i,t-1}^{*}$$

Group rho statistic:

$$\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\ \hat{\varepsilon}_{i,t-1}^{2}\right)^{-1}\sum_{t=1}^{T}\ (\hat{\varepsilon}_{i,t-1}^{2}\Delta\hat{\varepsilon}_{it}-\hat{\lambda}_{i})$$

Group PP statistic:

$$\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{\sigma}_{i}^{2}\ \hat{\varepsilon}_{i,t-1}^{2}\right)^{\frac{-1}{2}}\sum_{t=1}^{T}\ (\hat{\varepsilon}_{i,t-1}^{2}\Delta\hat{\varepsilon}_{it}-\hat{\lambda}_{i})$$

Group ADF statistic:

$$\sum_{i=1}^{N}\left(\sum_{t=1}^{T}\hat{s}_{i}^{*2}\ \hat{\varepsilon}_{i,t-1}^{*2}\right)^{\frac{-1}{2}}\sum_{t=1}^{T}\hat{\varepsilon}_{i,t-1}^{*}\Delta\ \hat{\varepsilon}_{it}^{*}$$

The null hypothesis of seven tests is that there is no cointegration amongst variables. If the null hypothesis is rejected, a conclusion of the existence of long-run relationship amongst

[1] Of these seven statistics, four are based on the within-dimension approach and three referred to group-mean panel or between-dimension approach.

variables could be draw. In contrast, the null hypothesis cannot be rejected: there is no long run relationship amongst variables.

3.1.3. *Fully Modified OLS Approach*

This paper applies the fully modified ordinary least square (FMOLS) technique proposed initially by Phillips and Hansen (1990) and extended by Pedroni (2000). The following co-integrated system of equations is considered as follows.

$$y_{it} = \alpha_i + \beta y_{it} + \mu_{it} \,; i = 1, \dots, N \,; t = 1, \dots, T \qquad \text{and } x_{it} = x_{it-1} + \varepsilon_{it}$$

where the variables y_{it} and x_{it} are non-stationary and the vector error terms

The group-mean FMOLS estimator for the coefficient β is given by:

$$\hat{\beta}^*_{NT} = \frac{1}{N}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}(x_{it} - \bar{x}_i)^2\right)^{-1}\left(\sum_{t=1}^{T}(x_{it} - \bar{x}_i)\, y^*_{it} - T\hat{\gamma}_i\right)$$

where $y^*_{it} = (y_{it} - \bar{y}_i) - \frac{\hat{L}_{21i}}{\hat{L}_{22i}}\Delta x_{it}$ and $\hat{\gamma}_i = \hat{\Gamma}_{21i} + \hat{\Omega}^0_{21i} - \frac{\hat{L}_{21i}}{\hat{L}_{22i}}\left(\hat{\Gamma}_{22i} + \hat{\Omega}^0_{22i}\right)$

$$L_{11i} = (\Omega_{11i} - \Omega^2_{21i}/\Omega_{22i})^{1/2} \,; L_{12i} = 0; \; L_{21i} = \frac{\Omega_{21i}}{\Omega_{22i}^{\frac{1}{2}}}; \; L_{22i} = \Omega_{22i}^{\frac{1}{2}}$$

The t-statistic for $\hat{\beta}^*_{NT}$ is defined as follows:

$$\bar{t}_{\hat{\beta}^*_{NT}} = \frac{1}{\sqrt{N}}\sum_{i=1}^{N}\hat{L}^{-1}_{11i}\left(\sum_{t=1}^{T}(x_{it} - \bar{x}_i)^2\right)^{-1/2}\left(\sum_{t=1}^{T}(x_{it} - \bar{x}_i)\, y^*_{it} - T\hat{\gamma}_i\right)$$

As N-> ∞ and T-> ∞, the t-statistic converges to the standard normal distribution.

3.2. *Empirical Models*

3.2.1. *Determinants of Thailand's Trade Balance*

The trade models are formed as follows:

$$TB_{it} = \Delta\frac{lnX_{it}}{lnM_{it}} = \beta_1\Delta lnRER_{it} + \beta_2\Delta\, ln\frac{GDP_{Thai}}{GDP_{it}} + \beta_3\Delta\, ln\left(\frac{(\frac{M2}{GDP})_{Thai}}{(\frac{M2}{GDP})_{it}}\right) + \beta_4\Delta\ln\left(\frac{(\frac{GOV}{GDP})_{Thai}}{(\frac{GOV}{GDP})_{it}}\right) + \beta_5\Delta ln\left(\frac{IR_{Thai}}{IR_{it}}\right) + +\varepsilon_{it}$$

where TB_{it} represents the trade balance between Thailand and her country partner i at the year t. The dependent variable, *bilateral trade balance*, is expressed as the ratio of the value of total exports to the value of total imports. This calculation is more favorable because of following reasons. *Firstly*, the trade balance could be expressed in term of logarithm and its negative value owing to trade deficit (Arora et al, 2003; Brada et al., 1997; Chiu et al, 2010). *Secondly*, the measurement could allow trade balance to intepret both real and nominal terms (Bahmani-Oskoee & Brooks, 1999). *Thirdly*, the ratio is not sensitive to the unit of value (Bahmani-Oskoee & Alse, 1994).

The independent variables appear in the right hand-side of the estimation equation. *Real bilateral real exchange rate* (RER_{it}) is defined as the nominal bilateral exchange rate adjusted by ratio of the consumer price index of country *i* to that of Thailand. *Relative income* is the ratio of Thailand GDP to GDP of a trading partner i (GDP_{Thai}/GDP_i). *Relative money supply* is the ratio of Thailand money supply to GDP in proportion to ratio of money supply to GDP of country i ($(M2/GDP)_{Thai}/(M2/GDP)_i$). *Relative interest rate* is the ratio of Thailand interest rate to interest rate of country i (IR_{Thai}/IR_i). *Fiscal variable* is the ratio of Thailand government expenditure to GDP in proportion to ratio of government expenditure to GDP of country i ($(GOV/GDP)_{Thai}/(GOV/GDP)_i$). All dependent and independent variables are first differentiated in order to be interpreted in terms of the growth rate (Bahmani-Oskooee, 1993; Miles, 1979). Rose and Jellen (1989) argued that the use of variables in terms of logs of level could be inappropriate owing to misleading statistic test with the presence of non-stationary variables. Thus, it is necessary to take variables first differenced, making them stationary and avoiding spurious estimation.

The coefficient of exchange rate variable is expected to be positive in order that the depreciation could offer a stimulus on trade balance. The sign of coefficients of the relative income is negative, providing that a reduction of relative growth rate leads to an improvement of trade balance ($\beta_1 > 0$). Additionally, an expectation is that the relative growth of money supply is negatively related to Thailand's trade balance. The effects of interest rate on consumption are unclear because of the switch between income and substitution effects, thus its impacts on trade performance are ambiguous. Coefficients of the government spending variable are expected to be negative.

The model for investigating the connection between bilateral real exchange rate and balance of trade includes four variables: (i) *bilateral trade balance* (TB_{it}), (ii) *bilateral real exchange rates* (RER_{it}), (iii) *domestic Thailand income* (GDP_t^{Thai}) and (iv) *foreign income* (GDP_{it}). The data is presented in term of natural log and in the real term. A panel framework in relation to CPI-based real exchange rate is described as follows:

$$ln\, TB_{it} = \alpha_i + \beta_1\, RER_{it} + \beta_2\, ln\, GDP_{it} + \beta_3\, ln\, GDP_{t\_Thai} + \varepsilon_{it}$$

4. Findings

4.1. *Determinants of Thailand's Trade Balance*

In this section, the OLS method and instrument variable (IV) method are used to consider the connection between Thailand trade balance and its determinants. The IV regression is applied as the endogeneity problem[2] from potential simultaneity bias, measurement errors would be likely to make OLS inconsistent and bias. Following the studies Willson (2001), Rose and

[2] The endogenity problem is taken into consideration in various studies (Brissimis & Leventakis, 1989, Chiu et al, 2010; Yol & Baharumshah, 2007; Rose & Yellen, 1989; Rose, 1991; Willson, 2001).

Yellen (1989), and Rose (1991), instrument variables for exchange rate comprise money supply, interest rate, and foreign exchange reserve in terms of foreign and domestic data.

With the similar framework, Miles (1979) and Himarios (1989) found different results for individual countries, proving that different countries may react in various ways in terms of trade balance and its determinants. Chiu et al (2010) strongly believes that nations with different per capital income may experience a diversity of their capability in export supply and import demand. Moreover, those factors like geographic distance, trade barriers, political and economic relationships are highly likely to influence to trade structure of Thailand to her trading partners. Hence, in this study, the entire data will be divided into seven sub-samples[3] to investigate whether the *geographic structure* and *income level* affect the relationship between Thailand's trade balance and its determinants.

Table 1 presents results using both OLS and IV regression for the fundamentals of Thailand's trade balance. Generally, two methods of regression provide consistent results with the exception for *bilateral real exchange rate*. In contrast, this coefficient in the IV regression carries a negative value, but statistical insignificance, providing that the exchange rate might not be an element of Thailand's trade. The coefficients of *the relative growth rate of income* are negative and statistically significant in both OLS and IV regressions. Such coefficients of the *growth rate of money supply* and *interest rate* are insignificant in both estimations.

Table 1: Results of OLS and IV estimations for determinants of Thai trade balance

Depentdent variable: *D.Trade*		
	OLS estimation	**IV estimation**
D.realer	0.879***	-0.107
	(4.00)	(-0.12)
D.gdpr	-0.930**	-1.733**
	(-2.06)	(-2.57)
D.m2gdpr	-0.268	-0.128
	(-1.48)	(-0.46)
D.govgdpr	-0.145	-0.536*
	(-0.68)	(-1.89)
D.rir	0.0372	0.0528
	(0.90)	(1.13)
Constant	0.0292***	0.0520**
	(2.83)	(2.60)
Observation	1275	1201

Source: *Authors' calculations; t statistics in parentheses. *, **, *** indicate the 10%, 5%, 1% significant levels, respectively.*

Note: *"D." represents for the first difference of the data*

3 The countries belonging to sub-samples ar displayed in Appendix A of the paper.

Table 2 presents estimation results for seven sub-groups divided by incomes and regions. The empirical results indicate that coefficients of *exchange rate* variable are statistical at least at 10% significance and carry correct signs for groups with low and middle income and in Asia, Oceania, and Europe. The largest coefficient of exchange rate (2.223) is for the case of upper middle-income group, meaning that reaction of trade balance to *exchange rate* face the most sensitive to this group. All coefficients of income variable holds negatively expected signs, but these coefficients are statistically significant for the case of high income and Africa and Western Asia. The coefficients of monetary variable (*the relative growth rate of money supply over GDP)* are statistical at 5% significance with negatively expected signs in the case of lower middle income and low income, Africa and Western Asia, and Asia and Oceania. This implies that a reduction of relative growth rate of Thailand's money supply over GDP would improve her trade balance to partners in these groups.

Table 2: Estimation results for countries within each of the seven sub-samples

	High income	**Upper middle income**	**Lower middle and low income**	**Asia and Oceania**	**Europe**	**Africa and Western Asia**	**America**
D.realer	0.421	2.223***	0.441*	0.238*	1.345***	0.398	-2.96
	(-1.68)	(-4.43)	(-1.94)	(-1.88)	(-3.38)	(-1.44)	(-0.97)
D.gdpr	-1.32***	-0.396	-0.801	-0.262	-1.23	-2.360***	-2.432
	(-1.73)	(-0.43)	(-1.28)	(-0.60)	(-1.27)	(-3.44)	(-0.96)
D.m2gdpr	0.019	-0.178	-1.33****	-0.510**	-0.0374	-1.047**	0.783
	(-0.09)	(-0.55)	(-5.22)	(-2.16)	(-0.14)	(-2.67)	(-0.98)
D.govgdpr	-0.052	-0.122	-0.2	-0.0841	-0.144	-0.203	-0.259
	(-0.09)	(-0.40)	(-0.69)	(-0.22)	(-0.39)	(-0.60)	(-0.19)
D.rir	-0.004	0.067	0.040	-0.024	0.087	0.117	0.041
	(-0.11)	(-0.96)	(-0.34)	(-0.76)	(-1.07)	(-0.72)	(-0.22)
Constant	0.047**	0.021	0.005	0.027**	0.028	0.038	0.116
	(-2.4)	(-0.77)	(-0.22)	(-2.66)	(-0.87)	(-1.36)	(-1.08)
Observation	658	312	305	448	445	198	176

Source: *Author's calculation. t statistics in parentheses. *, **, *** indicate the 10%, 5%, 1% significant levels, respectively. The America group is estimated using the IV regression, other groups with OLS regressions.*

Note: *Dependent variable is D.trade*

4.2. *Devaluation and Thailand's Trade Balance*

Table 3 indicates t-statistic of the Breitung (2001) panel-based unit root test both at the level and at the first difference. This results indicate that the *bilateral real exchange rates* are mixture of I(0) and I(1). On the contrary, the null hypothesis of a unit root cannot be rejected for the GDP and Thai's GDP variables at levels, but this hypothesis strongly reject at first difference at 1% significance, showing that two variables are integrated of I(1).

Table 4 present two types of cointergration tests by Pedroni (1999, 2001, &2004) and Kao (1999). Most t statistics from the Kao (1999) test indicate that the null hypothesis could be strongly rejected at 1% significant with an exception of high-income group. Meanwhile, seven statistics of Pedroni (1999, 2001, &2004) provide weaker evidence of long run relationship because of some insignificant statistics. All the *panel ADF* and *group ADF* statistics are statistically significant. As stated by Pedroni (1999), such statistics are superior to others statistics so that the results of long run relationship would be reliable. Thus, there is an existence of long run relationship amongst trade balance, bilateral real exchange rate, Thailand's GDP and foreign GDP.

Table 3: Results of Breitung (1999) unit root test - level and first difference

	Level				First difference			
	Trade	**RER**	**GDP**	**GDP_Thai**	**Trade**	**RER**	**GDP**	**GDP_Thai**
1980-2013	-4.94***	-8.31***	8.40	4.06	-12.26***	-8.31***	-8.33***	-22.45***
High income	-2.92***	0.34	2.13	3.21	-10.15***	-3.38***	-4.97***	-17.03***
Upper middle income	-3.35***	-3.02***	0.50	1.77	-4.19***	-7.78***	-6.69***	-10.22***
Lower middle and low income	-2.67***	-3.41	6.66	1.74	-5.95***	-8.56***	-5.58***	-10.45***
Asia and Oceania	-3.63***	-1.02	6.38	2.34	-6.48***	-7.14***	-6.56***	-12.49***
Europe	-3.49***	-2.38**	3.99	2.56	-8.16***	-5.51***	-3.51***	-14.23***
Africa and Western Asia	-0.94	-3.25***	1.89	1.42	-4.62***	-6.98***	-3.64***	-8.84***
America	-1.77**	1.20	0.49	1.55	-4.62***	1.49	-7.60***	-8.17***

Source: Authors' analysis

Table 4: Cointegration test

	Pedroni							Kao
	Panel v	*Panel rho*	*Panel PP*	*Panel ADF*	*Group rho*	*Group PP*	*Group ADF*	*t-statistic*
1980-2013	-0.37	-3.11***	-9.89***	-10.3***	-1.12***	-13.30	-11.1***	1.90***
High income	0.70	-4.07***	-8.51***	-4.51***	-1.4*	-10.1***	-7.79***	0.06
Upper middle income	-0.96	-1.18	-5.14***	-7.38***	-0.36	-7.69	-6.89***	8.45***
Lower middle and low income	0.36	-0.94	-3.48***	-3.99***	0.12	-4.62***	-4.41***	4.55***
Asia and Oceania	1.49*	-2.41***	-4.86***	-5.45***	-0.90***	-5.68***	-6.71***	3.07***
Europe	-0.36	-3.32***	-7.12***	-3.08***	-1.3*	-10.1***	-6.05***	5.18***
Africa and Western Asia	0.15	-0.33	-4.00***	-3.57***	0.51	-6.15***	-2.72***	12.07***
America	-1.25	-1.13	-3.67***	-7.44***	0.06	-3.56***	-6.81***	8.05***

*Source: Authors' calculation. *, **, *** indicate the 10%, 5%, 1% significant levels, respectively*

On the panel estimation from Table 5, most coefficients of *bilateral real exchange rate* are positive except for Africa and Oceania group. For the case of 1980-2013 periods, the coefficient of exchange rate implies that when the Thailand's currency depreciates 1% on average, her trade performance would grow approximately 0.6% in the long term. Moreover, the coefficient of *foreign income* is positively significant. The figure is 1.23, providing that when the total income of all surveyed countries increases 1%, the Thailand's trade would rise approximately 1.23%. In contrast, the coefficient of Thailand's income is negatively significant, showing that when Thailand income rises, her trade balance would be worsened because of her higher imports. The number of 0.61 means that an increase of 1% in Thailand's income would lead to a decrease of approximately 0.61% in her trade balance.

Table 5: Panel results of FMOLS estimation

Dependent variable is trade balance in terms of nurture logarithms						
	Ln RER		**Ln GDP**		**Ln GDP_Thai**	
	Coefficient	*t-Statstic*	Coefficient	*t-Statistic*	Coefficient	*t-Statistic*
1980-2013	0.61***	*3.94*	1.23***	*5.22*	-0.61***	*-3.20*
High income	0.44***	*3.42*	1.01***	*3.86*	-0.36**	*-2.16*
Upper middle income	1.41***	*4.04*	0.49	*1.14*	-0.09	*-0.22*
Lower middle and low income	0.31	*0.60*	2.45***	*3.48*	-1.74***	*-2.73*
Asia and Oceania	0.01	*0.03*	0.81*	*1.89*	-1.17***	*-2.61*
Europe	1.26***	*7.69*	0.96***	*2.70*	-0.34	*-1.50*
Africa and Western Asia	-0.43	*-1.29*	4.53***	*6.70*	-2.20***	*-6.16*
America	1.31*	*2.61*	-1.08*	*-1.90*	1.85***	*3.09*

*Source: Author's calculation. *, **, *** indicate the 10%, 5%, 1% significant levels, respectively.*

As far as three income groups are concerned, empirical results show that the depreciation of Thailand currency offers positive influences on her trade balance with countries having high and upper middle income. The lower middle and low income might not be suffered from the Thailand's depreciation. Moreover, the coefficients of foreign income are positively significant for the case of high income, lower middle- and low-income group. This means that when foreign income increases, countries in such groups have higher tendency to imports Thailand's products and services, thus improving Thailand's trade balance. The coefficients of domestic income for three groups above are negatively significant, providing that when Thailand's income rises, Thailand would be suffered a distortion in her trade balance when Thailand income rises owing to her higher demand for importing goods and services.

In relation to regional groups, America group has a largest elasticity of real exchange rate and reverse sides to expectation for coefficients of domestic and foreign income. This implies that a Thailand's depreciation considerably improve Thailand's trade balance with America rather than other regional groups. The coefficient of foreign income is statistically negative, implying that when the real income rises in American countries, the demand for Thailand's goods and services reduce. On the contrary, the coefficient of Thailand's income is statistically positive, showing that an increase in Thailand income results in an improvement

Table 6: Individual results of FMOLS estimation

Dependent variable is trade balance in terms of logarithms						
Partners	RER		GDP		GDP_Thai	
	Coefficient	*t-Statistic*	Coefficient	*t-Statistic*	Coefficient	*t-Statistic*
Australia	-0.92*	*-1.79*	3.23***	*5.03*	-1.05***	*-3.24*
Austria	1.91***	*4.88*	1.06	*0.98*	-0.68	*-1.35*
Bangladesh	-3.22***	*-4.46*	3.53***	*3.71*	-3.99***	*-3.74*
Belgium	0.93	*1.62*	3.14*	*1.87*	-0.84	*-1.27*
Benin	1.23	*0.92*	-2.00	*-0.86*	6.15**	*2.59*
Brazil	0.58	*1.43*	4.88***	*2.81*	-2.82*	*-1.87*
Brunei Darussalam	-2.50*	*-1.74*	-2.83	*-1.10*	2.90***	*3.37*
Bulgaria	0.78*	*1.80*	2.71	*1.68*	-3.31**	*-2.35*
Cambodia	-6.90	*-1.68*	10.30***	*4.33*	-21.61***	*-4.18*
Canada	2.77***	*3.78*	-3.37**	*-2.95*	2.10***	*4.32*
Colombia	0.99***	*2.87*	-5.71***	*-6.77*	7.84***	*14.65*
Coted'Ivoire	2.54	*1.16*	23.82***	*4.14*	-5.49***	*-3.13*
Cyprus	1.77	*1.36*	3.96	*1.67*	-2.23	*-1.39*
Czech Republic	1.19	*1.35*	3.94	*1.11*	-0.61	*-0.26*
Chile	0.00	*-0.03*	4.40***	*3.53*	-2.61***	*-2.13*
China	0.11	*0.37*	0.36	*0.97*	-0.50	*-0.67*
Denmark	-0.34	*-0.59*	3.71	*2.33*	-0.45	*-0.86*
Egypt	-0.75**	*-2.22*	1.77**	*2.02*	-0.84	*-1.12*
Finland	0.50	*0.93*	5.06***	*5.63*	-1.72***	*-4.35*
France	1.14***	*3.14*	0.84	*0.71*	-0.63	*-1.49*
Germany	0.04	*0.29*	4.77***	*4.38*	-1.60***	*-4.13*
Greece	2.25**	*2.01*	1.32	*1.04*	-0.36	*-0.75*
Hong Kong	-0.20	*-0.88*	0.29	*0.38*	0.30	*0.44*
Hungary	4.26***	*4.81*	-5.72***	*-4.84*	0.75	*1.30*
India	0.47	*0.59*	3.27***	*4.41*	-3.22***	*-3.45*
Indonesia	1.59***	*2.08*	0.11	*0.06*	0.01	*0.01*
Iran	0.20	*1.03*	7.91***	*8.22*	-6.51***	*-9.58*
Ireland	1.78***	*6.20*	-0.07	*-0.28*	1.18***	*5.27*
Israel	0.63	*1.66*	1.03**	*2.02*	-0.34	*-0.76*
Italy	-0.05	*-0.11*	6.15***	*3.24*	-1.79***	*-3.80*
Japan	0.77***	*3.27*	-2.02**	*-1.96*	0.76**	*2.34*
Korea	-0.31	*-0.68*	2.75***	*3.91*	-3.29***	*-3.92*
Kuwait	-4.66***	*-48.58*	6.62***	*37.05*	-8.27***	*-35.45*
Lao PDR	-0.33	*-0.28*	0.66	*1.24*	-2.84***	*-2.76*
Malaysia	-0.94	*-1.63*	1.72***	*5.15*	-1.95***	*-4.95*
Malta	2.74	*1.14*	-19.19***	*-4.45*	10.55***	*3.52*
Mexico	2.66***	*6.77*	-4.15***	*-3.76*	4.13***	*8.09*
Nepal	1.66	*0.41*	-5.57***	*-0.89*	3.76***	*0.68*
Netherlands	-0.58***	*-2.41*	3.33***	*6.23*	-1.70***	*-6.93*
New Zealand	0.80***	*2.58*	3.33***	*8.24*	-0.58***	*-2.70*
Nigeria	0.33	*0.73*	1.61*	*1.89*	-4.81***	*-5.83*
Norway	1.28***	*4.69*	1.24**	*2.36*	-0.30	*-1.17*
Oman	-2.10***	*-5.79*	5.29***	*6.40*	-2.62**	*-2.50*
Pakistan	8.03***	*3.80*	-1.06	*-0.52*	3.82*	*1.95*
Panama	2.13	*0.81*	-3.06**	*-2.16*	3.16**	*2.49*
Peru	0.16	*0.05*	-1.05	*-0.32*	2.37	*0.58*
Poland	-0.64	*-0.65*	-0.24	*-0.10*	1.63	*0.68*
Portugal	2.80**	*2.28*	-3.92	*-1.48*	1.53	*1.59*
Philippines	0.08	*0.06*	1.68***	*2.79*	-0.66	*-1.59*
Romania	1.72***	*16.87*	7.10***	*13.74*	-4.04***	*-8.44*
Russian	0.16	*0.54*	1.64	*2.28*	-2.26	*-2.37*
Saudi Arabia	-4.39***	*-3.34*	-2.28***	*-2.95*	0.10	*0.16*

Dependent variable is trade balance in terms of logarithms

Partners	RER		GDP		GDP_Thai	
	Coefficient	*t-Statistic*	Coefficient	*t-Statistic*	Coefficient	*t-Statistic*
Singapore	2.45***	*4.61*	-0.51	*-1.42*	0.48	*1.07*
South Africa	2.64*	*1.79*	1.54	*0.85*	0.57	*0.70*
Spain	2.59***	*8.27*	-1.21*	*-1.88*	0.67**	*2.06*
SriLanka	1.40	*0.83*	-1.39	*-1.10*	1.56*	*1.72*
Sweden	1.31***	*3.74*	3.01***	*4.65*	-0.88***	*-3.07*
Switzerland	1.11*	*1.71*	-0.53	*-0.32*	-0.44	*-0.71*
Turkey	3.07**	*2.56*	-0.13	*-0.06*	-0.86	*-0.58*
United Kingdom	-0.12	*-1.67*	2.06**	*2.52*	-0.09	*-0.21*
United States	1.1***	*6.17*	-0.59	*-1.31*	0.65***	*2.87*
Vietnam	-1.80***	*-3.22*	-2.41***	*-4.44*	3.75***	*3.77*

*Source: Author's calculation. *, **, *** indicate the 10%, 5%, 1% significant levels, respectively.*

in her trade balance due to a growth in producing import substitutes from such region, as stated in international trade theory. An explanation for the most striking feature of America group may be transportation costs with the furthest distance as compared to that of Thailand and other regions. Besides, the coefficients of real exchange rate, foreign income, and domestic income for Africa and Western Asia, Asia and Oceania, and Europe carry correct sides according to expectation, but few of them are not statistically significant.

As stated by Marquez (1990), sole reliance on multilateral elasticities conceals valuable information for both policy applications and empirical analysis of international trade. The individual estimations of FMOLS will also be conducted to further understand this relationship. The individual results are displayed in Table 6. The coefficients of *bilateral real exchange rates* are statistically significant in 30 out of 62 cases (countries), and 20 of them holds correctly-expected signs. This implies that a depreciation of Thailand Baht would stimulate her bilateral trade performance with over 20 countries. The coefficients of *foreign income* are statistically significant for 37 cases over the total of 62 countries. The number of cases carrying positively expected signs is 26, meaning that an increase in foreign income of these 26 countries leads to an improvement in Thailand trade balance in the long run. The similar patterns have been witnessed for coefficients of *domestic income*. The estimated coefficients being statistically significant and holding correctly expected signs are 36 and 26, respectively.

5. Conclusions and Implications for Vietnam

The study is conducted to examine the effects of a currency's devaluation on trade balance for the case of Thailand. This objective could be achieved by the two procedures. The first procedure is to analyze how changes on exchange rate policy, fiscal policy, and monetary policy affect Thailand's trade balance. In this task, effects of devaluation on trade balance are examined on various scenarios: (i) the entire sample of 62 countries who are trading partners with Thailand; (ii) different geography (between regions and regions of countries); (iii) different income levels. The second procedure is to examine the long run relationship between a devaluation of Thailand's currency and trade balance in term of panel and individual country.

Empirical findings indicate that the exchange rate policy and relative growth rate of incomes play a central role in explaining Thailand's trade balance, and the fiscal and monetary policies are beneficial in some cases. Moreover, the panel FMOLS estimations illustrate that a devaluation of Thailand Baht could provide positive effects on trade balance in the long run, especially for (i) the group of countries with high income, (ii) the group of countries with upper middle income, (iii) countries in America, and (iv) countries in Europe. The individual FMOLS regressions between Thailand and each of her 62 trading partners indicate that the devaluation of Thailand's currency would stimulate Thailand's trade performance with over 20 trading partners, but hurt its performance with the other 10 countries and inconclusive conclusion for the others.

Thailand and Vietnam are very similar in many aspects including both social and economic characteristics. This study is not conducted for Vietnam because of the data limitation. Given similarities between Thailand and Vietnam, we are of the view that implications from the findings of this empirical study can be drawn for the Government ogf Vietnam and also for the Government of Thailand. *First*, the government should focus on the money supply rather than on interest rate. As empirical findings from this study indicate money supply may provide a more significant effect to trade balance in comparison with interest rate. This finding also indicates that while an overall money supply is determined by the central bank (which then implies a basis interest rate), individual interest rates may be left with commercial banks to determine within a reasonable band. *Second*, a policy on currency devaluation should be strictly considered and adopted for the purpose of improving a national trade balance (and possibly encouraging economic growth) occasionally. However, it is cautious that this policy should be constantly reviewed to ensure that prevailing market condition still supports for an existence of such a devaluation policy.

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Appendix A:

Data sources

This study has used annually panel-unbalanced data over the periods from 1980 to 2013 between Thailand and 62 her trading partners with a total of 1950 observations. The data are collected from different sources such as the Economics magazine, IMF, World Bank, and Bank of Thailand. The data for bilateral exchange rate and bilateral trade between Thailand and her trading partners are collected from IMF and Bank of Thailand. The rest of data including CPI, GDP, money supply over GDP, ratio of government spending to GDP, lending interest rate, and international reserve both of Thailand and of foreign countries are taken from World Bank.

Appendix B:

Countries associated with income and region groups

Europe	Austria, Belgium Bulgaria, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Malta, Netherlands, Norway, Poland, Portugal, Romania, Russia
America	Brazil, Canada, Colombia, ChileMexico, PanamaPeru, United States
Afica and Western Asia	Benin, Coted' Ivoire, Egypt, Iran, Israel, Kuwait, Nigeria, Oman, Saudi Arabia, South Africa
Asia and Oceania	Australia, Bangladesh, Brunei,Cambodia, China, Hong Kong, India, Indonesia, Japan, South Korea, Lao PDR, Malaysia, Nepal, New Zealand, Pakistan, Philippines, Singapore, SriLanka, Vietnam
High income	Australia, Austria, Belgium,Brunei, Canada, Cyprus, Czech Republic, Chile, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Israel, Italy, Japan, South Korea, Kuwait
Upper middle income	Brazil, Bulgaria, Colombia, China, Hungary, Iran, Malaysia, Mexico, Panama, Peru, Romania, South Africa, Turkey
Lower middle and low income	Bangladesh, Benin, Cambodia, Coted' Ivoire, Egypt, India, Indonesia, Lao PDR, Nepal, Nigeria, Pakistan, Philippines, SriLanka, Vietnam

Adpating a Measure of Socially Responsible Consumption in France to the Vietnamese Context – A Study in Hochiminh City

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The major aim of this study is to employ the measure of socially responsible consumption (SRC) developed by Francois-Lecompte and Roberts (2006) to empirically explore the level of Vietnamese consumers' awareness of SRC. Consumers in Hochiminh city are approached to distribute the questionnaires in stores, supermarkets, shopping malls, traditional markets, … The research findings show some salient points. Firstly, the order of SRC factors in Vietnamese consumers' perspectives is different from that in France. Secondly, 17 over 20 variables to measure SRC factors can be used to conduct SRC study in Vietnam. However, it is necessary to conduct a qualitative study to develop a measure more appropriately to Vietnamese consumers.

1. Introduction

With the development of the economy in countries, especially in emerging economy like Vietnam, growths of many aspects are also increasing dramatically. Among these aspects, consumption is one having significant growth. However, any development also has its own backside with many problems and concerns, which, if not paid enough attention, will lead to many negative consequences. In Vietnam, accompanying with rapid economic development, levels of consumption has been increasing dramatically. According to The Saigon Times, two third of GDP in Vietnam are recently contributed by individual consumption (Phuc 2014). Moreover, individual consumption is considered as the main factor not only to degrade the environment, but also to encourage companies to behave in a responsible manner (Mohr, Webb et al. 2001; Singh 2009).

There are studies conducted on socially responsible consumption in some advanced economies like France, U.S., UK and some emerging ones like India, China, Morocco (Roberts 1995; Francois-Lecompte and Roberts 2006; Chen and Kong 2009; Singh 2009; Lebzar, Sidmou et al. 2012). The point highlighted in these studies is that SRC cannot be forced by the government, but there is need for consumers to be self-realization and self-regulation to minimize any bad or negative influence on the society and the environment (Singh 2009).

However, in Vietnam, the frequent mentioned terms are smart consumption and green purchasing which are used to describe how to smartly spend money on consumption and to consider impacts on the environment. Therefore, the purpose of this study is (1) to empirically explore the level of socially responsible concerns among Vietnamese consumers; (2) to analyze differences of Vietnamese consumers' concerns of SRC across demographic factors; and (3) to discuss implications for marketers and policy makers regarding to improve SRC in Vietnamese consumers.

2. Research background

2.1. *Consumption and socially responsible consumption (SRC)*

Consumption is a marketing concept; however, it has attracted as well the attention of many researchers in other fields like economy, politics science, sociology and philosophy (Díaz-méndez 2010). It is considered as the way consumers perform to satisfy their needs and they try to make it as a never-ending process (Marinas 2001, 2007; cited in Díaz-méndez 2010). In other words, consumption is described as the way in which individuals live by using different types of products and services from different producers/providers (Singh 2009; Díaz-méndez 2010). From their capabilities and understanding, consumers will combine these types of products and services in different ways. However, these combinations can lead to different consequences as they are impacted by four factors, namely: price, other goods' price, consumer's economic capacity, and his/her likings (Díaz-méndez 2010)

In their study, Lebzar, Sidmou et al. (2012) summarized different way to define *consumption* and identified its components, which are included of : the emotional dimension (consumption is a "source of emotion and experience of pleasure"), the functional dimension (consumption utilities meet goals and practices), the aesthetic dimension (consumption is sought for "the beauty and expression"), the epistemic dimension (consumption allows consumers to "satisfy the curiosity, the desire knowledge") and finally, the social dimension (consumption allows consumers to structure their identify and position themselves in relation to a group).

However, consumption is also defined in another way. “Consumption means to consume, waste, squander or destroy”; or, it is concerned as an aspect of social representations of the economy (Francois-Lecompte and Roberts 2006; Gonzalez, Korchia et al. 2009). These considerations of consumption did drive researchers to thinking and doing research on SRC (Gonzalez, Korchia et al. 2009). There are many SRC definitions; however, the very first one documented by Webster in 1975 is with two main issues (Francois-Lecompte and Roberts 2006; Özçaglar-Toulouse 2009). Firstly, consumers concern about public consequences due to his/her consumption. Secondly, they want to make some changes in society by their purchasing power.

Mohr, Webb et al. (2001) identify socially responsible consumers by actions of avoiding buying products/services from companies that harm society and actively seeking out ones from companies that help society. Similarly, Díaz-méndez (2010) highlighted that SRC is a buying decision based on product’s origin, manufacturing process, labour working conditions, environmental impact, and manufacturer’s social responsibility.

Among SRC definitions, the one developed by Roberts (1995), which is employed and cited in many other empirical studies (Roberts 1995; Francois-Lecompte and Roberts 2006; Gonzalez, Korchia et al. 2009; Lebzar, Sidmou et al. 2012), can be considered as the most-used SRC definition. In his study, Roberts (1995) defines SRC as consumer behaviors taking into account the impact on the environment of private consumption decisions or using purchasing power to express current social concerns.

2.2. *Factors influencing customers in SRC*

The factors which have their influences on consumers in their SRC can be divided into two groups, drivers and obstacles. In the literature, some studies explored these factors.

In their study, Mohr, Webb et al. (2001) point out a contradiction of a common assumption that SRC is based only on consumers’ self-interest. Their findings suggest some important issues relating to drivers for consumers to consume responsibly. Firstly, the more knowledge about social responsibility customers have; the more positive consumption they behave. Moreover, such knowledge also creates a positive relationship between customers’ beliefs and behaviors in SRC. Lastly, customers likely practice SRC when they recognize their purchasing power, which can impact companies’ behaviors. From these findings, it can be seen that drivers to promote consumers consuming responsible are rooted out from the way companies behave and from their purchasing power.

Regarding obstacles preventing socially responsible consumption, in his study, Carmen (2008) identified three groups which created a considerable gap between attitudes ad actual behaviors of customers. These three obstacles are: motivational, cognitive and behavioral obstacles.

Motivational obstacles can be considered as willingness to make political statements or actions in the marketplace depend on self-identity and perceived efficacy (Carmen 2008). The first obstacle is from consumers' perspectives of self-perception of citizenship and of corporate social responsibility (CSR). The main point mentioned is that, although good people, not all consumers are good citizens who concern about others' welfares; and they have different conceptualized understanding of CSR. The second obstacle is from their understanding of their purchasing power and from sources information they have. Carmen (2008) analyzed that "… if consumers believe that their purchase decision may make a difference, they are more likely to buy responsibly…" and this is used to express their expectation of the society (Brinkmann 2004).

Cognitive obstacles are described as opportunities to get information and ability to process, store and recall information about brands (Carmen 2008). This kind of obstacle refers to the information consumers have about corporate impact on social welfare (Carmen 2008; Öberseder, Schlegelmilch et al. 2011). It also refers to the availability of this information to customers (Mohr, Webb et al. 2001; Carmen 2008).

Behavioral obstacles is likely opportunity and ability to find a fair brand to purchase (Carmen 2008). Actually, customers can not be responsible in consuming if they cannot find good producers/manufacturers (Shaw and Clarke, 1999 cited in Carmen 2008). The other behavioral obstacle is cost spending for responsibly consuming, including higher price, travelling a certain distance to find good manufacturers, and so on.

2.3. *Measures of socially responsible consumption*

Even though the concept SRC is mentioned and studied from 1975, the measures of SRC have not been properly developed. Many scales are borrowed from sociology, therefore, they do not have items related to consumer behavior and not well suited in marketing and management context (Francois-Lecompte and Roberts 2006). Moreover, Francois-Lecompte and Robert (2006) also point out that SRC is only put in the context of environmental context.

In their study, Mohr, Webb et al. (2001) conducted a qualitative study to develop items to measure SRC. Their research findings suggested 5 items. However, it needs to be tested quantitatively and developed sub-items for SRC studies. Among studies conducted in developing countries, a study conducted in China by Chen and Kong (2009) developed and used a scale of 7 items to measure SRC. However, the process of developing these items is not described clearly to illustrate their reliability.

In their study conducted in France, Francois-Lecompte and Robert (2006) developed a scale of 5 factors to measure SRC, including firm's behavior with 5 factors, cause-related products with 4 items, small businesses with 4 items, geographic origin with 4 items, and consumption volume with 3 items. This 20 item-scale is developed by qualitative study with methods to collect data like in-depth interview, focus group. Then, this measurement is confirmed by a quantitative study. That is the reason this study employs the scale developed by Francois-Lecompte and Robert (2006) to base on.

3. Methodology

The main purpose of this study is to empirically explore the level of socially responsible concerns among Vietnamese consumers. Therefore, the main method used to collect data is through questionnaire to conduct a survey among consumers. The employed questionnaire is adapted from Francois-Lecompte and Robert (2006). In this questionnaire, there are five factors with 20 items, namely: firm's behaviors (consumption acts related to irresponsible corporate behaviors) - (BF), cause-related products (preferences for cause-related products, including purchase) - (CRP), small businesses (desires to help small businesses) - (SB), geographic origin (the purchasing local products) - (GO) and consumption volume (reducing one's consumption to what is only necessary for not bad impact on the environment - (CV).

The factors and items from the study of Francois-Lecompte and Roberts (2006) are adjusted for the appropriateness to the research and consumption context in Vietnam. To construct the questionnaire, a group of 6 people in different gender, age, occupation, and income has been gathered to discuss about the meaning of SRC. At first, it is free discussion about the meaning of SRC, to warm up and learning what people think about SRC. Then, the scale of Francois-Lecompte and Roberts (2006) is raised to discuss and clarify what should be included and adjusted to be accepted with the case of Vietnam. After consensus on using these 19 variables (omitting 1 variable regarding to politic matter), a pilot survey is conducted with small sample (20 respondents) to adjust the questions for more clear and understandable with Vietnam customers. The questionnaire is then finalized and used to survey with large sample to get data for analysis. After adjustment, there are 5 factors and 19 items which are presented as follow:

Factor 1: Firm's behaviors (FB)

1. I pay attention not to buy products from companies that are narrowly illegal.
2. I try not to buy products from companies that employ children
3. I try not to buy products from companies that don't respect their employees
4. I try not to buy products from companies that strongly harm the environment

In Vietnam, there is only one political party, therefore, the origin item "I try not to buy products from companies or shoppers that are narrowly linked to political parties that I condemn" in the study of Francois-Lecompte and Roberts (2006) has been removed from the questionnaire.

Factor 2: Cause-related products (CRP)

5. I buy some products of which a part of the price is transferred to a humanitarian cause.
6. I buy some products of which part of the price goes to developing the country.
7. I buy products of which part of the price is given to a good cause.
8. I buy fair trade products

Factor 3: Small businesses (SB)

9. I avoid doing all my shopping in big businesses (large retailers).
10. I buy in small businesses (bakeries, butcher's trade, book shoppers) as often as possible (small shopkeepers).

11. I help the storekeepers of my quarter to live through my purchases.
12. I go to small markets to support fruits and vegetables small producers.

Factor 4: Geographic origin (GO)

13. When I have the choice between a Vietnamese product and an exported product, I choose the local one.
14. I buy preferably Vietnamese products (like cosmetics…).
15. I buy fruits and vegetables made in Vietnam.
16. I buy products made in my country – Vietnam.

Factor 5: Consumption volume (CV)

17. I try to reduce my consumption to what I really need.
18. In a general manner, I try to reduce my consumption.
19. I try not to buy objects that I can do by myself.

The convenient sampling is chosen, and the participants in this study are consumers who are over 18. Totally, 180 respondents are approached to answer the questionnaire at supermarkets, convenient stores, markets, book stores, shopping malls. The data is cleaned and processed by using exploratory factor analysis (EFA technique) in SPSS software. The Principle component method with Promax rotation method are used to adapt with the method used in the study of Francois-Lecompte (2006). Before applying the EFA method, the reliability of the scales has been tested by using Cronbach's alpha criteria, it should be at least 0.6 to be accepted (Nunnanly và Burnstein, 1994). Then, EFA technique is applied with data exploration and variable reduction steps. The EFA process is accepted with the threshold of KMO measure higher than 0.5 and significant at 5%, Eigen values must be larger than 1, Factor loadings of each variable should be at least 0.5, it is no any cross-loading above 0.35 into more than one factors (Hair et al., 2006). Besides, the difference between groups of customer distinguish by demographic variables are considered by ANOVA analysis

4. Data analysis and findings

The percentage of men and woman in valid sample are 51 and 49, respectively. Most of respondents are in the age of 24-31 with 63 percent, the others are 28 percent for the age of 18-23 and 9 percent for over 32. The ranges of age also suit the occupation status, including: office staff, managers and engineers, students, workers and housekeepers at 44, 14, 28 and 7 percent, respectively. The ranges of respondents' incomes are relevant to the occupation with 49 percent of them earning from 5-10 millions VND; more than 37 percent getting less than 5 million VND; and about 14 percent receiving salary higher than 10 million VND.

Most of variables are dispersed in the Likert 5 scales with mean and mode is at 3 (neutral) or 4 (agree) (*See Table 1*). That means the customer's perceptions on SRC described by these variables seem not high, especially for variables measuring firm's behaviors and small business groups. It could be understood that the information of Vietnam enterprises is not transparent and their communication with customers is not so good. Therefore consumers have not thought much on the responsibility to help small businesses as well as corporations that have practiced social responsibility. Furthermore, due to low income, consumers tend to

Table 1: Descriptive Statistics for measurement scales of SRC

	Valid	Minimum	Maximum	Mean	Median	Mode	Variance
FB1	172	1	5	3.069767	3	3	0.860601
FB2	172	1	5	3.302326	3	3	0.913913
FB3	172	1	5	3.116279	3	3	0.945464
FB4	172	1	5	3.046512	3	3	0.839929
CRP1	172	1	5	3.860465	4	4	1.103223
CRP2	172	2	5	3.906977	4	4	0.599483
CRP3	172	1	5	3.744186	4	3	0.75289
CRP4	172	2	5	3.744186	4	3	0.706106
SB1	172	1	5	3.55814	4	3	0.575547
SB2	172	1	5	2.790698	3	3	1.008568
SB3	172	2	5	3.488372	3	3	0.43846
SB4	172	1	5	3.511628	3	3	0.578811
GO1	172	1	5	3.767442	4	4	0.740922
GO2	172	1	5	3.837209	4	4	0.792058
GO3	172	2	5	3.767442	4	4	0.647355
GO4	172	1	5	3.72093	4	4	0.76377
CV1	172	2	5	3.418605	4	4	0.759418
CV2	172	1	5	3.372093	3	3	0.983544
CV3	172	1	5	3.488372	4	4	0.906297

consume low-price-products or think about the products that bring most benefits to them, rather than share with firm's difficulties. These might contribute to form their consumption attitude. The variables of GO seem to take the highest concern since the scare of some products from China which may affect negatively their health and the campaign of boycott Chinese products have been emerging in recent years. Variables in CRP group also express concerns from customers if they know that a part of products price will be used for humanitarian charity or developing the country, especially after the call from the government '*For Hoang Sa and Truong Sa*' to contribute to Hoang Sa and Truong Sa or the campaign of using Vietnam products '*Vietnamese consumes Vietnamese products*'.

Testing the reliability of the scales, all 5 primary factors receive the Cronbach's Alpha from 0.792 (for SB) to 0.948 (for GO), satisfy the condition mentioned above. Therefore, all of these variables will be used in the EFA step.

Taking EFA for 19 variables, it is also divided into five factors as proposed model with KMO and Eigen values satisfy the condition mentioned above and factor leading for each variable higher than 0.5. However, there are cross-loading at two variables SB3 (*I help the storekeepers of my quarter to live through my purchases*) and CRP1 (*I buy some products of which a part of the price is transferred to a humanitarian cause*). Therefore, they are dropped out one by one from the next EFA steps. This process also satisfies KMO criteria and factor loadings requirements. This action also help increasing the total variance explained from

78.7% to 81.6%. The final components matrix and the result of testing reliability of the new factors are represented in the table 2.

Table 2 shows that the factor loading of all variables get value between 0.602 and 0.946. In that, variables from factor GO have values above 0.84 showing strong correlation between variables. As a result, Cronbach's alpha is on top at 0.948. This factor explains 30.4% for the variance being the most important factor to measure the meaning of SRC. The highest one among 5 factors using to measure SRC suggest for the case of Vietnam. With four variables of FB, although still having high factor loading and Cronbach's alpha is high (0.869), this factor contributes less than 20% in explaining for the variance when combines with the other factors and take the second position in the list of factors to measure SRC. CV and SB support factors take the ranks of 3 and 4 in the list and contribute about 12% each factor in explaining for the variance. The CRP factor come in end of the list with 7.6% of variance explained. This order is almost different with that in the study of Francois-Lecompte and Roberts (2006), i.e. CRP factor at first, FB-2nd, SB-3rd, GO-4th and CV-the last.

Table 2: EFR and reliability testing result

	Component					Cronbach's alpha	total variance explained
	1	2	3	4	5		
GO2 - I buy preferably Vietnamese products (like cosmetics…).	.936						
GO1 - When I have the choice between a Vietnamese product and an exported product, I choose the local one.	.934					0.948	30.4
GO3 - I buy fruits and vegetables made in Vietnam.	.856						
GO4 - I buy products made in my country – Vietnam	.843						
FB1- I pay attention not to buy products from companies that are narrowly illegal		.887					
FB3- I try not to buy products from companies that don't respect their employees		.870				0869	49.6
FB2- I try not to buy products from companies that employ children		.864					
FB4- I try not to buy products from companies that strongly harm the environment		.752					
CV2 - In a general manner, I try to reduce my consumption			.881				
CV1 - I try to reduce my consumption to what I really need.			.858			0.853	62.1
CV3 - I try not to buy objects that I can do by myself			.822				
SB1 - I avoid doing all my shopping in big businesses (large retailers).				.946			
SB4 - I go to small markets to support fruits and vegetables small producers				.894		0.797	74.0
SB2 - I buy in small businesses (bakeries, butcher's trade, book shoppers) as often as possible (small shopkeepers)				.602			
CRP4 - I buy fair trade products					.857		
CRP3 - I buy products of which part of the price is given to a good cause					.753	0.806	81.6
CRP2 - I buy some products of which part of the price goes to developing the country					.697		

Extraction Method: Principal Component Analysis.
Rotation Method: Promax with Kaiser Normalization.

Customer attitude from different demographic groups

Base on the variables remain after EFA, the score of each factor will be computed by taking the average score of the belong variables, and then used to test whether there is different on attitude between demographic groups for each factor of SRC by using ANOVA

With gender variable, only two factors – FB and GO – receive different attitudes between men and women significantly at 5%, women evaluate these factors more highly than men.

There is no significant difference between groups of age, statistically. The younger even give lower scores than the older; however, the groups of 24-31 and above 32 seem not so different.

In respect of the occupation variable, SB is the only factor supporting. Meanwhile, the other four factors are significantly different between occupational groups. Among these groups, engineers showing the lowest score in all these four factors (less than 2.5 – between disagree and neutral) are followed by the groups of students, housekeepers, staffs, and managers in orderly.

For income variable, average scores of low income and high income groups are slightly lower than that of the middle income group. This is due to the fact that almost people from low income group are student who are still receiving support from their family, still young and have not much experience as well as choice in consuming products. For the high income people, they tend to consume by convenience. However, the difference is not high and the confident level is not achieved at 95% for testing.

5. Discussion

This study is adapted from the study of Francois Lecomple and Roberts (2006) to test whether it could be used the measurement scale of SRC in France case for Vietnam context. The analysis has shown that the suggested scales ensuring the reliability and convergence in measuring the factors of SRC. Only 3 variables is not suitable with the context of Vietnam should be dropped out. In the study of Francois-Lecompte and Roberts (2006), 20 variables are divided into 5 factors. Similarly, in the present study, 17 variables are also divided into these 5 factors.

In comparison, mean score between demographic groups of customer, gender and occupation groups get statistical significant at 5%. This is a hint for company having suitable marketing campaign and the government has reasonable policy to improve it.

This research could be considered as a pioneer research in this field at Vietnam. It is taken place under circumstance of Vietnam customers scared of using low cost but harmful some products from China; and they are also getting angry with series of scandals about environment being degraded/ destroyed by unfaithful and irresponsible producers. They are more concerned on social responsibility when making consumption decision. Therefore, when conducting the present study, the researchers also received much of concern from customers. However, there are some variables in the questionnaire not easy for them to answer due to lacking of information, apparently. That might be the reason leading some of consumers to not think about it when making buying decision.

As mentioned above, even though SRC raised since 1970s, it is understood differently in different areas and cultures. Therefore, when applying this SRC measure to research in Vietnam, the suggested measure seems still strange and not receives high concern of Vietnam customer. Respondents still think that they are responsible consumer but the score they get from the survey has shown that they are not concern much on their responsibility. That's because the income of Vietnamese is still low, two thirds of their income is used for consumption. Therefore, the scale about supporting SB or CRP seem not being welcome.

Furthermore, Vietnam is a developing country with the incomplete legal system, and lacking of market information. This point creates more difficulties for consumers in realizing socially responsible firms to perform their socially responsible consumption. This has shown that, the measure of Francois-Lecompte and Roberts (2006) is not properly appropriate for Vietnamese context. It is needed to develop another measure more appropriately, which consumers can have enough information or easily understand to evaluate factors.

6. Implication and limitation

Even though some factors in the measure of Francois-Lecompte and Roberts (2006) are still strange with Vietnamese customers, it is also useful to improve their thinking and awareness of SRC. On the one hand, this contributes to increase their social responsible awareness when performing consuming behavior in the future. On the other hand, businesses may improve their performance to adapt with new requirements from customer.

The demographic origin factor receives highest concern as well as being the most important factor to measure SRC. As mentioned above, this could be the consequence of thread and dangerous of some products from China as well as the campaign of government with slogan of "*Vietnamese consume Vietnamese products*". People understand and react well with this factor. The government should focus on this to increase the SRC of customer and Vietnam companies should benefit this chance to develop and improve their business. In particular, they should concentrate on women, managers, and staffs who show that they are ready to encourage Vietnamese firms. Moreover, companies should grant same concern to firm's behavior, the second factor in the list of factors after EFA even the score of variables in this factor is not as high as that of demographic origin factor. Meanwhile the government should improve the information system to deliver more information about firms to the customers to help them making a better decision on consumption and having a chance to improve their SRC.

For the small business support factor, the score is not high and there are no significant different between demographic groups of customers. Beside the reason of low income as mentioned above, small businesses have still not created prestige in doing business and customers do not trust in them due to low quality or expensive products. This also an alert for them in changing their performance and improve themselves to pull customer.

With the responsibility on CRP factor, although getting slightly high score from customer, the convergence of this factor is not high, correlation between variable is loosen in some cases and it ranks in the last position in EFA. Thus, variables should be considered to adjust for more suitable with Vietnam case.

However, this research also suffers some limitations. Firstly, due to limit knowledge and information, the employed scale may not adapt well with Vietnamese consumers' perspectives; and something they understand as SRC are not included in the questionnaire and vice a versa. That is the reason, in some cases, respondents tried completing the questionnaire without properly understanding. This limitation is also mentioned in the study of Roberts (1995). Therefore, it is necessary to conduct a qualitative study to explore constructs to measure SRC in Vietnamese context. Secondly, the survey is conducted in Ho Chi Minh City only. Consequently, the findings cannot be generalized for Vietnamese market. Further studies can be conducted and collect data in many other areas in Vietnam to have a better understanding of Vietnamese customers' awareness of SRC.

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□ □ □ □ □ □ Speed of Adjustment of Firm’s Investment, Financing and Dividend Decisions

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This paper investigates whether firms dynamically alter their corporate decisions on investment, financing, and dividend payment, and compares speeds of adjustments among those corporate decisions. Using U.S. listed firms from 1965 to 2012, we find that those ratios are mean-reverting, indicating that firms adjust their levels of investment, leverage and dividend toward optimal levels. We further find that investment and leverage are adjusted faster than dividend payment. This result confirms that firms tend to stabilize their dividend to prevent changing the investors’ prospective. We reexamine Leary and Roberts’s (2014) results in term of joint determination of investment, financing and dividend policies. The firms with high market concentration have the higher speed of adjustment of debt financing. The firms with greater fixed production costs (i.e. capital-intensive firms) have less flexibility to adjust their investments and debt financing. The small firms correct deviations in debt financing more quickly than big firms. This finding tends to support the flexibility to the environmental change for small firms rather than the adjustment cost reduction for big firms.

Keywords: Corporate investment; Leverage; Dividend; Speed of adjustment

EL Classifications: G30; G32; G35

1. Introduction

The investment, dividend, and debt financing are major decisions of a firm. The literature of corporate finance views that firms strive to maintain optimal levels of the three policies. Most past theoretical papers presume the existence of optimal investment and try to find some variables to explain the target level (e.g., Abel and Eberly, 1996; Chenery, 1952; DeMarzo and Fishman, 2007; Fine and Freund, 1990; Gordon, 1963; Koyck, 1954). Richardson (2006) uses U.S. data to construct the optimal investment level for each firm. For dividend payout, Fama (1974), Benartzi et al. (1997), and Fama and French (2002) confirm the Lintner model, which suggests the firms have target payout level. Rozeff (1982), Lee et al. (2011), and Chen et al. (2013) suggest that the growth rate helps to determine the optimal dividend payout. Regarding the debt financing policy, Bradley et al. (1984), Leary and Roberts (2005), Flannery and Rangan (2006), Kayhan and Titman (2007), and Frank and Goyal (2009) find the evidence to support the optimal capital structure. The survey paper of Graham and Harvey (2001) indicates that about 80% of the CFOs responded to have a target range or a strict target for their debt-equity ratio[1].

The abovementioned papers studying optimal levels associated with corporate decisions imply that firms have incentive to adjust their levels toward the target levels to maximize firms' value. The past studies such as Shyam-Sunder and Myers (1999), Fama and French (2002), Flannery and Rangan (2006), and Byoun (2008) use the speed of adjustment to examine whether firms change their debt ratio toward the target levels. Moreover, Jalilvand, and Harris (1984), Drobetz and Wanzenried (2006), Faulkender et al. (2008), Cook and Tang (2010), and Ö ztekin and Flannery (2012) investigate the determinants of the speed of adjustment of debt ratio among firms. However, based on the optimal investment and dividend literature, few studies investigate the corresponding speed of adjustment from these two decisions.

In this paper, we estimate and compare the speed of adjustment of these three policies. If the optimal level exists, we would see mean-reverting situation, namely the adjustment coefficients of these three corporate finance variables are predicted to be negative. Given the presence of adjustment costs, the speed of adjustment should be less than one. The speed of adjustment, as such, means the speed that firms adjust their levels to the target levels. The faster speed of adjustment for corporate decision implies the more important for the firm to make this decision. The investment decision for the firm is related to the future outputs, productivity, and profitability. The speed of adjustment for financing decisions implies the degree of urgency for the outside funds. The dividend payout decision may be used to signal the future profitability of the firm to the outside investors[2]. Thus, comparing the speeds of adjustment among these three corporate decisions helps us to understand which one is more urgent for the firm to adjust to the optimal level.

We further investigate the determinants to influence the speed of adjustment toward the targets. Leary and Roberts (2014) argue that the manager considers the financial policies and

[1] In addition, Jalilvand and Harris (1984), Hovakimian et al. (2001), and Cook and Tang (2010) document that the firm's financing decision is characterized as partial adjustment to long run targets

[2] Bhattacharya (1979), Miller and Rock (1985), and Ambarish et al. (1987) argue that firms can use the dividend payout as a costly signal to convey their true values.

characteristics of its peer firms to decide its financial decisions. Accordingly, this externality effect may increase or decrease the speed of adjustment of the financial policies. Past studies suggest that firms in less competitive market (i.e. oligopolistic firms) tend to adjust their investment, payout, and debt financing more than firms in more competitive markets (Akdoğu and MacKay, 2008; Brander and Lewis, 1986; Grullon and Michaely, 2007; Massa et al., 2007). In addition, firms with greater fixed production costs have less flexibility to change the input resources, thus capital-intensive firms tend to spend more time to correct investment levels than labor-intensive firms. Further, the size of firm seems to be a relevant factor on the financial adjustment. Big firms usually have lower adjustment costs and thereby adjust faster than small firms because of the effect in economics of scale (e.g., Banerjee et al., 2004; Jalilvand and Harris, 1984; Skinner, 2008). However, small firms may decrease response time to environmental change because of the greater interaction among departments (Neilsen, 1974). Thus, we could directly examine the effect of market competition, capital-labor intensity, and firm size on the adjustment of firm's decision by considering the speed of adjustment toward the optimal levels.

Our sample consists of U.S. listed dividend-paying firms from 1965 to 2012[3]. We estimate the models by using individual firm's time-series data, which allow speeds of adjustment to vary with firms. Using firm-by-firm estimations, we then present the mean of the parameter estimates of our results to capture an average behavior of the firms. In addition, to prevent the autocorrelation and the unobserved individual-specific time-invariant effects we also estimate these three target adjustment models by generalized method of moments (GMM) estimation of dynamic panel regression as robust check. Papers argue that the investment decision is related to financing decision and dividend decision (Dhrymes and Kurz, 1967; Fama, 1974; McCabe, 1979; McDonald et al., 1975; Peterson and Benesh, 1983; Pruitt and Gitman, 1991; Switzer, 1984). Thus, we also apply two-stage least squares (2SLS) to estimate the simultaneous-equations model that consider the interaction of the three policies.

As expected, we find that those adjustment coefficients are mean-reverting, indicating that firms adjust their levels of investment, dividend, and leverage toward optimal levels. We further find that investment and leverage are adjusted faster than dividend payment. The economic implications are shown as follows. Generally, the dividend payment is relatively long term and tends to be a permanent decision. Garrett and Priestley (2000) find that firms tend to smooth the dividend payouts to prevent changing the investors' prospective. To avoid signaling bad information about firms' prospective, Brav et al. (2005) also show that managers have no incentive to cut dividend. By contrast, investment decisions are usually short-term and related to future outputs. Firms have to react quickly to the good investment opportunity in order to make profits. When the internal funds of firms are not sufficient, firms will raise cash from capital markets. Thus, the adjustment speed of debt financing may be quick to match up the fast adjustment of the investment and is faster than the adjustment of dividend payout.

Regarding the determinants of speed of adjustment, we find that the firms with a higher

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[3] Smirlock and Marshall (1983) and Fama and French (2002) also only consider the firms paying dividend.

market concentration tend to adjust to the debt financing faster, which is consistent with Brander and Lewis (1986). In addition, we find that capital-intensive firms correct deviation in investment and debt financing more quickly than labor-intensive firms. This result is consistent with the economic implication that firms with greater fixed production costs (i.e. capital-intensive firms) have less flexibility to adjust their investments. In addition, debt could be used to finance the investment needs for firms, thus a low speed of adjustment in investment would cause a low adjustment of debt financing. Finally, we find that small firms adjust faster in debt financing than do big firms. Our finding tends to support the flexibility to the environmental change for small firms rather than the adjustment cost reduction for big firms.

Our research offers three contributions to the literature. First, this paper is the first one to examine the speed of adjustment of investment, dividend, and debt financing policies in a simultaneous system while most past studies focus on the speed of adjustment for debt financing. Although Jalilvand and Harris (1984) and Fama and French (2002) investigate dividend and debt policies at the same time, they do not consider the possible influence of investment and do not discuss causes of adjustment speeds. Second, we compare the speed of adjustment of investment, dividend, and debt financing to understand which decision is more important for firms. Our result implies that firms care about the future productivity and sufficiency of funds more than the signal of dividend to outside investors. Third, by directly examining the speed of adjustment from the optimal adjustment model, we find that the market concentration, capital-labor intensity and firm size influence the speed of adjustment. While results of past studies (e.g., Brander and Lewis, 1986; Jalilvand and Harris, 1984; Skinner, 2008) imply these possible determinants for adjustment, they do not directly calculate and compare the speeds of adjustment.

The paper proceeds as follows. Section 2 presents the literature reviews about these three corporate decisions and our four hypotheses. Section 3 describes the empirical models and methodologies. Section 4 describes the data and shows the empirical results of speed of adjustment. Section 5 examines the determinants for the speed of adjustment. Conclusions are presented in Section 6.

2. Literature review and hypotheses

Most papers suppose that firms should have optimal investment level and try to find some variables to explain the target level. Chenery (1952) and Koyck (1954) use the flexible accelerator model of investment to capture the process that capital adjusts toward its target level. In this flexible accelerator model, capital is adjusted by a constant proportion of the deviation of its target from actual capital, and the target capital level is proportional to its output. Theoretical models such as Gordon (1963), Fine and Freund (1990), Abel and Eberly (1996), and DeMarzo and Fishman (2007) solve for the optimal investment of a firm under different conditions, indicating that optimal investment is a well-accepted concept. In addition to these theoretical papers, Richardson (2006) calculates the appropriate investment from the outlays for maintenance on assets in place and for future investment of positive NPV projects, which represents the optimal investment level for firms.

Since Lintner (1956) provides a partial adjustment model, the optimal dividend level is well investigated in finance papers. The Lintner model describes the tendencies that dividends adjust toward the target payouts, where the target dividend is proportional to profit. Based on the Lintner model, Fama (1974) applies simultaneous equations models of dividend and investment decisions and does not find an association between the dividend and investment decisions of firms. Fama and French (2002) confirm that dividends are mean-reverting and estimate the adjustment speed of dividend payout. The empirical results and theoretical models of Rozeff (1982), Lee et al. (2011), and Chen et al. (2013) show that there is an optimal dividend payout and a firm will reduce its dividend payout when the growth rate increases. Regarding the relationship among these three financial decisions, Lambrecht and Myers (2012) develop a dynamic Linter model of payout by maximizing the managers' rents, subject to the firm's budget constraint. In this theoretical model, they suggest that payout adjusts smoothly and propose the signaling information of the dividend payout through the manager view of the firm's prospects. Regarding the debt financing policy, a large body of literature agrees that leverage exhibits mean reversion and firms adjust their leverage toward the target levels. Bradley et al. (1984) find strong industry influences on firm leverage ratio and support the optimal capital structure. The survey paper of Graham and Harvey (2001) find that firms follow the trade-off theory and about 80% of the CFOs responded to have the target debt ratio. By allowing firms' target ratios to change over time, Hovakimian et al. (2001) confirm that firms tend to move toward a target debt ratio. Leary and Roberts (2005) find that firms actively rebalance their leverage to stay within an optimal range. Flannery and Rangan (2006) find firms pursue target capital ratios and use the partial-adjustment model to estimate the speed of adjustment. Kayhan and Titman (2007) find that the capital structures of firms are adjusted to target debt ratios even though firms' histories strongly influence their capital structures. Frank and Goyal (2009) support the optimal capital structure and find six core factors such as assets and profits for capital structure decisions. Huang and Ritter (2009) show that both the market-timing model and the static trade-off model are important determinants for the optimal capital structure.

The speed of adjustment, which is the proportion that changes in this variable are explained by deviations of its current level from the target level, is extensively used to examine whether the firms have the optimal level. Shyam-Sunder and Myers (1999), Fama and French (2002), and Flannery and Rangan (2006) estimate the speed of adjustment to examine the optimal capital structure. Most of investment papers such as Greenberg (1964) and Coen (1968) use the investment adjustment parameter to investigate the optimal investment model. Thus, according to the optimal hypothesis of the corporate decisions, we propose the following hypothesis:

Hypothesis 1: *The financial levels including investment, leverage, and dividend payment would be adjusted to the optimal level when the speeds of adjustment are significant.*

The externality effects such as the economic environment may influence the adjustment cost and thus affect the speed of adjustment of corporate decisions. Both Drobetz and Wanzenried (2006) and Cook and Tang (2010) find that firms adjust their leverage toward target faster in good macroeconomic states relative to bad states. Öztekin and Flannery (2012) compare firms' capital structure adjustment across countries and find that legal and financial traditions significantly correlate with firm adjustment speeds. Faulkender et al. (2008) find a faster adjustment speed when adjustment costs are sunk relative to when these costs are incremental. Byoun (2008) finds that firms make the most significant adjustment toward the target when they have above-target debt (below-target debt) with a financial surplus (a financial deficit). Leary and Roberts (2014) find that the behavior and characteristics of peer firms play an important role in determining corporate capital structures and financial policies. In their paper, smaller, younger, less successful, and more financially constrained firms are especially highly influenced by their large, more successful peers.

Accordingly, the characteristics of firms may be relevant to the speed of adjustment for the corporate decisions. First, past studies suggest that firms in less competitive market (i.e. oligopolistic firms) tend to adjust their corporate decisions more than firms in more competitive markets. Akdoğu and MacKay (2008) consider the value of investing strategically and the value of waiting to invest and find that investment speed are highest in oligopolistic industries and lowest in monopolistic industries. Grullon and Michaely (2007) and Massa et al. (2007) find that firms in a higher market concentration tend to pay out more cash than firms in a less market concentration. Brander and Lewis (1986) argue that firms in a low competitive market (i.e. oligopoly firms) have more incentive to adjust their financial structure to react to the change of financial structure of their competitors in order to influence their market outputs. Therefore, we propose the following hypothesis:

Hypothesis 2: *Firms in less competitive market (i.e. oligopolistic firms) tend to adjust their investment, payout, and debt financing faster than firms in more competitive markets.*

In addition, the production cost may be an issue for firms to decide the financial decisions. MacKay and Phillips (2005) find that firms that deviate from the industry median capital–labor ratio use more financial leverage than firms near the industry median capital–labor ratio. Their finding implies that firms near the industry median capital–labor ratio have lower cash flow risk and thereby use less debt financing. Mills and Schumann (1985) argue that the flexibility of firms is related to the capital intensity of their production technology and find that the firms relying on greater capital technology have higher fixed production cost. Firms with greater fixed production costs have less flexibility to change the input resources, thus capital-intensive firms tend to spend more time to correct their investment or debt financing than labor-intensive firms. Thus, we propose the following hypothesis:

Hypothesis 3: *Capital-intensive firms may adjust the financial levels more slowly than labor-intensive firms because of less flexibility resulted from greater capital intensity.*

Further, the size of firm is usually a relevant determinant in the financial decision. Big firms tend to have lower adjustment costs because of the effect in economics of scale. Jalilvand and Harris (1984) and Banerjee et al. (2004) suggest that large firms adjust faster to the target capital structure than small firms because less information asymmetry and less bankruptcy in big firms result in lower adjustment costs. Skinner (2008) finds that large firms adopt a stable dividend policy (i.e. lower speed of adjustment) because these firms use the flexible repurchase to substitute the dividend payout. However, in terms of the structure of organization, small firms have flexibility to react the market change. Neilsen (1974) finds that small firms decrease response time to environmental change because the greater interaction among departments. Leary and Roberts (2014) consider the mimicking effect among the peer firms and find that smaller firms are highly sensitive to the leverage changes of their larger peers. According to the above discussions, we propose the following competing hypotheses:

Hypothesis 4a: *Big firms have faster adjustment than small firms when the cost of adjustment is the dominant effect in the financial decisions.*

Hypothesis 4b: *Small firms have faster adjustment than big firms when the flexibility of organization is the dominant effect in the financial decisions.*

3. Models and methodologies

3.1. *Model*

In the finance literature, the simple form of target adjustment model for one variable states that changes in this variable are explained by deviations of its current level from the target level[4]. Specifically, changes in the investment (ΔInv_{it}), dividend (ΔDiv_{it}), and n debt financing ($\Delta Debt_{it}$) of firm *i* from year *t-1* to year *t* are given by

$$\Delta Inv_{it} = \phi_i\left(Inv_{it}^* - Inv_{i,t-1}\right) + \epsilon_{it} \ , \tag{1}$$

$$\Delta Div_{it} = \rho_i\left(Div_{it}^* - Div_{i,t-1}\right) + \eta_{it} \ , \tag{2}$$

$$\Delta Debt_{it} = \tau_i\left(Debt_{it}^* - Debt_{i,t-1}\right) + \xi_{it} \ , \tag{3}$$

Where Inv_{it}^*, Div_{it}^*, $Debt_{it}^*$, are the target investment, dividend, debt levels and ϕ_i, , τ_i are the speeds of adjustment for the investment, dividend, and debt. Inv_{it} is net property, plant, and equipment divided by shares outstanding. Div_{it} is the dividends divided by shares outstanding. $Debt_{it}$ is the ratio of total book liabilities to total book assets.

We follow the past studies to estimate the target levels. Chenery (1952) and Koyck (1954) suggest that the target investment for firms *i* at the year *t* is proportional to output (Q_{it}). Lintner (1956) proposes the targer dividends for firm *i* at year *t* are assumed to be proportional to earnings

[4] These studies include Chenery (1952), Koyck (1954), Lintner (1956), Fama (1974), Shyam-Sunder and Myers (1999), Fama and French (2002), Drobetz and Wanzenried (2006), Flannery and Rangan (2006), Byoun (2008), Huang and Ritter (2009), and Cook and Tang (2010).

(P_{it}). Fama and French (2002) suggest that target leverage is influenced by the volatility of earnings and net cash flows and the expected profitability of assets in places[5]. Fama and French (2002) use the firm size, the natural logarithm of total book assets, In $(A_{i,t-1})$, as the proxy for the volatility of earnings and net cash flows. They also adopt the ratio of annual pre-interest pretax earnings to end-of-year total assets, $E_{i,t-1}/A_{i,t-1}$, to present the expected profitability of assets in place. Thus, the target levels are shown as follows:

$$Inv^{*}_{it} = \phi_{1i} + \phi_{2i}Q_{it}\,, \tag{4}$$

$$Div^{*}_{it} = \rho_{1i} + \rho_{2i}P_{it}\,, \tag{5}$$

$$Debt^{*}_{it} = \tau_{1i} + \tau_{2i}\ln(A_{i,t-1}) + \tau_{3i}E_{i,t-1}/A_{i,t-1}\,, \tag{6}$$

where ϕ_{1i}, ρ_{1i}, τ_{1i} are ixed effects of the firm i. Q_{it} is calculated by sales plus change in inventories and P_{it} is net income before extraordinary items plus depreciation minus preferred dividends.

Therefore, substituting (4), (5), (6) into (1), (2), (3) and rearranging the model, we obtain the following estimated models[6]:

$$\Delta Inv_{it} = \alpha_{1i} + \alpha_{2i}Inv_{i,t-1} + \alpha_{3i}Q_{it} + \epsilon_{it}\,, \tag{7}$$

$$\Delta Div_{it} = \beta_{1i} + \beta_{2i}Div_{i,t-1} + \beta_{3i}P_{it} + \eta_{it}\,, \tag{8}$$

$$\Delta Debt_{it} = \gamma_{1i} + \gamma_{2i}\,Debt_{i,t-1} + \gamma_{3i}\ln(A_{i,t-1}) + \gamma_{4i}E_{i,t-1}/A_{i,t-1} + \xi_{it}\,. \tag{9}$$

Due to the presence of adjustment costs, the adjustment of corporate decisions toward the target levels may not be immediately. Specifically, the hypothesis will be held when the coefficient of speed of adjustment, α_{2i}, β_{2i}, γ_{2i}, are significantly between 0 and -1.

3.2. *Methodology*

3.2.1. *Regressions for single equation models*

We use ordinary least squares (OLS) method to estimate the abovementioned models (7), (8), and (9). By using OLS method, we estimate our time-series data for each of the 1,107 firms in the total sample, which allows speeds of adjustment to vary by firms. After firm-by-firm estimations, we present the mean of the parameter estimates of our results to capture an average behavior of the firms.

3.2.2. *Generalized method of moments estimation of dynamic panel data models.*

[5] We also consider the influence of expected investment opportunities, expected R&D investment, and depreciation to estimate the target investment as Fama and French (2002), then we obtain the similar result

[6] The coefficients in (7), (8) and (9) are displayed as follows: $\alpha_{1i} = \emptyset_i\emptyset_{1i}$, $\alpha_{2i} = -\emptyset_{1i}$, $\alpha_{3i} = \emptyset_i\emptyset_{2i}$, $\beta_{1i} = \rho_i\rho_{1i}$, $\beta_{2i} = -\rho_i$, $\beta_{3i} = \rho_i\rho_{2i}$, $\gamma_{1i} = \tau_i\tau_{1i}$, $\gamma_{2i} = -\tau_i$, $\gamma_{3i} = \tau_i\tau_{2i}$, $\gamma_{4i} = \tau_i\tau_{3i}$,

In regression models (7) to (9), we test the speed of adjustment by imposing the Inv_{t-1}, Div_{t-1}, $Debt_{t-1}$, which are lagged of dependent variables. Since the dependent (for example, Inv_t) and independent variables (Inv_{t-1}) share the same random source, it is obviously that covariance of independent and residual is not zero, leading an endogeneity concern. Therefore, as suggested by Arellano and Bond (1991), we estimate the coefficient estimates of our panel regression– a form of dynamic panel– for each regression (investment, dividend and debt ratio) with generalized method of moments (GMM). We select lagged variables of *Inv*, *Div* and *Debt* as instrument variables where Arellano and Bond (1991) suggest they are a useful instrument, if properly lagged. Denote $y_{(j)}$ to be lagged variable of independent variable (i.e., *Inv*, *Div* and *Debt* in our paper), and j denotes number of lags. We have

$$Z = \begin{pmatrix} y_{(1)} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & y_{(1)} & y_{(2)} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & y_{(1)} & y_{(2)} & y_{(3)} & 0 & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & & & & \vdots & \vdots & \vdots & \vdots \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & y_{(1)} & \cdots & y_{(T-2)} \end{pmatrix},$$

$$A_N = \left(\frac{1}{N}\sum_{i}^{N} Z'HZ\right)^{-1}, \text{ and}$$

$$H = \begin{pmatrix} 2 & -1 & 0 & \dots & 0 & 0 & 0 & 0 & 0 & 0 \\ -1 & 2 & -1 & 0 & \dots & 0 & 0 & 0 & 0 & 0 \\ 0 & -1 & 2 & -1 & 0 & \dots & 0 & 0 & 0 & 0 \\ \vdots & \vdots & \vdots & & & & \vdots & & \vdots & \vdots \\ 0 & 0 & 0 & 0 & \dots & 0 & 0 & -1 & 2 & -1 \\ 0 & 0 & 0 & 0 & \dots & 0 & 0 & 0 & -1 & 2 \end{pmatrix}.$$

We further define a vector of lagged difference as $\Delta y\_$ and Δy denotes vector of dependent variable, then the GMM estimator □ for α_2, β_2 and γ_2, in models (7) to (9) is

$$\phi = \left[\left(\sum_i \Delta y_-' Z\right) A_N \left(\sum_i Z'\Delta y_-\right)\right]^{-1} \left(\sum_i \Delta y_-' Z\right) A_N \left(\sum_i Z'\Delta y_-\right), \text{ and variance for the parameter:}$$

$$\sigma^2 \left[\left(\sum_i \Delta y_-' Z\right) A_N \left(\sum_i Z'\Delta y_-\right)\right]^{-1}.$$

3.2.3. *Regressions for system equation models*

Past studies argue some relations among investment, dividend and debt financing[7]. To prevent the possible endogenous problems among investment, dividend, and debt financing decisions, we also apply two-stage least squares (2SLS) method that includes the other two policy choices into each one equation. Specifically, each equation contains the remaining two endogenous variables as explanatory variables along with other exogenous variables. The other exogenous variables in each equation are controlled as the previous mentions. The structural equations are estimated as follows:

$$\Delta Inv_{it} = \alpha_{1i} + \alpha_{2i}\Delta Div_{it} + \alpha_{3i}\Delta Debt_{it} + \alpha_{4i}Inv_{i,-1} + \alpha_{5i}Q_{it} + \epsilon_{it} \quad , \tag{10}$$

$$\Delta Div_{it} = \beta_{1i} + \beta_{2i}\Delta Inv_{it} + \beta_{3i}\Delta Debt_{it} + \beta_{4i}Div_{i,-1} + \beta_{5i}P_{it} + \eta_{it} \quad , \tag{11}$$

$$\Delta Debt_{it} = \gamma_{1i} + \gamma_{2i}\Delta Inv + \gamma_{3i}\Delta Div_{it} + \gamma_{4i}Debt_{i,t-1} + \gamma_{5i}\ln(A_{i,t-1}) + \gamma_{6i}E_{i,-1}/A_{i,t-1} + \xi_{it} \quad . \tag{12}$$

To ensure these equations by 2SLS, we use the fitted values obtained from regressing the endogenous variables on all exogenous variables in the system as the instrumental variable estimates of the endogenous variables ΔInv_i, ΔDiv_{it} and $\Delta Debt_{it}$ in (10), (11), (12).

4. Data and empirical results

4.1. *Data*

The sample consists of all dividend-paying U.S. firms listed on NYSE, AMEX, OTC, and NASDAQ stock markets from 1965 to 2012. All of our accounting variables are annual and collected from Compustat Annual Industrial Files. Following previous research (e.g., Cook and Tang, 2010; Fama and Fench, 2002; Huang and Ritter, 2009), we exclude financial firms (SIC 6000-6999) and regulated utilities (SIC 4900-4999) from the sample. We also require firms to have positive total assets and a number of common shares outstanding.[8]To increase the testing power in the regression analysis, we also require firms to survive 20 years or longer.[9] These exclusions leave us with complete information for 35,300 firm-year observations, which consists of 1,107 firms.

Table 1 presents summary statistics on the investment, dividend, and debt financing for

[7] Higgins (1972), Fama (1974), Morgan and Saint-Pierre (1978), Smirlock and Marshall (1983), Lee et al. (2011) and Chen et al. (2013) investigate the relationship between investment decision and dividend decision. Fama and French (2002) consider the interaction between dividend and financing decisions. Dhrymes and Kurz (1967), McDonald et al. (1975), McCabe (1979), Peterson and Benesh (1983), Switzer (1984), and Pruitt and Gitman (1991) argue that the investment decision is related to financing decision and dividend decision.

[8] These variables are used to deflate other variables and the results become difficult to interpret when they have non-positive values.

[9] The different sample selection criteria for the firms with different survive years (7 and 15 years) also have the similar results in Appendix Table A1.

different time periods. All of these variables are winsorized at the 1st and 99th percentiles to avoid the influence of extreme observations. Compared with different time periods, the investment during 1980s is the highest. This result may be from the simulating policies (e.g., the reduction of capital gain tax and the reduction of interest rate), which are promoted by U.S. President Ronald Reagan during the 1980s. Dividend payout is more likely to be reduced after the 1990s. Such finding is consistent with Fama and French (2001), Grullon and Michaely (2002), and Brav et al. (2005), indicating that repurchase is more prevalent to adopt than dividend payout in the recent decades. The average book leverage is 0.489 and the book leverage tends to be higher in later years than in earlier years.

[Insert Table 1 about here]

4.2. *Empirical results*

4.2.1. *Ordinary least squares results*

Table 2 shows OLS regression results for single equation models. Panel A presents averages of individual firms' coefficient estimates of the investment, dividend, and debt financing regressions, respectively. In the investment equation, we find the coefficient of lagged investment is significantly negative, which is the speed of adjustment of investment, indicating that firm adjust its investment toward its target level. The coefficient of lagged investment of our paper implies that, on average, the firm closes 46.8% of the gap between its actual and its desired investment levels. The output positively and significantly affects the change of investment, which is consistent with Fama (1974).

[Insert Table 2 about here]

In the dividend model, the coefficient of lagged dividend is -0.402 significantly negative, implying that firms adjust the firms' dividends to the targeted levels. The speed of adjustment indicates that the firms close about 40% of the gap between current and desired dividend levels within one year. This finding is consistent with the past studies which also confirm the possible adjustment of dividend to optimal dividends[10].The coefficient of P_{it} is significantly positive, implying the firms with high net income tend to increase to pay dividends.

In the debt financing equation, the coefficient of lagged leverage is -0.363 significantly negative. The result is consistent with Jalilvand and Harris (1984), Flannery and Rangan (2006), and Huang and Ritter (2009), which implies firms also tend to adjust toward the target leverage levels. The coefficient of $\ln(A_{i,t-1})$ is significantly positive, indicating that large firms leverage more than small firms. This finding results from that large firms tend to have a greater reputation and less information asymmetry than small firms and thus large firms can finance at a lower cost

[10] These papers include Lintner (1956), Fama and Babiak (1968), Spies (1974), Jalilvand and Harris (1984), Fama and French (2002), and Brav et al. (2005).

than small firms. The positive relation between size and leverage is consistent with Fama and French (2002), Flannery and Rangan (2006), and Frank and Goyal (2009). The coefficient of $E_{i,-1}/A_{i,t-1}$ is significantly negative. This result implies that more profitable firms have higher internal funds from their earnings and thus have less incentive to obtain the outside funds by debt issuing. The negative relationship between profitability and leverage is consistent with the findings of Long and Malitz (1985), Rajan and Zingales (1995), Fama and French (2002), and Flannery and Rangan (2006).

The negative coefficients of lagged investment, lagged dividend, and lagged debt financing in Panel A of Table 2 imply that firms tend to adjust towards target levels. However, from these lagged coefficients, we cannot directly judge which decision is more important for firms. Thus, we further calculate the standardized coefficients of lagged investment, dividend, and debt financing in order to compare these three decisions. The standardized coefficient is calculated by multiplying the unstandardized coefficient by the ratio of the standard deviation of the independent variable (i.e. the lagged terms) to the standard deviation of the dependent variable[11]. Panel B of Table 2 shows the speed-of-adjustment coefficients after standardization. The absolute value of coefficients of lagged investment and lagged debt financing are larger than the absolute value of coefficient of lagged dividend. This result indicates that firms adjust toward the target investment and debt levels more quickly than the target dividend payment. In addition to the case with firm surviving 20 years or longer, we also examine speed of adjustments upon different sample selection criteria for the firms with different survive years (7 and 15 years). All these results are quantitatively similar. We present the results in Appendix Table A1.

4.2.2. *Dynamic generalized-method-of-moments results*

The investment, dividend, and debt in our sample are panel data and thus may have autocorrelation. For example, Skinner (2008) finds that firms' dividend payout decisions are substantially affected by their dividend history. Thus, as a robustness check, we estimate the speed of adjustment by panel regression; that is, for each corporate policy, we carry regression analysis by pooling all firm-year observations in one regression model. As the above mention, the GMM estimation of dynamic panel regression, which uses the first difference and lag dependent variables as instruments to calculate the asymptotic estimators, helps to solve the endogenous problem of individual-specific time-invariant effects.

The results of GMM estimation of dynamic panel regression for each corporate policy are shown in Table 3. Panel A of Table 3 shows the coefficients of lagged investment, lagged dividend and lagged debt financing are significantly negative, also indicating the mean-reverting for these three decisions. The influence of control variables in the GMM estimation also has thesimilar result as the OLS. Specifically, the firms with higher outputs need greater investment input; firms with higher net income are more likely to pay more dividends; large firm needs more debt financings; firms with higher internal funds have less incentive to issue debt financings.

[11] The standardized estimates of speed-of-adjustment coefficient are comparable because they all refer to one standard deviation change in their respective independent variables rather than a one unitchange.

Panel B of Table 3 shows the speed of adjustment by standardizing coefficients of lagged investment, lagged dividend, and lagged debt financing. By comparing these three speed of adjustment, we also find the similar result of OLS, namely, the adjustments toward the target investment and debt levels are more quick than the adjustment toward the target dividend payment. Thus, we find that our main conclusions are still valid in this GMM approach.

[Insert Table 3 about here]

4.2.3. *Two-stage least squares results*

Table 4 shows results of 2SLS of (10), (11), and (12). Panel A presents the means of individual firms' 2SLS coefficients across the 1,107 firms. The results of relations among these three financial decisions could be directly obtained in this method. First, the significantly positive coefficient of $\Delta Debt_{it}$ (in investment decision), and ΔInv_{it} (in debt financing decision) imply that firms with higher investment changes have higher debt financing changes and vice versa. Ross (1977) and Myers and Majluf (1984) suggest that debt is preferred to equity for managers to signal the optimistic investment opportunity to investors because the firms are expected to have higher future cash flows to repay the debt. Harris and Raviv (1990) argue that debt is a device to solve the asymmetric information for the investors because it helps to monitor managers and force the firm to liquidation. In addition, our finding that increases in debt financing enhance the funds available to outlays for investment is consistent with McCabe (1979), Peterson and Benesh (1983), John and Nachman (1985), and Froot et al. (1993). Thus, our optimal debt ratio may be the result of a trade-off between the value of information (from more debt) and the cost of monitor.

[Insert Table 4 about here]

Second, the significant coefficients of $\Delta \mathrm{Di}v_{it}$ and ΔInv_{it} imply that dividend outlays influence investment decisions and vice versa. This finding implies that the firms may use dividend payout to signal the growth opportunity and then these firms increase their investment. The firm with higher investment input may experience the higher earnings and thus could increase the dividend payout. Such finding, that dividend payout responds to investment, confirms the model prediction of Lambrecht and Myers (2012). The relationship between dividend payout and investment is also consistent with the signaling cash flow hypothesis of dividend payout in Yoon and Starks (1995).

Third, the changes of dividend on the change of debt financing are significantly negative, showing that the firms need less debt financing when they are capable of paying more dividend. This finding is consistent with the economics intuition that the firms with higher dividend payout usually have greater earnings (e.g., Lintner, 1956; Skinner, 2008) and thus have less incentive to issue debt financing. In addition, the increases in debt financing seem to enhance the funds available to outlays for dividend payout, implying that firms may transfer the wealth from bondholders to shareholders.

By comparing the results from these methods, we find all the coefficients of lagged investment, lagged dividend and lagged debt financing are negative significantly. This result supports our hypothesis 1, implying that these three policies tend to be adjusted to the optimal levels. All the exogenous variables have a similar impact as in the single equation models. In addition, all of the three equations in the 2SLS regressions have greater adjusted R-squares than that of OLS regressions. Thus, after considering the possible endogenous problems, we still obtain the similar result. Namely, firms tend to adjust toward the target investment, debt financing, and dividend levels. In Panel B of Table 4, we also show the speed-of-adjustment coefficients after standardization. By comparing the speed of adjustment of these three policies, we find that investment and debt financing decisions adjust more quickly than dividend payment. This finding is also consistent with the results of OLS and GMM.

Such a finding of speed of adjustment seems to have the following implication. The past studies (such as Brav et al., 2005; Garrett and Priestley, 2000) find that managers are reluctant to cut dividends because they want to prevent changing the investors' prospective. The dynamic Linter model suggested by Lambrecht and Myers (2012), which jointly incorporates the investment and debt into the payout policy, also suggest the payout adjusts smoothly than debt financing. In contrast to the dividend payout, investment is a relatively short-term decision. Usually, firms need to pursue good opportunities to earn profits and thus adjust investment quickly. In addition, firms need to raise fund from capital markets when the internal funds are insufficient for new investment projects. The investment infusion financed from debt may result in that debt financing is adjusted quickly to match the adjustment of the investment. Thus, the comparing results among speed of adjustment ofthese three decisions confirm the economic intuition and the past studies.

5. The determinants for the speed of adjustment

This section examines the effect of market concentration, capital-labor intensity, and firm size on the speed of adjustment. Any decision by firms is affected by their characteristics and the relationship with their competitors. First, we examine the relationship between the speed of adjustment and the industry effect. Fig. 1, Fig. 2, and Fig. 3 show the adjustment coefficients of investment, dividend, and debt financing, respectively, grouped by Fama-French 48 industry classifications. The negative speed of adjustment in all industries implies that firms still adjust toward the target investment, dividend, and debt levels even in different industries. In addition, Fig. 1 shows that firms in commodity sectors (such as tobacco products and food products) adjust their investment levels faster than ones in heavy industries (such as construction and steel works). This result is consistent with the economics intuition that firms in heavy industries tend to have higher capital and thus need more time to adjust toward their target investment level.

[Insert Figures 1, 2, and 3 about here]

Table 5 presents the speed of adjustment for corporate decisions sorted by Herfindahl–Hirschman Index (HHI). HHI is the sum of squared market shares in Fama-French 48 industries constructed from 4-digit Standard Industrial Classification (SIC) industry groupings. Firms with high HHI means firms are in a high concentration market or a low competitive market. Regarding the speed of adjustment for investment and dividend, we do not find any relationship with the market concentration. In addition, there is significantly positive relation between the speed of adjustment of capital structure and the market concentration, implying the higher speed of adjustment of debt financing for the oligopolistic firms. Thus, debt financing supports our hypothesis 2. Brander and Lewis (1986) suggest that compared with the monopolist or the perfectly competitive firms, oligopolistic firms tend to adjust financial structure to react the rival firms in influencing their output market. Our paper is consistent with Brander and Lewis (1986).

[Insert Table 5 about here]

Table 6 presents the speed of adjustment for corporate decisions sorted by capital-labor intensity. The capital-labor intensity is defined as net plant and equipment divided by number of employees. The speed of adjustment of investment decision is negatively related to the degree of capital-labor intensity. That is, capital-intensive firms adjust their investment more slowly than labor-intensive firms. This finding is consistent with the economic implication that capital-intensive firms with greater fixed production factors (i.e. capital) have less flexibility and thus need more time to adjust toward their target investment level. In addition, the speed of adjustment of capital structure is also negatively associated with capital-labor intensity. Debt could be used to finance the investment needs for firms, thus a low speed of adjustment in investment causes a low speed of adjustment of debt financing. Consequently, the adjustments of investment and debt financing support hypothesis 3.

[Insert Table 6 about here]

Table 7 presents the speed of adjustment for corporate decisions sorted by firm size. Firm size is defined as the natural logarithm of total assets (*lnA*). The speed of adjustment of investment is not significantly related to the degree of firm size. Also, the speed of adjustment of dividend is not related to the firm size. For debt financing, small firms adjust faster to the target leverage than large firms do. Big firms have an advantage in lower adjustment cost because of the economies of scale while small firms have an advantage in flexibility of adjustment because of greater interaction among departments (Fiegenbaum and Karnani, 1991; Neilsen, 1974). Our result that small firms adjust debt financings faster than big firms tends to support that small firms have the flexibility to react to the environmental change. This finding is consistent with Leary and Roberts (2014) that smaller firms are highly influenced by their large peers and small firms tend to adjust their financial structure to react to the peers' effects. The result in this table shows that the adjustments of debt financing support hypothesis 4b.

[Insert Table 7 about here]

6. Conclusion

This paper investigates whether firms dynamically alter their corporate decisions of investment, financing, and dividend payment. We estimate and compare the speed of adjustment of the three decisions. Using U.S. listed firms from 1965 to 2012, we find that those variables are mean-reverting, indicating that firms adjust their levels of investment, leverage, and dividend towards optimal levels.

By comparing the speed of adjustment of these three corporate decisions, we find that investment and leverage are altered faster than dividend payment. This result confirms the argument of past studies that firms tend not to change their dividend in order to prevent changing the investors' prospective. In addition, this finding also implies that firms usually adjust investment and debt financing quickly for pursuing good opportunities.

With respect to the determinants of speed of adjustment, we find that less competitive firms (i.e. oligopolistic firms) tend to adjust debt financing faster to react to the rival firms in the market. This result is consistent with Brander and Lewis (1986). In addition, capital-intensive firms adjust investment and debt financing more slowly than labor-intensive firms. Finally, we find that small firms adjust debt financing faster than big firms. These findings tend to support that the flexibility from firm with small size rather than the lower adjustment cost from firm with large size.

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Table 1

Summary statistics.

		Inv					*Div*					*Debt*				
	N	Mean	Median	Q1	Q3	Standard Deviation	Mean	Median	Q1	Q3	Standard Deviation	Mean	Median	Q1	Q3	Standard Deviation
1965-1969	2,414	16.160	10.461	5.191	20.469	17.020	1.032	0.920	0.480	1.364	0.754	0.421	0.423	0.315	0.522	0.150
1970-1979	8,110	17.008	10.371	5.337	21.733	18.218	0.880	0.716	0.366	1.194	0.732	0.450	0.459	0.350	0.553	0.148
1980-1989	9,309	18.692	11.362	5.879	24.727	19.226	0.958	0.713	0.381	1.281	0.840	0.485	0.496	0.375	0.595	0.160
1990-1999	8,223	14.514	8.866	4.475	17.944	16.139	0.731	0.525	0.260	0.973	0.707	0.516	0.531	0.395	0.639	0.178
2000-2012	7,244	13.202	7.132	3.541	16.147	16.093	0.716	0.538	0.257	0.939	0.679	0.530	0.543	0.414	0.649	0.182
1965-2012	35,300	16.032	9.638	4.780	20.283	17.652	0.843	0.625	0.320	1.119	0.756	0.489	0.497	0.374	0.605	0.169

This table presents the summary statistics where we show the mean, median, first quartile, third quartile, and the standard deviation of each variable from 1965 to 2012. N is the number of firm-year observations. The sample consists of 35,300 firm-year observations from annual Compustat files, excluding financial and regulated firms. Inv denotes net property, plant, and equipment. Div denotes dividends. Both v and Div are measured on a per share basis. $Debt$ refers to book leverage, defined as the ratio of total liabilities to total assets. All variables are winsorized at the 1st and 99th percentiles to avoid the influence of extreme observations.

Table 2

Results of OLS regression.

Independent Variables \ Dependent Variables	ΔInv_{it}	ΔDiv_{it}	$\Delta Debt_{it}$
Panel A: Regression analyses of investment, dividend and debt financing			
Constant	0.406	0.054	0.133
	(3.95)	(8.23)	(17.86)
$Inv_{i,t-1}$	-0.468		
	(-66.98)		
$Div_{i,t-1}$		-0.402	
		(-55.06)	
$Debt_{i,t-1}$			-0.363
			(-50.61)
Q_{it}	0.164		
	(26.64)		
P_{it}		0.073	
		(34.27)	
$\ln(A_{i,t-1})$			0.009
			(8.08)
$E_{i,t-1}/A_{i,t-1}$			-0.130
			(-10.59)
Adjusted R-squares	0.46	0.35	0.16
Panel B: Standardized coefficients of lagged investment, dividend and debt financing			
$Inv_{i,t-1}$	-0.805		
	(-65.69)		
$Div_{i,t-1}$		-0.591	
		(-59.81)	
$Debt_{i,t-1}$			-0.594
			(-51.92)

This table presents the OLS regression results of investment, dividend, and debt financing, respectively:

$$\Delta Inv_{it} = \alpha_{1i} + \alpha_{2i} Inv_{i,t-1} + \alpha_{3i} Q_{it} + \epsilon_{it} \quad ,$$
$$\Delta Div_{it} = \beta_{1i} + \beta_{2i} Div_{i,t-1} + \beta_{3i} P_{it} + \eta_{it} \quad ,$$
$$\Delta Debt_{it} = \gamma_{1i} + \gamma_{2i}\, Debt_{i,t-1} + \gamma_{3i} \ln(A_{i,t-1}) + \gamma_{4i} E_{i,t-1}/A_{i,t-1} + \xi_{it} \quad .$$

In Panel A, the coefficients are shown in averages across the 1,107 firms. Regressions are based on non-missing observations and winsorization at the 1st and 99th percentiles. The three dependent variables are ΔInv_{it}, ΔDiv_{it}, and $\Delta Debt_{it}$, which are the change in net plant and equipment, the change in dividends, and the change in book leverage ratio, respectively. The independent variables in the investment regression are lagged investment ($Inv_{i,-1}$), and sales plus change in inventories (Q_{it}). The independent variables in the dividend regression are lagged dividends ($Div_{i,-1}$), and net income before extraordinary items plus depreciation minus preferred divi-dends (P_{it}). All the variables in both of investment and dividend equations are measured on a per share basis. The independent variables in the debt financing regression are lagged book leverage ($Debt_{i,-1}$), natural logarithm of lagged total assets ($\ln(A_{i,t-1})$), and the lag of earnings before interest and taxes divided by total assets($E_{i,t-1}/A_{i,t-1}$). Panel B shows the average standardized coefficients of speed-of-adjustment across the firms, that is, the coefficients of lagged investment, dividend, and debt financing. The standardized coefficient is calculated by multiplying the unstandardized coefficient by the ratio of the standard deviation of the independent variable (i.e. the lagged terms) to the standard deviation of dependent variable. Numbers in the parentheses are t-statistics.

Table 3

Results of GMM estimation of dynamic panel regression

Independent Variables \ Dependent Variables	ΔInv_{it}	ΔDiv_{it}	$\Delta Debt_{it}$
Panel A: Regression analyses of investment, dividend and debt financing			
Constant	-0.096 (-2.41)	-0.000 (-0.22)	-0.001 (-1.00)
$Inv_{i,t-1}$	-0.431 (-23.62)		
$Div_{i,t-1}$		-0.581 (-45.52)	
$Debt_{i,t-1}$			-0.651 (-18.42)
Q_{it}	0.142 (20.51)		
P_{it}		0.093 (23.15)	
$\ln(A_{i.t-1})$			0.032 (2.60)
$E_{i,t-1}/A_{i,t-1}$			-0.269 (-6.29)
Panel B: Standardized coefficients of lagged investment, dividend and debt financing			
$Inv_{i,t-1}$	-1.793		
$Div_{i,t-1}$		-1.501	
$Debt_{i,t-1}$			-1.862

This table presents the results of Generalized-Method-of-Moments (GMM) of dynamic panel regression of investment, dividend, and debt financing, respectively, by pooling all firm year observations:

$$\Delta Inv_{it} = \alpha_{1i} + \alpha_{2i} Inv_{i,t-1} + \alpha_{3i} Q_{it} + \epsilon_{it} \quad ,$$

$$\Delta Div_{it} = \beta_{1i} + \beta_{2i} \mathrm{Div}_{i,t-1} + \beta_{3i} P_{it} + \eta_{it} \quad ,$$

$$\Delta Debt_{it} = \gamma_{1i} + \gamma_{2i}\, Debt_{i,t\text{-}1} + \gamma_{3i} \ln(A_{i,t-1}) + \gamma_{4i} E_{i,t-1}/A_{i,t-1} + \xi_{it} \quad .$$

The GMM estimations are based on non-missing observations and winsorization at the 1st and 99th percentiles. The three dependent variables are ΔInv_{it}, ΔDiv_{it}, and $\Delta Debt_{it}$, which are the change in net plant and equipment, the change in dividends, and the change in book leverage ratio, respectively. The other variables are the same as in Table 2. Numbers in the parentheses are t-statistics.

Table 4 Results of 2SLS regression.

Independent Variables \ Dependent Variables	ΔInv_{it}	ΔDiv_{it}	$\Delta Debt_{it}$
Panel A: Regression analyses of investment, dividend and debt financing			
Constant	0.449 (4.76)	0.026 (1.60)	0.126 (15.10)
$Inv_{i,t-1}$	-0.346 (-38.10)		
$Div_{i,t-1}$		-0.290 (-34.16)	
$Debt_{i,t-1}$			-0.350 (-42.08)
ΔInv_{it}		0.035 (8.73)	0.016 (5.88)
ΔDiv_{it}	5.715 (9.64)		-0.087 (-7.36)
$\Delta Debt_{it}$	9.890 (10.07)	0.423 (5.43)	
Q_{it}	0.113 (19.15)		
P_{it}		0.049 (20.48)	
$\ln(A_{i.t-1})$			0.009 (6.93)
$E_{i,t-1}/A_{i,t-1}$			-0.117 (-7.68)
Adjusted R-squares	0.52	0.47	0.20
Panel B: Standardized coefficients of lagged investment, dividend and debt financing			
$Inv_{i,t-1}$	-0.591 (-38.88)		
$Div_{i,t-1}$		-0.411 (-40.32)	
$Debt_{i,t-1}$			-0.577 (-40.23)

This table presents the 2SLS regression results of a simultaneous equation system model for investment, dividend, and debt financing:

$$\Delta Inv_{it} = \alpha_{1i} + \alpha_{2i}\Delta Div_{it} + \alpha_{3i}\Delta Debt_{it} + \alpha_{4i} Inv_{i,-1} + \alpha_{5i} Q_{it} + \epsilon_{it} \quad ,$$
$$\Delta Div_{it} = \beta_{1i} + \beta_{2i}\Delta Inv_{it} + \beta_{3i}\Delta Debt_{it} + \beta_{4i} Div_{i,-1} + \beta_{5i} P_{it} + \eta_{it} \quad ,$$
$$\Delta \mathrm{Debt}_{it} = \gamma_{1i} + \gamma_{2i}\Delta Inv_{it} + \gamma_{3i}\Delta \mathrm{Div}_{it} + \gamma_{4i}\mathrm{Debt}_{i,-1} + \gamma_{5i}\ln(A_{i,t-1}) + \gamma_{6i} E_{i,t-1}/A_{i,t-1} + \xi_{it} \quad .$$

Panel A shows the coefficients in averages across the 1,107 firms. Regressions are based on non-missing observations and winsorization at the 1st and 99th percentiles. The three endogenous variables are ΔInv_{it}, $\Delta \mathrm{D}iv_{it}$, and $\Delta \mathrm{D}ebt_{it}$, which are the change in net plant and equipment, the change in dividends, and the change in book leverage ratio, respectively. The other variables are the same as in Table 2. Panel B shows the average standardized coefficients of speed-of-adjustment across the firms, that is, the coefficients of lagged investment, dividend, and debt financing. The standardized coefficient is calculated by multiplying the unstandardized coefficient by the ratio of the standard deviation of the independent variable (i.e. the lagged terms) to the standard deviation of dependent variable. Numbers in the parentheses are t-statistics.

Table 5

Speeds of adjustment sorted by market concentration.

HHI	N	$Inv_{i,t-1}$	$Div_{i,t-1}$	$Debt_{i,t-1}$
$0 \leq$ HHI < 0.02	216	-0.479 (-32.75)	-0.380 (-23.70)	-0.357 (-23.11)
$0.02 \leq$ HHI < 0.028	236	-0.433 (-26.32)	-0.400 (-23.11)	-0.340 (-20.55)
$0.028 \leq$ HHI < 0.04	212	-0.482 (-29.88)	-0.389 (-25.13)	-0.345 (-21.83)
$0.04 \leq$ HHI < 0.055	210	-0.473 (-30.50)	-0.426 (-25.56)	-0.368 (-24.80)
$0.055 \leq$ HHI	233	-0.474 (-31.64)	-0.414 (-26.25)	-0.401 (-23.97)
ANOVA ProbF		0.142	0.286	0.045

This table presents the coefficients of speed-of-adjustment, that is, the coefficients of lagged investment, dividend, and debt financing in the three OLS regression models, sorted by Herfindahl–Hirschman Index (HHI). HHI= $\sum_{i=1}^{N} S_i^2$, where Si is the market share of firm in the belonging Fama and French 48 industry. Market share (Si) is calculated as sales of firm i divided by the sum of total sales in the industry. Numbers in the parentheses are t-statistics. HHI is the sum of squared market shares in Fama-French 48 industries constructed from 4-digit Standard Industrial Classification (SIC) industry groupings.

Table 6

Speeds of adjustment sorted by capital-labor ratio.

Capital-labor Intensity	N	$Inv_{i,t-1}$	$Div_{i,t-1}$	$Debt_{i,t-1}$
$0 \leq K/L < 13$	212	-0.483 (-30.45)	-0.427 (-23.83)	-0.426 (-25.29)
$13 \leq K/L < 22$	230	-0.500 (-36.71)	-0.377 (-24.93)	-0.357 (-20.95)
$22 \leq K/L < 35$	221	-0.498 (-30.51)	-0.396 (-23.63)	-0.351 (-21.70)
$35 \leq K/L < 80$	207	-0.460 (-28.10)	-0.395 (-23.52)	-0.338 (-22.50)
$80 \leq K/L$	212	-0.402 (-25.54)	-0.405 (-25.35)	-0.339 (-22.68)
ANOVA ProbF		<.0001	0.308	0.0005

This table presents the coefficients of speed-of-adjustment, that is, the coefficients of lagged investment, dividend, and debt financing in the three OLS regression models, sorted by capital-labor ratio (K/L). K/L = net plant and equipment / Number of employees. *N* is the number of firm-year observations. Numbers in the parentheses are t-statistics.

Table 7

Speeds of adjustment sorted by firm size.

Size	N	$Inv_{i,t-1}$	$Div_{i,t-1}$	$Debt_{i,t-1}$
$0 \leq lnA < 4.5$	240	-0.444 (-28.32)	-0.392 (-22.84)	-0.387 (-25.54)
$4.5 \leq lnA < 6$	235	-0.478 (-31.69)	-0.406 (-25.46)	-0.376 (-23.29)
$6 \leq lnA < 7$	231	-0.488 (-31.45)	-0.417 (-26.22)	-0.391 (-23.58)
$7 \leq lnA < 8$	182	-0.490 (-29.85)	-0.383 (-22.15)	-0.339 (-18.21)
$8 \leq lnA$	219	-0.442 (-29.30)	-0.407 (-27.04)	-0.310 (-23.70)
ANOVA ProbF		0.058	0.6235	<.0001

This table presents the coefficients of speed-of-adjustment, that is, the coefficients of lagged investment, dividend, and debt financing in the three OLS regression models, sorted by firm size. The proxy for firm size is the natural logarithm of total assets (lnA). N is the number of firm-year observations. Numbers in the parentheses are t-statistics.

Appendix Table A1

OLS Results of different sample selection criteria.

Independent Variables \ Dependent Variables	ΔInv_{it}	ΔDiv_{it}	$\Delta Debt_{it}$	ΔInv_{it}	ΔDiv_{it}	$\Delta Debt_{it}$
year		≧7			≧15	
N		3,009			1,633	
Panel A: Regression analyses of investment, dividend and debt financing						
Constant	0.864	0.086	0.150	0.616	0.065	0.145
	(8.64)	(13.56)	(9.71)	(6.47)	(10.95)	(13.31)
$Inv_{i,t-1}$	-0.521			-0.478		
	(-79.67)			(-78.61)		
$Div_{i,t-1}$		-0.503			-0.433	
		(-59.06)			(-58.16)	
$Debt_{i,t-1}$			-0.554			-0.428
			(-55.70)			(-56.79)
Q_{it}	0.185			0.164		
	(28.83)			(31.57)		
P_{it}		0.077			0.075	
		(31.82)			(36.73)	
$\ln(A_{i,t-1})$			0.023			0.013
			(8.74)			(8.23)
$E_{i,t-1}/A_{i,t-1}$			-0.103			-0.116
			(-5.42)			(-9.45)
Adjusted R-squares	0.46	0.43	0.25	0.46	0.38	0.19
Panel B: Standardized coefficients of lagged investment, dividend and debt financing						
$Inv_{i,t-1}$	-0.788			-0.798		
	(-79.70)			(-72.35)		
$Div_{i,t-1}$		-0.640			-0.610	
		(-92.91)			(-71.43)	
$Debt_{i,t-1}$			-0.722			-0.646
			(-61.07)			(-55.41)

This table presents the OLS regression results of investment, dividend, and debt financing, respectively, for different sample selection criteria. We presents results for firms that survive for at least 7 years and 15 years. Numbers in the parentheses are t-statistics.

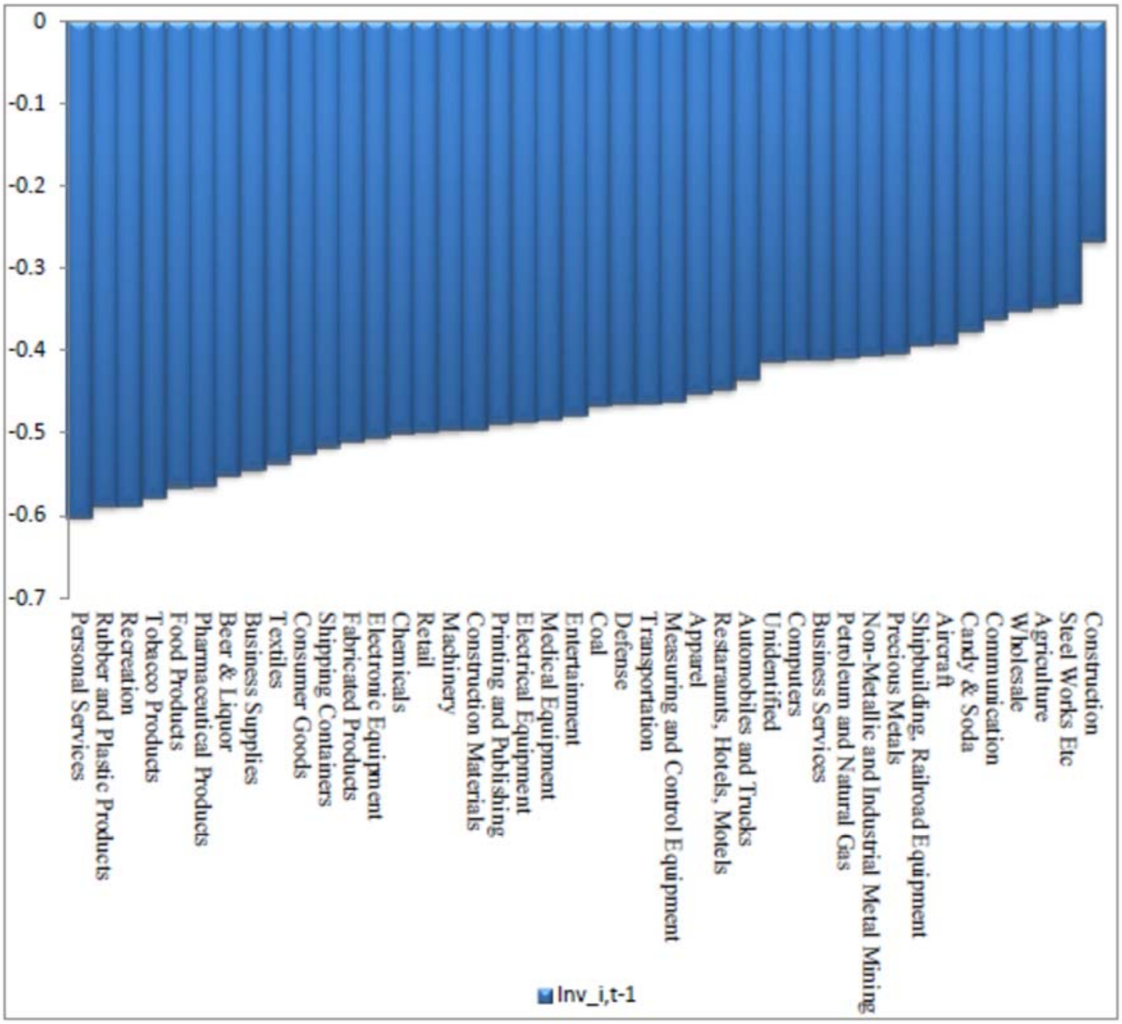

Fig. 1. Coefficients of speed of adjustment of investment—grouped by Fama-French 48 industry classifications.

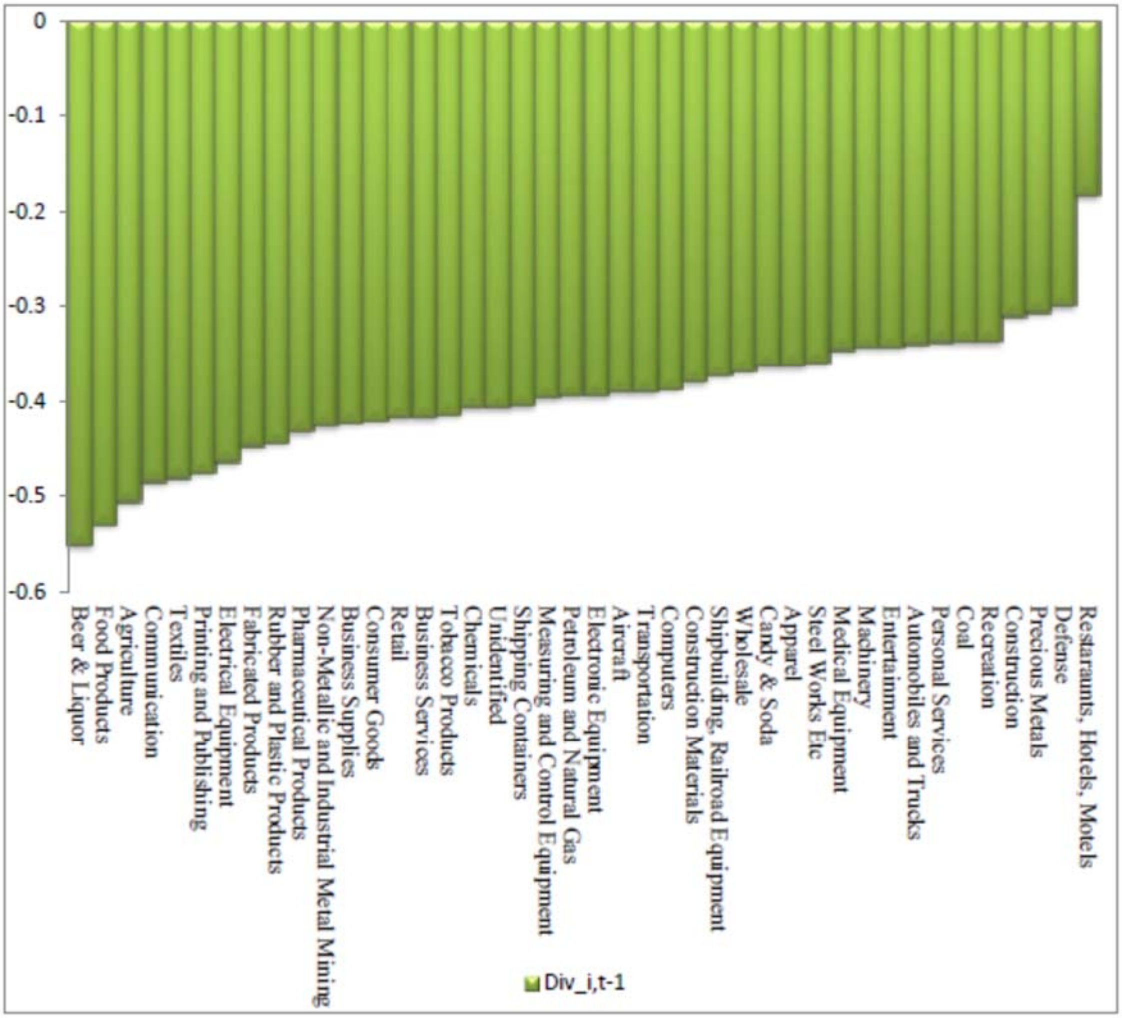

Fig. 2. Coefficients of speed of adjustment of dividend—grouped by Fama-French 48 industry classifications.

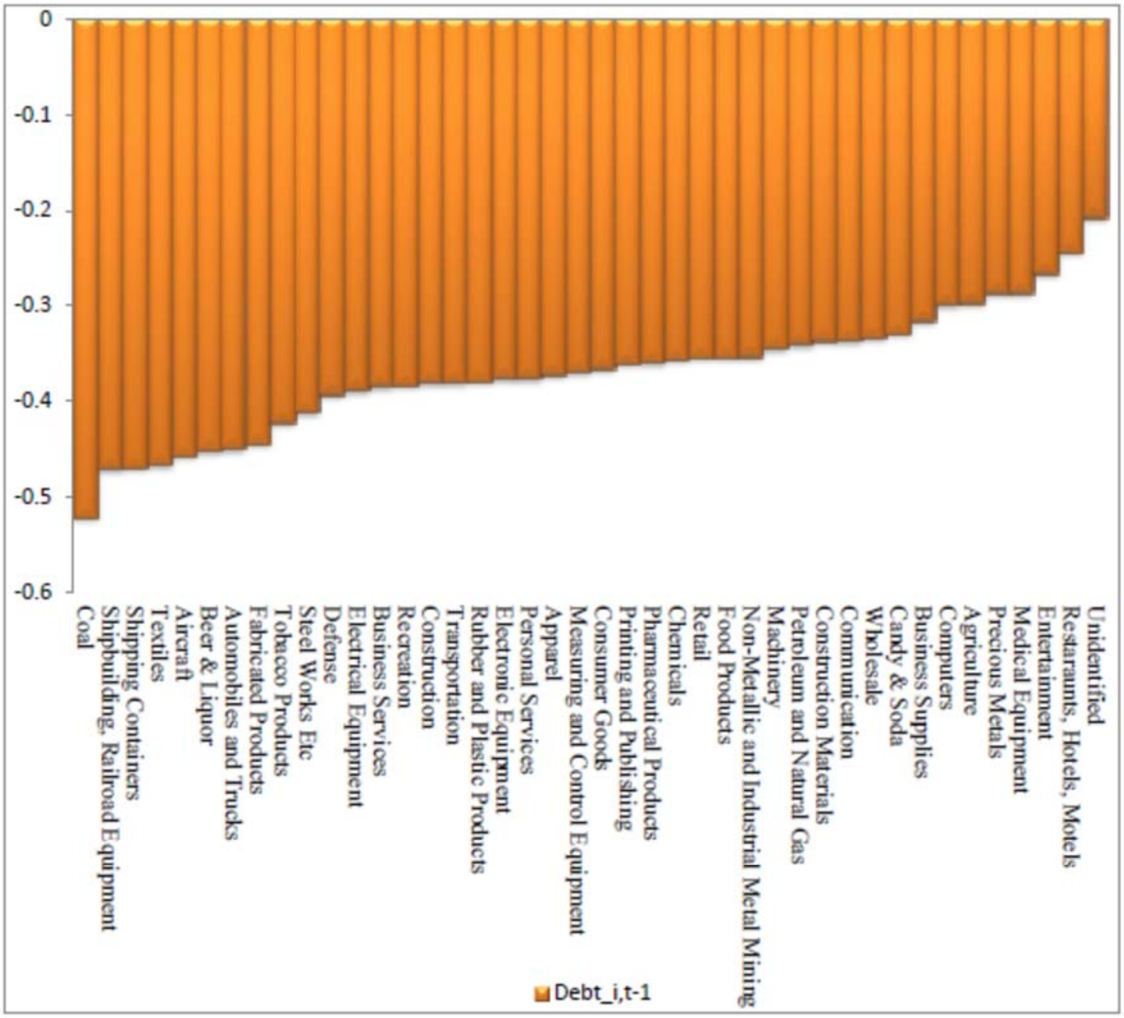

Fig. 3. Coefficients of speed of adjustment of debt financing—grouped by Fama-French 48 industry classifications.

Revisiting the Diversification Discount

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In this study, we reconfirm the pervasively documented diversification discount in the 2000-2013 sampling period. First, we decompose firms according to their diversification status and subsequent changes in diversification, and then explore the determinants and consequences of the changes in firm diversification. We find a unilateral relationship between diversification and firm value: an increase (decrease) in firm diversification is followed by a decrease (an increase) in firm value, but not the reverse. The factors that dictate changes in a firm's diversification are profitability and capital expenditure. On average, diversified firms are associated with 12.2% lower excess value than their focused counterparts. Moreover, firms that increase their degree of diversification are associated with 10.3% lower excess value than their unchanged counterparts. Finally, we find that a low coinsurance effect and managerial entrenchment are the two main factors that explain the diversification discount.

Keywords: diversification discount, coinsurance, entrenchment

1. Introduction

Firm diversification has been widely studied both theoretically and empirically for more than three decades. The main issue of debate is whether diversification increases or decreases firm value. Proponents of the former argument mainly refer to the potential benefits, such as greater operating efficiency, less incentive to forsake positive net-present-value projects, greater debt capacity, and lower taxes (e.g., Fluck and Lynch, 1999; Bradley et al., 1998; Kaplan and Weisbach, 1992; Porter, 1987; Ravenscraft, 1987, among others). Arguments supporting the latter indicate that diversification gives managers discretionary resources to undertake value-decreasing investments, and to cross-subsidize poor segments that drain resources from better-performing segments and create potential conflicts of interest between central and divisional managers(e.g., Comment and Jarrell, 1995; Liebeskind and Opler, 1995; Lang and Stulz, 1994; Servaes, 1996; Berger and Ofek, 1995; Denis et al., 2002).Recent studies seem to partially alleviate the negativity of diversification and propose that it may be beneficial, or at least not value destroying (Villalonga, 2004; Whited, 2001; Campa and Kedia, 2002; Mansi and Reeb, 2002). These studies attribute the diversification discount to the acquisition of poorly performing units (Graham et al., 2002) or to miscalculations of Tobin's Q (Whited, 2001).Nevertheless, Santalo and Becerra (2008) indicate that the effect of diversification on performance is not homogeneous across industries: diversified firms perform better in industries with a small number of non-diversified competitors or when specialized firms have a small combined market share, but worse when specialized firms increase in number and compete strongly.

The first part of this study revisits the controversial issue of whether diversification is value incremental or detrimental. Using data on U.S. listed firms in the 2000-2013 period, we find that diversification is indeed value detrimental, regardless of whether firm value is measured by Tobin's Q or the excess value proposed by Berger and Ofek (1995). Because diversification and firm value may be endogenously determined, we identify firms' diversification status and inter-temporal changes in diversification status, and then explore the determinants and consequences of these changes. The decomposition in firms' diversification status and changes in diversification may partially ameliorate the endogeneity issue associated with diversification and firm value. For example, if diversification and firm value are reciprocally affected, we would expect to find that a firm's value affects its subsequent diversification (change) status, which will in turn affect the firm's value in the next period.

Using logistic regression, we find that assets, profitability, capital expenditure, and leverage are the possible determinants of firms' changes in diversification status. However, the effects on diversified and focused firms are somewhat different. After showing a decrease in profitability, diversified firms tend to refocus their domain of businesses in the following period. They also tend to choose a refocused strategy after an increase in financial leverage. Focused firms are prone to increase the degree of diversification after experiencing an increase in profitability and are more likely to focus their domain of business after an increase in capital expenditure. We note that firm value is not in the array of possible determinants. We further investigate the effect of a change in diversification on a firm's follow-on value. The result indicates that an increase (decrease) in diversification is followed by a decrease (increase) in value. In a nutshell, our empirical results indicate that a change in a firm's diversification affects its value. However, a change in value does not affect a firm's change in diversification. The relationship between diversification and firm value is robust to alternative methods of identifying firms' diversification status and measures of firm value.

After identifying the detrimental effect associated with diversification, we further explore the possible factors influencing the diversification discount. The first factor is relative value added, proposed by Rajan, Servaes, and Zingales (2000), who indicate that the efficiency of redeploying assets or resources within a conglomerate could affect the value of diversification. Specifically, they argue that funds that are transferred among divisions with similar levels of resources and opportunities are efficient, while those that are transferred among divisions with diversified resources and opportunities are inefficient. The relative value added measure is used to gauge investment efficiency within diversified firms compared with that of single-segment firms. Unfortunately, we fail to find supporting evidence that the relative efficiency of redeploying assets affects the diversification discount.

The second factor of interest is the coinsurance effect proposed by Lewllen (1971) and Hann, Ogneva, andOzbas (2013). If coinsurance reduces default risk (Lewellen, 1971) and enables a diversified firm to avoid the countercyclical deadweight costs of financial distress (Elton, Gruber, Agrawal, and Mann, 2001; Almeida and Philippon, 2007), then coinsurance should lead to a reduction in a diversified firm's systematic risk and hence the cost of capital. Hann et al. (2013) use the correlation of cash flows among segments within a diversified firm as the surrogate of the coinsurance effect and find that diversified firms on average have a lower cost of capital than comparable portfolios of standalone firms. Moreover, diversified firms with less correlated segment cash flows have a lower cost of capital. Our empirical result indicates that the correlation between cash flows within a diversified firm is negatively correlated with its value. This supports the coinsurance effect, indicating that one reason diversified firms are associated with value detriment is that their lines of business are too homogeneous to reduce risks that could be mutually offset.

The third factor of interest is managerial entrenchment. Jiraporn, Kim, Davidson, and Singh (2006) illustrate that firms in which shareholder rights are more suppressed by restrictive corporate governance suffer a deeper diversification discount. Specifically, one additional governance provision results in a 1.1–1.4% decline in firm value. Hoechle, Schmid, Walter, and Yermack (2012) find that the diversification discount narrows by 16 to 21% when they add governance variables as regression controls. Bebchuk et al. (2004) construct an "Entrenchment Index" to measure managerial entrenchment based on 6 of the 24 governance provisions in Gompers et al. (2003). The six provisions included in the Entrenchment Index are staggered boards, limits to shareholder bylaw amendments, supermajority requirements for mergers, supermajority requirements for charter amendments, poison pills, and golden parachutes. They contend that this index can better explain firm value and stock returns than the 24-provision governance index. We also calculate the entrenchment index and find that it is negatively correlated with the value of diversified firms.

A synopsis of our findings is that we find a unilateral negative effect of diversification on firm value, which is mainly due to a low coinsurance effect and managerial entrenchment.

This paper makes two potential contributions. First, we decompose firms' diversification status. With this base, we trace the determinants and consequences of firms' changes in diversification. The decomposition at least partially ameliorates the endogeneity concern between firm value and diversification because we find no reciprocal or inter-temporal relationship. Second, we identify low coinsurance and high managerial entrenchment as the main causes of the diversification discount.

The remainder of this paper is organized as follows. Section 2 reviews the related literature. Section 3 depicts the sample and variable. Section 4 reports the empirical findings and Section 5 concludes.

2. Literature Review and Hypotheses Development

2.1. *Diversification and Firm Value*

Studies indicate that diversified firms tend to underperform and have lower values than their focused counterparts (Berger and Ofek, 1995; Lang and Stulz, 1994; Servaes, 1996). Hoechle et al. (2012) find that the diversification discount persists even when controlling for endogeneity. The negative effect of diversification on firm value seems to be robust in studies using different periods and countries[1]. An intuitive explanation is that diversification itself destroys value.

However, not all theories predict that diversification is detrimental to firm value. The benefits associated with diversification include tax benefits and a reduction in the probability of financial distress (Lewellen, 1971), and in information asymmetry (Hadlock et al., 1999). Another advantage of diversification, which is supported by empirical studies using samples from the 1960s (e.g., Hubbard and Palia, 1999; Fulghieri and Hodrick, 1997; Stein, 1997; Wulf, 2000), is related to the efficiency of the internal capital market.

We propose a possible resolution for these seemingly contradictory arguments. The crux probably lies in the tradeoff between the agency problem and the comparative efficiency of the internal capital market. Diversification is negatively associated with firm value when the agency problem outweighs the comparative efficiency of the internal capital market, and vice versa. It could also be that the comparative efficiency of the internal capital market has dwindled with the passage of time because external capital markets have become much more developed in the past decade. Therefore, cases of diversification that took place at a later point in time are more likely to have been value-destroying than value-enhancing. Given that most of the cases of diversification we investigate took place after the 1990s, the first hypothesis is proposed as follows.

Hypothesis 1: Diversification is negatively correlated with firm value.

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[1] Servaes (1996) finds a discount for conglomerates during the 1960s. Lins and Servaes (1999) document a significant discount in Japan and the UK, although none exists for Germany. However, the evidence from emerging economies is mixed: Lins and Servaes (1998) report a diversification discount in a sample of firms from seven emerging markets, while Khanna and Palepu (1999), Fauver, Houston and Naranjo (1998) find little evidence of a diversification discount in emerging markets.

However, firm value and diversification could either be endogenously related or simultaneously affected by firm characteristics. For example, Campa and Kedia (2002) indicate that firm characteristics that cause firms to diversify also cause them to be discounted. Himmelberg, Hubbard, and Palia (1998), Agrawal and Knoeber (1996), and Holthausen and Larcker (1993) control for the endogeneity of managerial ownership in evaluating the relationship between managerial ownership and performance. These papers follow the insight of Demsetz and Lehn (1985) by presenting models indicating that managerial ownership, as optimally determined by firms, is structured in such a way as to maximize firm value when the firm's contracting environment is heterogeneous. Campa and Kedia (2002) and Villalonga (2004) alternatively use instrumental variables, Heckman's two stage approach, and propensity scoring matching to control the endogeneity issue. They conclude that diversification is not detrimental to value; rather, it is associated with a positive spillover effect. In contrast, Lamont and Polk (2002) find that diversification remains detrimental after controlling for the endogeneity issue. Santalo et al. (2008) question the legitimacy of using instrumental variables by indicating that some of the instruments are questionable if industry heterogeneity is taken into account.

In this study, we characterize firms' diversification status into focused and diversified firms, and further categorize changes in status into refocused, no change, and more diversified. This decomposition allows us to mitigate the endogeneity issue. For example, if firm value and diversification are simultaneously determined by certain firm characteristics, the decomposition should be able to isolate the effects of firm characteristics when they are included in the empirical models. Moreover, if firm value and diversification are reciprocally affected, we would expect them to be inter-temporally related. However, our empirical findings do not support this argument. Finally, we relate changes in diversification to changes in firm value. The endogeneity issue is less severe for variables that are differentially treated.

2.2. *Factors Affecting the Value of Diversified Firms*

Previous studies (Lamont, 1997; Shin and Stulz, 1998) show that resource allocation in diversified firms differs from that in focused firms. Therefore, there seems to be a connection between resources allocation and the value of diversified firms. Berger and Ofek (1995) find that the investment in segments with a low Q is the main cause of the diversification discount. Other studies also indicate that the misallocation of resources results, on average, in diversified firms trading at a discount relative to a portfolio of single-segment firms in the same industries (Lang and Stulz, 1994; Berger and Ofek, 1995; Servaes, 1996; Lins and Servaes, 1999).

The allocation among segments of a diversified firm involves at least three theories. The first is the efficient internal capital market, which suggests that diversified firms form an internal capital market in which internally generated cash flows can be pooled and allocated to their best use (e.g., Matsusaka and Nanda, 1997; Stein, 1997; Weston, 1970; Williamson, 1975). The second is the agency cost model, which indicates that top management in diversified firms has greater opportunities to undertake negative net present value (NPV) projects (Stulz, 1990; Matsusaka and Nanda, 1997). Therefore, the decision to diversify could be viewed as an attempt by the CEO to entrench herself (Shleiferand Vishny, 1989). The third is the influence of cost models. As indicated by Meyer, Milgrom, and Roberts (1992), managers of bleak-future divisions have an incentive to influence the top management of the firm to channel resources in their direction.

Rajan, Servaes, and Zingales (2000) model the distortions that arise from internal power struggles and predict that funds are allocated efficiently if divisions have similar resources and opportunities, and are inefficiently allocated if divisions have varied resources and opportunities. We follow the relative value added measure proposed by Rajan et al. (2000), and postulate that it is positively correlated with the value of diversified firms.

Hypothesis 2: Diversified firms with better asset-redeployment efficiency, as manifested in a higher relative value added, are associated with a smaller diversification discount.

Hann, Ogneva, and Ozbas (2013) indicate that the imperfect correlation of cash flows among a firm's business units creates a coinsurance effect that can reduce systematic risk through the avoidance of countercyclical deadweight costs. The deadweight costs faced by firms include costly financial distress, adverse selection and transaction costs of external financing that result in investment distortions, forgone business opportunities due to defections by important stakeholders such as suppliers, customers, or employees, and so on. As these deadweight costs may be mitigated by the coinsurance effect, diversified firms with a high coinsurance effect have a lower default risk (Lewellen, 1971) that would otherwise have been incurred by standalone firms. The reduction in systematic risk gives diversified firms a lower cost of capital.

Hypothesis 3: Diversified firms with a higher coinsurance effect, as manifested in low correlations of cash flows among business units, are associated with a smaller diversification discount.

Managers who have access to free cash rights tend to spend it unwisely to reduce shareholder value (Jensen, 1986). One possible way for managers to waste free cash flow is to expand the firm through acquisitions in unrelated business segments that may not supply adequate returns to shareholders. However, this detrimental diversification can be constrained if shareholder rights are strong. Hoechleet al.(2012) suggest that better corporate governance is associated with less value destruction (or more value creation) when diversifying mergers occur. In this paper, we follow Gompers et al. (2003) and Bebchuck et al. (2009)in using the number of antitakeover provisions as the measure of shareholder rights. The Entrenchment Index, according to Bebchuck et al. (2009), measures how many of the six antitakeover provisions are implemented. The more antitakeover provisions, the higher the index, and the weaker the shareholder rights. Our fourth hypothesis is formulated as follows.

Hypothesis 4: Diversified firms with weaker shareholder rights, as manifested in a high Entrenchment Index, are associated with a larger diversification discount.

3. Sample and Variables

3.1. *Sample*

Our sample of U.S. listed firms in the 2000-2013 period was collected from the Compustat database. Following Berger and Ofek (1995), the following criteria were imposed on the sample selection: (1) all firms with at least one segment in the financial industry(SIC codes between 6000 and 6999) were excluded from the sample; (2) all firm-years with sales lower than $20 million were excluded to avoid distortion in valuation multiples; (3) the sum of segment sales had to be within 1% of the firm's total sales to ensure the integrity of the segment data; and (4) all of the firm segments with missing data for assets, sales, and equity value were excluded. The final sample of 32,643 firm-year observations is summarized in Table 1. The distribution shows that focused firms (23,944 firm-year observations) outnumber diversified firms (8,699 firm-year observations). The proportion of focused firms is in the range of 69-75%, and that of diversified firms is in the range of 25-31%.

3.2. *Valuation*

We use two methods to gauge firm value: Tobin's Q (Lang and Stulz, 1994) and excess value (Berger and Ofek, 1995). The measurement of Tobin's Q, referring to Chung and Pruitt (1994), is defined as

$$\text{Tobin's Q} = \frac{(MV(CS)+BV(PS)+BV(LTD)+BV(INV)+BV(CL)-BV(CA)}{BV(TA)}, \tag{1}$$

where MV(X) and BV(X) indicate the market and book values of the argument X, respectively. CS is common stock, PS is preferred stock, LTD is long-term debt, INV is inventory, CL is capital leases, CA is current assets, and TA is total assets.

The sales-based (assets-based) excess value is defined as

$$\text{Excess Value} = \ln\left(\frac{V}{I(V)}\right), \tag{2}$$

where V is a firm's value, I(V), is the intrinsic value calculated as

$$\mathrm{I(V)} = \sum_{i=1}^{n} Asset_i\ (or\ Sales_i) \times \left(\frac{Total\ Capital}{Asset\ (or\ Sales)}\right)_k, \tag{3}$$

where $(\text{Total capital/Assets (or Sales)})_k$ is the multiple of total capital to assets (or sales) for the median single-segment firm in segment i's industry.

3.3. *Diversification*

We use three variables to measure the degree of firm diversification. The first, referring to Berger and Ofek (1995), is a dichotomous variable that is assigned a value of 1 (diversified firms) for firms with multiple segments and 0 (focused firms) otherwise. The second is the number of segments. The third is the Herfindahl index (Comment and Jarrell, 1995; Berger and Ofek, 1995; Denis et al., 2002), valued with respect to sales or revenues (sales-based Herfindahl index and revenue-based Herfindahl index). The sale-based Herfindahl index is calculated as follows:

$$\text{Sales} - \text{based Herfindahl index} = \sum_{i=1}^{n}(Sales_i/\sum_{i=1}^{n} Sales_i)^2 \text{ ,} \tag{4}$$

where $Sales_i$ denotes the sales in segment i. The index values range between 0 and 1, and higher values indicate greater focus.

3.4. *Factors Affecting the Valuation of Diversification*

We include three possible factors affecting the valuation of diversification: the relative value added within internal assets deployment, the coinsurance effect, and corporate governance.

3.4.1. *Relative Value Added*

Rajan, Servaes, and Zingales (2000) propose a model that indicates that funds transferred among divisions with similar levels of resources and opportunities are efficient, while funds transferred among divisions with diversified resources and opportunities are inefficient. Relative value added (RVA), with reference to Rajan, Servaesm, and Zingales (2000), is calculated as follows:

$$\text{RVA} = \frac{1}{BA}\sum_{j=1}^{n} BA_j\left(q_j - \bar{q}\right)\left[\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{s}} - \sum_{j=1}^{n} w_j\left(\frac{I_j}{BA_j} - \frac{I_j^{ss}}{BA_j^{s}}\right)\right] \text{ ,} \tag{5}$$

where n denotes the number of segments;I_j/BA_j is the capital expenditure of segment jin proportion to the book value of assets of segment j; (I_j^{ss}/BA_j^{ss}) is the asset-weighted average capital expenditure to assets ratio for the single-segment firms in the corresponding industry;w_j is the ratio of segment assets to firm assets;q_j is the end-of-year, assets-weighted average Tobin's q of single-segment firms that operate in the three-digit industry of segment j; and $\bar{q}$ is the firm's asset-weighted average of q segments.

3.4.2. *Coinsurance Effect*

Past studies indicate that coinsurance reduces the default risk (Lewellen, 1971) and enables a diversified firm to avoid the countercyclical deadweight costs of financial distress (Elton, Gruber, Agrawal, and Mann, 2001; Almeida and Philippon, 2007). Hann, Ogneva, and Ozbas(2013) find that diversified firms have on average a lower cost of capital than comparable portfolios of standalone firms. In addition, diversified firms with less correlated segment cash flows have a lower cost of capital, which is consistent with a coinsurance effect. Following Hann et al. (2013), the coinsurance effect is defined by the correlation among cash flows, an inverse measure of coinsurance.

$$\text{Correlation among cash flows} = \sum_{p=1}^{n}\sum_{q=1}^{n} w_{ip(j)}\, w_{iq(k)}\, Corr_{[t-10,t-1]}\,(j,k) \text{ ,} \tag{6}$$

where $w_{ip(j)}$is the sales share of segment p of firm i operating in industry j (similarly for business segment q of firm i operating in industry k), and $Corr_{[t-10,t-1]}\ (j,k)$is the estimated correlation of idiosyncratic industry cash flows or investments between industries j and k over the 10-year period before year t.

3.4.3. *Entrenchment Index*

The Entrenchment Index proposed by Bebchuck et al. (2009) measures the number of anti-takeover provisions implemented by a firm. The six provisions are staggered board, limits to shareholder bylaw amendments, poison pills, golden parachutes, supermajority requirements for mergers, and charter amendments. The higher the index, in the range between 0 and 6, the poorer the firm's governance.

3.5. *Summary Statistics*

Table 2 reports the summary statistics and tests of differences between diversified and focused firms. The classification of diversified versus focused firms is based on lines of business. The result in Panel A indicates that diversified firms are associated with lower valuation measures than their focused counterparts, regardless of whether the valuation is measured by Tobin's Q, sales-based, or asset-based excess value. This reconfirms the findings of other studies on the diversification discount (e.g., Comment and Jarrell, 1995; Liebeskind and Opler, 1995; Lang and Stulz, 1994; Servaes, 1996; Berger and Ofek, 1995; Denis et al., 2002).

In Panel B, we contrast the variables measuring firm characteristics. Diversified firms have larger assets and a lower leverage than focused firms. This could easily be understood as implying that diversified firms covering a wide range of businesses are associated with larger assets, and that diversification allows firms to offset partial nonsystematic risks and therefore have a higher leverage in their capital structure. However, we find that diversified firms are associated with a higher profitability (as manifested in EBIT/sales and ROA) and a lower capital expenditure than focused firms. This probably illustrates the positive side of diversification: diversified firms are cautious in making investments and have better performance measures. In Panel C, the Herfindahl–Hirschman Index of diversified firms (mean of 0.644 and median of 0.618) is significantly lower than that of focused firms (mean and median of 1).

In Panel D we calculate the relative value added, the coinsurance effect, and the entrenchment index, which past studies identify as possible factors affecting the valuation of diversification. The relative value added is used to gauge the investment effectiveness among segments of diversified firms compared with signal segment firms. The mean RVA of diversified firms is 0.205, which is significantly higher than that of focused firms. However, the difference is due to some outliers that result in a right-skewed mean. The median value of diversified firms is insignificantly different from that of focused firms. The second measure is the coinsurance effect gauged by the correlation among cash flows. The result indicates that the mean correlation among cash flows is lower for diversified firms (0.572) than focused firms (1), implying that diversified firms benefit from the coinsurance effect among cash flows, such that diversified firms may have lower odds of encountering financial distress. In contrast, we find that, on average, diversified firms have a higher entrenchment index (2.738) than focused firms (2.508), implying that diversified firms are associated with poor corporate governance.

<<Insert Table 2 Here>>

3.6. *Change in Diversification and Firm Value*

The purpose of this study is to investigate the effect of diversification on firm value. However, the two issues are possibly endogenously determined. To partially tackle this issue, we explore inter-temporal changes in diversification and examine how past performance affects inter-temporal changes in diversification, and how such changes affect future value. In Table 3, we tabulate the possible changes in diversification across two consecutive periods. The diversified firms identified in t-1 can become refocused when the number of segments decreases in t ($SN_t - SN_{t-1} < 0$), unchanged when the number of segments remains the same ($SN_t - SN_{t-1} = 0$), and more diversified when the number of segments increases ($SN_t - SN_{t-1} > 0$). The status of focused firms can only change to unchanged ($SN_t - SN_{t-1} < 0$) or diversified ($SN_t - SN_{t-1} > 0$). The third row indicates the possible changes in diversification status for all firms.

<<Insert Table 3 Here>>

We explore the value and change in value for the possible types of diversification changes identified in Table 3. The values of interest include Tobin's Q and excess value in t-1 (Tobin's Q_{t-1}, EV_{t-1}), the averages of these values through t+1 and t+3 (Tobin's Q_{after}, EV_{after}), and the changes in them before and after a change in diversification (ΔTobin's Q and ΔEV). Specifically, the change in Tobin's Q (excess value) is calculated as the average of Tobin's Q (excess value) through t+1 and t+3 minus Tobin's Q (excess value) in t-1.

Panel A reveals the possible changes for diversified firms in t-1. Among these firms, those that choose to refocus are on average associated with an increase of 0.06 in Tobin's Q and an increase of 0.045 in excess value (ΔTobin's Q and ΔEV). The numbers are significantly higher than the corresponding measures of -0.228 and -0.167 for firms that choose to become more diversified. Moreover, firms choosing to refocus are on average associated with an increase of 0.089 in Tobin's Q and 0.047 in excess value. The numbers are significantly higher than the corresponding measures of -0.049 and -0.041 for firms with an unchanged diversification status. Furthermore, comparing more diversified and unchanged firms, we find that firms with a higher Tobin's Q (2.182) or excess value (-0.054) at t-1 tend to increase their level of diversification (Tobin's Q_{t-1}, EV_{t-1}).

In Panel B we investigate focused firms at t-1. The result indicates that firms that choose to increase their diversification are associated with a lower post-change mean Tobin's Q (Tobin's $Q_{after,}$ 2.151) than that of their unchanged counterparts (2.383). A summary of the findings so far illustrates an interesting pattern: that increasing (decreasing) diversification is value detrimental (enhancing), and that firms with good performance measures are more likely to increase their level of diversification.

<<Insert Table 4 Here>>

4. Empirical Results

4.1. *Effect of Diversification on Firm Value*

In Table 5, we conduct a regression analysis of firm value (alternatively gauged by Tobin's Q, sales-based, and assets-based excess value) on diversification. Diversification is also alternatively gauged by a diversification dummy in model 1 and the number of segments in model 2. We also include HHI to capture the clustering effect of industry, size, profitability, and leverage in the current and previous periods. The control variables are included with reference to Berger and Ofek (1995) and Campa and Kedia (2002).

The result indicates that diversification is negatively correlated with firm performance, measured either by Tobin's Q, sales-based, or assets-based excess value. Moreover, we find that HHI is positively correlated with sales-based and assets-based excess value, implying that the adoption of a focused strategy is value enhancing.

<<Insert Table 5 Here>>

4.2. *Determinants of Change in Diversification*

Although diversification has been proven to be value detrimental, the endogeneity issue between performance and diversification has not been successfully addressed. In this section, we explore the possible determinants that cause firms to change their diversification status. Table 6 presents the results of logistic regressions exploring the determinants of changes in diversification, given that a firm's diversification status has been identified. The possible classifications of firm diversification in t-1 and change in diversification in t are presented in Table 3. The result indicates that for firms classified as diversified in t-1, the EBIT to sales ratio is positively correlated with the odds of a firm's diversification status remaining unchanged. For focused firms, the EBIT to sales ratio is positively correlated with the odds of a firm choosing to become more diversified. This is consistent with the previous finding that high-performing firms are more likely to increase their level of diversification. Moreover, we find that for focused firms, the capital expenditure in proportion to total sales is negatively correlated with the odds of increasing diversification. This implies that focused firms that increase their capital expenditure prefer to spend the money on their focused segments rather than on alternative lines of business. Furthermore, for diversified firms we find that leverage is negatively correlated with the odds of enhancing diversification, meaning that highly leveraged and diversified firms try to reduce their level of diversification to mitigate risks.

<<Insert Table 6 Here>>

4.3. *Change in Diversification and Future Firm Value*

Table 6 indicates that firm value in t-1 does not affect a firm's change in diversification, whereas profitability and capital expenditure do. In Table 7, we further explore the effect of a change in diversification on future firm value. The most critical independent variable is the change dummy, which reflects a firm's diversification status in t-1 and its change in diversification status in t. For example, the change dummy of -0.48 in the first column indicates that firms that are identified as diversified in t-1 and that increase their diversification in t are associated with a reduction of 0.48 in Tobin's Q. The reduction is gauged by the difference between the average Tobin's Q from t+1 to t+3 and Tobin's Q in t-1. The increase in diversification for diversified firms is also associated with a reduction of 0.232 in excess value (column 2). The negative sign of the change dummy indicates that an increase in diversification status is detrimental to firm value. Moreover, we find that the drop in firm value is more significant when firm value is measured by excess value than by Tobin's Q. Specifically, the change dummy is significant across three models when firm value is gauged by excess value (model 2, 4, and 6), but in only one model when gauged by Tobin's Q (model 1).

<<Insert Table 7 Here>>

4.4. *Factors Affecting the Value of Diversified Firms*

The results so far suggest that firm value does not affect firm diversification, while increasing diversification negatively affects firm value. In this section, we explore the possible factors that result in the diversification discount. These factors include the relative value added (RAV), the coinsurance effect measured by the correlation of cash flows among segments within a diversified firm, and corporate governance measured by the entrenchment index. The results reported in Table 8 include these three factors in the regression on the value of diversified firms. The correlation of cash flows among segments within a diversified firm is negatively correlated with the value of diversified firms when the value is measured either by Tobin's Q or excess value. The higher the correlation of cash flows among segments within a diversified firm, the lower the coinsurance effect. Therefore, one possible explanation of the diversification discount is that diversified firms superficially cover a wide range of segments that indeed have highly correlated cash flows. Moreover, we find that the entrenchment index is negatively correlated with Tobin's Q, significant at the 1% level. This is another factor that results in a diversification discount when managers are engaged in launching anti-takeover provisions to secure their managerial positions. The negative relationship between the E-index and the diversification discount is also sustainable for the full sample. In contrast, the relative value added, which is used to measure managers' efficiency in asset deployment, is not significant. In a nutshell, the main causes of the diversification discount are a low coinsurance effect and high managerial entrenchment. In contrast, whether managers are capable of redeploying a firm's assets to their best use is less of a concern.

<<Insert Table 8 Here>>

5. Concluding Remarks

In this study, we decompose firms' diversification status and change in diversification status into identifiable categories. The decomposition helps us to disentangle the endogeneity issue between firm value and diversification. We find that firm value is not a critical factor affecting a firm's change in diversification. However, a firm's change in diversification affects its future value. Specifically, an increase in diversification results in a decrease in future value. We further explore the possible factors that affect this diversification discount. The main factors are a low coinsurance effect and strong managerial entrenchment. Whether managers are capable of redeploying assets or sources to their best use within a conglomerate is less of an issue.

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Table 1: Sample Distribution

Year	Diversified	Focused	Total
2000	823	2,156	2,979
2001	744	1,958	2,702
2002	697	1,847	2,544
2003	648	1,788	2,436
2004	638	1,841	2,479
2005	603	1,837	2,440
2006	599	1,804	2,403
2007	625	1,806	2,431
2008	606	1,716	2,322
2009	607	1,639	2,246
2010	578	1,639	2,217
2011	587	1,626	2,213
2012	646	1,621	2,267
2013	298	666	964
	8,699	23,944	32,643

Table 2: Test of Differences in Variables

Firms are classified into diversified and focused firms based on the number of lines of business. The criterion for selection is that there are at least five focused firms in the same 4-digit (2-digit) SIC code. This table reports the tests of differences in the variable means between diversified and focused firms. The variables of interest are valuation (Tobin's Q, and sales-based and assets-based excess value, from Berger and Ofek (1995), in Panel A), firm characteristics (total assets, profitability (EBIT/SALES), capital expenditure in proportion to sales (CAPX/SALES), debt ratio (Debt ratio), and return on assets (ROA) in Panel B), diversification (assets-based Herfindahl–Hirschman Index (HHI) in Panel C), and possible determinants of the value of diversified firms (relative value added (RVA), correlation among cash flows, and the Entrenchment Index in Panel D). The variables are defined as follows. Tobin's Q, following Chung and Pruitt (1994), is defined as Q = ((MV(CS)+BV(PS)+BV(LTD)+BV(INV)+BV(CL)-BV(CA))/(BV(TA)),where MV(X) and BV(X) indicate the market and book variables of argument X, respectively. CS is common stock, PS is preferred stock, LTD is long-term debt, INV is inventory, CL is capital leases, CA is current assets, and TA is total assets. The sales-based (assets-based) excess value is defined as ln(V/I(V)), where V is a firm's value, I(V) is the intrinsic value calculated as Imputed Value = $\sum_{\mathrm{i}=1}^{\mathrm{n}} \mathrm{Asset_i}\ (\mathrm{or\ Sales_i}) \times \left(\frac{\mathrm{Total\ Capital}}{\mathrm{Asset\ (or\ Sales)}}\right)_{\mathrm{k}}$, where (Total capital/Assets (or Sales))k is the multiple of total capital to assets (or sales) for the median single-segment firm in segment i's industry. Following Rajan, Servaes, and Zingales (2000), the RVA is calculated as follows: $\frac{1}{BA}\sum_{j=1}^{n} BA_j(q_j-\bar{q})\left[\frac{I_j}{BA_j}-\frac{I_j^{ss}}{BA_j^{s}}-\sum_{j=1}^{n} w_j\left(\frac{I_j}{BA_j}-\frac{I_j^{ss}}{BA_j^{s}}\right)\right]$, where n denotes the number of segments;I_j/BA_j is the capital expenditure of segment j (item #4 of the COMPUSTAT segment file) in proportion to the book value of assets of segment j; (I_j^{ss}/BA_j^{ss}) is the asset-weighted average capital expenditure to assets ratio for the single-segment firms in the corresponding industry;w_j is the ratio of segment assets to firm assets;q_j is the end-of-year asset-weighted average Tobin's q of single-segment firms that operate in the three-digit industry of segment j; and $\bar{q}$ is the asset-weighted average of segment q's for the firm. The correlation among cash flows, an inverse measure of coinsurance, is computed as $\sum_{p=1}^{n}\sum_{q=1}^{n} w_{ip(j)}\, w_{iq(k)}\, Corr_{[t-10,t-1]}\,(j,k)$, where $w_{ip(j)}$is the sales share of segment

p of firm i operating in industry j (similarly for business segment q of firm i operating in industry k), and $Corr_{[t-10,t-1]}\ (j,k)$is the estimated correlation of idiosyncratic industry cash flows or investments between industries j and k over the 10-year period before year t. Following Bebchuck et al. (2009), the entrenchment effect is the sum of the number of anti-takeover provisions, including a staggered board, limits to shareholder bylaw amendments, poison pills, golden parachutes, and supermajority requirements for mergers and charter amendments. The entrenchment index is in the range between 6 and 0.

	Firm Type	Observations	Mean	STD	Q1	Median (Q2)	Q3	t-statistic (p-value)
A. Valuation								
Tobin's Q	Diversified	8,699	1.926	4.907	1.356	1.715	2.276	***-11.440***
	Focused	23,944	2.420	2.736	1.436	1.963	2.835	(<.0001)
Excess Value (sales)	Diversified	8,671	-0.169	0.633	-0.536	-0.148	0.202	***-16.930***
	Focused	23,828	-0.022	0.714	-0.419	0	0.363	(<.0001)
Excess Value (asset)	Diversified	5,658	-0.071	0.400	-0.300	-0.066	0.158	***-15.360***
	Focused	21,427	0.033	0.468	-0.218	0	0.264	(<.0001)
B. Firm Characteristics								
Total Assets ($ millions)	Diversified	8,699	5525.690	17888.57	206.721	871.900	3396.500	***26.360***
	Focused	23,944	1939.030	6693.480	107.320	314.944	1100.020	(<.0001)
EBIT/ SALES	Diversified	8,699	0.067	0.276	0.035	0.083	0.139	***12.550***
	Focused	23,944	-0.005	0.509	-0.080	0.063	0.146	(<.0001)
ROA	Diversified	8,699	0.015	0.392	0.006	0.041	0.074	***9.170***
	Focused	23,943	-0.025	0.331	-0.042	0.032	0.082	(<.0001)
CAPX/ SALES	Diversified	6,311	0.043	0.121	0.004	0.013	0.034	-15.180
	Focused	21,384	0.134	0.473	0.017	0.037	0.087	(<.0001)
Debt Ratio	Diversified	8,687	0.525	0.336	0.357	0.524	0.668	***8.010***

	Focused	23,843	0.474	0.561	0.264	0.437	0.620	(<.0001)
C. Diversification Level								
HHI	Diversified	8,699	0.644	0.195	0.504	0.618	0.803	***-282.330***
	Focused	23,944	1	0.000	1	1	1	(<.0001)
D. Determinants of Diversified Firm Value								
RVA	Diversified	4,714	0.205	9.577	-0.003	-0.000	0.002	***3.06***
	Focused	20,515	0	0	0	0	0	(0.002)
Correlation among cash flows	Diversified	8,401	0.572	0.418	0.208	0.594	0.895	***-156.53***
	Focused	23,278	1.000	0	1.000	1	1	(<0.0001)
E-Index	Diversified	2,546	2.738	1.287	2	3	4	***7.05***
	Focused	4,316	2.508	1.313	2	2	3	(<0.001)

Table 3: Change in Diversification

This table summarizes the possible inter-temporal change for firms characterized as diversified and focused. SN denotes the number of segments.

Change at t / Status at t-1	SN_t-SN_{t-1}<0	SN_t-SN_{t-1}=0	SN_t-SN_{t-1}>0
Diversified	Refocused	Unchanged	More diversified
Focused	--	Unchanged	Diversified

Table 4: Change in Value due to Change in Diversification

This table reports the changes in value before and after the change in diversification for firms characterized as diversified, focused, or both in t-1. The value in t-1 is alternatively gauged by Tobin's Q in t-1（Tobin's Q_{t-1}）and excess value in t-1（EV_{t-1}）. Tobin's Q_{after} (EV_{after}) denotes the average Tobin's Q (excess value) in t+1 through t+3. ΔTobin's Q is the change in Tobin's Q (Tobin's Q_{after}- Tobin's Q_{t-1}) and ΔEV is the change in excess value (EV_{after}- EV_{t-1}).

PANEL A: Diversified Firms at t-1

	Variables	Status Change at t	Obs.	Mean	STD	T-statistic (p-value)
Refocused vs.	Tobin's Q_{t-1}	Δ<0	218	1.996	0.946	-1.3
More diversified		Δ>0	154	2.167	1.588	(0.1952)
	Tobin's Q_{after}	Δ<0	215	2.030	0.847	0.51
		Δ>0	88	1.975	0.887	(0.613)
	ΔTobin's Q	Δ<0	106	0.060	0.606	***2.25***
		Δ>0	67	-0.228	1.076	(0.026)
	EV_{t-1}	Δ<0	217	-0.164	0.709	-0.142
		Δ>0	154	-0.061	0.649	(0.155)
	EV_{after}	Δ<0	214	-0.196	0.617	0.53
		Δ>0	87	-0.236	0.543	(0.5975)
	ΔEV	Δ<0	105	0.045	0.546	***2.72***
		Δ>0	67	-0.167	0.417	(0.0073)
Refocused vs.	Tobin's Q_{t-1}	Δ<0	188	1.989	0.941	-0.54
Unchanged		Δ=0	5,966	2.032	1.063	(0.588)
	Tobin's Q_{after}	Δ<0	213	2.036	0.835	-1.36
		Δ=0	2,598	2.124	0.922	(0.174)
	ΔTobin's Q	Δ<0	89	0.089	0.575	***2.17***
		Δ=0	2,484	-0.049	0.905	(0.0321)
	EV_{t-1}	Δ<0	187	-0.144	0.701	-0.05
		Δ=0	5,950	-0.142	0.619	0.964
	EV_{after}	Δ<0	212	-0.163	0.624	-0.75
		Δ=0	2,580	-0.134	0.533	(0.455)
	ΔEV	Δ<0	88	0.047	0.535	***1.95***
		Δ=0	2,463	-0.041	0.410	(0.051)

More diversified	Tobin's Q_{t-1}	Δ>0	158	2.182	1.559	***1.73***
vs. Unchanged		Δ=0	5,951	2.031	1.063	(0.083)
	Tobin's Q_{after}	Δ>0	89	2.006	0.889	-1.2
		Δ=0	2,589	2.125	0.923	(0.229)
	ΔTobin's Q	Δ>0	69	-0.195	1.013	-1.33
		Δ=0	2,475	-0.048	0.905	(0.184)
	EV_{t-1}	Δ>0	158	-0.054	0.635	***1.76***
		Δ=0	5,935	-0.142	0.619	(0.078)
	EV_{after}	Δ>0	88	-0.202	0.528	-1.17
		Δ=0	2,571	-0.134	0.534	(0.2441)
	ΔEV	Δ>0	69	-0.145	0.421	***-2.08***
		Δ=0	2,454	-0.041	0.410	(0.0375)
PANEL B: Focused Firms at t-1						
Diversified	Tobin's Q_{t-1}	Δ>0	253	2.462	1.812	-0.01
vs. Unchanged		Δ=0	18,734	2.464	2.885	(0.988)
	Tobin's Q_{after}	Δ>0	152	2.151	1.023	***-2.71***
		Δ=0	9,760	2.383	2.103	(0.007)
	ΔTobin's Q	Δ>0	127	-0.393	1.213	-0.54
		Δ=0	9,512	-0.219	3.635	(0.589)
	EV_{t-1}	Δ>0	252	-0.012	0.709	-0.39
		Δ=0	18,662	0.005	0.705	(0.697)
	EV_{after}	Δ>0	152	-0.096	0.590	-1.32
		Δ=0	9,703	-0.031	0.595	(0.186)
	ΔEV	Δ>0	126	-0.072	0.549	0.35
		Δ=0	9,442	-0.087	0.474	(0.759)

Table 5: The Impact of Diversification on Firm Value

This table reports the regression of firm value (alternatively gauged by Tobin's Q, sales-based excess value, and assets-based excess value) on diversification and other control variables. Diversification is alternatively measured by D (diversification) (being assigned the value 1 for diversified firms and 0) and number of segments. All other variables are defined in Table 2. In each cell, the regression coefficient and p-value are reported in the upper and lower case, respectively. ***, **, and * denote the significance level of 1%, 5%, and 10%, respectively.

	Tobin's Q		Sales-Based Excess Value		Asset-Based Excess Value	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Constant	2.883***	2.604***	-0.619***	-0.541***	-0.049	-0.093*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.232)	(0.087)
D (diversification)	-0.413***		-0.122***		-0.049***	
	(0.000)		(0.000)		(0.004)	
# of segments		-0.121**		-0.072***		-0.013
		(0.017)		(0.000)		(0.263)
HHI	-0.0531	0.326	0.197***	0.180***	0.112***	0.167***
	(0.767)	(0.108)	(0.000)	(0.001)	(0.004)	(0.000)
Log of Assets	1.304***	1.301***	0.631***	0.631***	0.279***	0.279***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EBIT/SALES	0.131**	0.126**	-0.260***	-0.261***	0.104***	0.104***
	(0.036)	(0.043)	(0.000)	(0.000)	(0.000)	(0.000)
CAPX/SALES	-0.328***	-0.321***	0.138***	0.139***	-0.041***	-0.040***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
TD/TA	1.172***	1.171***	-0.022***	0.061***	0.061***	
	(0.000)	(0.000)	(0.005)	(0.006)	(0.000)	(0.000)
Ln (TA_{t-1})	-1.371***	-1.367***	-0.541***	-0.540***	-0.273***	-0.273***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$(EBIT/SALES)_{t-1}$	-0.227***	-0.230***	-0.061***	-0.062***	-0.055***	-0.055***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$(CAPX/SALES)_{t-1}$	-0.128***	-0.127***	0.012	0.012	-0.012	-0.012
	(0.005)	(0.006)	(0.334)	(0.334)	(0.144)	(0.150)
$(TD/TA)_{t-1}$	-1.426***	-1.432***	-0.416***	-0.418***	-0.263***	-0.264***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	21,239	21,239	21,167	21,167	19,228	19,228
Adjusted R^2	0.087	0.086	0.168	0.167	0.060	0.060

Table 6: The Determinants of Changes in Diversification

This table reports the logistic regression exploring the determinants of change in diversification. The status of diversification in t-1 is classified as diversified and focused. The dependent variable is a dummy indicating changes in status of diversification and is defined in the second row of each column. In each cell, the regression coefficient and p-value are reported in the upper and lower case, respectively. ***, **, and * denote the significance level of 1%, 5%, and 10%, respectively.

	Status: Diversified $_{t-1}$ Dependent Variables						**Status: Focused $_{t-1}$** Dependent Variables	
	Model 1		Model 2		Model 3		Model 4	
	(More) diversified=1 Refocus=0		Unchanged=1 Refocus=0		(More) diversified=1 Unchanged=0		(More) diversified=1 Unchanged=0	
Constant	-0.026	0.010	3.686***	3.940***	-3.721***	-3.858***	-4.319***	-4.366***
	(0.971)	(0.984)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Tobin_{t-1}$	-0.011		0.078		-0.067		-0.006	
	(0.950)		(0.505)		(0.579)		(0.632)	
Excess $value_{t-1}$		0.174		0.192		0.085		-0.016
		(0.402)		(0.223)		(0.606)		(0.882)
ROA_{t-1}	0.00006	0.0001	-0.00002	-0.00003	0.00001	0.00001	-0.00001	-0.00001
	(0.954)	(0.959)	(0.881)	(0.885)	(0.914)	(0.911)	(0.899)	(0.899)
$Ln(TA)_{t-1}$	0.097	0.086	-0.039	-0.048	0.068	0.062	0.031	0.036
	(0.182)	(0.235)	(0.433)	(0.331)	(0.191)	(0.239)	(0.481)	(0.437)

$EBIT/SALES_{t-1}$	0.578	0.571	0.772***	0.833***	-0.481	-0.487	0.510*	0.502*
	(0.470)	(0.409)	(0.004)	(0.002)	(0.370)	(0.335)	(0.084)	(0.090)
$CAPX/SALES_{t-1}$	-0.108	-0.450	0.908	0.759	-1.777	-1.814	-0.712*	-0.715*
	(0.950)	(0.799)	(0.441)	(0.512)	(0.229)	(0.222)	(0.069)	(0.071)
$(TD/TA)_{t-1}$	-1.454**	-1.336**	-0.103	-0.108	-0.225	-0.085	-0.415	-0.407
	(0.029)	(0.041)	(0.340)	(0.317)	(0.647)	(0.832)	(0.152)	(0.179)
Observations	255	255	4,498	4,486	4,487	4,475	16,974	16,919
Pseudo R^2	0.021	0.023	0.008	0.009	0.004	0.004	0.005	0.005

Table 7: Changes in Diversification and Firm Value

This table reports the regression of change in firm value on change in diversification. Change in firm value is alternatively gauged by change in Tobin's Q (the average of Tobin's Q from t+1 through t+3 minus the Tobin's Q in t-1) and change in excess value (the average excess value from t+1 through t+3 minus the excess value in t-1). Change dummy is alternatively defined in the second row. In each cell, the regression coefficient and p-value are reported in the upper and lower case, respectively. ***, **, and * denote the significance level of 1%, 5%, and 10%, respectively.

	Status: Diversified $_{t-1}$						Status: Focused $_{t-1}$	
Dependent Var.	Δ Tobin's Q	Δ EV	Δ Tobin's Q	Δ EV	Δ Tobin's Q	Δ EV	Δ Tobin's Q	Δ EV
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Change Dummy	More diversified=1, Refocus=0		Unchanged=1, Refocus=0		More diversified=1, Unchanged=0		Diversified=1,Unchanged=0	
Constant	-0.173	0.180	0.111	0.105*	-0.072	-0.003	-0.590	-0.074
	(0.474)	(0.249)	(0.346)	(0.058)	(0.379)	(0.938)	(0.557)	(0.571)
# of segments	0.153*	0.024	0.020	-0.0001	0.0281	0.001	0.441	0.064
	(0.052)	(0.633)	(0.433)	(0.996)	(0.286)	(0.954)	(0.658)	(0.622)
Change Dummy	-0.480**	-0.232*	-0.160	-0.091**	-0.151	-0.103**	-0.646	-0.054
	(0.018)	(0.075)	(0.106)	(0.050)	(0.179)	(0.043)	(0.565)	(0.711)
Ln (TA)	-0.056	-0.054**	-0.058***	-0.022***	-0.061***	-0.020***	-0.058**	-0.024***
	(0.116)	(0.020)	(0.000)	(0.000)	(0.000)	(0.000)	(0.013)	(0.000)
CAPX/SALES	-1.548***	-0.275	0.010	0.227***	-0.015	0.222***	-0.064	0.224***
	(0.000)	(0.312)	(0.922)	(0.000)	(0.891)	(0.000)	(0.542)	(0.000)
TD/TA	0.943***	0.428**	0.694***	0.146***	0.743***	0.150***	0.633***	0.137***
	(0.001)	(0.015)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Observations	173	172	2572	2550	2543	2522	9599	9528
Adjusted R^2	0.154	0.074	0.027	0.015	0.030	0.015	0.002	0.031

Table 8: Effects of Relative Value Added, Coinsurance, and Entrenchment Index on the Value of Diversification

The models are the same as those in Table 6 with the addition of relative value added (RVA), the correlation of cash flows among segments within a diversified firm, and the anti-takeover index (E-Index). Models 1-6 include the subsample of diversified firms only, while models 7-8 include the full sample. In each cell, the regression coefficient and p-value are reported in upper and lower case, respectively. ***, **, and * denote the 1%, 5%, and 10%significance levels, respectively.

	Diversified Firms Dependent Variables						**Full Sample** Dependent Variables	
	Tobin's Q	Excess Value	Tobin's Q	Excess Value	Tobin's Q	Excess Value	Tobin's Q	Excess Value
Constant	2.601***	-0.427***	2.527***	-0.438***	3.520***	-0.041	3.762***	0.042
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.678)	(0.000)	(0.6787)
Number of segments	-0.026	-0.007	0.020	-0.012	-0.032	-0.007	-0.098**	-0.052***
	(0.213)	(0.631)	(0.328)	(0.413)	(0.222)	(0.676)	(0.019)	(0.007)
HHI	-0.081	0.062	0.142*	0.136**	0.051	0.050	0.346**	0.162**
	(0.333)	(0.296)	(0.073)	(0.017)	(0.646)	(0.486)	(0.042)	(0.037)
Relative value added(RVA)	0.002	0.0001						
	(0.108)	(0.933)						
Correlation of cash flows			-0.118***	-0.046**				
			(0.000)	(0.042)				
E-index					-0.061***	-0.002	-0.066***	-0.026***
					(0.000)	(0.809)	(0.000)	(0.000)
Ln (TA)	0.609***	0.449***	0.663***	0.541***	0.208**	0.219***	1.113***	0.508***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.049)	(0.002)	(0.000)	(0.000)
EBIT/SALES	1.567***	0.677***	0.351***	-0.210***	2.442***	1.072***	0.346***	-0.204***
	(0.000)	(0.000)	(0.001)	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)

CAPX/SALES	0.403***	0.245***	-0.138	0.257***	-1.008***	-0.173	-0.362**	-0.017
	(0.000)	(0.000)	(0.163)	(0.000)	(0.000)	(0.290)	(0.037)	(0.831)
TD/TA	-1.078***	-0.050	-1.198***	-0.602***	-1.769***	-0.106	-1.396***	-0.502***
	(0.000)	(0.636)	(0.000)	(0.000)	(0.000)	(0.567)	(0.000)	(0.000)
Ln (TA_{t-1})	-0.613***	-0.387***	-0.679***	-0.473***	-0.274***	-0.190***	-1.221***	-0.457***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.009)	(0.006)	(0.000)	(0.000)
(EBIT/SALES) $_{t-1}$	-0.125	0.154	0.037	0.288***	0.558**	0.374**	-0.063	-0.035
	(0.409)	(0.153)	(0.763)	(0.001)	(0.020)	(0.018)	(0.440)	(0.353)
(CAPX/SALES) $_{t-1}$	-0.935***	0.022	-0.447***	0.078	-0.633**	-0.018	-0.151	0.061
	(0.000)	(0.857)	(0.001)	(0.399)	(0.021)	(0.920)	(0.376)	(0.431)
(TD/TA) $_{t-1}$	-0.211	-0.594***	-0.016	0.008	-0.091	-0.691***	0.178	-0.211*
	(0.175)	(0.000)	(0.631)	(0.729)	(0.741)	(0.000)	(0.373)	(0.021)
Observations	3534	3534	4404	4404	1530	1530	4810	4810
Adjusted R^2	0.190	0.142	0.162	0.119	0.363	0.168	0.180	0.126

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Does IFRS Provide More Relevant Information for Evaluating Systematic Risk? Evidence from ADRs

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This study explores whether IFRS provides more relevant information than GAAP to investors for evaluating systematic risks. By investigating American Depository Receipts' (ADRs) responses to the elimination of Form 20-F reconciliation, we find an insignificant difference in risk relevance between IFRS and U.S. GAAP. In addition, the findings show that dual reporting under IFRS and U.S. GAAP conveys incremental, risk-relevant accounting information to external users as compared to reporting only under IFRS. In the extensive analysis, the findings show that dual disclosure helps eliminate information asymmetry, which is conducive to lower firm-specific risks and more value relevance. Collectively, the findings suggest that dual reporting under IFRS and U.S. GAAP is necessary although accounting information under IFRS is sufficiently comparable to U.S. GAAP. However, several caveats are mentioned.

Keywords: risk relevance, systematic risk, market beta, accounting beta, IFRS

1. Introduction

Systematic risk is risk that impairs the functioning of a financial system to the point where economic growth and welfare suffer materially. During crises, for example, both the financial markets and individual assets are hit by catastrophic events whose ex-ante probabilities were previously considered negligible. As a result, determining a method for understanding the build-up of systematic risk and containing crises when they do happen becomes extremely important. Although previous studies document a positive relation between systematic risk in the form of market beta and accounting risk in the form of accounting beta,[1] little attention has been paid to whether accounting systems generate incremental risk information under different sets of accounting principles.

A growing number of countries have moved to direct adoption of or convergence with International Financial Reporting Standards (hereafter, IFRS). For example, the European Union (hereafter EU) required all listed companies in its member states to prepare their consolidated financial statements in accordance with IFRS after 2005[2]. The Chinese government allowed Chinese accounting standards to converge with IFRS by 2007. Nonetheless, to date some countries still hesitate to adopt or converge with IFRS for political reasons or due to concerns about IFRS financial reporting quality (Reilly, 2011; Ball, 2012).

In 2007, the Securities and Exchange Commission (hereafter, the SEC) took a step to allow non-U.S. companies coming from IFRS member states and cross-listing on U.S. exchanges (hereafter, IFRS firms) to prepare financial statements without reconciliation to the Generally Accepted Accounting Principles in the United States (hereafter, U.S. GAAP) (SEC 2007). This decision is based upon the belief that eliminating reconciliation improves the comparability and quality of accounting information, which in turn benefits users (SEC 2008; Barth, Landsman, Lang, and Williams 2012).

Among the users of accounting information, financial analysts play a key role in the capital markets (Beaver 1998). They intensively study companies' financial statements and rate risks and also provide guidance to businesses and individuals making investment decisions. In addition their concerns about financial reporting quality, they want to know more relevant information about systematic risk, given that unsystematic risks can be minimized through diversification. Thus, determining whether principle-based or rule- based accounting standards faithfully reflect more information about a firm's exposure to systematic risk is an extremely crucial issue. Therefore, the purpose of this study is to investigate which of these two systems (IFRS or U.S. GAAP) provides more risk-relevant accounting information to financial reporting users.

Based on a sample of non-U.S. companies traded as American Depository Receipts (hereafter, ADRs) from 1991 to 2012, we do not find a significant difference in risk relevance between IFRS and U.S. GAAP. This implies that the risk relevance under IFRS is comparable to that under U.S. GAAP. When we subdivide the ADRs into several groups

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[1] E.g., Ball and Brown (1969), Beaver, Kettler, and Scholes (1970), Mensah (1992), and Khan and Bradbury (2014).

[2] European Union (2002), Regulation (EC) 1606/2002 of the European Parliament and of the Council on the Application of International Accounting Standards, Brussels, Official Journal of the European Communities.

according to whether they eliminate the Form 20-F reconciliation, we find that dual reporting under IFRS and U.S. GAAP conveys incremental risk-relevant accounting information to external users as compared to single reporting under IFRS. In the extensive analysis, we find that ADRs choosing dual reporting under IFRS and U.S. GAAP have lower idiosyncratic risks and value relevance following their decisions. This implies that dual reporting helps eliminate information asymmetry, which is conducive to lower firm- specific risks and more value relevance. The findings also show that single reporting under IFRS fails to offer incremental, value-relevant accounting information. Collectively, the findings suggest that dual reporting under IFRS and U.S. GAAP provides better information to users, although accounting numbers under IFRS are sufficiently comparable to U.S. GAAP. The main findings remain robust when we use different earning measures following Baran, Lakonishok, and Ofer (1980).

Our study contributes to the literature in the following aspects. First, although many empirical studies compare accounting quality and value relevance under principle-based accounting with those under ruled-based accounting,[3] no studies compare the risk relevance under these two types of accounting standards. We fill this gap. Second, our findings show that dual reporting under IFRS and U.S. GAAP is important for non-U.S. companies cross-listing in the U.S. capital markets, although accounting numbers under IFRS are sufficiently comparable to U.S. GAAP. Finally, we add to traditional capital asset pricing theory by showing that incremental risk-relevance is conducive to value relevant accounting information.

The remainder of the paper is organized as follows: The next section reviews related research and develops predictions. Section three explains the methodology and sample selection. The empirical results are presented and discussed in section four, while additional tests are provided in section five. The final section offers conclusions.

2. Literature review and predictions

Risks and Accounting Information

In the capital market, financial reporting users face systematic and idiosyncratic risks. The former is relatively more important than the latter because users may not be able to reduce systematic risk through diversification. For example, investors cannot deal adequately with fluctuations in all stocks during a recession unless they stay away from all risky investments, but they can diversify idiosyncratic risk through portfolio strategies when a targeted company has a high possibility of financial distress.

Many studies probe related areas and empirically find a relation between accounting information and market risks. Ball and Brown (1969) is the pioneer research that investigates the relationship between accounting data and systemic risk. They show that accounting income numbers are sensitive to systematic risk. Beaver et al. (1970) examine the association

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[3] E.g., Francis, LaFond, Olsson, and Schipper (2004), Daske, Hail, Leuz, and Verdi (2008), Hail, Leuz, and Wysocki (2010a, and 2010b), Kabir, Laswad, and Islam (2010), Li, (2010), Liu, Yao, Hu, and Liu (2011), Barth et al. (2012), and Ahmed, Neel, and Wang (2013).

between market-determined and accounting-determined risk measures. They find that market risk is positively correlated with accounting risk, growth, dividend policy, and earnings variability, and is negatively correlated with liquidity and firm size. Many studies extend this stream of literature to explore the association between systematic risk and various accounting variables.[4] For instance, Lev (1974) finds operating leverage to be positively associated with systematic risk because the higher a company's capital expenditures, the higher its operating leverage. Beaver and Manegold (1975) investigate whether accounting information on profitability is associated with systematic risk. Their results show a high correlation between accounting information and profitability and systematic risk. Brimble and Hodgson (2007) provide evidence that accounting variables are significantly associated with systematic risk over time. Nevertheless, the association is shown to be influenced according to industry and size. Khan and Bradbury (2014) find comprehensive income to be associated with systematic risk, which is similar to the relationship between net income and systematic risk.

Value Relevance of IFRS

The trend toward convergence of local GAAP and IFRS has inspired researchers in the global accounting research community[5]. Some studies investigate the effects of shifting from local GAAP to IFRS, but the empirical results are inconsistent. Hung and Subramanyam (2007) investigate German companies adopting International Accounting Standards (hereafter, IAS) from 1998 through 2002 and find significant accounting differences between IAS and German GAAP. They find that total assets, book value of equity, and variations in book value and net income are higher under IAS than under German GAAP.

Jeanjean and Stolowy (2008) focus on three IFRS first-time adopter countries: Australia, France, and the United Kingdom (hereafter, UK). They find that the pervasiveness of earnings management does not decline after the introduction of IFRS; it even increases in France. Using European listed companies, Morais and Curto (2009) find that implementation of IFRS results in more value-relevant accounting information than local GAAP. Iatridis (2010) finds IFRS adoption enhances the quality of accounting information for UK firms, evidenced by decreases in earnings management, timely recognition of losses, and increases in the value relevance of accounting information. Devalle, Onali, and Magarini (2010) find accounting information is more relevant following the introduction of IFRS in Germany, France, and the UK, but the influence on book value of equity decreases in most of the countries except for the UK. Kabir et al. (2010) examine the earnings quality of accounting information for firms in New Zealand and find that earnings quality decreases with the adoption of IFRS. Liu et al. (2011) explore the effects of mandatory implementation of IFRS in China and provide evidence of a reduction in earnings management and higher value relevance in accounting information. Chua, Cheong, and Gould (2012) find that Australian

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[4] E.g., Lev (1974), Beaver and Manegold (1975), Bowman (1979), Hill and Stone (1980), Mandelker and Rhee (1984), Mensah (1992), Penman (2001), Brimble and Hodgson (2007), and Khan and Bradbury (2014).

[5] See Auer (1996); Barth, Clinch, and Shibano (1999); Harris and Muller (1999); Bartov, Goldberg, and Kim (2005); Van Tendeloo and Vanstraelen (2005); Daske (2006); Hung and Subramanyam (2007); Barth, Landsman, and Lang (2008); Kabir et al. (2010); Li (2010); Liu et al. (2011); Ahmed et al. (2013).

companies have better accounting quality following the mandatory adoption of IFRS.

Several empirical studies compare IFRS with U.S. GAAP by using German samples. Studies suggest insignificant differences in reporting quality (Leuz and Verrecchia 2000; Leuz 2003), earnings management (Van Tendeloo and Vanstraelen 2005), and value relevance (Bartov et al. 2005; Hung and Subramanyam 2007) between IFRS and U.S. GAAP.

By contrast, the findings in studies using U.S. cross-listed firms are relatively mixed. Harris and Muller (1999) investigate whether foreign firms should be allowed to list in the United States using IAS. They find that the U.S. GAAP earnings-reconciliation adjustment is value-relevant. They also find IAS amounts to be more related to price-per-share than U.S. GAAP amounts and U.S. GAAP amounts to be more related to stock returns than IAS amounts. Henry, Lin, and Yang (2009) evaluate the impact of IFRS on U.S. GAAP and IFRS using reconciliation disclosures of EU cross-listed companies from 2004 to 2006. They find that the differences in earnings and in shareholders' equity between U.S. GAAP and IFRS declined from 2004 to 2006, but reconciliation amounts vary with industries and with the legal origins of the companies' home countries.

More recently, Barth et al. (2012) examine the comparability of accounting information between IFRS and U.S. GAAP using a sample of non-U.S. companies cross- listing in the U.S. capital market. They find that IFRS is more comparable with U.S. GAAP as compared to other local GAAPs. The comparability between IFRS and U.S. GAAP is stronger for firms that adopt IFRS mandatorily, common law firms, and firms in countries with high enforcement. Despite the finding that IFRS is comparable to U.S. GAAP, Barth et al. (2012) indicate that IFRS exhibits lower value relevance than U.S. GAAP.

Similarly, Eng, Sun, and Vichitsarawong (2014) examine whether accounting amounts reported under IFRS by ADRs are comparable with those reported under U.S. GAAP from 2006 to 2009. They find no significant change in value relevance and accounting quality after 2007, the year in which SEC permitted elimination of Form 20-F reconciliation. Based on their findings, they suggest that reconciliation to U.S. GAAP is unnecessary when financial statements are prepared in accordance with IFRS. In their research design, however, Eng et al. (2014) did not check the exact year in which the ADRs changed their methods. Some ADRs switched to different forms of disclosure in later years which could lead to insignificant differences in value relevance and accounting quality before and after 2007.

Collectively, these studies support the substantial fair-value orientation of IFRS. However, there is a lack of research comparing the risk relevance under IFRS with U.S. GAAP. This study fills that gap.

Predictions

External users analyze financial accounting numbers for two purposes. First, they want to identify mispriced securities so that they might attempt to "beat the market" and earn abnormal returns. Second, they want to predict the systemic riskiness of stock returns (market beta), so that they might adjust their portfolio risk. Hence, a good accounting system should provide useful information by which users can predict systematic risk and reduce portfolio adjustment costs in attempting to achieve a target level of portfolio risk (Elgers

1980).

Although IFRS is considered closer to the fair value and the underlying economic phenomena that are real determinants of beta, a controversial issue is whether its principle-based approach applies to mature capital markets. Rules-based accounting is basically a list of detailed rules that must be followed when preparing financial statements intended to increase accuracy and reduce ambiguity. The complexity of such rules, however, can cause unnecessary complexity in the preparation of financial statements. Principles-based accounting provides a simple set of conceptual guidelines. Although some rules are unavoidable, the guidelines are not meant to be used for every situation. The drawback with principles-based guidelines is that a lack of guidelines can lead to inconsistent information that reduces comparability. Lease accounting under U.S. GAAP and IFRS best illustrates the differences between rules-based and principles-based accounting. Under U.S. GAAP, a lease is considered a capital lease if it meets any of the specified criteria. In contrast, under IFRS, a lease is classified as a finance lease if it transfers substantially all the risks and rewards incidental to ownership of an asset. Although the IASB also provides several indicators that are similar to the criteria under U.S. GAAP, it does not provide any specified percentage. Instead the IASB uses terms such as "substantially all" and"major part," which require a great deal of professional judgment. Hence, earnings are expected to be inherently volatile under IFRS. Ostensibly, IFRS simplifies the complex rules, yet it may in turn reduce the users' level of understanding of accounting numbers, especially in a developed capital market where complex transactions are prevalent. Thus, the risk relevance of IFRS might be lower than or insignificant in relation to that of U.S. GAAP. The risk relevance of IFRS, nevertheless, might be higher than that of U.S. GAAP if simplified accounting treatments and supplemental disclosures under IFRS collectively convey superior accounting information in regard to the prediction of systematic risk as compared to U.S. GAAP.

3. Methodology and Sample selection

ResearchDesign

We base our analyses on a sample of ADRs for three reasons. First, a single-country analysis mitigates potential effects caused by differences in legal, regulatory, political, and economic environments among countries[6]. Second, we believe that market discipline and rigid regulations on ADRs in the United States mitigate potential endogeneity rooted in the case of voluntary application[7]. Third, the SEC has allowed ADRs to prepare financial statements in accordance with IFRS without GAAP reconciliation since 2007[8], which grants us a valuable opportunity to investigate the risk relevance of accounting information.

We identify a firm that has both "-ADR" in the firm name and an ADR ratio

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[6] E.g. Alford, Jones, Leftwich, and Zmijewski (1993), Sloan (2001); Chaudhuri and Maitra (2008), Hail et al. (2010a), and Barth et al. (2012).

[7] E.g. Holthausen and Leftwich (1983), Core (2001), Lim, Matolcsy, and Chow (2007), Francis, Nanda, and Olsson (2008), and Hostak, Lys, Yang, and Carr (2013).

[8] Securities Act Release No. 8879, "Acceptance from Foreign Private Issuers of Financial Statements Prepared in Accordance with International Financial Reporting Standards Without Reconciliation to U.S. GAAP."

(Compustat item: ADRR) in the *COMPUSTAT* database, identifying it as an ADR firm. We then match the ADRs with U.S. companies that in the year 2007 or later changed their disclosure policies, have the closest market capitalizations, belong to the same quintile of total assets and cash flows from operation at the beginning of the year, and are in the same industry (on the basis of the two-digit SIC code).

Following the *COMPUSTAT* classification system, we divide the ADRs into three groups[9]: ADRs adopting domestic standards (*DS*), ADRs adopting domestic standards generally in accordance with U.S. GAAP (*DU*), and ADRs adopting domestic standards generally in accordance with or fully compliant with IFRS (*DI*). In the following sections, we define the ADRs in the *DI* group as IFRS firms.

We mainly pay attention to the risk-relevant information available for IFRS firms. We further subdivide the IFRS firms into three sub-groups based on their reporting choices: (1) IFRS firms that provide both IFRS and U.S. GAAP information (hereafter $\text{IFRS}^{\text{Both}}$), (2) IFRS firms that merely provide IFRS information (hereafter $\text{IFRS}^{\text{Only}}$), and (3) IFRS firms that became U.S. companies and used U.S. GAAP when the U.S. ownership exceeds 50 percent of issued share capital, or the firms reincorporate in the United States (hereafter IFRS^{US}).

To do this, we manually check the ADR firms' Form 20-F and 6-K filings via the SEC's EDGAR system, including the basis of accounting used to prepare the financial statements, the disclosure choices of accounting standards before and after eliminating the reconciliations requirements, and the first change year if the ADR makes a different disclosure choice.

We then compare the relationship between accounting beta and market beta of IFRS firms with that of their counterparts before and after the IFRS firms prepared financial statements without reconciliation to U.S. GAAP. In addition, we conduct regression analyses and additional checks. The following sections introduce the market beta, accounting beta, and regression model used in our research.

Estimation of Accounting Beta and Market Beta

In the research, we employ accounting and market betas to quantify the systematic volatility in earnings and the systematic risk, respectively. Empirical studies find that the systematic volatility in earnings, as captured by accounting beta, is an important explanatory variable of market beta, a measure of a security's systematic risk under the Capital Asset Pricing Model (CAPM) (Beaver et al. 1970; Bowman 1979; Baran et al. 1980; Bowman 1980; Bowen, Burgstahler and Daley 1986; Mensah 1992).

Folloing Mensah (1992), we use the following time-series regression model to iteratively estimate the accouting beta (α_1)

$$X_{it} = \alpha_0 + \alpha_1 X_{mt} + \varepsilon_{it}, \qquad (1)$$

where X_{it} refers to the change in earnings per share for firm *i* in fiscal year *t*, divided by the

[9] According to the COMPUSTAT database, *DI* firms were made available from December 31, 2004, forward; prior to that date, *DS* will appear. Therefore, we identify *DI* firms before 2005 based on the 2005 classification

earnings per share for firm i in fiscal year t-1. X_{mt} refers to the change in arithmetic average of the sample earnings per share for firm i in fiscal year t, divided by the arithmetic average of the sample earnings per share for firm i in fiscal year t-1.

The market beta (β_1) is iteratively estimated from the following time-series regression:

$$R_{it} = \beta_0 + \beta_1 R_{mt} + \varepsilon_{it}\ , \tag{2}$$

where R_{it} refers to the annualized monthly stock returns for firm i in fiscal year t. R_{mt} refers to the *ex post* annualized monthly stock returns of the market portfolio in fiscal year t. A firm's monthly returns are compounded starting from the beginning of the third month after the end of the prior fiscal year to ensure that the financial information has been released.

Regression Models

In addition to a correlation analysis, our primary analysis is a multivariate test that controls for potential differences across the sample groups. The estimated market betas are regressed on the estimated accounting betas, an indicator variable that represents the period following the elimination of Form 20-F reconciliations or the change in disclosure policies and several important variables that are related to the market beta.

We first shed light on the risk relevance of accounting before and after the IFRS firms choose to report only IFRS information. Thus, we separately apply equation (3) to firms according to different types of disclosure after the elimination of reconciliation. Second, we investigate the relative risk relevance between the IFRS and U.S. GAAP. As a result, we use Equation (4) to compare IFRS^{Only} with the matched U.S. companies.

$$\begin{aligned} MBeta_{it} = {} & \gamma_0 + \gamma_1 ABeta_{it} + \gamma_2 ELIMINATE + \gamma_3 ABeta_{it} \times ELIMINATE \\ & + \gamma_4 SIZE_{it} + \gamma_5 DOL_{it} + \gamma_6 DFL_{it} + \gamma_7 IBR_{it} + \gamma_8 \Delta GDP + \gamma_9 CIVIL \\ & + \varepsilon_{it} \end{aligned} \tag{3}$$

$$\begin{aligned} MBeta_{it} = {} & \gamma_0 + \gamma_1 ABeta_{it} + \gamma_2 ONLYIFRS + \gamma_3 ABeta_{it} \times ONLYIFRS \\ & + \gamma_4 SIZE_{it} + \gamma_5 DOL_{it} + \gamma_6 DFL_{it} + \gamma_7 IBR_{it} + \gamma_8 \Delta GDP + \gamma_9 CIVIL \\ & + \varepsilon_{it} \end{aligned} \tag{4}$$

where $MBeta_{it}$ is the market beta of the ith firm in year t, estimated from Equation (2). $ABetait$ is the accounting beta of the ith firm in year t, estimated from Equation (1). *ELIMINATE* is a dummy variable that equals 1 if the year is after 2007 or the year in which the firms changed their disclosure policies, and 0 otherwise. *ONLYIFRS* is a dummy variable that equals 1 if an IFRS firm switched to reporting only IFRS information after the elimination of Form 20-F reconciliation, and 0 otherwise. $SIZEit$ is the logarithm of total assets of the ith firm in year t. $DOLit$ is the firm's degree of operating leverage, measured by the ratio of percentage change in earnings before interest and taxes to the percentage change in sales in year t. DFL_{it} is the firm's degree of financial leverage, measured by the ratio of percentage change in earnings per share to percentage change in earnings before interest and taxes in year t. IBR_{it} is the firm's intrinsic business risks, measured following Mensah

(1992)[10].*ΔGDP* is the annual percentage change in gross domestic product in year *t*. *CIVIL* is a dummy variable that equals 1 if the firm is in a civil law country, and 0 otherwise.

In Equation (3), *ABeta* captures the correlation between accounting risk and market risk. *ELIMINATE* captures the shift in the intercept for the period when IFRS firms change their disclosure policies on Form 20-F. We expect the coefficient on *ABeta* × *ELIMINATE* in Equation (3) to be positive if the companies provide incremental risk-relevant accounting information after eliminating Form 20-F reconciliation.

In Equation (4), *ONLYIFRS* measures the shift in the intercept for IFRS firms as compared to that of other firms. *ABeta* × *ONLYIFRS* captures the marginal effect of IFRS on the slope of the variable *ABeta*. If IFRS provides more risk-relevant information than U.S. GAAP, we expect the coefficient on *ABeta* × *ONLYIFRS* in Equation (4) to be positive.

Following previous studies, we include a set of important variables that control for firm size (Ben-Zion and Shalit 1975), the degree of operating leverage (Hill and Stone 1980; Mandelker and Rhee 1984; Rhee 1986; Mensah 1992), the degree of financial leverage (Ben-Zion and Shalit 1975; Hill and Stone 1980; Mandelker and Rhee 1984; Rhee 1986; Mensah 1992), intrinsic business risks (Mandelker and Rhee 1984; Rhee 1986; Mensah 1992), differences in legal systems (Soderstrom and Sun 2007; Barth et al. 2012)[11], and macroeconomic effects (Vassalou and Xing 2004).

Sample Selection

We retrieve the financial and stock returns data from the *COMPUSTAT* and *CRSP* databases during the sample period from 1991 to 2012. We manually collect the ADR disclosure policies in Form-20F and 6-K filings via the SEC's EDGAR system. Data regarding the gross domestic product are retrieved from the U.S. Bureau of Economic Analysis.

We impose several restrictions: (1) we remove financial service firms (SIC codes between 6000 and 6999); (2) We require ADRs to have annual data at least two years before and one year after 2007; (3) We require IFRS firm to have annual data at least two years before and one year after 2007, as well as the year in which they changed their disclosure policies on Form 20-F during the period of post-elimination of reconciliation; (4) We require ADRs to have Form 20-F or 6-K filings available in the EDGAR system; (5) We require ADRs to have non-missing values of financial and stock returns data for the regression analyses; (6) We trim the top and bottom 1% and 99% of earnings before interest and taxes, as well as stock returns, to mitigate the potential effects of outliers.

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[10] To estimate *IBR*, we estimate the compound growth rates of sales (g_s) and earnings (g_x) by separately regressing the natural log of sales and the natural log of earnings before interest and taxes on the time period for each firm, expressed in the following equations. *IBR* is then derived as (g_s/g_x) * *Abeta*.

$$InS_{it} = v_0 + g_{si}T + \square_t,$$

$$InX_{it} = \omega_0 + g_{xi}T + \square_t,$$

where InS_{it} refers to the natural log of sales revenue for firm *i* in fiscal year *t*. InX_{it} refers to the natural log of earnings before interest and taxes for firm *i* in fiscal year *t*. *T* refers to the number of years after going public.

[11] The ADRs are classified into three legal systems according to the Central Intelligence Agency (CIA): (1) common law, (2) civil law, and (3) mixed legal system. See the CIA website at https://www.cia.gov/library/publications/the-world-factbook/fields/2100.html.

Table 1 summarizes the sample-selection procedure and the accounting standard choices of IFRS firms. As reported in Panel A of Table 1, the preliminary merged sample contains 10,702 firm-years with valid financial and stock return data, corresponding to 989 distinct ADRs. We delete 2,680 observations with extreme values and those with missing values as well as financial institutions, corresponding to 142 distinct ADRs. We remove 512 ADRs that do not meet the requirement on years or with SEC filings available, corresponding to 2,939 firm-years. We then remove 895 firm-years (61 firms) due to an inability to find matches. The final sample consists of 4,188 observations corresponding to 274 distinct ADRs.

Panel B of Table 1 reports the sample distribution of IFRS firm reporting choices. There are 189 IFRS firms corresponding to 3,155 firm-years. Among these IFRS firms, 73 firms (1,168 firm-years) choose to disclose both IFRS and U.S. GAAP information, 127 firms (1,957 firm-years) choose to disclose only IFRS information, and 2 firms (30 firm-years) switch to being a U.S. company and thus follow U.S. GAAP[12]. In Panel B, most of the IFRS firms disclose only IFRS information after the SEC allowed the elimination of Form 20-F reconciliation. This could be due to two reasons. First, managers of these IFRS firms believe that investors in the U.S. capital markets consider IFRS information more useful. In their Form 20-F, some firms state that they provide only IFRS information is because U.S. investors are familiar with IFRS. Second, the trade-off between costs and benefits could drive the decision to report only IFRS information. Providing only IFRS without reconciliation to U.S. GAAP may substantially reduce related charges on reconciliations.

[Insert Table 1 here]

Table 2 reports the distribution of ADRs across industries and time. Panel A shows that our sample spans 40 different two-digit SIC codes. Chemicals and Allied Products (12.9%), Electronic and Other Electric Equipment (9.6%), and Communications (13.5%) are well represented in the sample.

Panel B reports the distribution of the number of ADRs during the sample period. There was a fast-growing trend of ADRs since 1992. The growth rate slowed and became negative after 2008. Such a declining trend could be due to two reasons. First are the SEC's new ADR requirements in September 2008.[13] They include the following: (1) ADRs that prepare financial statements under U.S. GAAP should prepare segment data in accordance with U.S. GAAP; (2) ADRs must disclose information about their corporate governance practices that are different from U.S. firms, a change in certifying accountant, American Depositary Receipts fees and payments, and so on. These requirements increase costs associated with preparing financial statements for ADRs. Second, the declining trend may result from our requirement that sample firms have observations at least two years before and one year after the first year the IFRS firms change their disclosure policies

[12] When an IFRS firm's U.S. ownership exceeds 50% of issued share capital or the firm reincorporates in the United States, it loses its foreign private-issue status and must prepare a 10-K as its annual financial statement in accordance with U.S. GAAP.

[13] SEC Release Nos. 33-8959; 34-58620 "Foreign Issuer "Reporting Enhancements." (September 23, 2008).

[Insert Table 2 here]

Table 3 presents the descriptive statistics for the test and the control samples in 2007 and in the year the ADRs change their disclosure policies on Form 20-F. The mean log of market capitalization is 8.678 for ADRs and 8.467 for the matched U.S. companies, respectively. The mean log of total assets is 8.636 for ADRs and 8.375 for the matched U.S. companies, respectively. Both the mean differences in the total assets and in the market capitalization between the ADRs and their counterparts are statistically insignificant, indicating that our sample-selection procedure is effective in matching test and control firms on firm size. The insignificant difference in the mean market-to-book ratio suggests that the ADRs have growth opportunity similar to the matched U.S. companies. The ADRs have lower debt ratios than the matched U.S. companies (-0.033; t=-1.72). Both the accounting and the market betas of the ADRs are approximated to those of the matched U.S. companies. Overall, the results in Table 3 grant us confidence in the matching procedure.

[Insert Table 3 here]

4. Empirical Results

Correlation between Accounting Beta and Market Beta

Table 4 presents the analysis of the correlations between the accounting and market betas for the sample firms according to different types of disclosures on the Form 20-F reconciliations. All the correlations have a positive sign, indicating a positive relationship between accounting and market risk measures.

Columns (1) and (6) of Table 4 report the correlations between the accounting and market betas for the ADRs and for the matched U.S. companies, respectively. The correlation coefficient for the ADRs is 0.121 (p-value<0.01) in the pre-elimination period. The correlation coefficient increases to 0.125 (p-value<0.01) after the SEC allows the elimination of Form 20-F reconciliation. The correlation coefficient for the matched U.S. companies increases from 0.038 (p-value<0.01) to 0.082 (p-value<0.01) in the post- elimination period as well.

Columns (2), (3), (4) and (5) of Table 4 report the correlations between the accounting and market betas for the IFRS firms according to their choices of disclosure after the elimination of reconciliation, respectively. Column (2) shows the results for $IFRS^{Both}$.The correlation coefficient in Column (2) is 0.142 in the pre-change period, which increases to 0.166 in the post-change period. This suggests that IFRS firms switching to dual reporting under IFRS and U.S. GAAP exhibit higher levels of risk-relevant information after the change.

Column (3) shows results for $IFRS^{Only}$. As reported in Column (3), the correlation coefficient slightly shifts from 0.153 to 0.152 in the post-change period. This suggests that risk relevance decreased when IFRS firms choose to report only IFRS information on Form 20-F.

Column (4) shows results for $IFRS^{US}$. The correlation coefficient in Column (4) shifts from 0.500 to 0.877 in the post-change period. Column (5) shows the results for other ADRs that reconcile non-IFRS local GAAP to U.S. GAAP. The correlation coefficient in Column (5) is 0.072 in the pre-elimination period and reduces to 0.054 in the post- elimination period.

Overall, the correlation analysis in Table 4 outlines the IFRS firms' reporting choices around the elimination of the Form 20-F reconciliation, as well as the shifts in the correlations between accounting information and systematic risk.

[Insert Table 4 here]

Regression Analyses

In this section, we conduct a multivariate analysis that controls for potential differences across the sample groups. Table 5 reports the regression results. Column (1) reports the regression results for all ADRs. The coefficient on $ABeta \times ELIMINATE$ in Column (1) is 0.019 and is statistically significant at the 10% level, which indicates that eliminating Form 20-F reconciliation has a positive effect on risk relevance. Relatively, the insignificant coefficient on $ABeta \times ELIMINATE$ in Column (6) suggests that eliminating Form 20-F reconciliation has little influence on the matched U.S. companies.

Columns (2), (3), (4), and (5) of Table 4 further report the regression results according to the IFRS firms' reporting choices related to Form 20-F. Among these columns, we mainly shed light on Column (3). We expect a positive sign on $ABeta \times ELIMINATE$ in Column (3) if $IFRS^{Only}$ convey incremental risk-relevant accounting information.

The coefficient on $ABeta \times ELIMINATE$ in Column (2) is significantly positive (0.035; p-value=0.04), which indicates that the IFRS firms' decision to report accounting numbers under both IFRS and U.S. GAAP is associated with higher levels of risk relevance. For $IFRS^{Only}$, the coefficient on $ABeta \times ELIMINATE$ in Column (3) is significantly negative (-0.031; p-value=0.04). This indicates that the risk relevance was lower when IFRS firms switch to providing financial-reporting users with accounting information under IFRS. The insignificant coefficient on $ABeta \times ELIMINATE$ in Column (4) indicates that there is no significant change in risk relevance when IFRS firms switch to being U.S. companies and filing Form 10-K in accordance with U.S. GAAP. For other non-IFRS ADRs, the insignificant coefficient on $ABeta \times ELIMINATE$ in Column (5) indicates no significant change in risk relevance after eliminating the Form 20-F reconciliation.

Consistent with prior studies (Beaver et al. 1970; Beaver and Manegold 1975), the negative coefficients on *SIZE* in most of the Columns indicate that larger firms are less risky than smaller firms. The coefficients on *DFL* and *IBR* in some of the Columns are significantly positive, indicating that a firm's financial leverage and intrinsic business risks are positively related to market risk. The results of the relation between market beta and legal system are mixed. The coefficient on *CIVIL* in Column (3) is positive and significant at the 10% level, which suggests that IFRS firms in civil law countries that provide only IFRS information have higher market betas than other IFRS firms with similar decisions. The coefficient on *CIVIL* in Column (5) is significantly negative, suggesting that non-IFRS ADRs coming from civil law countries have lower market betas than other non-IFRS ADRs.

Collectively, the regression analysis indicates that IFRS firms switching to reporting under IFRS information do not provide incremental risk-relevant accounting information. By contrast, IFRS firms that switch to dual reporting under IFRS and U.S. GAAP provide more risk-relevant accounting information.

[Insert Table 5 here]

We further compare the risk relevance of IFRS with that of U.S. GAAP. Therefore, we run Equation (4) with two sets of samples. One set contains $IFRS^{Only}$ and $IFRS^{US}$. The other set contains $IFRS^{Only}$ and the matched U.S. companies.

Columns (1) and (2) of Table 6 show the regression results for the first set of samples before and after the decisions related to IFRS firm disclosure choices, respectively. The coefficient on $ABeta \times ONNLYIFRS$ in Column (1) is statistically insignificant, which suggests that the relation between accounting risk and market risk for the $IFRS^{Only}$ is not different from $IFRS^{US}$ before their decisions. Following their decisions, the risk-relevance difference between $IFRS^{Only}$ and $IFRS^{US}$ in Column (2) is statistically insignificant, too.

Columns (3) and (4) of Table 6 report the regression results for the second set of samples before and after the decisions related to IFRS firm disclosure choices. The coefficient on $ABeta \times ONNLYIFRS$ in Column (3) is significantly positive (0.032; p-value<0.01), which indicates that $IFRS^{Only}$ has higher risk relevance than U.S. companies required to reconcile IFRS to U.S. GAAP. After the $IFRS^{Only}$ choose single reporting under IFRS, the risk-relevance difference became statistically insignificant. This is evidenced by the insignificant coefficient on $ABeta \times ONNLYIFRS$ in Column (4). Overall, the regression results in Table 6 suggest that the risk relevance under the IFRS is not different from that under U.S. GAAP.

[Insert Table 6 here]

5. Extensions

Risk-Relevant Accounting Information and Idiosyncratic Risk

In previous analyses, we observe that the impact of Form 20-F reconciliation elimination on the relation between systematic risk and accounting risk varies with IFRS firm reporting decisions. We find that IFRS firms have higher risk relevance after they chose dual reporting under IFRS and U.S. GAAP as compared to those choosing single reporting. In their study, Hughes, Liu, and Liu (2007) document that greater information asymmetry related to systematic factors is associated with higher uncertainty and costs of capital. Rajgopala and Venkatachalam (2011) find higher earnings quality to be associated with lower idiosyncratic return volatility. In this section, we further investigate the impact of IFRS firms' reporting choices on idiosyncratic risk. Building on those studies, we expect that companies having high risk relevance related to accounting information exhibit low levels of idiosyncratic risk.

Following Ferreira and Laux (2007), we use three indices to measure idiosyncratic risk: (1) annualized monthly idiosyncratic volatility estimated from the market model, (2) the logarithm of idiosyncratic volatility relative to market-wide volatility, and (3) idiosyncratic volatility to total volatility.

Table 7 reports the idiosyncratic risks of the ADRs and the matched U.S. firms before and after eliminating Form 20-F reconciliation, as well as the idiosyncratic risks of IFRS firms with different types of reporting choices. Panel A of Table 7 shows that the idiosyncratic risks of IFRS firms do not change significantly with the exception of $\text{IFRS}^{\text{Both}}$. In Column (2) of Panel A, the mean idiosyncratic variance declines significantly from 0.149 to 0.106 after $\text{IFRS}^{\text{Both}}$ choose to report accounting numbers under both IFRS and U.S. GAAP. In Column (2) of Panel B, the idiosyncratic risk relative to market-wide risks declines significantly by 0.216, which indicates that $\text{IFRS}^{\text{Both}}$ have lower idiosyncratic risk relative to market-wide risks following their decisions. The outcomes in Panel C are quite similar to those in Panel B. $\text{IFRS}^{\text{Both}}$ have the lowest growth rate in idiosyncratic to total risks.

Collectively, the results in Table 7 suggest that the IFRS firms reporting both IFRS and U.S. GAAP information have lower levels of idiosyncratic risk following their decisions.

[Insert Table 7 here]

We next further conduct a multivariate analysis. As shown in Equation (5), the idiosyncratic risk is regressed on an indicator variable that represents the period following the elimination of Form 20-F reconciliations or a change in disclosure policies, as well as several variables that control for size, growth opportunities, and legal system.

$$IdioMRisk_{it} = \gamma_0 + \gamma_1 ELIMINATE + \gamma_2 SIZE_{it} + \gamma_3 MB_{it} + \gamma_4 CIVIL + \varepsilon_{it}, \quad (5)$$

where $IdioMRisk_{it}$ is annualized monthly idiosyncratic volatility estimated from the market model. *ELIMINATE* is a dummy variable that equals 1 if the year is after 2007 or the year in which the firm changed its disclosure policies, and 0 otherwise. *ONLYIFRS* is a dummy variable that equals 1 if an IFRS firm shifts to reporting only IFRS information after the elimination of Form 20-F reconciliation, and 0 otherwise. $SIZE_{it}$ is the logarithm of total assets of the *i*th firm in year *t*. MB_{it} is the market-to-book ratio of the *i*th firm in year *t*. *CIVIL* is a dummy variable that equals 1 if the firm is in a civil law country, and 0 otherwise.

Table 8 reports the results of the multivariate analysis. The coefficient on *ELIMINATE* in Column (2) is significantly negative (-0.043; $p<0.01$), indicating that the idiosyncratic variances for the $\text{IFRS}^{\text{Both}}$ decrease after companies decide to provide both IFRS and U.S. GAAP information. By contrast, there is no significant change in the idiosyncratic variances for other types of IFRS firms, evidenced by insignificant coefficients on *ELIMINATE*.

[Insert Table 8 here]

Value Relevance of IFRS and U.S. GAAP

In this section, we examine whether dual-reporting IFRS firms provide incremental, value-relevant accounting information. According to CAPM, systemic risk is the major determinant of a capital asset's required rate of return, which is related to its value. Based on this logic, we therefore infer that firms with dual disclosure, which provide more risk-relevant accounting information, might also be more conducive to value-relevant accounting information.

We examine the explanatory power of three value-relevance metrics commonly used in empirical studies[14]:stock price, stock return, and cash flow. In addition to firm-specific variables, the value-relevance metrics include an indicator variable that represents economic downturn during the sample period. For each value-relevance metric, we focus on the difference in R-squared from the regression models before and after the firm's decision. Based on prior research, we interpret a higher R-squared as evidence of greater value relevance. Equations (6), (7), and (8) express the value-relevance metrics. We estimate significance levels for all comparisons of R-squared using univariate analysis

$$P_{it} = \beta_0 + \beta_1 BVE_{it} + \beta_2 EPS_{it} + \beta_3 Crisis + \varepsilon_{it}\,, \tag{6}$$

$$Return_{it} = \beta_0 + \beta_1 \frac{EPS_{it}}{P_{it-1}} + \beta_2 \frac{\Delta EPS_{it}}{P_{it-1}} + \beta_3 LOSS_{it} + \beta_4 LOSS_{it} \times \frac{EPS_{it}}{P_{it-1}}$$
$$+ \beta_5 LOSS_{it} \times \frac{\Delta EPS_{it}}{P_{it-1}} + \beta_6 Crisis + \varepsilon_{it}\,, \tag{7}$$

$$CF_{it} = \beta_0 + \beta_1 \frac{EPS_{it}}{TA_{it-1}} + \beta_2 Crisis + \varepsilon_{it}\,, \tag{8}$$

where P_{it} is the mean value of the 12-month stock price three months after the beginning of the fiscal year. BVE_{it} is book value of equity per share of the *i*th firm in year *t*. EPS_{it} is net income before extraordinary items per share of the *i*th firm in year *t*. *Crisisit* is a dummy variable that equals 1 if the year is 2000 or 2008, and 0 otherwise. $Return_{it}$ is annualized monthly stock returns three months after the beginning of the fiscal year. $LOSS_{it}$ is a dummy variable that equals 1 if the EPS of the *i*th firm in year *t* is negative, and 0 otherwise. CF_{it+1} is net cash flow from operations of the *i*th firm in year *t+1*, scaled by lagged total assets. TA_{it-1} is one-year lagged total assets of the *i*th firm.

Table 9 reports the results. In the case of the stock price metric, the difference in R-squared values between the IFRS firms and the matched U.S. companies is significantly negative (-0.061; p=0.02) during the pre-change period, indicating that the IFRS firms have less value-relevant accounting information than U.S. companies. This difference becomes statistically insignificant during the post-change period. The change in difference is 0.121 and is statistically significant. In Columns (2) and (3), the results for the stock return and cash flow metrics are quite similar as well. This suggests that the value relevance of accounting numbers for ADRs increases over time.

We shed further light on the value relevance for each type of IFRS firm according to the forms of disclosure on Form 20-F. Before the change, $IFRS^{Both}$ has less value relevance than the matched U.S. companies. This is shown via the negative differences in R-squared values for all the metrics (-0.049 for *Price*, -0.002 for *Return*, and -0.121 for *Cash Flow*). $IFRS^{Both}$ exhibits significantly more value-relevant accounting information than U.S. companies during the post-change period, evidenced with significantly positive differences for all the

[14] Amir and Lev (1996), Collins, Maydew, and Weiss (1997), Harris and Muller (1999), Song, Thomas, and Yi (2010), and Barth et al. (2012).

metrics (0.177 for *Price*, 0.164 for *Return*, and 0.081 for *Cash Flow*). The differences in the changes in value-relevance for $\text{IFRS}^{\text{Both}}$ are all significantly positive, measured with the three metrics (0.227 for *Price*, 0.162 for *Return*, and 0.203 for *Cash Flow*). These results indicate value relevance increases when $\text{IFRS}^{\text{Both}}$ choose dual reporting under IFRS and U.S. GAAP. In the case of $\text{IFRS}^{\text{Only}}$, the difference in value relevance before and after the change is statistically insignificant. Consistent with Eng et al. (2014), this result suggests that single reporting under IFRS fails to offer incremental, value-relevant accounting information. Similarly, IFRS^{US} does not exhibit incremental value relevance after switching to reporting under U.S. GAAP.

Collectively, the findings in Table 9 suggest that dual reporting under IFRS and U.S. GAAP is necessary, even though accounting numbers under IFRS are sufficiently comparable to U.S. GAAP.

[Insert Table 9 here]

Alternative Measures of Earnings

Following Baran et al. (1980), we re-perform the analyses with three earnings variables: (a) net income before non-recurring items, divided by common equity, (b) net income before non-recurring items, divided by market value, and (c) net income before non- recurring items and depreciation, divided by market value. The unreported results indicate that the findings remain robust when we use these earnings variables.

6. Conclusions and suggestions

The main purpose of this study is to investigate if principle-based accounting standards provide more relevant information than rule-based accounting standards for evaluating systematic risk. Through a series of tests of ADRs and the matched U.S. companies from 1991 to 2012, we do not find a significant difference in risk relevance between principle-based and rule-based accounting standards. In the analysis according to ADR reporting choices, we find that dual reporting under IFRS and U.S. GAAP conveys incremental risk-relevant accounting information to external users compared to single reporting under IFRS.

We further investigate whether this incremental risk relevance is associated with lower idiosyncratic risks and more value-relevant accounting information.

The findings show that ADRs selecting dual reporting under IFRS and U.S. GAAP have lower idiosyncratic risks and value relevance following their decisions. This implies that dual disclosure helps eliminate information asymmetry, which reduces firm-specific risks and is conducive to value-relevant accounting information. Although our findings that single reporting under IFRS fails to offer incremental value-relevant accounting information is consistent with those of a previous study (i.e., Eng et al. 2014), we find that dual reporting under IFRS and U.S. GAAP is important, although accounting numbers under IFRS are sufficiently comparable to U.S. GAAP. Finally, we change different earning measures following Baran et al. (1980) for our tests and still obtain consistent results.

The findings must be tempered by several limitations. First, although we assume a linear relationship between accounting and market betas, the relationship could be nonlinear. However, this is beyond the scope of our research. Second, although 20-F reconciliations provide useful descriptive evidence on the magnitude and direction of the differences between IFRS and U.S. GAAP, the findings may not apply to all U.S. firms and hence should be interpreted cautiously.

Based on the aforementioned limitations, we propose several avenues for future research. First, future studies could provide direct evidence by conducting field research. Furthermore, future studies could embrace the nonlinear relationship between the IFRS and the U.S. GAAP when comparing differences in risk-relevance. In addition, future studies could investigate how to improve the risk relevance of accounting information.

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Table 1
Sample Selection

Panel A: Sample Selection

Criterion	**Firm-Years**	**Firms**
Preliminary merged ADRs with required financial and stock return data available on *Compustat* (1991-2012).	10,702	989
Less: Missing values of variables required for the regression analyses and the top and the bottom 1% and 99% of all variables, as well as financial institutions	(2,680)	(142)
Less: ADRs that do not have data for at least two years before and one year after 2007, the first year IFRS firms changed their accounting principles, and filings of Form 20-F unavailable in the EDGAR system.	(2,939)	(512)
Data available	5,083	335
Less: control firms unavailable	(895)	(61)
Final matched sample of ADR firms	4,188	274

Panel B: Sample Distribution of IFRS Firms by Disclosure Policies in Form 20-F

Types of Disclosure after Elimination	**Firm-Years**	**Firms**
(1) $IFRS^{Both}$	1,168	73
(2) $IFRS^{Only}$	1,957	127
(3) $IFRS^{US}$	30	2
Total	3,155	189

Notes: $IFRS^{Both}$ refers to IFRS firms that provide both IFRS and U.S. GAAP information. $IFRS^{Only}$ refers to IFRS firms that merely provide IFRS information. $IFRS^{US}$ refers to IFRS firms that became U.S. companies and followed U.S. GAAP when the U.S. ownership exceeds 50% of issued share capital, or the firms reincorporated in the United States.

Table 2
Industry and Time Sample Distribution of ADR firms

Panel A: Industry Distribution

Two-Digit SIC Code	Description	Firm-Years	% of Sample
10	Metal, Mining	189	4.5
12	Coal Mining	15	0.4
13	Oil and Gas Extraction	116	2.8
16	Heavy Construction, Except Building	20	0.5
20	Food and Kindred Products	251	6.0
21	Tobacco Products	36	0.9
23	Apparel and Other Textile Products	65	1.6
25	Furniture and Fixtures	20	0.5
26	Paper and Allied Products	67	1.6
27	Printing, Publishing, and Allied Industries	48	1.1
28	Chemicals and Allied Products	542	12.9
29	Petroleum Refining and Related Industries	83	2.0
32	Stone, Clay, Glass, and Concrete Products	57	1.4
33	Primary Metal Industries	156	3.7
34	Fabricated Metal Products	21	0.5
35	Industrial Machinery and Equipment	235	5.6
36	Electronic and Other Electrical Equipment	404	9.6
37	Transportation Equipment	136	3.2
38	Instruments and Related Products	130	3.1
39	Miscellaneous Manufacturing Industries	26	0.6
40	Railroad Transportation	17	0.4
42	Motor Freight Transportation and Warehousing	15	0.4
44	Water Transportation	63	1.5
45	Transportation by Air	103	2.5
47	Transportation Services	10	0.2
48	Communications	566	13.5
49	Electric, Gas, and Sanitary Services	245	5.9
50	Wholesale Trade-Durable Goods	37	0.9
51	Wholesale Trade-non-Durable Goods	48	1.1
52	Building Materials and Gardening Supplies	12	0.3
53	General Merchandise Stores	18	0.4
54	Food Stores	68	1.6
58	Eating and Drinking Places	10	0.2
59	Miscellaneous Retail	22	0.5
70	Hotels and Other Lodging Places	22	0.5
73	Business Services	237	5.7
78	Motion Pictures	13	0.3
80	Health Services	17	0.4
87	Engineering and Management Services	35	0.8
99	Nonclassifiable Establishments	13	0.3
	Total	4,188	100%

Panel B: Time Distribution

Year	Number of Firms	%	Year	Number of Firms	%	Year	Number of Firms	%
1991	55	1.3	1999	172	4.1	2007	274	6.5
1992	65	1.6	2000	205	4.9	2008	274	6.5
1993	80	1.9	2001	220	5.3	2009	260	6.2
1994	89	2.1	2002	226	5.4	2010	253	6.0
1995	99	2.4	2003	239	5.7	2011	244	5.8
1996	117	2.8	2004	255	6.1	2012	234	5.6
1997	129	3.1	2005	267	6.4			
1998	157	3.7	2006	274	6.5			

Table 3
Descriptive Statistics

Variables	Mean: ADRs (N=274)	Mean: U.S. Firms (N=274)	Mean: Difference (t-stat.)	Median: ADRs (N=274)	Median: U.S. Firms (N=274)	Median: Difference (z-stat.)
Log of market capitalization	8.678	8.467	0.211 [1.34]	8.968	8.687	0.281* [1.71]
Log of total assets	8.636	8.375	0.261 [1.67]	9.002	8.683	0.319** [2.20]
Market to book ratio	3.308	3.056	2.251 [0.31]	2.172	2.507	-0.335 [-1.61]
Debt ratio	0.508	0.541	-0.033* [-1.72]	0.506	0.547	-0.041* [-1.73]
ABeta	1.859	1.965	-0.106 [-0.59]	1.135	1.320	-0.185 [-0.99]
MBeta	0.992	0.974	0.018 [0.30]	0.872	0.785	0.087 [1.38]

Notes: *refers to significant at the 10% level; ** refers to significant at the 5% level; *** refers to significant at the 1% level, using a two-tailed test. t-statistic/z-statistics for the difference in means/Wilcoxon sign-rank test for the difference of medians. T-statistics are given in brackets. Table 3 compares 274 ADRs (4,188 firm-years) with their matched U.S. firms in the year 2007 or in the year in which the ADR firms changed their disclosure policies. Market-to-Book ratio is determined by dividing market capitalization by total stockholders' equity. Debt ratio is determined by dividing total liabilities by total assets. Accounting Beta (*ABeta*) is the slope coefficient estimated from Equation (1). Market Beta (*MBeta*) is the slope coefficient estimated from Equation (2).

Table 4
Correlation between Market and Accounting Betas

	Test Sample					Control Sample
	Sample Subgroups of ADRs					
	(1) ADRs	(2) IFRS^{Both}	(3) IFRS^{Only}	(4) IFRS^{US}	(5) Other ADRs	(6) US Firms
Pre-Period Correlation	0.121***	0.142***	0.153***	0.500**	0.072*	0.038**
(p-value)	(<0.01)	(<0.01)	(<0.01)	(0.02)	(0.06)	(0.02)
Post-Period Correlation	0.125***	0.166***	0.152***	0.877***	0.054*	0.082***
(p-value)	(<0.01)	(<0.01)	(<0.01)	(<0.01)	(0.05)	(<0.01)

Notes: *refers to significant at the 10% level; ** refers to significant at the 5% level; *** refers to significant at the 1% level. The correlation of the accounting and the market betas is the Pearson Correlation between the two betas. The ADRs are classified into four subsamples depending on firm disclosure policies after the Form 20-F reconciliation elimination. IFRS^{Both} represents the ADRs that disclosed both IFRS and U.S. GAAP information. IFRS^{Only} represents the ADRs that only disclosed IFRS information. IFRS^{US} represents the ADRs that changed from disclosing IFRS to disclosing U.S. GAAP information. *Other ADRs* represents the firms that disclosed reconciled U.S. GAAP and local GAAP information. *US Firms* represents the matched U.S. companies. The pre- or post-elimination periods are separated based on the year 2007 or the year in which the firms change their disclosure policies.

Table 5
Risk Relevance for the ADRs and the Matched U.S. Companies

Independent Variables	(1) ADRs	Subgroups of ADRs (2) $IFRS^{Both}$	(3) $IFRS^{Only}$	(4) $IFRS^{US}$	(5) Other ADRs	(6) U.S. Firms
(γ_0) *Intercept*	1.474*** (<0.01)	1.430*** (<0.01)	1.405*** (<0.01)	0.544*** (<0.01)	1.521*** (<0.01)	1.459*** (<0.01)
(γ_1) *ABeta*	0.027*** (<0.01)	0.019* (0.05)	0.027*** (<0.01)	0.032* (0.09)	0.011 (0.34)	0.009* (0.08)
(γ_2) *ELIMINATE*	-0.044 (0.16)	-0.052 (0.24)	0.018 (0.71)	-0.392** (0.02)	-0.012 (0.86)	-0.002 (0.96)
(γ_3) *ABeta×ELIMINATE*	0.019* (0.07)	0.035** (0.04)	-0.031** (0.04)	0.084 (0.14)	0.017 (0.38)	0.013 (0.21)
(γ_4) *SIZE*	-0.059*** (<0.01)	-0.067*** (<0.01)	-0.029*** (<0.01)	0.049*** (<0.01)	-0.035** (0.01)	-0.064*** (<0.01)
(γ_5) *DOL*	0.006 (0.35)	0.006 (0.98)	0.004 (0.68)	-0.008 (0.66)	-0.020 (0.59)	0.001 (0.83)
(γ_6) *DFL*	-0.004 (0.34)	-0.005 (0.87)	-0.013 (0.36)	0.046 (0.59)	-0.003 (0.57)	0.006** (0.02)
(γ_7) *IBR*	0.000*** (<0.01)	-0.141 (0.16)	0.099 (0.37)	0.166 (0.61)	0.083*** (<0.01)	0.652*** (<0.01)
(γ_8) *ΔGDP*	-0.606 (0.28)	0.011 (0.98)	-0.763 (0.34)	0.111 (0.90)	-0.106 (0.93)	-0.101 (0.87)
(γ_9) *CIVIL*	-0.021 (0.29)	-0.001 (0.95)	0.053* (0.08)		-0.380*** (<0.01)	
Adjusted R^2	5.6%	7.5%	1.4%	78.7%	13.8%	3.1%
F-statistic	25.80	10.16	3.28	13.79	17.48	20.51
N	4,188	1,168	1,957	30	1,033	4,985

Notes: *refers to significant at the 10% level; ** refers to significant at the 5% level; *** refers to significant at the 1% level. P-values are given in parentheses. The samples consist of 4,188 ADR firms and 4,985 U.S. firm-year observations from 1991-2012.

The ADRs are classified into four subsamples depending on firm disclosure policies after the Form 20-F reconciliation elimination. $IFRS^{Both}$ represents the ADRs that disclosed both IFRS and U.S. GAAP information. $IFRS^{Only}$ represents the ADRs that only disclosed IFRS information. $IFRS^{US}$ represents the ADRs that changed from disclosing IFRS to disclosing U.S. GAAP information. *Other ADRs* represents the firms that disclose reconciled U.S. GAAP and local GAAP information. *U.S. Firms* represents the matched U.S. companies.

$MBeta_{it}$ is the market beta of the ith firm in year t, estimated from equation (2). $ABeta_{it}$ is the accounting beta of the ith firm in year t, estimated from equation (1). *ELIMINATE* is a dummy variable that equals 1 if the year is within the years after year 2007 or the year in which the firms change their disclosure policies, and 0 otherwise. $SIZE_{it}$ is the logarithm of total assets of the ith firm in year t. DOL_{it} is the firm's degree of operating leverage, measured by the ratio of percentage change in earnings before interest and taxes to percentage change in sales in year t. DFL_{it} is the firm's degree of financial leverage, measured by the ratio of percentage change in earnings per share to percentage change in earnings before interest and taxes in year t. IBR_{it} is the firm's intrinsic business risks, measured following Mensah (1992). ΔGDP is annual percentage change in gross domestic product in year t. *CIVIL* is a dummy variable that equals 1 if the firm is in a civil law country, and 0 otherwise.

Table 6
Relative Risk Relevance Between IFRS and U.S. GAAP

	IFRS^{Only} and IFRS^{US}		IFRS^{Only} and U.S. Firms	
Independent Variables	**(1) Pre-Period**	**(2) Post-Period**	**(3) Pre-Period**	**(4) Post-Period**
(γ_0) *Intercept*	1.343***	-0.037	1.369***	1.432***
	(<0.01)	(0.95)	(<0.01)	(<0.01)
(γ_1) *ABeta*	0.034	0.277*	0.013**	0.024***
	(0.79)	(0.07)	(0.01)	(<0.01)
(γ_2) *ONLYIFRS*	0.106	0.241*	0.003	-0.024
	(0.71)	(0.08)	(0.92)	(0.65)
(γ_3) *ABeta×ONLYIFRS*	0.011	-0.239	0.032***	0.012
	(0.92)	(0.12)	(<0.01)	(0.43)
(γ_4) *SIZE*	-0.049***	-0.045***	-0.048***	-0.066***
	(<0.01)	(<0.01)	(<0.01)	(<0.01)
(γ_5) *DOL*	-0.014	0.007	0.001	0.002
	(0.68)	(0.51)	(0.81)	(0.72)
(γ_6) *DFL*	-0.009	-0.019	0.008**	-0.006
	(0.51)	(0.11)	(0.01)	(0.15)
(γ_7) *IBR*	0.254**	0.341**	0.058	0.105
	(0.02)	(0.03)	(0.15)	(0.52)
(γ_8) *ΔGDP*	-2.623**	0.861	-1.353*	0.462
	(0.01)	(0.42)	(0.06)	(0.49)
(γ_9) *CIVIL*	0.098**	0.213***	0.097**	0.208***
	(0.01)	(<0.01)	(0.01)	(<0.01)
Adjusted R^2	5.2%	6.9%	2.9%	4.6%
F-statistic	8.31	5.53	15.83	11.18
N	1,373	614	4,945	1,997

Notes: *refers to significant at the 10% level; ** refers to significant at the 5% level; *** refers to significant at the 1% level. P-values are given in parentheses. The samples consist of 3,912 ADR firms and 4,661 U.S. firm-year observations from 1991-2012.

IFRS^{Only} represents the ADRs that only disclose IFRS information. IFRS^{US} represents the ADRs that changed from disclosing IFRS to disclosing U.S. GAAP information. *US Firms* represents the matched U.S. companies.

$MBeta_{it}$ is the market beta of the *i*th firm in year *t*, estimated from equation (2). $ABeta_{it}$ is the accounting beta of the *i*th firm in year *t*, estimated from equation (1). *ONLYIFRS* is a dummy variable that equals 1 if an IFRS firm shifts to reporting only IFRS information after the elimination of Form 20-F reconciliation, and 0 otherwise. $SIZE_{it}$ is the logarithm of total assets of the *i*th firm in year *t*. DOL_{it} is the firm's degree of operating leverage, measured by the ratio of percentage change in earnings before interest and taxes to percentage change in sales in year *t*. DFL_{it} is the firm's degree of financial leverage, measured by the ratio of percentage change in earnings per share to percentage change in earnings before interest and taxes in year *t*. IBR_{it} is the firm's intrinsic business risks, measured following Mensah (1992). *ΔGDP* is annual percentage change in gross domestic product in year *t*. *CIVIL* is a dummy variable that equals 1 if the firm is in a civil law country, and 0 otherwise.

Table 7
Comparison of Idiosyncratic Risk

Panel A: Idiosyncratic Volatility

	Test Sample					Control Sample
		Subgroups of ADRs				
	(1) ADRs	(2) $IFRS^{Both}$	(3) $IFRS^{Only}$	(4) $IFRS^{US}$	(5) Other ADRs	(6) U.S. Firms
Pre-Period Volatility	0.109***	0.149***	0.091***	0.077*	0.096***	0.096***
Post-Period Volatility	0.101**	0.106***	0.091**	0.053*	0.111***	0.109**
Post Minus Pre	-0.008	-0.042***	-0.000	-0.023	-0.014	0.012**
	(0.12)	(<0.01)	(0.97)	(0.58)	(0.17)	(0.02)

Panel B: Logarithm of Idiosyncratic Volatility Relative to Market-Wide Volatility

	(1) ADRs	(2) $IFRS^{Both}$	(3) $IFRS^{Only}$	(4) $IFRS^{US}$	(5) Other ADRs	(6) U.S. Firms
Pre-Period Volatility	0.686***	1.191***	0.467***	0.458*	0.411***	0.524***
Post-Period Volatility	0.914***	0.974***	0.790***	0.536*	1.042***	0.927***
Post Minus Pre	0.228***	-0.216**	0.322***	0.078	0.631***	0.402***
	(<0.01)	(0.01)	(<0.01)	(0.82)	(<0.01)	(<0.01)

Panel C: Idiosyncratic Volatility to Total Volatility

	(1) ADRs	(2) $IFRS^{Both}$	(3) $IFRS^{Only}$	(4) $IFRS^{US}$	(5) Other ADRs	(6) U.S. Firms
Pre-Period Volatility	0.029***	0.030***	0.028**	0.008*	0.026***	0.028***
Post-Period Volatility	0.049**	0.034***	0.045**	0.016*	0.060***	0.060***
Post Minus Pre	0.019***	0.004**	0.016***	0.007*	0.034***	0.031***
	(<0.01)	(0.03)	(<0.01)	(0.07)	(<0.01)	(<0.01)

Notes: *refers to significant at the 10% level; ** refers to significant at the 5% level; *** refers to significant at the 1% level. P-values are given in parentheses. The ADRs are classified into four subsamples depending on firm disclosure policies after the Form 20-F reconciliation elimination. $IFRS^{Both}$ represents the ADRs that disclose both IFRS and U.S. GAAP information. $IFRS^{Only}$ represents the ADRs that only disclose IFRS information. $IFRS^{US}$ represents the ADRs that change from disclosing IFRS to disclosing U.S. GAAP information. *Other ADRs* represents the firms that disclose reconciled U.S. GAAP and local GAAP information. *US Firms* represents the matched U.S. companies.

Table 8
Regression Results of Idiosyncratic Risk

		Subgroups of ADRs				
Independent Variables	**(1) ADRs**	**(2) IFRS^{Both}**	**(3) IFRS^{Only}**	**(4) IFRS^{US}**	**(5) Other ADRs**	**(6) U.S. Firms**
(γ_0) *Intercept*	0.071*** (<0.01)	0.166*** (<0.01)	0.059*** (<0.01)	-0.012 (0.90)	0.061*** (<0.01)	0.075*** (<0.01)
(γ_1) *ELIMINATE*	-0.003 (0.54)	-0.043*** (<0.01)	-0.003 (0.72)	-0.031 (0.60)	0.014 (0.16)	0.011** (0.12)
(γ_2) $SIZE_{it}$	0.003*** (<0.01)	-0.002 (0.68)	0.004 (0.02)	0.008 (0.62)	0.004 (0.10)	0.002** (0.03)
(γ_3) MB_{it}	-0.000 (0.27)	-0.001 (0.21)	-0.000 (0.16)	-0.000 (0.95)	0.001 (0.18)	0.000 (0.81)
(γ_4) *CIVIL*	0.000 (0.97)	0.002 (0.84)	0.001 (0.85)	0.025 (0.47)	-0.007 (0.53)	
Adjusted R^2	0.1%	1.5%	1.3%	5.2%	0.6%	0.1%
F-statistic	2.12	3.13	3.10	0.48	2.08	3.31
N	4,188	1,168	1,957	30	1,033	4,985

Notes: *refers to significant at the 10% level; ** refers to significant at the 5% level; *** refers to significant at the 1% level. $IdioMRisk_{it}$ is annualized monthly idiosyncratic volatility estimated from the market model. *ELIMINATE* is a dummy variable that equals 1 if the year is within the years after year 2007 or the year in which the firms change their disclosure policies, and 0 otherwise. *ONLYIFRS* is a dummy variable that equals 1 if an IFRS firm shifts to reporting only IFRS information after the elimination of Form 20-F reconciliation, and 0 otherwise. $SIZE_{it}$ is the logarithm of total assets of the *i*th firm in year *t*. MB_{it} is the market-to-book ratio of the *i*th firm in year *t*. *CIVIL* is a dummy variable that equals 1 if the firm is located in a civil law country, and 0 otherwise.

Table 9
Value Relevance Comparability

	(1) Price	(2) Return	(3) Cash Flow
Pre-Period R-Squared Difference			
IFRS Firms-U.S. Firms	-0.061** (0.02)	0.032 (0.45)	-0.039 (0.23)
$IFRS^{Both}$–U.S. Firms	-0.049 (0.22)	-0.002 (0.97)	-0.121*** (<0.01)
$IFRS^{Only}$–U.S. Firms	0.055 (0.24)	0.060 (0.25)	-0.003 (0.94)
$IFRS^{US}$–U.S. Firms	0.183 (0.64)	-0.064 (0.83)	0.044 (0.85)
Post-Period R-Squared Difference			
IFRS Firms – U.S. Firms	0.070 (0.13)	0.125 (0.11)	0.128*** (<0.01)
$IFRS^{Both}$ – U.S. Firms	0.177*** (<0.01)	0.164* (0.05)	0.081** (0.04)
$IFRS^{Only}$ – U.S. Firms	-0.000 (0.99)	0.014 (0.91)	0.044 (0.37)
$IFRS^{US}$ – U.S. Firms	0.147 (0.95)	0.074 (0.33)	0.091 (0.79)
Post-Period R-Squared Minus Pre-Period R-Squared			
Change in difference: IFRS Firms – U.S. Firms	0.121*** (<0.01)	0.092** (0.01)	0.167*** (<0.01)
Change in difference: $IFRS^{Both}$ – U.S. Firms	0.227*** (<0.01)	0.162** (0.02)	0.203*** (<0.01)
Change in difference: $IFRS^{Only}$ – U.S. Firms	0.055 (0.30)	-0.045 (0.71)	0.047 (0.38)
Change in difference: $IFRS^{US}$ – U.S. Firms	-0.045 (0.93)	0.138 (0.60)	0.047 (0.92)

Notes: *refers to significant at the 10% level; ** refers to significant at the 5% level; *** refers to significant at the 1% level. P-values are given in parentheses. $IFRS^{Both}$ represents the ADRs that disclose both IFRS and U.S. GAAP information. $IFRS^{Only}$ represents the ADRs that only disclose IFRS information. $IFRS^{US}$ represents the ADRs that change from disclosing IFRS to disclosing U.S. GAAP information. *US Firms* represents the matched U.S. companies.

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The Investment Performance of "Ethical" Equity Mutual Funds in the US: An Empirical Investigation

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This papers examines the investment performance of a sample of US ethical equity mutual funds relative to the market and a matching sample of traditional equity mutual funds using a survivorship-bias-free database and a comprehensive and integrated model to simultaneously capture stock selection and market timing skill of fund managers. Our empirical results indicate that the ethical funds perform no worse that their traditional counterparts, although the ethical and traditional funds do not outperform the market. We found some evidence of superior security selection and/or market timing skill among a small number of ethical and traditional funds. It appears that the matching traditional funds have slightly more abnormal (superior as well as inferior) performance than the ethical funds in our sample.
Keywords: Ethical investment, socially responsible investment (SRI), stock screening, positive screening, negative screening, portfolio management, trading strategy, performance evaluation, security selection, market timing.

JEL Classification: A13, G11, G12, G20, G23, M14

1. Introduction

Ethical investing, more popularly known as sustainable, socially conscious, "green" or socially responsible investment (SRI) is the application of ethical as well as financial considerations or screens in investment decision-making. It is an investment strategy based on normative ethical and social values. According to Cowton (1994), ethical investing is "the exercise of ethical and social criteria in the selection and management of investment portfolios." Ethical investment has been defined as putting your money where your morals are, or investing according to your beliefs (Brownlow, 2009). Traditional investment is driven by only financial considerations such as maximizing return or wealth, diversifying risk, and maintaining liquidity. Ethical investing is driven by societal needs and benefits and takes into account non-financial criteria, such as certain attributes of the companies in which money is invested, in addition to the financial considerations of traditional investors. Ethical considerations may include, among others, religious affiliations, beliefs, or values.[1] Knoll (2002) pointed out that ethical considerations might be a screening process or a variable in the selection process. Screens can be either negative (exclusionary) or positive (inclusionary). Negative screening excludes companies that are incompatible with the investors' ethical values while positive screening seeks out companies that act in a manner consistent with the investors' ethical values. Examples of negative screening are excluding companies that are engaged in gambling, pornography, production and distribution of alcohol, tobacco, and weapons, employing under-age workers, damaging the environment, and exploiting animals for cosmetics and apparels. Examples of positive screening include investing in companies that promote environmental improvement, pollution control, community engagement, energy conservation, sustainability, consumer protection, human rights, diversity, and such other stakeholder-friendly activities as well as companies serious about product safety, improved working condition for employees, seeking renewable energy to replace fossil fuels, *etc*. Ethical investing aims at rewarding ethical corporate behavior through positive screening and rebuking unethical corporate behavior through negative screening. The demand for ethical investment opportunities has been growing very rapidly. Assets under management (AUM) of global ethical investment funds climbed to $13.6 trillion at the start of 2012, a 22 percent increase since 2010, according to Global Sustainable Investment Alliance (GSIA), and this represents 21.8 percent of the total global AUM (Global Sustainable Investment Alliance, 2013). In the US alone, sustainable, responsible and impact investing assets have expanded 76 percent in two years: from $3.74 trillion at the start of 2012 to $6.57 trillion at the start of 2014, according to the US SIF Foundation's latest biennial survey, the Report on US Sustainable, Responsible and Impact Investing Trends 2014. As a result, AUM of US ethical funds now accounts for more than one out of every six dollars under professional management in the US (USSIF, 2014).

The purpose of this paper is to examine the investment performance of ethical equity mutual funds in the US using a comprehensive and integrated model. Several prior studies examined investment performance of ethical mutual funds and unit trusts in the US (Hamilton, Jo, and Statman, 1993, Statman, 2000, Bauer, Koedijk, and Otten, 2005, and Benson and Humphrey, 2008) and other countries (Mallin, Saadouni, and Briston, 1995, Gregory, Matatko, and Luther, 1997, Cummings, 2000, Tippet, 2001, Bauer, Koedijk, and Otten, 2005, Kreander, Gray, Power, and Sinclair, 2005, Jones, Laan, Frost, and Loftus, 2008, Renneboog, Horst, and Zhang, 2008a, and Cortez, Silva, and Areal, 2009).[2] Most of these studies examined investment performance of ethical funds employing unconditional risk-adjusted performance measures such as Sharpe's reward to variability ratio, Treynor's reward to volatility ratio, and Jensen's alpha or its multi-factor version based on Fama and French (1993) and Carhart (1997). One weakness of all these measures is focus on fund managers' security selection or selectivity skill only while totally disregarding the manager's ability to time the market. A few studies examined fund managers' market timing skill using a rudimentary market timing model of Treynor and Mazuy (1966) [Gregory and Whittaker, 2007 and Renneboog, Horst, and Zhang, 2008a] or a less sophisticated model of Hendriksson and Merton (1981) [Kreander, Gray, Power, and Sinclair, 2005]. However, the studies using the Treynor-Mazuy model did not correct for heteroscedasticity of regression errors resulting from the fund manager's attempt to time the market. A comprehensive and integrated model to simultaneously capture stock selection and market timing skill has been developed by Jensen (1972) by extending the Treynor-Mazuy model. Bhattacharya and Pfleiderer (1983) further refined the Treynor-Mazuy model and Lee and Rahman (1990) developed the econometric methodology to apply the model in empirical investigation. This refined model has been used to examine investment performance of US equity mutual funds (Lee and Rahman, 1990, 1991) and US equity pension funds (Coggin, Fabozzi, and Rahman, 1993). These studies found evidence of security selection and/or market timing skill in a small number of funds. There is no prior research work in the extant literature examining the investment performance of ethical funds using such a refined model. This paper fills the void in the literature by examining the investment performance of a sample of ethical funds in the US using the Bhattacharya-Pfleiderer model. Another weakness of the majority of previous studies is survivorship bias. These studies excluded funds that disappeared via merger, acquisition or liquidation. In their empirical investigation, Grinblatt and Titman (1989) and Brown and Goeszmann (1995) found survivorship bias of approximately .5 percent per year and this could overstate the performance measures to some extent. This paper is free from survivorship bias as it uses a survivorship-bias-free database. This paper is organized as follows: section II briefly traces the development of the Bhattacharya-Pfleiderer model and discusses its superiority over other measures and justification for using this model in empirical investigation of investment performance of managed portfolios. Section III discusses the data and econometric methodology used in this paper, section IV discusses the empirical results, and section V concludes the paper.

2. A Model for Security Selection and Market Timing Skill

The unconditional risk-adjusted performance measures of Sharpe's reward to variability ratio, Treynor's reward to volatility ratio, and Jensen's alpha assume that the risk level of managed portfolio under consideration is stationary through time and ignore the manager's market timing skill (*i.e.*, ability to shift the overall risk composition of the portfolio by moving into and out of segments of the market). Selling "winners" for realizing capital gains or "losers" for tax purposes and reinvesting the proceeds (not necessarily in the stocks of same risk-class) is one reason risk as measured by standard deviation (in Sharpe's reward to variability ratio) or beta (in Treynor's reward to volatility ratio) changes. Average turnover of mutual funds is another indication that risk changes. Mutual funds have an average turnover rate (*i.e.*, the percentage of a fund's holdings that change every year) of approximately 85 percent, meaning that funds are turning over or selling nearly all of their holdings every year (Barker, n.d). This results in violation of the stationarity assumption of risk made in Sharpe's or Treynor's measure. When fund managers adopt a market-timing strategy, the unconditional measure of Jensen's alpha becomes biased. Jensen (1968) acknowledged the ability of the fund managers to change the risk level of their portfolios in anticipation of broad market movements. Fama (1972) and Jensen (1972) addressed this issue and suggested a somewhat finer breakdown of performance. Fama (1972) suggested that the portfolio manager's forecasting skill could be partitioned into two distinct components: (1) forecasts of price movements of selected individual stocks (selectivity or microforecasting), and (2) forecasts of price movements of the general stock market as a whole (market timing or macroforecasting). This partitioning of forecasting skills is also evident in Treynor and Black (1973) who have shown that portfolio managers can effectively separate actions related to security analysis from those related to market timing. When managers successfully time the market, the measures without controlling market timing behavior are biased (Ferson and Schadt, 1996). Jensen (1968) demonstrated that, in the presence of market timing ability, the estimated measure of systematic risk or beta will be biased downward and the estimated performance measure (Jensen's alpha) will be biased upward. Grant (1978) explained how market timing actions would affect the results of empirical tests that focus only on microforecasting skill.

Admati and Ross (1985) discussed the failure of traditional measures based on CAPM (Treynor's reward-to-volatility ration and Jensen's alpha) to evaluate the fund manager's performance in the presence of changing risk level and information asymmetry. When there is information asymmetry, the manager changes the composition of the portfolio in response to the private information he or she receives. Based on information signal received, the manager forms his or her posterior distribution of assets' returns that is unknown to others and varies over time (depending on what the information happens to be). The true and relevant risk actually carried by the manager now changes over time though other parameters are stationary (Lee and Rahman, 1994). Admati and Ross (1985) also showed that the weakness of CAPM-based measures is applicable to Sharpe's reward-to-variability ratio that is independent of CAPM. Intuitively, although better information implies higher expected returns, it also leads to a larger variance. This results in lower reward-to-variability ratio for better-informed managers (see Lee and Rahman, 1994, for details).

It is apparent that fund managers be evaluated by both selection ability and timing skill. This necessitates modeling selection skill and timing simultaneously. Market timing is common among fund managers. Same fund managers manage ethical and traditional funds and while managing ethical funds, they are primarily driven by investment objectives and constraints of respective funds rather than their own ethical belief. They are more likely to try to time the market (in traditional as well as ethical funds) to increase portfolio returns. It is, therefore, appropriate to examine selectivity and market timing skill of ethical fund managers so that there is no model misspecification leading up to biased estimates. However, whether they are successful market timer is an empirical question.

Using the option-pricing model, Merton (1981) and Henriksson and Merton (1981) developed a measure that permits identification and separation of selectivity and timing skills of fund managers. In their model, the fund manager forecasts whether the stock market will provide a higher or lower return than the risk-free rate. The forecaster does not attempt or is not able to predict by how much stocks will outperform or underperform the risk-free rate. Based on their forecasts, fund managers adjust the relative weight of the market portfolio and the risk-free asset. Merton (1981) demonstrated that the returns on the portfolio using the indicated market timing rule is same as those that would be generated by a strategy of investing in the market portfolio and risk-free asset and acquiring free put options on the market portfolio with an exercise price equal to the risk-free rate. The forecasters in this model are less sophisticated than those of Jensen (1972) where the fund managers have ability to forecast how much better the superior investment will perform. The Henriksson-Merton model, on the other hand, assumes that the managers have a coarse information structure in which binary signals (up or down) are only indicative of the sign or direction (and not the size) of the excess of the market return over the risk-free rate. One weakness of the Henriksson-Merton model is that information is measured but there is no test of whether information is being used correctly (Dybvig and Ross, 1985). In their empirical analysis, Cheng and Lewellen (1984) and Henriksson (1984) found a large number of negative timing coefficients reflecting irrational behavior on the part of the fund managers. In order to generate a negative timing coefficient, the fund managers must possess superior information and employ it irrationally, that is, raise (lower) market risk when the signal indicates that the market will fall (rise). Connor and Korajczyk (1991) termed this behavior *perverse timing*.

Treynor and Mazuy (1966) observed that if the fund managers can forecast market returns, they will hold more high beta stocks or a greater portion of the market portfolio when they expect the market to go up to increase portfolio return. Conversely, they will hold more low beta stocks or a smaller portion of the market portfolio when they expect the market to go down to reduce capital losses. Thus, the portfolio return will be a nonlinear function of the return on the market portfolio. To capture this, the authors added a quadratic term to standard CAPM version of Jensen's alpha:

$$R_{pt} = \alpha_p + \beta_p R_{mt} + \gamma(R_{mt})^2 + \varepsilon_{pt} \tag{1}$$

where R_{pt} is the excess (net of risk-free rate) return on the fund, R_{mt} is the excess (net of risk-free rate) return on the market portfolio, α_p is a measure of security selection skill, β_p measures the sensitivity of the fund return to the market return, γ measures fund manager's market timing skill, and ε_{pt} is a random error with an expected value of zero. Thus, the fund return will be a convex function of the market return. Using annual returns for fifty seven open-end mutual funds, they found that the hypothesis of no market-timing skill can be rejected with 95 percent confidence for only one of the funds.

Jensen (1972) developed a model similar to Treynor-Mazuy model to detect selectivity and timing skill of fund managers. In the Jensen analysis, the fund manager forecasts the market return and the forecasted and actual market return are assumed to have a joint normal distribution. Jensen showed that the fund manager's market timing skill could be measured by the correlation between the forecasted and actual market return. Bhattacharya and

Pfleiderer (1983) corrected an error in Jensen's model and showed that one could use a regression technique to detect selectivity and timing.[3] They specify a relationship in observed variables that is similar to Treynor-Mazuy model:

$$R_{pt} = \alpha_p + \theta\ E(R_{mt})\ (1 - \Psi)\ R_{mt} + \Psi\theta(R_{mt})^2 + \theta\Psi\ \zeta_{pt}\ R_{mt} + \mu_{pt} \tag{2}$$

where

θ = the fund manager's response to information

Ψ = the coefficient of determination between the manager's forecast and excess market return

ζ_{pt} = the error of the manager's forecast

$E(R_{mt})$ = expected excess market return

The quadratic regression of R_{pt} on R_{mt} and $(R_{mt})^2$ allows us to detect manager's selectivity skill from α_p. The error term of eq. (2):

$$\omega_t = \theta\Psi\ \zeta_{pt}\ R_{mt} + \mu_{pt} \tag{3}$$

provides the information to detect the manager's timing skill. We can extract this information by regressing $(\omega_t)^2$ on $(R_{mt})^2$. This regression produces a consistent estimator of $\theta^2\Psi^2\sigma^2_\zeta$, where σ^2_ζ is the variance of the manager's forecast error. We now divide $\theta^2\Psi^2\sigma^2_\zeta$ by the square of $\theta\Psi$ which is the estimated coefficient of $(R_{mt})^2$ in eq. (2), to obtain an estimate of σ^2_ζ . This coupled with knowledge about σ^2_π , the variance of excess market return, allows us to estimate $\Psi = (\sigma^2_\pi)/[\ \sigma^2_\pi + \sigma^2_\zeta] = \rho^2$, where ρ is the correlation coefficient between the manager's forecast and excess return on the market. Finally, we calculate ρ, which truly measures the quality of the manager's timing skill. This model is a refinement of the Treynor-Mazuy model and it is the first model that analyzes the error term to identify a manager's forecasting skill. Such a refinement makes the model more powerful than other competitive models.

3. Data and Methodology

The data for this study consists of monthly returns for the period January 2004 through December 2013 (120 months) for a sample of 67 ethical equity mutual funds in the US with no missing data for the entire sample period or inception through December 2013 for those funds that started after January 2004. This resulted in a maximum number of 120 monthly observations and a minimum number of 49 monthly observations. The list of funds came from US SIF – the Forum for Sustainable and Responsible Investment and the monthly return observations and monthly total net assets were collected from the CRSP survivorship-bias-free US mutual fund database. The monthly returns are net of all management expenses and 12-b fees, but before deducting front- and back-end load fees. These returns are appropriate when evaluating the investment performance of fund managers without regard to whether the managed funds are load or no-load funds. The fund managers do not control load fees which are decided by fund administrators and fund managers should not be evaluated based on returns net of load fees, if there is any. A matched sample of another 67 traditional equity funds was generated from the CRSP mutual fund database to compare the performance of each ethical fund with that of a traditional counterpart. Each ethical fund was matched with a traditional fund that was nearest to it in asset size (measured by monthly total net assets) on December 31st, 2008—the mid-point of the sample period. The matched sample is also free from survivorship-bias as the sample includes funds that disappeared from the database before December 2013—the end of sample period—because of merger, acquisition, or termination. The monthly return on the CRSP value-weighted index including dividends is used for market return. Monthly observations of the 91-day Treasury bill rate are used as a proxy for the risk-free rate.

To compare results, we examined investment performance of fund managers using both the Treynor-Mazuy and the Bhattacharya-Pfleiderer model. It is necessary to correct for heteroscedasticity in both models. In the Treynor-Mazuy model, the error term exhibits conditional heteroscedasticity because of the fund manager's attempt to time the market, even though security returns are assumed to be independent and identically distributed through time. To correct this, following Breen, Jagannathan, and Ofer (1986) and Lehmann and Modest (1987), Coggin, Fabozzi, and Rahman (1993) used heteroscedasticity-consistent covariance matrix estimators proposed by White (1980), Hansen (1982), and Hsieh (1983). Long and Ervin (2000) found this estimator to have weak small sample properties often resulting in incorrect inferences. MacKinnon and White (1985) introduced three alternative heteroscedasticity-consistent covariance matrix estimators that are all asymptotically equivalent to the estimator proposed by White (1980) but typically have strong small sample properties. MacKinnon and White (1985) and Long and Ervin (2000) examined the performance of these estimators in small samples using Monte Carlo simulations in regression models and strongly recommended using the alternative known as HC3 if the sample size is less than 250. We used the HC3 estimator to correct for heteroscedasticity in Treynor-Mazuy model. In the Bhattacharya-Pfleiderer model, the disturbance terms in eq. (2) and (3) are heteroscedastic and standard regression technique does not produce the most efficient estimates. We use the following GLS procedure to obtain efficient estimates of parameters by taking into account the changing variances of the error terms. First, we divide all the variables (on both sides) of eq. (2) by the variance of error term in eq. (2) and all the variables (on both sides) of eq. (3) by the variance of error term in eq. (3). We then apply OLS regression to the transformed observations of eq. (2) and (3) to obtain more efficient estimates [see Lee and Rahman (1990) for details]. The significance tests reported in the next section are based on heteroscedasticity-adjusted t-statistics.

One weakness of the Bhattacharya-Pfleiderer model is its failure to detect negative or inferior market timing (Coggin and Hunter, 1993). We resolve this issue by examining the sign of the coefficient of the squared excess market return in eq. (3) following Coggin, Fabozzi, and Rahman (1993). Intuitively, in the spirit of the Treynor-Mazuy model, the sign of this coefficient is indicative of the nature of the fund manager's timing skill. If this coefficient is negative, we designate timing skill (as measured by ρ) to be poor or negative. This modification makes the model more realistic. A similar adjustment of the Bhattacharya-Pfleiderer model was implicitly introduced in Jagannathan and Korajczyk (1986).

4. Empirical Results

Table 1 presents summary empirical results from employing the Treynor-Mazuy model and the Bhattacharya-Pfleiderer model to the time series of monthly returns of ethical and traditional equity mutual funds. These results show some evidence of selectivity and market timing at the individual fund level. There are some noticeable differences between the Treynor-Mazuy model and the Bhattacharya-Pfleiderer model in detecting abnormal performance of ethical as well as traditional funds. Thirty three out of sixty seven ethical funds have positive selectivity measure of the Treynor-Mazuy model only two of which are statistically significant at the .05 level. Twenty three out of sixty seven traditional funds have positive selectivity measure of the Treynor-Mazuy model only five of which are statistically significant at the .05 level. Thirty four ethical and forty two traditional funds have negative selectivity measure of the Treynor-Mazuy model and these measures are statistically significant at the .05 level for seven ethical and seventeen traditional funds. Twenty seven ethical and thirty seven traditional funds have positive timing measure of the Treynor-Mazuy model and these measures are statistically significant at the .05 level for two ethical and ten traditional funds. For the Bhattacharya-Pfleiderer model, thirty five ethical funds have positive selectivity measure only two of which are statistically significant at the .05 level and twenty nine traditional funds have positive selectivity measure only six of which are statistically significant at the .05 level. Thirty two ethical and thirty eight traditional funds have negative selectivity measure of the Bhattacharya-Pfleiderer model and these measures are statistically significant at the .05 level for seven ethical and seventeen traditional funds. One ethical and seven traditional funds have positive timing measure of the Bhattacharya-Pfleiderer model and these measures are statistically significant at the .05 level one ethical and three traditional funds. Fifteen ethical funds have both positive selectivity and timing measure of the Treynor-Mazuy model and two of those funds have statistically significant selectivity and timing measure. Twenty two traditional funds have both positive selectivity and timing measure of the Treynor-Mazuy model and three of those funds have statistically significant selectivity and timing measure. Only one ethical fund has both positive selectivity and timing measure of the Bhattacharya-Pfleiderer model and its timing measure only is statistically significant. Two traditional funds have both positive selectivity and timing measure of the Bhattacharya-Pfleiderer model and none of these two has statistically significant selectivity and timing measure.

The results show that traditional funds have more abnormal (superior as well as inferior) performance than their ethical counterparts. While restricted (because of screening criteria) investment opportunities require managers of ethical funds to be more efficient and disciplined in picking “winners” and avoiding “losers” to keep their transaction costs low and portfolio return reasonably high, enlarged boundary of unrestricted feasible investment opportunity set makes managers of traditional equity funds wonder around unsuccessfully searching for mispriced assets and thereby generate too many transaction costs that drives down their portfolio returns. It appears that both traditional and ethical funds do not outperform the market judged by risk-adjusted performance measures as neither group has a large number of funds demonstrating superior performance on a risk-adjusted basis. Our results are consistent with those of prior studies of investment performance of managed portfolios. (See, for example, Jensen, 1968, Kon, 1983, Chang and Lewwellen, 1984, Henrikkson, 1984, Cumby and Glen, 1990, Lee and Rahman, 1990, Connor and Korajczyk, 1991, and Coggin, Fabbozi, and Rahman, 1993). These results are also consistent with efficient market hypothesis, which states that no investors (individual or institutions) can consistently generate superior risk-adjusted returns.

We employed parametric matched-pairs t-test and nonparametric Wilcoxon matched-pairs signed-rank test to investigate if ethical funds and traditional funds differ significantly in terms of risk-adjusted performance measures. Both matched-pairs t-test and Wilcoxon matched-pairs signed-rank test fail to reject the null hypothesis of no significance difference between ethical and traditional funds in timing measure of the Treynor-Mazuy model and both selectivity and timing measure of the Bhattacharya-Pfleiderer model. However, both

Table 1:
Performance Measures Across Models and Types of Funds

	Ethical Funds	**Traditional Funds**
Treynor-Mazuy Model		
Selectivity Measure		
Positive	33	23
Significant Positive*	2	5
Negative	34	42
Significant Negative*	7	17
Timing Measure		
Positive	27	37
Significant Positive*	2	10
Bhattacrarya-Pfleiderer Model		
Selectivity Measure		
Positive	35	29
Significant Positive*	2	6
Negative	32	38
Significant Negative*	7	17
Timing Measure		
Positive	1	7
Significant Positive*	1	3
*** significant at the .05 level**		

matched-pairs t-test and Wilcoxon matched-pairs signed-rank test reject the hypothesis of no significant difference between ethical and traditional funds in selectivity measure of the Treynor-Mazuy model. As discussed earlier, the Bhattacharya-Pfleiderer model of measuring investment performance of managed portfolios is more robust and econometrically and methodologically superior to and improvement over the Treynor-Mazuy model. It appears that empirical results based on the Bhattacharya-Pfleiderer model are consistent with those of prior studies (Hamilton, Jo and Statman 1993, Mallin, Saadouni, and Briston, 1995, Goldreyer, Ahmed, and Diltz, 1999, Statman, 2000, Kreander, Gray, Power, and Sinclair, 2005, Geczy, Stambaugh, and Levin, 2006, Bauer, Koedijk, and Otten, 2005, Bauer, Derwall, and Otten, 2007, and Jones, Laan, Frost, and Loftus, 2008) that found that ethical funds perform no worse than their traditional counterparts. However, we observe that there are slightly more outliers (superior and inferior performer) in traditional funds than in ethical funds. The Bhattacharya-Pfleiderer model used in this paper has resolved all methodological and econometric issues that confound the empirical results of the previous studies and our results are free from any specification error. Moreover, our results are free from survivorship-bias that partially distorts empirical results of the prior studies.

Ethical mutual funds are at an apparent disadvantage compared to traditional mutual funds because the ethical screening process reduces the set of stocks available for efficient diversification and risk-reduction. It is possible to improve the efficient frontier and further reduce systematic risk by adding stocks from enlarged global market to the portfolio because stocks in a larger sample are likely to be uncorrelated, less positively correlated, or somewhat negatively correlated (Solnik, 1974). However, a subset of stocks from enlarged global market may not be compatible with an ethical fund's screening criteria and the manager of an ethical fund may encounter "lost opportunity." This smaller asset universe to be considered in the portfolio formation process may negatively affect investor's efficient frontier and risk-reduction via diversification. The empirical evidence in this paper and other previous studies that ethical funds match the performance of traditional funds on a risk-adjusted basis goes against conventional wisdom, which states that limited opportunity for risk reduction via diversification along with incremental expenses associated with implementing the ethical screening process and monitoring the acceptable companies to ensure reasonable compliance with designated ethical values will result in lower risk-adjusted return for ethical funds compared to traditional funds with unrestricted investment and diversification opportunity. Advocates of ethical investing may argue that competitive returns to ethical funds arise because screening tools allow fund managers to identify the best companies in terms of potential for profits (Cortez, Silva, and Areal, 2009).

Empirical findings of this paper have important implications for investors of ethical funds. Ethical fund may have diverse clientele base including "devoted" ethical investors who are willing to sacrifice a fraction of risk-adjusted return for ethical values and "profit-maximizing" ethical investors who are unwilling to accept risk-adjusted return lower than that of a traditional fund in a comparable risk class. The empirical results of this paper are good news for both of these investors. Devoted ethical investors do not have to sacrifice return to invest in ethical funds and profit-maximizing ethical investors will get what they want.

5. Conclusions

The demand for ethical investing has been growing very fast in the recent decades and along with it asset under management of ethical equity mutual funds is experiencing phenomenal growth. It is of utmost importance to evaluate the performance of managers of ethical funds using risk-adjusted performance measures for managed portfolios so that individual investors of ethical funds can select appropriate funds based on their risk-tolerance and investment objectives. The performance of ethical funds should be compared to those of traditional funds so that investors can determine if they are sacrificing a fraction of risk-adjusted return for adhering to cherished ethical values. This paper examines investment performance of a sample US equity ethical funds and compares their performance with that of a comparable traditional fund based on fund size. This paper employs a sophisticated model to resolve all methodological and econometric issues that confound the empirical results of the previous studies of investment performance. Using a survivorship-bias-free data base from US market, this paper compares and contrasts investment performance of a sample of ethical and traditional funds. The empirical results presented in the paper demonstrates that ethical funds perform no worse than their traditional counterparts, although ethical and traditional funds as a group do not outperform the market which is consistent with prior studies of mutual fund performance. The ability of the ethical funds to match the performance of the traditional funds implies that ethical investors are not making financial sacrifice as a price for adhering to their precious ethical values. We also find that a small number of ethical and traditional funds exhibit superior security selection skill and/or market timing skill although we notice that traditional funds have more abnormal (superior as well as inferior) performance relative to the market. These results have important implications for investors of ethical funds regardless of their preferred utility maximization formula, *i.e.*, whether they are "dedicated" ethical or "profit-maximizing" ethical investors.

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Endnotes

1 It is notable that the roots of socially responsible investing seem to have stemmed from a religious connection – they have been traced back to the 1920s when the Methodist Church of Great Britain wished to invest in the UK stock market while avoiding companies involved in alcohol and gambling (Brownlow, 2009).

2 See Renneboog, Horst, and Zhang (2008b) for a survey of these studies.

3 See Lee and Rahman (1990) and Coggin, Fabozzi, and Rahman (1993) for details.

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□ □ □ □ □ □ Corporate governance, tax avoidance, and firm value: international evidence

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Our paper explores how corporate governance affects the valuation of tax avoidance. We argue that better governance enhances investor valuation of tax avoidance primarily through deterring managers from misallocating tax savings to pursue their private benefits. By exposing cross-country data, we find that investors on average negatively value corporate tax avoidance and such negative valuation is attenuated in countries with strong protection for investor rights. Furthermore, in countries with weaker investor protection managers are more likely to misuse tax savings on suboptimal investments and this leads tax avoidance to negatively impact firm operating performance. Our findings suggest that the primary agency issue concerning tax avoidance is the misallocation of tax savings instead of managers exploiting tax avoidance to shield their rent extraction.

Keywords: tax avoidance; firm value; corporate governance

JEL Classification: G3; H25; H26

1. Introduction

Our study explores how corporate governance affects investor valuation of corporate tax avoidance.[1] We find that better governance enhances the value of tax avoidance primarily through deterring managers (i.e. controlling shareholders in non-US countries) from using tax savings to pursue private benefits. Our study is motivated by the debates regarding the corporate governance view of tax avoidance (Desai and Dharmapala 2006, 2009; Desai et al. 2007).

Specifically, the corporate governance view of tax avoidance argues that tax avoidance does not naturally increase firm value because tax avoidance facilitates managers to extract rent[2] by allowing them to exploit the opaqueness of tax avoidance activity to shield their rent extraction behaviors (tax-shielded rent extraction). In this regard, this view further argues that good governance can reduce tax-shielded rent extraction and therefore leads to higher valuation of tax avoidance. By incorporating agency conflicts into analysis, the corporate governance view of tax avoidance has received considerable attention in recent literature (e.g., Hanlon and Slemrod 2009; Chen et. al., 2010; Kim et al. 2010; Dhaliwal et al. 2011).

However, some recent studies find results contradicting the prevalence of the tax-shielded rent extraction (e.g., Wang 2010; Blaylock 2011).[3] In fact, evidence in support of tax-shielded rent extraction is primarily anecdotal (e.g., the cases of Enron and Dynegy), while the only empirical evidence comes from studies exploring Russian firms (Desai et al. 2007; Mironov 2013) and whether results of these studies can generalize to other countries is unclear. The scarcity of empirical evidence suggests that tax-shielded rent extraction is either

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[1] Following Hanlon and Heitzman (2010), we broadly define tax avoidance as the reduction of explicit taxes per dollar of pre-tax accounting earnings. However, to correspond with the theory of Desai and Dharmapala (2006, 2009) and Desai et al. (2007), in our study tax avoidance specifically refers to tax avoidance with aggressive forms that require some extent of obfuscation.

[2] Following prior studies (Desai and Dharmapala 2006, 2009; Desai et al. 2007; Blaylock 2011), the term "extract rent" is defined as managerial opportunism that managers somehow extract personal benefits through corporate tax avoidance activity.

[3] By exploring a large panel of US firms, Blaylock (2011) find no consistent evidence that tax avoidance is related to managerial rent extraction and he concludes that the managerial rent extraction from tax avoidance is on average not economically significant among US firms. Wang (2010) report that transparent firms avoid more taxes relative to their opaque counterparts, which suggests that managers engage in tax avoidance transactions mainly to enhance shareholder wealth.

difficult for outsiders to detect or it may only occur in extreme cases. In this regard, it is doubtful that corporate governance affects the valuation of tax avoidance just because it alleviates an agency issue that rarely occurs and difficult to detect in real world. Therefore, there may be alternative explanation for why governance affects investor valuation of tax avoidance.

We propose the "*misallocation argument*" as an alternative explanation beyond the tax-shielded rent extraction argument. Specifically, the general consequence of tax avoidance is to produce cash savings, but this does not necessarily enhance firm value because managers may misallocate these cash savings to advance their personal benefits (Christie and Nanda 1994) and tax avoidance will be worth less if there is more chance that tax savings are going to be wasted or expropriated (Pinkowitz et al. 2006).[4] Investors of poor-governed firms may negatively value corporate tax avoidance because their firms afford the costs of tax avoidance while the benefits of tax savings are expropriated by managers. In this regard, good corporate governance can rectify the misallocation of tax savings by redeploying them to more productive uses, as it is well documented that good governance induces managers to use firm liquid resources more efficiently (e.g., Dittmar et al. 2003; Dittmar and Mahrt-Smith 2007; Harford et al. 2008; Iskandar-Datta and Jia 2013).[5]

The misallocation argument is consistent with the corporate governance view of tax avoidance that managers can extract rent from tax avoidance and better governance can enhance the value of tax avoidance, but the novelty here is that managers extract rent through misusing tax savings rather than through exploiting the opaqueness of tax avoidance to shield rent extraction. The misallocation argument emphasizes a more general concern regarding how managers use tax savings. With this emphasis, better governance can still enhance the value of tax avoidance by inducing managers to use tax savings more efficiently even if managers do not exploit the opaqueness of tax avoidance to conceal their rent extraction. In contrast, the tax-shielded rent extraction argument does not rely on actual tax savings but

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[4] This notion is similar to the finding of Pinkowitz et al. (2006) that corporate cash holdings are valued at a discount in countries with weak investor protection due to the increased opportunities for managers (or controlling shareholders) to misuse or tunnel these liquid resources.

[5] For example, Dittmar and Mahrt-Smith (2007) and Harford et al. (2008) report that the use of cash is more likely to enhance future operating performance for firms that are well governed. By conducting an international research, Iskandar-Datta and Jia (2013) also show that greater shareholder rights lead to a positive relation between cash depletion and firm performance.

instead emphasizes that tax avoidance facilitates rent extraction by providing managers with an excuse for entering into obscure tax avoidance transactions to shield their rent extraction, although such shielded behaviors may be not prevalent in reality.

Our study explores an international setting because this allows us to measure governance quality with country-level investor protection measures (La Porta et al.1998, 2000). This increases the power of our research design since the cross-country variation in the extent to which manager can extract rent from tax avoidance is likely to be more substantial than the cross-firm variation within a particular country (Desai et al. 2007; Blaylock 2011).[6] Moreover, using international data also avoids potential sample selection-bias that biases our test toward finding insignificant results, while this bias is more salient if we explore only single country and in this country managers inherently have little opportunities to extract rent (e.g., US).

Our study uses a sample that spans 34 countries and 17 years. We find that investors in the U.S. positively value tax avoidance but this result is insignificant, consistent with the finding of Desai and Dharmapala (2009). In addition, investors in non-US countries on average negatively value tax avoidance, so the idea that tax avoidance does not increase firm value holds not only for the U.S but also for other countries. This negative valuation may arise because investors perceive that most tax savings are going to be misused and the remaining tax savings cannot cover the costs of tax avoidance incurred by their firms. We also find that the valuation of tax avoidance is higher in countries with stronger investor protection, which finding suggests that the value of tax avoidance is a function of corporate governance.

However, our finding that better governance leads to higher valuation of tax avoidance is consistent with both the tax-shielded rent extraction argument and the misallocation argument. To determine which argument dominates, we follow the specification of Almeida et al. (2004) to examine the relation between tax avoidance and cash flow, as the tax-shielded

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[6] Blaylock (2011) finds that the magnitude of rent extracted from tax avoidance is not distinct between poor-governed and well-governed firms. Desai et al (2007) report that country-level tax enforcement can hinder rent extraction of tax avoidance. These results suggest that country-level granting and enforcing of investor protection may be more important than firm-level governance mechanisms in the determination of the extent to which managers can extract rent from tax avoidance. This argument makes sense because firm-level governance mechanisms cannot effectively mitigate managerial entrenchment in an environment with weak protection for investor rights as prior studies (e.g. Doidge et al. 2007; Aggarwal et al. 2009) show that countries' institutions are major forces in shaping firm-level governance mechanisms.

rent extraction argument predicts that tax avoidance does not necessarily relate to actual cash savings while the misallocation argument makes an opposite prediction.

Consistent with the misallocation argument, we find that tax avoidance generally produces cash savings and this finding holds even for countries with weak investor protection. As tax-shielded rent extraction should be most prevalent in a poor-governed environment, this result suggests that tax-shielded rent extraction may be not as general as argued by prior studies. We further find that cash savings from tax avoidance is lower when firms have more capital and R&D investments, and this finding suggests that managers use tax savings to fund investments. As corroborating evidence, we find that tax avoidance is positively related to investment expenditures.

We further investigate how tax avoidance affects investment efficiency. We find that tax avoidance relates to overinvestment (Richardson 2006) and this relation is attenuated in countries with strong investor protection. This result suggests that managers may squander tax savings on projects that advance their personal benefits and better governance can rectify such squandering behavior. We also examine how tax avoidance impacts operating performance. If tax avoidance leads to overinvestment, then it should also lead to lower operating performance (Blaylock 2011). As anticipated, we find that tax avoidance negatively impact performance and this negative impact is mitigated in countries with strong investor protection.

Our additional tests show that tax avoidance is positively related to excess cash holdings (Dittmar and Mahrt-Smith 2007; Harford et al. 2008), but this positive relation is attenuated in countries with strong investor protection. This result contradicts the tax-shielded rent extraction argument as it predicts that excess cash should be lower because managers may shield their diversion of firm cash with tax avoidance transaction. This result implies that in countries with poor investor protection managers are more likely to employ tax avoidance transactions to serve their own interests instead of to meet their firm's normal needs. Managers hoard as much cash as they can in a poor-governed environment (Dittmar et al. 2003) while tax avoidance is one means that facilitates them to do so.

We also find that tax avoidance is negatively related to payouts to shareholders, while this negative relation is attenuated by strong investor protection. This implies that managers appear to be reluctant to disgorge tax savings to shareholders, but strong investor protection induces them to do so, consistent with the outcome model as elaborated in La Porta et al. (2000b). Moreover, we find that the negative valuation implication for tax avoidance is more pronounced when firms hold excess cash. Therefore, investors perceive that tax savings exacerbate the agency problem of excess cash.

Our study makes following contributions to the literature. First, we contribute to the emerging literature examining the agency cost implications of corporate tax avoidance. Overall, our findings suggest that the primary agency issue concerning tax avoidance is how managers use tax savings instead of how managers exploit tax avoidance to mask their rent extraction as argued by Desai and Dharmapala (2006, 2009) and Desai et al. (2007). We find that strong investor protection can deter managerial misallocation of tax savings, and this finding helps to clarify how good governance enhances the value of tax avoidance. Because the magnitude of tax savings is typically substantial,[7] we believe that our misallocation argument is more general than the tax-shielded rent extraction argument.

In addition, our results suggest that the extent to which managers can extract rent from tax avoidance depends on investor protection. These results explain why prior studies (e.g., Wang 2010; Blaylock 2011) fail to find significant relation between tax avoidance and rent extraction among US firms and a possible explanation for this finding is that investors in the U.S. enjoy good protection so that managers have few opportunities to extract rent. In this regard, our results corroborate that the corporate governance view of tax avoidance is more appropriate to firms in countries with weaker investor protection (e.g., Russia) than those in countries with stronger investor protection (e.g., U.S.).

Our study also contributes to the literature examining heterogeneity in investor valuation of tax avoidance. With this respect, we find that country-level investor protection is an important determinant of how investors perceive the value of corporate tax avoidance. Our international setting is particularly relevant given that there is little systematic evidence on exploring the valuation of tax avoidance outside the U.S. market. Our paper also relates to the broad literature on the agency issue of holding cash (e.g., Harford et al., 2008; Dittmar and Mahr-Smith, 2007). Prior literature suggests that the misuse of internal funds can be substantial. We extend this stream of literature by showing that as one source of internal funds, tax savings also encounter with managerial misuse.

[7] The importance of tax savings is salient as Mills et al. (1998) estimate that firms generate $4 of tax savings for each $1 invested in tax planning and Rego and Wilson (2012) note that in a recent study of tax shelters, firms were able to generate annual tax deductions large enough to shield income equal to almost 10 percent of assets.

The second section develops our hypothesis. The third section describes our empirical design and sample selection. The fourth section discusses the empirical results, the fifth section describes our additional analysis, and the sixth section concludes.

2. Literature review and hypothesis development

2.1. *The effect of corporate governance on the valuation of tax avoidance*

Prima facie, tax avoidance produces tax savings and thereby enhances firm value. In contrast to this intuition, the corporate governance view of tax avoidance argues that tax avoidance does not necessarily increase firm value because tax avoidance transactions facilitate managers to extract rent from the firm (Desai and Dharmapala 2008).[8] Specifically, to shield income from tax authorities managers often attempt to obscure the underlying intent of tax avoidance transactions and this limits firm-specific information flow to the public (Kim et al. 2010). The proprietary and obfuscatory feature of tax avoidance facilitates rent extraction by providing managers with a shield to conceal their opportunistic behaviors. Accordingly, better governance leads to higher valuation of tax avoidance (e.g., Desai and Dharmapala 2009; Wilson 2009).[9]

However, the positive influence of good governance on the valuation of tax avoidance is not naturally attributed to the tax-shielded rent extraction argument. Another explanation is

[8] Desai and Dharmapala (2008) describe an example of how tax avoidance relates to rent extraction. Suppose that managers of a firm begin creating several special purpose entities (SPEs) in tax havens. These entities are rationalized as providing the means for reducing tax obligations. The details of the structures and transactions cannot be explicated fully or widely due to the likelihood of detection by the tax authority and the revocation of those benefits. Such structures may allow managers to engage in various activities harmful to shareholders, such as earnings manipulation (by creating vehicles that can manufacture earnings without enabling investors to understand their source), concealment of obligations (by taking on debt that is not fully consolidated), or outright diversion (by allowing for insider transactions that are not reported widely).

[9] Desai and Dharmapala (2009) find that the effect of tax avoidance on firm value is a function of firm governance and only for well-governed firms will tax avoidance increase firm value. By exploring market reaction to news about tax shelter involvement, Wilson (2009) contends that tax sheltering creates wealth for shareholders in well-governed firms.

that better governance deters managers from using tax savings to pursue personal benefits.[10] In an environment with poor governance, even if tax avoidance produces cash savings to the firm, investors are difficult to capture the value of tax savings. In this regard, investors will negatively value corporate tax avoidance because their firm affords the costs of tax avoidance[11] while they enjoy no benefit from tax savings, given that managers expropriate the benefit of tax savings for personal purposes.

Which argument drives the positive valuation implication of good governance is an open empirical issue. As a first step to explore this issue, we examine whether the influence of governance on the valuation of tax avoidance can extend to an international setting. Specifically, we anticipate that strong investor protection leads to higher valuation of tax avoidance, as it is well documented in the literature (e.g., La Porta et al. 1998, 2000a, 2000b) that in an environment with more protection for their rights investors can better fight against managerial opportunisms so that they can capture more value from corporate tax avoidance. Consistent with our argument, Cloyd et al. (2003) find that US market often negatively reacts to firms' expatriation announcements and the authors attribute this result to the reasoning that tax haven countries usually have low level of investor protection. Accordingly, we propose our first hypothesis as follow.

H1: *Ceteris paribus, valuation of tax avoidance is higher in countries with better protection for investor rights.*

2.2. *Tax avoidance and firm cash policy*

To determine which argument drives the result of H1, we further explore the relation between tax avoidance and firm cash flow as the tax-shielded rent extraction and the misallocation arguments have different predictions regarding this relation. If the misallocation argument dominates and the primary agency issue is how managers use tax savings, we should observe

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[10] Similar to this notion, Goh et al. (2013) find that corporate tax avoidance reduces a firm's cost of equity and such reduction is stronger for firms that likely realize higher marginal benefits from tax savings. Their results suggest that how investors perceive the value of corporate tax avoidance depends on how tax savings are used.

[11] Tax avoidance can impose significant costs on firms. For example, these costs include fees paid to tax experts, time devoted to the resolution of tax audits, reputational penalties, and penalties paid to tax authorities. Even without costs, tax savings can still destroy firm value because cash flows from tax avoidance may reduce managers' incentive to operate efficiently. It is also likely that tax avoidance transactions change a firm's organizational structure so that its operation is distorted, which deteriorates its operating performance.

a positive relation between tax avoidance and cash flow because the prerequisite of misallocating tax savings is that tax avoidance can generally produce cash flow to the firm. In contrast, if the tax-shielded rent extraction argument dominates and managers employ tax avoidance primarily to conceal their rent extraction, then we should observe no specific relation between tax avoidance and cash flow. Because the direction of how tax avoidance affects cash flow is an open empirical issue, we state our second hypothesis non-directionally as follow.

H2: *Ceteris paribus, tax avoidance is associated with firm cash flow.*

2.3. *Tax avoidance and investment policy*

To support our misallocation argument, we must examine not only whether tax avoidance generates cash savings but also how these cash savings are used, and the most direct type of misallocation is that managers squander tax savings on perk projects or empire building. Consistent with this notion, Khurana and Moser (2011) find that firms with higher levels of tax avoidance generally have higher level of excess capital expenditures and such excess capital expenditures are more pronounced for poor-governed firms. Accordingly, if the misallocation argument holds, we expect that tax avoidance relates to overinvestment, while in countries with good investor protection this relation is attenuated as good governance reduces the opportunities for managers to overinvest (Richardson 2006). This leads to our third hypothesis:

H3: *Ceteris paribus, tax avoidance is related to overinvestment and this relation is attenuated in countries with better protection for investor rights.*

2.4. *Tax avoidance and firm operating performance*

One concern for H3 is that overinvestment only reflects one dimension of squandering tax savings, while managerial misuse may extend to outlays other than corporate investments. In fact, the exact nature and scope of misusing tax savings are difficult to pin down, because managers can adopt many varied and often subtle ways to extract private benefits from tax savings. To capture a broader scope of this effect, we explore the relation between tax avoidance and firm operating performance as any managerial actions will ultimately reflect on firm performance. Because good governance can mitigate misallocation of tax savings, we expect that tax avoidance is related to higher firm performance in countries with stronger investor protection as in these countries managers are more likely to use tax savings to advance firm operating performance instead of to benefit themselves. This leads to our fourth hypothesis:

H4: *Ceteris paribus, tax avoidance is related to higher firm operating performance in countries with better protection for investor rights.*

It is noteworthy that our H3 and H4 do not argue that tax avoidance itself affects performance or overinvestment. Instead, what we argue is that it is the agency issues arising from tax avoidance, instead of tax avoidance itself, that result in lower performance and overinvestment, and strong investor protection is expected to alleviate such result by mitigating the agency issues of tax avoidance.

3. Research design and sample

3.1. *Test of H1: whether the valuation of tax avoidance is higher in countries with better investor protection*

3.1.1. *Valuation specification*

Following the specification of Desai and Dharmapala (2009), we estimate regression (1) to test H1.[12] Definitions of variables used in our main tests are shown in the appendix.

$$MV_{it} = \alpha_0 + \alpha_1 \cdot TA_{it} + \alpha_2 \cdot TA_{it} \cdot INP_j + \alpha_3 \cdot TA_{it} \cdot TAXEF_j + \alpha_4 \cdot TA_{it} \cdot CMARD_{jt} + \alpha_5 \cdot INP_j + \alpha_6 \cdot TAXEF_j + \alpha_7 \cdot CMARD_{jt} + \alpha_8 \cdot GDP_{jt} + \sum_{k=9}^{17} \alpha_k \cdot FSCONTROL + Fixed\ effects + \varepsilon_{it} \quad (1)$$

where *MV* is the market value of the firm; *TA* represents the level of corporate tax avoidance; *INP* is the level of protection for investor rights; *GDP*,*TAXEF* and *CMARD* are country-level control variables; *FSCONTROL* is firm-specific control variables; *Fixed effects* represent year and industry fixed effects. Subscripts *i*, *j*, and *t* denote firm, country, and year, respectively.

MV is measured with Tobin's *q* ratio, which is defined as the sum of the market value of equity and the book value of debt minus deferred tax expense[13] and then divided by the book value of total asset.

[12] For regression here and those afterward, we adjust the standard error of coefficient by the procedure of Newey-West (1987).

INP is measured with *LAW* and *CORUP*. *LAW* is a combined index of the legal protection for shareholders, which equals the anti-director rights index plus 50 percent[14] of the rule of law index (La Porta et al. 1998). As contended by La Porta et al. (1998, 2000a, 2000b), controlling shareholders (i.e. managers in our case) in countries with strong investor legal protection have few opportunities to extract private benefits of control. Prior studies (e.g. Doidge et al. 2007; Aggarwal et al. 2009) also show that countries' institutions are major forces in shaping corporate governance practices. *CORUP* is the corruption index (La Porta et al. 1998), which assesses the risk of corruption of high government officials and a lower value of this index represents a higher level of corruption. We use *CORUP* because it is difficult for investors to use their formal rights in an environment where corruption is rampant.

Our H1 predicts a positive coefficient on *TA·INP*, which suggests that the valuation of tax avoidance is higher in countries with better protection for investor rights.[15] This result implies that better governance leads to higher valuation of tax avoidance.

3.1.2. *Tax avoidance measures*

TA is proxied by three measures: book-tax difference (*BTD*), residual book-tax difference (*RBTD*), permanent book-tax difference (*PBTD*). There is no universally accepted definition of tax avoidance in the literature so we use multiple measures to increase the robustness of our results.

Book-tax difference (*BTD*) is calculated as [pretax book income – (domestic current tax expenses+ foreign current tax expenses) / top corporate statutory tax rate] / total assets.[16]

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[13] Following Desai and Dharmapala (2009), we exclude deferred tax expense from the calculation of *q* measure, because current tax avoidance activity may result in changes to future tax liabilities and thus create a mechanical correlation between the dependent variable and the measure of tax avoidance.

14 We use 100 percent of the anti-director rights index and 50 percent of the efficiency of judicial system index and the rule of law index because the former ranges from 0 to 5, while the latter two range from 0 to 10. Prior studies such as Berkman and Nguyen (2010) or Choi and Wong (2007) also use similar combined index. We use a combined index because the quality of investor legal protection depends not only on the contents of regulations (i.e., anti-director rights index) but also on the proper enforcement of these regulations (i.e., efficiency of judicial system and rule of law indexes).

15 Note that the relation between TA and MV as explored in regression (1) may be endogenous since MV can also represent growth opportunities which may reversely explain firms' incentives to avoid taxes. However, this concern is mitigated as our focus on interaction effect TA·INP makes it hard to argue for reverse causality.

Prior studies suggest that larger book-tax difference is associated with higher probability of engaging in actual tax shelter activity (Mills 1998; Manzon and Plesko 2002; Desai and Dharmapala 2009; Wilson 2009). By exploring an international setting, Goncharov (2009) find that large book-difference is associated with tax evasion and this result suggests the feasibility of using *BTD* as a measure of tax avoidance in an international setting.

We use *BTD* to measure tax avoidance because this makes our results to be comparable with those of Desai and Dharmapala (2006, 2009) and because *BTD* captures more aggressive forms of tax avoidance.[17] If we use a less aggressive measure such as accounting effective tax rate, then our results will be biased toward to reject the tax-shielded rent extraction argument as tax-shielded rent extraction must be accomplished by aggressive forms of tax avoidance. However, one concern of using *BTD* is that the effect of book-tax difference may be confounded by earnings management. We thus use residual book-tax difference to mitigate this concern.

Residual book-tax difference (*RBTD*) (Desai and Dharmapala 2006) is the residual from a firm fixed-effect regression of *BTD* on total accruals that is estimated for each country, where total accruals is calculated as (net income before extraordinary items - operating cash flow) / total assets. Excluding the effect of total accruals eliminates, at least partially, the effect of earnings management embedded in *BTD*. In this regard, *PBTD* is expected to capture the effect of tax avoidance. Excluding the effect of total accruals also alleviates the concern that

[16] When current tax expense is missing, we infer it with total tax expense less deferred taxes when both domestic and foreign data are available. We exclude observations where current tax expense is missing and we have no required data to infer it.

[17] Aggressive forms of tax avoidance provide complexity and opacity to conceal managers' intent to extract rent and thus they conceptually fit the tax-shielded rent extraction story than less aggressive ones. Lisowsky et al. (2012) suggest that the probability of engaging in tax sheltering, discretionary permanent book-tax difference, permanent book-tax difference, book-tax difference, cash effective tax rate, and book effective tax rate capture the varying degree of tax aggressiveness, from most aggressive to least aggressive. Due to data availability, we cannot calculate discretionary permanent book-tax difference and the probability of engaging in tax shelter so the use of book-tax difference yields the best measure that can be obtained using publicly available data in our international setting.

difference in accounting rules across countries may introduce a noise to using book-tax difference as a proxy of tax avoidance.[18]

Permanent book-tax difference (*PBTD*) is computed as [pretax book income – (deferred tax expense + domestic current tax expenses+ foreign current tax expenses) / top corporate statutory tax rate] / total assets. Compared with *BTD*, *PBTD* captures more aggressive forms of tax avoidance as prior research (e.g., Shevlin, 2002; Wilson 2009) suggests that an ideal tax shelter or tax avoidance investment creates a permanent rather than a temporary book-tax difference.

It is cautious that in addition to errors in inferring taxable income, the use of book-tax difference contains measurement error that arises from the mechanical difference in the calculations of book income and taxable income.[19] However, this is not a serious concern since our main focus is on the interaction between investor protection and tax avoidance so any measurement error in tax avoidance is not expected to systematically affect our empirical results. We will further assess whether this measurement error affect our results in the robustness test section.

3.1.3. *Control variables*

Firm-specific control variables include the natural log of total assets (*SIZE*) in US dollar.[20] We also include the closely-held shares percentage[21] (*CHS*) and dividend amount (*DIV*) because higher insider stock ownership and dividend payment affect agency problems and

[18] The use of *RBTD* also helps to rule outs the confounding interpretation that investor view large book-tax differences as an indicator of earnings management and thus a positive coefficient of *BTD·INP* implies the effect of strong investor protection on restraining earnings management.

[19] The mechanical difference arises because some items that directly lower tax expense affect the computed taxable income even if the items are not true differences between book and taxable incomes. For example, research and development and other credits decrease tax expense and, thus, decrease taxable income and increase book-tax differences.

[20] The use of total assets could be mechanically correlated with *q* ratio because total assets are used to calculate *q* ratio. As a robustness test, we use total sales to replace total assets and this does not change our conclusion.

[21] Closely-held shares correspond to shares held by insiders. Insiders are considered to be officers, directors, and their immediate families, shares held in trusts, shares held by another corporation (except shares held in a fiduciary capacity by financial institutions), shares held by pension benefit plans, and shares held by individuals who hold 5% or more of the outstanding shares. For Japanese firms, closely held shares represent the holdings of the ten largest shareholders.

thus in turn affect firm value.[22] To control for the effect of tax shields, we include capital expenditures (*CAP*), book value of total debt (*LEV*), and interest expenses (*INT*), as tax shields may affect the value of engaging in tax avoidance. Interest expenses are included as an additional proxy for debt tax shields since the book value of debt may capture both the effect of financial distress and tax shields. Research and development expenses (*RD*) is included to control for the possibility that some intangibles are not imperfectly measured in book value of assets but are reflected on market value. Two-year (year t to t-1) average sales growth rate (*GROWTH*) is included to control for growth opportunities. We also include income tax credit (*TAXCR*) because it can affect the incentives to engage in tax avoidance and because the realization of tax deductions may also lead the incidence of book-tax difference that is mechanical in nature and has no relation with tax avoidance. Similar to *BTD*, all control variables are scaled with book value of total assets except for *SIZE*, *CHS*, and *GROWTH*.[23]

For country-level control variables, we include the natural log of gross domestic product per capita in US dollar (*GDP*) to control for the effect of economic development on firm value. We also include the perceived strength of tax enforcement (*TAXEF*) (Dyck and Zingales 2004) because strong tax enforcement increases the probability of tax avoidance being challenged by tax authorities (Atwood et al. 2012) and this reduces the value of tax avoidance. More importantly, strong tax enforcement may confound the interpretation of our results because stronger tax enforcement can also deter managerial opportunistic behaviors (Haw et al. 2004; Desai et al. 2007).[24] Accordingly, we include *TA·TAXEF* to ensure that our finding concerning *TA·INP* does not reflect the effect of tax enforcement on deterring managerial opportunisms due to the potential correlation between investor protection and tax enforcement.

We also include the degree of capital market development (*CMARD*), calculated as the sum of stock market capitalization and domestic credit provided by banking normalized by

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[22] Desai and Dharmapala (2006) suggest that the equity-based executive compensation plays a central role in managerial tax avoidance decisions and the inclusion of *CHS* can partially capture this effect.

[23] When the value of *CAEXP*, *RD*, or *DIV* is missing, we set it to zero.

[24] Desai et al. (2007) find that increases in tax enforcement by the Russian government lead to significantly positive market reactions, despite the fact that these firms would likely pay higher future taxes that reduce firm value. They interpret this finding as evidence that outside investors expected less rent extraction by managers due to the increased monitoring provided by the government.

gross domestic product (Dittmar et al. 2003). *CMARD* is used to control for external financing opportunities, as recent studies suggest that financial constraint is one determinant of tax avoidance (Edwards et al. 2012). Because counties with high investor protection are usually those with well-developed capital markets, we include *TA·CMARD* to control for the confounding interpretation that the effect of *TA·INP* reflects the difference in opportunities for accessing external financing.

3.2. *Test of H2: Tax avoidance and cash flow*

To test H2 we draw from Almeida et al. (2004) to specify the relation between tax avoidance and cash flow. Borrowing insights from the literature on cash management (Kim et al. 1998; Opler et al. 1999; Harford 1999), Almeida et al. model the change in firm's cash holdings as a function of several funding sources and uses. If tax avoidance generates cash savings, it should represent a funding source and thus has a positive association with cash flow. To test H2, we explore following empirical specification.

$$\begin{aligned} \Delta Cash_{it} = {} & \beta_0 + \beta_1 \cdot TA_{it} + \beta_2 \cdot CashFlow_{it} + \beta_3 \cdot \Delta NWC_{it} + \beta_4 \cdot \Delta STD_{it} + \beta_5 \cdot MV_{it} + \beta_6 \cdot SIZE_{it} + \\ & \beta_7 \cdot INVEST_{it} + \beta_8 \cdot INP_j + \beta_9 \cdot TAXEF_j + \beta_{10} \cdot CMARD_{jt} + \beta_{11} \cdot GDP_{jt} + \\ & Fixed\ effects + \varepsilon_{it} \end{aligned} \quad (2)$$

where Δ*Cash* is the change in cash holdings scaled by total assets; *CashFlow* is cash flow from operations minus dividend scaled by total assets; Δ*NWC* is change in noncash net working capital scaled by total assets; Δ*STD* is change in short-term debt scaled by total assets; *INVEST* is defined as (capital expenditures + research and development expense - proceeds from sale of fixed assets - depreciation) / the average total assets of years t and t-1;[25] remaining variables are defined as in previous section.

In regression (2), *CashFlow* is included to accommodate the precautionary allocation of cash flows into cash savings (Almeida et al. 2004).[26] We control for Δ*NWC* because working

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[25] Proceeds from the sale of fixed assets are excluded, since replacing one asset with another of similar value is not counted as new investment. Depreciation expense is subtracted because it proxies for the amount of investment necessary to maintain current stock of assets.

[26] In addition to explore precautionary cash saving from operating cash flow, the model of Almeida et al. (2004) can also extend to other topics. For example, Fresard (2012) modify the model of Almeida et al. (2004) to examine whether corporate cash savings are more sensitive to stock price when the price contains more

capital can be a substitute for cash (Opler et al. 1999) or it may compete for the available pool of cash reserves. Similarly, ΔSTD is included because short-term debt could be a substitute for cash or firms may use short-term debt to build cash reserves. *SIZE* is included to control for economies of scale with respect to cash management. *INVEST* is included since firms may draw down on cash reserves in a given year to pay for investment expenditures. *MV* is included to control for growth opportunities available to the firm because firms may reserve cash today to meet future investment opportunities. We use *MV* to proxy for growth opportunities because omitting it may make *TA* to absorb its effect, as our test of H1 in regression (1) implies that *TA* is associated with *MV*.[27]

If the main agency issue of tax avoidance is tax-shielded rent extraction as argued by Desai and Dharmapala (2006, 2009) and Desai et al. (2007), we will find a negative coefficient on *TA* in regression (2). In contrast, if the main agency issue of tax avoidance is the misallocation of tax savings, we will find a positive coefficient on *TA*.

3.3. *Test of H3: Tax avoidance and investment policy*

To test H3, we follow Richardson (2006) by running regression (3.1) and the residual from this regression is the measure of overinvestment (positive) or underinvestment (negative).

$$\begin{aligned} INVEST_{it} = {} & \theta_0 + \theta_1 \cdot LEV_{it-1} + \theta_2 \cdot CASH_{it-1} + \theta_3 \cdot SIZE_{it-1} + \theta_4 \cdot INVEST_{it-1} + \theta_5 \cdot MV_{it-1} + \\ & Fixed\ effects + \varepsilon_{it} \end{aligned} \tag{3.1}$$

where LEV_{t-1} is lagged book value of total debt over average total assets; $CASH_{t-1}$ is lagged cash and cash equivalent over average total assets; $SIZE_{t-1}$ is the natural log of lagged total assets in US dollar. *INVEST* is defined as in previous section. We estimate regression (3.1) separately for each country.

We then test whether tax avoidance relates to overinvestment with regression (3.2).

$$\begin{aligned} INVEST^{\varepsilon}{}_{it} = {} & \eta_0 + \eta_1 \cdot TA_{it} + \eta_2 \cdot TA_{it} \cdot INP_j + \eta_3 \cdot TA_{it} \cdot TAXEF_j + \eta_4 \cdot TA_{it} \cdot CMARD_{jt} + \eta_5 \cdot INP_j + \\ & \eta_6 \cdot TAXEF_j + \eta_7 \cdot CMARD_{jt} + \eta_8 \cdot GDP_{jt} + \eta_9 \cdot FCF_{it} + \varepsilon_{it} \end{aligned} \tag{3.2}$$

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information that is unknown to managers. The argument of Almeida et al. (2004) is also tested in an international setting by prior studies (e.g., Kusnadi and Wei 2011).

[27] We also repeat our tests by replacing *MV* with the two-year average sales growth rate (*GROWTH*) to proxy for investment opportunities and the results remain qualitatively unchanged.

where $INVEST^{\varepsilon}$ is the residual from regression (3.1); *FCF* is free cash flow, calculated as (cash from operations + research and development expense - depreciation expense) / average total assets minus the predicted value of *INVEST* from regression (3.1).

Our test in regression (3.2) includes observations with positive value of $INVEST^{\varepsilon}$ that represents overinvestment. H3 argues that tax avoidance is positively related to overinvestment and strong investor protection can mitigate this relation. In this regard, we expect to observe a positive coefficient on *TA* and a negative coefficient on *TA·INP*.

3.4. *Test of H4: Tax avoidance and operating performance*

To test H4 that investor protection affects the relation between tax avoidance and firm performance, we explore regression (4) as below.

$$\begin{aligned} ROA_{it+1} = {} & \tau_0 + \tau_1 \cdot TA_{it} + \tau_2 \cdot TA_{it} \cdot INP_j + \tau_3 \cdot TA_{it} \cdot TAXEF_j + \tau_4 \cdot TA_{it} \cdot CMARD_{jt} + \tau_5 \cdot INP_j + \\ & \tau_6 \cdot TAXEF_j + \tau_7 \cdot CMARD_{jt} + \tau_8 \cdot GDP_{jt} + \tau_9 \cdot SIZE_{it} + \tau_{10} \cdot MV_{it} + \tau_{11} \cdot PPE_{it} + \\ & \tau_{12} \cdot CHS_{it} + \tau_{13} \cdot LEV_{it} + Fixed\ effects + \varepsilon_{it} \end{aligned} \tag{4}$$

ROA_{t+1} is industry-adjusted return on assets, defined as operating income of year t+1 divided by the average total assets of t and t+1 and then adjusted with industry median value.[28] Definitions of all variables in regression (4) are defined as in previous section. The specification of regression (4) refers to those in Core et al. (1999), Dittmar and Mahrt-Smith (2007) and Harford et al. (2008).

To support H4, we expect a positive coefficient on *TA·INP* in regression (4), which implies that better investor protection makes managers to be more likely to use tax savings on enhancing firm performance.

Following Blaylock (2011), regression (4) explores future performance instead of current performance because managers may undertake tax avoidance transaction to artificially inflate current earnings (e.g., Enron) and this makes it difficult to interpret the coefficient on *TA* in regression (4). Because the effect of inflating earnings could be reversed due to the nature of accrual accounting, the use of future performance is more appropriate. As a robustness test, we also repeat the estimate of regression (4) with current performance and untabulated results show that this does not change our conclusions.

3.5. *Sample selection and summary statistics*

[28] Industry median is computed for each two-digit SIC industry in each country-year.

We retrieve all required financial information from the Worldscope database. Our sampling period begins from 1996 to 2012. We start our sampling period from 1996 because firm coverage in the database prior to this year is spare. The calculation of book-tax differences requires statutory corporate tax rates for each sample country, and we hand-collect statutory tax rates from a KPMG LLP online summary, PricewaterhouseCoopers LLP's online information, Coopers & Lybrand LLP's worldwide tax summary guides, and the website of OECD. These statutory corporate tax rates include both the federal income tax rate and the average effects of state, provincial, and other local government income tax rates.

For investor protection measures, the anti-director rights index, the rule of law index and the corruption index are all collected from La Porta et al. (1998). The perceived strength of tax enforcement is from Dyck and Zingales (2004). Microeconomic data including gross domestic product per capita, stock market capitalization, domestic credit provided by banking, and gross domestic product are all collected from statistics disclosed by the World Bank.

We exclude countries with missing value of statutory tax rates, investor protection measures, or required microeconomic data. Our initial sample consists of firms with all required data on estimating regression (1). We further delete firms with book values of total assets less than US$ 10 million because small firms may behave unlike ordinary firms and several of our control variables are scaled by total assets while small total assets will lead to extreme value. After imposing these data requirements, we obtain a sample of 161,376 firm-year observations[29] from 34 countries. To alleviate the concern of outliers, we winsorize all firm-level variables at the 1st and the 99th percentile levels.

[Insert Table 1 about here]

Table 1 presents the summary statistics of our main test variables and institutional variables for each country in our sample. The number of firm-year observations for each country is shown in the first column of Table 1, which ranges from 88 for Argentina to 57,977 for the United States. The considerable variation in the number of observations per country raises the concern that our results may be unduly influenced by countries with

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[29] The number of firm-year observations 161,376 is for *BTD* and *PBTD*. For *RBTD* we have 154,670 firm-year observations. Because these numbers are meant to those can be used to estimate equation (1), the observation numbers used to test regressions (2) to (4) could be different from these numbers due to missing values of variables not included in regression (1) but included in these subsequent regressions.

extreme number of observations. We will further evaluate the effect of this concern in the robustness test section.

4. Main empirical results

4.1. *Test results of H1: The effect of investor protection on the valuation of tax avoidance*

In this section, we report our results of testing H1. We estimate equation (1) for the U.S. and non-US countries separately. This allows us to determine whether the idea that tax avoidance does not always increase firm value (Desai and Dharmapala 2009) is specific to the U.S. or it can also extend to other countries. The results are shown in Table 2.

[Insert Table 2 about here]

Panel A of Table 2 presents the estimate results of using only US observations. Column (1) shows that the coefficient on *BTD* is positive but insignificant. In Column (2) the coefficient on *RBTD* is negative but insignificant while in Column (3) the coefficient on *PBTD* is positive and significant at 10% level (p-value=0.069). These results suggest that investors in the U.S. market do not always perceive corporate tax avoidance as increasing firm value, consistent with the finidng of Desai and Dharmapala (2009).

Panel B of Table 2 presents the estimate results of using observations from non-US countries. Coefficients on our three tax avoidance measures across Columns (4) to (6) are all negative and significant at 1% level. This result suggests that investors in non-US countries generally perceive that corporate tax avoidance impairs firm value, so the idea that tax avoidance does not naturally increase firm value holds not only for the U.S market but also for other countries. This negative valuation result suggests that investors perceive that most tax savings will be misused and the remaining tax savings cannot cover the costs of tax avoidance incurred by their firms.

Contrasting results in Panel A and Panel B, we know that the negative market valuation of tax avoidance is attenuated in the US than in other countries, and this may be because protection for investor rights is usually more stringent in the US than in other countries. In this regard, results in Table 2 provide preliminary evidence to support our H1. For control variables, coefficients on most of them are significant at conventional level so it is necessary to include them in our estimate.

Results of estimating the full specification of equation (1) are shown in Table 3, where results of measuring investor protection with *LAW* and *CORUP* are presented separately.

[Insert Table 3 about here]

Consistent with H1, Table 3 shows that coefficients on *TA·INP* are all positive and significant at 1% level for the three tax avoidance measures and coefficients on *TA* are negative and significant in most columns. This result holds for measuring *INP* with either *LAW* or *CORUP*. Results in Table 3 suggest that market valuation of corporate tax avoidance is higher in countries with better legal protection for investor rights.

Moreover, Table 3 shows that coefficients on *TA·TAXEF* are positive in most columns, albeit they are insignificant. This result suggests that although strong tax enforcement provides additional monitoring from tax authorities on managerial opportunistic behaviors (e.g., Haw et al. 2004; Desai et al. 2007), investors perceive that this monitoring effect is offset by the correspondingly increased risk of tax avoidance being challenged by tax authorities. In addition, coefficients on *TA·CMARD* are consistently negative and significant at 1% level in all columns, which suggests that the valuation of tax avoidance is higher with more difficulty in accessing external capital, in which situation tax savings are an important source of internal funds.

Overall, results in this section suggest that strong investor protection enhances the valuation of corporate tax avoidance, consistent with H1. And the conclusion of Desai and Dharmapala (2009) that the value of tax avoidance is a function of firm governance can extend to an international setting.

4.2. *Test results of H2: Tax avoidance and firm cash policy*

In this section, we report results of testing H2 about whether tax avoidance positively or negatively affects cash flow. The results of estimating equation (2) are shown in Part I of Table 4. We present the results separately for using only US observations and non-US observations in high or low investor protection countries where the cutoff point is the median value of *LAW*.

[Insert Table 4 about here]

H2 argues that if the primary agency issue is how managers use tax savings, we should observe a positive relation between tax avoidance and cash flow because the prerequisite of misallocating tax savings is that tax avoidance can generally produce cash flows. Consistent with this argument, Part I of Table 4 shows that the coefficients on *TA* are all positive and significant at 1% level across all columns, which suggests that tax avoidance is a substantial funding source that provides firms with additional internal funds. In particular, results of columns (7) through (9) show that in countries with poor investor protection tax avoidance still produces cash savings. This result seems to suggest that tax-shielded rent extraction may not be as prevalent as thought by prior literature (e.g., Desai et al. 2007; Desai and Dharmapala 2006, 2009), given that tax-shielded rent extraction should be most prevalent in these countries so that producing cash flows is not the primary goal of corporate tax avoidance in these countries

However, finding a positive coefficient on *TA* does not necessarily mean that managers spend these tax savings on investment expenditures. It is also possible that managers hoard these tax savings for future uses. To resolve this concern and thus bridge the gap between H2 and H3, we investigate the association between tax avoidance and the cash outflow effect of investment expenditures.

Specifically, referring to Almeida et al. (2004), a larger coefficient on *TA* in regression (2) implies that firms save a larger portion of cash flow from tax avoidance as cash reserves. In this regard, if managers use tax savings to fund investment expenditures, then greater investment expenditures should lead to smaller coefficient on *TA*, because now some tax savings are used to invest and only a smaller portion of them is hoarded as cash reserves. This yields an empirical testable prediction that the coefficient on *TA* in equation (2) should be smaller with a larger amount of *INVEST*, and we explore this prediction by extending equation (2) with an interaction term *TA·INVEST*.

As shown in Part II of Table 4, coefficients on *TA·INVEST* are negative and significant at conventional levels in all columns, and this holds even for non-US countries with low investor protection. These results support our expectation that managers use tax savings to finance investment projects. Furthermore, coefficients on *TA·INVEST* are largely smaller (more negative) in Panel C of Part II than those in Panels A and B and this result seems to suggest that managers in countries with weak investor protection spend a larger portion of tax savings on investment expenditures.

4.3. *Test results of H3: Tax avoidance and investment policy*

H3 argues that tax avoidance relates to overinvestment because managers may misuse tax savings on perk projects or building empires and this relation is attenuated in countries with strong investor protection. However, H3 relies on two premises. The first is that managers use tax savings to fund investments and the second is that these investments are inefficient.

Results of Part II of Table 4 provide some support for the first premise, but this evidence is indirect. To further support the first premise we explore the association between tax avoidance and investment expenditures and the results are shown in Table 5.

[Insert Table 5 about here]

Table 5 shows that coefficients on *TA* are positive and significant at 1% level across all columns, so tax avoidance is positively associated with investment expenditures.[30] This positive association confirms that managers use tax savings to finance investment projects. In addition, coefficients on *TA·INP* are negative and significant in all columns, so the positive relation between tax avoidance and investment expenditures is attenuated in countries with strong investor protection. This suggests that a larger portion of tax savings are used to fund investments in countries with weak investor protection. Overall, results in Table 5 are consistent with those in Part II of Table 4.

Thus far our results imply that managers spend tax savings on funding investments and such spending is more salient in countries with weak investor protection. As investments for poor-governed firms are more likely to be inefficient, the higher investment expenditures in countries with weaker investor protection provide preliminary evidence to suggest managerial overinvestment of tax savings. However, it is also possible that firms in countries with weak investor protection rely more on tax savings to finance their investments because it is more difficult to raise capitals in these countries due to their less developed capital markets and financial institutions. Therefore, we further explore regression (3.2) to explore the association between tax avoidance and investment efficiency. The results are shown in Table 6.

[Insert Table 6 about here]

In Panel A of Table 6, coefficients on *TA* are positive and significant in most columns, consistent with H3 that tax avoidance is associated with overinvestment. This result together with results in Table 5 suggests that managers may immediately dissipate tax savings on suboptimal projects. Panel A of Table 6 also shows that coefficients on *TA·INP* are negative and significant at 1 % level in all columns, consistent with H3 that the overinvestment of tax savings is mitigated in countries with good investor protection.

[30] Coefficients on *TA* remain to be significantly positive in all columns when we remove the interaction terms between *TA* and other country-level variables (*INP*, *TAXEF*, and *CMARD*).

In Panel B of Table 6, we repeat the estimate of regression (3.2) by using one-year ahead overinvestment ($INVEST^{\varepsilon}_{t+1}$) as the dependent variable because managers may not immediately invest tax savings but instead wait until the following period. This specification also mitigates the endogeneity concern that tax avoidance and investment decisions are determined simultaneously. As shown in Panel B of Table 6, we find that all results are similar to those in panel A, which suggests that managers may hoard tax savings to invest in following period while this investment is also inefficient and good governance can mitigate this inefficiency.

Overall, results in this section suggest that tax avoidance relates to overinvestment because managers dissipate tax savings on suboptimal projects, while such investment inefficiency is alleviated in countries with strong investor protection. These findings support for the misallocation argument.[31]

4.4. *Test results of H4: Tax avoidance and firm operating performance*

H4 explores how tax avoidance relates to firm performance because misuse of tax savings on suboptimal projects suggests only one type of misallocation. It is also likely that managers squander tax savings on non-investment expenditures and such misallocation is usually more subtle and difficult to detect. Because good governance can rectify misallocation of tax savings by inducing managers to deploy tax savings to more efficient uses, we expect that tax avoidance leads to higher firm performance in countries with stronger investor protection. We estimate regression (4) to test H4, and the results are shown in Table 7.

[Insert Table 7 about here]

Table 7 shows that coefficients on *TA* are negative and significant in most cases, and this suggests that tax avoidance leads to lower operating performance. This result could be explained by the finding in Table 6 that tax avoidance relates to overinvestment since investment inefficiency usually deteriorates operating performance. This result also suggests

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[31] An alternative explanation for the relation between tax avoidance and investment inefficiency is that firms with more tax avoidance activities may be more opaque (e.g., Balakrishnan et al. 2012) and poor transparency has been shown to reduce investment efficiency (Biddle and Hilary 2006). However, our finding about how tax avoidance affects investment efficiency cannot be merely explained by the opaqueness of tax avoidance, since we have shown that managers use tax savings to invest and that tax avoidance is positively related to investment expenditures.

that in addition to suboptimal investment projects, managers may also dissipate tax savings on non-investment outlays. Furthermore, *TA·INP* are positive and significant at 1% level in all columns of Table 7, consistent with H4 that tax avoidance leads to higher firm performance in countries with stronger investor protection. Therefore, results in this section provide evidence to confirm that misuse of tax savings has a negative impact on operating performance and this negative impact is more salient when managers are more entrenched as featured by weak investor protection.[32]

In sum, our results in Table 3 through Table 7 are more consistent with the misallocation argument than the tax-shielded rent extraction argument. We find that tax avoidance generate cash savings and managers use tax savings to fund investment, while in countries with weaker investor protection this investment is more likely to advance managerial self-interests and thus leads tax avoidance to be associated with lower operating performance. All these results suggest that the main agency issue of tax avoidance is how managers use tax savings instead of whether managers exploit tax avoidance to mask their rent extraction. We also find that all these negative consequences of tax avoidance is attenuated with strong external governance, and this explains why in Table 3 we find that investors place higher valuation on corporate tax avoidance in countries with stronger protection for their rights.

4.5. *Robustness test*

Our first robustness test examines whether our results are sensitive to different measures of investor protection. Because the legal regime quality for a country may change over time, we repeat our tests by using an anti-director rights index that is the average of the index developed in La Porta et al. (1998) and the index developed in Djankov et al. (2008), as the former is complied using laws prevailing in 1993 while the latter is complied using laws prevailing in 2003. We also use the expropriation index extracted from La Porta et al. (1998) that evaluates the threat of outright confiscation or forced nationalization. We also follow Huang et al. (2013) by using the time-series investor protection measure developed by

[32] We recognize that our argument regarding the relation between tax avoidance and performance should be more plausible on the condition of overinvestment. Therefore, we repeat our tests in Table 7 by using only observations with positive $INVEST^{\varepsilon}_{t}$ and we find that this does not change our conclusions.

Kaufmann et al. (2010).[33] We find that our results remain qualitatively similar with the use of these investor protection measures.

In addition, one potential concern for our international setting is that sample-concentration in some countries (e.g., US or Japan) may induce our results to be unduly influenced by these countries. To mitigate this concern, we refer to Atwood et al. (2012) by calculating country-year-industry mean value for each variable and using the resulting mean value to repeat our tests, where we now have only one observation per industry in each country-year. While this procedure reduces the influence that any particular country has on our results, it also removes much of the variation in the dependent variables and firm-specific variables and thus makes some of our results insignificant. However, this procedure does not change our conclusions.

Moreover, as mentioned previously, book-tax difference contains measurement error that arises from mechanical reasons due to different rules governing the calculations of book income and taxable income. Although finding results consistent with our hypotheses suggests that this measurement error is serious, we still conduct several tests to mitigate this concern.

First, we consider the variation in cross-country required book-tax conformity (*BTC*) that is estimated by following the approach of Atwood et al. (2010).[34] A high level of *BTC* implies that in many respects the determination of book income is the same as taxable income and this minimizes the measurement error of book-tax differences due to mechanical reasons. Untabulated results show that considering *BTC* in our tests does not affect our conclusions[35] and this suggests that our book-tax difference measures are less confounded by measurement error.

Second, we use firms that adopt the same accounting standards, because the recognition and calculation of tax expenses may differ when adopting different accounting standards and

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[33] Kaufmann et al. (2010) provide a time series of six governance indices relating to voice and accountability, political stability and absence of violence or terrorism, government effectiveness, regulatory quality, rule of law, and control of corruption. We construct the Kaufmann et al.'s measure as the sum of these six country-level investor protection indicators for each country over our study period.

[34] Atwood et al. (2010) measure book-tax conformity based on the proportion of current tax expense that cannot be explained by pre-tax book income. We follow Atwood et al. (2010) to estimate this model by requiring at least 40 usable observations in a year for any specific country.

[35] Like stronger tax enforcement, higher level of required book-tax conformity also makes firms more difficult in evading taxes (Atwood et al. 2012). In this regard, the inclusion of both *TAXEF* with *BTC* may confound our estimates, so our robustness test herein replaces *TAXEF* with *BTC*.

this may hamper the comparability of book-tax differences across countries. We identify whether a firm adopts IFRS or US GAAP and repeat our tests by using two subsamples that adopt these two accounting standards separately, and we find that most of our results remain qualitatively unchanged for both subsamples.

Finally, we repeat our tests by using industry-adjusted tax avoidance measures.[36] The use of industry-adjusted measures partially removes the effect of cross-country difference in accounting standards, as financial reporting regulations are often developed with specific industry practices. This also mitigates the concern that differences in tax regulations across countries may introduce noise to our tax avoidance measure. We find similar results with the use of industry-adjusted tax avoidance measures.[37]

5. Additional tests

5.1. *Test of H1: alternative valuation specification*

In Table 2, we test H1 with the valuation specification of Desai and Dharmapala (2009). However, this specification raises the concern that the negative value implication of tax avoidance may be interpreted as market's expectation that firms will experience a negative shock on future performance so they evade more taxes and use tax savings as a buffer to mitigate this negative shock. To rule out this confounding interpretation, we repeat our test of H1 with the specification of Fama and French (1998), because it controls for determinants that are likely to affect investors' expectations of future cash flows as well as earnings. Specifically, we extend the specification of Fama and French as following regression (5):

[36] We subtract our three tax avoidance measures from their corresponding industry median values to obtain the industry-adjusted measures, where the industry median value is computed for each two-digit SIC industry in a yearly basis for each country.

[37] We also repeat our tests by using cash effective tax rate to measure tax avoidance as in Amiram et al. (2012) and we find that this does not change our conclusions. This result confirms that our findings with book-tax differences are indeed attributed to real cash saving from tax avoidance, even although cash effective tax rate captures less aggressive forms of tax avoidance.

$$\begin{aligned} MV_{it} = {} & \gamma_0 + \gamma_1 \cdot TA_{it} + \gamma_2 \cdot TA_{it} \cdot INP_j + \gamma_3 \cdot TA_{it} \cdot TAXEF_j + \gamma_4 \cdot TA_{it} \cdot CMARD_{jt} + \gamma_5 \cdot INP_j + \\ & \gamma_6 \cdot TAXEF_j + \gamma_7 \cdot CMARD_{jt} + \gamma_8 \cdot GDP_{jt} + \gamma_9 \cdot E_{it} + \gamma_{10} \cdot dE_{it} + \gamma_{11} \cdot dE_{it+1} + \gamma_{12} \cdot dA_{it} + \\ & \gamma_{13} \cdot dA_{it+1} + \gamma_{14} \cdot RD_{it} + \gamma_{15} \cdot dRD_{it} + \gamma_{16} \cdot dRD_{it+1} + \gamma_{17} \cdot INT_{it} + \gamma_{18} \cdot dINT_{it} + \\ & \gamma_{19} \cdot dINT_{it+1} + \gamma_{20} \cdot DIV_{it} + \gamma_{21} \cdot dDIV_{it} + \gamma_{22} \cdot dDIV_{it+1} + \gamma_{23} \cdot dMV_{it+1} + \\ & Fixed\ effects + \varepsilon_{it} \end{aligned} \tag{5}$$

where X_t is the level of variable X in year t divided by total assets; dX_t is the change in the level of X from year t-1 to year t (i.e., X_t - X_{t-1}) divided by total assets; dX_{t+1} is the change in the level of X from year t to year t+1 (i.e., X_{t+1} - X_t) divided by total assets; E is earnings before extraordinary items plus interest expenses; A is book value of total assets; remaining variables are defined as in previous sections. The results are presented in Table 8.

[Insert Table 8 about here]

Table 8 shows that controlling for investors' expectations does not change our conclusions. Coefficients on *TA* remain to be consistently negative and coefficients on *TA·INP* are still significantly positive, consistent with the results of Table 3. Therefore, our result regarding the negative valuation of tax avoidance does not merely reflect investors' expectations about firms' future performance.[38]

5.2. *Tax avoidance and cash holdings*

In this section we examine how tax avoidance affects firms' cash holding decisions, a topic that is underexplored in the literature. Our test herein is motivated by results of Table 6 that managers may hoard tax savings to invest in following period. We conjecture that such hoarding behavior may impact cash holdings. Results herein also help to distinguish whether the tax-shielded rent extraction argument or the misallocation argument is empirically more prevalent, as these two arguments make different predictions about the cash holding implication of tax avoidance.

Specifically, we examine the relation between tax avoidance and excess cash and how corporate governance affects this relation, where excess cash is defined as cash held by firms that is more than ''legitimate'' reasons such as investment opportunities, hedging needs,

[38] The inclusion of E_t in regression (5) alleviates the concern that the calculation of book-tax difference involves current book income so it may reflect the influence of current earnings. It also reduces the noise in measuring book-tax difference in an international setting because the influence of cross-country difference in accounting standards could be absorbed by E_t.

availability of alternative sources of liquidity, etc. (see, Dittmar and Mahrt-Smith 2007; Harford et al. 2008). We explore excess cash because it represents the amount of cash that is at risk of being turned into managers' private benefits and it considers that managers may not waste cash reserves that are needed to maintain normal operations. Thus, using excess cash offers a powerful test to detect whether managers divert firm cash. In this regard, the tax-shielded rent extraction argument predicts that tax avoidance leads to lower excess cash if managers exploit tax avoidance activity to hide their diversion of firm cash (Dhaliwal et al. 2011).

However, it is also likely that managers deliberately hoard too much tax savings as cash reserves because doing so offers them a private benefit option.[39] If managers exploit tax avoidance to generate tax savings and hoard them as cash reserves due to self-serving reasons,[40] then tax avoidance will positively relate to excess cash since hoarding cash reserves unrelated to operation needs will lead cash balance to deviate from normal level.[41] This is consistent with the misallocation argument because hoarding too much tax savings as cash reserves due to self-serving reasons also suggests a possible type of misallocating tax savings.

Following Fresard and Salva (2010), we estimate excess cash with regression (6.1) for each country, where excess cash is the residual from the regression.

$$\begin{aligned}\ln(Cash_{it}) = {} & \delta_1 \cdot CF_{it} + \delta_2 \cdot NWC_{it} + \delta_3 \cdot MB_{it} + \delta_4 \cdot SIZE_{it} + \delta_5 \cdot CAP_{it} + \delta_6 \cdot LEV_{it} + \delta_7 \cdot RD_{it} + \\ & \delta_8 \cdot DIV_{it} + Fixed\ effects\,(\text{firm,industry,and year}) + \varepsilon_{it} \qquad (6.1)\end{aligned}$$

where ln(*Cash*) is the natural log of cash and cash equivalents over total assets; *CF* is

[39] Ceteris paribus, managers prefer to hold as much cash as they can, because this entrenches them by enhancing job security or reducing capital market scrutiny due to less reliance on external financing. Holding excess cash also reduces the pressures on managers to operate efficiently by minimizing costs, improving margins, closely monitoring employees and operations, and engaging in other profit enhancing measures.

[40] This implicitly assumes that when deciding how to use cash savings from tax avoidance, managers trade off current misuse versus the private benefit option offered by reserving tax savings, and they put some weight on the latter. This is a plausible assumption, because self-interested managers have incentives to increase the amount of assets under their control, which suggests that tax savings are retained instead of spending immediately.

[41] From the perspective of maximizing shareholders' wealth, the optimal level of tax avoidance is that just enough cash savings are saved to meet firm's normal need and no excess cash left, given that holding excess cash exacerbates agency problems and investing in cash produces little return.

operating income minus interest and tax expenses over total assets; *NWC* is noncash net working capital over total assets; *MB* is the market-to-book ratio; *Fixed effects* include firm, industry, and year fixed effects; remaining variables are defined as in previous sections.

By using the residual of (6.1) as the dependent variable, we explore the relation between excess cash and tax avoidance with regression (6.2).

$$XCash_{it} = \lambda_0 + \lambda_1 \cdot TA_{it} + \lambda_2 \cdot TA_{it} \cdot INP_j + \lambda_3 \cdot TA_{it} \cdot TAXEF_j + \lambda_4 \cdot TA_{it} \cdot CMARD_{jt} + \lambda_5 \cdot INP_j + \lambda_6 \cdot TAXEF_j + \lambda_7 \cdot CMARD_{jt} + \lambda_8 \cdot GDP_{jt} + \varepsilon_{it} \tag{6.2}$$

where *XCash* is excess cash, which is the residual of regression (6.1). The results of estimating (6.2) are presented in Table 9.

[Insert Table 9 about here]

Table 9 shows that coefficients on *TA* are positive in all columns and they are significant in most columns, while coefficients on *TA·INP* are all significantly negative. Consistent with the misallocation argument, this result suggests that tax avoidance allows managers to hoard excess cash due to self-serving reasons, while such hoarding behavior is alleviated in countries with better investor protection.[42] This result also conforms to the conclusion of Dittmar et al. (2003) and Pinkowitz et al. (2004) that in countries with weak investor protection managers hoard as much cash as they can, and tax avoidance is one means that facilitates them to do so.

Overall, the positive relation between tax avoidance and excess cash in Table 9 implies that managers do not spend all tax savings immediately and they hoard some tax savings as cash reserves for future misuse. This is consistent with the finding in Panel B of Table 6 that current-period tax avoidance is associated with next-period overinvestment. More

[42] We recognize that managers may simply hoard tax savings to build financial flexibility. To rule out this interpretation, we have considered the effect of external financing opportunities by including *CMARD* in equation (6.2), as the extent to which firms can access to external capitals affects their incentives to build financial flexibility from hoarding tax savings (Edwards et al. 2012). Moreover, misallocation is not the only explanation for the positive relation between tax avoidance and excess cash. Another explanation is that managers hoard tax savings for legitimate purposes such as to counteract future economic downturn. External non-agency factors such as error in estimating firms' normal needs of cash or shocks to profitability may also drive this relation. However, we can rule out these confounding interpretations given that we find that strong corporate governance attenuates the relation between tax avoidance and excess cash, as corporate governance do not affect the effect of either external non-agency factors or economic downturn.

importantly, results herein indicate that in countries with poor investor protection self-serving is a possible incentive for managers to conduct tax avoidance, and such self-serving incentive is consistent with our finding that managers squander tax savings on suboptimal investment expenditures instead of spend on more value-enhancing expenditures.

5.3. *Tax avoidance and payout policy*

As a supplement test, we also investigate how tax avoidance relates to corporate payout policy. If managers hoard tax savings for self-serving reasons, then they would not want to pay tax savings out to shareholders, as payouts to shareholders will reduce the amount of cash that otherwise would be used to advance their private benefits. To test this conjecture, we follow the specification of Alzahrani and Lasfer (2012) by regressing corporate payouts on tax avoidance, the interaction between tax avoidance and investor protection, and other control variables, where payout is defined as (dividend paid on common shares + repurchases of common shares – proceeds from issuance of common shares) divided by total assets. The results are shown in Table 10.

[Insert Table 10 about here]

Table 10 shows that coefficients on *TA* are significantly negative in most columns, while coefficients on *TA·INP* are significantly positive in all column. This result is consistent with our conjecture that managers tend to be reluctant to pay tax savings out to shareholders, but this tendency is weakened in countries with better investor protection. This result also conforms to the outcome model of La Porta et al. (2000b) that with better legal protection minority shareholders can force corporate insiders to disgorge more cash to them.

5.4. *Excess cash and the valuation of tax avoidance*

In section 5.2 we have shown that tax avoidance positively relates to excess cash. Here we further examine how excess cash affects the valuation of tax avoidance. We conjecture that the presence of excess cash suggests that managers are more likely to misuse tax savings, since the further increase in cash from tax savings will bring little benefit but instead exacerbate the agency concern for holding excess cash. In this regard, the presence of excess cash will amplify the negative valuation of tax avoidance.

To test this conjecture, we estimate equation (1) by using observations with positive excess cash in previous period ($XCash_{t-1}>0$) and including this variable and its interaction with tax avoidance. We expect a negative coefficient on $TA{\cdot}XCash_{t\text{-}1}$. The estimate results are exhibited in Table 11.

[Insert Table 11 about here]

Table 11 shows coefficients on $TA{\cdot}XCash_{t\text{-}1}$ are negative for the full sample case in Panel A, and they are all significant except for in column (2). In Panel B, we use only US observations and coefficients on $TA{\cdot}XCash_{t\text{-}1}$ are significantly negative in columns (4) through (6). In Panel C we use observations for countries with low investor protection as the effect of our conjecture should be most pronounced in these countries. Consistent with our expectation, Panel C shows that coefficients on $TA{\cdot}XCash_{t\text{-}1}$ are all significantly negative and these coefficients are consistently smaller (more negative) than those in Panels A and B. Overall, results in Table 11 suggest that holding excess cash has a negative effect on the valuation of tax avoidance and this negative effect is more prominent when investor protection is weak.

6. Conclusion

Jensen (1986) argues that entrenched managers may waste free cash flows. We extend this argument to cash savings from tax avoidance. Our study proposes a new explanation for why corporate governance can affect the value of tax avoidance, which is beyond the tax-shielded rent extraction argument proposed by Desai and Dharmapala (2006, 2009) and Desai et al. (2007). Our results suggest that the main agency issue regarding tax avoidance is the misallocation of tax savings instead of managers exploiting tax avoidance to mask their rent extraction.

We find that better investor protection leads investors to place higher valuation on corporate tax avoidance. This finding is attributed to the reasoning that in countries with weak investor protection managers are more likely to squander tax savings on suboptimal investments or misallocate too much of them as cash reserves, so in these countries tax avoidance negatively impact operating performance. In contrast, these negative consequences of tax avoidance are all mitigated by better investor protection. Our international evidence suggests that the extent to which managers extract rent from tax avoidance through misallocating tax savings varies across countries with different level of investor protection.

Findings in this paper contribute to our understanding about the interaction between firm governance and tax avoidance. Although a large literature documents that better governance enhances firm value, much less is understood about how better governance works. Our study provides insight into this question by providing a direct link between governance and the value of tax savings. In this regard, we find that better governance increases firm value by improving the use of tax savings. This result sheds new light on the role of governance in the valuation of tax avoidance.

Appendix

Table A1
Empirical Definitions of Variables

Variable		Empirical Definition	Data Source
Measures of Tax Avoidance (*TA*)[1]			
BTD	=	[pretax book income – (domestic current tax expenses+ foreign current tax expenses) / top corporate statutory tax rate] / total assets.	Worldscope
RBTD	=	the residual from a firm fixed-effect regression of *BTD* on total accruals that is estimated for each country, where total accruals is calculated as (net income before extraordinary items - operating cash flow) / total assets.	Worldscope
PBTD	=	[pretax book income – (deferred tax expense + domestic current tax expenses+ foreign current tax expenses) / top corporate statutory tax rate] / total assets.	Worldscope
Measures of Legal Protection for Investor Rights (*INP*)			
LAW	=	the anti-director rights index plus 50 percent of the rule of law index	La Porta et al. 1998
CORUP	=	the corruption index	
Firm-Level Variables Used in Equations (1) to (4)			
(a) Dependent Variables			
MV	=	the sum of the market value of equity plus the book value of debt minus deferred tax expense and then divided by the book value of total asset.	Worldscope
$\Delta Cash$	=	change in cash holdings scaled by total assets	Worldscope
INVEST	=	(capital expenditures + research and development expense - proceeds from sale of fixed assets - depreciation) / the average total assets of years t and t-1	Worldscope
$INVEST^{\varepsilon}$	=	residual from regression (3.1), where positive value of $INVEST^{\varepsilon}$ represents overinvestment.	Worldscope
ROA_{t+1}	=	industry-adjusted return on assets, defined as operating income of year t+1 divided by the average total assets of t and t+1 and then adjusted with industry median value.	Worldscope

(b) Control Variables

SIZE	=	the natural log of total assets in US dollar.	Worldscope
CHS	=	the closely-held shares percentage.	Worldscope
DIV	=	dividend scaled by total assets	Worldscope
CAP	=	capital expenditures scaled by total assets	Worldscope
LEV	=	total debt scaled by total assets	Worldscope
INT	=	interest expenses scaled by total assets	Worldscope
RD	=	research and development expenses scaled by total assets	Worldscope
GROWTH	=	two-year (year t to t-1) average sales growth rate	Worldscope
TAXCR	=	income tax credit scaled by total assets	Worldscope
CashFlow	=	cash flow from operations minus dividend scaled by total assets	Worldscope
ΔNWC	=	change in noncash net working capital scaled by total assets	Worldscope
ΔSTD	=	change in short-term debt scaled by total assets	Worldscope
$LEV_{t\text{-}1}$	=	lagged book value of total debt over average total assets	Worldscope
$CASH_{t\text{-}1}$	=	lagged cash and cash equivalent over average total assets	Worldscope
$SIZE_{t\text{-}1}$	=	natural log of lagged total assets in US dollar	Worldscope
FCF	=	free cash flow, calculated as (cash from operations + research and development expense - depreciation expense) / average total assets - the predicted value of *INVEST* from regression (3.1)	Worldscope

Country-Level Control Variables

TAXEF	=	perceived strength of tax enforcement	Dyck and Zingales 2004
CMARD	=	the degree of capital market development, calculated as the sum of stock market capitalization and domestic credit provided by banking normalized by gross domestic product	World Bank Statistics
GDP	=	natural log of gross domestic product per capita in US dollar	World Bank Statistics

1. Statutory tax rates are hand-collected from a KPMG LLP online summary, PricewaterhouseCoopers LLP's online information, and Coopers & Lybrand LLP's worldwide tax summary guides.

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Table 1
Summary Statistics

	Firm-level variables								Country-level variables					
Country	***Obs.***	***BTD***	***RBTD***	***PBTD***	***MV***	Δ***Cash***	***INVEST***	ROA_{t+1}	***CMARD***	***GDP***	***ANTI***	***RULE***	***CORUP***	***TAXEF***
Argentina	88	0.0088	0.0281	0.0090	1.0540	0.0019	0.0053	0.0743	0.6814	3.8401	4	5.35	3.5	2.41
Austria	514	0.0108	0.0260	0.0125	1.2066	0.0020	0.0007	0.0414	1.5497	4.5597	2	10.00	7.7	3.60
Australia	4115	0.0030	0.0206	0.0013	1.1944	0.0025	0.0000	0.0542	2.2265	4.4991	4	10.00	8.3	4.58
Brazil	1750	0.0078	0.0281	0.0070	1.1018	0.0106	0.0075	0.0749	1.3678	3.7452	3	6.32	3.9	2.14
Canada	2105	0.0135	0.0366	0.0043	1.3475	0.0017	0.0122	0.0733	2.6979	4.4423	5	10.00	9.2	3.77
Chile	505	-0.0145	-0.0028	-0.0201	1.4420	0.0052	0.0187	0.0864	1.7918	3.8756	5	7.02	7.4	4.20
Colombia	159	0.0075	0.0475	0.0098	1.6902	0.0356	0.0462	0.0552	0.8216	3.5559	3	2.08	3.2	2.11
Denmark	933	-0.0025	0.0081	-0.0009	1.0853	-0.0010	0.0001	0.0341	2.1640	4.6329	2	10.00	9.8	3.70
Finland	879	-0.0017	0.0125	0.0010	1.2266	0.0061	0.0041	0.0775	1.8386	4.5292	3	10.00	10.0	3.53
France	1985	0.0040	0.0225	0.0032	1.2125	0.0029	0.0076	0.0486	1.9123	4.4972	3	8.98	6.7	3.86
Germany	9398	0.0081	0.0352	0.0072	1.4598	0.0049	0.0205	0.0689	1.8176	4.5070	1	9.23	7.6	3.41
Hong Kong	10936	-0.0055	-0.0011	-0.0067	0.9741	0.0084	0.0016	0.0253	5.3615	4.4501	5	8.22	7.7	4.56
Indonesia	3052	-0.0093	0.0034	-0.0071	1.0923	0.0058	0.0002	0.0580	0.7861	3.1379	2	3.98	1.7	2.53
Israel	501	-0.0008	0.0104	-0.0002	1.1363	0.0017	0.0038	0.0306	1.5946	4.3103	3	4.82	6.6	3.69
Italy	1448	-0.0298	-0.0219	-0.0260	1.3090	-0.0113	0.0014	0.0199	1.5304	4.4362	1	8.33	4.6	1.77
Japan	26417	-0.0048	0.0060	-0.0033	1.0426	0.0005	0.0092	0.0406	3.8149	4.5633	4	8.98	6.4	4.41
Korea	1390	-0.0042	0.0096	-0.0010	0.9899	0.0090	-0.0044	0.0222	1.9903	4.1733	2	5.35	4.0	3.29
Malaysia	6727	-0.0003	0.0058	-0.0006	0.9411	0.0026	-0.0003	0.0336	2.7165	3.7498	4	6.78	4.8	4.34

Mexico	394	-0.0010	0.0068	0.0014	1.3071	0.0036	-0.0013	0.0676	0.6796	3.8203	1	5.35	3.3	2.46
New Zealand	717	0.0046	0.0161	0.0032	1.0714	0.0005	0.0001	0.0613	1.6539	4.3219	4	10.00	9.4	5.00
Netherlands	417	-0.0079	0.0296	0.0060	1.2722	0.0029	0.0113	0.0589	2.7876	4.5874	2	10.00	8.9	3.40
Norway	362	0.0075	0.0228	0.0096	1.1730	0.0163	0.0037	0.0342	1.2169	4.6462	4	10.00	9.1	3.96
Peru	641	-0.0079	0.0152	-0.0072	2.2571	0.0096	0.0245	0.1239	0.6139	3.4937	3	2.50	4.4	2.66
Philippines	1638	0.0042	0.0115	0.0052	0.9650	0.0027	0.0015	0.0226	1.0637	3.1399	3	2.73	2.8	1.83
Portugal	234	0.0039	0.0143	0.0005	1.1208	0.0046	-0.0073	0.0307	2.0242	4.2504	3	8.68	6.4	2.18
South Africa	1877	0.0228	0.0407	0.0188	1.3178	0.0061	0.0085	0.1000	3.7812	3.7014	5	4.42	5.0	2.40
Singapore	5191	-0.0016	0.0046	-0.0023	1.0125	0.0072	0.0003	0.0353	2.4810	4.4812	4	8.57	9.1	5.05
Spain	398	0.0189	0.0479	0.0156	1.4692	0.0224	0.0167	0.0854	2.3751	4.3444	4	7.80	7.0	1.91
Sweden	1995	0.0031	0.0207	-0.0010	1.3159	0.0021	0.0128	0.0521	2.2411	4.5790	3	10.00	9.4	3.39
Switzerland	2021	-0.0035	0.0126	-0.0041	1.4066	0.0041	0.0159	0.0733	3.9509	4.7071	2	10.00	8.6	4.49
Thailand	2588	0.0023	0.0238	0.0014	1.0515	0.0013	-0.0097	0.0367	1.9868	3.4629	2	6.25	3.2	3.41
Turkey	1500	0.0084	0.0037	0.0075	1.2982	0.0476	0.0156	0.0962	0.7704	3.7674	2	5.18	3.8	2.07
UK	10524	-0.0008	0.0148	-0.0018	1.2944	0.0027	0.0015	0.0724	3.0239	4.5034	5	8.57	8.7	4.67
US	57977	0.0056	0.0242	0.0036	1.2818	0.0031	0.0087	0.0543	3.4469	4.5963	5	10.00	7.8	4.47

ANTI is the anti-director rights index. *RULE* is the rule of law index. Both of these two indexes are retrieved from La Porta et al. (1998). Definitions of remaining variables are shown in Table A1 in the appendix. For each firm-level variable, the reported statistics are the means of yearly medians for specific country. For *CMARD* and *GDP*, the reported statistics is the mean over our sampling period for each country. The number of observations for each country is shown in the first column. The total of observations is161,376 and this is for *BTD* and *PBTD*. For *RBTD* we have 154,670 firm-year observations.

Table 2
Corporate Tax Avoidance and Firm Valuation
(The dependent variable is *MV*)

	Panel A: Estimated with observations for the U.S.			Panel B: Estimated with observations for non-US countries		
	(1)	(2)	(3)	(4)	(5)	(6)
TA=	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***
Intercept	1.698	1.644	1.713	1.081	1.084	1.094
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TA	**0.027**	**-0.036**	**0.121**	**-0.561**	**-0.723**	**-0.489**
	(0.667)	**(0.649)**	**(0.069)***	**(0.000)*****	**(0.000)*****	**(0.000)*****
SIZE	-0.082	-0.076	-0.086	-0.013	-0.014	-0.015
	(0.000)***	(0.000)***	(0.000)***	(0.009)***	(0.005)***	(0.003)***
CHS	-0.275	-0.287	-0.277	-0.114	-0.120	-0.116
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
DIV	9.834	9.847	9.775	11.527	11.544	11.485
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
CAP	2.091	2.168	2.086	1.531	1.625	1.512
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
RD	6.233	6.168	6.317	7.514	7.525	7.565
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
GROWTH	0.226	0.226	0.227	0.198	0.192	0.198
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
INT	-2.676	-2.655	-2.595	-0.542	-0.663	-0.442
	(0.000)***	(0.000)***	(0.000)***	(0.031)**	(0.014)**	(0.078)*
TAXCR	-484.265	-491.672	-483.990	789.531	730.820	792.491
	(0.002)***	(0.002)***	(0.002)***	(0.016)**	(0.026)**	(0.015)**
LEV	-0.007	0.002	0.002	0.273	0.301	0.276
	(0.840)	(0.959)	(0.962)	(0.000)***	(0.000)***	(0.000)***
Industry and year effects?	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	57977	57601	57977	103399	97069	103399
Adj.-R^2	0.271	0.274	0.271	0.258	0.261	0.257
F-value	248.654	250.763	248.788	414.349	395.629	412.743

This table shows the results of estimating equation (1) without considering country-level variables, where the dependent variable is the Tobin's q ratio, defined as the sum of the market value of equity plus the book value of debt minus deferred tax expense and then divided by the book value of total asset. Definitions of remaining variables are shown in Table A1 in the appendix. The P-values are reported in parentheses. The estimated standard errors are adjusted by the procedure of Newey-West (1987). ***, **, and * represent statistical significant (two-tailed) at the 1%, 5% and 10% levels, respectively.

Table 3
The Effect of Investor Protection on the Valuation of Corporate Tax Avoidance
(The dependent variable is *MV*)

	Panel A: Investor Protection (INP) Measured with LAW			***Panel B: Investor Protection (INP) Measured with CORUP***		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
TA=	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***
Intercept	1.072	1.043	1.077	1.226	1.096	1.228
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TA	**-0.694**	**-0.541**	**-0.742**	**-0.762**	**-0.727**	**-0.772**
	(0.014)**	**(0.123)**	**(0.009)*****	**(0.005)*****	**(0.034)****	**(0.005)*****
TA*INP	**0.142**	**0.133**	**0.120**	**0.236**	**0.205**	**0.212**
	(0.000)***	**(0.007)*****	**(0.003)*****	**(0.000)*****	**(0.000)*****	**(0.000)*****
TA*TAXEF	0.153	0.133	0.218	-0.007	0.024	0.050
	(0.115)	(0.271)	(0.031)**	(0.938)	(0.825)	(0.577)
TA*CMARD	-0.456	-0.473	-0.443	-0.372	-0.365	-0.365
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
INP	0.075	0.069	0.073	0.035	0.020	0.034
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TAXEF	-0.154	-0.160	-0.152	-0.098	-0.098	-0.098
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
CMARD	-0.035	-0.024	-0.034	0.002	0.009	0.002
	(0.000)***	(0.000)***	(0.000)***	(0.649)	(0.009)***	(0.532)
GDP	0.035	0.041	0.035	0.030	0.050	0.031
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Firm-level control variables included?	Yes	Yes	Yes	Yes	Yes	Yes
Industry and year effects included?	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	161376	154670	161376	161376	154670	161376
Adj.-R^2	0.264	0.266	0.263	0.262	0.264	0.261
F-value	616.954	597.863	615.187	609.980	590.320	608.193

This table shows the results of estimating the full specification of equation (1), where the dependent variable is the Tobin's q ratio, defined as the sum of the market value of equity plus the book value of debt minus deferred tax expense and then divided by the book value of total asset. Definitions of remaining variables are shown in Table A1 in the appendix. For brevity, firm-level control variables are included in our estimates but their results are not presented in this table. The P-values are reported in parentheses. The estimated standard errors are adjusted by the procedure of Newey-West (1987). ***, **, and * represent statistical significant (two-tailed) at the 1%, 5% and 10% levels, respectively.

Table 4
Corporate Tax Avoidance and Cash Flow
(The dependent variable is Δ*Cash*)

Part I: Results of estimating equation (2)

	Panel A: Observations for the US			Panel B: Observations for non-US Countries with high *INP*			Panel C: Observations for non-US Countries with low *INP*		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
TA=	*BTD*	*RBTD*	*PBTD*	*BTD*	*RBTD*	*PBTD*	*BTD*	*RBTD*	*PBTD*
Intercept	0.016	0.005	0.017	0.008	0.003	0.015	0.002	-0.001	0.003
	(0.010)**	(0.405)	(0.006)***	(0.773)	(0.923)	(0.600)	(0.697)	(0.906)	(0.645)
TA	**0.108**	**0.076**	**0.115**	**0.122**	**0.068**	**0.116**	**0.117**	**0.071**	**0.113**
	(0.000)*	**(0.000)***	**(0.000)***	**(0.000)***	**(0.000)***	**(0.000)***	**(0.000)***	**(0.000)***	**(0.000)***
CashFlow	0.164	0.187	0.161	0.207	0.231	0.213	0.218	0.230	0.226
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Δ*NWC*	-0.210	-0.157	-0.214	-0.190	-0.140	-0.185	-0.143	-0.102	-0.137
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Δ*STD*	-0.098	-0.045	-0.103	0.001	0.049	0.006	0.006	0.043	0.011
	(0.000)***	(0.001)***	(0.000)***	(0.955)	(0.001)***	(0.675)	(0.602)	(0.000)***	(0.308)
MV	0.016	0.016	0.016	0.016	0.015	0.016	0.008	0.008	0.008
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***

SIZE	-0.007	-0.006	-0.007	-0.007	-0.006	-0.007	-0.002	-0.001	-0.002
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.006)***	(0.000)***
INVEST	-0.053	-0.055	-0.050	-0.161	-0.155	-0.158	-0.145	-0.139	-0.142
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
INP				0.001	0.001	0.002	0.001	0.001	0.001
				(0.217)	(0.540)	(0.168)	(0.150)	(0.040)**	(0.139)
TAXEF				-0.003	-0.003	-0.003	0.002	0.003	0.002
				(0.316)	(0.336)	(0.339)	(0.001)***	(0.000)***	(0.001)***
CMARD				0.007	0.007	0.007	-0.004	-0.004	-0.004
				(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
GDP				-0.001	-0.001	-0.002	-0.001	-0.002	-0.001
				(0.482)	(0.521)	(0.262)	(0.032)	(0.000)***	(0.015)**
Industry and year effects included?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	39295	39292	39295	41035	41035	41035	37035	37035	37035
Adj.-R^2	0.139	0.130	0.140	0.157	0.145	0.155	0.149	0.138	0.148
F-value	76.255	71.171	76.970	87.813	79.910	86.584	74.824	68.125	74.311

Part II: The association between tax avoidance and the cash outflow effect of investment expenditures

	Panel A: Observations for the US			**Panel B: Observations for non-US Countries with high *INP***			**Panel C: Observations for non-US Countries with low *INP***		
	(10)	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**
TA=	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***
Intercept	0.020	0.008	0.021	0.008	0.003	0.015	0.003	0.000	0.003
	(0.000)***	(0.115)	(0.000)***	(0.769)	(0.905)	(0.598)	(0.654)	(0.933)	(0.631)
TA	0.120	0.095	0.127	0.124	0.075	0.117	0.118	0.074	0.113
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TA*INVEST	**-0.142**	**-0.149**	**-0.134**	**-0.178**	**-0.194**	**-0.141**	**-0.279**	**-0.197**	**-0.272**
	(0.004)***	**(0.011)****	**(0.008)*****	**(0.021)****	**(0.044)****	**(0.073)***	**(0.004)*****	**(0.075)***	**(0.005)*****
INVEST	-0.076	-0.069	-0.072	-0.174	-0.161	-0.168	-0.155	-0.141	-0.152
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Control variables included?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry and year effects included?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	39295	39292	39295	41035	41035	41035	37035	37035	37035
Adj.-R^2	0.136	0.127	0.137	0.158	0.145	0.155	0.151	0.138	0.150
F-value	90.573	83.853	91.330	87.203	79.298	85.837	74.723	67.627	74.153

This table shows the results of estimating equation (2), where the dependent variable is $\Delta Cash$, defined as change in cash holdings scaled by total assets. Definitions of remaining variables are shown in Table A1 in the appendix. For Panels B and C in Parts I and II, countries with high (low) investor protection are deified as those with *LAW* values higher (lower) than the median of *LAW*, where the median is calculated with all our non-US sample countries. For brevity, in Part II firm-level and country-level variables are included in the estimates but their results are not presented. The P-values are reported in parentheses. The estimated standard errors are adjusted by the procedure of Newey-West (1987). ***, **, and * represent statistical significant (two-tailed) at the 1%, 5% and 10% levels, respectively.

Table 5
Corporate Tax Avoidance and Investment Expenditure
(The dependent variable is *INVEST*)

	Panel A: Investor Protection (INP) Measured with LAW			***Panel B: Investor Protection (INP) Measured with CORUP***		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
TA=	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***
Intercept	-0.010	-0.010	-0.010	-0.025	-0.026	-0.025
	(0.001)***	(0.001)***	(0.001)***	(0.000)***	(0.000)***	(0.000)***
TA	**0.058**	**0.070**	**0.037**	**0.051**	**0.067**	**0.033**
	(0.000)***	**(0.000)*****	**(0.023)****	**(0.001)*****	**(0.001)*****	**(0.047)****
TA*INP	**-0.020**	**-0.029**	**-0.021**	**-0.004**	**-0.009**	**-0.005**
	(0.000)***	**(0.000)*****	**(0.000)*****	**(0.069)***	**(0.000)*****	**(0.017)****
TA*TAXEF	0.026	0.039	0.031	-0.005	0.001	0.000
	(0.000)***	(0.000)***	(0.000)***	(0.352)	(0.885)	(0.985)
TA*CMARD	0.007	0.011	0.008	0.003	0.003	0.003
	(0.000)***	(0.000)***	(0.000)***	(0.077)*	(0.166)	(0.080)*
LEV_{t-1}	-0.024	-0.024	-0.024	-0.023	-0.024	-0.024
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
$CASH_{t-1}$	0.047	0.047	0.046	0.047	0.047	0.046
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
$SIZE_{t-1}$	0.001	0.001	0.001	0.001	0.001	0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
$INVEST_{t-1}$	0.564	0.563	0.563	0.567	0.567	0.567
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
MV	0.007	0.007	0.007	0.008	0.008	0.008
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
INP	0.001	0.002	0.001	-0.001	-0.001	-0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TAXEF	-0.003	-0.004	-0.003	-0.001	-0.001	-0.001
	(0.000)***	(0.000)***	(0.000)***	(0.007)***	(0.011)**	(0.014)**
CMARD	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
GDP	0.001	0.000	0.001	0.003	0.003	0.003
	(0.045)**	(0.169)	(0.098)*	(0.000)***	(0.000)**	(0.000)***
Industry and year effects included?	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	124156	123975	124156	124156	123975	124156
Adj.-R^2	0.431	0.431	0.431	0.430	0.430	0.429
F-value	1045.380	1046.380	1044.485	1039.912	1040.224	1038.924

This table shows the results of estimating equation (3.1), where the dependent variable is *INVEST*, defined as (capital expenditures + research and development expense - proceeds from sale of fixed assets - depreciation) / the average total assets of years t and t-1. Definitions of remaining variables are shown in Table A1 in the appendix. The P-values are reported in parentheses. The estimated standard errors are adjusted by the procedure of Newey-West (1987). ***, **, and * represent statistical significant (two-tailed) at the 1%, 5% and 10% levels, respectively.

Table 6

Corporate Tax Avoidance and Overinvestment

(The dependent variable is positive $INVEST^{\varepsilon}_{t}$ in Panel A and positive $INVEST^{\varepsilon}_{t+1}$ in Panel B)

Panel A: Tax Avoidance and date *t* overinvestment

	INP measured with LAW			*INP measured with CORUP*		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
TA=	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***
Intercept	0.061	0.060	0.061	0.094	0.091	0.094
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TA	**0.044**	**0.070**	**0.027**	**0.046**	**0.074**	**0.036**
	(0.028)**	**(0.005)*****	**(0.186)**	**(0.024)****	**(0.005)*****	**(0.084)***
TA*INP	**-0.031**	**-0.040**	**-0.032**	**-0.014**	**-0.024**	**-0.016**
	(0.000)***	**(0.000)*****	**(0.000)*****	**(0.000)*****	**(0.000)*****	**(0.000)*****
TA*TAXEF	0.037	0.051	0.044	0.003	0.017	0.008
	(0.000)***	(0.000)***	(0.000)***	(0.694)	(0.031)**	(0.231)
TA*CMARD	0.009	0.010	0.008	0.002	0.000	0.000
	(0.001)***	(0.004)***	(0.005)***	(0.541)	(0.929)	(0.916)
Control variables included?	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	57319	57319	57319	57319	57319	57319
Adj.-R^2	0.031	0.027	0.032	0.029	0.025	0.031
F-value	203.448	178.380	214.337	189.990	161.475	202.166

Panel B: Tax Avoidance and date *t*+1 overinvestment

	INP measured with LAW			***INP measured with CORUP***		
	(7)	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
TA=	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***
Intercept	0.054	0.052	0.054	0.079	0.074	0.079
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TA	**0.067**	**0.094**	**0.063**	**0.080**	**0.101**	**0.080**
	(0.019)**	**(0.010)****	**(0.036)****	**(0.004)*****	**(0.004)*****	**(0.006)*****
TA*INP	**-0.054**	**-0.070**	**-0.057**	**-0.026**	**-0.038**	**-0.029**
	(0.000)***	**(0.000)*****	**(0.000)*****	**(0.000)*****	**(0.000)*****	**(0.000)*****
TA*TAXEF	0.072	0.099	0.076	0.011	0.033	0.014
	(0.000)***	(0.000)***	(0.000)***	(0.379)	(0.025)**	(0.289)
TA*CMARD	0.010	0.009	0.012	-0.003	-0.011	-0.003
	(0.004)***	(0.075)*	(0.002)***	(0.432)	(0.035)**	(0.502)
Control variables included?	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	63358	63357	63358	63358	63357	63358
Adj.-R^2	0.071	0.065	0.073	0.063	0.056	0.066
F-value	537.345	491.000	558.889	473.890	417.264	496.268

This table shows the results of estimating equation (3.2). For brevity, variables *INP*, *TAXEF*, *CMARD*, *GDP*, and *FCF* are included in the estimates but their results are not presented. The dependent variable in Panel A is date *t* overinvestment $INVEST^{\varepsilon}$ defied as residual from regression (3.1), where positive value of $INVEST^{\varepsilon}$ represents overinvestment and observations used in this table are those with positive $INVEST^{\varepsilon}$. The dependent variable in Panel B is date *t*+1 overinvestment, defied as residual from regression (3.1) running with one-year ahead variables. Definitions of remaining variables are shown in Table A1 in the appendix. The P-values are reported in parentheses. The estimated standard errors are adjusted by the procedure of Newey-West (1987). ***, **, and * represent statistical significant (two-tailed) at the 1%, 5% and 10% levels, respectively.

Table 7
Corporate Tax Avoidance and Operating Performance
(The dependent variable is ROA_{t+1})

	INP measured with LAW			*INP measured with CORUP*		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
TA=	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***
Intercept	-0.112	-0.092	-0.110	-0.117	-0.093	-0.112
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TA	**-0.068**	**-0.138**	**-0.102**	**-0.042**	**-0.103**	**-0.082**
	(0.024)**	**(0.000)*****	**(0.001)*****	**(0.158)**	**(0.002)*****	**(0.009)*****
TA*INP	**0.102**	**0.128**	**0.108**	**0.024**	**0.033**	**0.025**
	(0.000)***	**(0.000)*****	**(0.000)*****	**(0.000)*****	**(0.000)*****	**(0.000)*****
TA*TAXEF	-0.069	-0.075	-0.069	0.079	0.102	0.088
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TA*CMARD	-0.035	-0.048	-0.037	-0.012	-0.014	-0.012
	(0.000)***	(0.000)***	(0.000)***	(0.019)**	(0.022)**	(0.018)**
SIZE	0.019	0.021	0.019	0.019	0.022	0.019
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
MV	0.019	0.019	0.019	0.019	0.018	0.019
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
PPE	0.011	-0.002	0.012	0.012	-0.002	0.012
	(0.000)***	(0.013)**	(0.000)***	(0.000)***	(0.010)**	(0.000)***
CHS	0.021	0.026	0.019	0.024	0.031	0.022
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
LEV	-0.007	-0.019	-0.007	-0.007	-0.019	-0.007
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
INP	-0.004	-0.009	-0.003	-0.002	-0.003	-0.002
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TAXEF	0.012	0.017	0.011	0.009	0.008	0.009
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
CMARD	0.003	0.005	0.003	0.001	0.002	0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
GDP	-0.006	-0.007	-0.007	-0.007	-0.009	-0.007
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Industry and year effects included?	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	130099	124024	130099	130099	124024	130099
Adj.-R^2	0.330	0.337	0.328	0.318	0.323	0.315
F-value	720.691	710.644	713.944	681.083	666.088	673.702

This table shows the results of estimating equation (4). The dependent variable is industry-adjusted return on assets ROA_{t+1}, defined as operating income of year t+1 divided by the average total assets of t and t+1 and then adjusted with industry median value, where industry median is computed for each two-digit SIC industry in each country-year. Definitions of remaining variables are shown in Table A1 in the appendix. The P-values are reported in parentheses. The estimated standard errors are adjusted by the procedure of Newey-West (1987). ***, **, and * represent statistical significant (two-tailed) at the 1%, 5% and 10% levels, respectively.

Table 8
Valuation of Corporate Tax Avoidance: Using the Specification of Fama and French (1998)
(The dependent variable is *MV*)

	INP measured with LAW			***INP measured with CORUP***		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
TA=	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***
Intercept	0.553	0.514	0.554	0.750	0.595	0.749
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TA	**-0.558**	**-0.222**	**-0.476**	**-0.583**	**-0.416**	**-0.489**
	(0.067)*	**(0.531)**	**(0.121)**	**(0.051)***	**(0.230)**	**(0.105)**
TA*INP	**0.131**	**0.093**	**0.095**	**0.179**	**0.150**	**0.169**
	(0.002)***	**(0.072)***	**(0.033)****	**(0.000)*****	**(0.000)*****	**(0.000)*****
TA*TAXEF	-0.002	0.035	0.051	-0.094	-0.052	-0.096
	(0.983)	(0.777)	(0.637)	(0.305)	(0.638)	(0.318)
TA*CMARD	-0.486	-0.468	-0.453	-0.406	-0.368	-0.381
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
E_{t+1}	0.766	0.710	0.755	0.768	0.708	0.756
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
E_t	1.002	0.793	0.956	1.007	0.792	0.962
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
E_{t-1}	-0.042	-0.006	-0.038	-0.047	-0.010	-0.043
	(0.321)	(0.866)	(0.354)	(0.259)	(0.787)	(0.287)
Control variables included?	Yes	Yes	Yes	Yes	Yes	Yes
Industry and year effects included?	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	142578	137331	142578	142578	137331	142578
Adj.-R^2	0.298	0.297	0.296	0.295	0.294	0.294

This table shows the results of estimating equation (5), where the dependent variable is the Tobin's q ratio, defined as the sum of the market value of equity plus the book value of debt minus deferred tax expense and then divided by the book value of total asset. Definitions of remaining variables are shown in Table A1 in the appendix. For brevity, we only present the results relevant to our analysis and other variables are included in the estimates but their results are not presented. Data used in the estimates herein do not cover 1996 and 2012, since coverage of these two years requires data of 1995 and 2013 and this is beyond our sampling period. The P-values are reported in parentheses. The estimated standard errors are adjusted by the procedure of Newey-West (1987). ***, **, and * represent statistical significant (two-tailed) at the 1%, 5% and 10% levels, respectively.

Table 9
Corporate Tax Avoidance and Excess Cash
(The dependent variable is *XCash*)

	INP measured with LAW			***INP measured with CORUP***		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
TA=	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***
Intercept	-0.261	-0.261	-0.262	-0.334	-0.337	-0.334
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TA	**0.179**	**0.530**	**0.247**	**0.165**	**0.548**	**0.244**
	(0.102)	**(0.000)*****	**(0.030)****	**(0.141)**	**(0.000)*****	**(0.035)****
TA*INP	**-0.118**	**-0.215**	**-0.110**	**-0.032**	**-0.077**	**-0.038**
	(0.000)***	**(0.000)*****	**(0.000)*****	**(0.029)****	**(0.000)*****	**(0.010)****
TA*TAXEF	0.089	0.211	0.066	-0.075	-0.056	-0.075
	(0.019)**	(0.000)***	(0.090)*	(0.027)**	(0.153)	(0.033)**
TA*CMARD	0.080	0.109	0.077	0.048	0.038	0.047
	(0.000)***	(0.000)***	(0.000)***	(0.001)***	(0.032)**	(0.001)***
INP	-0.002	0.004	-0.002	-0.008	-0.006	-0.008
	(0.230)	(0.044)**	(0.240)	(0.000)***	(0.000)***	(0.000)***
TAXEF	0.002	-0.004	0.002	0.005	0.005	0.005
	(0.571)	(0.239)	(0.617)	(0.131)	(0.110)	(0.135)
CMARD	0.011	0.009	0.011	0.008	0.007	0.008
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.001)***	(0.000)***
GDP	0.023	0.022	0.023	0.033	0.033	0.034
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Obs.	131832	125920	131832	131832	125920	131832
Adj.-R^2	0.007	0.005	0.006	0.006	0.004	0.005
F-value	109.724	80.451	94.586	101.867	61.153	89.008

This table shows the results of estimating equation (6.2), where the dependent variable is excess cash *XCash*, which is the residual of regression (6.1). Definitions of remaining variables are shown in Table A1 in the appendix. The P-values are reported in parentheses. The estimated standard errors are adjusted by the procedure of Newey-West (1987). ***, **, and * represent statistical significant (two-tailed) at the 1%, 5% and 10% levels, respectively.

Table 10
Corporate Tax Avoidance and Payout

	INP measured with LAW			*INP measured with CORUP*		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
TA=	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***
Intercept	-0.010	-0.002	-0.007	0.023	0.037	0.028
	(0.000)***	(0.392)	(0.006)***	(0.000)***	(0.000)***	(0.000)***
TA	**-0.098**	**0.023**	**-0.055**	**-0.099**	**-0.001**	**-0.056**
	(0.000)***	**(0.064)***	**(0.000)*****	**(0.000)*****	**(0.942)**	**(0.000)*****
TA*INP	**0.004**	**0.004**	**0.005**	**0.003**	**0.004**	**0.003**
	(0.000)***	**(0.008)*****	**(0.000)*****	**(0.001)*****	**(0.006)*****	**(0.007)*****
TA*TAXEF	-0.017	-0.016	-0.020	-0.015	-0.010	-0.015
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.006)***	(0.000)***
TA*CMARD	-0.002	-0.003	-0.003	0.001	0.002	0.000
	(0.043)**	(0.124)	(0.013)**	(0.486)	(0.172)	(0.881)
LEV_{t-1}	-0.011	-0.008	-0.010	-0.010	-0.008	-0.009
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
$CASH_{t-1}$	0.035	0.039	0.036	0.035	0.040	0.036
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
$SIZE_{t-1}$	0.006	0.005	0.006	0.006	0.006	0.006
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
CF	0.193	0.098	0.161	0.189	0.096	0.157
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
MV_{t-1}	0.005	0.007	0.006	0.005	0.007	0.006
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
RE/TE_{t-1}	0.001	0.001	0.001	0.001	0.001	0.001
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Control variables included?	Yes	Yes	Yes	Yes	Yes	Yes
Industry and year effects included?	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	130730	124865	130730	130730	124865	130730
Adj.-R^2	0.284	0.244	0.271	0.287	0.249	0.275
F-value	571.793	443.358	536.235	578.990	454.897	546.107

This table shows the results of regressing payouts on tax avoidance, where payout is defined as (dividend paid on common shares + repurchases of common shares – proceeds from issuance of common shares) divided by total assets. RE/TE_{t-1} is the date t-1ratio of retained earnings over total equity. Definitions of remaining variables are shown in Table A1 in the appendix. For brevity, variables *INP*, *TAXEF*, *CMARD*, and *GDP* are included in the estimates but their results are not presented. The P-values are reported in parentheses. The estimated standard errors are adjusted by the procedure of Newey-West (1987). ***, **, and * represent statistical significant (two-tailed) at the 1%, 5% and 10% levels, respectively.

Table 11
Valuation of Corporate Tax Avoidance and Excess Cash
(The dependent variable is *MV*)

	Panel A: Full sample			**Panel B: Observations for the US**			**Panel C: Non-US Countries with low *INP***		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
TA=	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***	***BTD***	***RBTD***	***PBTD***
Intercept	1.129	1.151	1.145	1.811	1.794	1.841	0.924	0.926	0.929
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TA	0.186	0.256	0.308	0.897	0.908	1.121	0.678	0.775	0.651
	(0.099)*	(0.067)*	(0.007)***	(0.000)***	(0.000)***	(0.000)***	(0.001)***	(0.002)***	(0.001)***
TA*XCash$_{t-1}$	**-0.448**	**-0.192**	**-0.558**	**-0.956**	**-0.697**	**-1.198**	**-1.529**	**-1.185**	**-1.299**
	(0.056)**	**(0.495)**	**(0.020)****	**(0.000)*****	**(0.005)*****	**(0.000)*****	**(0.001)*****	**(0.058)***	**(0.007)*****
XCash$_{t-1}$	0.323	0.330	0.322	0.153	0.202	0.148	0.117	0.151	0.124
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.001)***	(0.000)***	(0.000)***
Control variables included?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry and year effects included?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	60250	57783	60250	20664	20522	20664	17253	17169	17253
Adj.-R^2	0.268	0.267	0.268	0.251	0.252	0.253	0.309	0.311	0.309
F-value	252.151	240.579	252.280	79.872	79.375	80.363	88.763	88.877	88.679

This table shows the results of estimating equation (1) by using observations with positive excess cash in previous period ($XCash_{t-1}$>0), where the dependent variable is the Tobin's q ratio, defined as the sum of the market value of equity plus the book value of debt minus deferred tax expense and then divided by the book value of total asset. Excess cash is the residual of equation (6.1). In Panel C countries with low investor protection (*INP*) are deified as those with *LAW* values lower than the median of *LAW*, where the median is calculated with all our non-US sample countries. For brevity, we only present the results relevant to our analysis and other control variables in equation (1) are included in the estimates but their results are not presented. Definitions of remaining variables are shown in Table A1 in the appendix. Data used in the estimates do not cover 1996, since coverage of 1996 has to estimate excess cash of 1995 and this is beyond our sampling period. The P-values are reported in parentheses. The estimated standard errors are adjusted by the procedure of Newey-West (1987). ***, **, and * represent statistical significant (two-tailed) at the 1%, 5% and 10% levels, respectively.

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Alternative Methods to Estimate Implied Variance: Review and Comparison

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The main purpose of this paper is to review and compare alternative methods for estimating implied variance. In this paper, we first review several alternative methods to estimate implied variance. Then we show how the MATLAB computer program can be used to estimate implied variance based upon the Black-Scholes model. In addition, we also discuss how the approximation method derived by Ang, Jou et al. (2013) can be used to estimate implied variance and implied stock price per share. Real world data are used to compare the estimation results using three typical alternative methods: regression method proposed by Lai, Lee et al, MATLAB computer program approach and approximation method derived by Ang, Jou et al.

1. Introduction

It is well known that implied variance estimation is important for evaluating option pricing. In this paper, we first review several alternative methods to estimate implied variance in Section B. We classify them into two different estimation routines: numerical search methods and closed-form derivation approaches. In Section C, we show how the MATLAB computer program can be used to estimate implied variance. This computer program is based upon the Black-Scholes model using Newton-Raphson method. In Section D, we discuss how the approximation method derived by Ang, Jou et al. (2013) can be used to estimate implied variance and implied stock price per share. This approximation method can also estimate implied volatility from two options with the same maturity, but different exercise prices and values. In Section E, real data from American option markets are used to compare the performances of three typical alternative methods: regression method proposed by Lai, Lee et al, MATLAB computer program approach and approximation method derived by Ang, Jou et al. The results are presented in Section E. Section F summarizes the paper.

2. Literature review

The derivation and use of the implied volatility for an option as originated by Latane and Rendleman (1976) has become a widely used methodology for variance estimation. Latane and Rendleman (1976) argued that although it is impossible to solve the B-S equation directly, one can use numerical search to closely approximate the standard deviation implied by given option price. The exact form of Black and Scholes model they used is given below.

$$C = SN(d_1) - Xe^{-rT}N(d_2) \tag{1}$$

where

$$d_1 = \frac{\ln(S/X) + (r + \frac{1}{2}s^2)T}{s\sqrt{T}}$$

$$d_2 = d_1 - s\sqrt{T}$$

S =current market price of the underlying stock;

X =exercise price;

r =continuous constant interest rate;

T =remaining life of the option.

Their procedure is to find an implied standard deviation which makes the theoretical option value, i.e. the right-hand side of Equation (1), within ± 0.001 of the observed actual call price. This is a kind of trial-and-error method.

Later researchers such as Beckers (1981), Manaster and Koehler (1982), Brenner and Subrahmanyam (1988), Lai, Lee et al. (1992), Chance (1996), Corrado and Miller (1996), Hallerbach (2004), Li (2005) and Corrado and Miller (2006), and have studied implied variance estimation in more detail.

Since the Black-Scholes' option pricing model is a nonlinear equation, an explicit analytic solution for the ISD is not available in the literature (except for at-the-money call) and numerical methods are generally used to approximate the ISD. Manaster and Koehler (1982) used the Newton-Raphson method to provide an iterative algorithm for the ISD.

They rewrote the Black-Scholes formula as in Equation (2), for given values of S, X, r and T.

$$C = f(S, X, r, T, \sigma) = f(\sigma) \tag{2}$$

For given values of S, X, r and T, f is a function of σ alone, and satisfies that:

$$\lim_{\sigma \to 0^+} f(\sigma) = \max(0, S - Xe^{-rT})$$

$$\lim_{\sigma \to \infty} f(\sigma) = S$$

Equation (2) will have a positive solution of implied standard deviation σ^*, if and only if the option is rationally priced that $\max(0, S - Xe^{-rT}) < C < S$. This is because function $f(\cdot)$ is strictly monotone increasing in σ over $(0, \infty)$ [1], and the monotonicity and continuity of $f(\cdot)$ guarantees there is a unique solution.

Newton-Raphson method is a common used method to solve nonlinear systems of equation. In this case for Equation (2), the method is stated as:

$$\sigma_{n+1} = \sigma_n - \frac{f(\sigma_n) - C}{f'(\sigma_n)} \tag{3}$$

where σ_n is the n-th estimate of σ^*, and $f'(\sigma_n)$ is the first derivative of $f(\sigma)$ when $\sigma = \sigma_n$.

Mean-Value Theorem. *Let f be a continuous function on the closed interval $[a, b]$, and can be differentiable on the open interval (a, b), where $a < b$. There exists some $c \in (a, b)$ such that:*

$$f'(c) = \frac{f(b) - f(a)}{b - a} \tag{4}$$

---

[1] Here we will briefly prove that the function $f(\cdot)$ is strictly monotone increasing in σ.

$$\begin{aligned}
f'(\sigma) &= \frac{\partial C}{\partial \sigma} = S\frac{\partial N(d_1)}{\partial \sigma} - Xe^{-rT}\frac{\partial N(d_2)}{\partial \sigma} \\
&= S\frac{\partial N(d_1)}{\partial d_1}\frac{\partial d_1}{\partial \sigma} - Xe^{-rT}\frac{\partial N(d_2)}{\partial d_2}\frac{\partial d_2}{\partial \sigma} \\
&= S\frac{1}{\sqrt{2\pi}}e^{-\frac{d_1^2}{2}}\left(\frac{\sigma^2 T^{\frac{3}{2}} - [\ln(\frac{S}{X}) + (r + \frac{1}{2}\sigma^2)T]\sqrt{T}}{\sigma^2 T}\right) - Xe^{-rT}\left(\frac{1}{\sqrt{2\pi}}e^{-\frac{d_1^2}{2}}\frac{S}{X}e^{rT}\right)\left(\frac{-[\ln(\frac{S}{X}) + (r + \frac{1}{2}\sigma^2)T]\sqrt{T}}{\sigma^2 T}\right) \\
&= S\frac{1}{\sqrt{2\pi}}e^{-\frac{d_1^2}{2}}\left(\frac{\sigma^2 T^{\frac{3}{2}}}{\sigma^2 T}\right) \\
&= S\sqrt{T}\frac{1}{\sqrt{2\pi}}e^{-\frac{d_1^2}{2}} \\
&= S\sqrt{T}N'(d_1)
\end{aligned}$$

See Chapter 20 of Lee, C.-F., J. Finnerty, et al. (2013) for more details if interested in derivation of partial derivatives.

Since $f'(\sigma) > 0$ when S, X, r and $T > 0$, and $\sigma > 0$, we have that $f(\cdot)$ is strictly monotone increasing in σ.

Under this case, mean-value theorem is stated as:

$$f'(\lambda \sigma_n + (1-\lambda)\sigma^*) = \frac{f(\sigma_n) - f(\sigma^*)}{\sigma_n - \sigma^*} = \frac{f(\sigma_n) - C}{\sigma_n - \sigma^*}, \text{ for some } \lambda \in (0,1) \tag{5}$$

Combining the above equation and Equation (3) in the main text, we can easily get:

$$\frac{\left|\sigma_{n+1} - \sigma^*\right|}{\left|\sigma_n - \sigma^*\right|} = \left|1 - \frac{f(\sigma_n) - C}{f'(\sigma_n)(\sigma_n - \sigma^*)}\right| = \left|1 - \frac{f'(\lambda \sigma^* + (1-\lambda)\sigma_n)}{f'(\sigma_n)}\right| \tag{6}$$

This motivates to choose σ_1 as σ that maximizes $f'(\sigma)$ so that σ_2 will be closer to σ^* than σ_1. From footnote 1, we know that to maximize $f'(\sigma)$ is to maximize $N'(d_1)$, where $N'(\cdot)$ is the standard normal density function. $N'(d_1) = \frac{1}{\sqrt{2\pi}}\exp(-\frac{d_1^2}{2})$. For simplicity of presentation, we denote $N'(d_1) = g(d_1)$. First order conditions for maximizing $N'(d_1)$, i.e $g(d_1)$, is: $\frac{\partial g(d_1)}{\partial \sigma} = 0$.

We then have:

$$\begin{aligned}
\frac{\partial g(d_1)}{\partial \sigma} &= \frac{1}{\sqrt{2\pi}} e^{-\frac{d_1^2}{2}} \cdot (-d_1) \cdot (\frac{\partial d_1}{\partial \sigma}) \\
&= \frac{1}{\sqrt{2\pi}} e^{-\frac{d_1^2}{2}} \cdot (-d_1) \cdot (-\frac{\ln(S/X) + rT}{\sigma^2 \sqrt{T}} + \frac{\sqrt{T}}{2}) \\
&= \frac{1}{\sqrt{2\pi}} e^{-\frac{d_1^2}{2}} \cdot (d_1) \cdot (\frac{1}{\sigma})(\frac{\ln(S/X) + rT}{\sigma\sqrt{T}} - \frac{\sigma\sqrt{T}}{2}) \\
&= \frac{1}{\sqrt{2\pi}} e^{-\frac{d_1^2}{2}} d_1 d_2 / \sigma \\
&= g(d_1) d_1 d_2 / \sigma \\
&= 0
\end{aligned}$$

Therefore, first order condition is simplified to: $d_1 d_2 = 0$. This happens if either $d_1 = 0$ in which case $\sigma^2 = \frac{-2(\ln(S/X) + rT)}{T}$ or $d_2 = 0$ in which case $\sigma^2 = \frac{2(\ln(S/X) + rT)}{T}$. Now we are checking second order conditions under both the two cases.

$$\begin{aligned}
\frac{\partial^2 g(d_1)}{\partial \sigma^2} &= \frac{\partial g'(d_1)}{\partial \sigma} \\
&= g'(d_1)\frac{\partial d_1}{\partial \sigma}\frac{d_1 d_2}{\sigma} + g(d_1)(\frac{d_1 d_2}{\sigma})' \\
&= g(d_1)(\frac{d_1 d_2}{\sigma})^2 - g(d_1)\frac{d_1^2 + d_2^2 + d_1 d_2}{\sigma^2} \\
&= g(d_1)\frac{d_1^2 d_2^2 - d_1^2 - d_2^2 - d_1 d_2}{\sigma^2}
\end{aligned}$$

First order condition give that either $d_1 = 0$ or $d_2 = 0$. When $d_1 = 0$, $\frac{\partial^2 g(d_1)}{\partial \sigma^2} = g(d_1)\frac{-d_2^2}{\sigma^2} < 0$. Similarly, when $d_2 = 0$, $\frac{\partial^2 g(d_1)}{\partial \sigma^2} = g(d_1)\frac{-d_1^2}{\sigma^2} < 0$. $\frac{\partial^2 g(d_1)}{\partial \sigma^2} < 0$ holds under both cases, therefore, $g(d_1)$ and $f'(\sigma)$ are simultaneously maximized.

From the above discussion, we know that the starting point σ_1 should be chosen by maximizing the partial derivative of call option respective to volatility $f'(\sigma)$, as given in Equation (7).

$$\sigma_1^2 = \left| \ln\left(\frac{S}{X}\right) + rT \right| \frac{2}{T} \tag{7}$$

Manaster and Koehler (1982) claimed that by starting with the above σ_1, implied variance estimate converges monotonically quadratically.

Brenner and Subrahmanyam (1988) applied Taylor series expansion to the cumulative normal function at zero up to the first order in the Black-Scholes option pricing model.

For at-the-money options, they set the underlying asset price S equal to the present value of exercise price Xe^{-rT}, i.e $S = Xe^{-rT}$, then d_1 and d_2 in Equation (1) are:

$$d_1 = \frac{1}{2}\sigma\sqrt{T}$$

$$d_2 = -\frac{1}{2}\sigma\sqrt{T} \tag{8}$$

Taylor series expansion is applied to the cumulative normal function at zero, while ignoring all the remaining terms beyond d_1.

$$N(d_1) = N(0) + N'(0)d_1 + \cdots = \frac{1}{2} + \frac{1}{\sqrt{2\pi}}d_1 + o(d_1) \tag{9}$$

Therefore, we have:

$$N(d_1) \approx \frac{1}{2} + \frac{1}{\sqrt{2\pi}}d_1 = \frac{1}{2} + \frac{1}{2\sqrt{2\pi}}\sigma\sqrt{T} \tag{10}$$

$$N(d_2) \approx 1 - N(d_1) = \frac{1}{2} - \frac{1}{2\sqrt{2\pi}}\sigma\sqrt{T} \tag{11}$$

Substituting Equations (10) and (11) into call option pricing equation demonstrated in Equation (1), we get:

$$C = \frac{S\sigma\sqrt{T}}{\sqrt{2\pi}} \tag{12}$$

Implied standard deviation then can be solved from Equation (13), shown below:

$$\sigma = \frac{C\sqrt{2\pi}}{S\sqrt{T}} \tag{13}$$

Note that Brenner and Subramanyam's method can only be used to estimate implied standard deviation from at-the-money or at least not too far in- or out-of-the-money options.

Lai, Lee et al. (1992) derived a closed form solution for the ISD in terms of the delta $\frac{\partial C}{\partial S}$, $\frac{\partial C}{\partial X}$, and other observable variables.

From Equation (1), ceteris paribus, the effects of a change in stock price S and exercise price X on the call price are determined by Smith Jr (1976), as following equations respectively:

$$\frac{\partial C}{\partial S} = N(d_1) \qquad (14)$$ [2]

$$\frac{\partial C}{\partial X} = -e^{-rT}N(d_2) \qquad (15)$$ [3]

Equations (14) and (15) can be rearranged as Equations (16) and (17) respectively:

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[2] The derivation of $\frac{\partial C}{\partial S}$ is as follows.

$$\begin{aligned}
\frac{\partial C}{\partial S} &= N(d_1) + S\frac{\partial N(d_1)}{\partial S} - Xe^{-rT}\frac{\partial N(d_2)}{\partial S} \\
&= N(d_1) + S\frac{\partial N(d_1)}{\partial d_1}\frac{\partial d_1}{\partial S} - Xe^{-rT}\frac{\partial N(d_2)}{\partial d_2}\frac{\partial d_2}{\partial S} \\
&= N(d_1) + S\frac{1}{\sqrt{2\pi}}e^{-\frac{d_1^2}{2}} \cdot \frac{1}{S\sigma\sqrt{T}} - Xe^{-rT}\frac{1}{\sqrt{2\pi}}e^{-\frac{d_1^2}{2}}\frac{S}{X}e^{rT} \cdot \frac{1}{S\sigma\sqrt{T}} \\
&= N(d_1) + S\frac{1}{S\sigma\sqrt{2\pi T}}e^{-\frac{d_1^2}{2}} - S\frac{1}{S\sigma\sqrt{2\pi T}}e^{-\frac{d_1^2}{2}} \\
&= N(d_1)
\end{aligned}$$

Please note that:

$$\begin{aligned}
\frac{\partial N(d_2)}{\partial d_2} &= \frac{1}{\sqrt{2\pi}}e^{-\frac{d_2^2}{2}} = \frac{1}{\sqrt{2\pi}}e^{-\frac{(d_1-\sigma\sqrt{T})^2}{2}} \\
&= \frac{1}{\sqrt{2\pi}}e^{-\frac{d_1^2}{2}} \cdot e^{d_1\sigma\sqrt{T}} \cdot e^{-\frac{\sigma^2 T}{2}} \\
&= \frac{1}{\sqrt{2\pi}}e^{-\frac{d_1^2}{2}} \cdot e^{\ln(\frac{S}{X})+(r+\frac{\sigma^2}{2})T} \cdot e^{-\frac{\sigma^2 T}{2}} \\
&= \frac{1}{\sqrt{2\pi}}e^{-\frac{d_1^2}{2}} \cdot \frac{S}{X} \cdot e^{rT}
\end{aligned}$$

See Chapter 20 of Lee, C.-F., J. Finnerty, et al. (2013) for details if interested.

[3] The derivation of $\frac{\partial C}{\partial X}$ is as follows.

$$\begin{aligned}
\frac{\partial C}{\partial X} &= S\frac{\partial N(d_1)}{\partial X} - e^{-rT}N(d_2) - Xe^{-rT}\frac{\partial N(d_2)}{\partial X} \\
&= S\frac{\partial N(d_1)}{\partial d_1}\frac{\partial d_1}{\partial X} - e^{-rT}N(d_2) - Xe^{-rT}\frac{\partial N(d_2)}{\partial d_2}\frac{\partial d_2}{\partial X} \\
&= S\frac{1}{\sqrt{2\pi}}e^{-\frac{d_1^2}{2}}\frac{1}{\sigma\sqrt{T}}\frac{X}{S}(-\frac{S}{X^2}) - e^{-rT}N(d_2) - Xe^{-rT}(\frac{1}{\sqrt{2\pi}}e^{-\frac{d_1^2}{2}}\frac{S}{X}e^{rT})\frac{1}{\sigma\sqrt{T}}\frac{X}{S}(-\frac{S}{X^2}) \\
&= -e^{-rT}N(d_2)
\end{aligned}$$

See Chapter 20 of Lee, C.-F., J. Finnerty, et al. (2013) for details if interested.

$$d_1 = N^{-1}[(\frac{\partial C}{\partial S})] \tag{16}$$

$$d_2 = d_1 - \sigma\sqrt{T} = N^{-1}[e^{rT}(-\frac{\partial C}{\partial X})] \tag{17}$$

Combining Equations (16) and (17) yields:

$$\sigma = \{[N^{-1}(\frac{\partial C}{\partial S}) - N^{-1}[e^{rT}(-\frac{\partial C}{\partial X})]\} \Big/ \sqrt{T} \tag{18}$$

where $N^{-1}(\cdot)$ is the inverse cumulative normal distribution function.

Equation (18) shows that ISD calculation depends on two partial derivatives of the call option with respect to the stock price and exercise price, i.e. $\frac{\partial C}{\partial S}$ and $\frac{\partial C}{\partial X}$, and other two observable variables: time to maturity T and risk-free rate r.

Note that implied volatility σ should not be negative, therefore, a negative right-hand side of Equation (18) is not feasible.

Lai, Lee et al. (1992) argued that although the Black-Scholes option pricing model is a function of five variables, according to Merton (1973), the BS model exhibits homogeneity of degree one in the stock price and exercise price, which is shown in Equation (19).

$$C = (\frac{\partial C}{\partial S})S + (\frac{\partial C}{\partial X})X = \beta_S S + \beta_X X \tag{19}$$

where $\beta_S = \frac{\partial C}{\partial S}$ and $\beta_X = \frac{\partial C}{\partial X}$.

The two partial derivatives can be estimated by running the following linear multiple regression:

$$C_{it} = \alpha + \beta_S S_t + \beta'_X e^{-rT} X_{it} + \varepsilon_{it} \tag{20}$$

Substituting the least square estimators $\hat{\beta}_S$ and $\hat{\beta}'_X$ in Equation (20) into Equation (18), the implied variance can be estimated as:

$$\sigma = [N^{-1}(\hat{\beta}_S) - N^{-1}(-\hat{\beta}'_X)] \Big/ \sqrt{T} \tag{21}$$

Instead of running linear regression to estimate the two partial derivatives $\frac{\partial C}{\partial S}$ and $\frac{\partial C}{\partial X}$, we can first find $\frac{\partial C}{\partial X}$ by simple or weighted averaging $\frac{\Delta C}{\Delta X}$ for various exercise prices (S is being held constant provided the call price quotes are simultaneous). Then the other partial derivative $\frac{\partial C}{\partial S}$ is got from Equation (19). Lai, Lee et al. (1992) mentioned that this alternative approach would work best for index options, where there are many simultaneous quotes.

It should also be noted that, following their method, there is an alternative way to estimate implied standard deviation only using one partial derivative $\frac{\partial C}{\partial S}$. From Equation (19), we have:

$$(\frac{\partial C}{\partial X})X = C - (\frac{\partial C}{\partial S})S$$

$$\Rightarrow \ (\frac{\partial C}{\partial X}) = \frac{C}{X} - \frac{S}{X}(\frac{\partial C}{\partial S}) \tag{22}$$

Substituting Equation (22) into Equation (18), we will have a new closed form solution for the ISD only depending on delta $\frac{\partial C}{\partial S}$ and other observable variables, as shown in Equation (23).

$$\sigma = \{[N^{-1}(\frac{\partial C}{\partial S}) - N^{-1}[e^{rT}(\frac{S}{X}(\frac{\partial C}{\partial S}) - \frac{C}{X})]]\} \Big/ \sqrt{T} \tag{23}$$

Brenner and Subrahmanyam (1988)'s formula for estimating implied variance is simple, but limited only to at-the-money or at least too far in- or out-of-the-money cases. On the basis of their research, Chance (1996) developed a generalized formula so that this formula can be implemented under other cases when options are in-the-money or out-of-the-money.
Recall Brenner-Subrahmanyam formula for ISD is:

$$\sigma^* = \frac{C^*\sqrt{2\pi}}{S\sqrt{T}} \tag{24}$$

where C^* is the price of the at-the-money call. We assume the call has an exercise price X^*.

Chance (1996) proposed a model that start with Equation (24), and added terms to reflect both the moneyness and sensitivity of standard deviation. The option with the unknown implied standard deviation is priced at C and has an exercise price of X. By definition, the difference between the at-the-money call and the call with unknown ISD is given as:

$$\Delta C^* = C - C^* \tag{25}$$

He argued that the difference in the prices of the two calls comes from: (1) the difference in exercise prices, i.e. $\Delta X^* = X - X^*$; (2) the difference in standard deviation, i.e. $\Delta\sigma^* = \sigma - \sigma^*$. He applied second-order Taylor series expansion on ΔC^*, which yields:

$$\Delta C^* = \frac{\partial C^*}{\partial X^*}(\Delta X^*) + \frac{1}{2}\frac{\partial^2 C^*}{\partial X^{*2}}(\Delta X^*)^2 + \frac{\partial C^*}{\partial \sigma^*}(\Delta\sigma^*) + \frac{1}{2}\frac{\partial^2 C^*}{\partial \sigma^{*2}}(\Delta\sigma^*)^2 + \frac{\partial^2 C^*}{\partial \sigma^* \partial X^*}(\Delta\sigma^*\Delta X^*) \tag{26}$$

Since these partial derivatives which appear in Equation (26) are for at-the-money calls, their formulas can be simplified using the following relationships.

$$S = X^* e^{-rT} \tag{27}$$

$$d_1^* = \frac{1}{2}\sigma^*\sqrt{T} \tag{28}$$

$$d_2^* = -\frac{1}{2}\sigma^*\sqrt{T} \tag{29}$$

Therefore, we have the following important equations for partial derivatives hold, respectively.

$$\frac{\partial C^*}{\partial X^*} = -e^{-rT} N(d_2^*) \qquad (30)^4$$

$$\frac{\partial^2 C^*}{\partial X^{*2}} = -e^{-rT}\frac{\partial N(d_2^*)}{\partial d_2^*}\frac{\partial d_2^*}{\partial X^*} = -e^{-rT}\frac{e^{-\frac{d_2^{*2}}{2}}}{\sqrt{2\pi}}\frac{1}{\sigma^*\sqrt{T}}\left(\frac{X^*}{S^*}\right)\left(-\frac{S^*}{X^{*2}}\right) = \frac{e^{-rT}e^{-\frac{d_2^{*2}}{2}}}{X^*\sigma^*\sqrt{2\pi T}} \qquad (31)$$

For an at-the-money call, Equation (31) is given as in Equation (32):

$$\frac{\partial^2 C^*}{\partial X^{*2}} = \frac{e^{-rT}e^{-\frac{d_2^{*2}}{2}}}{X^*\sigma^*\sqrt{2\pi T}} = \frac{e^{-rT}}{X^*\sigma^*\sqrt{2\pi T}}e^{-\frac{\sigma^{*2}T}{8}} \qquad (32)$$

$$\frac{\partial C^*}{\partial \sigma^*} = S\frac{\partial N(d_1^*)}{\partial \sigma^*} - X^*e^{-rT}\frac{\partial N(d_2^*)}{\partial \sigma^*} = \frac{S\sqrt{T}e^{-\frac{d_1^{*2}}{2}}}{\sqrt{2\pi}} \qquad (33)^5$$

Given the call is at the money, Equation (33) is given as in Equation (34):

$$\frac{\partial C^*}{\partial \sigma^*} = \frac{Xe^{-rT}\sqrt{T}}{\sqrt{2\pi}}e^{-\frac{\sigma^{*2}T}{8}} \qquad (34)$$

$$\frac{\partial^2 C^*}{\partial \sigma^{*2}} = \frac{S\sqrt{T}e^{-\frac{d_1^{*2}}{2}}}{\sqrt{2\pi}}(-d_1^*)\frac{\partial d_1^*}{\partial \sigma^*} = -\frac{S\sqrt{T}e^{-\frac{d_1^{*2}}{2}}}{\sqrt{2\pi}}d_1^*\left(-\frac{\ln(S/X^*) + rT}{\sigma^{*2}\sqrt{T}} + \frac{\sqrt{T}}{2}\right) = \frac{S\sqrt{T}}{\sqrt{2\pi}}e^{-\frac{d_1^{*2}}{2}}\frac{d_1^*d_2^*}{\sigma^*} \qquad (35)$$

For an at-the-money call, Equation (35) becomes:

$$\frac{\partial^2 C^*}{\partial \sigma^{*2}} = \frac{X^*e^{-rT}T^{\frac{3}{2}}\sigma^*}{4\sqrt{2\pi}}e^{-\frac{\sigma^{*2}T}{8}} \qquad (36)$$

$$\frac{\partial^2 C^*}{\partial \sigma^*\partial X^*} = -e^{-rT}\frac{\partial N(d_2^*)}{\partial d_2^*}\frac{\partial d_2}{\partial \sigma} = -e^{-rT}\left(\frac{1}{\sqrt{2\pi}}e^{-\frac{d_1^{*2}}{2}}\frac{S}{X^*}e^{rT}\right)\left(\frac{-[\ln(\frac{S}{X^*}) + (r + \frac{1}{2}\sigma^{*2})T]\sqrt{T}}{\sigma^{*2}T}\right) = \frac{Se^{-\frac{d_1^{*2}}{2}}d_1^*}{X^*\sigma^*\sqrt{2\pi}} \qquad (37)$$

Given the call is at the money, Equation (37) becomes:

$$\frac{\partial^2 C^*}{\partial \sigma^*\partial X^*} = \frac{e^{-rT}\sqrt{T}}{2\sqrt{2\pi}}e^{-\frac{\sigma^{*2}T}{8}} \qquad (38)$$

Equation (25) can be restated as:

$$C^* - C + \Delta C^* = 0 \qquad (39)$$

Substituting Equation (26) into Equation (39), Equation (39) can be viewed as a quadratic equation of $\Delta\sigma^*$, written as:

$$a(\Delta\sigma^*)^2 + b(\Delta\sigma^*) + c = 0 \qquad (40)$$

Where

$$a = \frac{1}{2}\frac{\partial^2 C^*}{\partial \sigma^{*2}}$$

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4 The derivation of Equation (30) has been shown in Footnote 3.

5 The derivation of Equation (33) has been shown in Footnote 1.

$$b = \frac{\partial C^*}{\partial \sigma^*} + \frac{\partial^2 C^*}{\partial \sigma^* \partial X^*}(\Delta X^*)$$

$$c = C^* - C + \frac{\partial C^*}{\partial X^*}(\Delta X^*) + \frac{1}{2}\frac{\partial^2 C^*}{\partial X^{*2}}(\Delta X^*)^2$$

Therefore, the solution of the Equation (40) should be:

$$\Delta \sigma^* = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{41}$$

Experiments in Chance (1996) suggest that positive root for $\Delta \sigma^*$ of Equation (40) give the correct solution for implied variance when adding it to the value of σ^* from Brenner-Subrahmanyam formula.

One thing that needs to be noted is that in order to apply Chance's formula to compute the ISD, the standard deviation and the option price under the at-the-money case must be given. In other words, if the underlying asset price deviates from the present value of the exercise price and the call option price is not available (or unobservable) in the market, then Chance's formula for the ISD may not apply, just as the case of Brenner-Subrahmanyam formula.

To allow for the deviation between the underlying asset price and the present value of exercise price, Corrado and Miller (1996) expanded the cumulative normal function at zero to the first order term in the Black-Scholes OPM to derive a quadratic equation of the ISD.

Their approach followed the method employed by Brenner and Subramanyam, and made use of the expansion of the normal distribution function as stated in Equation (42).

$$N(z) = \frac{1}{2} + \frac{1}{\sqrt{2\pi}}(z - \frac{z^3}{6} + \cdots) \tag{42}$$

Substituting Equation (42) into the normal probabilities $N(d_1)$ and $N(d_2)$ in classic Black-Scholes model as Equation (1) states, we have Equation (43) hold when cubic and higher order terms are ignored.

$$C = S(\frac{1}{2} + \frac{d_1}{\sqrt{2\pi}}) - Xe^{-rT}(\frac{1}{2} + \frac{d_1 - \sigma\sqrt{T}}{\sqrt{2\pi}}) \tag{43}$$

K is defined as the present value of strike price X, i.e: $K = Xe^{-rT}$.

Recall the expressions for d_1 and d_2 are:

$$d_1 = \frac{\ln(S/X) + (r + \frac{1}{2}\sigma^2)T}{\sigma\sqrt{T}} = \frac{\ln(S/K) + \frac{1}{2}\sigma^2 T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

Equation (43) can be restated as:

$$C = S(\frac{1}{2} + \frac{\ln(S/K) + \frac{1}{2}\sigma^2 T}{\sigma\sqrt{2\pi T}}) - K(\frac{1}{2} + \frac{\ln(S/K) - \frac{1}{2}\sigma^2 T}{\sigma\sqrt{2\pi T}}) \tag{44}$$

Equation (44) can be formulated as the quadratic equation of $\sigma\sqrt{T}$, as shown in Equation (45)

$$\sigma^2 T(S + K) - \sigma\sqrt{T}[(2\sqrt{2\pi}C - \sqrt{2\pi}(S - K)] + 2(S - K)\ln(S/K) = 0 \tag{45}$$

Corrado and Miller (1996) proved that only the largest root for Equation (45) reduced to the original Brenner-Subramanyam formula, which is shown in Equation (46).

$$\sigma\sqrt{T} = \sqrt{2\pi}\left(\frac{2C - S + K}{2(S+K)}\right) + \sqrt{\frac{\pi}{2}\left(\frac{2C - S + K}{S+K}\right)^2 - \frac{2(S-K)\ln(S/K)}{S+K}} \tag{46}$$

After solving the quadratic equation of $\sigma\sqrt{T}$, they improve the accuracy of approximation by minimizing its concavity[6]. Therefore, their final formula to compute the implied standard deviation was given as:

$$\sigma = \sqrt{\frac{2\pi}{T}}\frac{1}{S+K}\left[C - \frac{S-K}{2} + \sqrt{\left(C - \frac{S-K}{2}\right)^2 - \frac{(S-K)^2}{\pi}}\right] \tag{47}$$

Li (2005) also followed Brenner and Subramanyam and expanded the expression to the third order term and solved for the ISD with a cubic equation.

Taylor expansion as Equation (42) states was used in Li's paper. He retained the cubic order and substituted Equation (42) into the normal probabilities in the Black-Scholes model as stated in Equation (1), and this yielded:

$$C = S\left(\frac{1}{2} + \frac{d_1}{\sqrt{2\pi}} - \frac{d_1^3}{6\sqrt{2\pi}}\right) - Xe^{-rT}\left(\frac{1}{2} + \frac{d_2}{\sqrt{2\pi}} - \frac{d_2^3}{6\sqrt{2\pi}}\right) \tag{48}$$

For at-the-money calls, $d_1 = \frac{1}{2}\sigma\sqrt{T}$, $d_2 = -\frac{1}{2}\sigma\sqrt{T}$, $S = Xe^{-rT}$.

When defining $x = \frac{1}{2}\sigma\sqrt{T}$, the following equation hold for at-the-money calls:

$$\frac{\sqrt{2\pi}C}{S} \approx 2x - \frac{1}{3}x^3 \tag{49}$$

Equation (49) can be solved by using the cubic formula[7].

He went through some tedious derivations and simplifications, and finally obtained the formula to compute implied standard deviation:

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[6] This approach included several steps.

First, logarithmic approximation was used. $\ln(S/K) \approx 2(S-K)/(S+K)$.

Secondly, they replaced the value "4" with the parameter α to restate Equation (46) as:

$$\sigma\sqrt{T} = \sqrt{2\pi}\left(\frac{2C - S + K}{2(S+K)}\right) + \sqrt{\frac{\pi}{2}\left(\frac{2C - S + K}{S+K}\right)^2 - \alpha\left(\frac{S-K}{S+K}\right)^2}$$

They chose a value for α such that the above equation is approximately linear in the stock price when the option is near the at-the-money case. When setting the second derivative of right-hand side of the above equation with respect to stock price equal to zero, they found the realistic estimated value for α was close to 2.

[7] The general cubic equation has the form $ax^3 + bx^2 + cx + d = 0$, with $a \neq 0$. If the cubic equation is in the form of $t^3 + pt + q = 0$, it is called a depressed cubic equation. Please note that any general cubic equation can be reduced to the depressed cubic equation by dividing the general equation with a and substituting variable x with $t = x - \frac{b}{3a}$.

For a depressed cubic equation $t^3 + pt + q = 0$, the roots are:

$$t_k = 2\sqrt{-\frac{p}{3}}\cos\left(\frac{1}{3}\arccos\left(\frac{3q}{2p}\sqrt{\frac{-3}{p}}\right) - k\frac{2\pi}{3}\right), k = 0, 1, 2.$$

$$\sigma = \frac{2\sqrt{2}}{\sqrt{T}} z - \frac{1}{\sqrt{T}} \sqrt{8z^2 - \frac{6\alpha}{\sqrt{2}z}} \tag{50}$$

where $\alpha = \frac{\sqrt{2\pi}C}{S}$ and $z = \cos\left[\frac{1}{3}\cos^{-1}\left(\frac{3\alpha}{\sqrt{32}}\right)\right]$

Since Li included the third order term in the Taylor expansion on the cumulative normal distribution in his derivation, Li claimed that his formula for ISD provided a consistently more accurate estimate of the true ISD than previous studies.

To sum up, the existing researches mainly follow two different routines to estimate implied volatility. Numerical search methods tried to find an approximate solution for implied volatility which makes the theoretical option value equal to or very close to market observed option price. These methods don't provide closed-form solution for estimated implied volatility, and need iterative algorithms to approximate the ISD. Other closed-form derivation approaches took use of either Taylor expansion or inverse function to calculate the analytical solutions for the ISD. First-order, second-order, and third order Taylor expansions were applied to cumulative normal distribution function respectively to estimate the implied volatility in previous studies. There were also studies using inverse function of normal distribution to derive closed-form solution of the ISD.

An important point to be noted is that some methods rely upon the existence of "at-the-money" options, or at least not too far in- or out-of-the-money options. These approaches include Brenner and Subrahmanyam (1988), Chance (1996), and Li (2005).

Table 1 classifies the existing researches of estimating implied volatility accordingly.

Table 1. classification of the ISD estimation methods

Numerical Search	**Closed-form Derivation**
Trial and error Latane and Rendleman (1976)	**Taylor Series Expansion** First-order expansion:Brenner and Subrahmanyam (1988); Corrado and Miller (1996) Second-order expansion: Chance (1996) Third-order expansion: Li (2005)
Choose an initial point, iterative algorithm Manaster and Koehler (1982)	**Inverse Function** Estimate parameters by regression: Lai, Lee et al. (1992)

3. MATLAB approach to estimate implied variance

Usually, implied variance can be obtained from a call or put option model by an optimization technique. For each individual option, the implied variance can be obtained by first choosing an initial estimate σ_0, and then Equation (51) is used to iterate towards the correct value.

$$C_{j,t}^{M} - C_{j,t}^{T}(\sigma_0) = \left[\left. \frac{\partial C_{j,t}^{T}}{\partial \sigma} \right|_{\sigma_0} \right] (\sigma - \sigma_0) + e_{j,t} \tag{51}$$

Where

$C_{j,t}^{M}$ =market price of call option j at time t;

σ =true or actual implied standard deviation;

σ_0 =initial estimate of implied standard deviation;

$C_{j,t}^{T}(\sigma_0)$ =theoretical price of call option j at time t given $\sigma = \sigma_0$;

$\left. \frac{\partial C_{j,t}^{T}}{\partial \sigma} \right|_{\sigma_0}$ =partial derivative of the call option with respect to the standard deviation σ at $\sigma = \sigma_0$;

$e_{j,t}$ =error term.

The partial derivative of the call option with respective to the standard deviation $\frac{\partial C_{j,t}^{T}}{\partial \sigma}$ from Black-Scholes model is:

$$\frac{\partial C_{t,j}^{F}}{\partial \sigma} = X e^{-r\tau} \sqrt{\tau} N'(d_1) = X e^{-r\tau} \frac{\sqrt{\tau}}{\sqrt{2\pi}} e^{-d_1^2/2} \tag{52}$$

It is also called Vega of option.

The iteration proceeds by reinitializing σ_0 to equal σ_1 at each successive stage until an acceptable tolerance level is attained. The tolerance level used is:

$$\left| \frac{\sigma_1 - \sigma_0}{\sigma_0} \right| < .001 \tag{53}$$

The MATLAB finance toolbox provides a function blsimpv to search for implied volatility. The algorithm used in the blsimpv function is Newton's method, just as the procedure described in Equation (51). This approach minimizes the difference between observed market option value and the theoretical value of B-S model, and obtain the ISD estimate until tolerance level is attained.

The complete command of the function *blsimpv* is: Volatility = *blsimpv*(Price, Strike, Rate, Time, Value, Limit, Yield, Tolerance, Class). And the command with default setting is: Volatility = *blsimpv*(Price, Strike, Rate, Time, Value).

There are nine inputs in total, while the last four of them are optional. Detailed explanations of all the inputs are as follows:

Inputs:

Price - Current price of the underlying asset.

Strike - Strike (i.e., exercise) price of the option.

Rate - Annualized continuously compounded risk-free rate of return over the life of the option, expressed as a positive decimal number.

Time - Time to expiration of the option, expressed in years.

Value - Price (i.e., value) of a European option from which the implied volatility of the underlying asset is derived.

Optional Inputs:

Limit - Positive scalar representing the upper bound of the implied volatility search interval. If empty or missing, the default is 10, or 1000% per annum.

Yield - Annualized continuously compounded yield of the underlying asset over the life of the option, expressed as a decimal number. For example, this could represent the dividend yield and foreign risk-free interest rate for options written on stock indices and currencies, respectively. If empty or missing, the default is zero.

Tolerance - Positive scalar implied volatility termination tolerance. If empty or missing, the default is 1e-6.

Class - Option class (i.e., whether a call or put) indicating the option type from which the implied volatility is derived. This may be either a logical indicator or a cell array of characters. To specify call options, set Class = true or Class = {'Call'}; to specify put options, set Class = false or Class = {'Put'}. If empty or missing, the default is a call option.

Output:

Volatility - Implied volatility of the underlying asset derived from European option prices, expressed as a decimal number. If no solution can be found, a NaN (i.e., Not-a-Number) is returned.

Example:

Consider a European call option trading at $5 with an exercise price of $95 and 3 months until expiration. Assume the underlying stock pays 5% annual dividends, which is trading at $90 at this moment, and the risk-free rate is 3% per annum. Under these conditions, the command used in Matlab will be either of the following two:

```
Volatility = blsimpv(90, 95, 0.03, 0.25, 5,[],0.05,[], { 'Call'})
Volatility = blsimpv(90, 95, 0.03, 0.25, 5,[],0.05,[], true)
```

Note that this function provided by MATLAB's toolbox can only estimate implied volatility from a single option. For more than one option, the user needs to write their own programs to estimate implied variances.

4. Approximation approach to estimate implied variance

In this section, we will discuss alternative method proposed by Ang, Jou et al. (2009) to use the call option model and put option model to estimate implied volatility. Our approximation approach can also estimate implied volatility from two options with the same maturity, but different exercise prices and values.

Recall the Black-Scholes call option pricing model (with continuous dividends), we have:

$$C = S'N(d_1) - KN(d_2) \tag{54}$$

where

$$d_1 = \frac{\ln(S/X) + (r + \frac{s^2}{2} - q)T}{s\sqrt{T}} = \frac{\ln(S'/K)}{s\sqrt{T}} + s\sqrt{T}/2$$

$d_2 = d_1 - s\sqrt{T}$;

C =call price;

S =stock price;

q =annual dividend yield;

$S' = Se^{-qT}$

X =exercise price;

r =risk-free interest rate;

$K = Xe^{-rT}$, present value of exercise price

T =time to maturity of option in years;

$N(\cdot)$ =standard normal distribution;

s =stock volatility.

We derive a formula to estimate the ISD by applying the Taylor series expansion on a single call option. We show that, following method proposed by Ang, Jou et al. (2009) and Ang, Jou et al. (2013),the formula for ISD derived by Corrado and Miller (1996) can be improved further without any replacements.

Recall the Taylor series expansion approximating complex functions from calculus(Lee, Lee et al. 2009) (Lee, Lee et al. 2009, Appendix 5.B), which can be mathematically written as follows:

$$F_n(x) = F(a) + F'(a)(x - a) + \frac{F''(a)}{2!}(x - a)^2 + \mathrm{L} + \frac{F^{(n)}(a)}{n!}(x - a)^2 \tag{55}$$

where

$F_n(x)$ is the function we are approximating;

$F'(a)$ is the first derivative of the function;

$F^{(n)}(a)$ is the n th derivative of the function;

$n!$ is the factorial value of n , i.e $n! = (n)(n - 1)\mathrm{L}\ (2)(1)$;

a is the value near which we are making the approximation to the function $F(x)$.

Let $L' = \ln(S'/K)/\sigma\sqrt{T}$. Here, we apply the Taylor series expansion to both cumulative normal distributions in the Black-Scholes formula at L'.

Then we have

$$\begin{aligned} N(L'+\sigma\sqrt{T}/2) &= N(L') + N'(L')(L'+\sigma\sqrt{T}/2 - L') + N''(L')\frac{(L'+\sigma\sqrt{T}/2 - L')^2}{2!} + \cdots \\ &= N(L') + N'(L')\sigma\sqrt{T}/2 + N''(L')(\sigma\sqrt{T}/2)^2/2 + e_1 \\ &= N(L') + N'(L')(\sigma\sqrt{T}/2)[1 - \ln(S'/K)/4] + e_1 \end{aligned} \tag{56}$$

and

$$\begin{aligned} N(L'-\sigma\sqrt{T}/2) &= N(L') + N'(L')(L'-\sigma\sqrt{T}/2 - L') + N''(L')\frac{(L'-\sigma\sqrt{T}/2 - L')^2}{2!} + \cdots \\ &= N(L') - N'(L')\sigma\sqrt{T}/2 + N''(L')(\sigma\sqrt{T}/2)^2/2 + e_2 \end{aligned}$$

$$\begin{aligned} N(L'-\sigma\sqrt{T}/2) &= N(L') - N'(L')\sigma\sqrt{T}/2 + N''(L')(\sigma\sqrt{T}/2)^2/2 + e_2 \\ &= N(L') - N'(L')(\sigma\sqrt{T}/2)[1 + \ln(S'/K)/4] + e_2 \end{aligned} \tag{57}$$

where, e_1 and e_2 are the remainder terms of Taylor's formulas.

The above equations can be obtained by the fact that $N''(x) = -N'(x)x$.

Given $N(0) = 1/2$, $N'(0) = 1/\sqrt{2\pi}$, $N'''(0) = -N'(0)$, $N''(0) = N''''(0) = 0$, we expand $N(L')$ and $N'(L')$ at 0 respectively.

$$N(L') = N(0) + N'(0)L' + N''(0)L'^2/2 + e_3 = \frac{1}{2} + L'/\sqrt{2\pi} + e_3 \tag{58}$$

$$N'(L') = N'(0) + N''(0)L' + N'''(0)L'^2/2 + e_4 = 1/\sqrt{2\pi} - L'^2/2\sqrt{2\pi} + e_4 \tag{59}$$

Substituting Equations (56) – (59) into Equation (54) , dropping all of remainder terms, Equation (54) becomes:

$$\begin{aligned} C = {} & (S'-K)/2 + (\ln(S'/K)/\sigma\sqrt{2\pi T})[(S'-K)(1 + [\ln(S'/K)/4]^2) - \ln(S'/K)(S'+K)/4] \\ & + (\sigma\sqrt{T}/2\sqrt{2\pi})[S'+K - \ln(S'/K)(S'-K)/4] \end{aligned} \tag{60}$$

Equation (60) is a quadratic equation of $\sigma\sqrt{T}$ and can be rewritten as:

$$\begin{aligned} & \sigma^2 T[8(S'+K) - 2(S'-K)\ln(S'/K)] - 8\sigma\sqrt{T}\sqrt{2\pi}(2C - S'+K) \\ & + \ln(S'/K)[(S'-K)(16 + (\ln(S'/K))^2) - 4(S'+K)\ln(S'/K)] = 0 \end{aligned} \tag{61}$$

Solving $\sigma\sqrt{T}$ from equation (61) yields

$$\sigma\sqrt{T} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{62}$$

Where $a = 8(S'+K) - 2(S'-K)\ln(S'/K)$

$$b = -8\sqrt{2\pi}(2C - S'+K)$$

$$c = \ln(S'/K)[(S'-K)(16 + \ln(S'/K))^2] - 4(S'+K)\ln(S'/K)]$$

A merit of Equation (62) is to circumvent the ad hoc substitution present in Corrado and Miller (1996) and improve the accuracy of the ISD's estimation. Other methods to calculate the implied volatility can be found in Lai, Lee et al. (1992) and.

According to Lee, Lee et al. (2013), put-call parity can be defined in Equation (63), we can calculate implied volatility, stock price per share, and exercise price per share in terms of put option model.

$$P = C + Xe^{-rT} - Se^{-qT} \tag{63}$$

Let $Xe^{-rT} = K$ and let $Se^{-qT} = S'$, then we have following equation.

$$P = C + K - S' \tag{64}$$

Substituting Equation (60) into Equation (64), we obtain following equation:

$$\begin{aligned} P = {} & (K - S')/2 + \left(\ln(S'/K)/s\sqrt{2pT}\right)[(S' - K)(1 + [\ln(S'/K)/4]^2) - \ln(S'/K)(S' + K)/4] \\ & + (s\sqrt{T}/2\sqrt{2p})[S' + K - \ln(S'/K)(S' - K)/4] \end{aligned} \tag{65}$$

Equation (65) is also a quadratic equation of $s\sqrt{T}$ and can be rewritten as:

$$\begin{aligned} & s^2T[8(S' + K) - 2(S' - K)\ln(S'/K)] - 8s\sqrt{T}\sqrt{2p}(2P - K + S') \\ & + \ln(S'/K)[(S' - K)(16 + (\ln(S'/K))^2) - 4(S' + K)\ln(S'/K)] = 0 \end{aligned} \tag{66}$$

Solving $s\sqrt{T}$ from Equation (66) yields

$$s\sqrt{T} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \tag{67}$$

Where $a = 8(S' + K) - 2(S' - K)\ln(S'/K)$, $b = -8\sqrt{2p}(2P - K + S')$,

$$c = \ln(S'/K)[(S' - K)(16 + \ln(S'/K)^2)] - 4(S' + K)\ln(S'/K)]$$

We rearrange Equation (61) in terms of S', then we obtain Equation (68).

$$\begin{aligned} & [8s^2T + 8s\sqrt{2pT} + 2s^2T\ln K - 16\ln K - 4(\ln K)^2 - (\ln K)^3]S' \\ & +[2s^2TK - 16K + 8K\ln K - 3K(\ln K)^2]\ln S' + [16 - 2s^2T + 8\ln K + 3(\ln K)^2]S'\ln S' \\ & +(3K\ln K - 4K)(\ln S')^2 - (3\ln K + 4)S'(\ln S')^2 - K(\ln S')^3 + S'(\ln S')^3 \\ & = 16Cs\sqrt{2pT} + 8s\sqrt{2pT}K - 8s^2TK + 2s^2TK\ln K - 16K\ln K + 4K(\ln K)^2 - K(\ln K)^3 \end{aligned} \tag{68}$$

Equation (68) can be used to estimate S' if we have the information of the other five variables. The solution of S' can only be obtained by the trial-and-error method.

Now, consider two call options, C_1 and C_2, on the same time to the maturity with exercise prices of X_1 and X_2. q is an annual dividend yield, S is the underlying asset value, and we denote $S' = Se^{-qT}$. We also denote the present values of the exercise prices $K_1 = X_1e^{-rT}$ and $K_2 = X_2e^{-rT}$, respectively.

For C_1, we apply Taylor's expansion to Equation (54) at K_2. This yields the following equation:

$$C_1 = C_2 - N(\ln(S'/K_2)/s\sqrt{T} - s\sqrt{T}/2)(K_1 - K_2) + e_1 \tag{69}$$

Where e_1 is the remainder term of Taylor's formula.

Similarly, for C_2, we apply Taylor's expansion to Equation (54) at K_1, which yields the following equation.

$$C_2 = C_1 - N(\ln(S'/K_1)/s\sqrt{T} - s\sqrt{T}/2)(K_2 - K_1) + e_2 \tag{70}$$

Where e_2 is the remainder term of Taylor's formula.

Rearranging the equations, dividing both sides by $(K_2 - K_1)$, then applying the inverse function of cumulative normal function on both sides, we have the following two equations.

$$N^{-1}[(C_1 - C_2)/(K_2 - K_1)] = \ln(S'/K_1)/s\sqrt{T} - s\sqrt{T}/2 + h_1 \tag{71}$$

$$N^{-1}[(C_1 - C_2)/(K_2 - K_1)] = \ln(S'/K_2)/s\sqrt{T} - s\sqrt{T}/2 + h_2 \tag{72}$$

Combining the two above equations, the effect of remainder terms may be partially offset. Then we get the quadratic equation of $s\sqrt{T}$ as follows.

$$s^2T + 2N^{-1}[(C_1 - C_2)/(K_2 - K_1)](s\sqrt{T}) - \ln(S'/K_1) - \ln(S'/K_2) = 0 \tag{73}$$

Then we can solve implied volatility as:

$$s\sqrt{T} = -N^{-1}((C_1 - C_2)/(K_2 - K_1)) \pm \sqrt{[N^{-1}((C_1 - C_2)/(K_2 - K_1))]^2 + \ln(S'^2/K_1K_2)} \tag{74}$$

Similarly, we consider two put options P_1 and P_2 on the same time to the maturity with exercise prices of X_1 and X_2. q is the annual dividend yield, S is the underlying asset value, we denote $S' = Se^{-qT}$. We also denote the present values of the exercise prices $K_1 = X_1e^{-rT}$ and $K_2 = X_2e^{-rT}$, respectively.

According to put-call parity defined in Equation (64), we have the following equations.

$$P_1 = C_1 + K_1 - S' \tag{75}$$

$$P_2 = C_2 + K_2 - S' \tag{76}$$

If we substitute the above equations into Equations (69) and (70), then we have the following equations:

$$P_1 = P_2 + (K_1 - K_2) - N(\ln(S'/K_2)/s\sqrt{T} - s\sqrt{T}/2)(K_1 - K_2) + d_1 \tag{77}$$

$$P_2 = P_1 + (K_2 - K_1) - N(\ln(S'/K_2)/s\sqrt{T} - s\sqrt{T}/2)(K_2 - K_1) + d_2 \tag{78}$$

Rearranging the equations, dividing both sides by $(K_2 - K_1)$, and then applying the inverse function of cumulative normal function on both sides, we have the following two equations.

$$N^{-1}((P_1 - P_2)/(K_2 - K_1) + 1) = \ln(S'/K_2)/s\sqrt{T} - s\sqrt{T}/2 + g_1 \tag{79}$$

$$N^{-1}((P_1 - P_2)/(K_2 - K_1) + 1) = \ln(S'/K_1)/s\sqrt{T} - s\sqrt{T}/2 + g_2 \tag{80}$$

By combining the two above equations, the effect of the remaining terms may be partially offset. Then we get the quadratic equation of $s\sqrt{T}$ as follows.

$$s^2T + 2N^{-1}[(P_1 - P_2)/(K_2 - K_1) + 1](s\sqrt{T}) - \ln(S'/K_1) - \ln(S'/K_2) = 0 \tag{81}$$

Solving the equation for $s\sqrt{T}$, we obtain:

$$s\sqrt{T} = -N^{-1}((P_1 - P_2)/(K_2 - K_1) + 1) \pm \sqrt{[N^{-1}((P_1 - P_2)/(K_2 - K_1) + 1)]^2 + \ln(S'^2/K_1K_2)} \tag{82}$$

5. Some Empirical Results

We select 10 constituent companies of S&P 500 as examples to compare the implied volatility estimation methods. The selected companies have relative large market values, and are from different industries. Table 2 shows the details of our sample.

Table 2. Details of Sample Companies

Security ID	Ticker	Company Name	SIC Code	Industry
101594	AAPL	Apple Inc.	3571	Electronic Computers
104533	XOM	Exxon Mobil Corporation	2911	Petroleum Refining
121812	GOOGL	Google Inc.	7375	Information Retrieval Services
107525	MSFT	Microsoft Corporation	7372	Prepackaged Software
106566	JNJ	Johnson & Johnson	2834	Pharmaceutical Preparations
111953	WFC	Wells Fargo & Company	6022	State Commercial Banks
105169	GE	General Electric Company	3511	Steam, Gas, and Hydraulic Turbines, and Turbine Engine
111860	WMT	Wal-Mart Stores Inc.	5331	Variety Stores
102968	CVX	Chevron Corporation	2911	Petroleum Refining
109224	PG	The Procter & Gamble Company	2841	Soap and Other Detergents
102936	JPM	JPMorgan Chase & Co.	6211	Security Brokers, Dealers & Flotation Companies
111668	VZ	Verizon Communications Inc.	4812	Radiotelephone Communications
108948	PFE	Pfizer Inc.	2834	Pharmaceutical Preparations
106276	IBM	International Business Machines Corporation	3571	Electronic Computers
109775	T	AT&T, Inc.	4812	Radiotelephone Communications

Sample time spans from July, 2013 to August, 2013. 10-year treasury rate is used as the risk-free rate, i.e 2.7%. We calculated the continuously compounded annual risk free interest rate accordingly: $\ln(1+2.7\%) = 2.66\%$ as the parameter r .

Empirical results(to be filled in the table)

6. Summary

The main purpose of this paper is to discuss how to use alternative methods for estimating implied variance. In this paper, we will first review alternative methods to estimate implied variance. We classify them into two different estimation routines: numerical search methods and closed-form derivation approaches, and discussed their limitations. Then, we show how the MATLAB computer program can be used to estimate implied variance. This kind of approach used Newton-Raphson method to derive the implied variance from the standard Black-Scholes model. In addition, we also discuss how the approximation method derived by Ang, Jou et al. (2013) can be used to estimate implied variance and implied stock price per share. Not only the case of single option is presented, this approximation method also estimate implied volatility from two options with the same maturity, but different exercise prices and values. At last, we select some large-cap stocks from S&P 500 as empirical examples. The performances of three typical alternative methods: regression method proposed by Lai, Lee et al, MATLAB computer program approach and approximation method derived by Ang, Jou et al are compared.

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Taxpayers as a Disciplinary Mechanism in Governmental Budgeting: The Case of Balloting in School District Budgets

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This study examines the relation between taxpayer balloting, budget levels, and standardized tests in New Jersey school districts over a ten-year period. Cost and production functions are jointly estimated, where the endogenous variables are costs per pupil and weighted test scores. From these regressions, efficiency and effectiveness scores are derived for each school district. Granger causality tests are then used to determine the direction of causality between efficiency, effectiveness, and voting outcomes.

We find a negative relation between the one-year lag of efficiency and the current year's effectiveness scores, suggesting that cutting costs has an adverse effect on test scores the following year. We also find that a defeated budget ("no vote") is negatively related to efficiency, but positively related to effectiveness, suggesting that the proposed budget signals inefficiencies that are not cured by remedial actions, but that the negative vote is instead used as an incentive to improve performance.

Keywords: Taxpayer Voting; School District Budgets; Student Achievement Scores; Efficiency in Public Schools.

1. Introduction

It has been commonly observed that while expenditure on education has been increasing, there has not been a corresponding increase in students' performance. As a result, an active debate rages over whether public schools utilize the considerable resources at their disposal in an efficient and effective manner. Many proposed reforms aimed at increasing the efficiency of public schools in the United States share a common driving force: increased parental participation. The underlying logic is that stakeholders should be better able to allocate resources in ways that lead to improvements in academic performance. Although this argument is intuitively appealing, relatively little research is available about the effectiveness of taxpayers' voting in curbing inefficiency in public school education.

The objective of this study is to evaluate the effectiveness of taxpayers as a disciplinary mechanism for budgeting in governmental institutions. We address this question by studying the effects of defeated budgets in New Jersey – one of the few states where school budgets are subject to a direct vote of approval by the electorate – over the period of 2003 to 2013. Standardized test scores are used as an outcome measure to examine the impact of defeated budgets on efficiency. For academic year 2009-2010, 315 New Jersey school district budgets were defeated out of a total of 538 budgets (i.e., 59 percent). This is a sharp increase relative to the previous year, when only 26 percent of the budgets were defeated. An interesting question arises: "Can school districts manage with decreased resources without affecting student test performance, or do budget-cutting measures in response to defeated budgets cause test performance to deteriorate?"

There are *prima facie* reasons to expect that taxpayer balloting may not be the best control mechanism. Firstly, they may not have the necessary technical expertise to understand (or to discover the potential inefficiencies in) the budgets as proposed by the institutional administrators. (Arguably, the legislature or local governing body may be more competent in this regard.) Secondly, even if taxpayers possess the expertise, political considerations (including political apathy) may influence the outcome of the voting process, thus rendering the results of the ballot an unreliable control mechanism to curb cost inefficiencies in public institutions. Third, large numbers of taxpayers may be myopic decision-makers and may vote a budget down if the marginal benefit to them is lower than the cost imposed on them through taxes.

On the other hand, taxpayer balloting as the control mechanism may be justified as the most cost-effective means of determining the preferences of a diverse electorate. If the output of the public sector institution is a public good for which differential demand exists, allowing the electorate to approve the level of output through a vote may result in the revelation of the preference of the taxpayers. Thus, a potential justification for allowing a direct ballot on the budget of public sector institutions may be to obtain a consensus from the electorate on the value placed on the provision of the public good.

This study arrives at an important time to provide evidence on the merits of New Jersey's new school election law (P.L. 2011, c. 202) that was signed by Governor Christie on January 17, 2012. This law allowed school boards or governing bodies to change the election date of school board members from the third Tuesday in April up to the date of the general election in November. For those school districts that adopted the change, the annual vote on the school district budget was eliminated, provided the districts stay within a mandatory 2% tax levy cap.

In response to the new school election law, school districts rushed to move up the school elections from April to November.[1] The following figures summarize the number of school districts with budget referenda that were put on the ballot in April prior to the budget year:

Academic Year	Number of NJ School Districts with April Budget Votes[2]
2010-2011	538
2011-2012	539
2012-2013	70
2013-2014	39

Of the 539 school districts that were required to hold budget votes in April of 2011, only 70 (13.0%) continued to hold budget referenda in April of 2012. By April of 2013, this figure had fallen to 7.2%.

The overwhelming move to November elections may save taxpayer money in state-wide election costs in April, but the new election law may have unintended consequences. Absent direct taxpayer budget voting, an important mechanism for public oversight of the school district budgets is removed. Without this disciplinary mechanism over the budget, increases in cost inefficiencies and/or decreases in outcome effectiveness (i.e., test scores) may result. Our paper has the potential to shed light on this possibility.

We use a panel analysis approach to evaluate the relative efficiency and effectiveness of the school districts in our sample from 2003 to 2012. To measure efficiency and effectiveness, a cost function is estimated simultaneously with a production function, where the two dependent variables are the comparative cost per pupil and weighted test scores, respectively. From these regressions, efficiency (EFFCY) and effectiveness (EFTV) scores are obtained for each school district. We then estimate the relationships between EFFCY, EFTV, and voting outcomes (NO_VOTE) using Granger causality tests that control for other factors and lagged values of the endogenous variables.

Some of our main results are as follows. We document a negative relation between $EFFCY_{(t-1)}$ and $EFTV_{(t)}$, suggesting that greater efficiency in one year is associated with relatively lower test score performance the following year. Thus, cost-cutting in one period may have an adverse effect on test scores in the following year. We document a similar negative relation between $EFTV_{(t-1)}$ and $EFFCY_{(t)}$, suggesting higher performing districts may subsequently become lax on efficiency in order to maintain high levels of achievement (or they do not face the same pressure as lower performing districts to increase their cost efficiency the following year). However, both EFFTV and EFFCY have positive serial correlation, indicating a tendency for school districts to maintain their relative postures

[1] FSLR, "Scores of N.J. school districts moving elections from April to November," *NJ.Com*, February 26, 2012. www.nj.com/news/index.ssf/2012/02/scores_of_nj_school_districts.html.

[2] Source: State of New Jersey Department of Education, DOE Data and Reports, School Election Results, www.state.nj.us/education/data/vote/.

through time. Moreover, in general, we find that more efficient school districts also tend to be more test outcome-effective. In regards to voting outcomes (as motivators of behavior), we find that the $NO\_VOTE_{(t)}$ (which occurs in April preceding school year t's budget year beginning in July of that same calendar year) is positively associated with $EFTV_{(t)}$ but negatively related to $EFFCY_{(t)}$. In essence, there is a positive effect stemming from the negative budget vote on the school district's test score performance, but higher cost efficiency (the primary objective of the negative budget vote) is not achieved. This suggests two things. First, the observed budget that taxpayers are voting on signals school district inefficiencies, and subsequent remedial actions taken by the school district in response to the negative vote are ineffective in curing the inefficiency. Second, school districts would prefer to appease voters by increasing test scores, rather than making reductions in the budget.

The lagged effect of $NO\_VOTE_{(t-1)}$ on $EFTV_{(t)}$ and $EFFCY_{(t)}$ is quite different. $No\_Vote_{(t-1)}$ is negatively related to $EFTV_{(t)}$ and has no significant relationship with $EFFCY_{(t)}$. Thus, the test- score enhancing effect of $NO\_VOTE_{(t)}$ (discussed above) is mitigated, since there is a partial reversal in the following year. However, further investigation reveals that the contemporaneous positive effect of the negative vote is about three times that of the subsequent reversal, so improvements in test score performance remains positive on a cumulative basis.

The remainder of this study proceeds as follows. Section II reviews the literature on inefficiencies in school district budgeting, determinants of taxpayer balloting outcomes, and alternative institutional arrangements for setting the budget. In section III we present our methodology for assessing the effectiveness of the direct vote on school district budgets, including model specification and variable selection. We present our findings and subsequent sensitivity tests in Section IV. Our conclusions follow in section V.

2. Literature review

This literature review consists of three parts. The first part looks at evidence of budgetary inefficiencies in school spending. Both direct and indirect evidence is examined. The second part focuses on voting behavior and empirically observed determinants of public voting outcomes, including reasons why proposed budget referenda fail. The third part reviews literature on alternative institutional arrangements for approving governmental expenditures, and to what extent budget referenda serve as a cost minimizer through voter participation.

Inefficiency in Educational Spending

According to data provided by the U.S. Department of Education, expenditures on public schools rose from \$75 billion in 1975 to \$681 billion in 2010.[3] Using constant-dollar figures, public schools spent, on average, \$12,743 per pupil in 2010, relative to \$6,253 per pupil in 1975, the latest year for which data are available.[4] Despite that doubling of funds, just about

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[3] (U.S. Department of Education, National Center for Education Statistics, NCES 2014-015, *Digest of Education Statistics*, 2012, table 28, p. 55).

[4] U.S. Department of Education, National Center for Education Statistics, NCES 2014-015, *Digest of Education Statistics*, 2012, table 213, p. 297).

every measure of educational outcomes has remained stagnant since 1975. Notwithstanding the poor results, state lawmakers, courts and bureaucrats keep pushing for even more spending.[5]

While a modest positive correlation between per-pupil spending and educational ranking has been found, vast differences still exist between spending per pupil and quality of education. For example, the National KIDS COUNT ranks Colorado ninth nationally in quality of education,[6] even though the State spent an average of $9,305 per student in 2009, putting it among the bottom 10 states in spending the least per pupil.[7] In comparison, Alaska, ranked 41st for its education quality, but spent an average of $15,363 per student, putting it third in the country (excluding the District of Columbia).

There is a large body of literature that indicates that school budgets are using money inefficiently. Although it is difficult to know what constitutes efficiency in a situation where private market forces are fairly weak or absent, several forms of inefficiencies in education spending have been documented.

Chalos (1997) employs data envelope analysis to examine budgetary efficiency across elementary school districts in the State of Illinois. He finds that budgetary inefficiency was positively associated with: (1) the size of the budget, (2) the administrative overhead in the budget, and (3) the proportion of the budget financed by local property taxes. These findings offer a partial explanation for the weak relationship traditionally found between educational spending inputs and performance outcomes. The results are suggestive of how school districts might improve their budgetary goal setting, performance auditing and resource allocation practices.

Ruggiero and Vitaliano (1999) use data from 520 New York school districts and show that inefficiency exists in the production of "learning" in public elementary and secondary education. Based on both the results of their stochastic frontier model and DEA, they find that operating expenditure per student is 14% above the “least cost” estimate, after controlling for socioeconomic variables.

Saito and McIntosh (2003) use data envelopment analysis to examine the efficiency of public schools in Georgia. They find that Georgia school districts utilize educational budgets with reasonable efficiency, achieving an overall efficiency of 98%, with a range of 93-100%. If all school districts were 100% efficient, outputs could be expanded 2%. However, from the consumers' (voters') point of view, this result suggests that inefficiency cost Georgia a total of $226.38 million annually on average from 1994 to 1996.

Dodson and Garrett (2004) estimate scale economies for Arkansas school districts. The results suggest that districts, especially rural districts, would experience measurable cost savings from consolidation. Simulations indicate that districts could save on average 34% on variable costs. At the state level, consolidation of rural districts in Arkansas could annually

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[5] Over the last decade, high courts in several states have ruled that public school spending in certain urban systems violates state constitutional requirements to spend enough on public schools to produce “adequate” results.

[6] National KIDS COUNT Educational rankings, KIDS COUNT Data Center, Annie E. Casey Foundation, Baltimore, MD, 2012.

[7] U.S. Department of Education, National Center for Education Statistics, NCES 2014-015, *Digest of Education Statistics*, 2012, table 217, p. 303).

save $40 million.

Marlow (2001) tests the hypothesis that monopoly power of school districts allows bureaucratic expansion in public school budgets, spawning inefficiency and poor academic performance. Using 1992-1993 data at the county level in the State of California, he provides evidence in support of the bureaucratic expansion hypothesis from the standpoint that monopoly power is positively associated with employment of more teachers and administrators. On the other hand, he shows that employment of more administrators raises SAT scores and lowers drop-out rates, suggesting a misallocation of resources between teachers and administrators.

Lee and Plummer (2007) examine budgets for 1,034 Texas school districts over a 1995-2002 sample period, and find budget ratcheting (budget increases associated with prior year spending variances) within subcategories of both instructional and non-instructional expenditures, although it is more prevalent in the latter. They also find that budget ratcheting is more pronounced for school districts that operate in a less competitive environment and for districts that have less voter influence.

Indirect evidence of inefficiency is presented by studies that show little or no relationship between expenditures and student performance. Hanushek (1986, 1989, 1996) has summarized the reported findings from a multitude of studies that examine the school input-test score relation. In his most recent (1996) survey, he found that expenditures had a significant positive effect on student achievement in only 27 percent of 163 studies, while 7 percent reported a significant negative relation, and 76 percent had insignificant coefficients. Hanushek's (1996) survey of the literature also examined the effects of other school input variables on student achievement. The teacher-pupil ratio, teacher experience, and teacher's salaries had significant positive effects on test scores in only 15 percent, 29 percent, and 20 percent of the studies, respectively. He concludes that "Today's schools exhibit continuing inefficiency in their operations as there is no strong or consistent relationship between variations between school resources and student performance." Because of the weak or inconsistent relation between school inputs and test scores, we omit these school input variables from our test score model in section 3.2 in favor of the known driver of test scores - socio-economic variables (e.g., Jaggia and Kelly-Hawke, 1999).

Determinants of Voting Outcomes and why Budget Referenda Fail.

A number of researchers have examined how taxpayers voted on specific budget referenda and have identified empirical determinants of budget referenda outcomes. The focus has been on the characteristics of the individual voters and budget voting patterns. For the sake of brevity, we limit our discussion to studies that examine budget votes on public schools, beginning with capital investment decisions.

Bowers, Metzger, and Militello (2010) examined voting patterns on 789 school construction bonds in the state of Michigan. They find that voter turnout, amount of bond principal, and two socio-economic variables - percent student receiving free lunches and percent district population with only a high school degree - were all negative and significant factors in passing a bond issue. Although district enrollment was not significant, being in a small or rural town was a negative factor. Zimmer, Buddin, Jones, and Liu (2011) also examine voting outcomes on capital investments in Michigan, and find that there is a higher approval rate for maintenance of existing facilities than the construction of new school buildings or additions.

Wang, Duncombe, and Yinger (2011) examine the capital investment decisions in New York's school districts in response to matching state building aid programs. They find that rural districts are much more likely to take advantage of state aid in approving capital projects than are high-need urban districts. In most cases the budgetary problems of urban districts are so severe they are unwilling or unable to accept new debt, even when most of the cost will be picked up by the state government. Urban districts face additional obstacles, including higher construction prices and greater superintendent turnover than rural districts.

Silverman (2011) examines voting on New York school district budgets over the 2003–2010 period, and finds that the overwhelming majority (92%) of proposed budgets are approved by voters. Although voter turnout was low in general,[8] higher voter turnout is associated with a greater percentage of "no votes." He also finds that the percent increase in annual spending is associated with "no votes," and that the probability of a budget being approved is greater in school districts with higher enrollment.

Ehrenberg, Ehrenberg, Smith, and Zhang (2004) analyze historical data for New York State on the percentage of school budget proposals that are defeated each year. They show that once a budget is rejected by voters, there is an increased likelihood that subsequent budgets will be voted down. Changes in per-capita county income increase the likelihood that budgets will pass. They also find that districts whose school board members have longer terms have lower probabilities of having their budget proposals defeated.

A study conducted by New York State's Department Of Education (NYSDE, 2005) found that the greater the proposed increase in the local tax levy, the greater the probability of the budget being rejected by voters. Other factors associated with budget rejection were dependence on local taxes, percentage change in district spending, the local effective tax rate, and school district enrollment. School districts in Nassau or Suffolk counties in Long Island experienced a disproportionate number of budget failures, accounting for 44 percent of defeated budgets.

In order to understand district characteristics and funding trends, several authors study the relation between voting on school budgets and community demographics. Using data from telephone surveys in the State of North Carolina, Priest and Cox (2005) found that African Americans were more likely to pass school budgets irrespective of whether they had school age children living in their households. Respondents who had more confidence in public officials and the school board were more likely to approve the bond issue. In a test of the "Gray Peril" hypothesis,"[9] Lambert, Clark, Wilcox, and Park (2009) show that senior citizens

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[8] Silverman explains that the budget process in New York does not provide much incentive to vote. When budgets are not approved by voters, a school district can adopt a contingency budget. Due to state regulations, there is usually only a marginal difference between a proposed school district budget and a default contingency budget. So there is little motivation to go to the polls and reject a budget that ultimately will be passed in a slightly revised form.

[9] Under the "Gray Peril" hypothesis, funding for education and other public services will suffer because retirees are unwilling to support services not benefiting them. Education is considered most susceptible to Gray Peril since retirees do not have school-age children, and education expenditures are often determined by local public referenda where seniors tend to vote in large numbers. Likewise, in popular retirement destinations such as the

in the State of Tennessee tend to support local spending on public schools at the same level as other citizens, even though they do not have school age children in their households.

Taken together, the results of Silverman (2011), Bowers et al. (2010), and NYSDE (2005) suggest that voters' frustration with increases in school spending or borrowing can augment turnout at the ballot box and can result in taxpayer revolt,[10] leading to a higher rate of defeated budgets and forcing schools to manage with inadequate resources. The findings from these papers present a dilemma for school board and administrators, since there are potential incentives to discourage turnout in order to increase the chance of budgets being approved.

Are Budget Referenda an Efficient Institutional Arrangement for Approving Governmental Expenditures?

This final part of our literature review examines research on alternative institutional arrangements for budgeting government expenditures. Much of this research focuses on direct voting verses budget-setting by elected or appointed officials, and whether or not holding a budget referenda results in lower expenditures. In light of the State of New Jersey's new election law, this is a relevant question for this study.

Megdal (1983) uses a principal-agent setting to investigate the importance of the budget referendum on spending in New Jersey school districts. Her model predicts no difference between observed outcomes in communities where agents in the form of elected officials set the budget on behalf of principal taxpayers and in communities where a budget referendum is held. Her results are inconclusive, neither accepting nor rejecting the null hypothesis.

Steunenberg (1992) examines the influence of different institutional arrangements in setting and approving the budget, including obligatory fiscal referendum, voter initiative, and veto power on the outcomes of budget games. Steunenberg argues that the smallest budget is found in direct voting initiative where voters determine the level of expenditure, but that the level of spending under a representative arrangement can be equivalent to that in the case of referenda. Other studies find no significant linkage between referenda and expenditures (Bails and Tieslau 2000; Santerre 1989; Sass 1991), or even a counter-intuitive positive relation between them (Farnham 1990).

However, a large majority of studies provide empirical evidence of a constraining effect of budget referenda on public expenditures and revenues in the United States. Romer, Rosenthal, and Munley (1992) examine public school budget referenda data from 544 New York SCSDs (Small City School Districts) for the 1975-1976 fiscal year, and show that spending varies according to referendum rules. In addition, large school districts appear to be more inefficient and behave more like "budget maximizers" than small districts, where proposals are more in line with "median voter" demands. Ebdon (2000) also compares expenditures in New York State school districts with and without budget referendum

south and west that contain more transients, retirees may lack direct connections to the local school system (Duncombe, Robbins, and Stonecash 2003).

[10] Taxpayer revolt implies a large voter turnout and negative votes against the budget, as a form of protest. Protest voting is of interest because it can highlight socioeconomic conditions that augment the probability of a budget defeat. See Archibald and Feldman (2006) for a more in-depth review of the taxpayer revolt.

requirements. Using an 11 year sample period (1990-2000), Ebdon shows that total spending is 5.5% higher in districts without referenda, ceteris paribus.

Nguyen-Hoang (2012) finds that budget referenda lead to a decrease in spending. Using data from New York in 1998, he offers empirical evidence that spending-inhibiting budget referenda induce district officials to cut back expenditures on instructional services and increase student- teacher ratios while preserving administrative spending. However, Nguyen-Hoang's paper does not address how reductions in total and instructional spending and an increase in student–teacher ratios may affect student performance.

This literature review provides an overview of the literature at this time. A significant vacuum in this literature is the question of whether taxpayer balloting on school district budgets is based on an accurate assessment of the relative efficiency and effectiveness of the school districts. A related research question is whether, regardless of whether the school budget vote results are based on a well-informed evaluation of relative efficiency and effectiveness, the results of the ballot serve as a signal to school district administrators and teachers. Specifically, are the subsequent actions of the administrators and teachers (in terms of achieving greater efficiency and/or effectiveness) related to the antecedent vote outcomes? These two issues are addressed in the rest of this paper.

3. Methodology

Conceptual Framework

The preceding literature review has highlighted the intended disciplinary role that taxpayer balloting can have over school district budgets. For this disciplinary mechanism to be effective, two conditions must be met: (1) taxpayers must be fully informed about the relative efficiency and effectiveness of their school districts; and (2) school district administrators must be cognizant of the fact that the taxpayers have been provided information that enables them to assess the relative efficiency and effectiveness of the school districts in the state.

In the State of New Jersey, both conditions are easily met. The State's Department of Education has posted on its website detailed historical and current records of expenditures, standardized test scores results, and other outcomes (graduation rates, etc.) for all the school districts in the state. In addition, to improve comparability, the Department also has compiled what it refers to as District Factor Groupings (DFGs) which classify school districts into eight socio-economic groupings based on the commonality of the socio-economic factors in which the districts operate. Thus, taxpayers have access to the data on which they can access both the cost efficiency and the outcome effectiveness of the school districts, and the school districts are aware of this data accessibility.

Given the fulfillment of both conditions, we posit that in a dynamic setting, there will be interactive feedback effects, with the results of the taxpayer ballot informing school district administrators whose response in turn affects the outcomes of the following year's ballot. This results in a Granger causality type setting where the lagged values of the endogenous variables affect the current values. Specifically, we postulate the following relationships:

$$EFFCY_{(t)} = \square\,[\,EFFCY_{(t\text{-}1)}, EFTV_{(t)}, EFTV_{(t\text{-}1)}, VOTE_{(t)}, VOTE_{(t\text{-}1)}, TYPE, \text{control variables (set 1)}\,] \tag{1}$$

$$EFTV_{(t)} = \square\,[\,EFFCY_{(t)}, EFFCY_{(t\text{-}1)}, EFTV_{(t\text{-}1)}, VOTE_{(t)}, VOTE_{(t\text{-}1)}, TYPE, \text{control variables (set 2)}\,] \tag{2}$$

$$VOTE_{(t)} = \square\,[\,EFFCY_{(t\text{-}1)}, EFTV_{(t\text{-}1)}, VOTE_{(t\text{-}1)}, TYPE, \text{control variables (set 3)}\,] \tag{3}$$

where

$EFFCY_{(t)}$	=	Cost efficiency of the school district relative to other school districts in year t.
$EFTV_{(t)}$	=	Test outcome effectiveness of the school district relative to other districts in year t.
$VOTE_{(t)}$	=	Result of school districts budget ballot held in April preceding the July 1 start date of school year t (coded as dummy variable with NO = 1, and YES = 0).
TYPE	=	School district type, where:

Type 1	=	Kindergarten to Grade 4;
Type 2	=	Kindergarten to Grade 8;
Type 3	=	Kindergarten to Grade 12;
Type 4	=	Grade 5 to Grade 8; and
Type 5	=	Grade 9 to Grade 12.

As described in Equations (1) to (3), EFFCY is seen as a function of EFTV for the same budget year, the values of EFFCY and EFTV from the previous year, the results of the vote on that year's budget (conducted in April preceding the July 1st – June 30th budget year), and last year's vote outcome. Similarly, EFTV is seen as a function of the concurrent EFFCY, the lagged values of EFTV and EFFCY, and the VOTE outcome for the current year as well as the prior year. Finally, the vote outcome is seen as a function of EFFCY and EFTV of the previous year,[11] and last year's vote outcome.

An issue that arises from this conceptual framework is the measurement of EFFCY and EFTV. The literature on cost and production functions has provided a wide variety of ways in which cost efficiency and output effectiveness can be estimated. In traditional neo-classical models where well-behaved functions are assumed, Shephard's Lemma can be applied to derive the equivalence of cost and production functions (Shephard, 1953). Unfortunately, in the educational context, such well-behaved functions do not exist, as noted by Costrell, Hanuschek and Loeb (2008) and others who note the lack of any relationship (or a very weak one at best) between educational outcomes and school expenditures. The absence or weak relationship between educational spending and test outcomes suggests that cost efficiency and test outcome effectiveness can be measured independently from cost and outcome functions.

Following Imazeki (2008), a system of two equations is employed to estimate simultaneously the cost and outcome functions. Joint estimation provides a statistical approach for resolving the possible simultaneous equation bias that may result from estimating the two functions independently. The variables used to estimate these models are

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[11] Since the school district budget vote takes place in April of each year, results of the prior year's state- wide achievement tests and actual expenditures are known by this time.

discussed in the next section.

Model Specification and Variables

The jointly dependent variables used in the cost and outcome functions are CC_TOT and TPASSR_2, respectively. CC_TOT is defined as Comparative Cost per-pupil, computed by the State of Jersey. This variable includes five major categories of school costs: classroom instructional costs, administrative costs, student support costs, operating and maintenance, and extracurricular activities. It excludes transportation, facilities acquisition costs, interest, and other miscellaneous items.

The second jointly dependent variable is test scores. The three standardized tests used in the study are given in Grades 4, 7 and 12. Students sit for the NJ ASK4 (Assessment of Skills and Knowledge) test in grade 4, the GEPA (Grade Education Proficiency Analysis) test in Grade 7, and the HSPA (High School Proficiency Analysis) test in grade 12. The State of New Jersey has now moved to having students sit for NJASK tests for all grades, but since we are using panel data, we have retained the standardized tests in these three grades because they have the longest histories. It should be noted that the use of standardized test scores (including pass rates) as the sole measure of school district performance has been criticized as inadequate since public schools pursue multiple objectives (Hanushek 1979, 1986). Nevertheless, since it is a measure that is typically used by the state as well as the general public to evaluate school performance, we rely on these statistics for our analyses.

Our test score variable is based on the mean pass rates for tests taken in that school district. Thus, for a Type 2 (K-8) school district, we compute an average pass rate using test results from both the NJ ASK4 (Grade 4) and the GEPA (Grade 7). The State distinguishes "Advanced Pass" from "regular pass." To take this into account, an "Advanced Pass" is assigned twice the weight of a "Regular Pass." So our test score variable, TPASSR_2, is a weighted pass rate. The exact computation of this variable is included in the appendix. For comparative purposes, we also provide descriptive statistics on the unweighted pass rate, TRPASSR_1, also computed in the appendix.

To estimate the two functions using actual spending and test performance data, additional controls must be introduced (see Duncombe and Yinger, 2005). Many of the hypothesized determinants of comparative cost per pupil (CC_TOT) and test results (TPASSR_2) overlap. The question is what socioeconomic and other control variables are expected to be uniquely related to the cost and test outcomes. The independent variables included in our models are discussed next.

Our first predictor variable used in the cost function is the geographic cost of living index (GEOCEI), calculated by the State of New Jersey from the US Census data. Chalos (1997) found that the proportion of school district budgets financed by local property taxes was related to greater inefficiencies (greater costs). We include the variable NON_LOCAL, defined as the amount of school district revenues funded from non-local sources (local sources of funds include property tax revenues and direct payments by the local municipal government). Dopuch and Gupta (1997) found average family income to be positively related to total school district expenditures. Thus, we include two socio-economic variables in the cost function: (1) average household family income (Lg_FAMY), and (2) percentage of the population in the school district with some college education (SOM_COLL).

Because the dependent variable for school expenditures, CC_TOT, is on a per-pupil basis, we include the total number of students enrolled in the school district (Lg_ENROLL) to capture possible economies of scale in the production of teaching. However, if the number of students exceeds a threshold, then diseconomies of scale may set in. To allow for the possibility of an inflection point, the square of enroll (Lg_ENROLL*SQR) is also included in the model (Green 1980). Since special education programs can substantially increase the costs of education, we include percentage of students in the school district classified as Special Education as an independent variable (SP_ED). Finally, we include four demographic variables to capture cross- sectional differences in the costs of education. These variables are the percentage of the population that is male (TMALE_PCT), Black (TBLCK_PCT), Asian (TASIA_PCT), and Hispanics (THSPC_PCT), respectively.

Turning to the test score model, the primary driver of student achievement is socio-economic background (Jaggia and Kelly-Hawke, 1999). Thus, we include four socio-economic variables in the test scores equation. These variables are the same two variables included in the cost function (Lg_FAMY and SOM_COLL), plus (3) proportion of the population who did not graduate from high school (NO_HS); and (4) the average occupational status of the population (OCCP_ST) (Nakao and Treas 1994). It should be noted that because of the prior lack of findings on the school inputs-test score relation, our model omits some of the common school input variables (e.g., average teacher salaries), which are often a function of the NJEAs (New Jersey Education Associations) collective bargaining process.

Mensah, Schoderbek, and Sahay (2013) find that the percentage of school district revenues raised from local property taxes was positively related to test score performance. Thus the variable NON_LOCAL is included as an explanatory variable in the test scores equation. Heineson (2005) finds that students from larger school districts had a significantly higher probability of attaining a secondary education, so we include two variables (Lg_ENROLL and Lg_ENROLL*SQR) to control for possible school size effects. The variable SP_ED is included in the model due to the predicted lower test scores for special education students. Student mobility has been found to have a negative effect on test scores in prior studies (e.g., Hanushek, Kain and Rivkin 2004), while student attendance has been shown to have positive effects (Parke and Kanyongo 2012; Mensah, Schoderbek, and Werner 2009). Thus, both the student mobility rate (STUMOB) and student attendance rate (ATTDR) are included in our model. The ACT Profile report for the State of New Jersey shows significant variation in average composite ACT scores by race/ethnicity (ACT Profile – NJ, 2012). Thus our four demographic variables TMALE_PCT, TBLCK_PCT, TASIA_PCT, and THSPC_PCT, are included in the model to capture cross-sectional differences in test scores from demographics.

We have an additional socio-economic variable (Abbott) that pertains to the TYPE3 districts (Kindergarten to Grade 12) only. ABBOTT, is a dummy variable that equals one if the school district is included among the State's 31 Abbott School districts (all K-12 school districts), else zero. Abbott districts have been identified by the New Jersey Supreme Court (or later legislative processes) as school districts with "low student achievement and concentrated poverty" (Librera 2005). Due to the educational disparities in Abbott Districts, the State provides "Abbott parity aid" that puts their per-pupil expenditures on par with the wealthiest school districts in the State. Because the Abbott remedy effects total costs, ABBOTT is included in the cost function. And since the Abbott designation is based on low student achievement, this variable is also included in the test score model.

The functional form of our two regressions is specified in equations (4) and (5) below:

$$\begin{aligned} LG\_CCTOT_i = \alpha_{10} &+ (\alpha_{11} * YR03) + (\alpha_{12} * YR04) + (\alpha_{13} * YR05) + (\alpha_{14} * YR06) \\ &+ (\alpha_{15} * YR07) + (\alpha_{16} * YR08) + (\alpha_{17} * YR09) + (\alpha_{18} * YR10) \\ &+ (\alpha_{19} * YR11) + (\beta_{11} * GEOCEI_i) + (\beta_{12} * NON\_LOCAL_i) \\ &+ (\beta_{13} * Lg\_FAMY_i) + (\beta_{14} * SOM\_COLL_i) + (\omega_{11} * lg\_ENROLL_i) \\ &+ (\omega_{12} * lg\_ENROLL*SQR_i) + (\omega_{13} * SP\_ED_i) + (\gamma_{11} * TMALE\_PCT_i) \\ &+ (\gamma_{12} * TBLCK\_PCT_i) + (\gamma_{13} * TASIA\_PCT_i) + (\gamma_{14} * THSPC\_PCT_i) \\ &+ (\gamma_{15} * ABBOTT_i) + (\lambda_{11} * TPASSR\_2_i) + e_{1i} \end{aligned} \tag{4}$$

$$\begin{aligned} TPASSR\_2_i = \alpha_{20} &+ (\alpha_{21} * YR03) + (\alpha_{22} * YR04) + (\alpha_{23} * YR05) + (\alpha_{24} * YR06) \\ &+ (\alpha_{25} * YR07) + (\alpha_{26} * YR08) + (\alpha_{27} * YR09) + (\alpha_{28} * YR10) \\ &+ (\alpha_{29} * YR11) + (\beta_{22} * NON\_LOCAL_i) + (\beta_{23} * Lg\_FAMY_i) \\ &+ (\beta_{24} * SOM\_COLL_i) + (\beta_{25} * NO\_HS_i) + (\beta_{26} * OCCP\_ST_i) \\ &+ (\omega_{21} * lg\_ENROLL_i) + (\omega_{22} * lg\_ENROLL*SQR_i) + (\omega_{23} * SP\_ED_i) \\ &+ (\omega_{24} * STMOB_i) + (\omega_{25} * ATTDR_i) + (\gamma_{21} * TMALE\_PCT_i) \\ &+ (\gamma_{22} * TBLCK\_PCT_i) + (\gamma_{23} * TASIA\_PCT_i) + (\gamma_{24} * THSPC\_PCT_i) \\ &+ (\gamma_{25} * ABBOTT_i) + (\lambda_{21} * LG\_CCTOT_i) + e_{2i} \end{aligned} \tag{5}$$

These models are estimated using the deterministic frontier function approach (Greene, 1980) to derive the cost efficiency and test outcome effectiveness measures. This approach is discussed in the next section.

Empirical Models Estimated

The EFFCY scores were obtained by running the equivalent of Equation (4) for each year and type of school district. As noted by Greene (1980), the regression estimates of the coefficients are unbiased frontier estimates except for the intercepts. By displacing the intercept term in Equation (4) until one of the residuals is zero and the rest are positive, the resulting cost frontier function can be used to derive the EFFCY ratings of individual school districts by taking the ratio of the predicted frontier cost to the actual cost. The resulting values range from 100 percent (for the most cost efficient) to values below 100. Similarly, the EFTV ratings are derived from Equation (5) by shifting the intercept until one of the residuals is zero and the rest are negative. The resulting deterministic test outcome frontier function provides an estimate of the predicted outcomes based on the explanatory variables, and the ratio of actual output to predicted output thus yields the EFTV rating of the individual school districts.

Once the EFFCY and EFTV ratings are derived for each year and school district type, the final set of regressions can be undertaken as follows:

$$\begin{aligned} EFFCY_{it} = \alpha_{10} &+ (\alpha_{11} * TYPE1_i) + (\alpha_{12} * TYPE2_i) + (\alpha_{14} * TYPE4_i) + (\alpha_{15} * TYPE5_i) \\ &+ (\gamma_{12} * EFFCY_{it-1}) + (\gamma_{13} * EFTV_{it}) + (\gamma_{14} * EFTV_{it-1}) \\ &+ (\lambda_{11} * NO\_VOTE_{it}) + (\lambda_{12} * NO\_VOTE_{it-1}) + (\phi_{11} * GEOCEI_i) \\ &+ (\phi_{12} * Lg\_CCTOT_{it}) + e_{1i} \end{aligned} \quad (6)$$

$$\begin{aligned} EFTV_{it} = \alpha_{20} &+ (\alpha_{21} * TYPE1_i) + (\alpha_{22} * TYPE2_i) + (\alpha_{24} * TYPE4_i) + (\alpha_{25} * TYPE5_i) \\ &+ (\gamma_{21} * EFFCY_{it}) + (\gamma_{22} * EFFCY_{it-1}) + (\gamma_{24} * EFTV_{it-1}) \\ &+ (\lambda_{21} * NO\_VOTE_{it}) + (\lambda_{22} * NO\_VOTE_{it-1}) + (\phi_{21} * Lg\_FAMY_i) \\ &+ (\phi_{22} * SOM\_COLL_i) + (\phi_{23} * OCCP\_ST_i) + (\phi_{24} * STMOB_i) \\ &+ (\phi_{25} * ATTDR_i) + e_{2i} \end{aligned} \quad (7)$$

$$\begin{aligned} NO\_VOTE_{it} = \alpha_{30} &+ (\alpha_{31} * TYPE1_i) + (\alpha_{32} * TYPE2_i) + (\alpha_{34} * TYPE4_i) + (\alpha_{35} * TYPE5_i) \\ &+ (\gamma_{32} * EFFCY_{it-1}) + (\gamma_{34} * EFTV_{it-1}) + (\lambda_{32} * NO\_VOTE_{it-1}) \\ &+ (\phi_{31} * OCCP\_ST_i) + (\phi_{32} * Lg\_CCTOT_{it}) + (\phi_{33} * \Delta Lg\_CCTOT_{it}) \\ &+ (\phi_{34} * \Delta LOCAL_{it}) + e_{3i} \end{aligned} \quad (8)$$

where

NO_VOTE_t	=	Dummy variable denoting voting outcome on the school district's budget was negative for year t.
$\Delta LOCAL_t$	=	Change in the percentage of the school district spending from local sources.
ΔLg_CCTOT_t	=	$Lg\_CCTOT_t - Lg\_CCTOT_{t-1.}$

Equations (6) to (8) estimate the Granger causality relationships between EFCY, EFTV and NO_VOTE after controlling for other factors that are hypothesized to be related to the endogenous variables. GEOCIE is hypothesized to be related to cross-sectional differences in EFFCY partly because the index may be an imperfect measure of the systematic variation of the cost of living in the different areas. Similarly, Lg_FAMY, SOM_COLL, and OCCP_ST, although they are controlled for in the initial estimation of EFTV, are hypothesized to have some residual effects on EFTV but not on EFFCY. OCCP_ST is hypothesized to affect the likelihood of the NO_VOTE but not EFFCY. Finally, based on the findings from the literature, both the levels of spending (Lg_CCTOT) and the change in spending (ΔLg_CCTOT_{it}) are hypothesized to influence voting outcomes. In addition, the change in the level of funding from local sources has been found in the prior literature to influence voting outcomes (NYSDE, 2005), so it is included here as a control variable.

4. Results of analyses

Descriptive Statistics

The data for the study were compiled from databases posted on the Department of Education website for years 2003-2012. Because the data exhibits similarity for each year, summary statistics for 2006 are presented in Table 1 as a representative sample of the data range for each type of school district.

Insert Table 1 here

Panels A to E of Table 1 present the summary statistics for the K-4, K-8, K-12, Grades 5-12 and 9-12 school districts, respectively. A cursory look at the details shows that in terms of the average household family income (FAMY), K-8 school districts tended to be the wealthiest districts with median household income of $82,088, followed by high school districts (Grades 9-12) with median household income of $80,360. In contrast, the K-12 school districts tended to the districts with the lowest average household income (median of $67,414), although this group also contained the district with the highest average family income ($158,888).

In terms of comparative per-pupil spending, the Grades 9 to 12 school districts have the highest median (9.43 in natural log terms). The groups with the lowest (not surprisingly) spending were the K-4 and the K-8 districts (medians of 9.25 and 9.27 respectively). At the same time, the average overall unweighted pass rate (TPASSR_1) on the relevant exams ranged from 82.32 percent for the K-12 school districts (in terms of median) to 90.90 percent for the Grade 9- 12 school districts. For illustrative purposes, we also include summary statistics for percentage pass rates (both "Regular Pass" and "Advanced Pass") on the Grade 4 NJ ASK4 tests, Grade 8 GEPA tests, and Grades 11-12 HSPA tests. As discussed in section 3.2, these pass rates are used to construct our weighted pass rate variable used in the estimation of Equations (4) and (5). Summary statistics for this variable, TPASS_2, are also shown in table 1. Because an "Advanced Pass" is weighted twice a "Regular Pass", values of TPASS_2 may exceed 100.0%.

Among the control variables, a result of interest is the percentage of total operating expenditures funded by sources other than local property taxes (NON_LOCAL) whose median value ranged from 21.5 percent for K-8 school districts to 42.5 percent for Grades 5 to 12 school districts. The maximum value for NON_LOCAL was 98.0 percent for the K-12 school districts, which includes the Abbott Districts.

Results of Estimation of the Cost Function

Equations (4) and (5) were estimated with lg_CCTOT and TPASSR_2 as the jointly endogenous variables. To evaluate whether OLS would have been appropriate without the need for joint estimation, Hausman specification tests were performed comparing OLS, 2SLS, and 3SLS. The results of these Hausman tests are disclosed in Table 2 for each type of school district- Kindergarten to Grade 4 (panel A), Kindergarten to Grade 8 (Panel B), Kindergarten to Grade 12 (Panel C), Grades 5-12 (Panel D) and Grades 9-12 (Panel E). In Panels A-C, 2SLS was found to be more consistent than either OLS or 3SLS. In order to be parsimonious, only the 2SLS results are reported.

Insert Table 2 here

To deal with heteroscedasticity, the standard errors and related t-values reported are derived using White's heteroscedasticity-consistent covariance matrix. Table 3 presents the results obtained using lg_CCTOT as the dependent variable, and Table 4 presents those with TPASSR_2 as the jointly-dependent variable.

Insert Table 3 here

The results in Table 3 are presented separately for each type of school district in panels A-E, respectively - K-4 (Type 1 districts), K-8 (Type 2 districts), K-12 (Type 3 districts), Grades 5 to 12 (Type 4 districts), and High School (Grades 9 to 12 – Type 5 districts). Since interest at this point is mostly in the signs and statistical significance of the coefficients, we present below a summary of this findings:

COS0T FUNCTION COEFFICIENTS

Variables	School District Type				
	Type 1 K-4	Type 2 K-8	Type 3 K-12	Type 4 G5-8	Type 5 G9-12
GEOCIE	+	+	+	+	+
NON_LOCAL	–	–	ns	+	–
FAMY	–	+	–	ns	–
SOM_COL	+	ns	+	–	ns
ENROLL	–	–	–	–	ns
ENROLL*SQR	+	+	+	+	ns
SP_ED	–	+	+	–	+
TMALE_ PCT	ns	+	ns	ns	ns
TBLK_ PCT	ns	ns	+	–	+
TASIA_ PCT	–	ns	ns	–	–
THSPC_PCT	ns	–	+	+	ns
ABBOTT			+		
TPASSR_2	–	–	+	+	+

As shown above, the Geographic Cost of Educational Index (GEOCIE) as calculated by the state is consistently significant and positive in all the school district types. This finding supports the inference that intra-state differences in the cost of living accounts for some of the cross- sectional differences in the average spending per pupil. In contrast, NON_LOCAL (the proportion of spending from non-local sources) has a negative coefficient only for Types 1, 2, and 5.[12] It is not significant for Type 3 school districts, and has a positive coefficient for Type 4 districts. Thus, it appears that local funding is associated with higher spending for autonomous elementary, middle school, and High School districts, but has no independent effect on the more common K-12 school districts.

Two socio-economic factors that are traditionally linked to higher student test score performance show mixed results in the estimated cost functions. Lg_FAMY (natural log of family income) is positively associated with higher per-pupil spending in the Type 2 school districts, negatively associated for the Types 1, 3 and 5 school districts, and is not significant in the Type 4 school districts. These results suggest that higher family incomes are associated with higher per pupil spending only in school districts catering to the youngest public school

[12] This result is consistent with the findings from Chalos (1997), who reports a positive relation between the proportion of school district budgets financed by local property taxes and costs.

children. In contrast, in school districts focused on older kids, higher family income is associated with less per-pupil spending. Conceivably, older kids from affluent families may depend less on the resources of the school district and more on parental resources, thus reducing the need for higher relative spending by the school district. Similarly, the proportion of the population in the school district with at least some college education (SOM_COLL) is positively associated with higher per-pupil spending in Type 1 and Type 3 school districts, negatively associated for Type 4 districts, and not significantly related to per-pupil spending in Type 2 and Type 5 districts.

With regard to the existence of possible economies and diseconomies of scale, the results are much more consistent. For all school district types except Type 5, there exists a U-shaped curve (negative coefficient for lg_ENROLL and a positive coefficient for lg_ENROLL*SQR) which suggests the existence of an optimal enrollment size within the range of observed school sizes for all school types. The sole exception of the High School districts (Type 5) suggests that enrollment size does not play a role in explaining cross-sectional differences in per-pupil spending there.

The demographic characteristics of the student population of the school districts have mixed effects on differences in per-pupil spending. The percentage of Males (MALE_PCT) is not significant in any school district type except for Type 2 where the coefficient is positive. The percentage of Blacks (TBLK_PCT) is not significant for Type 1 and 2, positive for Types 3 and 5, and negative for Type 4. The percentage of Asian (TASIA_PCT) is not significant for Types 2 and 3, and negative for Types 1, 4, and 5. Finally, for the percentage of Hispanics (THSPC_PCT), the coefficient(s) are not significant for Types 1 and 5, negative for Type 2, and positive for Types 3 and 4. Overall, the inconsistent signs make drawing any broad inferences difficult, except for ASIA_PCT where lower spending appears to be dominant. Consistent with prior expectations, the ABBOTT districts among the Type 3 districts have higher average per- pupil spending.

Finally, with regard to the potential effect of higher test score achievement on per-pupil spending, the evidence is mixed. School districts with higher test scores spend lower on a per-pupil basis in Type 1 and Type 2 school districts, but higher amounts in Types 3, 4, and 5 districts. The best interpretation of this finding is that, for school districts focused on educating younger children, higher test score achievement does not drive higher spending, whereas for the older students, the best performing schools do spend more. Creative educational approaches can lead to superior performance which can lead to reductions in per-pupil spending at the lower grade levels. At the upper grade levels, higher achievement does lead to additional spending.

Results of Estimation of the Test Outcome Function

As noted previously, Equations (4) and (5) were estimated simultaneously in order to control for possible simultaneity bias which was confirmed by the Hausman specification tests. Since the Hausman test also indicated that the 2SLS statistical technique results in the most consistent results (compared to OLS and 3SLS), the results of estimating the test outcome function are presented in Table 3 only for the 2SLS model.

Insert Table 4 here

To facilitate the discussions which follow, and also because our primary interest is in the signs of the coefficients of the explanatory variables (and their significance) at this stage, we present below a summary:

TEST OUTCOME FUNCTION COEFFICIENTS

Variables	School District Type				
	Type 1 K-4	Type 2 K-8	Type 3 K-12	Type 4 G5-8	Type 5 G9-12
NON_LOCAL	Ns	ns	ns	ns	-
FAMY	Ns	+	+	ns	+
SOM_COL	Ns	+	+	-	+
NO_HS	Ns	ns	+	-	-
OCCP_ST	Ns	+	ns	ns	ns
ENROLL	-	+	+	ns	+
ENROLL*SQR	+	-	-	ns	-
SP_ED	-	-	-	-	ns
STMOB	-	-	-	ns	-
ATTDR	Ns	+	+	+	+
TMALE_ PCT	Ns	ns	ns	ns	ns
TBLK_ PCT	Ns	-	-	ns	-
TASIA_ PCT	Ns	+	+	ns	+
THSPC_PCT	Ns	-	-	ns	-
ABBOTT			-		
CC_TOT	Ns	ns	ns	ns	-

To analyze the observed results, we focus on identifying the factors that explain the observed cross-sectional differences in test score performance by school district type. For Type 1 school districts, the only significant explanatory variables are the returns to scale (lg_ENROLL and lg_ENROLL*SQR), Special Education (SP_ED), and student mobility (STU_MOB).

Somewhat surprisingly, the returns to scale function observed here is U-shaped, implying that test scores of the smallest districts decline initially as the school district size increases, but subsequently rise as the district size increases. Not surprisingly, increases in SP_ED students exact a toll on average test score performance, as does increases in student mobility (STU_MOB).

For Type 2 school districts, Lg_FAMY, SOM_COL, occupational status (OCCP_ST), and attendance rates (ATTDR) are all positive influences on test score performance. On the other hand, STU_MOB and SP_ED are both negative influences on performance. Among the student demographic characteristics, BLK_PCT and HSPC_PCT are negative factors in explaining performance while ASIA_PCT has a positive effect. The effect of enrollment size on performance is the opposite of what was observed for the Type 1 school districts. Here, lg_ENROLL has a positive sign while its square has a negative sign, implying an inverted U-shape. Thus, the best performance in terms of test scores is observed among the medium–sized school districts and not at either extreme. It may be that as school enrollments increase, test scores for the smallest schools increase as schools take advantage of economies of scale in the production of education; but then test scores decrease after an inflection point on enrollments occurs. Per-pupil spending has no effect on test score performance in this type of school district or any other besides Type 5.

The results for the Type 3 school districts are very similar to those found in the Type 2 districts. The main differences are that OCCP_ST is not significant, and NO_HS (the percentage of households with no high school education) is now significant (but with an unexpected positive sign). The additional socio-economic variable, ABBOTT, is significant with its predicted negative sign.

Summarizing the Type 4 and Type 5 results, the variable NO_HS is now significant with its predicted negative sign in both regressions. In the Type 5 districts (Grades 9-12), Lg_ENROLL and Lg_ENROLL*SQR exhibit the same pattern as in the Type 2 and Type 3 districts, but neither variable is significant in the Type 4 districts. Likewise, three of the demographic variables (TBLK_ PCT, TASIA_ PCT and THSPC_PCT) are significant in the Type 5 districts and show the same signs as in the Type 2 and Type 3 districts, but are not significant in the Type 4 districts.

The Type 5 districts also show some results not found in the other districts. First, the variable NON_LOCAL (Proportion of school district funding from non-local sources) is significant with a negative sign, suggesting that as funding from nonlocal sources increase, achievement decreases. Also, the jointly dependent variable Lg_CCTOT is also negative, which is indicative of the mixed findings in the literature on the spending-test outcome relation.

Across all the school district types, the variables that show the most consistent positive signs are Lg_FAMY, SOM_COL, ENROLL, ATTDR, and ASIA_PCT. At the opposite end, the variables with predominantly negative coefficients are ENROLL*SQR, SP_ED, STMOB, BLK_PCT, and HSPC_PCT. All the other variables are either inconsistent across different school district types, or are predominantly not statistically significant.

Overview of Cost Efficiency and Test Outcome Effectiveness Measures

The results of applying the deterministic frontier estimation technique on a year-by-year basis to Equations (4) and (5) using the 2SLS approach are presented in Table 5A for the cost function, and 5B for the test outcome function.

Insert Tables 5A and 5B here

To facilitate the discussion, a summary of the means across the 11 years of the estimated minimum, median and maximum efficiencies by school district type are presented below:

COST EFFICIENCY MEASURES

School District Type	Min	Median	Max
Type 1: K- Grade 4	47.5%	70.4%	100.0%
Type 2: K- Grade 8	55.6%	73.7%	100.0%
Type 3: K- Grade 12	52.1%	77.4%	100.0%
Type 4: Grades 5-8	80.9%	90.2%	100.0%
Type 5: Grades 9-12	75.7%	85.9%	100.0%

OUTCOME EFFECTIVENESS MEASURES

School District Type	Min	Median	Max
Type 1: K- Grade 4	52.4%	75.7%	100.0%
Type 2: K- Grade 8	56.8%	80.4%	100.0%
Type 3: K- Grade 12	52.9%	83.0%	100.0%
Type 4: Grades 5-8	91.0%	95.1%	100.0%
Type 5: Grades 9-12	84.3%	92.6%	100.0%

As can be seen in this summary, with respect to the cost efficiency (EFFCY) measures, Type 4 school districts show the least amount of dispersion, with the minimum at 80.9 percent and the median at 90.2 percent. Note that the maximum is 100 percent by construction. At the other extreme, Type 1 school districts show the widest dispersion, with the range from a minimum of 47.5 percent and the median at 70.4 percent. This is followed by the Type 3 school districts (the most common type of school district – the K-12 districts) with a range from a minimum of 52.1 percent and a median of 77.4 percent.

A similar result is observed for the test outcome effectiveness measures. The Type 4 districts show the narrowest range from 91.0 percent minimum to a median of 95.1 percent and the maximum of 100 percent. Types 1 and 3 districts are at the other extreme, with respective minimums of 52.4 and 52.9 percent, and respective medians of 75.7 and 83.0 percent. Type 5 districts are closer to the Type 4 districts, with the average minimum effectiveness ratings of 84.3 percent and median of 92.6 percent. Type 2 school districts are intermediate between the Type 1 and Type 3 school districts in average effectiveness dispersion, with the minimum at 52.9 percent and the median at 80.4 percent.

The consistency in the relative rankings of the school district types with respect to cost efficiency measures and test outcome effectiveness measures might suggest some degree of correlation between the two measures. However, the simultaneous derivation of the two measures allow for their separate effects to be isolated, so it is not self-evident that they are necessarily highly correlated. To evaluate this empirically, the Pearson rank order correlations between the two measures by district type were computed. Below are the results:

School District Type	ρ (EFTV, EFFCY)
Type 1: K- Grade 4	-0.1777
Type 2: K- Grade 8	-0.3375
Type 3: K- Grade 12	0.0468
Type 4: Grades 5-8	-0.1261
Type 5: Grades 9-12	0.0150

The results above show a surprising degree of variations by school district type. The negative (and statistically significant) correlations between EFFCY and EFTV observed for Type 1, Type 2, and Type 4 school districts are in stark contrast to the positive but statistically insignificant correlations for the Type 3 and Type 5 districts. These results clearly do not support the presumption that school districts can be both efficient and effective. Clearly, some trade-off between these measures is the norm. The difficulty in defining the most effective actions that district administrators can take to improve both simultaneously is demonstrated by the fact that it appears that few if any school districts can achieve both.

Granger Causality Test of Relationships between EFFCY, EFTV, and Voting Results

Equations (6) to (8) were estimated using a Granger causality test approach to determine the direction of presumed causality between EFFCY, EFTV, and the voting results (measured as NO-VOTE). In order to determine the most appropriate estimation technique, the Hausman test was conducted to choose between OLS, 2SLS, and 3SLS. As disclosed in Panel B of Table 6, the results support the 2SLS technique as being most consistent. For comparability, the results of the OLS and 2SLS are reported in full, along with those obtained using the Generalized Method of Moments (GMM). The results of estimating the three equations are reported in Tables 6, 7, and 8.

Insert Tables 6, 7, and 8 here

2SLS Estimation Summary Results			
Current Year & Lagged Jointly Endogenous Variables	Current Year Variables		
	$EFFCY_{(t)}$	$EFTV_{(t)}$	$No\_Vote_{(t)}$
$EFFCY_{(t)}$	n/a	+	n/a
$EFFCY_{(t-1)}$	+	–	ns
$EFTV_{(t)}$	ns	n/a	n/a
$EFTV_{(t-1)}$	–	+	ns
$No\_Vote_{(t)}$	–	+	n/a
$No\_Vote_{(t-1)}$	ns	–	+

Key: + = Significant positive relationship.
– = Significant negative relationship.
ns = not significant.
n/a = not applicable.

Because Granger Causality tests rely on the relationships between the lagged variables of the jointly endogenous variables with their current counterparts, the results in these three tables are best evaluated by examining the summary findings below extracted from the three tables.

The 2SLS results in table 6 show that the lagged effectiveness rating ($EFTV_{(t-1)}$) is significantly related to the current year's efficiency rating ($EFFCY_{(t)}$). Likewise, table 7 shows that the lagged efficiency rating ($EFFCY_{(t-1)}$) is significantly related to the current year's effectiveness rating ($EFTV_{(t)}$). Both relationships have negative signs, suggesting a negative feedback loop where higher test scores in one period are followed in the subsequent year by more spending, and cost-cutting in one year has an adverse effect on test scores in the following year.

However, in terms of the contemporaneous relationship, $EFTV_{(t)}$ is not significantly related to $EFFCY_{(t)}$ when other factors are controlled for. In contrast, $EFFCY_{(t)}$ is a positive explanatory variable for $EFTV_{(t)}$, thus suggesting that the direction of influence or causality is from greater efficiency to greater effectiveness. In other words, more cost-efficient school districts also tend to be more test outcome-effective.

The relationship between $EFFCY_{(t)}$ and $No\_Vote_{(t)}$ is rather more complicated. Since the voting takes place in April and the budget for the school district takes effect from July of that calendar year, $EFFCY_{(t)}$ is observed well after the $No\_Vote_{(t)}$**.** Thus, while $No\_Vote_{(t)}$ can be a predictor of $EFFCY_{(t)}$, the converse is not valid. But taxpayers may condition their vote in April on the observed school district budget for which school ballot takes place (denoted here as $EFFCY_{(t-1)}$). The results thus show that $No\_Vote_{(t)}$ is significantly related to $EFFCY_{(t)}$, whereas the vote results from the previous year have no effect on $EFFCY_{(t)}$. At the same time, the observed cost efficiency in the school year in which the vote takes place ($year_{(t-1)}$) has no statistically significant effect on the voting outcome. Thus, taxpayers are not influenced in their voting by the contemporarily-observed relative cost efficiency of the school district. On the other hand, negative voting outcomes are based on the anticipated cost inefficiency included in the observed budget. Unfortunately, the corrective actions taken are not effective in curing the anticipated cost inefficiency.

Finally, the relationship between $EFTV_{(t)}$ and $No\_Vote_{(t)}$ is examined. $No\_Vote_{(t)}$ is positively related to $EFTV_{(t)}$ while $No\_Vote_{(t-1)}$ has a negative coefficient relative to $EFTV_{(t)}$. At the same time, $EFTV_{(t-1)}$ has no statistically significant relationship to $No\_Vote_{(t)}$. Taken together, these results suggest an interesting interplay where the current period's No_Vote (taken in April) appears able to motivate the school districts to improve test score performance in the year starting in July and ending in June of the following calendar year. However, the curative effect of the No_Vote appears to be short-lived since there is a partial reversal of the improvement in the test outcome effectiveness in the school year commending in the following calendar year (as noted from the negative coefficient for $No\_Vote_{(t-1)}$). In Table 7 (under 2SLS), the coefficients for $No\_Vote_{(t)}$ is 0.124 and that for $No\_Vote_{(t-1)}$ is -0.036. Thus, the contemporaneous positive effect of the negative vote is about three times that of the subsequent reversal that occurs the following calendar year. These results indicate that the improvements in test score performance remain positive on a cumulative basis.

5. Summary and conclusions

We set out in this study to examine whether balloting on school district budgets serve a useful social function. Presumably, negative votes may signal taxpayers' unhappiness with the proposed budget or dissatisfaction with expected student performance relative to proposed spending. Alternatively, it could be argued that the low voter turnout in school budget elections signals lack of interest on the part of taxpayers, and that those who vote are not fully informed about the potential benefits of the proposed budget.

Our results shows that, contrary to what may be a widespread impression, taxpayer balloting has a very salutary effect on school districts. Negative ballot outcomes have a net positive effect on improving test outcome effectiveness. The effect on cost efficiency is more limited. While taxpayers vote down a budget due to perceived cost inefficiencies, remedial action on the part of administrators is ineffective in curing these inefficiencies. Overall, the results show that actions or proposals to remove taxpayer oversight of local school district budgets are misguided because they will remove an important element of public accountability.

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TABLE 1
Summary Statistics of the Variables Used in the Study (Year = 2006)

	Panel A *Kindergarten to Grade 4 School Districts (n=48)*					*Panel B* *Kindergarten to Grade 8 School Districts (n=116)*				
Variable [1]	**Mean**	**Std. Dev.**	**Min.**	**Median**	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Median**	**Max.**
Lg_CCTOT	9.27	0.19	8.99	9.25	9.86	9.27	0.13	8.94	9.27	9.69
GEOCEI	0.95	0.04	0.90	0.94	1.09	1.00	0.06	0.85	0.99	1.11
NON_LOCAL	33.31	18.87	6.00	36.00	91.00	26.81	17.69	2.00	21.50	77.00
Lg_ENROLL	6.07	0.83	4.62	5.88	7.83	6.82	0.83	4.80	6.75	8.97
SP_ED	2.90	3.16	0.00	2.25	11.43	2.81	2.21	0.00	2.35	11.11
STMOB	11.53	10.21	0.00	8.45	49.00	7.61	5.62	0.00	6.73	24.90
ATTDR	5.19	1.08	1.40	5.50	6.60	5.66	0.80	1.77	5.75	7.70
FAMY	70,180	23,375	27,662	71,649	174,043	83,471	24,302	40,068	82,088	150,189
SOM_COLL	52.85	12.41	28.56	53.05	87.37	60.40	13.99	29.63	62.57	86.31
TPASSR_1	86.36	8.00	66.90	87.67	98.57	85.97	8.37	55.35	88.48	97.88
TPASSR_2	112.84	16.79	77.10	114.80	144.47	112.04	16.50	64.93	114.84	149.92
TMALE_PCT	51.50	5.43	42.59	50.15	69.07	51.37	3.65	43.45	51.32	62.34
TBLCK_PCT	0.97	3.58	0.00	0.00	19.60	3.70	8.39	0.00	0.00	40.71
TASIA_PCT	1.08	4.59	0.00	0.00	27.27	3.80	7.69	0.00	0.00	37.50
THSPC_PCT	0.48	1.80	0.00	0.00	9.68	4.46	11.48	0.00	0.00	62.96
EPASS_1	59.88	5.33	46.83	60.87	69.00	59.01	6.00	40.10	59.57	77.80
EPASS_2	26.48	9.55	8.90	25.33	48.67	28.87	9.41	5.57	29.43	56.70
GPASS_1	-	-	-	-	-	60.80	5.83	43.60	61.67	71.90
GPASS_2	-	-	-	-	-	23.27	9.66	4.13	24.70	47.37
HPASS_1	-	-	-	-	-	-	-	-	-	-
HPASS_2	-	-	-	-	-	-	-	-	-	-

TABLE 1 (*Continued*)

	Panel C ***Kindergarten to Grade 12 School Districts (n=217)***					***Panel D*** ***Grades 5-12 School Districts (n=16)***				
Variable	**Mean**	**Std. Dev.**	**Min.**	**Median**	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Median**	**Max.**
Lg_CCTOT	9.33	0.16	8.99	9.30	9.99	9.37	0.18	9.11	9.37	9.90
GEOCEI	1.04	0.06	0.90	1.05	1.13	0.98	0.04	0.94	0.97	1.10
NON_LOCAL	38.39	26.02	5.00	32.00	98.00	36.00	17.11	7.00	42.50	62.00
Lg_ENROLL	8.14	0.73	6.74	8.12	10.61	7.30	0.59	5.80	7.51	8.17
SP_ED	3.49	2.40	0.00	3.04	16.12	1.56	1.56	0.00	0.85	4.32
STMOB	11.32	7.07	0.00	9.77	39.50	5.79	3.77	0.30	5.13	13.70
ATTDR	4.90	1.22	0.56	5.16	7.18	3.67	1.71	-0.75	3.93	6.10
FAMY	70,914	23,291	24,612	67,414	158,888	67,942	17,075	42,248	68,194	109,477
SOM_COLL	54.05	15.52	22.40	52.66	88.56	51.27	10.83	32.76	52.47	72.34
TPASSR_1	78.51	13.47	34.51	82.32	97.36	81.86	6.34	66.03	82.41	90.69
TPASSR_2	99.85	23.55	36.97	102.51	141.70	102.08	12.10	77.07	104.31	125.23
TMALE_PCT	51.26	1.98	43.92	51.18	58.80	51.98	2.63	48.58	50.99	59.39
TBLCK_PCT	14.47	21.19	0.00	4.71	95.06	3.21	4.81	-	-	12.47
TASIA_PCT	6.30	8.82	0.00	2.16	45.12	1.40	3.57	-	-	13.72
THSPC_PCT	15.41	19.41	0.00	7.71	94.54	2.12	2.20	-	1.99	5.53
EPASS_1	58.21	5.06	42.90	58.77	70.07	-	-	-	-	-
EPASS_2	24.17	9.85	3.70	24.07	47.63	-	-	-	-	-
GPASS_1	56.73	9.22	23.23	59.40	71.20	61.84	3.82	54.10	62.72	69.97
GPASS_2	16.44	10.11	0.57	15.73	42.53	16.28	5.67	9.67	15.37	28.63
HPASS_1	56.58	8.86	28.65	58.55	71.75	61.44	5.31	52.10	61.60	70.90
HPASS_2	23.40	14.18	0.90	20.80	60.55	24.16	8.12	11.20	25.68	40.45

TABLE 1 (*Continued*)

Panel E
Grades 9-12 School Districts (n=31)

Variable	Mean	Std. Dev.	Min.	Median	Max.
Lg_CCTOT	9.43	0.14	9.09	9.43	9.65
GEOCEI	1.02	0.05	0.91	1.01	1.12
NON_LOCAL	26.97	16.28	3.00	27.00	56.00
Lg_ENROLL	7.45	0.68	6.31	7.32	9.34
SP_ED	1.21	1.25	0.00	0.89	5.08
STMOB	6.92	5.70	0.00	5.30	24.90
ATTDR	4.91	1.73	1.70	5.00	9.50
FAMY	82,852	22,234	50,402	80,360	128,192
SOM_COLL	60.38	12.68	35.09	63.09	83.93
TPASSR_1	88.03	6.46	70.45	90.90	95.40
TPASSR_2	118.48	16.90	81.20	120.20	144.10
TMALE_PCT	50.83	3.17	45.95	50.00	57.89
TBLCK_PCT	5.33	7.90	-	-	25.39
TASIA_PCT	4.93	6.46	-	2.56	30.57
THSPC_PCT	6.23	8.36	-	3.88	43.62
EPASS_1	-	-	-	-	-
EPASS_2	-	-	-	-	-
GPASS_1	-	-	-	-	-
GPASS_2	-	-	-	-	-
HPASS_1	57.58	5.76	45.60	59.70	65.35
HPASS_2	30.45	10.85	10.75	30.30	49.25

[1] All variables are defined in the Appendix.

TABLE 2
Estimating the Cost and Production Function as a System of Simultaneous Equations: Hausman's Specification Test Results [1,2]

Panel A: Kindergarten to Grade 4 School Districts

Efficient under HO	Consistent under H1	DF	m-statistic	P < Chi-Square
OLS	2SLS	45	14.6	1.0000
OLS	3SLS	47	133.2	0.0001
3SLS	2SLS	47	-153.0	.

Interpretation: 2SLS is the preferred model

Panel B: Kindergarten to Grade 8 School Districts

Efficient under HO	Consistent under H1	DF	m-statistic	P < Chi-Square
OLS	2SLS	45	17.6	0.9999
OLS	3SLS	47	182.0	0.0001
3SLS	2SLS	47	-253.0	.

Interpretation: 2SLS is the preferred model

Panel C: Kindergarten to Grade 12 School Districts

Efficient under HO	Consistent under H1	DF	m-statistic	P < Chi-Square
OLS	2SLS	43	17.15	0.9999
OLS	3SLS	47	-37.2	.
3SLS	2SLS	49	-154.0	.

Interpretation: 2SLS is the preferred model

Panel D: Grades 5-12 School Districts

Efficient under HO	Consistent under H1	DF	m-statistic	P < Chi-Square
OLS	2SLS	44	-131.0	.
OLS	3SLS	46	256.3	0.0001
3SLS	2SLS	46	37.7	0.8033

Interpretation: 3SLS is the preferred model

Panel E: Grades 9-12 School Districts

Efficient under HO	Consistent under H1	DF	m-statistic	P < Chi-Square
OLS	2SLS	46	16.91	1.0000
OLS	3SLS	47	75.09	0.0057
3SLS	2SLS	47	2865	0.0001

Interpretation: 3SLS is the preferred model

[1] Table 2 reports the results of Hausman specification tests comparing OLS, 2SLS, and 3SLS in the joint estimation of Equations
(4) and (5), by each type of school district, with lg_CCTOT and TPASSR_2 as the jointly endogenous variables.
[2] All variables are defined in the Appendix.

TABLE 3
Results of Estimating the Cost Function as a System of Simultaneous Equations with the Production Function
(Dependent Variable = LG_CCTOT)

	Panel A *K-4 School Districts*			*Panel B* *K-8 School Districts*			*Panel C* *K-12 School Districts*		
Variable [1]	Coefficient	t-value	Sig. level[2]	Coefficient	t-value	Sig. level	Coefficient	t-value	Sig. level
INTERCEPT	14.635	15.88	***	7.750	15.78	***	12.828	28.28	***
YR03	0.031	0.79		0.037	2.33	*	0.063	6.03	***
YR04	0.127	3.48	***	0.119	7.41	***	0.082	7.21	***
YR05	0.256	5.48	***	0.209	12.72	***	0.112	6.70	***
YR06	0.357	6.83	***	0.285	13.45	***	0.133	5.97	***
YR07	0.476	5.95	***	0.382	12.66	***	0.169	7.27	***
YR08	0.395	8.4	***	0.375	18.45	***	0.251	14.58	***
YR09	0.506	10.2	***	0.488	17.01	***	0.277	11.47	***
YR10	0.547	9.64	***	0.524	15.73	***	0.262	8.69	***
YR11	0.559	8.86	***	0.508	14.83	***	0.232	6.96	***
GEOCEI	0.856	2.63	**	0.803	7.21	***	0.162	2.55	*
NON_LOCAL	-0.002	-1.87	&	-0.001	-3.56	***	0.000	-0.45	
Lg_FAMY	-0.198	-2.66	**	0.222	4.64	***	-0.243	-6.59	***
SOM_COLL	0.008	4.81	***	0.001	1.47		0.003	2.26	*
ENROLL	-1.070	-4.43	***	-0.340	-5.20	***	-0.450	-6.57	***
ENROLL*SQ	0.076	4.04	***	0.019	4.31	***	0.023	5.81	***
SP_ED	-0.011	-3.39	***	0.003	2.10	*	0.009	7.08	***
TMALE_PCT	-0.001	-0.76		0.002	1.66	&	0.000	0.05	
TBLCK_PCT	0.000	-0.17		-0.001	-1.41		0.004	5.14	***
TASIA_PCT	-0.009	-4.11	***	0.000	0.62		0.000	-1.03	
THSPC_PCT	-0.001	-0.23		-0.003	-4.74	***	0.002	4.53	***
ABBOTT							0.297	20.73	***
TPASSR_2	-0.009	-2.94	**	-0.007	-3.82	***	0.007	3.78	***
Adjusted R-Square =	0.67			0.66			0.72		
Number observations =	486			1177			2177		

TABLE 3 (*Continued*)

	Panel D ***Grades 5-12 School Districts***			***Panel E*** ***Grades 9-12 School Districts***		
Variable	Coefficient	t-value	Sig. level	Coefficient	t-value	Sig. level
INTERCEPT	13.379	10.90	***	15.244	7.20	***
YR03	0.032	1.28		0.075	1.81	&
YR04	0.061	2.19	*	-0.042	-0.96	
YR05	0.072	2.36	*	-0.138	-1.89	&
YR06	0.108	3.04	**	-0.116	-1.54	
YR07	0.177	6.04	***	0.151	3.86	***
YR08	0.193	4.70	***	0.154	3.66	***
YR09	0.246	6.02	***	0.219	5.18	***
YR10	0.246	4.73	***	0.127	1.95	&
YR11	0.215	3.79	***	0.026	0.35	
GEOCEI	2.839	4.71	***	1.927	5.39	***
NON_LOCAL	0.002	1.84	&	-0.003	-3.22	**
Lg_FAMY	0.095	0.86		-0.712	-3.58	***
SOM_COLL	-0.011	-3.90	***	-0.005	-1.31	
ENROLL	-1.994	-6.58	***	-0.336	-1.01	
ENROLL*SQ	0.124	6.04	***	0.014	0.67	
SP_ED	-0.007	-3.12	**	0.006	2.08	*
TMALE_PCT	-0.002	-0.85		0.000	0.13	
TBLCK_PCT	-0.007	-3.45	***	0.011	2.62	**
TASIA_PCT	-0.007	-2.25	*	-0.010	-4.13	***
THSPC_PCT	0.016	3.84	***	0.002	0.59	
ABBOTT						
TPASSR_2	0.006	1.99	*	0.021	3.52	***
	Adjusted R-Square	=	0.80	Adjusted R-Square	=	0.51
	Number observations	=	160	Number observations	=	310

[1] All variables are defined in the Appendix.
[2] & = significant at 0.10, * = significant at 0.05, ** = significant at 0.01, *** = significant at 0.001 (all two-tailed tests).

TABLE 4
Results of Estimating the Production Function as a System of Simultaneous Equations with the Cost Function
(Dependent Variable = TPASSR_2)

	Panel A			*Panel B*			*Panel C*		
	K-4 School Districts			*K-8 School Districts*			*K-12 School Districts*		
Variable [1]	Coefficient	t-value	Sig. level[2]	Coefficient	t-value	Sig. level	Coefficient	t-value	Sig. level
Intercept	512.329	1.68	&	-182.168	-2.10	*	-516.731	-2.26	*
YR03	-3.561	-1.18		-3.954	-3.41	***	-3.649	-3.11	**
YR04	1.340	0.33		-1.456	-0.88		-0.117	-0.05	
YR05	12.557	2.79	**	1.215	0.58		2.073	0.63	
YR06	18.864	3.41	***	4.503	1.76	&	4.184	0.99	
YR07	29.027	4.73	***	10.359	3.35	***	3.505	0.69	
YR08	12.113	1.39		1.004	0.28		-2.334	-0.38	
YR09	19.698	2.21	*	7.470	1.77	&	0.331	0.05	
YR10	23.082	2.46	*	10.002	2.21	*	3.622	0.48	
YR11	25.417	2.81	**	10.711	2.54	*	5.705	0.80	
NON_LOCAL	-0.076	-1.03		0.005	0.14		0.002	0.08	
Lg_FAMY	-5.932	-0.67		7.766	2.11	*	15.258	5.86	***
SOM_COLL	0.170	0.32		0.241	2.36	*	0.448	2.32	*
NO_HS	-0.256	-0.57		0.037	0.23		0.414	3.07	**
OCCP_ST	7.001	1.19		5.925	4.62	***	1.437	1.15	
ENROLL	-66.331	-4.78	***	13.959	2.42	*	27.156	2.96	**
ENROLL*SQ	4.976	4.71	***	-0.950	-2.50	*	-1.441	-2.89	**
SP_ED	-0.845	-3.76	***	-0.359	-2.86	**	-0.566	-3.50	***
STMOB	-0.316	-2.30	*	-0.363	-3.69	***	-0.179	-3.15	**
ATTDR	0.313	0.74		0.133	2.21	*	0.201	1.83	&
TMALE_PCT	-0.052	-0.54		0.050	0.68		0.040	0.48	
TBLCK_PCT	0.036	0.24		-0.365	-6.63	***	-0.495	-20.56	***
TASIA_PCT	-0.180	-0.85		0.257	8.23	***	0.059	3.03	**
THSPC_PCT	-0.289	-1.05		-0.232	-5.08	***	-0.273	-12.91	***
ABBOTT							-13.755	-2.52	*
Lg_CCTOT	-19.294	-0.85		10.443	1.03		31.213	1.59	

Adjusted R-Square	=	0.51	Adjusted R-Square	=	0.79	Adjusted R-Square	=	0.92
Number observations	=	486	Number observations	=	1177	Number observations	=	2177

TABLE 4 (*Continued*)

	Panel D *Grades 5-12 School Districts*			*Panel E* *Grades 9-12 School Districts*		
Variable [1]	Coefficient	t-value	Sig. level	Coefficient	t-value	Sig. level
Intercept	158.330	0.72		38.802	0.36	
YR03	-2.082	-0.80		-1.315	-0.91	
YR04	1.767	0.73		5.917	4.02	***
YR05	7.023	2.26	*	12.191	7.98	***
YR06	10.516	2.64	**	12.263	7.05	***
YR07	9.437	1.82	&	3.028	1.63	
YR08	14.003	2.06	*	5.206	2.49	*
YR09	17.296	1.96	&	6.636	2.59	*
YR10	21.638	2.26	*	13.554	4.55	***
YR11	22.339	2.56	*	15.737	6.26	***
NON_LOCAL	-0.391	-1.44		-0.136	-1.70	&
Lg_FAMY	29.466	0.99		10.677	1.83	&
SOM_COLL	-0.815	-2.73	**	0.432	2.52	*
NO_HS	-1.385	-3.08	**	-0.575	-1.71	&
OCCP_ST	-1.209	-0.08		-1.619	-0.77	
ENROLL	18.559	0.68		39.777	4.56	***
ENROLL*SQ	-1.316	-0.76		-2.517	-4.52	***
SP_ED	-0.493	-1.70	&	-0.163	-1.42	
STMOB	-0.073	-0.39		-0.136	-2.74	**
ATTDR1	2.076	3.88	***	1.098	4.20	***
TMALE_PCT	-0.087	-0.44		-0.117	-0.91	
TBLCK_PCT	-0.112	-0.63		-0.400	-3.50	***
TASIA_PCT	0.244	1.08		0.307	6.54	***
THSPC_PCT	-0.099	-0.36		-0.251	-2.97	**
ABBOTT						
Lg_CCTOT	-40.225	-1.13		-22.208	-2.22	*
Adjusted R-Square =	0.66			Adjusted R-Square = 0.89		
Number observations =	160			Number observations = 310		

[1] All variables are defined in the appendix.
[2] & = significant at 0.10, * = significant at 0.05, ** = significant at 0.01, *** = significant at 0.001 (all two-tailed tests).

TABLE 5A
Summary of Cost Efficiency (EFFCY) Measures by Year and School District Type [1]

	Panel A: Kindergarten to Grade 4 School Districts (n=47)					*Panel B: Kindergarten to Grade 8 School Districts (n=116)*				
Year	**Mean**	**Std. Dev.**	**Min.**	**Median**	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Median**	**Max.**
2002	67.8%	9.6%	49.5%	67.7%	100.0%	70.3%	7.1%	58.4%	69.3%	100.0%
2003	71.1%	9.0%	48.9%	71.1%	100.0%	71.3%	7.8%	56.0%	70.8%	100.0%
2004	67.2%	8.6%	43.1%	66.9%	100.0%	79.8%	8.9%	61.7%	78.6%	100.0%
2005	78.9%	10.4%	47.4%	77.6%	100.0%	79.1%	9.3%	57.9%	78.2%	100.0%
2006	71.2%	11.0%	49.4%	70.5%	100.0%	75.9%	9.3%	57.0%	76.5%	100.0%
2007	77.7%	9.6%	51.4%	78.2%	100.0%	72.4%	9.6%	53.3%	70.1%	100.0%
2008	52.5%	15.7%	25.5%	51.0%	100.0%	68.9%	10.9%	46.5%	68.0%	100.0%
2009	69.6%	12.1%	48.1%	68.2%	100.0%	79.2%	8.1%	57.0%	78.9%	100.0%
2010	76.5%	11.4%	58.7%	75.0%	100.0%	74.3%	9.0%	57.3%	73.8%	100.0%
2011	78.7%	10.7%	52.7%	77.7%	100.0%	73.6%	9.9%	51.0%	72.9%	100.0%
	71.1%	**10.8%**	**47.5%**	**70.4%**	**100.0%**	**74.5%**	**9.0%**	**55.6%**	**73.7%**	**100.0%**

TABLE 5B
Summary of Test Outcome Effectiveness (EFFTV) Measures by Year and School District Type [2]

	Panel A: Kindergarten to Grade 4 School Districts (n=47)					*Panel B: Kindergarten to Grade 8 School Districts (n=116)*				
Year	**Mean**	**Std. Dev.**	**Min.**	**Median**	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Median**	**Max.**
2002	74.1%	9.3%	48.3%	73.9%	100.0%	76.3%	7.1%	54.4%	77.7%	100.0%
2003	64.8%	10.5%	43.4%	64.6%	100.0%	86.6%	6.0%	72.3%	86.7%	100.0%
2004	68.7%	12.1%	44.9%	67.6%	100.0%	73.7%	8.0%	40.1%	74.4%	100.0%
2005	71.1%	11.8%	42.2%	71.0%	100.0%	76.0%	6.3%	52.7%	77.2%	100.0%
2006	77.8%	9.4%	54.5%	77.7%	100.0%	80.3%	7.0%	58.5%	80.6%	100.0%
2007	86.5%	6.3%	70.4%	86.2%	100.0%	87.6%	5.5%	68.9%	88.1%	100.0%
2008	73.7%	12.4%	48.1%	72.0%	100.0%	79.2%	7.9%	52.5%	78.7%	100.0%
2009	84.3%	8.5%	57.6%	84.8%	100.0%	77.7%	6.5%	52.6%	78.0%	100.0%
2010	77.9%	8.7%	57.8%	79.1%	100.0%	80.2%	7.6%	55.4%	81.1%	100.0%
2011	79.1%	9.1%	57.1%	79.8%	100.0%	80.2%	6.9%	61.1%	81.1%	100.0%
	75.8%	**9.8%**	**52.4%**	**75.7%**	**100.0%**	**79.8%**	**6.9%**	**56.8%**	**80.4%**	**100.0%**

TABLE 5A (*Continued*)

	Panel C: Kindergarten to Grade 12 School Districts (n=217)					Panel D: Grades 5-12 School Districts (n=16)				
Year	**Mean**	**Std. Dev.**	**Min.**	**Median**	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Median**	**Max.**
2002	80.3%	7.8%	58.5%	79.9%	100.0%	95.7%	2.0%	91.5%	95.9%	100.0%
2003	77.9%	7.4%	55.5%	77.5%	100.0%	93.0%	3.0%	88.3%	93.3%	100.0%
2004	78.3%	7.7%	48.2%	78.0%	100.0%	86.2%	5.9%	76.9%	86.6%	100.0%
2005	78.1%	7.9%	50.6%	78.2%	100.0%	93.9%	4.6%	84.1%	95.5%	100.0%
2006	70.7%	6.9%	48.1%	70.8%	100.0%	86.3%	6.8%	72.3%	84.6%	100.0%
2007	80.5%	8.1%	53.5%	80.7%	100.0%	91.0%	4.6%	81.4%	92.1%	100.0%
2008	69.8%	8.6%	44.9%	69.4%	100.0%	89.2%	5.7%	77.5%	90.5%	100.0%
2009	79.7%	8.0%	54.9%	80.0%	100.0%	89.5%	6.8%	78.7%	88.9%	100.0%
2010	83.3%	7.8%	56.2%	83.4%	100.0%	88.3%	5.9%	79.3%	88.1%	100.0%
2011	76.3%	8.6%	50.8%	76.2%	100.0%	88.1%	6.2%	78.8%	86.1%	100.0%
	77.5%	**7.9%**	**52.1%**	**77.4%**	**100.0%**	**90.1%**	**5.2%**	**80.9%**	**90.2%**	**100.0%**

TABLE 5B (*Continued*)

	Panel C: Kindergarten to Grade 12 School Districts (n=217)					Panel D: Grades 5-12 School Districts (n=16)				
Year	**Mean**	**Std. Dev.**	**Min.**	**Median**	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Median**	**Max.**
2002	86.6%	6.9%	59.8%	87.3%	100.0%	91.1%	4.5%	82.9%	91.4%	100.0%
2003	86.8%	6.9%	65.2%	87.8%	100.0%	98.7%	0.9%	96.4%	98.8%	100.0%
2004	81.6%	7.1%	55.4%	82.7%	100.0%	96.2%	2.0%	91.8%	96.2%	100.0%
2005	83.8%	7.3%	57.8%	85.0%	100.0%	98.2%	0.7%	97.2%	98.2%	100.0%
2006	84.7%	6.7%	56.1%	85.6%	100.0%	99.8%	0.1%	99.6%	99.8%	100.0%
2007	82.4%	7.1%	50.1%	83.5%	100.0%	96.3%	1.9%	91.9%	96.7%	100.0%
2008	77.0%	8.3%	44.3%	77.7%	100.0%	91.3%	3.6%	84.5%	90.7%	100.0%
2009	76.9%	7.0%	45.1%	78.3%	100.0%	80.2%	7.8%	67.9%	80.5%	100.0%
2010	79.5%	7.0%	46.8%	80.3%	100.0%	100.0%	0.0%	99.9%	100.0%	100.0%
2011	81.0%	7.2%	48.9%	81.8%	100.0%	99.1%	0.4%	98.3%	99.2%	100.0%
	82.0%	**7.2%**	**52.9%**	**83.0%**	**100.0%**	**95.1%**	**2.2%**	**91.0%**	**95.1%**	**100.0%**

TABLE 5A (*Continued*)

Panel E: Grades 9-12 School Districts (n=31)

Year	Mean	Std. Dev.	Min.	Median	Max.
2002	81.8%	6.5%	69.5%	80.7%	100.0%
2003	87.4%	5.7%	74.4%	86.5%	100.0%
2004	88.6%	4.7%	80.1%	87.5%	100.0%
2005	84.3%	6.0%	77.1%	83.4%	100.0%
2006	88.9%	5.5%	77.9%	89.0%	100.0%
2007	89.8%	4.6%	81.0%	88.9%	100.0%
2008	88.6%	5.3%	78.9%	87.8%	100.0%
2009	85.0%	5.6%	73.5%	83.8%	100.0%
2010	83.0%	6.6%	72.3%	83.9%	100.0%
2011	86.9%	6.7%	72.2%	87.1%	100.0%
	86.4%	**5.7%**	**75.7%**	**85.9%**	**100.0%**

TABLE 5B (*Continued*)

Panel E: Grades 9-12 School Districts (n=31)

Year	Mean	Std. Dev.	Min.	Median	Max.
2002	90.4%	5.2%	78.1%	90.1%	100.0%
2003	92.4%	3.6%	85.1%	93.0%	100.0%
2004	94.3%	3.8%	86.9%	94.8%	100.0%
2005	95.7%	2.8%	89.2%	95.5%	100.0%
2006	92.8%	3.8%	84.8%	92.9%	100.0%
2007	91.5%	3.9%	83.0%	91.8%	100.0%
2008	91.2%	3.4%	84.6%	91.4%	100.0%
2009	92.2%	3.7%	85.2%	92.6%	100.0%
2010	93.7%	3.4%	85.7%	93.9%	100.0%
2011	89.9%	3.8%	80.9%	89.6%	100.0%
	92.4%	**3.7%**	**84.3%**	**92.6%**	**100.0%**

[1] EFFCY = Cost Efficiency score derived from estimation of Equation (4).
[2] EFTV = Test outcome effectiveness score derived from estimation of Equation (5)

TABLE 6
Results of Estimating Simultaneous Equations Model: Cost Efficiency as a Function of Test Outcome Effectiveness and Voting Outcomes
(Dependent Variable = $EFFCY_t$)

Panel A: Regression Results

	OLS Estimation			2SLS Estimation			GMM Estimatio ı		
Independent Variable [1]	Coefficient	t-value	Sig. Level[2]	Coefficient	t-value	Sig. Level	Coefficient	t-value	Sig. Level
INTERCEPT	2.498	27.01	***	2.465	19.32	***	2.569	18.03	***
TYPE1	-0.058	-7.93	***	-0.058	-7.20	***	-0.063	-7.74	***
TYPE2	-0.025	-8.33	***	-0.024	-7.15	***	-0.027	-7.13	***
TYPE4	0.142	20.71	***	0.122	11.58	***	0.125	10.25	***
TYPE5	0.126	24.62	***	0.113	13.61	***	0.117	12.55	***
$EFFCY_{t-1}$	0.292	17.29	***	0.297	16.35	***	0.290	13.44	***
$EFTV_t$	-0.173	-7.50	***	0.034	0.45		0.001	0.01	
$EFTV_{t-1}$	-0.083	-4.17	***	-0.174	-4.95	***	-0.176	-5.04	***
NO_VOTE_t	0.005	1.70	&	-0.055	-2.78	**	-0.080	-4.01	***
NO_VOTE_{t-1}	-0.018	-6.01	***	0.000	0.01		0.006	1.00	
GEOCEI	0.079	3.16	**	0.030	1.08		0.019	0.63	
Lg_CCTOT	-0.195	-22.42	***	-0.195	-19.00	***	-0.200	-17.19	***
Adjusted R-Square		0.427			0.340			0.275	

Panel B: Hausman's Specification Test Results

Efficient under HO	Consistent under H1	DF	m-statistic	P < Chi-Square
OLS	2SLS	28	96.83	<.0001
OLS	3SLS	38	-3,307.00	.
3SLS	2SLS	38	-28.40	.

Interpretation: 2SLS is the preferred model

[1] All variables are defined in the Appendix.
[2] & = significant at 0.10, * = significant at 0.05, ** = significant at 0.01, *** = significant at 0.001 (all two-tailed tests).

TABLE 7
Results of Estimating Simultaneous Equations Model: Test Outcome Effectiveness as a Function of Cost Efficiency and Voting Outcomes
(Dependent Variable = $EFTV_t$)

	OLS Estimation			2SLS Estimation			GMM Estimatio ı		
Independent Variable [1]	Coefficient	t-value	Sig. Level[2]	Coefficient	t-value	Sig. Level	Coefficient	t-value	Sig. Level
INTERCEPT	0.487	14.26	***	0.323	6.82	***	0.398	8.33	***
TYPE1	-0.043	-6.81	***	-0.024	-3.25	***	-0.032	-4.26	***
TYPE2	-0.021	-7.25	***	-0.021	-4.98	***	-0.020	-4.79	***
TYPE4	0.113	14.83	****	0.092	8.88	***	0.098	10.01	***
TYPE5	0.079	20.04	***	0.054	7.75	***	0.062	8.60	***
$EFFCY_t$	-0.104	-5.98	***	0.154	2.71	**	0.065	1.15	
$EFFCY_{t-1}$	0.024	1.46		-0.088	-2.99	**	-0.066	-2.27	*
$EFTV_{t-1}$	0.323	15.50	***	0.355	14.33	***	0.325	11.70	***
NO_VOTE_t	0.006	2.33	*	0.124	3.81	***	0.137	4.16	***
NO_VOTE_{t-1}	-0.005	-1.98	*	-0.036	-3.85	***	-0.043	-4.58	***
FAMY	0.000	1.40		0.000	2.24	**	0.000	1.41	
SOM_COLL	0.000	-0.47		0.001	1.65	&	0.000	1.30	
OCCP_ST	0.018	3.27	***	0.007	1.01		0.014	2.04	*
STMOB	0.000	-1.46		0.000	0.00		-0.001	-1.98	*
ATTDR	0.001	1.00		0.002	1.39		-0.001	-0.81	
Adjusted R-Square		0.413			0.013			-0.038	

[1] All variables are defined in the Appendix.
[2] & = significant at 0.10, * = significant at 0.05, ** = significant at 0.01, *** = significant at 0.001 (all two-tailed tests).

TABLE 8
Results of Estimating Simultaneous Equations Model: Voting Outcomes as a Function of Cost Efficiency and Test Outcome Effectiveness
(Dependent Variable = Vote Outcome: No Vote = 1; Yes Vote = 0)

	OLS Estimation			**2SLS Estimation**			**GMM Estimatio ı**		
Independent Variable [1]	Coefficient	t-value	Sig. Level[2]	Coefficient	t-value	Sig. Level	Coefficient	t-value	Sig. Level
INTERCEPT	2.360	4.49	***	2.360	4.49	***	2.179	4.24	***
TYPE1	-0.080	-3.20	**	-0.080	-3.20	**	-0.092	-3.77	***
TYPE2	0.011	0.58		0.011	0.58		0.002	0.10	
TYPE4	0.039	0.88		0.039	0.88		0.043	0.92	
TYPE5	0.084	2.47	*	0.084	2.47	*	0.088	2.51	*
$EFFCY_{t-1}$	-0.058	-0.67		-0.058	-0.67		-0.046	-0.55	
$EFTV_{t-1}$	-0.058	-0.62		-0.058	-0.62		-0.120	-1.30	
NO_VOTE_{t-1}	0.264	15.56	***	0.264	15.56	***	0.252	13.79	***
OCCP_ST	-0.066	-6.69	***	-0.066	-6.69	***	-0.072	-7.22	***
Lg_CCTOT	-0.167	-3.28	**	-0.167	-3.28	**	-0.138	-2.71	**
ΔLg_CCTOT	0.094	1.47		0.094	1.47		-0.052	-1.01	
ΔLOCAL	0.003	3.78	***	0.003	3.78	***	0.003	4.33	***
Adjusted R-Square		0.100			0.100			0.098	

[1] All variables are defined in the Appendix.
[2] & = significant at 0.10, * = significant at 0.05, ** = significant at 0.01, *** = significant at 0.001 (all two-tailed tests).

APPENDIX
List of Variables Used in the Study

Variable		Definition
Lg_CCTOT	=	Comparative cost per pupil (expressed in natural logarithm).
ΔLg_CCTOT$_t$	=	Lg_CCTOT$_t$ - Lg_CCTOT$_{t-1.}$
TPASSR_1	=	Total unweighted pass rate, computed as follows: [Σ [TEST_P$_k$ + TEST_AP$_k$)]] /[Σ NTEST$_k$], where k = Grades 4, 7, and 12 standardized tests.
TPASSR_2	=	Weighted total pass rate, computed as follows: [Σ [TEST_P$_k$ + (2.0 * TEST_AP$_k$)]] /[Σ NTEST$_k$], where k = Grades 4, 7, and 12 standardized tests.
TEST_P$_k$	=	"Regular" pass rate on TEST$_k$ weighted by number of students who took the test.
TEST_AP$_k$	=	"Advanced Pass" rate on TEST$_k$ weighted by number of students who took the test.
NTEST$_k$	=	Number of students who took TEST k.
GEOCEI	=	Geographic cost of education index.
NON_LOCAL	=	Proportion of school district funding from non-local sources.
ΔLOCAL$_t$	=	Change in the percentage of the school district spending from local sources.
Lg_ENROLL	=	Total student enrollment (expressed in natural logarithm).
Lg_ENROLL*SQR	=	Square of the natural logarithm of student enrollment.
STMOB	=	Student mobility rate.
ATTDR	=	Student attendance rate.
SP_ED	=	Proportion of the students classified as "special education."
Lg_FAMY	=	Average household family income (expressed in natural logarithm).
SOM_COLL	=	Proportion of the school district's population with some college education.
NO_HS	=	Proportion of the school district's population without a high school degree.
OCCP_ST	=	Average occupancy status of the school district.
TMALE_PCT	=	Total proportion of Male students taking the tests.
TBLCK_PCT	=	Total proportion of Black students taking the tests.
TASIA_PCT	=	Total proportion of Asian students taking the tests.
THSPC_PCT	=	Total proportion of Hispanic students taking the tests.
EPASS_1	=	Percentage of students with "Regular Pass" on the Grade 4 NJ ASK4 tests.
EPASS_2	=	Percentage of students with "Advanced Pass" on the Grade 4 NJ ASK4 tests.
GPASS_1	=	Percentage of students with "Regular Pass" on the Grade 8 GEPA tests.
GPASS_2	=	Percentage of students with "Advanced Pass" on the Grade 8 GEPA tests.
HPASS_1	=	Percentage of students with "Regular Pass" on the Grades 11-12 HSPA tests.
HPASS_2	=	Percentage of students with "Advanced Pass" on the Grades 11-12 HSPA tests.
ABBOTT	=	Dummy variable for K-12 school districts classified as "ABBOTT" districts.
EFFCY	=	Cost Efficiency score derived from estimation of Equation (4).
EFTV	=	Test outcome effectiveness score derived from estimation of Equation (5).
NO_VOTE	=	Dummy variable that equals one if the voting outcome on the school district's budget was negative, else zero.

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□ □ □ □ □ □ Characteristics of Conflicts of Interest in Stock Recommendations

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This paper studies characteristics of conflicts of interest in stock recommendations, and finds that analyst recommendations have an impact on recommended stocks, and that this phenomenon occurs for both traditional and revise recommendations. Moreover, the negative recommendations have a much greater impact than positive recommendations on stock returns. Findings suggest that high performance analysts are more concerned with enhancing their reputations and tend to not expose themselves to conflicts of interest when making upgrade recommendations. Furthermore, the results also suggest that concentrated ownership of individual stocks corresponds with a reduction in conflicts of interest.

Keywords: Conflict of interest; recommendation; concentrated ownership; event study.

1. Introduction

The sell-side security analyst plays the important role as a stock market information intermediary. A review of the relevant literature shows that analyst recommendations have short-term investment value (Womack, 1996; Barber et al. 2001; Jegadeesh et al. 2004). While the impact of security analyst skill and recommendations investment value is widely understood, such analysts, along with their reports and employers are subject to conflicts of interest.

Conflicts of interest exist because security analysts are dependent on investment banks or brokerage houses, which will seek to increase their revenue through accessing sensitive analysis information prior to public release.[1] For instance, Irvine et al. (2007) argue that analysts are incentivized to provide such information because their firms place a high value on their relationships with institutional clients, who will then act on this information to earn outsize profits. Shen and Chih (2009) demonstrated that analysts frequently allow their investment banking colleagues to buy shares ahead of the release of recommendations, and then sell for profit after the recommendations push up the share price.

Irvine et al. (2007) and Shen and Chih (2009) both focus on trading behavior in traditional recommendations, while Loh and Stulz (2011) argue that a recommendation change event has a more significant impact on stock price than traditional recommendation events. Therefore, this study examines the trading behavior of investment banks around the release of both traditional and revision recommendations. Furthermore, this paper measures the conflicts of interest for investment banks and individual stocks based on the index provided by Shen and Chih (2009). The study seeks to extend empirical research that directly links analyst recommendations and proprietary trading.[2]

This paper also examines the characteristics of conflicts of interest for investment banks. Previous studies have shown that conflicts of interest are influenced by characteristics of investment banks. However, Ljungqvist et al. (2007) argues that the analyst is often under pressure to help generate brokerage revenue. Other studies, however, also show that analyst characteristics have a differential impact on stock prices (e.g., Stickel 1992; Mikhail et al. 1997; Fang and Yasuda 2009; and Loh and Stulz 2011). Therefore, conflicts of interest for investment banks are expected to be affected not only by firm characteristics but also by analyst characteristics. This study further examines whether analyst characteristics influence conflicts of interest for investment banks.

Finally, we focus on conflicts of interest for individual stocks. Shen and Chih (2009) document conflicts of interest for individual stocks as affected by the characteristics of individual firms. Fan and Wong (2002) report that concentrated ownership may result in low earnings informativeness, implying information ambiguity on the part of the analyst, thus decreasing the likelihood of conflicts of interest on recommendations.

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[1] Michaely and Womack (1999) document several sources of revenue for investment banks, such as raising bank loans, M&A consulting, investment advice and proprietary trading.

[2] Irvine (2004) demonstrates that sell-side analysts have greater economic incentives to bias their recommendations than their earnings forecasts.

The results show that both traditional and revise analyst recommendations have an impact on recommended stocks. Moreover, negative recommendations have a much greater impact than positive recommendations on stock returns. Investment banks are found to have conflicts of interest in upgrade events, suggesting that high-performance analysts are more concerned with enhancing their reputations and tend not to engage in conflicts of interest when making upgrade recommendation. The results also suggest that conflicts of interest can be reduced by concentrated ownership of individual stocks.

The rest of this paper is structured as follows. Section 2 presents a literature review and proposes hypotheses. Section 3 reviews the data, discusses data constructs, defines the measures used and outlines the methodology. Section 4 presents empirical results. Conclusions are presented in Section 5.

2. Literature review and hypotheses

Many recent studies have highlighted potential conflicts of interest among sell-side security analysts and investment banks. On the one hand, sell-side analyst reports tend to be overly optimistic or pessimistic for stocks with specific characteristics. For instance, Dugar and Nathan (1995) showed that analysts tend to be overly optimistic for companies that are customers of the analyst's firm.[3] Ljungqvist et al. (2007) argues that investors are not the analyst's only constituency, but also consider the interests of the firm being assessed because the analyst is often under pressure to assist in the production of brokerage revenue. On the other hand, investment banks are concerned with maintaining their client relationships. Mehran and Stulz (2007) argue that a conflict of interest could arise if a financial institution were to obtain a direct advantage, such as additional underwriting fees. Bolton et al. (2007) showed that a specialist financial institution can differentiate itself and acquire market share by providing credible information.

Recent studies have found that conflicts of interest occur in investment banks not only because of the need to service clients but also due to proprietary trading activity. Juergens and Lindsey (2009) and Shen and Chih (2009) showed direct links between analyst recommendations and proprietary trading behavior. Juergens and Lindsey (2009) show that market makers employed by the analysts' firms engage in increased trading activity prior to recommendation revisions. Shen and Chih (2009) similarly found that the analyst's firm frequently buys the same recommended stocks through its broker-dealer before the release of the recommendation and sells it after.

However, Loh and Stulz (2011) argue that recommendation change events have a more significant impact than traditional recommendation events. Dugar and Nathan (1995) argue that analysts often produce overly optimistic stock recommendations, and will only issue sell or downgrade recommendations as a result of specifically credible information. That is, negative recommendations are usually based on more substantial information content than positive recommendations. Therefore, this study expects that negative recommendations should have a stronger stock price impact than positive recommendations.

[3] Eastwood and Nutt (1999) also finds that analysts both underreact to negative information and overreact to positive information.

Hypothesis 1: *Negative recommendations have a stronger stock price impact than positive recommendations.*

The second research question is based on characteristics of conflicts of interest for investment banks. The literature shows that conflicts of interest for investment banks may be dependent on common characteristics. For instance, Shen and Chih (2009) show that the conflicts of interest of investment banks exhibit common characteristics such as the size and age of the investment bank, and the frequency with which recommendations are issued. However, this explanation focuses on the characteristics of the investment bank. Ljungqvist et al. (2007) argue that analysts are often under pressure to push brokerage revenue. Also, prior work shows that analyst characteristics lead to differential impact of stock recommendation changes. For example, Stickel (1992), Fang and Yasuda (2009) and Loh and Stulz (2011) report that recommendation changes made by star analysts have more impact and profitable. Mikhail et al. (1997) show that analysts improve the accuracy of their earnings forecasts as they accumulate experience. Thus, it is assumed here that conflicts of interest for investment banks are affected by analyst characteristics.

Hypothesis 2: *The conflicts of interest for investment banks are affected by analyst performance or experience.*

The last research question deals with characteristics of conflicts of interest for individual stocks. Previous studies show that the magnitude of conflicts of interest for individual stocks is affected by firm characteristics (Shen and Chih, 2009), such as trading volume, firm size, number of peer firms in the same industry, systematic risk and the number of shares held by insiders. However, Fan and Wong (2002) argue that the concentrated ownership is associated with low earnings informativeness as ownership concentration prevents leakage of proprietary information. The low earnings informativeness implies that analysts obtain ambiguous information from the firm, thus reducing the likelihood of conflicts of interest in the recommendations. Gomes (2000) reports that a high ownership concentration can also serve as a credible indication that the controlling owner is interested in establishing a reputation for protecting minority shareholders. Gul et al. (2010) argues ownership concentration and foreign shareholding affected information quality. It is thus expected that high ownership concentrations decrease the likelihood of conflicts of interest in analyst recommendations, and thus for individual stocks.

Hypothesis 3: *Concentrated ownership will reduce the likelihood of conflicts of interests for individual stocks.*

3. Data and methodology

3.1. *Sample construction*

Analyst recommendation data was obtained from the Institutional Brokers' Estimate System (I/B/E/S) Recommendations Detail International files from April 1995 to

October 2013. Only recommendations related to the Taiwan market were collected by sorting for Country ID, Exchange ID, Currency, and Home Market Code.

Next, trading information and other financial variables for companies making recommendations were obtained from the Taiwan Economic Journal (TEJ) database. Our sample included investment bank recommendations, but the two databases (I/B/E/S and TEJ) use different identifiers for investment banks. A Google search provided the respective identifiers, allowing for the investment bank data from the two databases to be integrated. The final sample contained a total of 631 recommended stocks and 11 investment banks trading those stocks. Each of the investment banks can evaluate a given stock one or more times, so the total number of analyst recommendations in the sample was 10,709.[4]

3.2. *Variable definitions and measures*

To examine the conflicts of interest, this study makes use of two measures proposed by Shen and Chih (2009). The first identifies the conflicts of interest for investment banks by computing the investment bank's net buy (sell) position for the recommended stocks eight weeks prior and eight weeks following the release of the recommendation. Net traded shares of the upgrade (buy) recommendation are defined as the buy shares minus the sell shares, divided by the mean daily trading volumes of the upgrade (buy) recommendation across the sample period to eliminate the scale problem. In contrast, the net traded shares of the downgrade (sell) recommendation are calculated as the sell shares minus the buy shares, divided by the mean daily trading volumes of the downgrade (sell) recommendation across the sample period to eliminate the scale problem. The following equation is applied:

$$NTS_{i,\tau} = \frac{\sum_{j=1}^{M_i} Buy\_Shares_{i,\tau}^{j} - \sum_{j=1}^{M_i} Sell\_Shares_{i,\tau}^{j}}{M_i} \tag{1}$$

where i represents the i th investment bank issuing the recommendation, τ is the τ th week before or after the release of the report, j denotes the j th recommendation report issued by the i th investment bank, and M_i represents the total number of recommendations published by the i th recommending investment bank.

The investment banks' conflicts of interest are calculated using the net traded shares of all recommended stock recommended by the i th making issued investment bank during the period $-t$ to t weeks around the release of the analyst's recommendation.

$$CI\_IB_{i,t} = \left(\sum_{\tau=-t}^{-1} NTS_{i,\tau} - \sum_{\tau=1}^{t} NTS_{i,\tau} \right) \tag{2}$$

Equation (2) calculates the sum of the net traded shares of the i th making issued. investment bank from eight weeks preceding the release of the analyst report and the sum of the

[4] See Table A.1 in the Appendix for more detail.

net traded shares in the eight weeks following the release.

The second part denotes the conflicts of interest for individual stocks, which are computed based on the net traded shares of the k th recommended stock for all investment banks. Similar to Eq. (1), Eq. (3) is therefore as follows:

$$NTS_{k,\tau} = \frac{\sum_{l=1}^{N_k} Buy\_Shares_{i,\tau}^{l} - \sum_{l=1}^{N_k} Sell\_Shares_{i,\tau}^{l}}{N_k} \tag{3}$$

where k represents the k th recommended stock, τ is the τ th week before or after the release of the report, l denotes the l th recommendation report, and N_k represents the total number of recommendations issued regarding the k th stock by all recommending investment banks.

The conflicts of interest for individual stocks are difference between the net traded shares of k th stock by all investment banks that recommend the k th stock. Equation (4) is therefore as follows:

$$CI\_IS_{k,t} = \left(\sum_{\tau=-t}^{-1} NTS_{k,\tau} - \sum_{\tau=1}^{t} NTS_{k,\tau} \right) \tag{4}$$

Equation (4) calculates the sum of the total number of traded shares of the k th recommended stock eight weeks prior to the release of the analyst report and the sum of the net traded shares eight weeks following the release.

This study also examines the profit made by investment banks when trading the recommended stocks. Abnormal returns and cumulative abnormal returns are both calculated based on the standard event study method, which uses the market model of ordinary least squares (OLS) regressions for 250 trading days. The abnormal returns and cumulative abnormal returns can then be calculated over 40 trading days around the buy, sell, upgrade and downgrade recommendations.

4. Empirical results

4.1. *Recommendations for net traded shares*

Table 1 presents net traded shares of the recommended stocks by buy and sell around recommendations. Price share statistics are provided for the 11 investment banks and 10,709 recommendations, include mean, cumulative mean, standard deviation, maximum, and minimum across all stocks for each week for a period spanning eight weeks before and after the release of the recommendations. The cumulative mean is calculated beginning in the 8^{th} week preceding the release of the recommendations.

Panel A of Table 1 shows the mean net traded shares by the recommending investment bank around the zero before the release of the buy recommendations, and remains the status until one week after recommendation. The cumulative mean covers the eight weeks prior to the release of the report, and indicates there is no significant evidence of conflicts of interest for investment banks in buy recommendations.

In Panel B of Table 1, the mean net traded shares by the recommending investment bank takes place seven weeks before the sell recommendations, and peaks two weeks before the release of the report. The cumulative mean covers the eight weeks preceding the release of the report. However, the mean net traded shares become positive immediately following the publishing of the report, and this remains true until the 5th week following the release of the report. This result shows that the recommending investment banks become net sellers of the recommended stocks before the publication of their sell recommendations. Moreover, investment banks making a sell recommendation will buy those stocks back later. Normally, when an investment bank issues a sell recommendation, it should mean the bank considers the share price to be unjustified in terms of risk or that it is aware of news that will adversely affect the share price. The question is why would an investment bank issue sell recommendations to investors but buyback later? Such behavior may indicate potential conflicts of interest.

Insert Table 1 about here.

Panel A of Table 2 shows the mean net traded shares by the recommending investment bank before and after the upgrade recommendation, and result is similar to that of a buy recommendation. The mean net traded shares indicate the eight weeks preceding the release of the upgrade recommendation. The results for the cumulative mean are consistent with those for the mean, indicating upgrade recommendations present no significant evidence to suggest the existence of conflicts of interest for investment banks.

In Panel B of Table 2, the mean net traded shares by the recommending investment bank from seven weeks preceding the downgrade recommendation, and peaks one week prior to the release of the report. The cumulative mean covers the seven weeks prior to the release of the downgrade recommendation. Interestingly, the mean net traded shares become positive immediately following the publication of the downgrade recommendation, and remains positive for four weeks. This result suggests that the recommending investment bank was a net seller of the recommended stock prior to the publication of the downgrade recommendation. Furthermore, the investment banks which issued the downgrade recommendations later begin to buy these ‘underperforming’ stocks, again suggesting a conflict of interest on the part of the investment banks.

Insert Table 2 about here.

4.2. *Benefits of recommendations*

This section explores whether analyst recommendations produce benefits. Table 3 reports the results of ARs and CARs of the recommended stocks over 40 trading days around the buy recommendations. The ARs are positive at 2 trading days before the release of the buy recommendation until at 3 trading days after the recommendation, and become negative after 5 trading days following the recommendation. The highest and lowest returns respectively occur 1 trading day (0.19%) and 12 trading days (-0.21%) after the buy recommendation. Most CARs are significant beginning 1 trading day and ending 7 trading days after the recommendation, and CAR is -0.70% 20 trading days after. Graphs A and B of Fig. 1 plot the ARs and CARs around the buy recommendation. The ARs of Graph A are significant and positive from trading day -4 to +1. From trading day +5, the ARs are negative to the end of the event window. The CARs exhibit a stable trend from days -20 to -4, but change significantly from trading day -3 to +20. The results show that the buy recommendation had an impact on the recommended stock.[5]

Insert Table 3 and Figure 1 about here.

Table 4 presents the results of the ARs and CARs for the recommended stocks over 40 trading days around the sell recommendations. The ARs are negative starting at trading day -19, and the lowest AR is -0.74% at trading day +2. In Fig. 2, Graphs A and B respectively plot the ARs and CARs. The ARs of Graph A are significant and negative from trading days -2 to +3. In particular, the ARs are still negative and significant at trading day +18 even though recommendation is over three weeks old. The CARs are stable reduction on event windows, and CAR is -5.19% and significant at trading day +20. The results show that negative recommendations have a greater impact than positive recommendations on the recommended stock, which is consistent with hypothesis 1 and the findings of Dugar and Nathan (1995).

Insert Table 4 and Figure 2 about here.

Table 5 lists the ARs and CARs of the recommended stocks over 40 trading days around the upgrade recommendations. Most ARs are significant from trading day -2 to +3, and become negative and significant at trading day +10. The highest and lowest returns respectively occur on trading days +1 (0.28%) and +16 (-0.26%). In addition, significant CAR clusters are found from trading days -2 to +17, and CAR is 0.57% at trading day +20. Graphs A and B of Fig. 3 plot the ARs and CARs around the upgrade events. The CARs exhibit a growth trend from trading days -14 to +6, but the CARs significance falls from trading day +7 to +20. These results and trends are similar to those for buy recommendations.

Insert Table 5 and Figure 3 about here.

Table 6 presents the ARs and CARs of the recommended stocks over a period of 40 trading days around the downgrade recommendations. Most ARs are significant from trading day -5 to +3, and all ARs are negative in the downgrade event window. The highest and lowest returns respectively occur at trading days -3 (-0.09%) and +1 (-0.53%). In particular, significant CAR clusters are found from trading days -19 to +20, and CAR is -5.26% at trading day +20. Graphs A and B of Fig. 4 respectively plot the

[5] The Wilcoxon sign and Wilcoxon sign rank tests are used because Kothari and Warner (1997) found that abnormal returns around firm-specific events are severely misspecified. The rejection frequencies using parametric tests sometimes exceed 30% when the significance level of the test is 5%. Nonparametric tests are likely to reduce misspecification.

ARs and CARs from downgrade events. The CARs exhibit a descending trend in the downgrade event windows. These results and trends are similar to those of the sell recommendations. The experimental results are consistent with hypothesis 1 that negative recommendations should have a stronger impact on stock prices than positive recommendations.

Insert Table 6 and Figure 4 about here.

4.3. *Determinants of conflicts of interest for investment banks*

Six variables are considered in determining conflicts of interest: the investment bank's size (*BrokSize*) and age (*Duration*), the frequency with which the investment bank issues recommendations (*Times*), the analyst's prior-year performance (*Prior_Perf*), the average analyst's experience (*Experience*) and the investment bank's monthly sales figure (*Sale*).

BrokSize measured as the number of analysts employed by analyst's brokerage firm in the year prior to issuing the revised recommendation. *Duration* is computed as the number of years the investment bank has been in business. Shen and Chih (2009) note that *BrokSize* and *Duration* should be negative coefficients because larger or older investment banks are more concerned about their reputations. *Times* is computed as the frequency with which the investment bank issues recommendations. The coefficients should be positive, because high frequency issuing of recommendations provides an increased opportunity for conflicts of interest to develop in their trading strategy.

Following by Mikhail et al. (2004), *Prior_Perf* is the average quintile ranking of the analyst's prior performance (ranging from 0, worst, to 4, best), based on the prior-year return to the analyst's equal-weight portfolio of recommendation revisions over the event window of t= -2 to +60, where t=0 is the recommendation date. *Experience* is average analyst's experience measured in quarters (Lol and Stulz, 2011). The impacts of *Prior_Perf* and *Experience* are uncertain. An increase in the analyst's prior performance or experience should increase the impact on the recommended stock (Stickel, 1992; Kim and Verrecchia, 1994; Mikhail et al. 1997), and could provide increased incentive to include conflicts of interest in their trading strategy. On the other hand, increased prior performance or experience may leave the analyst increasingly concerned about maintaining his reputation, thus leaving the analyst reluctant to engage in conflicts of interest. The final variable is *Sale,* which is computed as the investment bank's monthly sales, and is expected to be positively correlated to the extent of conflicts of interest in the firm's trading strategy.

Table 7 reports the cross-sectional regressions of the conflict of interest indices for investment banks for positive (i.e., buy and upgrade) recommendations. In Panel A of Table 7, the dependent variables are $CI\_IB_{i,1}$ *to* $CI\_IB_{i,4}$, which denotes a period of 1 week before to 4 weeks after the analyst recommendation. To capture more information and characteristics of the conflicts of interest indices, $CI\_IB_{i,8}$ is also shown. *Duration* is found to be significantly negative for $CI\_IB_{i,1}$ in buy recommendations, suggesting that longer IB periods are more concerned with reputation and tend not to engage in conflicts of interest when making recommendations.

In Panel B of Table 7, when $CI\_IB_{i,1}$ is the dependent variable, the coefficients for *Duration* and *Prior_Perf* are significantly negative (at the 10% and 5% level, respectively) in upgrade events. When $CI\_IB_{i,2}$ is the dependent variable, the coefficients for *Size*, *Duration* and *Prior_Perf* are significantly negative (at the 5%, 10% and 10% level, respectively). When $CI\_IB_{i,3}$ is the dependent variable, the coefficients for *Size* and *Duration* are significantly negative (at the 5% and 10% level, respectively). If we observe $CI\_IB_{i,4}$ or $CI\_IB_{i,8}$ for longer windows, the coefficients for *Size* or *Duration* are significantly negative (at the 5% and 10% level, respectively). The result of conflicts of interest indices in upgrade events, suggesting that larger and older investment banks are more concerned with reputation and tend not to engage in conflicts of interest when making upgrade recommendations.

Insert Table 7 about here.

Table 8 presents the coefficient estimates for the conflicts of interest indices for investment banks for negative (i.e., sell and downgrade) recommendations. Panel A gives result for the sell recommendations. The coefficient of most interest is that for *Prior_Perf*, which is positive and statistically significant 4 weeks before and after the sell recommendation ($CI\_IB_{i,4}$). The positive coefficient implies that senior analysts tend to have conflicts of interest on sell recommendations. Panel B gives the result for the downgrade recommendations. The coefficient for *Duration* is significantly positive in $CI\_IB_{i,4}$ and $CI\_IB_{i,8}$ (both at the 10% level), indicating that older investment banks tend to have conflicts of interest for downgrade recommendations. The coefficient for *Times* is significantly positive in $CI\_IB_{i,1}$, $CI\_IB_{i,2}$, $CI\_IB_{i,4}$ and $CI\_IB_{i,8}$ (at the 10%, 5%, 10% and 10% level, respectively), implying that banks which frequently issue downgrade recommendations tend to have conflicts of interest. Also, for $CI\_IB_{i,8}$, the t-value of *Sale* is significantly positive at the 5% level, indicating that investment banks with higher sales volume tend to have conflicts of interest for downgrade recommendations. The experimental results are consistent with hypothesis 2 which states that conflicts of interest for investment banks are affected by analyst characteristics.

Insert Table 8 about here.

4.4. *Determinants of conflicts of interest for individual stocks*

Eight variables are adopted to examine the determinants of conflicts of interests for individual stocks: the average daily trading volume (*Volume*), the market value of the stock (*Size*), the frequency with which a particular stock is recommended by all investment banks (*FREQ*), the number of peer firms in the same industry (*Number*), the systematic risk of a recommended stock (*Beta*), the market-to-book ratio (*MB*), the percentage of shares held by directors or senior officers (*Insider*), and the percentage of shares held by foreign investors (*FIH*).

Volume is measured as the average daily trading volume of the recommended security. Bhushan (1989a) showed that a high trading volume in a particular stock may stem from liquidity traders causing high volatility. Shen and Chih (2009) argued that an investment bank may take advantage of such conditions to earn profits. Hence, *Volume* is expected to be positively related to conflicts of interest.

Size should be negative in sign, Lang and Lundholm (1996) argued that larger firms draw increased attention from investors, and Shen and Chih (2009) noted that, mindful of their reputations, investment banks are more vigilant when making recommendations for high-profile firms. Similar to *Times*, *FREQ* should be positive, while *Number* should be positive. Bhushan (1989b) and Shen and Chih (2009) reported that the cost to analysts for collecting information increases with the number of business lines a firm maintains, and high information collecting costs might reduce competition in information collecting, thus resulting in more informative recommendations and increasing the likelihood of conflicts of interest.

Beta should be negative, with a higher *Beta* value implying stock returns are more sensitive to market information, and relatively insensitive to firm-specific information. Thus, Shen and Chih (2009) noted that a higher *Beta* value makes it more difficult for investment banks to exploit firm-specific information by trading recommended stocks. *MB* should be positive, with Frankel et al. (2006) noting that a high *MB* value is often associated with younger firms with high growth potential. Such firms usually lack a financial experience, providing increased likelihood that their operating strategies will be vulnerable to conflicts of interest. The last two variables are *Insider* and *FIH*, which are proxy variables for concentrated ownership, and are expected to be negatively related to conflicts of interest.

Table 9 presents the cross-sectional regressions of the conflict of interest indices for individual stocks for positive recommendations. Panel A of Table 9 lists the buy recommendations. When $CI\_IS_{k,3}$ and $CI\_IS_{k,4}$ serve as the dependent variables, the coefficient for *Insider* is significantly negative (at the 1% and 5% level, respectively). On the other hand, *FIH* is significantly negative for $CI\_IS_{k,2}$ and $CI\_IS_{k,8}$ (at the 10% and 5% level, respectively). These results suggest that when a relatively higher ratio of equity is held by insiders or foreign investors, individual stocks tend to be less vulnerable to lower conflicts of interest on buy recommendations. The experimental results are consistent with hypothesis 3 which states that concentrated ownership of individual stocks reduces the incidence of conflicts of interest.

Panel B of Table 9 lists the upgrade recommendations. The coefficients for *Size* are significantly negative at $CI\_IS_{k,3}$ and $CI\_IS_{k,8}$ (at the 10% and 5% level, respectively), indicating that larger firms tend to have fewer conflicts of interest on upgrade recommendations. The coefficient for *FREQ* is significantly positive at $CI\_IB_{i,8}$ (at the 10% level), implying that higher frequency of upgrade recommendations tends to correlate with higher incidence of conflicts of interest. This result indicates that investment banks have more difficulty exploiting firm-specific information if the recommended stock has higher information transparency.

Insert Table 9 about here.

Table 10 presents the cross-sectional regressions of the conflict of interest indices for individual stocks for negative recommendations, with results for sell and downgrade recommendations respectively displayed in Panels A and B. In Panel A, the conflicts of interest for sell recommendations are almost insignificant in all coefficients. In Panel B, *Number* is significant and positive in $CI\_IB_{i,1}$ (at the 5% level), implying that a greater number of peer firms in same industry tends to correlate with increased conflicts of interest. *Beta* is significant and negative from $CI\_IS_{k,1}$ to $CI\_IS_{k,8}$, (at the 1% , 5%, 5%, 5% and 10% level, respectively), suggesting that higher systematic risk makes it more difficult for investment banks build a strategy to profit from such recommendations.

Judging from the above, sell recommendations appear not to be influenced by the explanatory variables. However, this view is quite unsatisfactory, and the above results are not absolute proof that stock characteristics have no impact on conflicts of interest. One possible explanation for these results is that the majority of conflicts of interest are not affected by the explanatory variables.

Insert Table 10 about here.

5. Conclusions

This paper studies the characteristics of conflicts of interest in stock recommendations through asking three questions: Are stock prices more heavily impacted by negative recommendations than by positive recommendations? Are conflicts of interest for investment banks affected by analyst characteristics? Will concentrated ownership reduce conflicts of interest for individual stocks?

Empirical results show that individual stocks are influenced by analyst recommendations, and this holds true for both traditional (buy and sell) recommendations and revised (upgrade and downgrade) recommendations. Moreover, negative recommendations were found to have a much greater impact on recommended stocks than positive recommendations.

This paper also uses the model proposed by Shen and Chih (2009) to examine the characteristics of conflicts of interest in stock recommendations for investment banks and for individual stocks. Variables found to impact conflicts of interests for investment banks include the age and size of the investment bank, the analyst's prior-year performance, and investment bank sales volume. More specifically, the result for conflict of interest indices in upgrade events suggest that larger and older investment banks, along with high-performing analysts, are more concerned with maintaining their reputations and tend not to engage in conflicts of interest when making upgrade recommendations.

On the other hand, for individual stocks, incidence of conflict of interest is affected by firm size, frequency of recommendations, the number of peer firms in the same industry, *Beta*, insider holdings, and foreign investor holdings. These results suggest that increased insider or foreign holdings tend to reduce the incidence of conflicts of interest on buy recommendations.

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Table 1. Net Traded Shares of Recommended Stocks around the Release of Buy and Sell Recommendations

Net traded shares (NTS) of buy recommendations (Panel A) and sell recommendations (Panel B) from investment banks. The cumulative mean at the τth week is calculated by summing the means over the τth week and all preceding weeks. Following Shen and Chih (2009), the NTS value is divided by the average daily trading volume across the sample period (April, 1995 to October, 2013) to eliminate the scale effect.

	-8	-7	-6	-5	-4	-3	-2	-1	1	2	3	4	5	6	7	8
Panel A. Buy Recommendations (1995/4-2013/10)																
Mean	0.000%	0.000%	-0.001%	-0.001%	0.000%	0.000%	-0.001%	0.000%	0.003%	0.000%	0.000%	0.000%	-0.001%	0.000%	0.000%	0.000%
Cum. Mean	0.000%	0.000%	-0.001%	-0.002%	-0.002%	-0.002%	-0.003%	-0.003%	0.000%	0.000%	0.000%	0.000%	-0.001%	-0.001%	-0.001%	-0.001%
Std. dev.	0.037%	0.019%	0.024%	0.019%	0.026%	0.071%	0.025%	0.017%	0.019%	0.044%	0.030%	0.026%	0.029%	0.017%	0.020%	0.013%
Max	2.532%	0.622%	0.864%	0.516%	0.994%	2.830%	0.606%	0.524%	0.896%	0.473%	0.942%	1.365%	0.257%	0.547%	0.383%	0.240%
Min	-0.342%	-0.682%	-0.433%	-0.752%	-0.342%	-1.373%	-1.281%	-0.517%	-0.155%	-3.068%	-1.271%	-0.287%	-1.661%	-0.623%	-0.983%	-0.540%
No. of obs.	5781	5781	5781	5781	5781	5781	5781	5781	5781	5781	5781	5781	5781	5781	5781	5781
Panel B. Sell Recommendations (1995/4-2013/10)																
Mean	-0.009%	-0.014%	-0.013%	-0.006%	0.000%	-0.007%	-0.024%	-0.009%	0.008%	0.009%	0.004%	0.001%	-0.007%	0.001%	0.003%	-0.004%
Cum. Mean	-0.009%	-0.023%	-0.036%	-0.042%	-0.042%	-0.048%	-0.072%	-0.081%	-0.073%	-0.065%	-0.060%	-0.060%	-0.067%	-0.066%	-0.063%	-0.067%
Std. dev.	0.258%	0.166%	0.155%	0.131%	0.118%	0.107%	0.452%	0.129%	0.321%	0.219%	0.214%	0.196%	0.113%	0.096%	0.099%	0.111%
Max	2.632%	0.692%	0.500%	1.306%	1.306%	0.713%	0.511%	0.469%	3.242%	2.963%	2.729%	3.242%	0.228%	1.107%	1.117%	0.756%
Min	-5.597%	-3.810%	-2.611%	-1.809%	-2.375%	-1.817%	-12.073%	-3.165%	-7.521%	-3.389%	-3.890%	-3.597%	-2.583%	-1.702%	-1.675%	-2.409%
No. of obs.	735	735	735	735	735	735	735	735	735	735	735	735	735	735	735	735

Table 2. Net Traded Shares of Recommended Stocks around the Release of Upgrade and Downgrade Recommendations

Net traded shares (NTS) of upgrade recommendations (Panel A) and downgrade recommendations (Panel B) from investment banks. The cumulative mean at the τth week is calculated by summing the means over the τth week and all preceding weeks. Following Shen and Chih (2009), the NTS values are divided by the average daily trading volumes across the sample period (April, 1995 to October, 2013) to eliminate the scale effect.

	-8	-7	-6	-5	-4	-3	-2	-1	1	2	3	4	5	6	7	8
Panel A. Upgrade Recommendations (1995/4-2013/10)																
Mean	-0.001%	-0.001%	-0.001%	-0.001%	0.000%	0.001%	-0.002%	-0.001%	0.005%	0.001%	0.003%	0.000%	-0.001%	-0.001%	0.000%	0.000%
Cum. Mean	-0.001%	-0.002%	-0.002%	-0.003%	-0.003%	-0.002%	-0.003%	-0.004%	0.001%	0.002%	0.005%	0.005%	0.004%	0.003%	0.003%	0.003%
Std. dev.	0.031%	0.036%	0.119%	0.051%	0.037%	0.119%	0.048%	0.031%	0.036%	0.042%	0.059%	0.032%	0.045%	0.038%	0.037%	0.032%
Max	0.649%	0.684%	5.726%	0.783%	0.806%	3.113%	1.081%	0.647%	0.953%	1.130%	1.565%	1.201%	0.836%	0.499%	0.641%	0.433%
Min	-0.504%	-0.749%	-0.539%	-1.680%	-0.344%	-1.511%	-0.737%	-0.569%	-0.282%	-0.479%	-0.561%	-0.316%	-1.827%	-1.058%	-1.081%	-1.206%
No. of obs.	2473	2473	2473	2473	2473	2473	2473	2473	2473	2473	2473	2473	2473	2473	2473	2473
Panel B. Downgrade Recommendations (1995/4-2013/10)																
Mean	0.000%	-0.003%	-0.004%	0.000%	0.000%	0.001%	-0.002%	-0.001%	0.004%	0.001%	0.001%	-0.001%	-0.001%	-0.001%	0.000%	0.000%
Cum. Mean	0.000%	-0.003%	-0.006%	-0.006%	-0.006%	-0.005%	-0.007%	-0.009%	-0.004%	-0.003%	-0.002%	-0.003%	-0.004%	-0.005%	-0.005%	-0.005%
Std. dev.	0.065%	0.066%	0.046%	0.040%	0.039%	0.085%	0.026%	0.025%	0.032%	0.042%	0.045%	0.020%	0.026%	0.032%	0.033%	0.020%
Max	2.830%	0.622%	0.148%	1.365%	0.733%	2.830%	0.246%	0.531%	0.451%	1.118%	1.247%	0.434%	0.193%	0.397%	0.510%	0.345%
Min	-0.938%	-3.068%	-1.121%	-0.490%	-1.230%	-1.373%	-0.506%	-0.517%	-0.270%	-0.320%	-0.563%	-0.659%	-0.802%	-1.242%	-0.983%	-0.282%
No. of obs.	2810	2810	2810	2810	2810	2810	2810	2810	2810	2810	2810	2810	2810	2810	2810	2810

Table 3. Abnormal Returns and Cumulative Abnormal Returns of Recommended Firms over 40 Days around Buy Recommendations

Abnormal return response to buy recommendations by investment banks for 40 days around the recommendation date. Cross-sectional *t*-tests, non-parametric Wilcoxon sign tests (Sign) and Wilcoxon sign rank tests (Sign rank) are applied to determine whether AR or CAR are significantly smaller than zero. Significance at the 1, 5, and 10% levels is denoted by ***, **, and *, respectively.

	AR (%)	*t*-test	Sign	Sign rank	CAR (%)	*t*-test	Sign	Sign rank
-20	0.03%		***		0.03%		***	
-19	0.10%	***	*		0.13%	**		*
-18	-0.05%		***	***	0.08%			
-17	-0.06%		***	***	0.02%		**	
-16	-0.10%	***	***	***	-0.08%		**	
-15	-0.10%	**	***	***	-0.18%	*	***	**
-14	0.02%		**		-0.16%			
-13	0.10%	**	***		-0.06%		**	
-12	0.04%		***	*	-0.02%			
-11	0.07%		***	*	0.04%			
-10	-0.01%		***	**	0.04%			
-9	0.05%		***	**	0.08%			
-8	0.02%		***	*	0.11%			*
-7	-0.03%		***	***	0.08%			*
-6	-0.05%		***	***	0.03%			*
-5	0.03%		***		0.06%			**
-4	-0.01%		***	**	0.05%			*
-3	-0.01%		***	***	0.04%			**
-2	0.15%	***	***		0.18%			**
-1	0.08%	**	***		0.27%		**	***
+1	0.19%	***		**	0.45%	*	***	***
+2	0.17%	***	***		0.62%	***	***	***
+3	0.10%	**	***		0.72%	***	***	***
+4	0.06%		***	**	0.78%	***	***	***
+5	-0.01%		***	**	0.77%	***	***	***
+6	-0.11%	**	***	***	0.66%	**	***	***
+7	-0.04%		***	***	0.62%	**	***	***
+8	-0.09%	**	***	***	0.53%	*	***	***
+9	-0.09%	**	***	***	0.44%		***	***
+10	-0.07%	*	***	***	0.37%		***	***
+11	-0.04%		***	***	0.33%		***	***
+12	-0.21%	***	***	***	0.12%		***	***
+13	-0.11%	***	***	***	0.00%		***	***
+14	-0.14%	***	***	***	-0.14%		**	***
+15	-0.13%	***	***	***	-0.27%		**	**
+16	-0.12%	***	***	***	-0.39%			*
+17	-0.05%		***	***	-0.44%		*	*
+18	-0.06%		***	***	-0.50%		**	*
+19	-0.06%	*	***	***	-0.56%		**	
+20	-0.13%	***	***	***	-0.70%	*	*	

Table 4. Abnormal Returns and Cumulative Abnormal Returns of Recommended Firms over 40 Days around Sell Recommendations

Abnormal return response to buy recommendations by investment banks for 40 days around the recommendation date. Cross-sectional *t*-tests, non-parametric Wilcoxon sign tests (Sign) and Wilcoxon sign rank tests (Sign rank) are applied to determine whether AR or CAR are significantly smaller than zero. Significance at the 1, 5, and 10% levels is denoted by ***, **, and *, respectively.

	AR (%)	*t*-test	Sign	Sign rank	CAR (%)	*t*-test	Sign	Sign rank
-20	0.13%				0.13%			
-19	-0.17%	*	***	***	-0.04%			
-18	-0.19%	**	***	**	-0.23%		***	**
-17	-0.14%		***	**	-0.37%	*	***	***
-16	0.07%				-0.30%		***	***
-15	0.11%				-0.19%		***	**
-14	0.06%				-0.14%		**	*
-13	-0.04%				-0.18%		***	**
-12	0.01%				-0.18%		***	**
-11	-0.06%		**		-0.24%		**	**
-10	-0.09%		*		-0.33%		***	***
-9	-0.20%	**		**	-0.53%		***	***
-8	0.10%				-0.43%		***	***
-7	-0.36%	***	***	***	-0.80%	*	***	***
-6	-0.06%		**	**	-0.86%	*	***	***
-5	-0.07%		**	*	-0.93%	**	***	***
-4	-0.16%			*	-1.09%	**	***	***
-3	-0.10%				-1.18%	**	***	***
-2	-0.21%	**	***	***	-1.40%	***	***	***
-1	-0.21%	*	*	**	-1.61%	***	***	***
+1	-0.44%	***	***	***	-2.05%	***	***	***
+2	-0.74%	***	***	***	-2.79%	***	***	***
+3	-0.45%	***	***	***	-3.25%	***	***	***
+4	-0.17%				-3.42%	***	***	***
+5	0.01%				-3.40%	***	***	***
+6	-0.30%	***	***	***	-3.70%	***	***	***
+7	-0.22%	**	***	***	-3.92%	***	***	***
+8	-0.03%				-3.95%	***	***	***
+9	0.12%				-3.84%	***	***	***
+10	-0.35%	***	**	***	-4.18%	***	***	***
+11	-0.06%		***	**	-4.24%	***	***	***
+12	0.08%				-4.16%	***	***	***
+13	0.00%				-4.16%	***	***	***
+14	-0.14%				-4.30%	***	***	***
+15	-0.18%	*	**	**	-4.48%	***	***	***
+16	-0.36%	***	***	***	-4.84%	***	***	***
+17	-0.13%		**	*	-4.97%	***	***	***
+18	-0.19%	*	*	**	-5.16%	***	***	***
+19	0.06%				-5.10%	***	***	***
+20	-0.09%				-5.19%	***	***	***

Table 5. Abnormal Returns and Cumulative Abnormal Returns of Recommended Firms over 40 Days around the Upgrade Recommendations

Abnormal return response to upgrade recommendations by investment banks for 40 days around the recommendation date. Cross-sectional *t*-tests, non-parametric Wilcoxon sign tests (Sign) and Wilcoxon sign rank tests (Sign rank) are applied to determine whether AR or CAR are significantly smaller than zero. Significance at the 1, 5, and 10% levels is denoted by ***, **, and *, respectively.

	AR (%)	*t*-test	Sign	Sign rank	CAR (%)	*t*-test	Sign	Sign rank
-20	0.05%				0.05%			
-19	0.09%		*		0.14%	*		
-18	-0.03%			**	0.11%			
-17	-0.05%		***	***	0.05%			
-16	-0.05%		***	***	0.01%			
-15	-0.07%		***	***	-0.06%			
-14	0.02%		**		-0.04%			
-13	0.14%	***			0.10%			
-12	0.03%		***		0.13%			
-11	-0.04%		***	**	0.09%			
-10	0.02%		*		0.11%			
-9	-0.02%		***	**	0.09%			
-8	0.12%	**	**		0.21%			
-7	0.05%		**		0.27%			
-6	0.03%		***		0.30%			*
-5	0.10%	*			0.40%	*		**
-4	0.04%				0.44%	*		*
-3	0.07%		**		0.51%	**		**
-2	0.13%	**			0.64%	**	*	***
-1	0.13%	**			0.76%	***	**	***
+1	0.28%	***		***	1.05%	***	***	***
+2	0.23%	***		**	1.27%	***	***	***
+3	0.19%	***			1.46%	***	***	***
+4	0.01%		***	*	1.48%	***	***	***
+5	0.04%		**		1.52%	***	***	***
+6	0.01%		*		1.53%	***	***	***
+7	-0.01%		***	*	1.52%	***	***	***
+8	-0.05%		***	**	1.47%	***	***	***
+9	-0.04%		***	**	1.42%	***	***	***
+10	-0.12%	**	***	***	1.30%	***	***	***
+11	-0.04%		***	*	1.26%	***	***	***
+12	-0.10%	*	***	***	1.16%	***	***	***
+13	-0.09%	*	***	***	1.07%	***	**	***
+14	-0.06%		***	***	1.01%	***	***	***
+15	-0.04%		**	*	0.97%	**	***	***
+16	-0.26%	***	***	***	0.71%	*		***
+17	-0.01%		***	*	0.70%	*	**	***
+18	0.01%				0.71%	*	***	***
+19	-0.09%		***	***	0.62%		***	***
+20	-0.05%		***	*	0.57%		***	**

Table 6. Abnormal Returns and Cumulative Abnormal Returns of Recommended Firms over 40 Days around Downgrade Recommendations

Abnormal return response to downgrade recommendations by investment banks for 40 days around the recommendation date. Cross-sectional *t*-tests, non-parametric Wilcoxon sign tests (Sign) and Wilcoxon sign rank tests (Sign rank) are applied to determine whether AR or CAR are significantly smaller than zero. Significance at the 1, 5, and 10% levels is denoted by ***, **, and *, respectively.

	AR (%)	*t*-test	Sign	Sign rank	CAR (%)	*t*-test	Sign	Sign rank
-20	-0.01%		**		-0.01%		**	
-19	-0.16%	***	***	***	-0.17%	**	***	***
-18	-0.14%	***	***	***	-0.31%	***	***	***
-17	-0.08%		***	***	-0.39%	***	***	***
-16	-0.06%		***	***	-0.44%	***	***	***
-15	-0.02%		***	**	-0.46%	***	***	***
-14	0.03%		***	**	-0.44%	***	***	***
-13	-0.09%	*	***	***	-0.53%	***	***	***
-12	-0.05%		***	**	-0.58%	***	***	***
-11	-0.08%		***	***	-0.66%	***	***	***
-10	-0.07%		***	***	-0.74%	***	***	***
-9	-0.18%	***	***	***	-0.91%	***	***	***
-8	-0.07%		***	***	-0.99%	***	***	***
-7	-0.12%	**	***	***	-1.11%	***	***	***
-6	-0.07%		***	***	-1.18%	***	***	***
-5	-0.13%	**	***	***	-1.31%	***	***	***
-4	-0.16%	***	***	***	-1.47%	***	***	***
-3	-0.09%	*	***	***	-1.56%	***	***	***
-2	-0.15%	***	***	***	-1.70%	***	***	***
-1	-0.25%	***	***	***	-1.95%	***	***	***
+1	-0.53%	***	***	***	-2.48%	***	***	***
+2	-0.46%	***	***	***	-2.95%	***	***	***
+3	-0.25%	***	***	***	-3.20%	***	***	***
+4	-0.09%		***	***	-3.29%	***	***	***
+5	-0.07%		***	***	-3.35%	***	***	***
+6	-0.27%	***	***	***	-3.62%	***	***	***
+7	-0.19%	***	***	***	-3.82%	***	***	***
+8	-0.13%	**	***	***	-3.95%	***	***	***
+9	-0.06%		***	**	-4.00%	***	***	***
+10	-0.11%	**	***	***	-4.12%	***	***	***
+11	-0.16%	***	***	***	-4.27%	***	***	***
+12	-0.09%	*	***	***	-4.36%	***	***	***
+13	-0.05%		**		-4.42%	***	***	***
+14	-0.07%		***	***	-4.49%	***	***	***
+15	-0.10%	*	***	***	-4.59%	***	***	***
+16	-0.20%	***	***	***	-4.79%	***	***	***
+17	-0.11%	**	***	***	-4.89%	***	***	***
+18	-0.10%	**	***	***	-4.99%	***	***	***
+19	-0.12%	**	***	***	-5.11%	***	***	***
+20	-0.15%	***	***	***	-5.26%	***	***	***

Table 7. Cross-Sectional Regressions of the Conflict of Interest Indices for Investment Banks on Positive Recommendations

The table reports coefficient estimates of the following regression:

$$CI\_IB_{i,t} = \alpha + \beta_1 BrokSize + \beta_2 Duration + \beta_3 Times + \beta_4 Prior\_Perf + \beta_5 Experience + \beta_6 Sale$$

$CI\_IB_{i,t}$ is the conflict of interest indices for investment banks t trading weeks before and after the recommendation. *BrokSize* is the size of recommending investment bank, *Duration* is the age of the investment bank in years, *Times* is the frequency with which the IBs issue buy (upgrade) recommendations, *Prior_ Perf* is the analyst's prior-year performance with which the IBs issue recommendations, *Experience* is the average analyst's experience (in quarters) with which the IBs issue recommendations, and *Sale* is the IB's monthly sales volume. *t*-statistics are reported in parentheses. Significance at the 1, 5, and 10% levels is denoted by ***, **, and *, respectively.

Panel A: Buy recommendation

	$CI\_IB_{i,1}$	$CI\_IB_{i,2}$	$CI\_IB_{i,3}$	$CI\_IB_{i,4}$	$CI\_IB_{i,8}$
Intercept	2.167	-1.632	-5.221	1.903	-8.840
	(0.31)	(-0.16)	(-0.45)	(0.14)	(-0.54)
BrokSize	-0.005	-0.045	-0.102	-0.093	0.036
	(-0.14)	(-0.83)	(-1.62)	(-1.30)	(0.41)
Duration	-0.046*	-0.033	-0.017	0.006	0.047
	(-1.95)	(-1.00)	(-0.44)	(0.14)	(0.86)
Times	-0.002	-0.004	-0.002	-0.002	0.001
	(-0.36)	(-0.50)	(-0.27)	(-0.26)	(0.14)
Prior_ Perf	-0.760	-0.880	-0.584	-0.413	-0.114
	(-1.50)	(-1.23)	(-0.70)	(-0.43)	(-0.10)
Experience	0.073	-0.008	-0.233	0.138	-0.115
	(0.21)	(-0.02)	(-0.42)	(0.22)	(0.15)
Sale	0.106	0.441	0.692	0.110	0.538
	(0.25)	(0.72)	(0.97)	(0.13)	(0.53)
#Obs.	46	46	46	46	46
R- Square	0.126	0.077	0.087	0.054	0.033

Panel B: Upgrade recommendation

	$CI\_IB_{i,1}$	$CI\_IB_{i,2}$	$CI\_IB_{i,3}$	$CI\_IB_{i,4}$	$CI\_IB_{i,8}$
Intercept	-1.158	-0.265	11.28	16.62	30.54
	(-0.11)	(-0.02)	(0.82)	(0.95)	(1.31)
BrokSize	-0.069	-0.163**	-0.198**	-0.159*	-0.037
	(-1.21)	(-2.43)	(-2.65)	(-1.67)	(-0.30)
Duration	-0.064*	-0.082*	-0.082*	-0.057	-0.166**
	(-1.79)	(-1.94)	(-1.76)	(-0.96)	(-2.11)
Times	-0.015	-0.010	-0.006	-0.000	0.012
	(-0.95)	(-0.57)	(-0.32)	(-0.01)	(0.35)
Prior_ Perf	-1.869**	-1.772*	-1.491	-1.150	-1.682
	(-2.38)	(-1.93)	(-1.46)	(-0.88)	(-0.98)
Experience	-0.436	-0.696	-0.865	0.089	0.463
	(-0.84)	(-1.14)	(-1.27)	(0.10)	(0.40)
Sale	0.754	0.843	0.121	-0.545	-1.429
	(1.14)	(1.09)	(0.14)	(-0.50)	(-0.99)
#Obs.	46	46	46	46	46
R- Square	0.209	0.239	0.229	0.099	0.139

Table 8. Cross-Sectional Regressions of the Conflict of Interest Indices for Investment Banks on Negative Recommendations

The table reports coefficient estimates of the following regression:

$$CI\_IB_{i,t} = \alpha + \beta_1 BrokSize + \beta_2 Duration + \beta_3 Times + \beta_4 Prior\_Perf + \beta_5 Experience + \beta_6 Sale$$

$CI\_IB_{i,t}$ is the conflict of interest indices for investment banks *t* trading weeks before and after the recommendation. *BrokSize* is the size of recommending investment bank, *Duration* is the age of the investment bank in years, *Times* is the frequency with which the IBs issue sell (downgrade) recommendations, *Prior_ Perf* is the analyst's prior-year performance with which the IBs issue recommendations, *Experience* is the average analyst's experience (in quarters) with which the IBs issue recommendations, and *Sale* is the IB's monthly sales volume. *t*-statistics are reported in parentheses. Significance at the 1, 5, and 10% levels is denoted by ***, **, and *, respectively.

Panel A: Sell recommendation

	$CI\_IB_{i,1}$	$CI\_IB_{i,2}$	$CI\_IB_{i,3}$	$CI\_IB_{i,4}$	$CI\_IB_{i,8}$
Intercept	11.62	4.344	-1.72	-10.34	-123.7
	(0.84)	(0.23)	(-0.05)	(-0.23)	(-1.19)
BrokSize	-0.000	0.052	0.105	0.174	0.063
	(-0.02)	(0.80)	(0.88)	(1.15)	(0.18)
Duration	0.016	0.051	0.041	0.075	-0.058
	(0.50)	(1.15)	(0.51)	(0.73)	(-0.24)
Times	0.001	-0.001	-0.030	-0.002	-0.237
	(0.05)	(-0.03)	(-0.30)	(-0.02)	(-0.79)
Prior_ Perf	0.357	0.637	2.082	3.833**	7.379
	(0.61)	(0.78)	(1.40)	(2.03)	(1.66)
Experience	-0.756	-0.978	-1.385	-1.95	2.064
	(-1.39)	(-1.30)	(-1.01)	(-1.12)	(0.50)
Sale	-0.693	-0.352	-0.153	-0.015	6.498
	(-0.75)	(-0.27)	(-0.07)	(-0.01)	(0.93)
#Obs.	34	34	34	34	34
R-Square	0.173	0.168	0.130	0.197	0.215

Panel B: Downgrade recommendation

	$CI\_IB_{i,1}$	$CI\_IB_{i,2}$	$CI\_IB_{i,3}$	$CI\_IB_{i,4}$	$CI\_IB_{i,8}$
Intercept	-3.542	-10.86	-8.564	-22.01	-69.13***
	(-0.39)	(-0.86)	(-0.62)	(-1.48)	(-2.86)
BrokSize	0.056	0.096	0.063	0.114	0.116
	(1.17)	(1.43)	(0.85)	(1.43)	(0.90)
Duration	0.001	0.019	0.067	0.104*	0.161*
	(0.05)	(0.42)	(1.32)	(1.92)	(1.84)
Times	0.024*	0.046**	0.014	0.040*	0.071*
	(1.79)	(2.42)	(0.67)	(1.80)	(1.93)
Prior_ Perf	0.507	1.083	-1.417	-0.807	1.935
	(0.70)	(1.07)	(-1.27)	(-0.67)	(1.00)
Experience	-0.215	-0.185	-0.378	-0.412	-0.256
	(-0.49)	(-0.30)	(-0.56)	(-0.57)	(-0.22)
Sale	0.024	0.220	0.677	1.222	3.590**
	(0.04)	(0.28)	(0.79)	(1.33)	(2.42)
#Obs.	46	46	46	46	46
R-Square	0.135	0.204	0.196	0.312	0.271

Table 9. Cross-Sectional Regressions of the Conflict of Interest Indices for Individual Stocks on Positive Recommendations

The table reports coefficient estimates of the following regression:

$$CI\_IS_{k,t} = \alpha + \beta_1 Volume + \beta_2 Size + \beta_3 FREQ + \beta_4 Number + \beta_5 Beta + \beta_6 MB + \beta_7 Insider + \beta_8 FIH$$

$CI\_IS_{k,t}$ is the conflict of interest indices for individual stocks t trading weeks before and after the recommendation. *Volume* is the average daily trading volume of the recommended security, *Size* is the market value of the recommended firm, *FREQ* is the frequency with which the particular stock is recommended by all investment banks, *Number* is the number of peer firms in the same industry, *Beta* is the systematic risk of the recommended stock, *MB* is the market-to-book ratio, *Insider* is the percentage of shares held by directors or senior officers, and *FIH* is the percentage of shares held by foreign investors. *t*-statistics are reported in parentheses. Significance at the 1, 5, and 10% levels is denoted by ***, **, and *, respectively.

Panel A: Buy recommendation

	$CI\_IS_{k,1}$	$CI\_IS_{k,2}$	$CI\_IS_{k,3}$	$CI\_IS_{k,4}$	$CI\_IS_{k,8}$
Intercept	-2.083	-1.623	2.765	1.300	2.632
	(-0.93)	(-0.54)	(0.68)	(0.26)	(0.41)
Volume	0.543	0.461	0.150	0.971	1.430
	(1.52)	(0.97)	(0.23)	(1.21)	(1.38)
Size	-0.068	-0.023	-0.142	-0.582	-1.073
	(-0.18)	(-0.05)	(-0.21)	(-0.69)	(-0.98)
FREQ	-0.030	-0.025	-0.006	-0.032	0.006
	(-1.13)	(-0.70)	(-0.14)	(-0.54)	(0.08)
Number	0.001	-0.005	-0.007	-0.011	-0.019
	(0.03)	(-0.88)	(-0.96)	(-1.21)	(-1.60)
Beta	0.207	1.341	1.779	0.978	0.297
	(0.19)	(0.93)	(0.91)	(0.40)	(0.10)
MB	-0.103	-0.110	0.090	0.330	0.697
	(-0.54)	(-0.43)	(0.26)	(0.77)	(1.26)
Insider	-0.005	-0.034	-0.096***	-0.079**	-0.0544
	(-0.36)	(-1.40)	(-3.26)	(-2.19)	(-1.15)
FIH	-0.033	-0.053*	-0.060	-0.069	-0.140**
	(-1.58)	(-1.87)	(-1.56)	(-1.46)	(-2.27)
#Obs.	468	468	468	468	468
R- Square	0.030	0.031	0.037	0.030	0.031

Table 9. Cross-Sectional Regressions of the Conflict of Interest Indices for Individual Stocks on Positive Recommendations (cont.)

The table reports coefficient estimates of the following regression:

$$CI\_IS_{k,t} = \alpha + \beta_1 Volume + \beta_2 Size + \beta_3 FREQ + \beta_4 Number + \beta_5 Beta + \beta_6 MB + \beta_7 Insider + \beta_8 FIH$$

$CI\_IS_{k,t}$ is the conflict of interest indices for individual stocks t trading weeks before and after the recommendation. *Volume* is the average daily trading volume of the recommended security, *Size* is the market value of the recommended firm, *FREQ* is the frequency with which the particular stock is recommended by all investment banks, *Number* is the number of peer firms in the same industry, *Beta* is the systematic risk of the recommended stock, *MB* is the market-to-book ratio, *Insider* is the percentage of shares held by directors or senior officers and *FIH* is the percentage of shares held by foreign investors. *t*-statistics are reported in parentheses. Significance at the 1, 5, and 10% levels is denoted by ***, **, and *, respectively.

Panel B: Upgrade recommendation

	$CI\_IS_{k,1}$	$CI\_IS_{k,2}$	$CI\_IS_{k,3}$	$CI\_IS_{k,4}$	$CI\_IS_{k,8}$
Intercept	-0.763	4.900	10.11**	8.129	21.09***
	(-0.25)	(1.06)	(2.01)	(1.34)	(2.77)
Volume	0.162	0.607	1.092	1.301	1.638
	(0.31)	(0.75)	(1.24)	(1.23)	(1.23)
Size	-0.184	-0.927	-1.543*	-1.564	-3.079**
	(-0.38)	(-1.25)	(-1.91)	(-1.61)	(-2.52)
FREQ	0.021	0.077	0.133	0.149	0.235*
	(0.40)	(0.96)	(1.52)	(1.41)	(1.78)
Number	-0.003	-0.009	-0.012	-0.013	-0.022
	(-0.59)	(-0.96)	(-1.17)	(-1.08)	(-1.42)
Beta	1.813	0.546	-2.54	-2.745	-4.142
	(0.93)	(0.18)	(-0.79)	(-0.70)	(-0.84)
MB	-0.179	-0.271	0.017	0.257	0.463
	(-0.67)	(-0.65)	(0.04)	(0.47)	(0.68)
Insider	0.003	-0.004	-0.026	-0.024	-0.021
	(0.17)	(-0.11)	(-0.69)	(-0.53)	(-0.36)
FIH	0.020	-0.004	-0.000	-0.004	0.010
	(0.70)	(0.41)	(-0.00)	(-0.08)	(0.14)
#Obs.	276	276	276	276	276
R- Square	0.014	0.023	0.037	0.024	0.042

Table 10. Cross-Sectional Regressions of the Conflict of Interest Indices for Individual Stocks on Negative Recommendations.

The table reports coefficient estimates of the following regression:

$$CI\_IS_{i,t} = \alpha + \beta_1 Volume + \beta_2 Size + \beta_3 FREQ + \beta_4 Number + \beta_5 Beta + \beta_6 MB + \beta_7 Insider + \beta_8 FIH$$

$CI\_IS_{k,t}$ is the conflict of interest indices for individual stocks t trading weeks before and after the recommendation. *Volume* is the average daily trading volume of the recommended security, *Size* is the firm's market value, *FREQ* is the frequency with which the particular stock is recommended by all investment banks, *Number* is the number of peer firms in the same industry, *Beta* is the systematic risk of the recommended stock, *MB* is the market-to-book ratio, *Insider* is the percentage of shares held by directors or senior officers and *FIH* is the percentage of shares held by foreign investors. *t*-statistics are reported in parentheses. Significance at the 1, 5, and 10% levels is denoted by ***, **, and *, respectively.

Panel A: Sell recommendation

	$CI\_IS_{k,1}$	$CI\_IS_{k,2}$	$CI\_IS_{k,3}$	$CI\_IS_{k,4}$	$CI\_IS_{k,8}$
Intercept	-0.187	-10.09	-7.918	3.393	12.42
	(-0.05)	(-1.55)	(-0.83)	(0.30)	(0.71)
Volume	0.244	1.093	0.366	-0.403	-1.439
	(0.38)	(1.02)	(0.23)	(-0.22)	(-0.50)
Size	-0.145	0.060	0.516	0.190	0.060
	(-0.26)	(0.07)	(0.38)	(0.12)	(0.02)
FREQ	-0.010	-0.281	-0.262	-0.143	-0.152
	(-0.08)	(-1.28)	(-0.81)	(-0.38)	(-0.26)
Number	-0.003	-0.000	-0.003	-0.006	0.002
	(-0.39)	(-0.00)	(-0.20)	(-0.26)	(0.07)
Beta	-0.094	-0.219	-0.641	-1.851	-3.562
	(-0.04)	(-0.06)	(-0.11)	(-0.28)	(-0.35)
MB	0.493	0.699	0.594	0.320	0.141
	(1.38)	(1.16)	(0.67)	(0.31)	(0.09)
Insider	-0.030	0.013	0.010	0.007	0.042
	(-1.21)	(0.32)	(0.16)	(0.10)	(0.37)
FIH	-0.038	-0.031	-0.006	-0.014	0.066
	(-1.10)	(-0.54)	(-0.08)	(-0.14)	(0.42)
#Obs.	162	162	162	162	162
R- Square	0.027	0.027	0.013	0.006	0.013

Table 10. Cross-Sectional Regressions of the Conflict of Interest Indices for Individual Stocks on Negative Recommendations (cont.)

The table reports coefficient estimates of the following regression:

$$CI\_IS_{k,t} = \alpha + \beta_1 Volume + \beta_2 Size + \beta_3 FREQ + \beta_4 Number + \beta_5 Beta + \beta_6 MB + \beta_7 Insider + \beta_8 FIH$$

$CI\_IS_{k,t}$ is the conflict of interest indices for individual stocks *t* trading weeks before and after the recommendation. *Volume* is the average daily trading volume of the recommended security, *Size* is the firm's market value, *FREQ* is the frequency with which the particular stock is recommended by all investment banks, *Number* is the number of peer firms in the same industry, *Beta* is the systematic risk of the recommended stock, *MB* is the market-to-book ratio, *Insider* is percentage of shares held by directors or senior officers. *FIH* is the percentage of shares held by foreign investors. *t*-statistics are reported in parentheses. Significance at the 1, 5, and 10% levels is denoted by ***, **, and *, respectively.

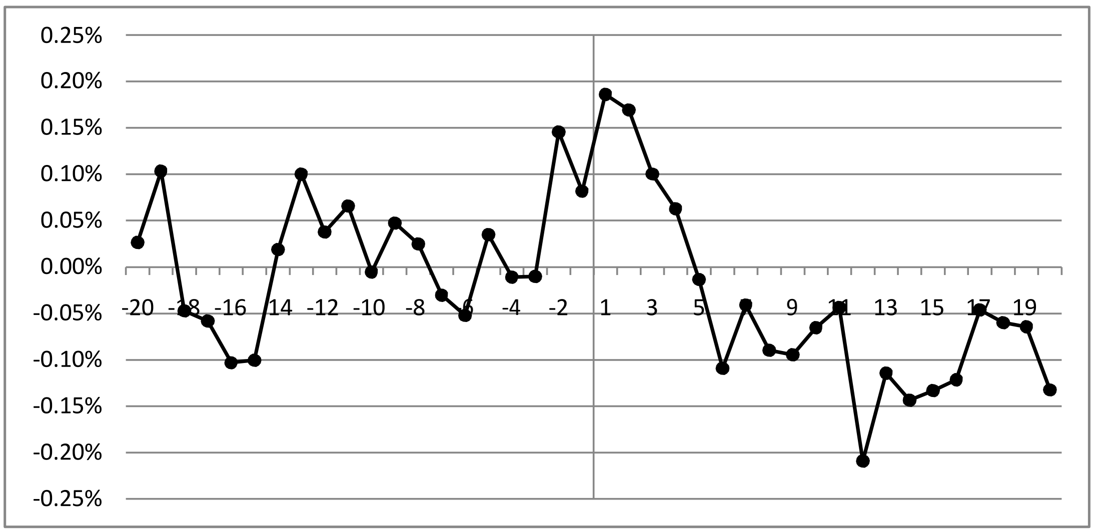
Panel B: Downgrade recommendation

	$CI\_IS_{k,1}$	$CI\_IS_{k,2}$	$CI\_IS_{k,3}$	$CI\_IS_{k,4}$	$CI\_IS_{k,8}$
Intercept	-2.775	-1.723	-2.754	-0.949	-28.61
	(-1.58)	(-0.45)	(-0.59)	(-0.19)	(-1.60)
Volume	0.225	0.716	0.680	0.208	5.011
	(0.74)	(1.08)	(0.85)	(0.24)	(1.62)
Size	0.378	-0.096	0.137	0.380	0.402
	(1.37)	(1.24)	(0.19)	(0.48)	(0.14)
FREQ	-0.032	-0.002	0.022	0.041	-0.204
	(-1.04)	(-0.04)	(0.27)	(0.47)	(-0.64)
Number	0.008**	0.009	0.012	0.006	0.038
	(2.52)	(1.24)	(1.29)	(0.66)	(1.09)
Beta	-3.157***	-4.726**	-6.635**	-6.590**	-18.20*
	(-2.99)	(-2.06)	(-2.37)	(-2.16)	(-1.69)
MB	-0.031	0.169	0.134	-0.027	1.271
	(-0.21)	(0.51)	(0.33)	(-0.06)	(0.82)
Insider	0.011	0.022	0.042	0.052	0.004
	(0.92)	(0.82)	(1.28)	(1.43)	(0.03)
FIH	0.003	0.005	0.019	0.022	-0.075
	(0.22)	(0.17)	(0.46)	(0.48)	(-0.46)
#Obs.	324	324	324	324	324
R- Square	0.063	0.018	0.031	0.035	0.022

Figure 1. Abnormal returns and cumulative abnormal returns around positive announcements from buy recommendations.

This figure shows the average estimated abnormal returns (Graph A) and cumulative abnormal returns (Graph B) around positive announcements from buy recommendations based on the event study method. The recommendation date is defined as the event day, the estimation period is 250 trading days, and the event window is 20 trading days before and after the buy recommendation. The Taiwan Volume-Weighted Index is used as a market proxy .

Graph A. Abnormal returns of recommended stocks over 40 trading days around buy recommendation.



Graph B. Cumulative abnormal returns of recommended stocks over 40 trading days around buy recommendations.

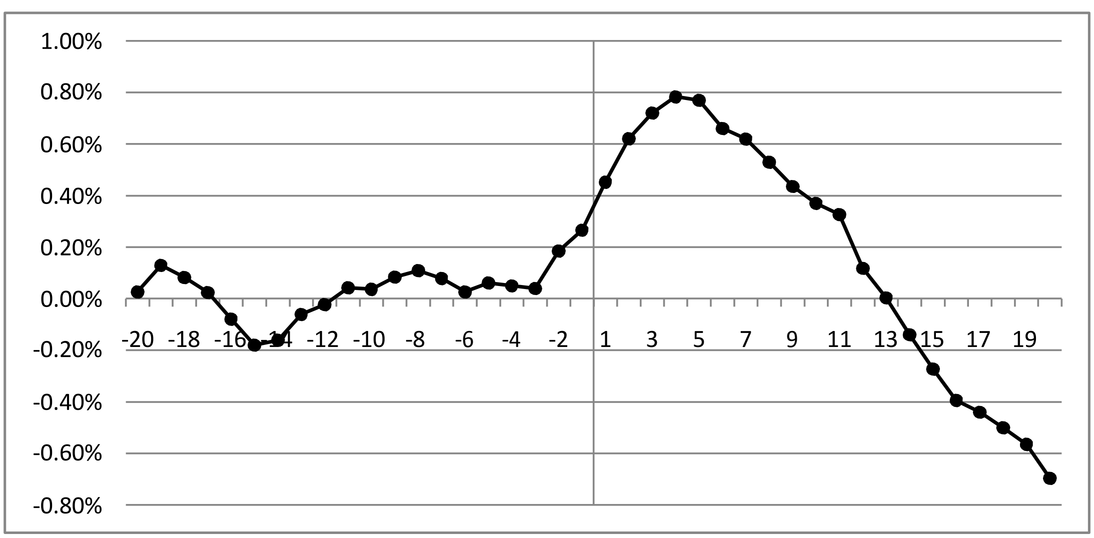
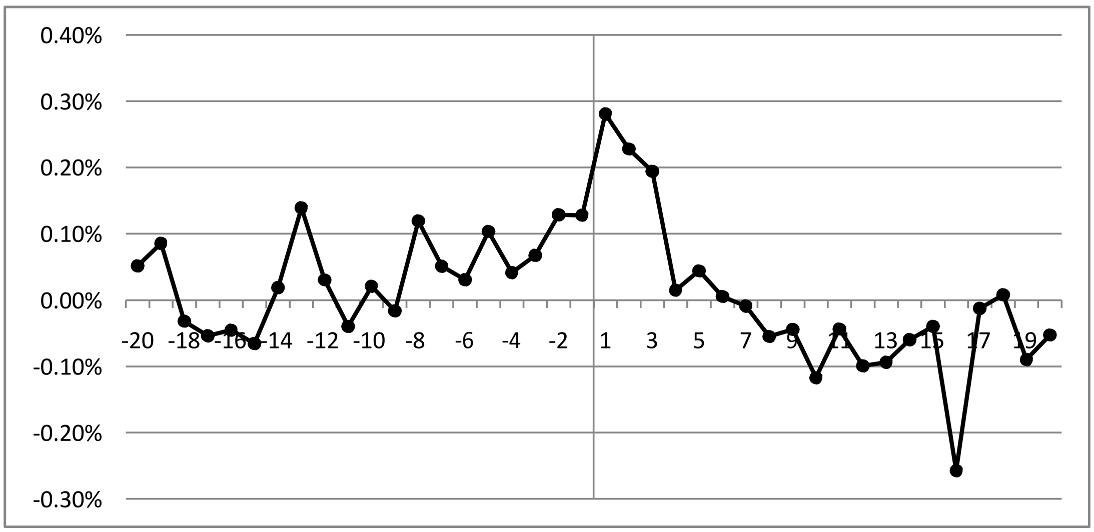


Figure 2. Abnormal returns and cumulative abnormal returns around positive announcements from upgrade recommendations.

This figure shows the average estimated abnormal returns (Graph A) and cumulative abnormal returns (Graph B) around positive announcements from upgrade recommendations based on the event study method. The recommendation date is defined as the event day, the estimation period is 250 trading days, and the event window is 20 trading days before and after the upgrade recommendation. The Taiwan Volume-Weighted Index is used as a market proxy.

Graph A. Abnormal returns of recommended stocks over 40 trading days around upgrade recommendations.

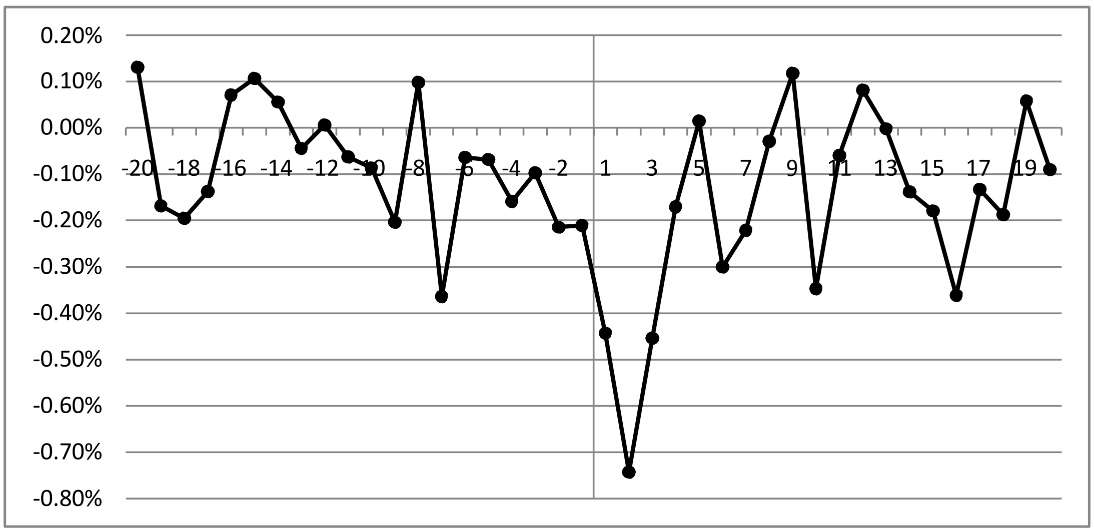


Graph B. Cumulative abnormal returns of recommended stocks over 40 trading days around upgrade recommendations.

Figure 3. Abnormal returns and cumulative abnormal returns around negative announcements from sell recommendations.

This figure shows the average estimated abnormal returns (Graph A) and cumulative abnormal returns (Graph B) around negative announcements from sell recommendations based on the event study method. The recommendation date is defined as the event day, the estimation period is 250 trading days, and the event window is 20 trading days before and after the buy recommendation. The Taiwan Volume-Weighted Index is used as a market proxy.

Graph A. Abnormal returns of recommended stocks over 40 trading days around sell recommendations.



Graph B. Cumulative abnormal returns of recommended stocks over 40 trading days around sell recommendations.

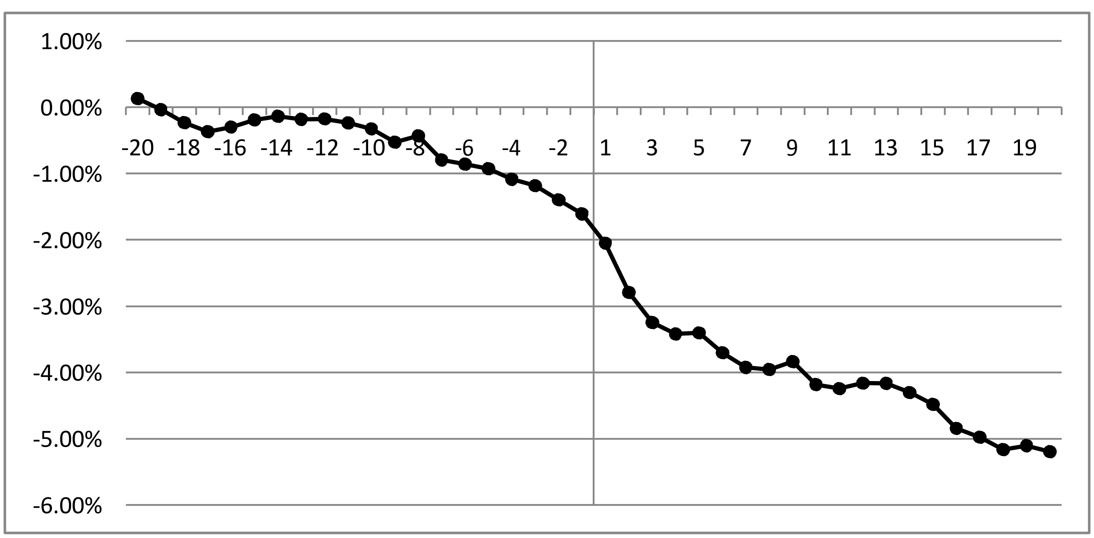
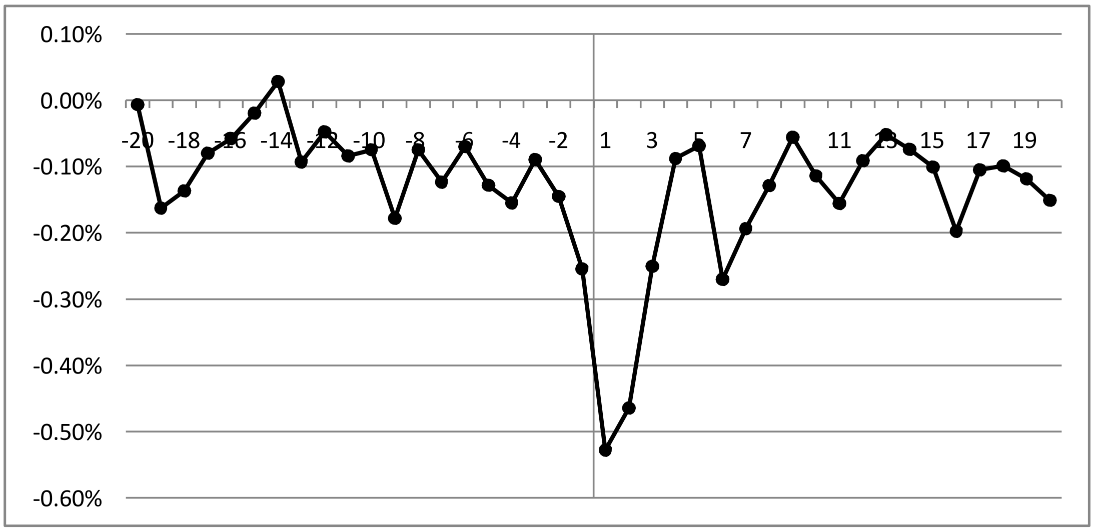


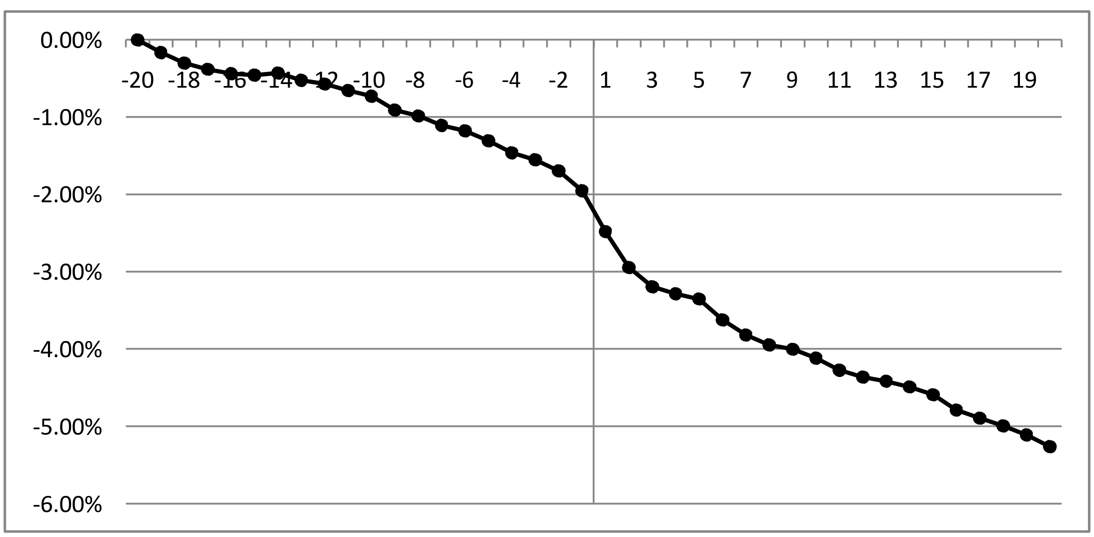
Figure 4. Abnormal returns and cumulative abnormal returns around negative announcements from downgrade recommendations.

This figure shows the average estimated abnormal returns (Graph A) and cumulative abnormal returns (Graph B) around negative announcements from downgrade recommendations based on the event study method. The recommendation date is defined as the event day, the estimation period is 250 trading days, and the event window is 20 trading days before and after the recommendation. The Taiwan Volume-Weighted Index is used as a market proxy.

Graph A. Abnormal returns of recommended stocks over 40 trading days around downgrade recommendations.



Graph B. Cumulative abnormal returns of recommended stocks over 40 trading days around downgrade recommendations.



Appendix

Table A.1. Brokerage list

Table A.1 shows investment banks from the sample as listed in the I/B/E/S and TEJ databases. Yuanta Core Pacific Securities merged with Fuhwa Financial Holdings on 2 April 2007 under Yuanta Financial Holdings, and the merged company was renamed Yuanta Securities on 23 September 2007. Barits Securities Corporation changed its name to Mega Securities on 26 June 2006.

	Name	I/B/E/S Name	I/B/E/S Code	Home Market Code
1	Polaris Securities	POLARIS	00004150	2854
2	MasterLink Securities Corporation	MASTERFA	00004213	2856
3	Daiwa Securities Group Inc.	DAIWAFA	00000663	30135
4	Barits Securities Corp.	BARITSFA	00004200	30634
5	Mega Securities	BARITSFA	00004200	30700
6	JP Morgan Taiwan Securities Ltd.	JPMORGAN	00001243	30844
7	E.SUN Securities	ESUN	00038826	30884
8	Yuanta Securities	YUANTA	00005137	30982
9	Yuanta Core Pacific Securities	YUANTA	00005137	6004
10	Fubon Securities	FUBON	00005486	6007
11	Jih Sun Securities	JIHSUN	00038207	6014

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Managerial Talent and Hedge Fund Performance

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We propose a new measure of managerial skill based on the maximum monthly returns of hedge funds over a fixed time interval and test if this new measure (MAX) is an indicator of greater managerial talent leading to superior fund performance. We find significant cross-sectional variations and persistence in MAX. Our main finding indicates that hedge funds in the highest MAX quintile generate 8.4% more annual returns compared to funds in the lowest MAX quintile. After controlling for a large set of fund characteristics, risk factors, and past performance measures, the positive relation between MAX and future returns remains highly significant. We also show that the directional and semi-directional hedge fund managers can predict and exploit changes in the market and economic conditions by increasing (decreasing) fund exposures to risk factors when market risk and/or economic uncertainty is high (low). However, mutual funds do not have market- or macro-timing ability. Thus, we find no evidence of a significant link between managerial talent of mutual fund managers and their future returns. Overall, the results indicate that the predictive power of MAX over future returns for hedge funds is driven by superior timing ability and better managerial skills of hedge funds.

Keywords: hedge funds; mutual funds; managerial skill; return predictability.

JEL Classifications: G10, G11, C13

1. Introduction

Having experienced significant growth over the past two decades, the hedge fund industry plays an important role in investment decisions of a wide variety of investors. As the hedge fund industry grows, there is increasing interest in developing criteria for selecting talented hedge fund managers. Recent studies provide evidence for the presence of professional fund managers in the marketplace that can provide value above and beyond a passively managed fund. However, proponents of passive money management believe the active management industry provides no value-added, because fund managers lack investment-picking skills. This constituency believes markets are efficient; superior performance of hedge funds is attributed to pure randomness (luck), whereas funds that underperform are considered unlucky. However, if we assume markets are perfectly efficient and active managers lack skill, we must simultaneously assume that institutional and (wealthy) individual investors investing in active hegde funds are completely irrational. Despite little evidence of timing ability previously documented for mutual funds, we show that the hedge fund industry with dynamic trading strategies does possess strong market- and macro-timing ability. Hence, we believe both the efficient market and the completely irrational investor hypotheses are farfetched.

Managerial skills are what the manager uses to assist the fund in accomplishing its goals. Specifically, a fund manager will make use of his or her own abilities, knowledge base, experiences, and perspectives to increase the productivity of those with whom they manage. In order to perform their job effectively, fund managers need strong technical, human, and conceptual skills. In this paper, we argue that the value of a talented hedge fund manager is driven by the private, unique information she brings to the investment process. Only unique investment ideas with dynamic trading strategies are likely to generate superior performance because any potential abnormal return resulting from a well-known, heavily traded strategy is likely to be arbitraged away. Therefore, identifying professional fund managers with strong managerial skills and unique investment ideas is crucial for hedge fund investors who pay high fees for superior performance.

If one thinks of hedge fund managers as skilled professionals whose job involves gathering and analyzing data, it seems reasonable to hypothesize that some fund managers may perform better than others. We examine whether superior hedge fund performance is related to characteristics of fund managers identified by strong market- and macro-timing ability and suberp knowledge of financial markets, proxied by frequent use of dynamic trading strategies with derivatives, short-selling, and leverage. In particular, we study the cross-sectional relation between future fund returns and the manager's extreme past positive performance. We introduce a new measure of managerial skill based on the maximum monthly returns of hedge funds over a fixed time interval and test if this new measure is an indicator of greater managerial talent leading to superior fund performance in the future.

We investigate whether the extremely large positive returns observed over the past six to 24 months predict future performance of individual hedge funds. First, we conduct univariate portfolio-level analysis. For each month from January 1995 to December

2014, we form quintile portfolios by sorting individual hedge funds based on their maximum monthly return (MAX) over a specified period, where quintile 1 contains the hedge funds with the lowest MAX and quintile 5 contains the hedge funds with the highest MAX. We find that the average return difference between quintiles 5 and 1 is 0.70% per month and highly statistically significant, indicating that hedge funds in the highest MAX quintile (funds with strong managerial skill) generate 8.4% more annual returns compared to funds in the lowest MAX quintile (funds with weak managerial skill). After controlling for Fama-French-Carhart's four factors of market, size, book-to-market, and momentum as well as Fung-Hsieh's five trend-following factors on currency, bond, commodity, short-term interest rate, and stock index, the return spread between the high-MAX and low- MAX funds (9-factor alpha) remains positive, 0.47% per month, and highly significant.

Next, we provide results from the bivariate portfolios of MAX and competing proxies of managerial skill. Specifically, after controlling for the past 12-month average return, standard deviation, Sharpe ratio, appraisal ratio, incentive fee, and net fund flows in bivariate sorts, MAX remains a significant predictor of future fund returns. The univariate and bivariate portfolio-level analyses clearly indicate that managerial skill is an important determinant of future fund performance and MAX is a distinct, persistent measure of managerial talent containing orthogonal information to alternative measures such as the Sharpe ratio, appraisal ratio, incentive fee, and fund flows.

In addition to these portfolio-level analyses, we run fund-level cross-sectional regressions to control for multiple effects simultaneously. In multivariate Fama-MacBeth (1973) regressions, we control for lagged returns, standard deviation, Sharpe ratio, appraisal ratio, and a large set of fund characteristics (age, size, management fee, incentive fee, redemption period, minimum investment amount, lockup and leverage structures). Even after controlling for this large set of fund characteristics, past performance, and alternative measures of managerial skill simultaneously, the significantly positive link between MAX and future fund returns remains highly significant in multivariate Fama-MacBeth regressions. We also perform subsample analyses and find that these regression results are robust across different sample periods and different states of the economy. Thus, both Fama-MacBeth regressions and portfolio-level analyses provide strong corroborating evidence for an economically and statistically significant positive relation between MAX and future hedge fund returns.

Hedge funds have various trading strategies; some willingly take direct market exposure and risk (directional strategies), while some try to minimize market risk altogether (non-directional strategies), and some try to diversify market risk by taking both long and short, diversified positions (semi-directional strategies). After classifying hedge funds into these three groups, we test whether the predictive power of MAX changes among different hedge fund investment styles. The results indicate that the predictive power of MAX gradually increases as we move from the least directional strategies to the most directional strategies. We obtain the highest predictive power of MAX for the directional strategies because the directional funds with higher MAX and stronger managerial skill employ a wide variety of dynamic trading strategies and make extensive use of derivatives, short-selling, and leverage, compared to the non-directional funds with lower MAX and weaker managerial skill.

We also investigate whether hedge funds have the ability to time fluctuations in the equity market and macroeconomic fundamentals. Henriksson-Merton (1981) pooled panel regression results show that the directional funds are willingly take direct exposure to financial and macroeconomic risk factors, relying on their market- and macro-timing ability to generate superior returns. Since these are funds with dynamic trading strategies frequently using derivatives/leverage that are highly exposed to market risk and economic uncertainty, timing the switch in economic trends is essential to their success. Hence, our main finding indicating a stronger link between MAX and future returns for the directional funds with stronger managerial skill can be attributed to the evidence of superior market- and macro-timing ability of directional hedge fund managers.

We provide an alternative explanation for the superior performance of the directional and semi- directional hedge funds by replicating our main analyses for the mutual fund industry. We first investigate whether managerial skill of mutual fund managers (proxied by the maximum monthly return of mutual funds over the past one year) predicts their future returns. Then, we analyze whether mutual funds have the ability to time fluctuations in the equity market and macroeconomic uncertainty. Since mutual funds do not use dynamic trading strategies and tend to invest primarily on the long side without extensively using other tools (e.g., derivatives, leverage, and short-selling), the results provide no evidence for a significant link between managerial talent of mutual fund managers and their future returns. We also show that while the directional and semi-directional hedge fund managers have the ability to time changes in the market and macroeconomic fundamentals by increasing (decreasing) fund exposure to risk factors when market risk and/or economic uncertainty is high (low), mutual funds, as in the case of the non-directional hedge funds, do not have significant market- or macro-timing ability.

Finally, we examine whether investors take differences in managerial skill into account and find that the ability of high-MAX funds to produce higher returns motivates those hedge fund managers to charge higher management and incentive fees to their clients, compared to the low-MAX funds with weak managerial skill. In addition, we show that the high-MAX funds are able to attract higher inflows as well. These two results suggest investors' preference for the high-MAX funds. That is, funds with high-MAX are rewarded with higher fees and also their flows, as a percentage of assets, are significantly greater. This is most probably due to the fact that investors learn about managerial skills and they are indeed willing to pay higher fees and invest more in the high-MAX funds under the expectation of receiving large positive returns in the future.

This paper proceeds as follows. Section 2 provides a literature review. Section 3 describes the data and variables. Section 4 presents the empirical results and provides a battery of robustness checks. Section 5 examines the predictive power of managerial skill for directional, semi-directional, and non-directional hedge funds and sets forth market- and macro-timing tests. Section 6 compares and contrasts hedge funds with mutual funds to provide an alternative way to explain superior performance of directional hedge funds with stronger managerial skill. Section 7 concludes the paper.

2. Literature Review

The concept of sophisticated investors has been widely investigated in empirical asset pricing and corporate finance literatures. Whether such investors with strong manageral skills exist and whether they outperform others has been the subject of debate for at least a few decades, particularly in the literature on mutual funds.[1] While a vast number of performance measures has been proposed and extensively used to identify successful mutual fund managers, several studies question whether these measures actually capture managerial skills, given existing alternative explanations, such as luck (e.g., Kosowski et al. (2006)), model misspecification (e.g., Pastor and Stambaugh (2002), Avramov and Wermers (2006)), survivorship bias (e.g., Brown, Goetzmann, Ibbotson, and Ross (1992) and Brown and Goetzmann (1995)), or weak statistical power of empirical tests undermining the source of high performance (e.g., Kothari and Warner (2001)). Different from the aforementioned literature on mutual funds, our objective is to measure the strength of managerial skill for individual hedge funds and then test whether superior hedge fund performance is related to talent of hedge fund managers.

This paper contributes to the growing literature on the cross-sectional determinants and predictors of hedge fund performance.[2] Bali, Brown, and Caglayan (2011) find a positive (negative) and significant link between default premium beta (inflation beta) and future hedge fund returns. Funds in the highest default premium beta quintile generate 5.8% higher annual returns compared to funds in the lowest default premium beta quintile. Similarly, the annual average return of funds in the lowest inflation beta quintile is 5% higher than the annual average return of funds in the highest inflation beta quintile. Titman and Tiu (2011) find that better-informed hedge funds choose to have less exposure to factor risk. Consistent with their argument, they find that hedge funds that exhibit lower R-squareds with respect to systematic factors have higher Sharpe ratios, higher information ratios, and higher alphas. Sun, Wang, and Zheng (2012) construct a measure of the distinctiveness of a fund's investment strategy (*SDI*) and find that higher *SDI* is associated with better subsequent performance of hedge funds. Bali, Brown, and Caglayan (2012) introduce a comprehensive measure of systematic risk for individual hedge funds by breaking up total risk into systematic and residual risk components. They find that systematic variance is a highly significant factor in explaining the dispersion of cross-sectional returns, while at the same time measures of residual risk and tail risk have little explanatory power. Cao, Chen, Liang, and Lo (2013) investigate how hedge funds manage their liquidity risk by responding to aggregate liquidity shocks. Their results indicate that hedge fund managers have the ability to time liquidity by increasing portfolio market exposure when equity market liquidity is high.

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[1] See Fama and French (2010) and the references therein.

[2] A partial list includes Fung and Hsieh (1997, 2000, 2001, 2004), Ackermann, McEnally, and Ravenscraft (1999), Liang (1999, 2001), Mitchell and Pulvino (2001), Agarwal and Naik (2000, 2004), Kosowski, Naik, and Teo (2007), Bali, Gokcan, and Liang (2007), Fung et al. (2008), Patton (2009), Jagannathan, Malakhov, and Novikov (2010), Aggarwal and Jorion (2010), Brown, Gregoriou, and Pascalau (2012), and Patton and Ramadorai (2013).

This study is also related to an extensive literature on market-timing ability of mutual funds. Following the pioneering work of Treynor and Mazuy (1966), a large number of studies investigated timing ability of professional fund managers. With a few exceptions, most of the earlier work focused on the mutual fund sample and find little evidence of market-timing ability.[3] Only recently, a few studies have investigated whether individual hedge funds have the ability to time fluctuations in the equity market, aggregate market liquidity, and macroeconomic fundamentals.[4]

Motivated by existing evidence of a preference among investors for assets with lottery-like payoffs and that many investors are poorly diversified, Bali, Cakici, and Whitelaw (2011) investigate the significance of extreme positive returns in the cross-sectional pricing of individual stocks and find a significantly negative relation between the maximum daily return over the past one month and expected stock returns. The low (high) abnormal returns of stocks with high (low) market beta – known as the betting against beta (BAB) effect – is the most persistent anomaly in empirical asset pricing literature. Bali, Brown, Murray, and Tang (2015) show that the BAB phenomenon disappears after controlling for persistent lottery characteristics of the stocks, while other measures of firm characteristics and risk fail to explain the effect. When we use the term MAX in this paper, we inevitably draw a reference to Bali, Cakici, and Whitelaw (2011) and Bali, Brown, Murray, and Tang (2015). However, the term MAX used by Bali et al. (2011, 2015) is to identify demand for lottery-like stocks, whereas in this paper it is used as a proxy for managerial talent leading to superior fund performance.[5] More importantly, in this paper, we investigate the in-sample MAX of hedge funds' managed portfolios, whereas Bali et al. (2011, 2015) examine the MAX of portfolios chosen by reference to the prior MAX of their constituent assets. Specifically, we explore the cross-sectional link between managerial talent and timing ability, and their impacts on future returns of hegde funds and mutual funds. Hence, the paper makes a significant contribution to the aforementioned comprehensive literatures on managerial skill, market-timing, and the cross-sectional determinants of fund performance.

3. Data and Variables

In this section, we first describe the hedge fund database, fund characteristics, and their summary statistics. Then, we provide definitions of key variables used in the cross-sectional predictability of future fund returns. Finally, we present the standard risk factors used in the estimation of risk-adjusted returns (alphas) of MAX-sorted portfolios.

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[3] A partial list includes Henriksson and Merton (1981), Chang and Lewellen (1984), Henriksson (1984), Admati, Bhattacharya, Pfleiderer, and Ross (1986), Jagannathan and Korajczyk (1986), Lehmann and Modest (1987), Ferson and Schadt (1996), Goetzmann, Ingersoll, and Ivkovich (2000), Bollen and Busse (2001), and Jiang, Yao, and Yu (2007).

[4] Chen and Liang (2007), Cao, Chen, Liang, and Lo (2013), and Bali, Brown, and Caglayan (2014).

[5] Also note that MAX for individual stocks is defined as the maximum daily return over the past one month, whereas MAX for hedge funds' managed portfolios is defined as the maximum monthly return over the past six to 24 months.

3.1. *Hedge fund database*

This study uses monthly hedge fund data from the Lipper TASS (Trading Advisor Selection System) database. In the database, originally we have information on a total of 19,746 defunct and live hedge funds. However, among these 19,746 funds, there are many funds that are listed multiple times as these funds report returns in different currencies, such as USD, Euro, Sterling, and Swiss Franc. These funds are essentially not separate funds, but just one fund with returns reported on a currency converted basis. In addition, typically a hedge fund has an off-shore fund and an on-shore fund, following the exact same strategy. Therefore, naturally, for all these funds their returns are highly correlated. However, the TASS database assigns a separate fund reference number to each on-shore and off-shore fund, and to each of the funds reporting in different currencies, treating these funds as separate individual funds. In order to distinguish between different share classes (of the same fund) and other actual funds, and not to use any duplicated funds (and hence returns) in our analyses, we first omit all non-USD-based hedge funds from our sample. That is, we keep in our database only the hedge funds reporting their returns in USD. Next, if a hedge fund has both an off-shore fund and an on-shore fund with multiple share classes, we keep the fund with the longest return history in our database and remove all the other share classes of that particular fund from our sample. This way, we make sure that each hedge fund is represented only once in our database. After removing all non-USD-based hedge funds and hedge funds with multiple share classes, our database contains information on a total of 11,099 distinct, non-duplicated hedge funds for the period January 1994 – December 2014, where 8,684 of them are defunct funds and the remaining 2,415 of them are live funds.

The TASS database, in addition to reporting monthly returns (net of fees) and monthly assets under management, also provides information on certain fund characteristics, including management fees, incentive fees, redemption periods, minimum investment amounts, and lockup and leverage provisions.

Table 1 provides summary statistics on hedge fund numbers, returns, assets under management (AUM), and fee structures for the sample of 11,099 hedge funds. For each year, Panel A of Table 1 reports the number of funds entering the database, the number of funds dissolved, total AUM at the end of each year (in $ billion), and the mean, median, standard deviation, minimum, and maximum monthly percentage returns on the equal-weighted hedge fund portfolio. One important characteristic about TASS is that it includes no defunct funds prior to 1994. Therefore, in an effort to mitigate potential survivorship bias in the data, we select 1994 as the start of our sample period and employ our analyses on hedge fund returns for the period January 1994–December 2014.

Table 1, Panel A reports a sharp reversal in the growth of hedge funds both in numbers and in AUM since the end of 2007, the starting point of the last worldwide financial crisis. The AUM in our database increased exponentially from a small $55 billion in 1994 to $892 billion in 2007, and the number of operating hedge funds increased almost seven times to 5,275 in December 2007 from 748 in January 1994. However, both these figures reversed course beginning with 2008, the start of the worldwide financial crisis; the number of operating hedge funds fell sharply to below

2,500, while total AUM dropped by more than half, to $405 billion by the end of December 2014. In addition, the yearly attrition rates in Panel A of Table 1 (ratio of the number of dissolved funds to the total number of funds at the beginning of the year) paints a similar picture: from 1994 to 2007, on average, the annual attrition rate in the database was only 8.1%; between 2008 and 2014, however, this annual figure increased by almost 2.4 times to 19.4%. These statistics simply reflect the severity of the financial crisis of the past seven years. In 2008 and 2011 alone, for example, hedge funds on average lost 1.56% and 0.48% (return) per month, respectively.

Panel B of Table 1 reports the cross-sectional mean, median, standard deviation, minimum, and maximum values for certain hedge fund characteristics for the period January 1994–December 2014. One interesting point evident in Panel B is the short lifespan of hedge funds. The median age (number of months in existence since inception) is only 60 months, equivalent to five years. This short lifespan is mostly due to the fact that hedge fund managers must first cover all losses from previous years before getting paid in the current year. This forces hedge fund managers to dissolve quickly and form new hedge funds after a bad year, instead of trying to cover losses in subsequent years. Another remarkable observation that can be detected from this panel is the large size disparity seen among hedge funds. When we measure fund size as average monthly AUM over the life of the fund, we see that the mean hedge fund size is $85.7 million, while the median hedge fund size is only $40.0 million. This suggests that there are a few hedge funds with very large AUM in our database, which reflects true hedge fund industry conditions.

Lastly, hedge fund studies can be subject to potential data bias issues. Brown, Goetzmann, Ibbotson, and Ross (1992), Fung and Hsieh (2000), Liang (2000), and Edwards and Caglayan (2001) cover these well-known data bias problems extensively in the hedge fund literature. The first potential data bias in a hedge fund study is the survivorship bias if the database does not include the returns of non-surviving hedge funds. In our study, for the period January 1994–December 2014, we do have monthly return histories of 2,415 funds in the live funds (survivor) database and 8,684 funds in the graveyard (defunct) database. We estimate that if the returns of non-surviving hedge funds (graveyard database) had been excluded from the analyses, there would have been a survivorship bias of 2.70% in average annual hedge fund returns. This is the difference between the annualized average return of only surviving funds in the sample and the annualized average return of all surviving and non-surviving funds in the sample.[6] However, the fact that we use the returns of defunct funds in our analyses as well, removes any potential concerns about the effect of survivorship bias on our main findings.

Another important data bias in a hedge fund study is called the back-fill bias. Once a hedge fund is included into a database, that fund's previous returns are automatically added to that database as well (this process is called "back-filling"). This practice in the hedge fund industry is problematic, because it generates an incentive only for successful

[6] This finding is comparable to earlier studies of hedge funds. Liang (2000) reports an annual survivorship bias of 2.24% and Edwards and Caglayan (2001) report an annual survivorship bias of 1.85%.

hedge funds to report their initial returns to the database vendor, and as a result, it may generate an upward bias in returns of newly reporting hedge funds during their early histories. Fung and Hsieh (2000) report that the median backfill period is about 12 months based on the TASS database from 1994 to 1998. They adjust for this bias by dropping the first 12 months of returns of all individual hedge funds in their sample and report a back-fill bias estimate of 1.4% per annum (see also Malkiel and Saha (2005) and Kosowski, Naik, and Teo (2007) for previous literature on back-fill bias and how they adjust their samples to mitigate the impact of back-fill bias on their results). In order to eliminate the potential effects of back-fill bias on our main findings, in this study we eliminate the returns of all individual hedge funds prior to the date they are added to the database. In other words, in our analyses we use the returns of hedge funds only after they are added to the TASS database.[7] During our sample period January 1994–December 2014, we measure the magnitude of the back-fill bias as 3.66% per annum, calculated as the annual average return difference between the back-fill corrected sample and the back-fill not corrected sample.

The last possible data bias in a hedge fund study is called the multi-period sampling bias. Investors generally ask for a minimum of 24 months of return history before making a decision whether to invest in a hedge fund or not. Therefore, in a hedge fund study, inclusion of hedge funds with shorter return histories than 24 months would be misleading to those investors who seek past performance data to make future investment decisions. Also, a minimum 24-month return history requirement makes sense from a statistical perspective to be able to run regressions and get sensible estimates of alphas, betas, sharpe ratios, and appraisal ratios for individual hedge funds in the sample. Therefore, we require that all hedge funds in the sample to have at least 24 months of return history in our study. This 24-month minimum return history requirement, however, decreases our sample size from 10,442 to 8,010 funds (i.e., 2,432 funds in the sample have return histories less than 24 months). There is a slight chance that we might introduce a new survivorship bias into the system due to deletion of these 2,432 hedge funds from the sample (funds that had return histories less than 24 months most probably dissolved due to bad performance). In an effort to find the impact of these deleted 2,432 hedge funds on total hedge fund performance, we compare the performance of hedge funds *before* and *after* the 24-month return history requirement. We find that the annual average return of hedge funds that pass the 24-month requirement (8,010 funds) is only 0.44% higher than the annual average return of all hedge funds (10,442 funds) in the sample. This is a small insignificant percentage difference between the two samples in terms of survivorship bias considerations.[8]

[7] In the TASS database, there are 657 hedge funds for which their entry date to the database is unknown. We remove these 657 hedge funds from our sample; as a result the total sample size is reduced to 10,442 funds from 11,099 funds.

[8] This figure is similar to the estimates from earlier studies. Edwards and Caglayan (2001) also impose a 24-month return history requirement and find a small survivorship bias estimate of 0.32%. Fung and Hsieh (2000), on the other hand, impose a 36-month return history requirement and find the survivorship bias estimate to be 0.60%.

3.2. *Variable definitions*

In the literature, managerial skill of hedge funds has been proxied by traditional measures of performance such as the CAPM alpha, the Sharpe ratio and the appraisal ratio. In addition to these risk- adjusted return measures, incentive fee and fund flows can be viewed as alternative proxies for managerial skill. This paper introduces a new measure of managerial talent based on the maximum monthly returns of funds over a fixed time interval and examines if the new measure can be considered a sign of successful fund managers leading to superior performance.

MAX: We use five alternative measures of extreme hedge fund returns (MAX) to proxy for managerial skill. MAX6, MAX9, MAX12, MAX18, and MAX24 represent the maximum monthly hedge fund returns over the past 6, 9, 12, 18, and 24 months, respectively.

Control Variables: We use a large set of fund characteristics, past return, volatility, and risk-adjusted return measures to test whether the predictive power of MAX is driven by these potential cross-secitonal predictors. Specifically, we use *Size* measured as monthly assets under management in billions of dollars; *Age* measured as the number of months in existence since inception; *Flow* measured as the change in the assets under management from previous month to current month adjusted with fund returns and scaled with previous month's assets under management;[9] *IncentFee* measured as a fixed percentage fee of the fund's annual net profits above a designated hurdle rate; *MgtFee* measured as a fixed percentage fee of assets under management, typically ranging from 1% to 2%; *MinInvest* measured as the minimum initial investment amount (measured in millions of dollars in the regression) that the fund requires from its investors to invest in a fund; *Redemption* measured as the minimum number of days an investor needs to notify a hedge fund before the investor can redeem the invested amount from the fund; *DLockup* measured as the dummy variable for lockup provisions (1 if the fund requires investors not able to withdraw initial investments for a pre-specified term, usually 12 months, 0 otherwise); and *DLever* measured as the dummy variable for leverage (1 if the fund uses leverage, 0 otherwise).

In addition to these large set of fund characteristics, in our analyses, we also control for alternative performance measures, including the one-month lagged return (*LagRet*), the past 12-month average return (*AVRG*), the past 12-month standard deviation (*STDEV*), the past 12-month Sharpe ratio (*SR*) computed as the past 12-month average excess return divided by the past 12-month standard deviation, and the appraisal ratio (*AR*) obtained from the 9-factor model of Fama-French (1993), Carhart (1997), and Fung and Hsieh (2001):

$$R_{i,t} = \alpha_i + \beta_{1,i} \cdot MKT_t + \beta_{2,i} \cdot SMB_t + \beta_{3,i} \cdot HML_t + \beta_{4,i} \cdot MOM_t + \beta_{5,i} \cdot FXTF_t + \beta_{6,i} \cdot BDTF_t + \beta_{7,i} \cdot CMTF_t + \beta_{8,i} \cdot IRTF_t + \beta_{9,i} \cdot SKTF_t + \varepsilon_{i,t} \quad (1)$$

[9] Fund flow is defined as $\{Assets_t - [(1+Return_t) \cdot Assets_{t-1}]\} / Assets_{t-1}$.

where MKT_t, SMB_t, HML_t, and MOM_t are the four factors of Fama-French (1993) and Carhart (1997), and $FXTF_t$, $BDTF_t$, $CMTF$, $IRTF$, and $SKTF$ are the five trend-following factors of Fung and Hsieh (2001). The unsystematic (or fund-specific) risk of fund i is measured by the standard deviation of $\varepsilon_{i,t}$ in eq. (1) denoted by $\sigma_{\varepsilon,i}$. The appraisal ratio (AR) is used to determine the quality of a fund's investment picking ability. It compares the fund's alpha (α_i) to the portfolio's unsystematic risk: $AR_i = \alpha_i / \sigma_{\varepsilon,i}$ [10]

3.3. *Risk factors*

We rely on the widely-accepted nine factors when computing the risk-adjusted return of MAX- sorted portfolios. Specifically, we use the market, size, book-to-market, and momentum factors of Fama and French (1993) and Carhart (1997) as well as five trend-following factors of Fung and Hsieh (2001) on currency, bond, commodity, short-term interest rate, and stock index. The market factor (MKT) of Fama- French is the value-weighted NYSE/AMEX/NASDAQ (CRSP) market index return in excess of the risk-free rate (one-month T-bill rate). The size factor (SMB) is the return of a zero-cost long-short size-based portfolio that is long stocks with low market capitalization and short stocks with high market capitalization. The book-to-market factor (HML) of Fama-French is the return of a zero-cost long-short book-to-market ratio-based portfolio that is long stocks with high book-to-market ratios and short stocks with low book- to-market ratios. The momentum factor (MOM) of Carhart (1997) is the return of a portfolio that is long stocks with high momentum and short stocks with low momentum. Fung-Hsieh (2001) currency trend- following factor (FXTF) is measured as the return of PTFS (Primitive Trend Following Strayegy) Currency Lookback Straddle; bond trend-following factor (BDTF) is measured as the return of PTFS Bond Lookback Straddle; commodity trend-following factor (CMTF) is measured as the return of PTFS Commodity Lookback Straddle; short-term interest rate trend-following factor (IRTF) is measured as the return of PTFS Short Term Interest Rate Lookback Straddle; and stock index trend-following factor (SKTF) is measured as the return of PTFS Stock Index Lookback Straddle.[11]

4. Empirical Results

In this section, we investigate whether the maxium monthly return of individual hedge funds (MAX) can predict their future performance. We conduct parametric and nonparametric tests to assess the predictive power of MAX over future hedge fund

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[10] By selecting a basket of investments, the managers of an active investment fund attempt to beat the returns of a relevant benchmark or of the overall market. The appraisal ratio measures the managers' performance by comparing the return of their security picks to the specific risk of those selections. The higher the ratio, the better the performance of the manager in question.

[11] The monthly returns on four factors of Fama-French-Carhart are obtained from Kenneth French's online data library: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data library.html. The five trend-following factors of Fung and Hsieh (2001); FXTF, BDTF, CMTF, IRTF, SKTF are provided by David Hsieh at http://faculty.fuqua.duke.edu/~dah7/HFRFData.htm.

returns. First, we perform univariate portfolio-level analysis. Second, we examine the significance of cross-sectional persistence in MAX. Third, we provide average portfolio characteristics of MAX-sorted portfolios of invididual hedge funds. Fourth, we report results from bivariate portfolios of MAX and competing proxies of managerial skill. Fifth, we present results from univariate and multivariate cross-sectional regressions controlling for fund characteristics, past return, volatility, and liquidity measures. Sixth, we investigate whether the predictive power of MAX for future fund returns remains intact during subsample periods when significant structural breaks are observed. Finally, we examine the long-term predictive power of MAX.

4.1. *Univariate portfolio analysis of MAX*

For each month, from January 1995 to December 2014, we form quintile portfolios by sorting individual hedge funds based on their maximum monthly return over the past 6, 9, 12, 18, and 24 months (MAX6, MAX9, MAX12, MAX18, and MAX24), where quintile 1 contains the hedge funds with the lowest MAX and quintile 5 contains the hedge funds with the highest MAX. Table 2 shows the average MAX values and the next month average returns on MAX-sorted portfolios. The last two rows in Table 2 display the differences between quintile 5 and quintile 1 the average monthly returns and the 9-factor alphas.

The top panel in Table 2 presents the average magnitude of MAX6, MAX9, MAX12, MAX18, and MAX24 for the MAX-sorted portfolios. As expected, the maximum monthly return of hedge funds increases as the estimation window increases from 6 to 24 months. The first column in Table 2 shows that, for MAX6-sorted portfolios, the average maximum return of hedge funds over the past 6 months is 1.07% per month for quintile 1 and 12.67% per month for quintile 5. Comparing the first and last columns of the top panel in Table 2 shows that the corresponding average MAX values are considerably higher for MAX24-sorted portfolios; the average maximum return of hedge funds over the past 2 years is 2.24% per month for quintile 1 and 19.63% per month for quintile 5. Overall, the results in the top panel of Table 2 indicate substantial cross-sectional variations in all measures of MAX.

The bottom panel in Table 2 shows that for each MAX measure, moving from quintile 1 to quintile 5, the next month average return on the MAX-sorted portfolios increases monotonically, leading to an economically and statistically significant return spread between the high-MAX and low- MAX quintiles. Specifically, for MAX6-sorted portfolios, the average return increases from 0.10% to 0.91% per month, yielding a monthly average return difference of 0.81% between quintiles 5 and 1 with a Newey-West (1987) *t*-statistic of 3.85. This result indicates that hedge funds in the highest MAX quintile (funds with stronger managerial skill) generate about 9.72% more annual returns compared to funds in the lowest MAX quintile (funds with weaker managerial skill). Similar return spreads are obtained from other measures of MAX as well. The average return difference between quintiles 5 and 1 is 0.75% per month (*t*-stat. = 3.79) for MAX9-sorted portfolios, 0.70% per month (*t*-stat. = 3.48) for MAX12-sorted portfolios, 0.56%

per month (t-stat. = 3.08) for MAX18-sorted portfolios, and 0.53% per month (t-stat. = 2.94) for MAX24- sorted portfolios.

We also check whether the significant return spread between high-MAX and low-MAX funds is explained by Fama-French-Carhart's four factors of market, size, book-to-market, and momentum as well as Fung-Hsieh's five trend-following factors on currency, bond, commodity, short-term interest rate, and stock index. As shown in the last row of Table 2, the 9-factor alpha difference between quintiles 5 and 1 is positive and significant for all measures of MAX. Specifically, the risk-adjusted return spread between quintiles 5 and 1 is 0.55% per month (t-stat. = 2.87) for MAX6-sorted portfolios, 0.50% per month (t-stat.= 2.70) for MAX9-sorted portfolios, 0.47% per month (t-stat. = 2.44) for MAX12-sorted portfolios, 0.37% per month (t-stat. = 1.99) for MAX18-sorted portfolios, and 0.34% per month (t-stat. = 1.80) for MAX24-sorted portfolios. These results suggest that after controlling for the well-known factors, the return spread between high-MAX and low-MAX funds remains positive and significant.[12]

Next, we investigate the source of the raw and risk-adjusted return difference between the high- MAX and low-MAX portfolios: Is it due to outperformance by high-MAX funds, underperformance by low-MAX funds, or both? For this, we compare the economic and statistical significance of the average returns and the 9-factor alphas of quintile 1 vs. quintile 5. Panel A of Table 3 shows for MAX12-sorted portfolios that the average return and the 9-factor alpha of quintile 1 are 0.09% and –0.01% per month, with t-statistics of 1.08 and –0.20, respectively, indicating that the average raw and risk-adjusted returns of the low-MAX funds are economically and statistically insignificant. On the other hand, the average return and the 9-factor alpha of quintile 5 are 0.79% and 0.46% per month with t-statistics of 3.13 and 2.25, respectively, implying economically large and statistically significant positive returns for the high-MAX funds. These results provide evidence that the positive and significant return spread between the high-MAX and low-MAX funds is due to outperformance by the high-MAX funds with stronger managerial skill, but not due to underperformance by the low-MAX funds.[13]

In addition to the average raw returns and alphas, we compute the annualized Sharpe ratios and the 9-factor appraisal ratios of quintiles 1 and 5.[14] The annualized Sharpe ratio is found to be 0.33 for the low- MAX funds (quintile 1) and 0.83 for the high-MAX funds

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[12] As expected, the predictive power of MAX does not remain significant when it is generated from long estimation windows because the maximum return observed in distant past does not capture future managerial skill that leads to higher future returns. For MAX24-sorted portfolios, the 9-factor alpha spread between quintiles 5 and 1 (0.34% per month) is economically significant, but it is only marginally significant with a t-statistic of 1.80. Consistent with our expectations, the predictive power of MAX becomes weaker when we extend the estimation window from 24 to 36 months.

[13] Instead of repeating the full set of analyses for all measures of MAX, we present the rest of our results based on MAX12 starting with Table 3 (and onwards). For notational simplicity, the maximum return over the past 12 months is from now on denoted by *MAX*.

[14] Brown, Goetzmann, Ibbotson, and Ross (1992) provide evidence that a fund that takes substantial risk and wins (thus earning a high MAX), that survives to a second year maintaining the same risk characteristics will either win or lose big. If these funds with high MAX lose, they may well die and so there could be a preponderance of winners conditioning on survival. Brown et al. (1992) point out a way to correct for this bias using the appraisal ratio rather than alpha. Hence, following Brown et al. (1992), we compute the appraisal ratio of MAX-sorted portfolios to address the look-ahead bias that may result from the necessity of funds surviving both a 12-month estimation period and a subsequent evaluation period.

(quintile 5). This indicates that the risk-adjusted return for the high-MAX funds is more than twice as large as that of the low-MAX funds. Similarly, the 9- factor appraisal ratio is estimated to be –0.02 for the low-MAX funds (quintile 1) and 0.21 for the high- MAX funds (quintile 5). This again implies that hedge funds with strong managerial skill generate higher risk-adjusted returns compared to funds with weak managerial skill, as the appraisal ratio measures the quality of a fund's investment-picking ability.

Proponents of passive money management believe that active portfolio managers do not provide significant value-added, because these fund managers lack asset-picking skills. This constituency believes markets are efficient; i.e., funds that outperform are considered lucky, funds that underperform are considered unlucky. However, our results suggest that there are certainly some professional money managers in the marketplace that can provide value above and beyond that can be obtained from a passively managed fund. Having said that, one may still wonder if investing in an index fund is the optimal decision for investors who lack the time and/or skills to identify skilled hedge fund managers. To test this hypothesis, we compute the annualized Sharpe ratio and the 8-factor appraisal ratio of the S&P500 index (passive money management) and then compare its risk-adjusted performance with the corresponding performance measures of the high-MAX and low-MAX funds.[15]

For the sample period of January 1995–December 2014, the annualized Sharpe ratio for the S&P500 index is estimated to be 0.52, which is 58% higher than the annualized Sharpe ratio for the low- MAX funds with weak managerial skill. This result suggests that investing in an index fund could be a better option for those investors who would only invest in hedge funds with weak managerial skill. More importantly, however, the annualized Sharpe ratio for the high-MAX funds is 60% higher than the annualized Sharpe ratio of the S&P 500 index, implying significant rewards for finding successful fund managers with strong investment-picking ability. Similar results are obtained from the 8-factor appraisal ratios as well; 0.07 for the low-MAX funds, 0.16 for the S&P500 index, and 0.27 for the high-MAX funds. Overall, these results provide evidence that active fund managers, by selecting a basket of investments, can indeed beat the overall market on a risk-adjusted return basis.

4.2. *Persistence of MAX*

Of course, the maximum return over the past 12 months documented in Panel A of Table 3 is for the portfolio formation month and, not for the subsequent month over which we measure average returns. Institutional investors as well as wealthy individual investors would like to pay high incentive and management fees for hedge funds that have exhibited high-MAX in the past in the expectation that this behavior will be repeated in the future. However, a natural question is whether these expectations are rational. Panel B of Table 3 investigates this issue by presenting the average month-to-month portfolio transition matrix. Specifically, Panel B presents the average probability that a

[15] When computing the 8-factor appraisal ratio for the S&P500 index, we use equation (1) without the market factor (MKT) since the S&P500 index is a proxy for the aggregate stock market and it is highly correlated with the value-weighted CRSP index.

hedge fund in quintile i (defined by the rows) in one month will be in quintile j (defined by the columns) in the subsequent 12 months. If MAX is completely random, then all the probabilities should be approximately 20%, since a high-MAX or low-MAX in one month should say nothing about the MAX in the following 12 months. Instead, all the top-left to bottom-right diagonal elements of the transition matrix exceed 30%, illustrating that the maximum return over the past 12 months is highly persistent even after putting a 12-month gap between the lagged and lead MAX variables. Of greater importance, this persistence is especially strong for the extreme MAX quintiles. Panel B of Table 3 shows that for the 12-month-ahead persistence of MAX, hedge funds in quintile 1 (quintile 5) have a 59.5% (58.2%) chance of appearing in the same quintile next year.

These results indicate that the estimated historical MAX successfully predicts future MAX and hence the maximum return observed over the past 12 months does capture the strength of future managerial talent leading to superior future performance.

A slightly different way to examine the persistence of MAX is to look at fund-level cross-sectional regressions of MAX on lagged predictor variables. Specifically, for each month in the sample we run a regression across funds of 12-month-ahead MAX on the current MAX and current fund characteristics:

$$R_{i,t+12} = \lambda_{0,t} + \lambda_{1,t} \cdot MAX_{i,t} + \lambda_{2,t} \cdot X_{i,t} + \varepsilon_{i,t+12}, \tag{2}$$

where $MAX_{i,t}$ is the maximum monthly return of fund i in month t over the past 12 months (from month t to t–12), $MAX_{i,t+12}$ is the 12-month-ahead MAX of fund i (from month t to t+12), and $X_{i,t}$ denotes past return, volatility, and other characteristics of fund i in month t. Specifically, $X_{i,t}$ includes the past 12-month average return (*AVRG*), the past 12-month standard deviation (*STDEV*), the past 1-month return (*LagRet*), and fund characteristics; *Size*, *Age*, *Flow*, *IncentFee*, *MgtFee*, *MinInvest*, *Redemption*, *DLockup*, and *Dlever*.

Table I in the online appendix reports the average cross-sectional coefficients from these regressions and the Newey-West adjusted t-statistics. In the univariate regression of 12-month-ahead MAX on current MAX, the average slope coefficient is positive, quite large, and extremely statistically significant, and the average R-squared of 28.5% indicates substantial cross-sectional predictive power. In other words, hedge funds with extreme positive returns over the past 12 months also tend to exhibit similar features in the following 12 months. This fund-level cross-sectional regression result confirms our finding from the portfolio-level transition matrix presented in Panel B of Table 3. When the aforementioned 12 control variables are added to the regression, the coefficient on lagged MAX remains large and highly significant (the last row in Table I). Besides MAX, of the remaining 12 variables, it is the standard deviation (*STDEV*), past 12-month average return (*AVRG*), past 1-month return (*Lagret*), and Incentive Fee (*IncentFee*) that contribute most to the preditive power of the regression, with univariate R-squareds of 6.7%, 5.6%, 4.6%, and 3.2%, respectively. The remaining 8 variables all have univariate R-squareds of less than 3%. Overall, the results in Table I indicate that the persistence of MAX is not captured by size, age, fee structure, risk/liquidity attibutes, and other characteristics of individual funds.

4.3. *Average portfolio characteristics*

To obtain a clearer picture of the composition of the MAX-sorted portfolios, Panel C of Table 3 presents summary statistics for the hedge funds in the quintiles. Specifically, Panel C reports the cross- sectional averages of various characteristics for the funds in each quintile averaged across the months. We report average values for the sort variable (the maximum return over the past 12 months denoted by *MAX*), the past 12-month return (*AVRG*), the past 12-month standard deviation (*STDEV*), the past 1-month return (*LagRet*), and fund characteristics; *Size*, *Age*, *Flow*, *IncentFee*, *MgtFee*, *MinInvest*, *Redemption*, *DLockup*, and *Dlever*.

Panel C of Table 3 shows that the high-MAX funds with stronger managerial skill have higher average 12-month return, higher 12-month standard deviation, higher past one-month return, higher incentive fee, higher management fee, larger fund flow, lower minimum investment amount, lower redemption period, and they have more frequent use of leverage. However, there is no clear pattern between MAX and fund size, fund age, and lockup. These average portfolio characteristics economicaly make sense because funds with stronger managerial skill (on average) outperform funds with weaker managerial skill. The ability of the high-MAX funds to produce higher returns motivates them to charge higher management and incentive fees to their clients, compared to the low-MAX funds with weak managerial skill. The high- MAX funds also attract more capital. Accodingly, their clients are indeed willing to pay higher fees and invest more in the high-MAX funds under the expectation of getting higher returns in the future. The findings in Panel C of Table 3 also suggest that the high-MAX funds have more frequent use of dynamic trading strategies with derivatives and leverage, which may enable them to possess better market-timing and macro-timing ability.[16] Hence, the monthly returns of the high-MAX funds have higher volatility than those of the low-MAX funds.

These results also indicate that the cross-sectional predictive power of the maximum return over the past 12 months (used as a proxy for managerial skill) can be driven by its correlation with AVRG, STDEV, LagRet, IncentFee, MgmtFee, Flow, MinInvest, Redemption, and/or Dlever. We address this potential concern in the following two sections by providing different ways of dealing with the potential interaction of MAX with the aforementioned fund characteristics and risk factors. Specifically, we test whether the positive relation between MAX and the cross-section of hedge fund returns still holds once we control for these variables using bivariate portfolio sorts and Fama-MacBeth (1973) regressions.

4.4. *Bivariate portfolio analysis of MAX and alternative measures of managerial skill*

In this section, we conduct a similar nonparametric portfolio analysis, but this time by accounting for the interaction between MAX and competing proxies of managerial skill. Basically, we perform a bivariate quintile portfolio test for MAX by controlling for the past 12-month average return (AVRG), the past 12-month standard deviation

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[16] We provide a formal test of this hypothesis in Section 6.

(STDEV), the past 12-month Sharpe ratio (SR), the apprasisal ratio (9- factor AR) defined in equation (1), incentive fee, and fund flows.

To perform this test, in Table 4 quintile portfolios are formed every month from January 1995 to December 2014 by sorting hedge funds first based on each control variable (i.e., competing proxy for managerial skill; AVRG, STDEV, Sharpe ratio, Appraisal ratio, incentive fee, and fund flows). Then, within each control variable sorted portfolio, hedge funds are further sorted into sub-quintiles based on their MAX. Quintile 1 is the portfolio of hedge funds with the lowest MAX within each control variable sorted quintile portfolio and quintile 5 is the portfolio of hedge funds with the highest MAX within each control variable sorted portfolio. In each column of Table 4, the top panel reports the average MAX in each quintile and the lower panel reports those same quintiles' next month average returns. The last two rows in Table 4 show the monthly average return differences and the 9-factor alpha differences between quintile 5 (high-MAX funds) and quintile 1 (low-MAX funds).

A notable point in Table 4 is that moving from the low-MAX to high-MAX quintile, the next- month average return on MAX-sorted portfolios increases monotonically after controlling for all competing proxies of managerial skill. Specifically, the average return difference between quintiles 5 and 1 is 0.44% per month with a Newey-west *t*-static of 3.02 after controlling for the past 12-month average return, 0.69% per month (*t*-stat. = 5.71) after controlling for the past 12-month standard deviation, 0.67% per month (*t*-stat. = 3.39) after controlling for the past 12-month Sharpe ratio, 0.69% per month (*t*-stat. = 3.46) after controlling for the appraisal ratio, 0.68% per month (*t*-stat. = 3.37) after controlling for incentive fees, and 0.68% per month (*t*-stat. = 3.55) after controlling for the fund flows. We also check whether this significant return difference between the high-MAX and low-MAX portfolios from bivariate sorts can be explained by Fama-French (1993) and Carhart's (1997) four factors as well as Fung and Hsieh's (2001) five trend-following factors. As shown in the last row of Table 4, the 9-factor alpha differences between quintiles 5 and 1 are all positive, ranging from 0.29% to 0.68% per month, and all are statistically significant with Newey-West *t*-statistics well above 2.00.

These results provide strong evidence that after controlling for competing proxies of managerial skill and a large set of risk factors, the return difference between the high-MAX and low-MAX funds remains positive and highly significant. Hence, we conclude that MAX can be viewed as an indicator of graeter managerial talent leading to superior future performance.

4.5. *Fama-MacBeth cross-sectional regressions*

We have so far tested the significance of MAX as a determinant of the cross-section of hedge fund returns at the portfolio level. The portfolio-level analysis has the advantage of being nonparametric in the sense that we do not impose a functional form on the relation between MAX and future returns. The portfolio-level analysis also has two potentially significant disadvantages. First, it throws away a large amount of information in the cross-section via aggregation. Second, it is a difficult setting in which to control for multiple effects simultaneously. Consequently, we now examine the cross-sectional relation between managerial skill and future returns at the individual fund level using Fama and MacBeth (1973) regressions.

We present the time-series averages of the slope coefficients from the regressions of one-month- ahead hedge fund excess returns on the maximum return over the past 12 months (MAX) and a large set of control variables. The average slopes provide standard Fama-MacBeth tests for determining which explanatory variables, on average, have non-zero premiums. Monthly cross-sectional regressions are run for the following econometric specification and nested versions thereof:

$$R_{i,t+1} = \lambda_{0,t} + \lambda_{1,t} \cdot MAX_{i,t} + \lambda_{2,t} \cdot X_{i,t} + \varepsilon_{i,t+1}, \tag{3}$$

where $R_{i,t+1}$ is the excess return of fund *i* in month *t*+1, *MAX* is the maximum monthly return of fund *i* in month *t* over the past 12 months (from month *t* to *t*–12), and $X_{i,t}$ denotes a large set of fund characteristics such as past returns, volatility, and risk-adjusted return measures of fund *i* in month *t*. Specifically, $X_{i,t}$ includes the following fund characteristics; *Size*, *Age*, *Flow*, *IncentFee*, *MgtFee*, *MinInv*, *Redemption*, *DLockup*, and *DLever*. In addition to these characteristics, $X_{i,t}$ includes the one-month lagged fund returns (*LagRet*), the past 12-month average return (*AVRG*), the past 12-month standard deviation (*STDEV*), and the past 12-month Sharpe ratio (SR) computed as the past 12-month average excess return divided by the past 12-month standard deviation.[17]

Panel A of Table 5 presents the average intercept and slope coefficients from the Fama-MacBeth cross-sectional regressions for the full sample period January 1995 – December 2014. The Newey-West adjusted *t*-statistics are given in parentheses. We first investigate the cross-sectional relation between MAX and future fund returns without taking into account fund characteristics, lagged return, lagged volatility, and lagged risk-adjusted return (Sharpe ratio). Consistent with our earlier findings from the univariate portfolio analysis, Regression (1) in Panel A of Table 5 provides evidence for a positive and highly significant relation between MAX and future fund returns. The average slope from the monthly univariate regressions of one-month-ahead returns on MAX alone is 0.042 with a Newey-West *t*-statistic of 3.52.

To determine the economic significance of this average slope coefficient, we use the average values of MAX in the quintile portfolios. Table 3 shows that the difference in MAX values between average funds in the first and fifth quintile is 14.21% per month [14.21% = 15.88% – 1.67%]. If a fund were to move from the first to the fifth quintile of MAX, what would be the change in that fund's expected return? The average slope coefficient of 0.042 on MAX in Panel A of Table 5 represents an economically significant increase of $(0.042) \cdot (14.21\%) = 0.60\%$ per month in the average fund's expected return for moving from the first to the fifth quintile of MAX. This result is

[17] At an earlier stage of the study, we replace the Sharpe ratio with the appraisal ratio and replicate the multivariate regressions. Since the Sharpe and appraisal ratios are highly correlated in the cross-section of individual hedge funds, the regression results from the appraisal ratio turn out to be very similar to those reported in our tables.

similar to our earlier finding of a 0.70% per month return difference between the high-MAX and low-MAX funds from univariate portfolio analysis reported in Table 3, Panel A.

After confirming a significantly positive link between MAX and future returns in univariate Fama- MacBeth regresions, we now control for all fund characteristics, lagged return, lagged volatility, and lagged risk-adjusted return simultaneously and test if managerial skill of hedge funds remains a strong predictor of future returns. Regression (2) in Panel A of Table 5 shows that the average slope on MAX is 0.030 with a Newey-West *t*-statistic of 3.35, implying that after controlling for a large set of fund characteristics, risk factors, and alternative proxies of managerial skill, the positive relation between MAX and future hedge fund returns remains highly significant.

As expected, the average slope for MAX in Panel B of Table 5 is somewhat smaller (0.030 in Panel B vs. 0.042 in Panel A) after accounting for the large set of control variables. However, the average slope of 0.030 still represents an economically significant increase of 0.43% per month in the average fund’s expected return for moving from the first to the fifth quintile of MAX, controlling for everything else.

A notable point in Table 5 is that the average slope coefficients on the control variables are consistent with earlier studies. Regression (2) in Panel A of Table 5 shows that the average slope on the one-month lagged fund returns (LagRet) and the past 12-month average return (AVRG) is positive and highly significant.[18] Consistent with the findings of Bali, Brown, and Caglayan (2012), the average slope on the standard deviation of fund returns (STDEV) is also positive and statistically significant. In addition, in line with the findings of Titman and Tiu (2012), the average slope on the Sharpe ratio is again positive and highly significant. Despite the fact that past return, past volatility, and past risk-adjusted return measures of individual hedge funds are found to be significant predictors, the significantly positive link between MAX and future fund returns remains highly significant, suggesting that MAX is a strong predictor of future hedge fund performance.

Another interesting observation that emerges from Table 5, Panel A is that the incentive fee variable has a positive and significant coefficient in monthly Fama-MacBeth regressions, even when other fund characteristics are added to the regression equation.[19] As in previous results, however, the significance of incentive fee does not diminish the predictive power of MAX on future hedge fund returns. One last noteworthy point from Table 5, Panel A is that the minimum investment amount, the redemption period, and the dummy for lockup variables, which are used by Aragon (2007)

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[18] A similar result, that there is serial dependence in hedge fund returns is also found by Agarwal and Naik (2000), Getmansky, Lo, and Makarov (2004), Jagannathan, Malakhov, and Novikov (2010), and Bali, Brown, and Caglayan (2011, 2012, 2014). Jegadeesh and Titman (1993, 2001) find momentum in stock returns for 3, 6, 9, and 12-month horizons, although Jegadeesh (1990) and Lehmann (1990) provide strong evidence for the short-term reversal effect in individual stock returns for the one-week to one-month horizon. In addition to accounting for lagged returns in Fama-MacBeth regressions, we control for this phenomenon using the Carhart (1997) momentum factor in portfolio- level analyses.

[19] This suggests that incentive fee has a strong positive explanatory power for future hedge fund returns (i.e., funds that charge higher incentive fees also generate higher future returns), a finding similar to other studies (see Brown, Goetzmann, and Ibbotson (1999), Liang (1999), and Edwards and Caglayan (2001)).

to measure illiquidity of hedge fund portfolios, also have positive and significant average slope coefficients. This suggests that funds that use lockup and other share restrictions which enable them to invest in illiquid assets earn higher returns in succeeding months, an outcome that coincides with the findings in Aragon (2007). However, even the significance of these liquidity variables does not alter or reduce the predictive power of MAX over hedge fund returns.

4.6. *Subsample analyses*

The cross-sectional predictability results reported in earlier tables are based on the 20-year sample period from January 1995 to December 2014. We now investigate whether the predictive power of *MAX* for future fund returns remains intact during subsample periods. We conduct subsample anlaysis by dividing the full sample into two and then examining the significance of *MAX* for the first decade (January 1995 – December 2004) and the second decade (January 2005 – December 2014) separately. In addition to these two subsample periods, we examine the predictive power of *MAX* during high and low economic activity (i.e., good vs. bad states of the economy). We determine increases and decreases in economic activity by relying on the Chicago Fed National Activity (CFNAI) index, which is a monthly index designed to assess overall economic activity and related inflationary pressure. The CFNAI is a weighted average of 85 existing monthly indicators of national economic activity. It is constructed to have an average value of zero and a standard deviation of one. Since economic activity tends toward trend growth rate over time, a positive index reading corresponds to growth above trend and a negative index reading corresponds to growth below trend.[20]

We perform subsample analyses based on the Fama-MacBeth cross-sectional regressions. Panel B of Table 5 shows that, for the first half of our sample, the average slope on MAX is positive and highly significant both in univariate and multivariate regressions. The average slope from the monthly univariate regressions of one-month-ahead returns on MAX alone is 0.036 with a Newey-West *t*-statistic of 2.29. After controlling for a large set of fund characteristics, past return, volatility, and risk-adjusted returns, the average slope on MAX remains positive, 0.028 with a t-statistic of 2.12. These two average slopes (0.036 and 0.028) for the period 1995-2004 represent an economically significant increase of 0.60% and 0.47% per month, respectively, in the average fund's expected return for moving from the first to the fifth quintile of *MAX*.

Panel C of Table 5 shows that the predictive power of MAX is stronger for the second half of our sample. Specifically, the average slope on MAX has a larger magnitude of 0.048 in univariate regressions and higher statistical significance with a Newey-West *t*-statistic of 2.66. After controlling for the same set of variables, the average slope on MAX also remains positive and larger at 0.031 with a *t*-statistic of 2.62, compared to our

[20] The 85 economic indicators that are included in the CFNAI are drawn from four broad categories of data: production and income; employment, unemployment, and hours; personal consumption and housing; and sales, orders, and inventories. Each of these data series measures some aspect of overall macroeconomic activity. The derived index provides a single, summary measure of a factor common to these national economic data.

findings from the first decade (reported in Panel B of Table 5). We find that the economic significance of these two average slopes (0.048 and 0.031) for the period 2005-2014 corresponds to 0.56% and 0.36% per month increase, respectively, in the average fund's expected return when moving from the first to the fifth quintile of MAX. The results in Panels B and C of Table 5 indicate that successful hedge fund managers are able to produce superior returns during both subsample periods.

We now present the Fama-MacBeth regression results during the good and bad states of the economy separately. In Panel D of Table 5, monthly cross-sectional regressions are estimated only for those months when the CFNAI index is positive on a given month during the period January 1995– December 2014. Panel D shows that, for the good states of the economy (CFNAI > 0), the average slope on MAX is positive and highly significant in univariate regressions and after accounting for the control variables. The average slope from the monthly univariate regressions of one-month-ahead returns on MAX alone is 0.051 with a *t*-statistic of 4.09. After controlling for a large set of fund characteristics, past return, volatility, and risk-adjusted returns, the average slope on MAX remains positive, 0.033 with a *t*-statistic of 3.09. These two average slopes (0.051 and 0.033) for the good states of the economy represent an economically significant increase of 0.73% and 0.47% per month, respectively, in the average fund's expected return for moving from the first to the fifth quintile of MAX.

Panel E of Table 5 examines the predictive power of MAX during low economic activity for those months when the CFNAI index is negative. During the bad states of the economy (CFNAI < 0), the average slope on MAX in univariate regressions is again positive and statisitcally significant; 0.033 with a *t*-statistic of 2.21. After controlling for the same set of variables, the average slope on MAX remains significantly positive at 0.026 with a *t*-statistic of 2.34. We find that the economic significance of these two average slopes (0.033 and 0.026) during the bad states of the economy corresponds to 0.46% and 0.37% per month increase, respectively, in the average fund's expected return when moving from the first to the fifth quintile of MAX. Overall, the results in Panels D and E of Table 5 provide evidence that hedge fund managers with a strong set of skills are able to perform better than those with weak managerial skill during both good and bad states of the economy.

Despite large fluctuations observed in risk, return, and managerial characteristics of hedge funds during these four subperiods, Panels B through E of Table 5 provide evidence of a positive and significant relation between MAX and future fund returns for all subsample periods. These results clearly show that with and without controlling for a large set of variables, managerial skill is an important determinant of the cross-sectional dispersion in hedge fund returns for all states of the economy, including expansionary and contractionary periods.[21]

[21] We test the predictive power of MAX over future hedge fund returns with two alternative multivariate Fama- MacBeth specifications as well. Table II in the online appendix reports that, both for the full sample period and the subsample periods, the average slope coefficient on MAX is always positive and highly significant with Newey-west *t*-statistics well above 2.00, suggesting that our results are robust to alternative specifications of cross-sectional regressions.

4.7. *Long-term predictive power of MAX*

In this section, we investigate the long-term predictive power of MAX. Our empirical analyses have thus far focused on one-month-ahead return predictability. However, from a practical standpoint it would make sense to investigate the predictive power of MAX for longer investment horizons, since some investors and hedge fund portfolio managers may prefer portfolio holding periods or investment horizons longer than one month. We examine the long-term predictive power of MAX based on the univariate quintile portfolios. Table III in the online appendix reports the next 3-, 6-, 9-, and 12-month average returns for each of the five quintiles of MAX. The average return difference between quintiles 5 and 1 is 0.60% per month (*t*-stat. = 3.42) for 3-month ahead predictability, 0.49% per month (*t*-stat. = 3.13) for 6-month ahead predictability, 0.41% per month (*t*-stat. = 2.68) for 9-month ahead predictability, and 0.37% per month (*t*-stat. = 2.47) for 12-month ahead predictability. These results indicate that the positive relation between MAX and future fund returns is not just a one-month affair. Based on the average return spreads, the maximum return over the past 12 months predicts cross-sectional variation in hedge fund returns 12 months into the future.

The last row of Table III of the online appendix shows that the 9-factor alpha spread between quintiles 5 and 1 is 0.39% per month (*t*-stat. = 2.29) for 3-month ahead predictability, 0.33% per month (*t*-stat. = 2.11) for 6-month ahead predictability, 0.30% per month (*t*-stat. = 2.04) for 9-month ahead predictability, and 0.25% per month (*t*-stat. = 1.60) for 12-month ahead predictability. The 9-factor alpha spreads show that funds with higher MAX (stronger managerial skill) outperform funds with lower MAX (weaker managerial skill) not just for one-month-ahead, but nine months into the future.

5. Managerial Skill and Hedge Fund Performance by Investment Style

In this section, we first classify hedge funds into three groups (directional, semi-directional, and non-directional) and examine the strength of managerial skill and its link to derivatives use for each investment style. Then, we test if the predictive power of MAX changes among different hedge fund strategies. Second, we investigate whether hedge funds have the ability to time fluctuations in the equity market and macroeconomic fundamentals. Finally, we test whether investors take differences in managerial skill into account and are willing to pay higher fees and invest more in the high-MAX funds.

5.1. *Predictive power of MAX by hedge fund investment style*

We now test whether our main findings change if our analysis is applied to homogeneous groups of hedge funds, i.e., hedge fund investment strategies. Hedge funds have various trading strategies; some willingly take direct market exposure and risk (directional strategies, such as managed futures, global macro, and emerging market funds), while some try to minimize market risk altogether (non-directional strategies, such as equity market neutral, fixed income arbitrage, and convertible arbitrage funds), and some try to diversify market risk by taking both long and short, diversified positions (semi-directional strategies, such as fund of funds, long-short equity hedge, event-driven, and multi-strategy funds).

Table 6 provides some information and statistics on directional, semi-directional, and non- directional hedge fund categories. The first row in Table 6 presents the number of funds existing in each of the three broad investment categories. The second row in Table 6 reports for the same three broad categories the percentage of hedge funds in total sample. As shown in Table 6, we have a total of 7,645 hedge funds in our TASS database that claim a specific investment strategy, of which 9.4% follows non-directional strategies, 20.2% follows directional strategies, and the remaining 70.4% follows semi- directional strategies.

Given these three broad hedge fund investment strategies, it is not surprising to see varying strength of managerial skill and varying degrees of market/macro-timing ability by different investment strategy groups. Even within the same investment style group, one can observe varying degrees of exposures to different financial and macroeconomic risk factors over time, as hedge fund managers adjust their exposures dynamically in response to changing market conditions.

To understand the strength and variation in managerial skill among different investment strategies, we first analyze average MAX, standard deviation of MAX, and the spread between maximum and minimum values of MAX for these aforementioned three broad categories of hedge fund investment strategies separately. The third row in Table 6 presents the cross-sectional average of individual funds' MAX within each category during the full sample period. The fourth row presents the cross-sectional average of the individual funds' time-series standard deviation of MAX within each category during the sample period. The fifth row reports the cross-sectional average of the spread between the maximum and minium values of MAX within each category. As can be noticed by reading from left to right in Table 6, the directional funds have noticeably larger MAX, higher standard deviation of MAX, and greater Max– Min spread of MAX compared to non-directional and semi-directional funds. In addition, the non- directional strategies' MAX, standard deviation of MAX, and Max–Min spread of MAX are considerably smaller compared to the other strategies. Lastly, the semi-directional funds have average MAX, standard deviation of MAX, and Max–Min spread of MAX that are very similar to the all hedge fund group. We believe that directional funds' large standard deviation and large Max–Min spread of MAX might be due to superior market-timing ability of these funds' managers. In particular, when the opportunity comes (or predicted by fund managers), directional funds adjust their portfolios in such a way that they can generate large positive returns, causing their MAX to be more volatile and Max–Min spread to be larger.

Although not reported in Table 6, we test whether the average MAX of directional funds is significantly higher than the average MAX of non-directional funds, semi-directional, and all hedge funds in our sample. We find that the difference between the average MAX of directional and non-directional funds is economically very large, 5.56% (9.61% – 4.05%) per month, and highly significant with a Newey- West *t*-statistic of 22.04. Similar results are obtained when we compare the average magnitude of MAX for directional funds vs. semi-directional and all hedge funds. Specifically, the difference between the average MAX of directional and semi-directional funds is again economically large, 3.63% (9.61% – 5.98%) per month with a Newey-West *t*-statistics of 17.62; and the difference between average MAX of directional and all hedge funds is again economically large, 3.05% (9.61% – 6.56%) per month, and again highly significant with Newey-West *t*-statistics of 20.01. Overall, these results indicate that, for directional funds, the average MAX (proxy for managerial skill) is significantly greater than that of non-directional and semi-directional funds.

The last two rows in Table 6 report, for each of the three broad investment categories separately, the percentages of funds that utilize futures and other derivatives in their investment strategies. Table 6 clearly shows that the percentage of funds using futures and other derivatives increases monotonically as we move from the non-directional to the directional strategy group. Specifically, the percentage of funds using futures is 13.9% for the non-directional funds, 14% for the semi-directional funds, and 41% for the directional funds. Similarly, the percentage of funds using other derivatives is 17.5% for the non-directional funds, 18.5% for the semi-directional funds, and 24.1% for the directional funds. Overall, these results indicate that the directional funds with higher MAX and stronger managerial skill employ a wide variety of dynamic trading strategies and make extensive use of derivatives, short-selling, and leverage, compared to the semi-directional and non-directional funds with lower MAX and weaker managerial skill.

Based on this new set of results on varying strength of managerial skill among hedge fund investment strategies, we expect our main finding — a significantly positive link between MAX and future returns obtained for the overall hedge fund category — to be strongest for the directional funds with higher MAX and stronger managerial skill, and relatively weaker for the non-directional funds with lower MAX and weaker managerial skill. We now investigate the predictive power of MAX over future hedge fund returns for the three aforementioned investment strategies separately, and check whether indeed a larger MAX and dynamic trading strategies with more frequent use of futures and other derivatives are associated with stronger predictive power. We perform this test in Table 7 by forming univariate quintile portfolios of MAX for each investment style separately and by analyzing the next-month return and alpha differences between the high-MAX and low-MAX quintiles.

A notable point in Table 7 is that the average return and 9-factor alpha spreads between the high- MAX and low-MAX quintiles increase monotonically as we move from the non-directional to the directional funds. Specifically, the average return difference between quintiles 5 and 1 is 0.50% per month (*t*-stat. = 3.11) for the non-directional funds, 0.69% per month (*t*-stat. = 3.00) for the semi-directional funds, and 0.88% per month (*t*-stat. = 3.71) for the directional funds. The 9-factor alpha spreads follow a similar pattern among the three investment strategies; 0.30% per month (*t*-stat. = 2.11) for the non-directional funds, 0.40% per month (*t*-stat. = 2.43) for the semi-directional funds, and 0.76% per month (*t*-stat. = 2.71) for the directional funds.

Combining these new sets of results with the results obtained earlier on the strength of managerial skill (proxied by the magnitude of MAX) and the frequency of derivatives use across different investment styles, we observe an economically and statistically stronger relation between MAX and future returns for funds with higher MAX and more frequent use of futures and other derivatives. Another possible explanation for the stronger performance of funds with higher MAX and more frequent use of derivatives could be the market- and macro-timing ability of hedge fund managers. In the next section, we provide a formal test of the market- and macro-timing ability of the directional, semi-directional, and non-directional hedge funds.

5.2. *Market- and macro-timing ability of hedge funds*

While the results from the above analysis suggest the existence of a possible market-timing and/or macro-timing ability by fund managers in directional and semi-directional hedge funds, the analysis conducted thus far is not a direct test for market- or macro-timing. In this section, we rely on the market- timing test of Henriksson and Merton (1981) and the macro-timing test of Bali, Brown, and Caglayan (2014). We implement the same methodology to each of the three broad categories of hedge fund styles separately and determine whether funds' ability to time market and macroeconomic changes is specific to a group of hedge funds.

We investigate market-timing ability of hedge funds using pooled panel regressions based on the Henriksson and Merton model:[22]

$$R_{i,t} = \alpha + \beta_1 \cdot MKT_t + \beta_2 \cdot MKT_t^{high} + \varepsilon_{i,t}, \tag{4}$$

where $R_{i,t}$ is excess return of fund i in month t, MKT_t is the excess market return in month t, and MKT_t^{high} is the excess market return implying market-timing ability:

$$MKT_t^{high} = \begin{cases} MKT_t & \text{if } MKT_t \text{ is higher than its time-series median} \\ 0 & \text{otherwise} \end{cases}$$

In equation (4), regression parameters α, β_1, and β_2 are the intercept, the market beta, and the parameter for market-timing ability, respectively. Market timing indicates an increase (decrease) in market exposure prior to a market rise (fall), which results in a convex relation between fund returns and market returns. In this regression specification, a positive and significant estimate of β_2 implies superior market-timing ability of individual hedge funds.

Following Bali, Brown, and Caglayan (2014), we also investigate macro-timing ability of hedge funds using pooled panel regressions based on a modified model of Henriksson and Merton (1981):

$$R_{i,t} = \alpha + \beta_1 \cdot UNC_t + \beta_2 \cdot UNC_t^{high} + \varepsilon_{i,t}, \tag{5}$$

[22] Similar methodology is also used in a different context by Jagannathan and Korajczyk (1986), Chen and Liang (2007), Cao, Chen, Liang, and Lo (2013), and Caglayan and Ulutas (2013).

Where $R_{i,t}$ is excess return of fund i in month t, UNC_t is the economic uncertainty index of Bali et al. (2014) in month t, and UNC_t^{high} is the economic uncertainty index implying macro-timing ability:

$$UNC_t^{high} = \begin{cases} UNC_t & \text{if } UNC_t \text{ is higher than its time-series median} \\ 0 & \text{otherwise} \end{cases}$$

In equation (5), regression parameters α, β_1, and β_2 are the intercept, the uncertainty beta, and the parameter for macro-timing ability, respectively. In this regression specification, a positive and significant estimate of β_2 implies superior macro-timing ability of individual hedge funds.

Table 8 presents the estimated values of β_2 and the corresponding t-statistics from the pooled panel regression specifications in eqs. (4) and (5) for the sample period January 1995–December 2014. Equations (4) and (5) are estimated separately for each of the three hedge fund categories (non-directional, semi- directional, and directional). The t-statistics reported in parentheses are estimated using clustered robust standard errors, accounting for two dimensions of cluster correlation (fund and year). This approach allows for correlations among different funds in the same year as well as correlations among different years in the same fund (see Petersen (2009) for estimation of clustered robust standard errors).

As reported in the first row of Table 8, for market-timing tests, β_2 is estimated to be positive, 0.277, and highly significant with a t-statistic of 2.62 for the directional hedge funds. β_2 is also positive, 0.169, and significant with a t-statistic of 2.07 for the semi-directional hedge funds. However, the statistical and economic significance of β_2 is higher for the directional funds compared to the semi-directional funds. This indicates that directional hedge fund managers have higher capability to time fluctuations in the equity market. Consistent with our expectation, Table 8 shows that β_2 is economically and statistically insignificant for the non-directional funds, providing no evidence of market-timing ability for the non- directional hedge fund managers.

Similar results are obtained from the macro-timing tests. As presented in the last row of Table 8, β_2 is estimated to be positive, 0.894, and highly significant with a t-statistic of 2.58 for the directional hedge funds. Similar to our earlier findings from the market-timing tests, β_2 is positive, 0.494, and significant with a t-statistic of 2.32 for the semi-directional hedge funds. Consistent with the findings of Bali, Brown, and Caglayan (2014), the statistical and economic significance of β_2 is higher for the directional funds compared to the semi-directional funds, implying that the directional hedge fund managers have higher capability to time fluctuations in macroeconomic changes. As expected, β_2 is again economically and statistically insignificant for the non-directional funds, providing no evidence of macro-timing ability for the non-directional hedge fund managers.

Overall, these results make sense in the real world setting of hedge funds, as directional funds willingly take direct exposure to financial and macroeconomic risk factors, relying on their market-timing and macro-timing ability to generate superior returns. Since these are funds with dynamic trading strategies frequently using derivatives/leverage that are highly exposed to market and macroeconomic risk, timing the switch in economic trends is essential to their success. Hence, our previous results, which show a stronger link between *MAX* and future returns for the directional funds with stronger managerial skill (proxied by higher *MAX*), can be attributed to the evidence of superior market- and macro-timing ability of directional hedge fund managers.

5.3. *Do investors prefer high-MAX funds?*

Our results indicate that hedge fund portfolio managers with better managerial skill and better market- and macro-timing ability will employ an investment strategy that generates larger positive returns (high-MAX). Thus, sophisticated investors should consider past MAX as an indicator of managerial talent. To examine whether investors take differences in managerial skill into account, we test if investors are indeed willing to pay higher fees for funds with high-MAX.

As shown in Panel C of Table 3, the average management and incentive fees of individual funds increase monotonically when moving from quintile 1 to 5 in the univariate MAX-sorted portfolios. Specifically, the average management fee increases monotonically from 1.34% for the low-MAX funds to 1.58% for the high-MAX funds. Similarly, the average incentive fee increases monotonically from 12.9% for the low-MAX funds to 17.9% for the high-MAX funds.[23]

In addition to these portfolio-level analysis presenting a strong positive relation between MAX and fees, we run multivariate Fama-MacBeth regressions to check if this strong relation remains intact after controlling for individual fund characteristics, past performance, and risk/liquidity attributes. Table IV in the online appendix reports the average intercept and slope coefficients from the Fama-MacBeth regressions of management/incentive fees on MAX with and without control variables for the sample period January 1995 – December 2014. The univariate regression results (line (1) in Panel A and Panel B of Table IV) confirm the portfolio-level results presented in Panel C of Table 3. The multivariate regressions reported in line (2) of Panels A and B of Table IV produce consistently positive and highly significant average slope coefficients on MAX, indicating a strong positive link between MAX and hedge fund fees after controlling for past fund performance and other fund-specific characteristics.

To test the hypothesis that the high-MAX funds also attract more capital flows, we examine the cross-sectional relation between MAX and the one-month-ahead net flows into the fund. Specifically, we sort individual hedge funds into quintile portfolios based on their MAX and then calculate the average one- month-ahead net flows of funds in each quintile. The results indicate that the average net monthly flow, as a percentage of assets, is 52 basis points greater for the high-MAX funds than for the low-MAX funds. The

[23] The TASS database rewrites the fees if hedge funds change their management and/or incentive fee structure. The management and incentive fees used in our empirical analyses are as of December 2014. Since fees do not change much during a fund's history, one can assume that they were set at the beginning of the fund's history.

difference between the net monthly flows of high-MAX and low-MAX funds is also highly significant with a Newey-West t-statistic of 3.69.

We also run multivariate Fama-MacBeth regressions to check if this strong predictive relation between MAX and fund flows remains intact after controlling for individual fund characteristics, past performance, and risk/liquidity attributes. Panel C of Table IV in the online appendix presents the average intercept and slope coefficients from the Fama-MacBeth regressions of the one-month-ahead net fund flows on MAX with and without control variables for the sample period January 1995 – December 2014. The significantly positive average slope on MAX from the univariate regressions (average slope coefficient of 0.020 with a t-statistics of 2.96) confirm the portfolio-level results discussed earlier. The multivariate regressions reported in Panel C of Table IV produce consistently positive and highly significant average slope coefficient on MAX (average slope coefficient of 0.026 with a t-statistics of 3.76), indicating a strong positive link between MAX and the one-month-ahead net flows into the fund after controlling for past fund performance and other fund-specific characteristics.

Overall, the results in Section 5 indicate that the high-MAX funds have more frequent use of dynamic trading strategies with derivatives and leverage, which enable them to possess better market- and macro-timing ability. The ability of the high-MAX funds to produce higher returns motivates them to charge higher management and incentive fees to their clients, compared to the low-MAX funds with weak managerial skill. In addition, the high-MAX funds attract more capital (higher net inflows) as well. The findings in Table IV of the online appendix show that funds with high-MAX are rewarded with higher fees because investors learn about managerial skills and they are indeed willing to pay higher fees and invest more in the high-MAX funds under the expectation of receiving large positive returns in the future.

6. Evidence from Mutual Funds

We think that an alternative way to explain superior performance of the directional and semi- directional hedge funds with higher MAX and stronger managerial skill is to compare and contrast hedge funds with mutual funds. Therefore, in this section, we provide evidence from mutual funds by replicating our main analyses for the mutual fund industry for the sample period January 1995–June 2013.[24] We first investigate whether managerial talent of mutual fund managers (proxied by the maximum monthly return of mutual funds over the past one year) predicts their future returns. We then analyze whether mutual funds have the ability to time fluctuations in the equity market and

[24] We use monthly returns of individual mutual funds from the CRSP Mutual Fund database. However, most of the mutual funds in the CRSP database have multiple share classes designed for different client types. That is, a mutual fund may have a retail share class, an institutional share class, or a retirement share class. All of these share classes in essence constitute the same strategy, therefore their returns are highly correlated. As discussed in Section I of the online appendix, we make sure that each mutual fund is represented with a single share class in our database. After removing multiple share classes, our database contains information on a total of 16,881 distinct, non-duplicated mutual funds, of which 7,073 are defunct funds and the remaining 9,808 are live funds. Table V of the online appendix provides summary statistics both on numbers and returns of these single-share class, non-duplicated mutual funds.

macroeconomic fundamentals. Finally, we test the economic and statistical significance of timing ability for hedge funds vs. mutual funds.

6.1. *Does managerial skill matter for mutual fund performance?*

The primary differences between hedge funds and mutual funds are summarized as follows: (i) Hedge funds employ a range of investment tools, including derivatives, leverage, and short-selling, whereas mutual funds tend to invest primarily on the long side without extensively using other tools. The majority of mutual funds are long only, while hedge funds utilize much more aggressive dynamic trading strategies; (ii) Since hedge funds rely on hedging instruments and shorting techniques, they are more likely to outperform mutual funds in a down market; (iii) Mutual funds seek relative returns, or those compared to a benchmark or index. A mutual fund's sole goal is to beat the benchmark. Therefore, if the index is down 10% but the mutual fund is down only 8%, it is considered a success. On the flip side, hedge funds seek absolute returns, not related to index or benchmark performance; (iv) Hedge fund managers receive a performance fee at the end of the year paid from investor gains. Mutual funds typically do not charge performance fees. The most common hedge fund fee structure is the 2/20 – a 2% flat management fee skimmed off the top, and a 20% fee on all profits. Most mutual funds charge less than 2% in total fees; (v) The founder of a hedge fund is the general partner and an investor in the fund. The manager of a mutual fund is seldom the owner and may not be a significant fund investor; and (vi) Hedge funds have lockup periods typically of at least one year. That is, each investment must remain in the hedge fund for at least one year (the lockup period). Withdrawals are permitted only with advance notice following the lockup period. Therefore, in difficult market periods or economic conditions, some hedge funds put up gates that restrict redemptions. On the other hand, investments in mutual funds are essentially liquid and are not impacted by lock-ups or gates.[25]

The primary similarity between hedge funds and mutual funds is that both are managed portfolios. In other words, a manager or group of managers selects investments and adds them to a single portfolio. However, hedge funds are managed in a more aggressive manner than mutual funds. From the ability to short-sell stocks to taking positions in derivatives, hedge fund managers are more aggressive, as they attempt to generate the best gains possible for clients. With such an aggressive stance, hedge funds are in a better position to earn money even when the market is falling.

From an investment style perspective, mutual funds can be viewed as highly regulated hedge funds with a larger number of investors and larger AUM. Since mutual funds do not use dynamic trading strategies with unique investment ideas, we do not expect cross-sectional differences in managerial skills of mutual fund managers to explain cross-sectional dispersion in mutual fund returns. Along the same lines, we do not expect mutual funds to have significant market- or macro-timing ability either.

[25] There are other differences between hedge funds and mutual funds that are not listed here, such as differences in their regulations, asset allocation, and performance disclosure policies.

To test these conjectures, we first estimate managerial talent of mutual funds using the maximum monthly return over the past 12 months. Then, for each month, from January 1995 to June 2013, we form quintile portfolios by sorting mutual funds based on their MAX, where quintile 1 contains the mutual funds with the lowest MAX and quintile 5 contains the mutual funds with the highest MAX. Panel A of Table 9 shows the average MAX values and the next month average returns on MAX-sorted portfolios of mutual funds. The last two rows display the differences between quintile 5 and quintile 1 the average monthly returns and the 4-factor Fama-French-Carhart alphas.

The second column of Table 9, Panel A, shows that the average return difference between quintiles 5 and 1 is 0.49% per month, but statistically insignificant with a Newey-West *t*-statistic of 1.23. As shown in the last column of Table 9, Panel A, the risk-adjusted return spread turns out to be negative albeit insignificant. Specifically, the 4-factor Fama-French-Carhart alpha difference between quintiles 5 and 1 is –0.18% per month with a *t*-statistic of –1.61. This result indicates that mutual funds in the highest MAX quintile do not generate economically or statistically higher risk-adjusted returns than mutual funds in the lowest MAX quintile. Overall, the univariate portfolio results in Table 9 provide no evidence for a significant link between MAX and future returns on mutual funds, implying that managerial skill is not an important determinant of the cross-sectional differences in mutual fund returns.

6.2. *Market- and macro-timing ability of mutual funds*

To test our second conjecture, we investigate the market- and macro-timing ability of mutual funds with the same Henriksson-Merton (1981) model that we utilize in our earlier analysis for hedge funds. Panel B of Table 9 presents the estimated values of β_2 and the corresponding *t*-statistics for mutual funds. Essentially, equations (4) and (5) are estimated with a pooled panel regression for the sample period January 1995–June 2013, this time using mutual fund excess returns as the dependent variable. The *t*-statistics reported in parenthesis are again estimated using clustered robust standard errors, accounting for two dimensions of cluster correlation (fund and year). Table 9, Panel B shows that for the equity market index, β_2 is statistically insignificant (a coefficient of –0.037 with a *t*-statistic of –0.61) for mutual funds, providing no evidence of market-timing ability for mutual fund managers. Similar results are obtained for the economic uncertainty index; β_2 is again statistically insignificant (a coefficient of 0.609 with a *t*-statistic of 1.62), providing no evidence of macro-timing ability for mutual fund managers.

Overall, the results show that directional and semi-directional hedge fund managers have the ability to actively vary their exposure to market risk and economic uncertainty up or down in a timely fashion according to the macroeconomic conditions and state of the financial markets. As a result, they can generate superior returns, and there exists a positive and stronger link between their managerial talent and future returns. On the other hand, mutual funds do not have market- or macro-timing ability. In line with this finding, there is no evidence of a significant cross-sectional link between MAX and future returns for mutual funds.

6.3. *Testing the economic and statistical significance of timing ability*

Can professional fund managers predict and exploit changes in the market and macroeconomic conditions? Starting with Treynor and Mazuy (1966), there has been an extensive literature on market- timing ability of mutual funds. Most of the earlier studies provide little evidence of timing ability for mutual funds, and some studies even find negative timing ability (concavity) which can be interpreted as systematically adjusting market exposure in a perverse way.[26]

In this paper, we explore the cross-sectional link between managerial talent, timing ability, and future fund performance. In particular, we have tested whether hedge fund and mutual fund managers can time the market and/or economic uncertainty by strategically adjusting fund exposures based on their forecasts of future market and macroeconomic conditions. If so, how much economic value does timing skill bring to fund investors? In this section, we investigate this issue by testing the economic and statistical significance of market- and macro-timing ability for the directional, semi-directional, and non-directional hedge funds versus mutual funds.

Panel C of Table 9 presents results from testing the significance of average returns and 4-factor alphas for the high-MAX directional, semi-directional, and non-directional hedge funds versus the high- MAX mutual funds. In the first row of Panel C, the average returns and alphas are compared for the high- MAX directional funds (with strong timing ability) vs. the high-MAX mutual funds (with no timing ability). In the second row, the average returns and alphas are compared for the high-MAX semi-directional funds (with semi-strong timing ability) vs. the high-MAX mutual funds (with no timing ability). In the last row, the average returns and alphas are compared for the high-MAX non-directional hedge funds vs. the high-MAX mutual funds (both groups with no timing ability).

The results reported in the first two rows in Panel C of Table 9 clearly show that the predictive power of managerial talent (proxied by MAX) for future fund performance is substantially higher for the directional and semi-directional funds as compared to mutual funds, because the differences between the average returns and alphas for the high-MAX directional and semi-directional funds vs. the high-MAX mutual funds are economically and statistically significant. The last row of Table 9, Panel C, provides evidence that, due to lack of investment-picking skills and lack of timing ability of non-directional hedge fund managers, the predictive power of managerial skill for future fund performance is not robustly, significantly greater for the high-MAX non-directional funds, as compared to the high-MAX mutual funds. Overall, the results in Table 9 suggest that market- and macro-timing ability represent managerial skill adding

[26] Bollen and Busse (2001) using daily return data and Jiang, Yao, and Yu (2007) using portfolio holding data provide supporting evidence of timing ability for mutual funds. Their findings suggest that the identification of market-timing ability may be sensitive to data frequency or data type (see Goetzmann, Ingersoll, and Ivkovich (2000)).

significant economic value to investors of the directional and semi-directional hedge funds.

7. Conclusion

Investors pay a great deal of attention to the technical, human, and conceptual skills of individuals who are managing their money because investors prefer to put money in hedge funds run by talented managers with unique investment ideas and superior investment-picking skills that generate higher risk- adjusted returns. In light of this investor behavior, a natural question to ask is whether some fund managers are indeed better than others. Since hedge funds do not disclose their trading strategies, security holdings, or asset allocation decisions, identifying managerial talent is a difficult task.

We introduce a new measure of managerial skill based on the maximum monthly returns of hedge funds over the past one year and test if this new measure (MAX) is an indicator of greater managerial talent leading to superior fund performance. We find that this is indeed the case. Specifically, the hedge funds in the highest MAX quintile (with strong managerial skill) generate 8.4% more annual returns compared to funds in the lowest MAX quintile (with weak managerial skill). After controlling for Fama-French- Carhart's four factors of market, size, book-to-market, and momentum as well as Fung-Hsieh's five trend- following factors on currency, bond, commodity, short-term interest rate, and stock index, the 9-factor alpha spread between the high-MAX and low-MAX funds remains positive and highly significant. We also run fund-level cross-sectional regressions to control for fund characteristics and alternative measures of past performance and managerial skill simultaneously. Both Fama-MacBeth regressions and portfolio-level analyses provide strong corroborating evidence for an economically and statistically significant positive relation between MAX and future returns.

Once we establish our main finding that managerial talent matters for hedge fund performance, we test if the predictive power of MAX gradually increases as we move from the least directional strategies to the most directional strategies. Consistent with our expectation, the predictive power of MAX turns out to be the highest for the directional funds because these funds with higher MAX and stronger managerial skill employ a wide variety of dynamic trading strategies and make extensive use of derivatives, short-selling, and leverage. As expected, the predictive power of MAX is found to be the lowest for the non-directional funds with lower MAX and weaker managerial skill. We also investigate whether hedge funds and mutual funds have the ability to time fluctuations in the equity market and macroeconomic fundamentals. The results indicate that the directional hedge fund managers can predict and exploit changes in the market and macroeconomic conditions by increasing (decreasing) fund exposure to risk factors when market risk and/or economic uncertainty is high (low). However, mutual funds do not have market- or macro-timing ability. Thus, we find no evidence of a significant link between managerial talent of mutual fund managers and their future returns.

These results are consistent with our managerial skill hypothesis – skilled hedge fund managers with superior market- and macro-timing ability are more likely to pursue unique investment strategies that result in superior performance, while less-skilled non-directional and mutual fund managers do not have good investiment-picking skills and they are more likely to trade on known strategies. Overall, our findings suggest that MAX is a useful indicator of managerial talent which can be effectively used by investors when selecting individual hedge funds.

Finally, we examine whether hedge fund investors take differences in managerial skill into account. For high-MAX funds, both the management and performance fees are considerably higher compared to other funds. Thus, for investors, the reward for finding talented fund managers is justified with the increased fees that these fund managers charge investors. In sum, our results suggest investors' preference for high-MAX funds; funds with high-MAX are rewarded with higher fees and, also their flows, as a percentage of assets, are significantly greater. This is due to the fact that investors learn about managerial skills and they are indeed willing to pay higher fees and invest more in the high-MAX funds under the expectation of receiving large positive returns in the future.

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Table 1. Descriptive Statistics of Hedge Funds

There are total of 11,099 hedge funds that reported monthly returns to TASS for the years between 1994 and 2014 in this database, of which 8,684 are defunct funds and 2,415 are live funds. For each year from 1994 to 2014, Panel A reports the number of hedge funds, total assets under management (AUM) at the end of each year by all hedge funds (in billion $s), and the mean, median, standard deviation, minimum, and maximum monthly percentage returns on the equal-weighted hedge fund portfolio. Panel B reports for the sample period January 1994 – December 2014 the cross-sectional mean, median, standard deviation, minimum, and maximum statistics for hedge fund characteristics including returns, size, age, management fee, incentive fee, redemption period, and minimum investment amount.

Panel A. Summary Statistics Year by Year

						Equal-Weighted Hedge Fund Portfolio Monthly Returns (%)				
Year	**Year Start**	**Entries**	**Dissolved**	**Year End**	**Total AUM (billion $s)**	**Mean**	**Median**	**Std. Dev.**	**Minimum**	**Maximum**
1994	748	276	17	1,007	55.0	-0.01	0.14	0.97	–1.58	1.12
1995	1,007	304	54	1,257	66.5	1.40	1.48	1.05	–0.94	3.14
1996	1,257	354	113	1,498	89.2	1.45	1.56	1.53	–1.65	4.00
1997	1,498	389	100	1,787	133.1	1.47	1.69	2.01	–1.56	4.79
1998	1,787	400	146	2,041	142.3	0.35	0.38	2.22	–5.14	3.05
1999	2,041	467	165	2,343	175.2	2.03	1.23	2.13	–0.34	6.43
2000	2,343	481	211	2,613	195.3	0.85	0.47	2.23	–2.01	5.45
2001	2,613	592	222	2,983	245.7	0.56	0.67	1.21	–1.64	2.64
2002	2,983	657	253	3,387	285.6	0.28	0.57	0.89	–1.47	1.49
2003	3,387	769	238	3,918	406.1	1.40	1.20	0.96	–0.20	3.43
2004	3,918	865	286	4,497	567.3	0.69	0.78	1.22	–1.33	2.89
2005	4,497	897	428	4,966	627.8	0.76	1.29	1.35	–1.51	1.99
2006	4,966	777	485	5,258	755.4	1.04	1.36	1.43	–1.63	3.42
2007	5,258	750	733	5,275	891.7	1.00	0.96	1.48	–1.73	3.11
2008	5,275	625	1,153	4,747	629.1	-1.56	-1.91	2.61	–6.14	1.81
2009	4,747	571	851	4,467	553.4	1.43	1.33	1.54	–0.90	4.76
2010	4,467	377	703	4,141	504.9	0.77	0.93	1.72	–2.92	3.13
2011	4,141	307	779	3,669	479.3	-0.48	-0.26	1.70	–3.59	2.07
2012	3,669	227	713	3,183	466.2	0.52	0.64	1.24	–2.15	2.48
2013	3,183	177	644	2,716	446.9	0.80	1.03	1.13	–1.71	2.74
2014	2,716	95	597	2,214	404.9	0.20	-0.26	0.82	–0.61	1.57

Table 1 (continued)

Panel B. Cross-Sectional Statistics of Hedge Fund Characteristics: January 1994 – December 2014

	N	Mean	Median	Std. Dev.	Minimum	Maximum
Average Monthly Return over the life of the Fund (%)	11,099	0.50	0.49	1.24	–25.14	25.47
Average Monthly AUM over the life of the Fund (million $)	11,099	85.7	40.0	233.8	0.5	7,835.1
Age of the Fund (# of months in existence)	11,099	73.4	60.0	54.0	1.0	252.0
Management Fee (%)	10,971	1.46	1.50	0.65	0.00	10.00
Incentive Fee (%)	10,847	15.40	20.00	7.79	0.00	50.00
Redemption Period (# of days)	11,099	37.1	30.0	32.9	0.0	365.0
Minimum Investment Amount (million $)	11,014	1.30	0.25	15.32	0.00	1,000.00

Table 2. Univariate Portfolios of Alternative MAX measures

Quintile portfolios are formed every month from January 1995 to December 2014 by sorting hedge funds based on their alternative MAX measures. MAX6, MAX9, MAX12, MAX18, and MAX24 represent the maximum monthly hedge fund returns over the last 6, 9, 12, 18, and 24 months, respectively. Quintile 1 is the portfolio of hedge funds with the lowest MAX measures, and quintile 5 is the portfolio of hedge funds with the highest MAX measures. In each column, the top panel reports the average MAX measures in each quintile, and the lower panel reports those same quintiles' next month average returns. The last two rows show the monthly average raw return differences and the 9-factor Alpha differences between quintile 5 (High MAX funds) and quintile 1 (low MAX funds). Average returns and Alphas are defined in monthly percentage terms. Newey-West adjusted *t*-statistics are given in parentheses. Numbers in bold denote statistical significance.

	Average Size of MAX6	Average Size of MAX9	Average Size of MAX12	Average Size of MAX18	Average Size of MAX24
Q1	1.07	1.45	1.67	1.99	2.24
Q2	2.20	2.69	3.04	3.59	4.02
Q3	3.46	4.17	4.69	5.50	6.11
Q4	5.58	6.61	7.39	8.56	9.49
Q5	12.67	14.51	15.88	17.98	19.63
	Next-month returns of MAX6 Quintiles	Next-month returns of MAX9 Quintiles	Next-month returns of MAX12 Quintiles	Next-month returns of MAX18 Quintiles	Next-month returns of MAX24 Quintiles
Q1	0.10	0.08	0.09	0.12	0.16
Q2	0.30	0.33	0.33	0.35	0.34
Q3	0.43	0.44	0.45	0.45	0.42
Q4	0.59	0.60	0.58	0.56	0.51
Q5	0.91	0.83	0.79	0.69	0.69
Q5 – Q1 Return Diff.	**0.81** **(3.85)**	**0.75** **(3.79)**	**0.70** **(3.48)**	**0.56** **(3.08)**	**0.53** **(2.94)**
Q5 – Q1 9-factor Alpha Diff.	**0.55** **(2.87)**	**0.50** **(2.70)**	**0.47** **(2.44)**	**0.37** **(1.99)**	**0.34** **(1.80)**

Table 3. Univariate Portfolios of Hedge Funds Sorted by MAX

Panel A. Average Raw and Risk-Adjusted Returns of MAX Quintile Portfolios

In Panel A of Table 3, quintile portfolios are formed every month from January 1995 to December 2014 by sorting hedge funds based on their MAX. Quintile 1 is the portfolio of hedge funds with the lowest MAX, and quintile 5 is the portfolio of hedge funds with the highest MAX. The table reports average MAX in each quintile, the next month average returns, and the 9-factor alphas for each quintile. The last row shows the average monthly raw return difference and the 9-factor alpha difference between High MAX and Low MAX quintiles. Average returns and alphas are defined in monthly percentage terms. Newey-West adjusted *t*-statistics are given in parentheses. Numbers in bold denote statistical significance of the returns and alphas.

Quintiles	Average MAX in each Quintile	Next Month Average Returns	Next Month 9-Factor Alphas
Q1	1.67	0.09	–0.01
		(1.08)	(–0.20)
Q2	3.04	**0.33**	**0.20**
		(3.20)	**(2.56)**
Q3	4.69	**0.45**	**0.29**
		(3.63)	**(3.54)**
Q4	7.39	**0.58**	**0.32**
		(3.61)	**(3.00)**
Q5	15.88	**0.79**	**0.46**
		(3.13)	**(2.25)**
Q5 – Q1		**0.70**	**0.47**
t-statistic		**(3.48)**	**(2.44)**

Table 3 (continued)

Panel B. 12-month-ahead Transition Matrix

This table reports the average month-to-month portfolio transition matrix in 12 months ahead. The table presents the average probability that a hedge fund in quintile *i* (defined by the rows) in one month will be in quintile *j* (defined by the columns) in the subsequent 12 months. If *MAX* is completely random, then all the probabilities should be approximately 20%, since a high-MAX or low-MAX in one month should say nothing about the MAX in the following 12 months. Instead, all the diagonal elements from top left to bottom right of the transition matrix exceed 20%, illustrating that the maximum return over the past 12 months is highly persistent even after putting a 12-month gap between the lagged and lead MAX variables. The sample period is January 1995–December 2014.

	Low MAX	Q2	Q3	Q4	High MAX	Total
Low MAX	59.5%	24.9%	10.0%	3.8%	1.8%	100.0%
Q2	25.8%	35.7%	23.7%	10.8%	4.0%	100.0%
Q3	10.0%	24.5%	32.5%	23.1%	10.0%	100.0%
Q4	4.4%	10.7%	23.5%	35.6%	25.8%	100.0%
High MAX	1.6%	4.1%	10.0%	26.1%	58.2%	100.0%

Table 3 (continued)

Panel C. Average Fund Characteristics of MAX Quintile Portfolios

Quintile portfolios are formed every month from January 1995 to December 2014 by sorting hedge funds based on their MAX measure. MAX is the maximum monthly hedge fund returns over the last 12 months. Quintile 1 is the portfolio of hedge funds with the lowest MAX measure, and quintile 5 is the portfolio of hedge funds with the highest MAX measure. This table reports the average fund charactersitics of hedge funds for each of the five quintiles. AVRG is the past 12-month average return, STDEV is the past 12-month standard deviation, LagRet is the one-month lagged return, Size is measured as monthly assets under management in billions of dollars, Age is measured as the number of months in existence since inception, Flow is measured as the change in the assets under management from previous month to current month adjusted with fund returns and scaled with previous month's assets under management, IncentFee is a fixed percentage fee of the fund's annual net profits above a designated hurdle rate, MgtFee is a fixed percentage fee of assets under management, typically ranging from 1% to 2%, MinInvest is the minimum initial investment amount (measured in millions of dollars in the regression) that the fund requires from its investors to invest in a fund, Redemption is the minimum number of days an investor needs to notify a hedge fund before the investor can redeem the invested amount from the fund, DLockup is the dummy variable for lockup provisions (1 if the fund requires investors not to withdraw initial investments for a pre-specified term, usually 12 months, 0 otherwise), and DLever is the dummy variable for leverage (1 if the fund uses leverage, 0 otherwise).

	MAX	AVRG	STDEV	LagRet	Size	Age	Flow	IncentFee	MgtFee	MinInvest	Redemption	DLockup	DLever
Q1	1.67	0.22	1.12	–0.05	0.14	58.8	–0.21	12.9	1.34	1.69	42.4	0.20	0.49
Q2	3.04	0.41	1.79	0.17	0.15	59.5	–0.14	13.0	1.41	1.21	40.8	0.22	0.51
Q3	4.69	0.56	2.64	0.29	0.15	58.8	–0.09	14.8	1.46	1.08	37.0	0.23	0.56
Q4	7.39	0.82	3.97	0.52	0.13	58.9	0.09	16.8	1.49	0.83	33.2	0.25	0.62
Q5	15.88	1.61	7.57	1.32	0.10	59.9	0.11	17.9	1.58	0.64	29.9	0.24	0.66

Table 4. Bivariate Portfolios of MAX after Controlling for AVRG, STDEV, Sharpe Ratio, Appraisal Ratio, Incentive Fee, and Fund Flows

Quintile portfolios are formed every month from January 1995 to December 2014 by sorting hedge funds first based on their fund characteristics (AVRG, STDEV, Sharpe Ratio, 9-Factor Appraisal Ratio, Incentive Fee, and Fund Flows) separately. Then, within each fund characteristics sorted portfolio, hedge funds are further sorted into sub-quintiles based on their MAX. Quintile 1 is the portfolio of hedge funds with the lowest MAX within each fund characteristics sorted quintile portfolio (depending on which fund characteristic's effect on MAX is controlled for) and Quintile 5 is the portfolio of hedge funds with the highest MAX within each fund characteristics sorted quintile portfolio (again depending on which fund characteristic's effect on MAX is controlled for). In each column, the top panel reports the average MAX in each quintile, and the lower panel reports those same quintiles' next month average returns. The last two rows show the monthly average raw return differences and the 9-factor Alpha differences between quintile 5 (High MAX funds) and quintile 1 (low MAX funds). Average returns and Alphas are defined in monthly percentage terms. Newey-West adjusted *t*-statistics are given in parentheses. Numbers in bold denote statistical significance.

	MAX Portfolios after controlling for AVRG	MAX Portfolios after controlling for STDEV	MAX Portfolios after controlling for SR	MAX Portfolios after controlling for 9-Factor AR	MAX Portfolios after controlling for Incentive Fee	MAX Portfolios after controlling for Fund Flows
Q1	2.39	3.42	1.84	1.78	1.76	1.75
Q2	3.74	4.96	3.24	3.13	3.26	3.15
Q3	5.16	6.04	4.85	4.71	4.90	4.78
Q4	7.30	7.38	7.42	7.32	7.38	7.38
Q5	14.06	10.86	15.30	15.47	15.36	15.60
	Next-month returns of MAX Quintiles	Next-month returns of MAX Quintiles	Next-month returns of MAX Quintiles	Next-month returns of MAX Quintiles	Next-month returns of MAX Quintiles	Next-month returns of MAX Quintiles
Q1	0.21	0.06	0.12	0.04	0.10	0.09
Q2	0.37	0.34	0.32	0.29	0.34	0.35
Q3	0.47	0.49	0.45	0.39	0.47	0.45
Q4	0.53	0.61	0.56	0.53	0.55	0.58
Q5	0.65	0.75	0.79	0.73	0.78	0.77
Q5 – Q1 Return Diff.	**0.44** **(3.02)**	**0.69** **(5.71)**	**0.67** **(3.39)**	**0.69** **(3.46)**	**0.68** **(3.37)**	**0.68** **(3.55)**
Q5 – Q1 9-factor Alpha Diff.	**0.29** **(2.09)**	**0.68** **(5.00)**	**0.41** **(2.40)**	**0.50** **(2.60)**	**0.46** **(2.44)**	**0.45** **(2.47)**

Table 5. Fama-MacBeth Cross-sectional Regressions of Hedge Fund Returns on MAX and Control Variables

This table reports the average intercept and average slope coefficients from the Fama-MacBeth cross-sectional regressions of one-month-ahead hedge fund excess returns on MAX with and without control variables. The Fama-MacBeth regressions are run each month for the period January 1995–December 2014, and the average slope coefficients are calculated for the full sample period (in Panel A) as well as for two subsample periods (Panels B and C) and for good and bad states of the economy (Panels D and E). Newey-West *t*-statistics are reported in parentheses to determine the statistical significance of the average intercept and slope coefficients. Numbers in bold denote statistical significance of the average slope coefficients.

	Intercept	MAX	SR	AVRG	STDEV	LagRet	Size	Age	Flow	IncentFee	MgtFee	MinInv	Redemption	DLockup	DLever
Panel A: Full sample period (1995:01 – 2014:12)															
(1)	0.208	**0.042**													
	(2.25)	**(3.52)**													
(2)	0.065	**0.030**	**0.100**	**0.205**	**0.070**	**0.072**	–0.006	–0.003	–0.001	**0.004**	0.013	**0.004**	**0.001**	**0.096**	0.009
	(0.59)	**(3.35)**	**(4.19)**	**(4.82)**	**(1.96)**	**(5.62)**	(–0.19)	(–1.63)	(–1.16)	**(1.91)**	(0.43)	**(3.36)**	**(2.01)**	**(3.04)**	(0.50)
Panel B: First half of the full sample period (1995:01 – 2004:12)															
(1)	0.380	**0.036**													
	(3.57)	**(2.29)**													
(2)	0.166	**0.028**	**0.110**	**0.202**	**0.083**	**0.075**	–0.028	–0.006	–0.001	0.003	0.029	**0.006**	**0.002**	**0.172**	0.013
	(0.84)	**(2.12)**	**(2.50)**	**(3.38)**	**(1.76)**	**(4.19)**	(–0.42)	(–1.64)	(–1.31)	(0.98)	(0.49)	**(3.19)**	**(1.99)**	**(3.26)**	(0.41)
Panel C: Second half of the full sample period (2005:01 – 2014:12)															
(1)	0.037	**0.048**													
	(0.25)	**(2.66)**													
(2)	–0.037	**0.031**	**0.090**	**0.209**	0.058	**0.069**	0.015	–0.001	0.001	**0.004**	–0.002	**0.001**	0.001	0.020	0.005
	(–0.41)	**(2.62)**	**(4.96)**	**(3.40)**	(1.06)	**(3.70)**	(1.44)	(–0.48)	(0.25)	**(2.08)**	(–0.10)	**(1.81)**	(0.69)	(0.72)	(0.29)
Panel D: Good states of the economy (CFNAI > 0)															
(1)	0.324	**0.051**													
	(3.45)	**(4.09)**													
(2)	0.135	**0.033**	**0.101**	**0.220**	**0.093**	**0.068**	–0.009	–0.004	–0.001	0.001	0.004	**0.005**	**0.002**	**0.133**	0.019
	(0.83)	**(3.09)**	**(2.23)**	**(3.59)**	**(1.87)**	**(3.72)**	(–0.16)	(–1.51)	(–0.63)	(0.30)	(0.08)	**(2.50)**	**(2.05)**	**(2.87)**	(0.61)
Panel E: Bad states of the economy (CFNAI < 0)															
(1)	0.091	**0.033**													
	(0.82)	**(2.21)**													
(2)	–0.007	**0.026**	**0.099**	**0.190**	0.048	**0.076**	–0.004	–0.002	–0.001	**0.007**	0.023	**0.003**	0.001	0.060	–0.001
	(–0.05)	**(2.34)**	**(4.04)**	**(2.98)**	(1.14)	**(3.02)**	(–0.09)	(–0.71)	(–0.79)	**(3.41)**	(0.55)	**(2.55)**	(1.03)	(1.56)	(–0.04)

Table 6. MAX by Three Broad Hedge Fund Investment Categories

The first row of this table presents the number of funds existing in each of the three broad hedge fund investment style categories. The second row reports the percentage of hedge funds in total sample for each of the three hedge fund investment styles. The third row reports the cross-sectional average of individual funds' MAX within each category during the full sample period. The fourth row presents, for each investment style separately, the cross-sectional average of the individual funds' time-series standard deviation of MAX during the sample period. The fifth row reports for each investment style the cross-sectional average of the spread between Max and Min of MAX. The sixth and seventh rows report, for each of the three broad investment categories separately, the percentages of funds that utilize futures and other derivatives in their investment strategies. For comparison purposes, the same statistics across all hedge funds (irrespective of the hedge fund categories) are also reported in the last column. As can be noticed by reading from left to right, Non-directional category, which includes the Equity Market Neutral, Fixed Income Arbitrage, and Convertible Arbitrage hedge fund investment styles have noticeably lower MAX, lower standard deviation of MAX, and lower Max–Min spread of MAX compared to Directional category, which includes the Managed Futures, Global Macro, and Emerging Markets hedge fund investment styles. More importantly, Directional strategies' MAX, standard deviation of MAX, and Max–Min spread of MAX are considerably larger compared to the all hedge fund group as well. Finally, Semi-directional category, which includes the Fund of Funds, Multi Strategy, Long-short Equity Hedge, and Event Driven hedge fund investment styles have MAX, standard deviation of MAX, and Max–Min spread of MAX that are very similar to the all hedge fund group.

	Non-directional Hedge Funds	Semi-directional Hedge Funds	Directional Hedge Funds	All Hedge Funds
Number of Funds	718	5,383	1,544	7,645
% of Funds in total sample	9.4%	70.4%	20.2%	100.0%
Average MAX	4.05	5.98	9.61	6.56
Avg. Std. Dev. of MAX	1.76	2.43	3.75	2.63
Avg. Max–Min spread of MAX	5.61	7.95	12.25	8.60
% of Funds using Futures	13.9%	14.0%	41.0%	19.9%
% of Funds using other Derivatives	17.5%	18.5%	24.1%	19.6%

Table 7. Univariate Portfolios of MAX for Three Broad Hedge Fund Categories

For each of the three broad hedge fund investment style categories (Non-directional, Semi-directional, and Directional), univariate quintile portfolios are formed every month from January 1995 to December 2014 by sorting hedge funds based on their MAX. Quintile 1 (5) is the portfolio of hedge funds with the lowest (highest) MAX in each hedge fund category. In each column, the top panel reports the average MAX in each quintile, and the lower panel reports those same quintiles' next month average returns. The last two rows show the monthly average raw return differences and the 9-factor Alpha differences between quintile 5 (High MAX funds) and quintile 1 (low MAX funds). Average returns and Alphas are defined in monthly percentage terms. Newey-West adjusted *t*-statistics are given in parentheses. Numbers in bold denote statistical significance.

	Non-Directional Funds Average MAX	Semi-Directional Funds Average MAX	Directional Funds Average MAX
Q1	1.34	1.72	2.64
Q2	2.17	2.98	5.20
Q3	3.07	4.41	7.71
Q4	4.52	6.73	11.28
Q5	10.45	14.08	21.27
	Next-month returns of MAX Quintiles	Next-month returns of MAX Quintiles	Next-month returns of MAX Quintiles
Q1	0.18	0.13	0.09
Q2	0.27	0.34	0.26
Q3	0.42	0.44	0.54
Q4	0.57	0.58	0.58
Q5	0.67	0.82	0.96
Q5 – Q1 Return Diff.	**0.50** **(3.11)**	**0.69** **(3.00)**	**0.88** **(3.71)**
Q5 – Q1 9-factor Alpha Diff.	**0.30** **(2.11)**	**0.40** **(2.43)**	**0.76** **(2.71)**

Table 8. Market- and Macro-timing Tests of Individual Hedge Funds

This table investigates the market- and macro-timing ability of non-directional, semi-directional, and directional hedge funds. Market-timing ability is tested using the excess market return (*MKT*), and macro-timing ability is tested using the Economic Uncertainty Index (*UNC*) of Bali, Brown, Caglayan (2014). For each analysis, individual hedge fund excess returns are regressed on the excess market return and the economic uncertainty index separately as well as on the index implying market- and macro-timing ability using pooled panel regressions for the sample period January 1995–December 2014. Market and macro-timing ability of hedge funds is tested using a model similar to Henriksson and Merton (1981):

$$R_{i,t} = \alpha + \beta_1 \cdot Y_t + \beta_2 \cdot Y_t^{high} + \varepsilon_{i,t},$$

where $R_{i,t}$ is excess return of fund i in month t, Y_t is the excess market return in month t for the market-timing test, and the economic uncertainty index of Bali et al. in month t for the macro-timing test, and Y_t^{high} is variable implying market-timing ability for the market-timing test, and the economic uncertainty index implying macro-timing ability for the macro-timing test:

$$Y_t^{high} = \begin{Bmatrix} Y_t & \text{if } Y_t \text{ is higher than its time-series median} \\ 0 & \text{otherwise} \end{Bmatrix}$$

In this regression specification, a positive and significant value of β_2 implies superior market- and macro-timing ability of individual hedge funds. For the *t*-statistics reported in parentheses, clustered robust standard errors are estimated to account for two dimensions of cluster correlation (fund and year). This approach allows for correlations among different funds in the same year as well as correlations among different years in the same fund. Numbers in bold denote statistical significance.

	Non-Directional Hedge Funds	Semi-Directional Hedge Funds	Directional Hedge Funds
β_2 from using MKT in the market-timing estimation	–0.050 (–0.80)	**0.169** **(2.07)**	**0.277** **(2.62)**
β_2 from using UNC in the macro-timing estimation	0.101 (0.93)	**0.494** **(2.32)**	**0.894** **(2.58)**

Table 9. MAX and Mutual Fund Returns

Panel A. Average Raw and Risk-Adjusted Returns of MAX Quintile Portfolios

Quintile portfolios of mutual funds are formed every month from January 1995 to June 2013 by sorting mutual funds based on their MAX. Quintile 1 is the portfolio of mutual funds with the lowest MAX and quintile 5 is the portfolio of mutual funds with the highest MAX. Panel A reports average MAX in each quintile, the next month average returns, and the 4-factor alphas for each quintile. The last row of Panel A shows the average monthly raw return difference and the 4-factor alpha difference between High MAX and Low MAX quintiles. Average returns and alphas are defined in monthly percentage terms. Newey-West adjusted *t*-statistics are given in parentheses. Numbers in bold denote statistical significance of the returns and alphas.

Quintiles	Average MAX in each Quintile	Next Month Average Returns	Next Month 4-Factor Alphas
Q1	0.70	0.01	–0.00
		(0.26)	(–0.07)
Q2	2.73	0.21	0.03
		(1.67)	(0.28)
Q3	5.31	0.32	**–0.16**
		(1.22)	**(–1.94)**
Q4	7.59	0.47	–0.13
		(1.43)	(–1.52)
Q5	12.28	0.50	–0.18
		(1.22)	(–1.57)
Q5 – Q1		0.49	–0.18
t-statistic		(1.23)	(–1.61)

Panel B. Market- and Macro-timing Tests of Individual Mutual Funds

Panel B investigates the market- and macro-timing ability of mutual funds using pooled panel regressions of Henriksson-Merton (1981) and Bali, Brown, and Caglayan (2014) for the sample period January 1995–June 2013. A positive and significant value of β_2 implies superior market-and macro-timing ability of individual muutal funds. For the *t*-statistics reported in parentheses, clustered robust standard errors are estimated to account for two dimensions of cluster correlation (fund and year). This approach allows for correlations among different funds in the same year as well as correlations among different years in the same fund.

	Mutual Funds
β_2 from using MKT in the market-timing estimation	–0.037 (–0.61)
β_2 from using UNC in the macro-timing estimation	0.609 (1.62)

Table 9 (continued)

Panel C. Testing the significance of timing ability

Panel C tests the economic and statistical significance of market- and macro-timing ability for the high-MAX directional, semi-directional, and non-directional hedge funds versus the high-MAX mutual funds. In the first row of Panel C, the average returns and alphas are compared for the high-MAX directional funds (with strong timing ability) vs. the high-MAX mutual funds (with no timing ability). In the second row, the average returns and alphas are compared for the high-MAX semi-directional funds (with semi-strong timing ability) vs. the high-MAX mutual funds (with no timing ability). In the last row, the average returns and alphas are compared for the high-MAX non-directional hedge funds vs. the high-MAX mutual funds (both groups with no timing ability).

	Mutual Funds	
	Return Diff.	Alpha Diff.
Directional Hedge Funds	**0.50**	**0.82**
	(2.15)	**(3.38)**
Semi-directional Hedge Funds	**0.33**	**0.57**
	(1.97)	**(5.77)**
Non-directional Hedge Funds	0.23	**0.65**
	(0.89)	**(4.73)**

Managerial Talent and Hedge Fund Performance

Online Appendix

To save space in the paper, we present some of our findings in the Online Appendix. Section I describes the mutual fund database and reports the number of mutual funds, yearly attrition rates, and their summary statistics. Table I examines the persistence of MAX using fund-level Fama-MacBeth cross-sectional regressions of MAX on lagged predictor variables. Table II investigates the predictive power of MAX over future hedge fund returns with two alternative multivariate Fama-MacBeth specifications of future hedge fund returns on MAX and control variables. Table III examines the long-term predictive power of MAX and reports the next 3-, 6-, 9-, and 12-month-ahead returns of quintile portfolios sorted by MAX. Table IV tests whether investors are willing to pay higher fees and invest more in funds that generate higher MAX via separate cross-sectional regressions of hedge fund fees and one-month-ahead flows on MAX and other control variables. Table V presents summary statistics for the mutual funds database.

This Version: June 2015

I. Mutual Fund Database

This study uses monthly returns of individual mutual funds from CRSP Mutual Fund database. Originally in our database there are 48,218 funds that report monthly returns at some point during our sample period from January 1994 to June 2013. Most of the mutual funds in the CRSP database, however, have multiple share classes designed for different client types. That is, a mutual fund may have a retail share class, an institutional share class, or a retirement share class. All of these share classes in essence constitute the same strategy, therefore their returns are highly correlated. However, the CRSP Mutual Fund database assigns a separate fund id number to each share class of the same fund, treating these share classes as if they are separate funds. In order to distinguish between share classes and funds, and not to use any duplicated funds (and hence returns) in our analyses, we first remove the multiple share classes of mutual funds from our study. We do this by keeping only the share class with the smallest fund id number (within a mutual fund family) in the database, and by removing the rest of the share classes of that particular mutual fund family from our analyses. This way, we make sure that each mutual fund family is represented with a single share class in our database. After removing multiple share classes, our sample size of mutual funds drops from 48,218 funds to 16,881 funds. That is, our database contains information on a total of 16,881 distinct, non-duplicated mutual funds, of which 7,073 are defunct funds and the remaining 9,808 are live funds. Table V of this online appendix provides summary statistics both on numbers and returns of these single-share class, non-duplicated mutual funds. For each year, Table V reports the number of funds entered into database, number of funds dissolved, attrition rate (the ratio of number of dissolved funds to the total number of funds at the beginning of the year), and the mean, median, standard deviation, minimum, and maximum monthly percentage returns on the equal-weighted mutual fund portfolio.

The most notable point in Table V is a sharp increase in the yearly attrition rates of mutual funds after year 2007, the starting point of the big worldwide financial crisis. From 1994 to 2007, on average, the annual attrition rate in the database was only 4.98%; however, this annual figure jumped to 10.56% in 2008 and to 9.63% in 2009 (the two highest figures detected in our sample period), giving an indication on how harsh the financial crisis is felt in the mutual fund industry in those years. In line with this jump in attrition rates, just during 2008, for example, mutual funds on average lost 2.67% (return) per month, generating the largest losses ever for their investors since the start of our analysis in 1994.

Table I. Fama-MacBeth Cross-sectional Regressions of 12-month-ahead MAX on Current MAX and Other Fund Characteristics

This table reports the average intercept and average slope coefficients from the Fama-MacBeth cross-sectional regressions of 12-month-ahead MAX on current MAX and other fund characteristics. Fama-MacBeth regressions are run for each month, and the average slope coefficients are calculated for the period January 1995–December 2014. Newey-West *t*-statistics are reported in parentheses to determine the statistical significance of the average intercept and slope coefficients. Numbers in bold denote statistical significance.

Intercept	MAX	AVRG	STDEV	LagRet	Size	Age	Flow	IncentFee	MgtFee	MinInv	Redemption	DLockup	DLever	R^2
2.381	**0.530**													**28.47%**
(14.35)	**(30.35)**													**(27.63)**
5.105		**0.482**												**5.58%**
(17.30)		**(4.16)**												**(6.70)**
5.786			**1.150**											**6.66%**
(21.32)			**(18.86)**											**(11.11)**
5.386				**0.076**										**4.60%**
(19.94)				**(3.29)**										**(10.74)**
5.847					**–0.425**									**0.25%**
(21.75)					**(–3.62)**									**(9.69)**
6.431						–0.048								**0.16%**
(9.36)						(–1.11)								**(5.55)**
5.786							0.001							**0.11%**
(21.33)							(0.34)							**(5.02)**
3.829								**0.130**						**3.16%**
(15.24)								**(22.53)**						**(16.46)**
4.953									**0.573**					**0.80%**
(15.88)									**(10.55)**					**(7.29)**
5.849										**–0.065**				**0.19%**
(21.18)										**(–9.39)**				**(15.02)**
6.466											**–0.020**			**1.22%**
(23.70)											**(–11.35)**			**(8.69)**
5.686												**0.408**		**0.22%**
(21.18)												**(4.14)**		**(5.63)**
5.152													**1.092**	**0.91%**
(20.32)													**(15.98)**	**(9.76)**
2.092	**0.489**	**0.172**	**1.217**	**0.028**	0.016	–0.033	**0.001**	**0.038**	0.071	**–0.009**	0.001	**0.293**	**0.134**	**38.14%**
(5.02)	**(25.54)**	**(2.47)**	**(18.18)**	**(2.75)**	(0.18)	(–1.25)	**(1.79)**	**(7.76)**	(1.69)	**(–2.92)**	(0.06)	**(4.25)**	**(4.07)**	**(41.85)**

Table II. Fama-MacBeth Cross-sectional Regressions of Hedge Fund Returns on MAX and Control Variables

This table reports the average intercept and average slope coefficients from the Fama-MacBeth cross-sectional regressions of one-month-ahead hedge fund excess returns on MAX with and without control variables. The Fama-MacBeth regressions are run each month for the period January 1995–December 2014, and the average slope coefficients are calculated for the full sample period (in Panel A) as well as for two subsample periods (Panels B and C) and for good and bad states of the economy (Panels D and E). Newey-West *t*-statistics are reported in parentheses to determine the statistical significance of the average intercept and slope coefficients. Numbers in bold denote statistical significance of the average slope coefficients.

	Intercept	MAX	SR	AVRG	STDEV	LagRet	Size	Age	Flow	IncentFee	MgtFee	MinInv	Redemption	DLockup	DLever
Panel A: Full sample period (1995:01 – 2014:12)															
(1)	0.088	**0.029**		**0.226**	**0.065**	**0.072**	–0.004	–0.003	–0.001	**0.004**	0.012	**0.004**	**0.002**	**0.101**	0.010
	(0.82)	**(3.27)**		**(5.58)**	**(1.80)**	**(5.59)**	(–0.11)	(–1.66)	(–1.02)	**(1.94)**	(0.40)	**(3.45)**	**(2.31)**	**(3.16)**	(0.54)
(2)	0.054	**0.032**	**0.090**	**0.163**		**0.071**	–0.006	–0.003	–0.001	**0.005**	0.011	**0.004**	**0.001**	**0.105**	0.014
	(0.49)	**(3.45)**	**(3.46)**	**(3.74)**		**(5.31)**	(–0.18)	(–1.61)	(–1.03)	**(2.34)**	(0.36)	**(3.10)**	**(1.84)**	**(3.24)**	(0.76)
Panel B: First half of the full sample period (1995:01 – 2004:12)															
(1)	0.199	**0.027**		**0.222**	0.074	**0.075**	–0.023	–0.006	–0.001	0.004	0.028	**0.007**	**0.003**	**0.176**	0.014
	(1.02)	**(2.05)**		**(3.97)**	(1.58)	**(4.14)**	(–0.34)	(–1.67)	(–1.21)	(0.99)	(0.46)	**(3.35)**	**(2.27)**	**(3.28)**	(0.47)
(2)	0.156	**0.030**	**0.090**	**0.160**		**0.073**	–0.027	–0.006	–0.001	0.004	0.028	**0.006**	**0.002**	**0.181**	0.019
	(0.77)	**(2.18)**	**(1.88)**	**(2.79)**		**(3.88)**	(–0.39)	(–1.62)	(–1.26)	(1.32)	(0.46)	**(3.09)**	**(1.83)**	**(3.34)**	(0.60)
Panel C: Second half of the full sample period (2005:01 – 2014:12)															
(1)	–0.023	**0.030**		**0.230**	0.055	**0.069**	0.016	–0.001	0.001	**0.005**	–0.003	**0.001**	0.001	0.026	0.005
	(–0.26)	**(2.57)**		**(3.90)**	(1.00)	**(3.72)**	(1.47)	(–0.50)	(0.46)	**(2.10)**	(–0.14)	**(1.77)**	(0.84)	(0.92)	(0.26)
(2)	–0.048	**0.034**	**0.090**	**0.167**		**0.068**	0.014	–0.001	0.001	**0.005**	–0.005	0.001	0.001	0.030	0.008
	(–0.54)	**(2.67)**	**(4.33)**	**(2.50)**		**(3.58)**	(1.31)	(–0.35)	(0.52)	**(2.40)**	(–0.26)	(1.20)	(0.61)	(1.00)	(0.49)
Panel D: Good states of the economy (CFNAI > 0)															
(1)	0.177	**0.030**		**0.240**	**0.085**	**0.068**	–0.005	–0.004	–0.001	0.001	0.003	**0.005**	**0.002**	**0.138**	0.019
	(1.09)	**(2.84)**		**(4.14)**	**(1.71)**	**(3.70)**	(–0.08)	(–1.56)	(–0.56)	(0.27)	(0.06)	**(2.67)**	**(2.38)**	**(2.99)**	(0.63)
(2)	0.141	**0.036**	**0.085**	**0.167**		**0.064**	–0.006	–0.004	–0.001	0.002	–0.001	**0.004**	**0.002**	**0.143**	0.026
	(0.85)	**(3.19)**	**(1.90)**	**(2.89)**		**(3.54)**	(–0.10)	(–1.49)	(–0.43)	(0.64)	(–0.01)	**(2.33)**	**(1.92)**	**(3.05)**	(0.83)
Panel E: Bad states of the economy (CFNAI < 0)															
(1)	–0.002	**0.027**		**0.212**	0.044	**0.076**	–0.003	–0.002	–0.001	**0.008**	0.022	**0.003**	0.001	0.063	–0.001
	(–0.01)	**(2.46)**		**(3.48)**	(1.05)	**(3.01)**	(–0.07)	(–0.68)	(–0.71)	**(3.47)**	(0.52)	**(2.68)**	(1.23)	(1.67)	(–0.01)
(2)	–0.034	**0.027**	**0.096**	**0.159**		**0.077**	–0.007	–0.002	–0.001	**0.008**	0.023	**0.003**	0.001	**0.068**	0.001
	(–0.25)	**(2.26)**	**(3.64)**	**(2.50)**		**(3.02)**	(–0.17)	(–0.65)	(–0.81)	**(3.84)**	(0.53)	**(2.36)**	(0.84)	**(1.72)**	(0.04)

Table III. Long-term Predictive Power of MAX

Quintile portfolios are formed each month by sorting hedge funds based on their MAX measures. Quintile 1 is the portfolio of hedge funds with the lowest MAX measure and quintile 5 is the portfolio of hedge funds with the highest MAX measure. This table reports the next 3-month, 6-month, 9-month, and 12-month average returns for each of the five quintiles. The last two rows show the monthly average raw return differences and the 9-factor Alpha differences between quintile 5 (High MAX funds) and quintile 1 (low MAX funds). Average returns and alphas are defined in monthly percentage terms. Newey-West adjusted *t*-statistics are given in parentheses. Numbers in bold denote statistical significance.

	3-month ahead returns of MAX Quintiles	6-month ahead returns of MAX Quintiles	9-month ahead returns of MAX Quintiles	12-month ahead returns of MAX Quintiles
Q1	0.12	0.14	0.15	0.16
Q2	0.35	0.34	0.31	0.31
Q3	0.45	0.44	0.40	0.38
Q4	0.55	0.48	0.46	0.44
Q5	0.72	0.64	0.56	0.53
Q5 – Q1 Return Diff.	**0.60** **(3.42)**	**0.49** **(3.13)**	**0.41** **(2.68)**	**0.37** **(2.47)**
Q5 – Q1 9-factor Alpha Diff.	**0.39** **(2.29)**	**0.33** **(2.11)**	**0.30** **(2.04)**	0.25 (1.60)

Table IV. Fama-MacBeth Cross-sectional Regressions of Hedge Fund Fees and One-month-ahead Hedge Fund Flows on MAX and Control Variables

This table reports the average intercept and average slope coefficients from the Fama-MacBeth cross-sectional regressions of Incentive Fees, Management Fees, and one-month-ahead Flows (separately) on MAX with and without control variables. The Fama-MacBeth regressions are run each month for the period January 1995–December 2014, and the average slope coefficients are calculated for the full sample period. Newey-West *t*-statistics are reported in parentheses to determine the statistical significance of the average intercept and slope coefficients. Numbers in bold denote statistical significance of the average slope coefficients.

Panel A: Cross-sectional regressions of Incentive Fee on MAX with and without control variables:

	Intercept	MAX	SR	STDEV	LagRet	Size	Age	Flow	MgtFee	MinInv	Redemption	DLockup	DLever
(1)	13.378 (142.48)	**0.283** **(20.54)**											
(2)	10.326 (24.89)	**0.251** **(20.05)**	**0.688** **(4.14)**	**0.464** **(12.60)**	–0.006 (–0.68)	0.036 (0.58)	**–0.043** **(–2.55)**	**0.009** **(2.67)**	**1.130** **(7.30)**	**0.041** **(5.72)**	0.001 (0.82)	**3.022** **(46.58)**	**3.555** **(86.56)**

Panel B: Cross-sectional regressions of Management Fee on MAX with and without control variables:

	Intercept	MAX	SR	STDEV	LagRet	Size	Age	Flow	IncentFee	MinInv	Redemption	DLockup	DLever
(1)	1.383 (214.92)	**0.012** **(10.12)**											
(2)	1.319 (107.69)	**0.007** **(7.19)**	**–0.042** **(–3.61)**	**0.010** **(2.70)**	–0.002 (–1.32)	–0.013 (–0.86)	**0.002** **(2.69)**	**–0.001** **(–2.76)**	**0.008** **(9.24)**	**–0.006** **(–13.85)**	**–0.002** **(–7.43)**	**–0.148** **(–21.53)**	**0.095** **(11.67)**

Panel C: Cross-sectional regressions of one-month-ahead Hedge Fund Flows on MAX with and without control variables:

	Intercept	MAX	SR	STDEV	LagRet	Size	Age	MgtFee	IncentFee	MinInv	Redemption	DLockup	DLever
(1)	–0.410 (–3.75)	**0.020** **(2.96)**											
(2)	–0.535 (–3.61)	**0.026** **(3.76)**	**1.118** **(9.52)**	**–0.189** **(–6.29)**	**0.012** **(1.82)**	0.032 (0.49)	**–0.010** **(–1.79)**	**–0.062** **(–2.05)**	**0.007** **(1.79)**	–0.001 (–0.34)	**0.003** **(3.99)**	**0.165** **(3.55)**	**0.146** **(3.10)**

Table V. Descriptive Statistics of Mutual Funds

There are total of 16,881 mutual funds that reported monthly returns to CRSP Mutual Fund Database for the years between 1994 and 2013 in this database, of which 7,073 are defunct funds and 9,808 are live funds. For each year from 1994 to 2013, this table reports the number of mutual funds, yearly attrition rates, and the mean, median, standard deviation, minimum, and maximum monthly percentage returns on the equal-weighted mutual fund portfolio.

						Equal-Weighted Mutual Fund Portfolio Monthly Returns (%)				
Year	**Year Start**	**Entries**	**Dissolved**	**Year End**	**Attrition Rate (%)**	**Mean**	**Median**	**Std. Dev.**	**Minimum**	**Maximum**
1994	3,108	625	132	3,601	4.25	-0.17	0.18	1.64	-3.08	2.00
1995	3,601	545	78	4,068	2.17	1.37	1.44	0.82	-0.33	2.41
1996	4,068	660	125	4,603	3.07	0.84	0.89	1.37	-2.15	2.98
1997	4,603	782	164	5,221	3.56	0.98	1.01	2.23	-2.31	4.01
1998	5,221	794	171	5,844	3.28	0.78	1.51	3.36	-8.29	3.67
1999	5,844	812	118	6,538	2.02	1.26	1.70	2.25	-2.34	5.16
2000	6,538	848	431	6,955	6.59	0.06	-1.26	3.16	-4.96	4.37
2001	6,955	649	520	7,084	7.48	-0.38	-0.17	3.60	-6.38	4.72
2002	7,084	480	506	7,058	7.14	-0.87	-1.00	3.00	-5.24	3.60
2003	7,058	477	472	7,063	6.69	1.62	1.14	1.98	-1.28	4.85
2004	7,063	469	381	7,151	5.39	0.74	1.25	1.69	-2.49	3.10
2005	7,151	635	485	7,301	6.78	0.52	0.94	1.62	-1.64	2.54
2006	7,301	765	405	7,661	5.55	0.88	1.07	1.52	-2.51	3.27
2007	7,661	946	445	8,162	5.81	0.53	0.65	1.81	-3.03	3.04
2008	8,162	1,971	862	9,271	10.56	-2.67	-1.31	5.05	-14.10	3.41
2009	9,271	1,232	893	9,610	9.63	2.01	2.84	4.46	-6.26	8.42
2010	9,610	946	539	10,017	5.61	1.07	1.69	3.66	-5.34	6.56
2011	10,017	1,134	634	10,517	6.33	-0.13	-0.55	3.51	-6.43	7.56
2012	10,517	510	932	10,095	8.86	0.92	1.08	2.31	-4.92	4.37
2013	10,095	445	732	9,808	7.25	0.77	0.76	1.72	-1.99	3.11

□ □ □ □ □ □ Crisis Intervention, Financial Depth, and Economic Growth

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This study investigates the effects of government crisis interventions on economic growth under an international prospective. We also evaluate how financial markets (banking, insurance, and stocks), financial liberalization, and monetary policy shape the effect of crisis intervention on economic growth. Our main empirical result points out first that the proxies of government interventions do have a significantly negative impact on economic growth. A higher level of banking development supports the enhanced credit crunch effect, while greater insurance and stock market developments mitigate this negative impact. Financial liberalization and monetary also helps to mitigate this negative impact under certain circumstances.

Keywords: Crisis intervention, Financial market, Economic growth, Financial liberalization, Monetary policy.

JEL Classification: E22, E52, G01, G28

1. Introduction

In recent decades, multiple countries have experienced some sort of a systemic banking crisis. In fact, the recent global financial crisis has given rise to the largest wave of banking crises seen since the Great Depression. The effects of this financial crisis are still lingering and in many cases the crisis is still ongoing. The crisis not only resulted from the collapse of financial institutions such as Lehman Brothers and American International Group (AIG) and the subsequent economic downturn, but also hit global financial markets, thus pushing governments to quickly establish safety net interventions to stabilize the financial markets.

Governments spent as much as 40-55% of GDP in the early 1980s' crises in Argentina and Chile. A substantial part of the costs of the 1997 Asian financial crisis – projected in the region of 20-55% of GDP for the three worst affected countries – ultimately fell on the government budget of the affected. Despite the fact that their economies are small, developing economies as a group have suffered cumulative fiscal costs in excess of $1 trillion from financial crisis. Among industrialized countries, Japan has spent around 20% of GDP to restructure its financial system during its long, drawn-out banking crisis (Honohan and Klingebiel, 2003). The recent 2008-2011 Icelandic financial crisis was a major economic and political event in Iceland that involved the collapse of all three of the country's major privately owned commercial banks, following their difficulties in refinancing their short-term debt and a run on deposits in the Netherlands and the United Kingdom. In terms of fiscal costs it reached at least 44% of GDP (Laeven and Valencia, 2013).

Studies analyzing crisis intervention policies usually focus on the fiscal and output costs of alternative intervention policies. Most of these studies suggest that the fiscal cost is positively related to the extent to which countries adopt accommodative policies (Honohan and Klingebiel, 2003; Kane and Klingebiel, 2004; Claessens et al., 2005). Another strand of the literature argues that government guarantees or other crisis intervention measures reduce market discipline,[1] particularly if the guarantees are perceived to be credible (Martínez-Peria and Schmukler, 2001; Demirguc-Kunt and Huizinga, 2004; Hoggarth et al., 2005; Nier and Baumann, 2006; and Hadad et al., 2011). Cubillas et al. (2012) further find that adoptions of an explicit blanket guarantee, forbearance, government recapitalization, and nationalization programs are interventions that have a weakening effect on market discipline, but Cubillas et al. do not find that the provision of liquidity support to banks has a specific negative effect on market discipline after a crisis.

Government crisis interventions are expensive, but there are potential benefits. One typical benefit of the safety net is to limit depositors' tendency to overreact by changing the incentives of bank depositors. Problems in the banking sector have large spillover effects upon other sectors, because banks provide a unique source of credit to other firms and manage the flow of payments throughout the economy. Disruptions in bank credit supply and in the smooth functioning of the payments system create potentially large social costs borne outside the banking system. Thus, banks in distress entail uniquely large social costs. Second, banks suffer a special risk in that their claimants (depositors) may "rationally overreact" to information and produce costly systemic runs (Calomiris, 1999).

Two channels of crisis intervention need explanation. One is ***the crowding effect***. Crisis intervention policies cause governments to increase their fiscal costs and crowd other sectors' fiscal expenses out, resulting in a decline of real GDP per capita. The other one is the ***credit crunch effect***. Once a crisis occurs, the government usually adopts necessary intervention

[1] Market discipline is generally analyzed by whether depositors penalize riskier banks by requiring higher interest rates.

measures, while at the same time depositors generally penalize riskier banks by requiring higher interest rates. This reduces the amount of available loans from banks. In such situations, a credit crunch is accompanied by a flight to quality by lenders and investors, affecting the flow of bank loans to those agents (households and small and medium-sized enterprises) for whom close substitutes for bank credit are unavailable. In turn, the disruption to the availability of finance for bank-dependent borrowers may stymie economic activity (Ding et al., 1998).

Rather than targeting the impacts of crisis intervention on fiscal costs, this study fills the gap in the literature by examining the impacts on economic growth. However, it is essential to consider that the relationship between crisis intervention and economic growth will change under different certain circumstances, such as financial systems.

From a theoretical point of view, the relationship between a financial system and economic growth may run in either or both directions. The 'supply-leading' and 'demand following' views as presented by Patrick (1966) postulate that economic growth (real income) can be enhanced either through growth in financial systems, or alternatively through growth in the economy, which brings about the development of financial activities. Based on the 'supply-leading' view, financial development enhances economic growth by transferring resources from traditional sectors to modern sectors and by promoting entrepreneurial responses in these modern sectors. By contrast, the 'demand-following' view indicates that a lack of financial development or institutions is due to a lack of demand for financial services. Thus, as the growth rate of real income rises, investors' and savers' demands for various new financial services materialize, hence leading to the creation of modern financial institutions, a greater supply of their financial assets and liabilities, and more related financial services.

Most studies empirically confirm the existence of a positive nexus between financial development and economic performance. King and Levine (1993), for example, show that the degree of financial development helps to explain long-run growth using data on 80 countries over the 1960-1989 period. Levine and Zervos (1998) and others support this evidence. Nevertheless, counter-evidence also exists (such as, Ram, 1999; Khan and Senhadji, 2003; Zhang, 2003; Arestis et al., 2001). However, Shen and Lee (2006) exhibit mixed evidence in which only stock market development has a positive effect on growth and that banking development has an unfavorable, if not negative, effect on growth. As for the insurance sector, Fortune (1973), Lewis (1989), Beck and Webb (2003), Li et al. (2007), and Lee et al. (2010) all ascertain that life insurance demand is positively related to income.[2]

Financial liberalization may also affect economic growth by reducing capital market imperfections, which might in turn reduce the external finance premium. Rajan and Zingales (1998) present that financially constrained industries grow faster in more financially developed countries. Laeven (2003) shows that liberalization of the banking sector reduces the imperfections firms face when dealing with financial markets. Bekaert et al. (2001) demonstrate that financial liberalization does increase economic growth. Specifically, financial liberalization leads to a 1% increase in annual real per capita GDP growth over a five-year period. Klein and Olivei (2008) also confirm that countries with an open capital account have a significantly greater increase in financial depth and stronger economic growth.

Along with financial depth and financial liberalization, monetary policy also plays a stabilizing role in influencing economic growth through a number of channels, such as the setting of interest rate and money supply levels. Since financial depth does matter for growth, it may change the relationship between crisis intervention and economic growth, but to our best

[2] Please refer to Lee et al. (2013) for a comprehensive survey.

acknowledge, previous studies do not consider this issue. In this study we evaluate how financial markets (banking, insurance, and stocks), financial liberalization, and monetary policy shape the effect of government intervention on economic growth.

Our paper hence fills some gaps in previous studies. First, we provide empirical evidence from examining the effects of government interventions on economic growth under an international prospective by using a panel data framework from 39 selected countries over the period 1984-2009. Second, we consider both the containment phase and resolution phase as proxies for crisis intervention. The containment phase includes a blanket guarantee or liquidity support, whereas the resolution phase includes government recapitalization or banks' nationalization. Third, we consider whether financial market, financial liberalization, and monetary policy change the relationship between crisis intervention and economic growth.

The rest of this paper is organized as follows. Section 2 provides a brief literature review of related works. Section 3 outlines the empirical model and the methodology. Section 4 provides a description of the data including data sources and definitions of variables. Section 5 reports and analyzes the empirical results of both the benchmark model and extended model. The final section presents the conclusions and implications.

2. Conditions Influencing the Relationship between Crisis Intervention and Economic Growth

2.1 Financial Depth

Most studies confirm the existence of a positive nexus between financial development and economic growth. King and Levine (1993), for example, show that the degree of financial development helps to explain long-run growth, using data on 80 countries over the 1960-1989 period. Levine and Zervos (1998) and others also support this evidence. Levine (1997) shows the impact of stock markets on growth, as stock markets encourage specialization as well as the acquisition and dissemination of information about firms, which may mobilize savings, thereby facilitating growth. Well-developed stock markets may enhance corporate control by mitigating the principal-agent problem.

Some studies do not agree with this positive relationship and claim that banking development may actually hinder growth. More specifically, they assert that by enhancing resource allocation and hence the returns on savings, banking development may even lower savings rates. If there are sufficiently large externalities associated with savings and investments, then banking development, they hold, slows long-run growth (Beck, and Levine, 2004). Examining 95 countries over the 1960-89 period, Ram (1999) also argues that the results pertaining to the finance-growth nexus are, at best, uncertain and ambiguous. Khan and Senhadji (2003) similarly demonstrate that certain banking development indicators become statistically insignificant when growth equations are estimated through the use of panels. By considering eight Asian economies, Zhang (2003) notes that there was a significantly negative connection between banking development and economic growth during the 1960-1999 period. Similarly, De Gregorio and Guidotti (1995) confirm this negative nexus by employing 12 Latin American countries over 1950-1985.

Arestis et al. (2001) argue that stock markets and banks are clearly substitutive sources for corporate finance. They base this on the grounds that when a firm issues new equity, its borrowing requirements from the banking system decline. From this viewpoint, it seems that the relationship between bank development and growth may therefore not be so robust.

In addition to such possible negative effects of banking development on growth, as reported by some researchers, still other studies dispute the fact that stock market development may hamper growth. Stiglitz (1985) presents that stock market liquidity does not strengthen the incentives for acquiring information about firms or for exerting corporate governance. From a similar perspective, Bhide (1993) emphasizes that excessive liquidity may hinder the costly monitoring of managers since shareholders can readily sell their stakes in a firm. Devereux and Smith (1994) indicate that greater risk sharing through stock market activities can actually reduce savings rates, hence slowing economic growth. In a similar vein, De Long et al. (1989) show that excessive stock trading can introduce "noise" into the market and be detrimental to efficient resource allocation. Mayer (1988) makes the argument that if not much corporate investment is financed through the issuance of equity, then stock markets do not play any part in economic growth. Shen and Lee (2006) exhibit mix evidence in which only stock market development has a positive effect on growth and that banking development has an unfavorable, if not negative, effect on growth.

As for the insurance sector, Fortune (1973), Lewis (1989), Beck and Webb (2003), Li et al. (2007), and Lee et al. (2010) all ascertain that life insurance demand is positively related to income. Moreover, the insurance market contributes to economic growth by improving the sound functions of financial systems, as noted in Ward and Zurbruegg (2000), Haiss and Sümegi (2008), Han et al. (2010), Lee (2013), and Lee et al. (2013). Thus, their results suggest that insurance markets and economic growth are endogenous.

2.2 Financial Liberalization

The effects of liberalization on economic growth have, of course, been widely studied, and the different spheres of liberalization are three-fold: trade, financial, and globalization. Tornell et al. (2004) find that trade liberalization enhances growth, but that financial liberalization does not necessarily lead to more rapid growth, in large part because it is associated with risky capital flow, lending booms, and crises. The latter is exemplified by Demirgüç-Kunt and Detragiache

(1998), who show that financial liberalization has a very large and statistically significant effect on the probability of a banking crisis. Others also confirm the unfavorable effects of financial liberalization (such as Loayza and Ranciere, 2006; Rousseau and Wachtel, 2007; Angkinand et al., 2010; Misati and Nyamongo, 2012; Lee and Hsieh, 2014)

Financial liberalization may also affect economic growth by reducing capital market imperfections, which might in turn reduce the external finance premium. Rajan and Zingales (1998) show that financially constrained industries grow faster in more financially developed countries. Laeven (2003) offers that liberalization of the banking sector reduces the imperfections firms face when dealing with financial markets. Bekaert et al. (2001) demonstrate that financial liberalization does lead to a 1% increase in annual real per capita GDP growth. Ito (2006) focuses on Asia over the period 1980 to 2000 and finds that trade openness is a prerequisite for successful inducement of financial development via capital account liberalization; while Klein and Olivei (2008) confirm capital account liberalization have a significantly increase in economic growth.

Dreher (2006) presents an index of globalization covering its three main dimensions: economic integration, social integration, and political integration. Using panel data for 123 countries in 1970-2000, Dreher finds that globalization promotes growth. Dreher et al. (2008) further update the index of globalization. In the literature there is general agreement that globalization implies countries are becoming more integrated into the international economy, increasing people's interactions, information exchanges, technology transformations, and convergence in cultural activities (Dreher, 2006; Lee and Chang, 2012; Lee et al., 2013). García-Herrero and Martinez Peria (2007) also note some evidence for cross-border expansion into emerging market countries in which a larger share of foreign claims is extended through the local affiliates of foreign banks, allowing local firms to enjoy more stable foreign financing. Hsieh et al. (2014) reveal that a higher degree of globalization decreases bank stability through income diversity, but stability rises through asset diversity.

2.3 Monetary Policy

The pioneer work of Friedman and Schwartz (1963) identifies the notion that monetary contraction and errors by the Federal Reserve caused the Great Depression. This is the so-called Friedman-Schwartz hypothesis in that a more accommodative monetary policy could have greatly reduced the severity of the Great Depression. The monetary transmission mechanism has been a subject of much research over a number of years (see Stiglitz and Weiss, 1981; Bernanke and Gertler, 1995; and Christiano et al., 1997), describing how policy-induced changes in monetary policy actions impact policy goals, e.g. output and inflation. A substantial body of recent literature has focused on these issues looking at the transmission mechanisms and sectoral effects of monetary policy. The most distinguishing characteristic of the monetary transmission mechanism either focuses on prices (interest rate, exchange rate, and other asset prices) or quantities (money, credit, base money, bonds, foreign assets, etc.). Taylor (1995) presents the financial market price framework for analyzing the monetary transmission mechanism - the process through which monetary policy decisions are transmitted into changes in real GDP and inflation.

3. Models

Beyond the panel data, the model that establishes the relationship between crisis intervention and economic growth remains unanswered. The basic model can be given by:

$$Growth_{i,t} = \beta_0 + \beta_1 Interv_{i,t} + \lambda' X_{i,t} + \varepsilon_{i,t} \tag{1}$$

Here, i =1, ..., N; t =1, ...,T; N refers to the country number; and T is for time. The dependent variable, $Growth_{i,t}$, is proxied by real per capita GDP growth (Cavallo and Cavallo, 2010; Shen and Lee, 2006). $Interv_{i,t}$ is the policy of government crisis intervention; $X_{i,t}$ denotes the control variables, including government consumption, education (years of secondary schooling), investment, and inflation; and $\varepsilon_{i,t}$ is the error term.

We define crisis intervention policy variables (*Interv*) using the data provided by Laeven and Valencia (2008). These are all dummy variables taking the value of 0 when the intervention policy is strict and 1 when a more accommodative approach is chosen. We differentiate between containment and resolution phases of crisis policy responses. In the containment phase, we consider two types of intervention using two variables: (1) *BLANKG* is a dummy variable that takes a value of 1 if authorities issue an explicit blanket guarantee to depositors and creditors after the initial onset of the crisis, or if market participants are implicitly protected from any losses if public banks' market share exceeds 75%; otherwise, it takes a value of 0; and (2) *LIQSUP* is a dummy variable that takes a value of 1 if authorities provide emergency liquidity support; otherwise, it takes a value of 0. The definition of "emergency" support is when claims from monetary authorities on banks' deposit money to total deposits reach at least 5% and at least twice as much as in the year before the crisis. In the resolution phase, we consider two types of intervention using different variables: (1) *RECAP* is a dummy variable that takes a value of 1 if banks are recapitalized by the government during the first 3 years of the crisis and 0 otherwise; and (2) *NATION* is a dummy that takes a value of 1 if banks are nationalized during the first 5 years of the crisis.

As for other control variables, we follow Shen and Lee (2006), Shen et al. (2010), Cavallo and Cavallo (2010), Ben Salha et al. (2012), Misati and Nyamongo (2012), Christiansen et al.

(2013), and Law et al. (2013) and include the ratio of government consumption against GDP (*GC*) for controlling government size, secondary gross enrollment rate (*ED_SEC*) as a human capital proxy, capital formation (*KF*), and inflation (*INFLA*) The higher the government consumption ratio is, the lower economic growth will be, since high government consumption by the public sector crowds out private investment in the economy. Thus, the coefficient of government consumption is expected to be negative. We further expect a higher level of human capital formation to be positive to growth. The coefficients of investment are found to be positive and significant in nearly all the existing literature. We therefore anticipate that the coefficient of capital formation should be positive. Inflation is also included in the model to test the macroeconomic stability. It is especially true if high inflation is also associated with increased price variability and reduced economy stability. The coefficient of inflation is then expected to be negative.

As discussed earlier, this study thus considers the effect of financial depth. We further look at whether financial depth influences the relation between crisis intervention and growth. Our extended model is:

$$Growth_{i,t} = \beta_0 + \beta_1 Interv_{i,t} + \beta_2 (Interv_{i,t} \times FD_{i,t}) + \lambda' X_{i,t} + \varepsilon_{i,t} \tag{2}$$

Here, *FD* refers to financial markets (bank, insurance, and stocks), financial liberalization, and monetary policy. We introduce *FD* to control financial environmental (or institutional) quality.

Referring to King and Levine (1993), Levine and Zervos (1998), Shen and Lee (2006), Chen et al. (2012) and others, the proxies of financial markets include two variables to measure the bank sector: domestic credit growth, which denotes the annual growth rate (*BCG*), and the ratio of bank private credit to GDP (*BPC*). To proxy the insurance sector, we employ life and non-life insurance densities (*ILID*, *INLID*), defined as premiums per capita, and life and non-life insurance penetrations (*ILIP*, *INLIP*), defined as the ratio of premium volume to GDP. To measure the stock market, we consider the ratio of stock market capitalization to GDP (*SMC*) and the stock turnover ratio (*STR*).

Following Rajan and Zingales (1998), Bekaert et al. (2001), Laeven (2003), and Klein and Olivei (2008), we include two types of financial liberalization. One is the degree of capital account liberalization (freedom of trade internationally, *FTI*; Chin-Ito index series, *CIT*), and the other one is globalization (economic and social globalizations). Capital account liberalization consists of removing restrictions on cross-border financial transactions[3] (Ben Salha et al., 2012).

The proxy of freedom of trade internationally (*FTI*) is published annually by the Frasher Institute and represents financial liberalization variables (Gwartney et al., 2010; Shehzad and De Haan, 2009). The freedom of trade internationally denotes a wide variety of restraints that affect international exchange of goods: tariffs, quotas, hidden administrative restraints, and controls on exchange rates and capital. A higher level of the index indicates a larger degree of economic freedom.

We also use the Kaopen indicator with the Chin-Ito index series (*CIT*) of financial openness and the progress of financial liberalization developed by Chinn and Ito (2008), updated to 2012, as the measuring degree of capital account openness at the country level during a certain period. The index has a mean of 0 and ranges from −2.66, representing full capital controls, to +2.66, representing complete liberalization. Higher values of the financial openness index reflect a country that is more open to cross-border capital transactions. The Kaopen indicator is based on the binary dummy variables reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). The popularly used Chinn-Ito index series are often referred to as the degree of financial openness (Misati and Nyamongo, 2012) and a measure of

[3] We do not take the IMF dummy indicator into account, which takes the value one in years where there are restrictions on capital account transactions and zero otherwise, due to its restriction on intensity consideration.

intensity capital controls (Ahmed, 2013). Yalta and Yalta (2012) and Ahmed and Islam (2010) employ the Chin-Ito index as an essential measure of a liberal financial environment.

The second type of financial labialization we include is the index of globalization, whereby we use the index recently developed from the KOF database of the Swiss Economic Institute ("Konjunkturforschungsstelle") as proposed by Dreher (2006) and updated in Dreher et al. (2008). The globalization index is on a yearly basis and is frequently used in the recent empirical literature.[4] The index consists of economic, social, and political dimensions of globalization. In this study we select economic and social globalizations as financial liberalization proxies from the updated 2010 KOF index of globalization, which measures globalization over the range from 1 to 100, where higher values represent higher levels of globalization.

For the proxies of monetary policy, we apply the annual real interest rate (*INT*) following Shen et al. (2010) and employ the ratio of M2 to Reserves (*M2RES*).

We are now able to construct two hypotheses - *the mitigated credit crunch effect* and *the enhanced credit crunch effect*. Doing so allows us to investigate the indirect impacts from the financial market, financial liberalization, and monetary policy on economic growth during the financial crisis periods.

This paper hypothesizes four possible outcomes in relation to the coefficients β_1 and β_2 of equation (2) as follows. We explore the four hypotheses below individually.

(1) If $\beta_1 > 0$ and $\beta_2 > 0$, then crisis intervention has a positive effect on growth, and financial depth affects the relation favorably.

(2) If $\beta_1 > 0$ and $\beta_2 < 0$, then crisis intervention has a positive effect on growth, and financial depth affects the relation adversely.

(3) If $\beta_1 < 0$ and $\beta_2 > 0$, then crisis intervention has a negative effect on growth, and financial

[4] For a detailed description and a long list of articles using the index, see http://www.kof.ethz.ch/globalization.

depth adversely impacts that negative effect.

(4) If $\beta_1 < 0$ and $\beta_2 < 0$, then crisis intervention has a negative effect on growth, and financial depth favorably impacts that negative effect.

4. Descriptions and Sources of Data

Our sample contains 39 selected countries over the period between 1984 and 2009. Data availability dictates the choice of the sample period and size. Figure 1 plots the relationship between real GDP average growth rate and the number of public interventions. The patterns are not clear, except there are two significant economic downturns: during the periods 1997-1998 and 2007-2008. Economic growth obviously declined as interventions were implemented (see Table A1 of Appendix).

[Figure 1 about here]

Table 1 provides our variables' definitions and full information on data sources in the study, whereas Table 2 presents summary statistics of all variables used as well as the descriptive statistics for the raw variables. The dependent variable, *Growth*, has a mean of 8.955 in logarithmic form. The first intervention variable, *BLAGU*, has a mean of 9.17% with 93 out of 1014 observations. The liquidity support variable, *LIQSUP*, has a mean of 2.76% with 28 observations. The other two intervention variables, *NATION* and RECAP, have a mean of 8.97% and 7.79%, respectively.

[Tables 1 and 2 about here]

5. Empirical Results

5.1 Crisis Intervention Policy and Economic Growth

Tables 3-8 shows the panel data regression results with fixed effects, with Table 3 presenting our benchmark results.[5] We find that all crisis intervention variables are significantly negative to economic growth, supporting *the credit crunch effect*. Hence, our results further supplement the two strands of related literature: one is that crisis intervention policies are positively related to fiscal costs (Honohan and Klingebiel, 2003; Kane and Klingebiel, 2004; Claessens et al., 2005); the other one is that government guarantees or other crisis intervention measures reduce market discipline, particularly if the guarantees are perceived to be credible (Martínez-Peria and Schmukler, 2001; Demirguc-Kunt and Huizinga, 2004; Hoggarth et al., 2005; Nier and Baumann, 2006; and Hadad et al., 2011).

As for the control variables, government consumption (*GC*) and inflation (*INF*) are associated with a decreased tendency towards economic growth, matching the results of Shen and Lee (2006), Shen et al. (2010), Cavallo and Cavallo (2010), Misati and Nyamongo (2012), and Christiansen et al. (2013), who all conclude that higher government consumption and higher inflation are harmful to economic growth. On the contrary, our result indicates that a higher level of investment (*KF*) helps increase economic growth, which is in line with Shen et al. (2010), Ben Salha et al. (2012), Misati and Nyamongo (2012), and Law et al. (2013).

[Table 3 about here]

5.2 Results of the Extended Model

Tables 4-7 present the empirical results for the interaction between government crisis intervention and financial depth. The concept is expressed mathematically:

$$\frac{\partial Growth_{i,t}}{\partial Interv_{i,t}} = \beta_1 + \beta_2 \times FD_{i,t} \tag{3}$$

[5] The time-fixed effects are not reported in the table to save space. The full table is available upon request.

Here, β_1 indicates the direct effect, ($\beta_2 \times FD_{i,t}$) represents the indirect effect of crisis intervention, and $(\beta_1 + \beta_2 \times FD_{i,t})$ is the total effect. In other words, the final influential effect of crisis intervention on economic growth is confirmed, although only through observing the total effect. Accordingly, in the extended model we clearly find that the sign of the marginal effect is influenced by the coefficients β_1 and β_2 and the financial depth variable *FD*. Consequently, the marginal effects of the extended model may be ambiguous.

The effect of domestic credit growth and the direct (β_1) and indirect effects (β_2) of the four crisis intervention variables on economic growth are almost significantly negative, showing that the factors of domestic credit growth (*BCG*) and bank private credit (*BPC*) may enhance the negative relation between crisis intervention and growth (Table 4). Thus, the banking sector enhances *the credit crunch effect*. This result is in accordance with theoretical studies like Bencivenga and Smith (1991), Bencivenga et al. (1995), and King and Levine (1993). These models show that financial development can hurt growth. Specifically, financial development, by enhancing resource allocation and hence the returns to saving, may lower saving rates. If there are sufficiently large externalities associated with savings and investment, then financial development slows long-run growth (Beck and Levine, 2004). Our results also clearly support existing empirical studies like Ram (1999) and Khan and Senhadji (2003) who present the finance-growth nexus is, at best, uncertain and ambiguous. We also confirm Zhang (2003) and De Gregorio and Guidotti (1995) as they find a negative nexus. However, our results partially contradict the findings of Beck and Levine (2004), who offer evidence that both bank and stock markets positively influence economic growth.

[Table 4 about here]

Table 5 presents four crisis interventions with the insurance market. When non-life density and non-life penetration are applied in the liquidity support panel (columns 6 and 8), the direct and indirect effects are both positive and both reach at least the 10% significant level. This result may confirm that the insurance market has a perfect substitute channel for banking, supporting Ward and Zurbruegg (2000), Haiss and Sümegi (2008), Han et al. (2010), Lee (2013), and Lee et al. (2013): the insurance market fosters income or growth.

[Table 5 about here]

Table 6 presents the interaction effect of crisis intervention and the stock market. The effects of interventions and the direct and indirect effects of the stock market on economic growth are significantly negative and positive, showing that the stock market turnover rate plays an essential role in mitigating the negative relation between crisis intervention and growth. Thus, the stock market mitigates *the credit crunch effect*. Such evidence also confirms some theories that provide conflicting predictions about whether stock markets and banks are substitutes, compliments, or whether one is more conducive to growth than the other (Boyd and Prescott, 1986; Stiglitz, 1985; and Bhide, 1993).

[Table 6 about here]

With respect to the impact of financial liberalization, shown in Table 7, when *FTI*, *ECOGLO*, and *SOCGLO* are adopted, we see a negative and direct relation between intervention and growth. A positive and indirect effect shows that freedom of trade internationally and economic and social globalizations mitigate *the credit crunch effect*. This result could further confirm the discussion of the existing literature. For instance, Bekaert et al. (2001) demonstrate that financial liberalization does increase economic growth. Laeven (2003) shows that liberalization of the banking sector reduces the imperfections firms face when dealing with financial markets. Ito (2006) finds that trade openness is a prerequisite for successful inducement of financial development via capital account liberalization. Klein and Olivei (2008) also confirm that countries with an open capital account have a significantly greater increase in economic growth.

[Table 7 about here]

Turning to the impact of monetary policy, shown in Table 8, the interactions of interest rates and crisis interventions are significantly negative. However, the results of *M2RES* fail to reach the same pattern. This negative finding for interest rates is consistent with the monetary transmission mechanism (Stiglitz and Weiss, 1981; Bernanke and Gertler, 1995; Taylor, 1995 and Christiano et al., 1997). Specifically, our results are mostly related with Taylor (1995) in which the financial market price plays a more important role through which monetary policy decisions are transmitted into changes in real GDP and inflation.

[Table 8 about here]

5.3 Robustness Test

This section further performs a robustness check on our main findings in the previous section. We utilize an alternative specification, the dynamic panel GMM approach,[6] to further examine the indirect effects conditional on government interventions on economic growth using the same proxies. The dynamic panel GMM approach is used to control for joint endogeneity of all explanatory variables in a dynamic formulation and eliminates potential biases arising from country-specific effects by taking the first difference of all variables. We therefore follow Cavallo and Cavallo (2010) to take the first-difference transformation (i.e., Δ) of equation (1) in order to remove the unobserved country-specific effect. To check the appropriateness of the panel GMM estimator, we employ two specification tests. One is Hansen's J test of over-identifying restrictions, which examines the overall validity of the instruments by analyzing the

[6] The dynamic GMM approach suggested by Arellano and Bover (1995) and Blundell and Bond (2000) is appropriate for dealing with the potential endogeneity, heteroskedasticity, and autocorrelation problems.

sample analog of the moment conditions used in the estimation process (Hansen, 1982). Under the null of joint validity of the full instrument set, the J test statistics are asymptotically χ^2. The second test scrutinizes the hypothesis that the error term $\varepsilon_{i,t}$ is not serially correlated. In both the difference regression and the system difference-level regression we test whether the differenced error term is second-order serially correlated. Basically, the GMM estimator is consistent if there is no second-order serial correlation between error terms of the first-difference equation and when the Hansen statistics are insignificant.

Tables 9-12 report the overall robust estimation results.[7] The four tables present estimations based on the one-step system-GMM estimator corrected for heteroscedasticity and small sample bias. We report the Hansen statistics of over-identifying restrictions and the autocorrelation tests of order 2 in all tables. We rely on the two- to four-period lags of the same variables as instruments. The *p*-value for the AR (2) tests of all models suggests that there is no autocorrelation in levels, and the Hansen test confirms that the instruments we use are exogenous.

The main finding here is that our significant results are robust to addressing our conditional proxies of financial depth. The robustness estimation results are mostly supportive of our earlier findings. For example, the direct effects of the four crisis interventions are still significantly negative. For the banking sector variables, we find that the coefficient of the interaction term with bank private credit (*BPC*) is still significantly negative, implying it still deteriorates the negative effect of government interventions on economic growth. For the insurance sector, we find that the coefficient of the interaction term of life insurance density (*ILID*) turns out a significantly positive sign, while the interaction term of non-life insurance density (*INLID*)

[7] The robustness estimation results for the year dummy are not reported to save space. We also regress economic growth on the four crisis interventions with stock market capitalization (*SMC*), freedom of trade internationally (*FTI*), and the Chin-Ito index (*CIT*). The estimation results remain unchanged and are still insignificant.

maintains a significantly positive effect on economic growth, implying that the insurance sector plays a more important role in economic growth. However, the indirect effect of the stock market turnover rate (*STR*) falls below the 10% significant level and changes to an insignificant result.

For the proxies of financial liberalization, we find that the interactions of crisis interventions with economic globalization and social globalization remain significantly positively associated with economic growth. In addition, for the monetary policy proxies, we find that the coefficient of the interaction term for the interest rate (*INT*) turns out an insignificantly positive sign, while the interaction term for the M2 to total reserve ratio (*M2RES*) is significantly positively associated with economic growth, suggesting that an expansionary monetary policy benefits economy growth.

Our main results overall remain mostly unchanged. Specifically, a higher level of banking development supports *the enhanced credit crunch effect*, while greater insurance and stock market developments mitigate this negative impact. Financial liberalization and monetary policy also help to mitigate this negative impact under certain circumstances.

[Tables 9, 10, 11, and 12 about here]

6. Conclusion and Implications

This paper provides empirical evidence from investigating the effects of government crisis interventions on economic growth under an international prospective by using a panel data framework from 39 selected countries. We also evaluate how financial markets (banking, insurance, and stocks), financial liberalization, and monetary policy shape the effect of government intervention on economic growth. We apply the fixed effects model of panel data with the Hausman test and also control for unobservable country-specific and year-fixed effects with a country-level cluster.

Our main empirical result overall points out first that the proxies of government intervention do have a significantly negative impact on economic growth. Second, a higher level of banking development supports *the enhanced credit crunch effect*, while greater insurance and stock market developments mitigate this negative impact. Third, financial liberalization and monetary policy also help to mitigate this negative impact under certain circumstances. Finally, we conduct robustness checks on our main findings with an alternative specification- dynamic panel GMM model to further examine the indirect effect conditional on government interventions on economic growth using the same proxies. We find that the direct effects of the four crisis interventions are still significantly negative and remain unchanged. The crisis interventions that interact with the insurance sector, economic globalization, and social globalization still hold the same results. Overall, the robustness results are supportive of our earlier findings.

Some important policy implications can be drawn from our analyses. First, from our findings, the negative effect of public intervention policies on economic growth indicates that crisis interventions fail to positively stimulate economic performance. Policymakers or governments should be aware that any crisis intervention policy implementation is discouraged when a financial crisis erupts, because the crisis intervention policy involves a sacrifice of economic growth by increasing government fiscal costs and crowding out other fiscal expenses, thus lowering real GDP.

Second, the financial market, financial liberalization, and monetary policy all play an important role affecting the relationship between crisis intervention policy and economic growth. Policymakers or governments should further consider other conditional environments present that can help promote economic growth during a crisis period.

Third, the study finds that the roles of non-life insurance and stock markets are positively important in explaining economic growth, while a higher level of banking development is harmful to economic growth. In order to increase economic growth through a crisis intervention policy, policymakers or governments should not only pay more attention to highlighting a strong non-life insurance sector and/or stock market, but also focus on the banking sector. For the banking market, countries with higher credit growth rates and bank private credit should further consider the possible negative impact (i.e., moral hazard effect) when implementing a crisis intervention policy. Insurers and stock market investors also may have expectations that insurance and stock markets will be targeted for support during financial crises.

Fourth, higher levels of financial liberalization and monetary policy will mitigate the negative impact of a crisis invention policy on economic growth. This finding offers implications for policymakers and governments to act upon. Any policy related to improving financial liberalization and/or expanding the monetary base (e.g., lower interest rates or increases in money supply) may be highly recommended to promote economic growth during a financial crisis as well.

Fifth and finally, in view of the constraints on our collection of data, more research needs to be done on the conditional variables in order to analyze the economic growth issue. For example, future studies may investigate government supervision, market regulations, and political institutional environments.

Table A1. Banking intervention policy implementation and banking crisis episodes.

No.	Country	Blanket Guarantee	Liquidity Support	Nationalized Banks	Bank Recapitalization	Systemic Banking Crisis
1	Algeria					1990
2	Argentina	1995	1990, 2002	2001	1995, 2001	1989, 1995, 2001
3	Australia				2008	2008
4	Austria	2008, 2009	2008	2008	2008	2008
5	Belgium	2008, 2009	2008	2008	2008	2008
6	Canada			2008	2008	2008
7	Colombia		2000	1984, 1998, 2001, 2002	1984, 1998	1998, 2008
8	Denmark	2009	2008	2008, 2009	2008, 2009	2008
9	Egypt					
10	Finland	1991, 1993, 1994, 1995, 1996, 1997, 1998, 2008	1990	1991	1992, 2008	1991, 2008
11	France	2008	2008		2008	2008
12	Greece	2008, 2009	2008		2008	2008
13	India					1993
14	Indonesia	1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005	1998	1997	1997	1997
15	Ireland	2008, 2009	2008	2008	2008	2008
16	Israel					
17	Italy	2008, 2009	2008		2008	2008
18	Japan	1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005 2008		1997	1997	1997, 2008
19	Kenya			1992	1992	1985, 1992
20	Malaysia	1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005 2008	1997	1997, 2008	1997, 2008	1997, 2008
21	Mexico	1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003	1995, 2007	1994, 2007	1994, 2007	1994, 2007
22	Morocco					
23	Netherlands	2008, 2009	2008	2008, 2009	2008, 2009	
24	New Zealand					
25	Norway		1992	1991	1991	1991, 2008
26	Philippines			1997	1997	1997
27	Portugal	2008, 2009	2009		2008	2008
28	Singapore					
29	South Africa					
30	South Korea	1997, 1998, 1999, 2000	1996	1997, 2008	1997, 2008	1997, 2008
31	Spain	2008, 2009	2008			2008

32	Sweden	1992, 1993, 1994, 1995, 1996, 2008, 2009	1992, 2008	1991, 2008	1991, 2008, 2009	1991, 2008
33	Switzerland		2008		2008, 2009	2008
34	Taiwan					
35	Thailand	1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005	1998	1997	1997	1997
36	Turkey	2000, 2001, 2002, 2003, 2004	2000	2000	2000	2000
37	United Kingdom	2008, 2009	2008	2007	2007	2007
38	United States	2008, 2009	2008	2007, 2008, 2009	1988, 2007	1988, 2007
39	Venezuela		1995	1994	1994	1994
Total (countries, counts)		**(22, 93)**	**(25, 28)**	**(23, 37)**	**(29, 42)**	**(31, 43)**

Source: Laeven and Valencia (2008, 2013).

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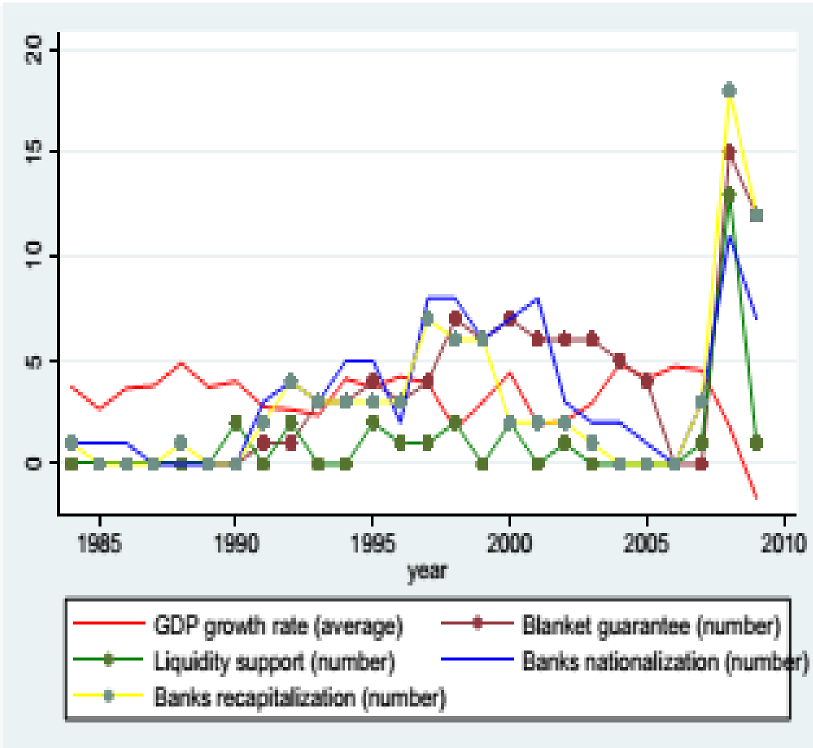

Figure 1. Plots of real GDP growth rate (average) and total number of crisis interventions 1984-2009. (Source: WDI, 2012, and Laeven and Valencia, 2008, 2013)

Table 1. Data descriptions and sources.

		Variables	Descriptions	Sources
Dependent Variables				
	Growth rate of real GDP per capita	Growth	Log difference of the ratio of real gross domestic product (constant 2000 USD)	World Development Indicator (WDI, 2012)
Independent Variables				
	Blanket guarantee	BLAGU	Dummy variable that takes a value of 1 if authorities issue an explicit blanket guarantee to depositors and creditors after the initial onset of a crisis; 0 otherwise.	Laeven and Valencia (2008, 2013)
	Liquidity support	LIQSUP	Dummy variable that takes a value of 1 if authorities provide emergency liquidity support; 0 otherwise.	
	Nationalized banks	NATION	Dummy variable that takes a value of 1 if banks are nationalized during the first 5 years of the crisis; 0 otherwise.	
	Bank recapitalized	RECAP	Dummy variable that takes a value of 1 if banks are recapitalized by the government during the first 3 years of the crisis; 0 otherwise.	
Controlled Variables				
	Inflation	INFLA	Log (1+annual change in consumer price index)	World Development Indicator (WDI, 2012)
	Government consumption	GC	Government consumption as a share of GDP	
	Education secondary level	ED_SEC	Total enrollment ratio in secondary education	
	Investment	KF	Gross capital formation as a share of GDP	
Conditional Factors:				
1) Financial Depth				
Banking	Domestic credit growth rate	BCG	Domestic credit growth rate %, annual	World Development Indicator (WDI, 2012)
	Bank private credit	BPC	Ratio of bank private credit to GDP	
Insurance	Life insurance density	ILID	Life insurance premium per capita	Sigma, Swiss Reinsurance Company
	Non-life insurance density	INLID	Non-life insurance premium per capita	
	Life insurance penetration	ILIP	Ratio of premium volume to GDP for life insurance	
	Non-life insurance penetration	INLIP	Ratio of premium volume to GDP for non-life insurance	
Stock	Stock market capitalization	SMC	Ratio of stock market capitalization to GDP	World Development Indicator (WDI, 2012)
	Stock turnover ratio	STR	Stock market turnover rate	
(2) Financial Liberalization				
i. Degree of capital account liberalization				
	Freedom of trade internationally	FTI	Measures a wide variety of restraints that affect international exchange of goods: tariffs, quotas, hidden administrative restraints, and controls on exchange rates and capital	Frasher economic freedom (Gwartney et al, 2010)
	Chin-Ito index	CIT	Measures an index of financial openness and progress of financial liberalization	Chin-Ito index series (updated to 2010)
ii. Index of globalization				
	Economic globalization	ECOGLO	Measured by actual flows and restrictions indictors	KOF index of globalization (Dreher et al. 2008)
	Social globalization	SOCGLO	Measured by personal contact, information flows, and culture proximity indictors	
(3) Monetary Policy				
	Interest rate	INT	Real interest rate (%)	World Development Indicator (WDI, 2012) 2012)
	Broad money to reserves ratio	M2RES	Money and quasi money (M2) to total reserves ratio (%)	

Table 2. Summary statistics of the variables.

Variable	Mean	Std. Dev.	Min.	Max.	Number
Growth	0.01915	0.0328	-0.15416	0.1505	934
BLAGU	0.09172	0.2888	0.0000	1.0000	1,014
LIQSUP	0.0276	0.1639	0.0000	1.0000	1,014
NATION	0.0897	0.28596	0.0000	1.0000	1,014
RECAP	0.0779	0.2681	0.0000	1.0000	1,014
INFLA	16.0923	123.6893	-11.2666	3057.6290	971
GC	16.7611	5.3995	2.9755	38.2268	985
ED_SEC	88.3960	26.6933	28.4292	161.7810	834
KF	23.0162	5.2818	10.2199	46.9535	988
BCG	1.4781	12.7270	106.8500	92.3400	1,014
BPC	67.7590	43.9900	4.1500	237.1500	906
ILID	5.1790	2.3153	0.9056	13.1484	1,014
INLID	5.3821	1.9116	0.8419	16.2920	1,014
ILIP	-4.1718	1.4275	-9.210	-1.5880	1,014
INLIP	-3.9694	0.6640	-5.7440	-2.3650	1,014
SMC	63.9150	53.0330	1.2103	281.3800	748
STR	62.8720	50.9360	1.5600	393.3000	725
FTI	7.2878	1.7974	0.4000	9.6400	1,014
CIT	0.9351	1.5347	-1.8550	2.4550	976
ECOGLO	63.7720	18.0920	19.1620	97.5180	962
SOCGLO	58.5690	22.6310	9.8540	93.2540	962
M2RES	9.7630	13.2570	0.0035	90.9440	781
INT	5.5800	6.5326	-35.3100	88.1100	847

Note: Please refer Table 1 for detailed definitions.

Table 3. Empirical results for the benchmark model.

	(1)	(2)	(3)	(4)
BLAGU	-0.0127**			
	(-2.55)			
LIQSUP		-0.0257**		
		(-2.21)		
NATION			-0.0150**	
			(-2.50)	
RECAP				-0.0227***
				(-3.28)
INFLA	-0.0000549***	-0.0000443***	-0.0000568***	-0.0000571***
	(-5.63)	(-3.57)	(-5.92)	(-6.04)
GC	-0.00390***	-0.00387***	-0.00369***	-0.00347***
	(-4.35)	(-4.16)	(-4.11)	(-3.68)
ED_SEC	0.000186	0.000157	0.000168	0.000131
	(1.01)	(0.84)	(0.89)	(0.71)
KF	0.00136***	0.00142***	0.00138***	0.00139***
	(2.96)	(3.06)	(3.01)	(3.06)
Sample	782	782	782	782
Country #	39	39	39	39
Cluster	country	country	country	country
Hausman test	Fixed effect	Fixed effect	Fixed effect	Fixed effect
Chi^2	41.53***	34.05***	31.81***	28.26***
Joint F test	3.68***	3.54***	3.63***	3.27***

Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Z statistics are in parentheses, and the dependent variable is growth of real GDP per capita. Panel data with the fixed effects model are utilized in the estimation model. The estimation results of year dummy are unreported in the table to save space.
For the Hausman test: the null hypothesis is that the fixed effects model is consistent, in favour of the random effects model. Joint F test jointly tests for the year-fixed effect (H_0: the jointly coefficients of all years are jointly equal to zero).

Table 4. Empirical results of government interventions into the banking sector on economic growth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BLAGU	-0.0132**	0.00896						
	(-2.54)	(1.16)						
BLAGU × BCG	-0.00171***							
	(-3.88)							
BLAGU × BPC		-0.000267**						
		(-2.57)						
LIQUI			-0.0187*	-0.0226				
			(-1.66)	(-1.15)				
LIQUI × BCG			-0.00209***					
			(-4.27)					
LIQUI × BPC				-0.0000675				
				(-0.44)				
NATION					-0.0143**	0.00380		
					(-2.39)	(0.56)		
NATION × BCG					-0.00175***			
					(-3.78)			
NATION × BPC						-0.000247**		
						(-2.33)		
RECAP							-0.0192**	-0.00630
							(-2.56)	(-0.83)
RECAP × BCG							-0.00166***	
							(-3.90)	
RECAP × BPC								-0.000195*
								(-1.87)
INFLA	-0.0000541***	-0.0000501***	-0.000140***	-0.0000413***	-0.0000562***	-0.0000501***	-0.0000592***	-0.0000514***
	(-5.63)	(-6.31)	(-5.00)	(-3.04)	(-5.83)	(-6.24)	(-6.39)	(-6.41)
GC	-0.00376***	-0.00348***	-0.00409***	-0.00351***	-0.00354***	-0.00346***	-0.00351***	-0.00333***
	(-4.14)	(-3.86)	(-3.89)	(-3.75)	(-3.95)	(-3.88)	(-3.73)	(-3.61)
ED_SEC	0.000180	0.0000438	0.000179	0.0000320	0.000166	0.0000253	0.000149	0.0000782
	(0.99)	(0.27)	(0.96)	(0.18)	(0.89)	(0.15)	(0.79)	(0.05)
KF	0.00143***	0.00120**	0.00137**	0.00127***	0.00141***	0.00124**	0.00137***	0.00125***
	(3.09)	(2.56)	(2.87)	(2.77)	(3.07)	(2.66)	(2.91)	(2.71)
Sample	782	716	782	716	782	716	782	716
Country #	39	35	39	35	39	35	39	35
Cluster	country	country	country	country	country	country	country	country
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Z statistics are in parentheses, and the dependent variable is growth of real GDP per capita. Panel data with the fixed effects model are utilized in the estimation model. The estimation results of the year dummy are unreported in the table to save space.

Table 5. Empirical results of blanket guarantee and liquidity support in the insurance market on economic growth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BLAGU	-0.0138**	-0.0150**	-0.0114	-0.0125				
	(-2.07)	(-2.38)	(-1.29)	(-1.38)				
BLAGU × ILID	0.00000126							
	(0.35)							
BLAGU × INLID		0.00000541						
		(1.14)						
BLAGU × ILIP			-0.0344					
			(-0.23)					
BLAGU × INLIP				-0.00765				
				(-0.03)				
LIQUI					-0.0295*	-0.0395**	-0.0293	-0.0467**
					(-1.71)	(-2.31)	(-1.57)	(-2.25)
LIQUI × ILID					0.00000288			
					(0.50)			
LIQUI × INLID						0.0000158*		
						(1.79)		
LIQUI × ILIP							0.0964	
							(0.41)	
LIQUI × INLIP								0.803*
								(1.69)
INFLA	-0.0000551***	-0.0000553***	-0.0000548***	-0.0000549***	-0.0000426***	-0.0000394***	-0.0000427***	-0.0000373**
	(-5.63)	(-5.63)	(-5.67)	(-5.64)	(-3.03)	(-2.83)	(-2.95)	(-2.58)
GC	-0.00394***	-0.00396***	-0.00387***	-0.00389***	-0.00388***	-0.00389***	-0.00388***	-0.00391***
	(-4.32)	(-4.40)	(-4.32)	(-4.33)	(-4.18)	(-4.24)	(-4.18)	(-4.25)
ED_SEC	0.000193	0.000199	0.000182	0.000185	0.000162	0.000179	0.000159	0.000173
	(1.07)	(1.10)	(1.02)	(1.02)	(0.87)	(0.98)	(0.85)	(0.94)
KF	0.00137***	0.00134***	0.00135***	0.00136***	0.00142**	0.00135**	0.00142**	0.00136**
	(2.95)	(2.95)	(2.85)	(2.99)	(3.08)	(2.95)	(3.08)	(2.97)
Sample	782	782	782	782	782	782	782	782
Country #	39	39	39	39	39	39	39	39
Cluster	country	country	country	country	country	country	country	country
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 5 (*Cont.*)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
NATION	-0.0147*	-0.0190***	-0.0108	-0.0201**				
	(-1.95)	(-2.63)	(-1.28)	(-2.05)				
NATION × ILID	-0.000000283							
	(-0.11)							
NATION × INLID		0.00000791						
		(1.33)						
NATION × ILIP			-0.121					
			(-1.15)					
NATION × INLIP				0.240				
				(0.77)				
RECAP					-0.0243***	-0.0296***	-0.0203**	-0.0319***
					(-2.78)	(-3.72)	(-1.97)	(-2.86)
RECAP × ILID					0.00000160			
					(0.53)			
RECAP × INLID						0.0000120**		
						(2.10)		
RECAP × ILIP							-0.0678	
							(-0.52)	
RECAP × INLIP								0.411
								(1.23)
INFLA	-0.0000568***	-0.0000577***	-0.0000561***	-0.0000572***	-0.0000573***	-0.0000582***	-0.0000567***	-0.0000577***
	(-5.88)	(-5.93)	(-5.89)	(-5.96)	(-6.03)	(-6.11)	(-6.00)	(-6.06)
GC	-0.00369***	-0.00374***	-0.00367***	-0.00373***	-0.00347***	-0.00345***	-0.00348***	-0.00348***
	(-4.10)	(-4.17)	(-4.09)	(-4.15)	(-3.68)	(-3.69)	(-3.69)	(-3.70)
ED_SEC	0.000167	0.000184	0.000158	0.000175	0.000137	0.000158	0.000129	0.000143
	(0.90)	(0.99)	(0.86)	(0.95)	(0.74)	(0.86)	(0.70)	(0.78)
KF	0.00138***	0.00136***	0.00137***	0.00137***	0.00140***	0.00136***	0.00139***	0.00138***
	(2.99)	(2.99)	(2.91)	(3.03)	(3.06)	(3.00)	(3.00)	(3.06)
Sample	782	782	782	782	782	782	782	782
Country #	39	39	39	39	39	39	39	39
Cluster	country	country	country	country	country	country	country	country
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. *Z* statistics are in parentheses, and the dependent variable is growth of real GDP per capita. Panel data with the fixed effects model are utilized in the estimation model. The estimation results of the year dummy are unreported in the table to save space.

Table 6. Empirical results of government interventions into the stock market on economic growth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BLAGU	-0.0128**	-0.0223***						
	(-1.98)	(-2.69)						
BLAGU × SMC	-0.0000176							
	(-0.04)							
BLAGU × STR		0.000115**						
		(2.14)						
LIQUI			-0.0364**	-0.0416**				
			(-2.18)	(-2.30)				
LIQUI × SMC			0.0001*					
			(1.79)					
LIQUI × STR				0.000138				
				(1.59)				
NATION					-0.0152**	-0.0220***		
					(-1.97)	(-2.61)		
NATION × SMC					-0.000423			
					(-0.11)			
NATION × STR						0.0000679*		
						(1.84)		
RECAP							-0.0242***	-0.0291***
							(-2.82)	(-3.19)
RECAP × SMC							0.000297	
							(0.97)	
RECAP × STR								0.000083**
								(2.17)
INFLA	-0.0000522***	-0.0000522***	-0.0000365***	-0.0000365***	-0.0000535***	-0.0000542***	-0.0000538***	-0.0000544***
	(-8.69)	(-9.17)	(-3.74)	(-4.03)	(-8.97)	(-9.02)	(-9.25)	(-9.12)
GC	-0.00469***	-0.00475***	-0.00464***	-0.00467***	-0.00437***	-0.00428***	-0.00410***	-0.00406***
	(-3.11)	(-3.27)	(-3.30)	(-3.29)	(-2.88)	(-2.77)	(-2.75)	(-2.70)
ED_SEC	0.000127	0.000115	0.000105	0.0000968	0.000115	0.000105	0.0000676	0.0000564
	(0.74)	(0.69)	(0.64)	(0.59)	(0.67)	(0.63)	(0.41)	(0.35)
KF	0.00113*	0.00114*	0.00120*	0.00120*	0.00118*	0.00116*	0.00117*	0.00116*
	(1.81)	(1.81)	(1.92)	(1.92)	(1.91)	(1.88)	(1.92)	(1.89)
Sample	600	601	600	601	600	601	600	601
Country #	31	30	31	30	31	30	31	30
Cluster	country	country	country	country	country	country	country	country
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. *Z* statistics are in parentheses, and the dependent variable is growth of real GDP per capita. Panel data with the fixed effects model are utilized in the estimation model. The estimation results of the year dummy are unreported in the table to save space.

Table 7. Empirical results of blanket guarantee and liquidity support with financial liberalization on economic growth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BLAGU	-0.102*	-0.0198**	-0.121*	-0.0895*				
	(-1.96)	(-2.27)	(-1.68)	(-1.69)				
BLAGU × FTI	0.0116*							
	(1.73)							
BLAGU × CIT		0.00698						
		(1.41)						
BLAGU × ECOGLO			0.00292					
			(1.62)					
BLAGU × SOCGLO				0.00197				
				(1.60)				
LIQUI					-0.134	-0.0302	-0.192**	-0.143**
					(-1.25)	(-1.62)	(-2.22)	(-2.36)
LIQUI × FTI					0.0139			
					(1.06)			
LIQUI × CIT						0.00425		
						(0.55)		
LIQUI × ECOGLO							0.00449**	
							(2.11)	
LIQUI × SOCGLO								0.00311**
								(2.21)
INFLA	-0.000055***	-0.000055***	-0.000055***	-0.000056***	-0.000021	-0.000040**	-0.000014	-0.000021
	(-5.63)	(-5.61)	(-5.53)	(-5.65)	(-0.76)	(-2.16)	(-0.65)	(-1.07)
GC	-0.00407***	-0.00407***	-0.00384***	-0.00407***	-0.00392***	-0.00385***	-0.00380***	-0.00382***
	(-4.44)	(-4.38)	(-4.40)	(-4.42)	(-4.30)	(-4.16)	(-4.36)	(-4.27)
ED_SEC	0.000218	0.000245	0.000237	0.000218	0.000182	0.000180	0.000202	0.000172
	(1.27)	(1.35)	(1.29)	(1.18)	(1.01)	(0.97)	(1.12)	(0.92)
KF	0.00133***	0.00136***	0.00141***	0.00133***	0.00140***	0.00139***	0.00140***	0.00137***
	(2.98)	(3.00)	(3.23)	(2.91)	(3.10)	(3.01)	(3.22)	(3.05)
Sample	782	771	782	782	782	771	782	782
Country #	39	38	39	39	39	38	39	39
Cluster	country	country	country	country	country	country	country	country
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Z statistics are in parentheses, and the dependent variable is growth of real GDP per capita. Panel data with the fixed effects model are utilized in the estimation model. The estimation results of the year dummy are unreported in the table to save space.

Table 7 (*Cont.*)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
NATION	-0.0698	-0.0169**	-0.139**	-0.0895***				
	(-1.35)	(-2.19)	(-2.23)	(-2.77)				
NATION × FTI	0.00716							
	(1.10)							
NATION × CIT		0.00273						
		(0.78)						
NATION × ECOGLO			0.00336**					
			(2.18)					
NATION × SOCGLO				0.00195**				
				(2.56)				
RECAP					-0.135	-0.0285**	-0.169**	-0.125**
					(-1.94)	(-3.02)	(-2.80)	(-3.45)
RECAP × FTI					0.0144			
					(1.63)			
RECAP × CIT						0.00683		
						(1.54)		
RECAP × ECOGLO							0.00400***	
							(2.66)	
RECAP × SCOGLO								0.00271***
								(3.19)
INFLA	-0.000058***	-0.000059***	-0.000057***	-0.000061***	-0.000057***	-0.000057***	-0.000055***	-0.000061***
	(-5.79)	(-6.04)	(-6.13)	(-6.31)	(-6.13)	(-6.14)	(-6.37)	(-6.51)
GC	-0.00386***	-0.00367***	-0.00357***	-0.00384***	-0.00354***	-0.00333**	-0.00323**	-0.00345**
	(-4.26)	(-4.08)	(-4.01)	(-4.20)	(-3.69)	(-3.49)	(-3.27)	(-3.57)
ED_SEC	0.000180	0.000188	0.000212	0.000186	0.000174	0.000171	0.000196	0.000164
	(0.98)	(0.99)	(1.11)	(0.97)	(0.97)	(0.91)	(1.07)	(0.86)
KF	0.00137***	0.00135***	0.00135***	0.00133***	0.00137***	0.00133***	0.00136***	0.00134***
	(3.00)	(2.92)	(3.15)	(2.97)	(3.04)	(2.93)	(3.21)	(3.04)
Sample	782	771	782	782	782	771	782	782
Country #	39	38	39	39	39	38	39	39
Cluster	country	country	country	country	country	country	country	country
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Z statistics are in parentheses, and the dependent variable is growth of real GDP per capita. Panel data with the fixed effects model are utilized in the estimation model. The estimation results of the year dummy are unreported in the table to save space.

Table 8. Empirical results of interventions with monetary policy on economic growth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
BLAGU	-0.00622	-0.0125^{*}						
	(-0.80)	(-1.90)						
BLAGU × INT	-0.00227^{**}							
	(-2.71)							
BLAGU × M2RES		-0.0000602						
		(-0.42)						
LIQUI			-0.0132	-0.0322^{**}				
			(-1.21)	(-1.98)				
LIQUI × INT			-0.00350^{*}					
			(-1.90)					
LIQUI × M2RES				0.000205				
				(0.87)				
NATION					-0.00515	-0.0154^{**}		
					(-0.53)	(-2.28)		
NATION × INT					-0.00215^{**}			
					(-2.08)			
NATION × M2RES						0.0000945		
						(0.09)		
RECAP							-0.0156	-0.0247^{***}
							(-1.43)	(-2.98)
RECAP × INT							-0.00149^{*}	
							(-1.69)	
RECAP × M2RES								0.000142
								(1.02)
INFLA	-0.00020	-0.000051^{***}	-0.00017	-0.000038^{***}	-0.00022	-0.000053^{***}	-0.00021	-0.000054^{***}
	(-0.77)	(-5.77)	(-0.71)	(-3.07)	(-0.85)	(-6.04)	(-0.83)	(-6.22)
GC	-0.00316^{**}	-0.00358^{***}	-0.00334^{**}	-0.00360^{***}	-0.00253^{*}	-0.00334^{***}	-0.00258^{**}	-0.00314^{***}
	(-3.06)	(-4.00)	(-3.00)	(-3.86)	(-2.54)	(-3.77)	(-2.43)	(-3.42)
ED_SEC	0.000102	0.000452^{**}	0.000101	0.000412^{*}	0.000106	0.000435^{**}	0.0000745	0.000390^{*}
	(0.53)	(2.13)	(0.52)	(1.79)	(0.55)	(2.01)	(0.39)	(1.74)
KF	0.00121^{**}	0.00170^{***}	0.00127^{**}	0.00174^{***}	0.00118^{**}	0.00172^{***}	0.00122^{**}	0.00172^{***}
	(2.44)	(3.61)	(2.55)	(3.63)	(2.36)	(3.63)	(2.40)	(3.69)
Sample	672	601	672	601	672	601	672	601
Country #	34	30	34	30	34	30	34	30
Cluster	country	country	country	country	country	country	country	country
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Z statistics are in parentheses, and the dependent variable is growth of real GDP per capita. Panel data with the fixed effects model are utilized in the estimation model. The estimation results of the year dummy are unreported in the table to save space.

Table 9. Robustness results of financial depth with blanket guarantee on economic growth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep(-1)	0.171*	0.183*	0.198	0.153	0.146	0.172*	0.177	0.143	0.171*	0.193**	0.203**	0.151
	(1.75)	(1.83)	(1.59)	(1.60)	(1.56)	(1.74)	(1.80)	(1.10)	(1.94)	(2.00)	(2.03)	(1.49)
INFLA	-0.006***	-0.006***	-0.006***	-0.00494*	-0.00440*	-0.0061***	-0.00600*	-0.005***	-0.006***	-0.005**	-0.00478*	-0.0065***
	(-2.60)	(-2.59)	(-2.66)	(-2.39)	(-2.18)	(-2.60)	(-2.56)	(-2.60)	(-2.73)	(-2.33)	(-1.84)	(-2.61)
GC	-0.129***	-0.129***	-0.080***	-0.132***	-0.124***	-0.130***	-0.128***	-0.099***	-0.080***	-0.094***	-0.106**	-0.137***
	(-3.55)	(-3.47)	(-2.69)	(-3.85)	(-3.88)	(-3.74)	(-3.58)	(-2.51)	(-3.05)	(-3.21)	(-3.02)	(-3.51)
ED_SEC	-0.000001	-0.000001	-0.0001	0.0000469	0.000206	-0.00009	-0.00018	-0.0001	-0.00003	-0.0002	-0.000141	0.000247
	(-0.06)	(-0.03)	(-1.36)	(0.30)	(1.12)	(-0.06)	(-0.11)	(-1.35)	(-0.23)	(-0.18)	(-0.82)	(1.15)
KF	0.004***	0.004***	0.005***	0.00406**	0.00363**	0.0042***	0.0042***	0.003***	0.003***	0.003***	0.004***	0.0051***
	(2.98)	(3.08)	(3.25)	(3.17)	(2.70)	(3.03)	(3.00)	(2.92)	(3.16)	(2.89)	(2.72)	(3.19)
BLAGU	-0.008***	-0.009***	-0.007**	-0.0154***	-0.0169***	-0.0089***	-0.009***	-0.010***	-0.013***	-0.008***	-0.0127***	-0.0115***
	(-2.77)	(-2.96)	(-2.36)	(-4.92)	(-5.34)	(-2.90)	(-2.87)	(-3.55)	(-4.86)	(-3.03)	(-3.99)	(-2.84)
BLAGU × BCG		-0.0003										
		(-0.95)										
BLAGU × BPC			-0.001***									
			(-2.71)									
BLAGU × ILID				0.0954***								
				(4.36)								
BLAGU × INLID					0.140***							
					(5.14)							
BLAGU × ILIP						0.000389						
						(0.01)						
BLAGU × INLIP							-3.974					
							(-0.85)					
BLAGU × STR								0.00006				
								(0.93)				
BLAGU × ECOGLO									0.009***			
									(6.86)			
BLAGU × SOCGLO										0.005***		
										(3.76)		
BLAGU × INT											-0.00133*	
											(-1.68)	
BLAGU × M2RES												0.0035***
												(3.21)
Sample size	649	649	583	649	649	649	649	483	649	649	546	485
AR(2)	0.519	0.594	0.189	0.132	0.557	0.524	0.567	0.098	0.664	0.540	0.584	0.118
Hansen test	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Notes: The dependent variable is growth of real GDP per capita. Regressions are estimated using the dynamic GMM approach and clustered years and standard errors. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. *Z* statistics are in parentheses. Dep(-1) represents one lag period of the dependent variable. The estimation results of the year dummy are unreported in the table to save space.

Table 10. Robustness results of financial depth with liquidity support on economic growth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep(-1)	0.179*	0.158*	0.190	0.173*	0.162*	0.179*	0.176*	0.144	0.165*	0.155*	0.212**	0.157
	(1.84)	(1.76)	(1.59)	(1.83)	(1.76)	(1.83)	(1.80)	(1.13)	(1.85)	(1.77)	(2.15)	(1.55)
INFLA	-0.006***	-0.006***	-0.005***	-0.006***	-0.0055***	-0.0064***	-0.0063**	-0.005***	-0.006***	-0.005***	-0.0045*	-0.0066**
	(-2.65)	(-2.59)	(-2.69)	(-2.70)	(-2.67)	(-2.61)	(-2.56)	(-2.79)	(-2.74)	(-2.57)	(-1.94)	(-2.54)
GC	-0.136***	-0.111***	-0.092***	-0.141***	-0.139***	-0.136***	-0.134***	-0.107***	-0.092***	-0.101***	-0.113***	-0.145***
	(-3.98)	(-3.47)	(-3.14)	(-4.27)	(-4.60)	(-4.07)	(-3.95)	(-2.91)	(-2.75)	(-3.27)	(-3.05)	(-3.95)
ED_SEC	-0.00007	-0.0001	-0.0002	-0.00006	-0.00002	-0.00008	-0.00004	-0.0002	-0.00009	-0.00009	-0.00015	0.00015
	(-0.46)	(-0.78)	(-1.58)	(-0.36)	(-0.16)	(-0.46)	(-0.24)	(-1.89)	(-0.60)	(-0.59)	(-0.89)	(0.61)
KF	0.004***	0.004***	0.003***	0.004***	0.0041***	0.0042***	0.00423***	0.003***	0.004***	0.004***	0.004***	0.005***
	(2.95)	(3.35)	(3.25)	(3.01)	(3.09)	(2.97)	(3.02)	(3.05)	(3.19)	(3.20)	(2.88)	(3.26)
LIQUI	-0.018*	-0.011**	-0.019*	-0.0151**	-0.0200***	-0.0187*	-0.0187*	-0.021**	-0.016**	-0.006	-0.0284**	-0.0217**
	(-1.84)	(-2.42)	(-1.90)	(-2.26)	(-3.86)	(-1.80)	(-1.88)	(-2.45)	(-2.21)	(-1.22)	(-2.36)	(-2.31)
LIQUI × BCG		0.001										
		(1.52)										
LIQUI × BPC			-0.0001									
			(-0.32)									
LIQUI × ILID				0.118***								
				(2.71)								
LIQUI × INLID					0.185***							
					(9.29)							
LIQUI × ILIP						-0.0112						
						(-0.20)						
LIQUI × INLIP							-0.155					
							(-0.03)					
LIQUI × STR								0.00004				
								(0.85)				
LIQUI × ECOGLO									0.005*			
									(1.91)			
LIQUI × SOCGLO										0.012***		
										(2.96)		
LIQUI × INT											-0.00036	
											(-0.25)	
LIQUI × M2RES												0.00440**
												(1.99)
Sample size	649	649	583	649	649	649	649	483	649	649	546	485
AR(2)	0.624	0.178	0.096	0.737	0.742	0.619	0.632	0.622	0.673	0.556	0.798	0.531
Hansen test	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Notes: The dependent variable is growth of real GDP per capita. Regressions are estimated using the dynamic GMM approach and clustered years and standard errors. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. *Z* statistics are in parentheses. Dep(-1) represents one lag period of the dependent variable. The estimation results of the year dummy are unreported in the table to save space.

Table 11. Robustness results of financial depth with bank nationalization on economic growth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep(-1)	0.153	0.182*	0.200	0.134	0.152	0.152	0.169*	0.131	0.181**	0.191*	0.191*	0.129
	(1.54)	(1.87)	(1.55)	(1.36)	(1.60)	(1.52)	(1.74)	(1.02)	(1.97)	(1.96)	(1.90)	(1.26)
INFLA	-0.005**	-0.006***	-0.005***	-0.00497**	-0.0044**	-0.0056**	-0.0058**	-0.004**	-0.005***	-0.005**	-0.0042*	-0.0059**
	(-2.36)	(-2.67)	(-2.57)	(-2.35)	(-2.22)	(-2.34)	(-2.40)	(-2.52)	(-2.66)	(-2.27)	(-1.68)	(-2.36)
GC	-0.111***	-0.102***	-0.084***	-0.105***	-0.123***	-0.112***	-0.135***	-0.106***	-0.074**	-0.095***	-0.112***	-0.121***
	(-3.06)	(-3.00)	(-2.66)	(-3.05)	(-3.78)	(-3.03)	(-3.81)	(-2.77)	(-2.31)	(-3.35)	(-3.24)	(-3.01)
ED_SEC	-0.000001	-0.00007	-0.0001	0.00007	0.0002	-0.00001	-0.00002	-0.0001	-0.00005	-0.00005	-0.00014	0.00021
	(-0.01)	(-0.46)	(-1.45)	(0.39)	(1.18)	(-0.07)	(-0.13)	(-1.49)	(-0.39)	(-0.33)	(-0.82)	(0.90)
KF	0.004***	0.004***	0.003***	0.0041***	0.0035***	0.00433**	0.00422***	0.003***	0.003***	0.003***	0.004***	0.005**
	(3.06)	(3.40)	(3.17)	(3.44)	(2.70)	(3.16)	(2.95)	(2.92)	(3.00)	(2.82)	(2.76)	(3.16)
NATION	-0.009**	-0.010***	-0.007	-0.0131***	-0.0119***	-0.0095**	-0.0099**	-0.119**	-0.014***	-0.008**	-0.0139***	-0.011**
	(-2.18)	(-2.58)	(-1.62)	(-3.61)	(-3.25)	(-2.26)	(-2.00)	(-2.47)	(-3.83)	(-2.17)	(-2.65)	(-2.35)
NATION × BCG		-0.0003										
		(-1.58)										
NATION × BPC			-0.001**									
			(-2.11)									
NATION × ILID				0.111***								
				(4.33)								
NATION × INLID					0.164***							
					(6.60)							
NATION × ILIP						0.0134						
						(0.31)						
NATION × INLIP							-3.217					
							(-0.99)					
NATION × STR								0.00005				
								(0.87)				
NATION × ECOGLO									0.008***			
									(3.92)			
NATION × SOCGLO										0.005***		
										(3.76)		
NATION × INT											-0.00042	
											(-0.72)	
NATION × M2RES												0.0034***
												(2.95)
Sample size	649	649	583	649	649	649	649	483	649	649	546	485
AR(2)	0.504	0.161	0.084	0.521	0.695	0.455	0.462	0.459	0.467	0.523	0.550	0.425
Hansen test	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Notes: The dependent variable is growth of real GDP per capita. Regressions are estimated using the dynamic GMM approach and clustered years and standard errors. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. *Z* statistics are in parentheses. Dep(-1) represents one lag period of the dependent variable. The estimation results of the year dummy are unreported in the table to save space.

Table 12. Robustness results of financial depth with bank recapitalization on economic growth.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Dep(-1)	0.121	0.162	0.175	0.134	0.159	0.121	0.137	0.102	0.174*	0.186*	0.163	0.0912
	(1.19)	(1.61)	(1.31)	(1.33)	(1.59)	(1.19)	(1.35)	(0.77)	(1.81)	(1.86)	(1.56)	(0.88)
INFLA	-0.005**	-0.006***	-0.005**	-0.0049***	-0.00460**	-0.0056**	-0.0056**	-0.004***	-0.005**	-0.004**	-0.0044*	-0.0059**
	(-2.51)	(-2.73)	(-2.53)	(-2.34)	(-2.30)	(-2.43)	(-2.32)	(-2.62)	(-2.50)	(-2.26)	(-1.67)	(-2.36)
GC	-0.112***	-0.100***	-0.088***	-0.108***	-0.128***	-0.112***	-0.134***	-0.107***	-0.076**	-0.096***	-0.111***	-0.122***
	(-3.10)	(-2.81)	(-2.74)	(-3.22)	(-3.89)	(-3.12)	(-3.86)	(-2.69)	(-2.29)	(-3.36)	(-2.93)	(-3.02)
ED_SEC	-0.000001	-0.00004	-0.0001	0.00006	0.00019	0.000004	0.000013	-0.0001	0.000001	-0.00002	-0.00014	0.00028
	(-0.04)	(-0.29)	(-1.29)	(0.38)	(1.16)	(0.02)	(0.08)	(-1.35)	(-0.05)	(-0.18)	(-0.81)	(1.19)
KF	0.0043***	0.0046***	0.0036***	0.0039***	0.0035***	0.0043***	0.0042***	0.0032***	0.0035***	0.0042***	0.0043***	0.0055***
	(3.11)	(3.37)	(3.26)	(3.07)	(2.74)	(3.10)	(3.00)	(3.07)	(2.94)	(3.36)	(2.94)	(3.23)
RECAP	-0.0184***	-0.0215***	-0.0132**	-0.0049***	-0.0126***	-0.0056**	-0.0187***	-0.018***	-0.020***	-0.012***	-0.0216***	-0.0059**
	(-3.23)	(-4.10)	(-2.53)	(-2.34)	(-2.82)	(-2.43)	(-2.89)	(-2.95)	(-4.09)	(-2.78)	(-2.93)	(-2.36)
RECAP × BCG		-0.0005*										
		(-1.82)										
RECAP × BPC			-0.0009									
			(-1.53)									
RECAP × ILID				0.1160***								
				(3.87)								
RECAP × INLID					0.1600***							
					(5.92)							
RECAP × ILIP						-0.0249						
						(-0.72)						
RECAP × INLIP							-3.4532					
							(-1.04)					
RECAP × STR								0.00005				
								(0.99)				
RECAP × ECOGLO									0.0093***			
									(4.43)			
RECAP × SOCGLO										0.0074***		
										(5.61)		
RECAP × INT											-0.00061	
											(-0.42)	
RECAP × M2RES												0.0033***
												(3.11)
Sample size	649	649	583	649	649	649	649	483	649	649	546	485
AR(2)	0.558	0.151	0.076	0.586	0.730	0.397	0.392	0.402	0.494	0.393	0.538	0.370
Hansen test	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Notes: The dependent variable is growth of real GDP per capita. Regressions are estimated using the dynamic GMM approach and clustered years and standard errors. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. *Z* statistics are in parentheses. Dep(-1) represents one lag period of the dependent variable. The estimation results of the year dummy are unreported in the table to save space.

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□ □ □ □ □ □ A Daily Model for the Forex Intervention in Japan _

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The determinants and effectiveness of the foreign exchange market interven- tion form a simultaneous equation system. Confining the attention to the determinants side, Chen, Chang and Yu (2012) regard the Japanese authori- ties' market intervention a variable that is censored from below at zero; and the latent variable is a linear model with determinants such as the current yen/dollar exchange rate, with heteroscedastic error such as Garch. This paper extends their model to a simultaneous equation system with market intervention and exchange rate as the endogenous variables. A conventional structural Tobit model is extended to cases with Garch errors. The classical MCMC estimation technique with data augmentation suggested in Chib (1992) and Nakatsuma (2000) is used. The results are compared with those in Ito (2003) who do not consider the censoring.

Keywords: Effectiveness; Garch errors; market intervention; MCMC estimation; reaction function, structural Tobit model

JEL Classification F31; F41

1 Introduction

In the early 1980s, Edison (1993) concludes that forex market interventions have marginal and temporary, if not no impact on the exchange rate. On the other hand, following the Plaza Accord in Year 1985, Dominguez (1990) and Dominguez and Frankel (1993a, 1993b, 1993c) show some effects of interventions, not only on the level of exchange rates, but also on their volatilities and risk premia.

Market intervention data had not been publicly available. It was not until July 2001 when the Japanese Ministry of Finance disclosed daily intervention records. Those records facilitate a lot of research on this topic. In a series of seminal papers (Ito 2003, 2005, 2007), he develops a framework in which intervention is described by a *reaction* function and its *effectiveness* is assessed by the impact on exchange rate. [1] While linear models (with or without Garch) are used in those papers, later on Ito and Yabu (2007) model the reaction function with an ordered probit model, in which the dependent variable equals 1 if three is *sale of yen*, and it equals -1 if there is *purchase of yen*. This approach is more appropriate as most of the daily interventions are *censored* at 0.

On the other hand, there is an interest on the endogeneity problem between the reaction and the effectiveness, possibly due to temporal aggregation. Applying the Markov-chain Monte Carlo (MCMC) approach to Japanese data, Chen, Watanabe and Yabu (2012) use data augmentation to obtain intraday intervention amounts (which is free of simultaneity) and conclude that an intervention, by the Japanese monetary authorities (the Ministry of Finance and the Bank of Japan), of 0.1 trillion yen moves the yen/dollar rate by 0.18%. This figure is twice as much using linear models. That said, their approach ceases to account for some other economic

[1] Some other interesting issues such as cost of intervention, consistency with monetary policy, and sterilization are beyond the scope of this paper. For the last issue, we need some publicly unavailable variable such as commercial banks' net receipts of yen funds. See Watanabe and Yabu (2013).

variables such as change in interest spread or stock return.

In this paper, we construct a structural censored regression model (more precisely a structural Tobit regression model) first proposed by Heckman (1978). Further, in view of the Garch effects documented in Chen, Chang and Yu (2012) and Wang, Yu and Xie (2014), we modify Heckman (1978)'s model so that Garch [2] is allowed. As with Chen, Watanabe and Yabu (2012), a *data-augmented MCMC approach* modified upon those in Chib (1992) and Nakatsuma (2000) is used. [3]

Following Almekinders and Eijffinger (1996) and Ito and Yabu (2007), this study considers the followings in explaining the reaction function: [4] (a) short-, medium- and long-term deviations from a moving average local trend; (b) the Fed's intervention in the New York yen/dollar market; (c) the interest rate spread between Japan and the U.S.; (d) the first-business-day on which intervention is arguably more effective; (e) the Nikkei 225 stock index which proxies the local economy; and (f) lagged Japan monetary authorities' interventions. As with Ito (2005), for the effectiveness function, we consider: (i) short- and long-term deviations from a moving average local trend, in lag terms; (ii) the Japan monetary authorities' intervention; (iii) the first-of week intervention effect; and (iv) the Fed's intervention in the New York yen/dollar market.

Our sample starts on April 1, 1991, when available Japanese intervention data starts, and it ends on December 31, 2010. To avoid the possible impacts of the Year 2011 Tohoku earthquake and tsunami, we do not go beyond Year 2010. Our M-CMC approach is rather data-demanding, we only divide the entire sample into two

[2]See also Ito (2003, 2005, 2007).

[3]See also Wei (1999) or Monokroussos (2013). An alternative is the simulated maximum likelihood estimation suggested in Calzolari and Fiorentini (1998) or Lee (1999). As far as Tobit-Garch model is concerned, the MCMC has recently attracted a lot of attention. On example is a Garch model of asset returns with price limits. See Wei (2002).

[4]As one can see in Figures 1-2 below, most of the Japanese intervention is sale of yen, rather than purchase of yean. In view of the limited information for the latter, this paper focuses on the former.

regimes: (I) April 1, 1991 - January 13, 2003; and (II) January 14, 2003 - December 31, 2010. [5] The first regime is sometimes called the "Sakakibara-Kuroda" period in which Mr. Sakakibara was first the Director General of International Finance Bureau, Ministry of Finance; then the Vice minister of Foreign Affairs, Ministry of Finance. In July 1997, Mr. Sakakibara was succeeded by Mr. Kuroda who shared the same intervention tactics with Mr. Sakakibara. The second regime covers the so-called "great intervention" period Year 2003 - Year 2004, which commenced when Mr. Mizoguchi succeeded the Vice minister of Foreign Affairs. Starting with small-size interventions, intervention under Mr. Mizoguchi continued with increasing frequency and increasing size.

The rest of this paper is organized as follows. Section 2 contains a detailed discussion on the reaction function and the effectiveness function, as well as that of Tobit-Garch model and its estimation method. Section 3 is devoted to the data description and the empirical findings. The last section concludes.

2 The model

2.1 Reaction and effectiveness functions

For the reaction function, we first define a latent variable: [6]

$$\begin{aligned} Sale_t^* &= \phi_0 + \phi_1 SDEV_t + \phi_2 MDEV_t + \phi_3 LDEV_t + \phi_4 DUSInt_{t-1} + \phi_5 FBD_{t-1} \\ &\quad + \phi_6 \Delta SPR_{t-1} + \phi_7 \Delta NIK_{t-1} + \phi_8 Sale_{t-1} + \phi_9 Sale_{t-2} + \varepsilon_{1t}, \end{aligned} \tag{2.1}$$

[5] Roughly speaking, we merge Ito (2003, 2005, 2007)'s four regimes into two.

[6] The IMM, net long position of currency futures in the Chicago Mercantile Exchange, is missed in this study. See the discussions in section 4 in Ito (2005).

where Δ denotes the difference operator. The *sale* of Japanese yen (purchase of U.S. dollar),

$$Sale_t = \begin{cases} Sale_t^*, & Sale_t^* > 0, \\ 0, & Sale_t^* \leq 0. \end{cases} \tag{2.2}$$

In other words, in (2.1), partially due to the limited sample size, we model the amount of sale of Japanese yen but *not* that of purchase. Denote the natural logarithm of nominal exchange rate by s_t (multiplied by 100). Further, the effectiveness function is specified as:

$$\Delta s_t = \beta_0 + \beta_1 SDEV_{t-1} + \beta_2 LDEV_{t-1} + \beta_3 Sale_t^* + \beta_4 IntIN_t + \beta_5 DUSInt_{t-1} + \varepsilon_{2t}, \tag{2.3}$$

The two functions (2.1) and (2.3) will be elaborated in order. Following Almekinders and Eijffinger (1996) and Ito and Yabu (2007), we start by considering a loss function of the monetary authority. A loss occurs when the nominal exchange rate deviates from the target rate, which in turn is a linear combination of the short-term, medium-term and long-term targets. Correspondingly, we define the short-term deviation (SDEV), medium-term deviation (MDEV) and long-term deviation (LDEV) respectively by:

$$SDEV_t = s_t - s_{t-1}, \tag{2.4}$$

$$MDEV_t = s_t - \frac{1}{21}\sum_{j=1}^{21} s_{t-j}, \tag{2.5}$$

$$LDEV_t = s_t - \frac{1}{150}\sum_{j=1}^{150} s_{t-j}. \tag{2.6}$$

In other words, the short-term target is the previous day's rate; the medium-term target is the previous month's moving-average rate; while the long-term target is the previous 150-day's moving-average rate. A negative coefficient is expected, if the monetary authority implements the so-called leaning *against* the wind; the coefficient is negative if the policy is leaning *with* the wind.

Apart from the two lags of $Sale_t$, other explanatory variables in the reaction function are $DIntUS_{t-1}$, FBD_{t-1}, ΔSPR_{t-1}, and ΔNIK_{t-1}. Both $DUSInt_{t-1}$

and FBD_{t-1} are discrete variables, where

$$DUSInt_t = \begin{cases} 1, & \text{U.S. sells yen,} \\ 0, & \text{U.S. neither sells nor purchases yen,} \\ -1, & \text{U.S. purchases yen;} \end{cases} \quad (2.7)$$

and the dummy variable for the first business day,

$$FBD_t = \begin{cases} 1, & \text{first business day,} \\ 0, & \text{otherwise.} \end{cases} \quad (2.8)$$

Further, the interest rate spread SPR_t is defined as the difference between Japan call money interest rate and the U.S. Federal Funds rate. On the other hand, the central bank may try stopping the local currency from appreciation (or invoking the depreciation) in order to maintain export competitiveness. For this sake, we use the Nikkei 225 stock index to proxy the local economy. Its natural logarithm (multiplied by 100) is denoted by NIK_t.

The effectiveness function in (2.3) is essentially Equation (2) suggested in Ito (2005). The first three terms capture the movement of the yen/dollar rate when there is intervention neither in Japan nor in any other countries. The last term captures the first-of-the-week effect. Denote Int_t as the Japanese intervention amount (either positive, 0 or negative, depending on yen-selling, no intervention, or yen-purchase).

$$IntIN_t = \begin{cases} Int_t, & Int_t \neq 0, Int_{t-1} = Int_{t-2} = Int_{t-3} = Int_{t-4} = Int_{t-5} = 0, \\ 0, & \text{otherwise.} \end{cases} \quad (2.9)$$

This term captures the special effect of surprise intervention, as opposed to continuous intervention. See, for instance, Ito and Yabu (2007). Note for sake of identification, in (2.3) one of the explanatory variable is $Sale_t^*$ rather than $Sale_t$. See the so-called "coherency condition" in (2.12) below. Moreover, the simultaneity between $IntIN_t$ and ε_{2t} is ignored. See also the next sub-section for the identification issue.

2.2 The structural Tobit-Garch model and its reduced from

Refer to the model (2.1)-(2.3) in the previous sub-sections. Write $y_{1t} = Sale_t$, $y^*_{1t} = Sale^*_t$ and $y_{2t} = \Delta s_t$. It is easy to see that our model is a special case of Heckman (1978)'s simultaneous equation system with endogenous limited dependent and/or latent variables. More precisely:

$$y^*_{1t} = \alpha_{12} y_{2t} + \gamma_{11} y_{1t} + x'_{1t}\beta_1 + \varepsilon_{1t}; \tag{2.10}$$

$$y_{2t} = \alpha_{21} y^*_{1t} + \gamma_{21} y_{1t} + x'_{2t}\beta_2 + \varepsilon_{2t}, \tag{2.11}$$

where x_{1t} and x_{2t} are some exogenous variables. Complication aries as y_{1t}, which is an endogenous variable, also appears as an explanatory variable in (2.11). Identification is attained if the following coherency condition holds:

$$\alpha_{12}\gamma_{21} + \gamma_{11} = 0, \tag{2.12}$$

which is satisfied in our model, as $\gamma_{11} = \gamma_{21} = 0$. Plugging (2.11) into (2.10),

$$\begin{aligned} &(1-\alpha_{12}\alpha_{21})\, y^*_{1t} = x'_{1t}\beta_1 + x'_{2t}\beta_2\alpha_{12} + \varepsilon_{1t} + \alpha_{12}\varepsilon_{2t} \\ \Leftrightarrow\quad & y^*_{1t} = x'_{1t}\frac{\beta_1}{(1-\alpha_{12}\alpha_{21})} + x'_{2t}\frac{\beta_2\alpha_{12}}{(1-\alpha_{12}\alpha_{21})} + \frac{\varepsilon_{1t} + \alpha_{12}\varepsilon_{2t}}{(1-\alpha_{12}\alpha_{21})}, \end{aligned}$$

Thus we may write the *reduced-from* of y^*_{1t} as:

$$y^*_{1t} = x'_t\pi_1 + \nu_{1t}, \tag{2.13}$$

where $\nu_{1t} := (\varepsilon_{1t} + \alpha_{12}\varepsilon_{2t}) / (1-\alpha_{12}\alpha_{21})$ is the reduced-form error; π_1 is the reduced-form parameter; and x_t contains all the *non-overlapping* exogenous variables. Putting (2.13) into (2.11), one obtains:

$$\begin{aligned} y_{2t} &= \gamma_{21} y_{1t} + x'_t\pi_1\alpha_{12} + x'_{2t}\beta_2 + \varepsilon_{2t} + \alpha_{21}\nu_{1t} \\ &= \gamma_{21} E[y_{1t}|x_t] + x'_t\pi_2 + \nu_{2t}, \end{aligned} \tag{2.14}$$

where $\nu_{2t} := \varepsilon_{2t} + \alpha_{21}\nu_{1t} + \gamma_{21}(y_{1t} - E[y_{1t}|x_t])$ is the reduced-form error. Needless to say, (2.14) is the *reduced-form* of y_{2t}.

2.3 The estimation method

The estimation method can be divided into four parts. Parts (I)-(II) are estimating the reduced-form equations (2.13)-(2.14). Parts (III)-(IV) are estimating the structural equations (2.10)-(2.11). Recall that $y_{1t} = Sale_t$, $y_{1t}^* = Sale_t^*$ and $y_{2t} = \Delta s_t$.

Part (I): Refer to the reduced-form equation (2.13). The reduced-form parameter π_1 is estimated with a Tobit-Garch(1,1) model.

Step (a) Given some *preliminary* estimator of π_1 (such as that ignoring Garch), we compute some reduced-form residual:

$$\hat{v}_{1t}, \text{ for } y_t = y_t^* > 0. \tag{2.15}$$

For $y_t = 0$, the $\hat{v}_{1t}$ is *generated* based on the data-augmentation method suggested in Chib (1992) who does not consider Garch. See also Chib and Greenberg (1995).

Step (b) Given the residual $\hat{v}_{1t}$ in Step (b), we estimate the Garch(1,1) parameter using a MCMC method. See, for instance, Nakatsuma (2000) and Ardia (2008). Consequently, one may compute the estimate of the variance, denoted by $\hat{s}_{1t}^2$'s. See also Chib and Greenberg (1995).

Step (c) Repeat (a) with the deflated y_{1t} and deflated x_t. That is,

$$\frac{y_{1t}}{\hat{s}_{1t}}, \text{ and } \frac{x_t}{\hat{s}_{1t}}. \tag{2.16}$$

Step (d) Repeat for $B + M$ times, Steps (b) and (c) *iteratively*, where B is the number of burning iterations, and M is the number of MCMC iterations.

Step (e) The predicted value is computed as:

$$\hat{y}_{1t}^* = x_t'\hat{\pi}_1, \text{ where } \hat{\pi}_1 = \frac{1}{M}\sum_{i=1}^{M} \pi_{1i}; \tag{2.17}$$

$$\hat{y}_{1t} = \begin{cases} \hat{y}_{1t}^*, & \hat{y}_{1t}^* > 0, \\ 0, & \hat{y}_{1t}^* \leq 0. \end{cases} \tag{2.18}$$

Part (II): Refer to the reduced-form equation (2.14). The reduced-form parameter $(\gamma_{21}, \pi_2')'$ is estimated with a standard Linear-Garch(1,1) model.

Step (a) Given the predicted value $\hat{y}_{1t}$ in (2.18). $(\gamma_{21}, \pi_2')'$ is estimated by the quasi-maximum likelihood (QML) estimation, with $(E[y_{1t}|x_t], x_t')'$ replaced by $(\hat{y}_{1t}, x_t')'$.

Step (b) The predicted value is computed as:

$$\hat{y}_{2t} = \hat{\gamma}_{21}\hat{y}_{1t} + x_t'\hat{\pi}_2, \text{ where } (\hat{\gamma}_{21}, \hat{\pi}_2')' \text{ is the QML estimator.} \tag{2.19}$$

Part (III): Refer to the structural equation (2.10). The structural parameter $(\alpha_{12}, \gamma_{11}, \beta_1')'$ is estimated with a Tobit-Garch(1,1) model. The procedure is exactly the same as that in Part (I), with x_t replaced by $(\hat{y}_{2t}, \hat{y}_{1t}, x_{1t}')'$. See (2.19) and (2.18).

Part (IV): Refer to the structural equation (2.11). The structural parameter $(\alpha_{21}, \gamma_{21}, \beta_2')'$ is estimated with a standard Linear-Garch(1,1) model. The procedure is exactly the same as that in Part (II), with $(\hat{y}_{1t}, x_t')'$ replaced by $(\hat{y}_{1t}^{*}, \hat{y}_{1t}, x_{2t}')'$. See (2.17) and (2.18).

3 Data description and empirical findings

3.1 Data description

Refer to the model described in the previous two sections. We use daily *raw* data which span from April 1, 1991 to December 31, 2010. The variables we use consist of:

(a) Int_t, daily amount of the Japanese monetary authorities' intervention: 0.1 trillion yen. A positive value indicates sale of yen (purchase of dollar), while a negative value indicates purchase of yen (sale of dollar).

(b) $USInt_t$, daily amount of the Fed's intervention: billion dollar. A positive value indicates sale of yen (purchase of dollar), while a negative value indicates purchase of yen (sale of dollar).

(c) Exc_t, yen per dollar rate.

(d) Rjp_t, daily close of Japanese call money interest rate: annual percentage.

(e) Rus_t, daily close of Federal Funds rate: annual percentage.

(f) FBD_t, dummy variable for first business day (see (2.8)): dummy variable.

(g) $Nikkei_t$, daily close of Nikkei 225 Stock Index: Index.

The Japanese intervention data are obtained from the Ministry of Finance of Japan ($http://www.mof.go.jp/english/international_policy/reference/feio/index.htm$) while the Fed's are obtained from the St. Louis Fed ($http://research.stlouisfed.org/$). Other variables are obtained either from St. Louis Fed or from Datastream. Altogether there are 5155 observations, after deleting the missing values for weekends and public holidays. In addition, we split the whole sample into two sub-samples. The first sub-sample spans from April 1, 1991 to January 13, 2003, while the second one spans from January 14, 2003 to December 31, 2010. The first sub-sample amounts to 3076 observations and the second one amounts to 2079. The summary statistics for the entire sample can be found in Table 1 while the time plots of the first three variables are depicted in Figure 1.

[Insert Table 1 here]

[Insert Figure 1 here]

Refer to the two equations in (2.1)-(2.2). The two key variables are defined as:

$$Sale_t = \begin{cases} Int_t, & Int_t > 0, \\ 0, & Int_t \le 0, \end{cases} \tag{3.1}$$

$$\Delta s_t = 100\left(\log(Exc_t) - \log(Exc_{t-1})\right). \tag{3.2}$$

In other words, $Sale_t$ is the daily Japanese sale of yen (in 0.1 trillion) while Δs_t is the daily return of yen/dollar rate. And it is clear from (2.4) that $SDEV_t = \Delta s_t$.

On the other hand,

$$SPR_t = Rjp_t - Rus_t, \; \Delta SPR_t = SPR_t - SPR_{t-1}; \qquad (3.3)$$

$$\Delta NIK_t = 100\left(\log(Nikkei_t) - \log(Nikkei_{t-1})\right). \qquad (3.4)$$

[Insert Table 2(A) here]

[Insert Table 2(B) here]

[Insert Table 2(C) here]

In essence, ΔSPR_t is the daily change in interest spread while ΔNIK_t is the daily return of Nikkei Stock Index. The other variables $MDEV_t$, $LDEV_t$, $DUSInt_t$, FBD_t and $IntIN_t$ are defined, respectively, as in (2.5)-(2.9). The summary statistics for the whole sample, the first sub-sample, and the second sub-sample can be found in Table 2(A), Table 2(B) and Table 2(C), respectively.

3.2 Empirical findings

The empirical findings of the structural and reduced-form parameters are reported in Tables 3(A)-3(B) and Tables 4(A)-4(B) respectively. To save space, we do not report the findings of the Garch(1,1) parameters, which are available upon request. Further, we also report in Tables 5(A)-5(B) the results that ignore Garch. That is, the findings with the conventional Heckman (1978)'s approach.

[Insert Tables 3(A)-3(B) here]

[Insert Tables 4(A)-4(B) here]

[Insert Tables 5(A)-5(B) here]

Comparing the results in Tables 3(B) and 5(B), one may conclude Garch does not alter the results for effectiveness, except possibly the first-of-the-week effect, which is captured by $IntNT_t$. In sum, both estimations, which correct for simultaneity, contrast with those conclusions in the literature. We found (i) intervention is effective; and (ii) controlling for interventions, the exchange rate does not follow a random walk. See, for instance, Table 3 in Ito (2005), for comparison. That said, the insignificant coefficients may due to the low goodness of fits in the reduced form equation of Δs_t, judging from the low t-values in Table 4(b).

Ignoring the fact that the whole-sample results may suffer from the time-varying parameter issue, let us look at the sole significant variable $IntNT_t$. The coefficient is 0.6583 which means one 0.1 trillion yen (about 1 billion dollar) sale of Japanese yen results in 0.66% rise in the yen-dollar rate. This is 3 to 4 times of that estimated by Chen, Watanabe and Yabu (2012), who also correct for simultaneity and Garch.

Next we turn to Table 3(A). For both regimes, coefficients for $DUSInt_{t-1}$, $Sale_{t-1}$ and $Sale_{t-2}$ are by and large significant, and have the correct positive signs (which means that interventions are positively correlated). The results are qualitatively the same in Table 5(A). Further, the first-business-day is significantly positive in the second regime, which suggests the monetary authorities take this advantage and no wonder the period of "great intervention" is described as "frequent intervention".

On the other hand, the coefficients for the three "deviations" are all negative in the first regime (see Table 3(A)). This suggests the authorities adopted the "leaning against the wind" policy. This is consistent with the negative coefficient of ΔSPR_t. Interestingly, the exactly opposite signs in the second regime (except that of $LDEV_t$) suggest that a "leaning with the wind" policy was adopted instead. Somewhat puzzling is ΔNIK_t. The coefficient is negative in the first regime which suggests "leaning with the wind" and it is negative in the second regime which suggests "leaning against the wind". Further investigation on how to interpret these results is needed.

4 Concluding remarks

In this paper, we construct a structural censored regression model, more precisely a structural Tobit-Garch model and apply it to two functions, namely reaction function and effectiveness function, of market intervention in yen-dollar rate. Using daily data publicized by the Japanese monetary authorities, we show evidence that: (i) Intervention is not effective; (ii) The Japanese monetary authorities adopted the "leaning against the wind" policy during Year 1991 to Year 2002, and they adopted the "leaning with the wind" policy during Year 2003 to Year 2010 except possibly stabilizing the long-term (150 days) exchange rate target.

Our results throw doubt on the existing conclusions in the literature which are based on methodologies that do not control for (a) the intervention amount being censored at 0; (b) simultaneity in the reaction and effectiveness functions; and/or (c) Garch. Having said that, it is unclear the insignificance in the effectiveness equation is due to the problem of "weak instruments", as one may conclude from the low t-values in one of the reduced-form equations.

Our version of MCMC approach with data augmentation is relatively new. First, a multivariate Garch model is not considered. Second, the Tobit-Garch model (for the reaction function) is not estimated with one single log-likelihood function (see Steps (b)-(c), Part (I) in sub-section 3.3). All these issues will be pursued in the future research.

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Table 1: Summary statistics of the raw data (Apr 1, 1991 - Dec 31, 2010)

	Int_t	$USInt_t$	Exc_t	Rjp_t	Rus_t	FBD_t	$Nikkei_t$
nobs	5155	5155	5155	5155	5155	5155	5155
Min	-26.201	-0.833	80.480	-0.012	0.050	0.000	7054.980
Max	21.249	0.800	147.140	8.438	7.800	1.000	26980.370
Mean	0.118	0.001	112.287	0.983	3.633	0.200	15262.044
Med	0.000	0.000	111.920	0.250	4.140	0.000	15882.490
Std	0.975	0.029	12.955	1.753	1.983	0.400	4289.040
Skew	4.897	11.473	-0.118	2.385	-0.421	1.500	0.101
Kurt	219.867	478.506	-0.240	5.257	-1.178	0.249	-0.875

See the description in sub-section 3.1.

Table 2(a): Summary statistics of the data used (Apr 1, 1991 - Dec 31, 2010)

	$Sale_t$	Δs_t	$MDEV_t$	$LDEV_t$	$DUSInt_t$	ΔSPR_t	FBD_t	ΔNIK_t	$IntIN_t$
nobs	5155	5155	5155	5155	5155	5155	5155	5155	5155
Min	0.000	-5.630	-12.752	-17.386	-1.000	-2.770	0.000	-12.111	-2.804
Max	21.249	3.240	8.205	15.815	1.000	2.500	1.000	13.235	21.249
Mean	0.127	-0.011	-0.109	-0.685	0.003	-0.001	0.200	-0.018	0.029
Med	0.000	0.000	-0.014	-0.160	0.000	0.000	0.000	0.000	0.000
Std	0.895	0.691	1.861	4.968	0.065	0.205	0.400	1.498	0.522
Skew	11.341	-0.559	-0.605	-0.252	9.639	-0.875	1.500	-0.116	23.932
Kurt	164.209	4.735	2.675	0.169	230.425	27.815	0.249	5.411	736.546

See the description in sub-section 3.1.

Table 2(b): Summary statistics of the data used (Apr 1, 1991 - Jan 13, 2003)

	$Sale_t$	Δs_t	$MDEV_t$	$LDEV_t$	$DUSInt_t$	ΔSPR_t	FBD_t	ΔNIK_t	$IntIN_t$
nobs	3076	3076	3076	3076	3076	3076	3076	3076	3076
Min	0.000	-5.630	-12.752	-17.386	-1.000	-2.770	0.000	-7.234	-2.804
Max	14.059	3.240	8.205	15.815	1.000	2.500	1.000	7.660	13.854
Mean	0.092	-0.005	-0.052	-0.232	0.005	-0.001	0.200	-0.037	0.032
Med	0.000	0.000	0.077	0.306	0.000	0.002	0.000	0.000	0.000
Std	0.726	0.704	1.956	5.504	0.084	0.254	0.400	1.459	0.495
Skew	12.167	-0.567	-0.783	-0.298	7.392	-0.785	1.497	0.162	16.927
Kurt	174.766	4.683	3.250	-0.055	135.929	18.594	0.242	2.441	346.429

See the description in sub-section 3.1.

Table 2(c): Summary statistics of the data used (Jan 14, 2003 - Dec 31, 2010)

	$Sale_t$	Δs_t	$MDEV_t$	$LDEV_t$	$DUSInt_t$	ΔSPR_t	FBD_t	ΔNIK_t	$IntIN_t$
nobs	2079	2079	2079	2079	2079	2079	2079	2079	2079
Min	0.000	-5.216	-9.843	-16.258	0.000	-1.050	0.000	-12.111	0.000
Max	21.249	3.059	7.043	7.607	0.000	0.950	1.000	13.235	21.249
Mean	0.179	-0.018	-0.194	-1.356	0.000	0.001	0.200	0.009	0.025
Med	0.000	0.000	-0.148	-0.698	0.000	0.000	0.000	0.000	0.000
Std	1.097	0.672	1.706	3.955	0.000	0.097	0.400	1.553	0.559
Skew	9.987	-0.549	-0.247	-0.523	NA	0.412	1.502	-0.463	30.862
Kurt	129.211	4.781	1.075	0.019	NA	36.649	0.256	8.804	1071.460

See the description in sub-section 3.1.

TABLE 3(A) REACTION FUNCTION: A TOBIT-GARCH(1,1) MODEL. DEPENDENT VARIABLE: $Sale_t$.

	Apr 1, 1991 - Dec 31, 2010			Apr 1, 1991 - Jan 13, 2003			Jan 14, 2003 - Dec 31, 2010		
	coef	stdev	t-value	coef	stdev	t-value	coef	stdev	t-value
$const$	-14.1921	0.6011	-23.6096	-12.6732	0.3630	-34.9226	-12.9995	0.9938	-13.0810
$SDEV_t$	2.3568	2.5640	0.9192	-53.7132	15.8421	-3.3909	84.2176	9.4078	8.9519
$MDEV_t$	0.1441	0.2425	0.5941	-0.6813	0.1259	-5.4100	1.1758	0.2664	4.4143
$LDEV_t$	-1.0048	0.0764	-13.1085	-0.7629	0.0489	-15.6002	-0.9782	0.1983	-4.9329
$DUSInt_{t-1}$	2.7627	1.2375	2.2324	5.2140	0.9976	5.2268	NA	NA	NA
FBD_{t-1}	0.0361	0.4732	0.0762	-0.6557	0.3805	-1.7234	2.0874	0.7417	2.8144
ΔSPR_{t-1}	-1.3138	0.8669	-1.5155	0.2872	0.7895	0.3637	-38.1587	5.8943	-6.4738
ΔNIK_{t-1}	0.0892	0.1246	0.7157	-0.8749	0.2816	-3.1063	1.5781	0.2342	6.7378
$Sale_{t-1}$	1.2860	0.1185	10.8490	0.3536	0.2458	1.4389	0.5213	0.1392	3.7441
$Sale_{t-2}$	1.2110	0.1027	11.7884	2.2198	0.4225	5.2533	1.3843	0.1308	10.5609

TABLE 3(B) EFFECTIVENESS: A LINEAR-GARCH(1,1) MODEL. DEPENDENT VARIABLE: Δs_t

	Apr 1, 1991 - Dec 31, 2010			Apr 1, 1991 - Jan 13, 2003			Jan 14, 2003 - Dec 31, 2010		
	coef	stdev	t-value	coef	stdev	t-value	coef	stdev	t-value
$const$	0.0040	0.1006	0.0395	0.0004	0.7275	0.0006	-0.0051	0.0715	-0.0717
$SDEV_{t-1}$	-0.0165	1.5797	-0.0105	1.3753	9.3159	0.1476	-2.3890	2.4013	-0.9949
$LDEV_{t-1}$	0.0727	0.7600	0.0956	0.1220	5.7585	0.0212	-0.3781	0.6538	-0.5784
$Sale_t^*$	0.0008	0.0071	0.1071	0.0001	0.0546	0.0024	0.0009	0.0052	0.1745
$IntIN_t$	0.6583	0.2079	3.1666	0.2157	0.9832	0.2194	-0.0188	0.0918	-0.2043
$DUSInt_{t-1}$	0.0223	0.2051	0.1086	0.0265	0.2269	0.1166	NA	NA	NA

TABLE 4(A) REDUCED-FORM EQUATION FOR $Sale_t$: A TOBIT-GARCH(1,1) MODEL.

	Apr 1, 1991 - Dec 31, 2010			Apr 1, 1991 - Jan 13, 2003			Jan 14, 2003 - Dec 31, 2010		
	coef	stdev	t-value	coef	stdev	t-value	coef	stdev	t-value
const	-14.2489	0.6173	-23.0730	-9.5588	0.3156	-30.2913	-11.8871	0.8578	-13.8573
$SDEV_{t-1}$	-0.4715	0.2818	-1.6731	-0.0889	0.2234	-0.3979	-0.9262	0.4730	-1.9580
$MDEV_{t-1}$	0.2561	0.2272	1.1271	-0.3813	0.1428	-2.6703	1.0143	0.2811	3.6080
$LDEV_{t-1}$	-1.0260	0.0775	-13.2352	-0.5766	0.0494	-11.6619	-1.1735	0.1810	-6.4835
$DUSInt_{t-1}$	2.8806	1.2599	2.2862	2.0396	0.7923	2.5743	NA	NA	NA
FBD_{t-1}	-0.0690	0.4670	-0.1478	-0.3200	0.4105	-0.7796	-0.6706	0.6137	-1.0927
ΔSPR_{t-1}	-1.2912	0.8597	-1.5054	-0.9909	0.6043	-1.6398	-9.0447	4.2883	-2.1092
ΔNIK_{t-1}	0.0746	0.1151	0.6479	0.0200	0.1083	0.1844	0.2978	0.1734	1.7178
$Sale_{t-1}$	1.2886	0.1262	10.2095	0.7691	0.1672	4.5987	1.1200	0.1205	9.2950
$Sale_{t-2}$	1.2121	0.1025	11.8241	0.7762	0.1715	4.5265	0.9321	0.1192	7.8168

TABLE 4(B) REDUCED-FORM EQUATION FOR Δs_t: A LINEAR-GARCH(1,1) MODEL.

	Apr 1, 1991 - Dec 31, 2010			Apr 1, 1991 - Jan 13, 2003			Jan 14, 2003 - Dec 31, 2010		
	coef	stdev	t-value	coef	stdev	t-value	coef	stdev	t-value
const	-0.0014	0.0100	-0.1405	-0.0030	0.0380	-0.0792	-0.0116	0.0169	-0.6817
$SDEV_{t-1}$	0.1432	1.6558	0.0865	1.2190	3.4158	0.3569	-1.5703	2.5451	-0.6170
$MDEV_{t-1}$	0.1163	0.6849	0.1697	0.1337	0.9345	0.1431	0.0545	1.0925	0.0498
$LDEV_{t-1}$	0.0480	0.2486	0.1929	0.1370	0.5033	0.2722	-0.3389	0.5634	-0.6015
$PredSale_t$	-0.0121	0.0106	-1.1400	0.0339	0.1035	0.3278	-0.0259	0.0197	-1.3173
$PredIntIN_t$	0.6963	0.2063	3.3744	0.1874	0.2632	0.7121	0.0614	0.1014	0.6052
$DUSInt_{t-1}$	0.0119	0.2011	0.0591	0.0367	0.3543	0.1035	NA	NA	NA
FBD_{t-1}	-0.0268	0.0222	-1.2081	-0.0011	0.0364	-0.1128	-0.0374	0.0328	-1.1421
ΔSPR_{t-1}	0.0378	0.0403	0.9396	0.0309	0.0403	0.7652	0.3408	0.2265	1.5044
ΔNIK_{t-1}	-0.0162	0.0070	-2.3231	-0.0155	0.0226	-0.6867	-0.0144	0.0115	-1.2509
$Sale_{t-1}$	0.0056	0.0086	0.6506	-0.0150	0.0114	-1.3216	0.0230	0.0133	1.7301
$Sale_{t-2}$	0.0100	0.0083	1.2029	0.0183	0.0229	0.7988	0.0062	0.0145	0.4243

TABLE 5(A) REACTION FUNCTION: A TOBIT MODEL (W/O GARCH). DEPENDENT VARIABLE: $Sale_t$.

	Apr 1, 1991 - Dec 31, 2010			Apr 1, 1991 - Jan 13, 2003			Jan 14, 2003 - Dec 31, 2010		
	coef	stdev	t-value	coef	stdev	t-value	coef	stdev	t-value
$const$	-8.2246	0.7972	-10.3165	-8.5645	1.1054	-7.7478	-8.6561	1.3054	-6.6307
$SDEV_t$	132.6612	18.3191	7.2417	13.1671	3.9659	3.3201	81.2628	11.9522	6.7990
$MDEV_t$	-0.0674	0.1160	-0.5813	-0.8594	0.1567	-5.4838	0.4662	0.1811	2.5739
$LDEV_t$	-0.2111	0.0416	-5.0764	-0.2110	0.0444	-4.7541	-0.0752	0.0688	-1.0920
$DUSInt_{t-1}$	5.7240	1.0320	5.5465	3.4176	0.9004	3.7955	NA	NA	NA
FBD_{t-1}	0.9001	0.3768	2.4686	-0.0245	0.4332	-0.0565	0.3283	0.5957	0.5511
ΔSPR_{t-1}	-8.5066	1.4292	-5.9521	-0.7267	0.8195	-0.8868	-36.5299	5.5862	-6.5393
ΔNIK_{t-1}	2.4390	0.3391	7.1934	0.1823	0.1228	1.4843	1.4135	0.2588	5.4625
$Sale_{t-1}$	1.7345	0.1832	9.4675	0.7524	0.1782	4.2221	0.3728	0.1355	2.7504
$Sale_{t-2}$	-0.2495	0.1677	-1.4873	0.5129	0.1904	2.6937	1.5536	0.2111	7.3585

TABLE 5(B) EFFECTIVENESS: A LINEAR MODEL (W/O GARCH). DEPENDENT VARIABLE: Δs_t

	Apr 1, 1991 - Dec 31, 2010			Apr 1, 1991 - Jan 13, 2003			Jan 14, 2003 - Dec 31, 2010		
	coef	stdev	t-value	coef	stdev	t-value	coef	stdev	t-value
$const$	0.0133	0.0411	0.3227	0.0470	0.0792	0.5936	0.0066	0.0509	0.1296
$SDEV_{t-1}$	-0.0067	0.0188	-0.3546	0.0186	0.0263	0.7089	-0.0272	0.0275	-0.9915
$LDEV_{t-1}$	-0.0003	0.0030	-0.0912	0.0018	0.0042	0.4369	-0.0039	0.0053	-0.7442
$Sale_t^*$	0.0025	0.0043	0.5778	0.0059	0.0091	0.6442	0.0031	0.0050	0.6259
$IntIN_t$	-0.5416	0.6613	-0.8189	-0.2504	0.2340	-1.0700	NA	NA	NA
$DUSInt_{t-1}$	-0.0337	0.1702	-0.1979	-0.0627	0.1721	-0.3641	NA	NA	NA

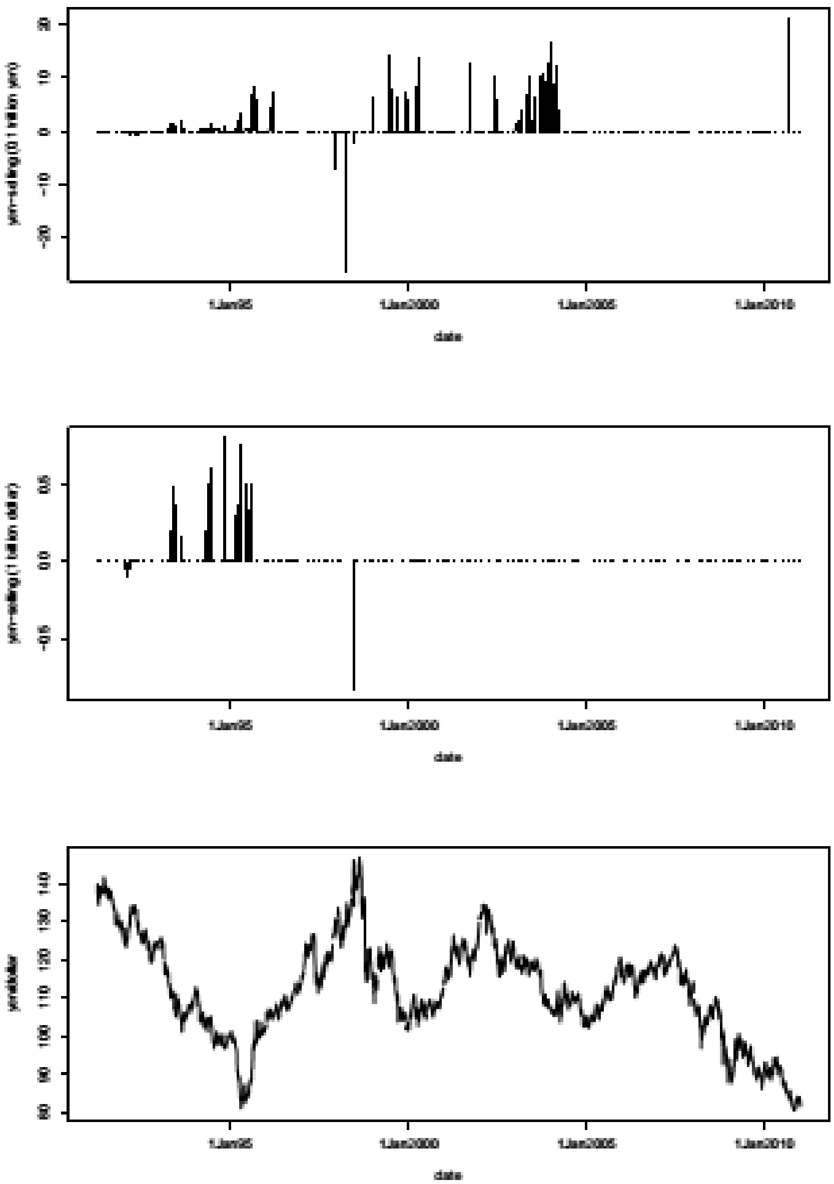

Figure 1: Time plots of Int_t (upper), $IntUS_t$ (middle), Exc_t (lower).

Long-Term Trends in Audit Market Shares: Effects of BIG-4 Pricing Strategies or Non BIG-4 Market Power?[1]

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We analyze changes in audit fees and market shares of the BIG-4 audit firms (KPMG, PWC, D&T, E&Y) as compared with those of NB-4 (Non BIG-4) auditors in the period 2000-2011. Both relative fees and relative market shares (compared across BIG-4 and NB-4) auditors changed radically over this period due to the enactment of the Sarbanes-Oxley Act (SOX). In addition, one of the major audit firms, Arthur-Andersen (AA) was driven out of business. We exploit variations in the effects of these two events across industries and across size quintiles to examine changes in pricing strategies and market shares of BIG-4 and NB-4 auditors. In particular we examine whether the market share changes have been driven primarily by the BIG-4 deterring clients through pricing strategies (which we characterize as 'cherry picking') or through more effective competition by NB-4 auditors (which we characterize as NB-4 market power). Our empirical results suggest that both these factors have played a significant role in the realignment of the market share for audit services across BIG-4 and NB-4 auditors following the enactment of SOX and the collapse of AA.

Keywords: BIG-4, Audit Fees, Market Share, Oligopolistic Competition.

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1. Introduction

Following the enactment of the Sarbanes-Oxley act in 2002 (hereafter SOX) and the demise of Arthur-Andersen (hereafter AA), audit fees have risen sharply and the market share for the BIG-4 auditors (KPMG, PWC, D&T and E&Y) has fallen dramatically (Figure 1).[2] In addition, the difference in fees between BIG-4 and other auditors (hereafter, NB-4), usually referred to as the BIG-4 premium, has increased over this period (Ghosh and Pawlewicz 2009). The goal of this paper is to examine whether the fall in market share is primarily a result of the increase in the BIG-4 premium, or whether, after controlling for the effects of the increase in the BIG-4 premium, increased competitiveness of NB-4 has also contributed to the decline in BIG-4 market share.[3] While these two effects have been discussed individually in earlier studies, our paper studies them jointly. Specifically, we examine the correlation between increases in the BIG-4 premium and decreases in the BIG-4 market share across each of thirteen different industry codes[4] in the post-SOX and AA period, 2003-2011. To augment this analysis, we study the switching behavior from BIG-4 to NB-4 auditors of individual firms and examine whether NB-4 empowerment has played any role in the erosion of BIG-4 market share.

At the industry level, we find that (percentage) industry market share losses of the BIG-4 are inversely correlated with industry rankings based on fee premia, that is, the BIG-4 lost *least* market share in industries where the excess premium is highest (Fee Premia measures I and III) or alternatively, in industries where the premium increased the most post-SOX (Fee Premia measure II). This finding is *inconsistent* with the market equilibrium being driven purely by BIG-4 pricing strategies -- greater BIG-4 selectiveness in choosing clients who are willing to pay large premia should lead to a smaller BIG-4 market share rather than a larger one. Analogously, at a firm level, we find that firms that are charged a larger *residual premium* (after controlling for mean industry fee effects) are *less* likely to switch to an NB-4 auditor in the following year. We also find that industries where the NB-4 held a lower market-share pre-SOX are also the ones where firms were more likely to switch *post-SOX* (after controlling for the excess BIG-4 premium). Together, these findings suggest that there has been a shift in terms of the perceived market value of NB-4 audits relative to BIG-4 audits on an industry-by-industry basis even after controlling for the pricing strategies of the BIG-4.

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[2] Papers that have documented fee increases following the enactment of SOX include (Asthana, Balsam and Kim 2009; Griffin and Lont 2007). BIG-4 market share losses have also been noted in earlier literature though we could not find a systematic reference documenting the effects that are categorized in Table 3 of this paper.

[3] Cassell, Giroux, Myers, and Omer (2013) analyze a list of firms they consider to be second-tier auditors and argue that the reference documenting the effects that are categorized in Table 3 of this paper. competitive position of these second-tier firms has improved post-SOX. Our evidence suggests that this phenomenon is more widespread and applies to other smaller NB-4 audit firms as well.

[4] Industry membership follows Ashbaugh, LaFond, and Mayhew (2003) and is determined by SIC code as follows: agriculture(0100-0999), mining and construction (1000-1999, excluding 1300-1399), food (2000-2111), textiles and printing/publishing (2200-2799), chemicals (2800-2824; 2840-2899), pharmaceuticals (2830-2836), extractive (1300-1399; 2900-2999), durable manufactures (3000-3999, excluding 3570-3579 and 3670-3679), transportation (4000-4899), retail (5000-5999), services (7000-8999, excluding 7370-7379), computers (3570-3579; 3670-3679; 7370-7379), and utilities (4900-4999).

The economic theory of the market for public audits focuses on the fact that audit quality is not observable by investors either before or after the use of audited information (that is, audit services are credence goods (Eamons 1997). This property leads to a theoretical prediction that auditor reputation will be used by the market as a proxy for audit quality and that the "deep pockets" of BIG-4 auditors serves as an observable proxy for auditor reputation (Dye 1993; Datar and Alles 1999; Mayhew 2001). Further, (contemporaneous) unobservability of audit quality helps sustain equilibrium in rational expectations where large auditors hold a preponderant market-share (Bar-Yosef and Sarath 2005). The higher perceived quality of BIG-4 audits translates to better market prices for their clients. However, deep pockets also imply greater payouts from litigation (if the plaintiffs succeed) and this expected cost has to be recovered through higher fees. Summarizing, the overall economic consequences of the unobservability of audit quality leads to a theoretical prediction of two components that constitute the BIG-4 premium – (i) a (partial) recapture of the market value to the client-firm associated with higher BIG-4 reputation and (ii) a (partial) recovery of greater expected litigation payouts that act as the implicit guarantee of better quality audits by the BIG-4. All these predicted theoretical factors, namely the existence of a BIG-4 premium, the presence of market benefits for BIG-4 clients, and greater payouts to settle litigation claims by BIG-4 auditors have been tested extensively in the empirical literature. [5]

A simple decision model of auditor choice is useful for developing our arguments further. We view client firms as collecting quotes from both BIG-4 and NB-4 auditors. The BIG-4 act as market leaders and set their prices first while NB-4 act as market followers and set their prices in response. Firms then weigh the benefits that will accrue from choosing a more reputable (i.e. BIG-4) auditor against the extra fees they will have to pay to this auditor. If the perceived value of a BIG-4 audit reduces while quoting strategy stays constant, firms are more likely to switch to an NB-4 auditor.[6] This is equivalent to a (downward) shift in the demand curve for BIG-4 services as a function of the premium charged by them. Conversely, if the perceived value of a BIG-4 audit goes up, the demand curve will shift up *ceteris paribus.* Similarly, if the perceived benefit stays constant while BIG-4 firms increase fees relative to NB-4 (i.e. increase the premium), the market share of the BIG-4 will go down but the clients who remain with the BIG-4 will pay higher fees. This is equivalent to a shift in

[5] The existence of a BIG-4 premium is now a standard feature of Audit Fee models as documented in the next section. There is a considerable stream of empirical literature attempting to document the market value generated by BIG-4 auditors. For example, Beatty (1989) associated BIG-8 auditors with reduced under pricing for their clients at the time of Initial Public Offerings. Teoh and Wong (1993) found the earnings response coefficient (ERC) is higher for firms audited by BIG-4. Pittman and Fortin (2004) and Mansi, Maxwell, and Miller (2004) suggested that debt financing costs are lower for firms audited by BIG-4. Khurana and Raman (2004) showed that the ex-ante cost of equity capital is lower for firms audited by BIG-4 than for companies audited by NB-4 audit firms.

[6] This is a variant of the classic Hotelling (1929) model on consumer choice. In that model, customers with heterogenous tastes try to decide on a preferred supplier while the suppliers compete through price and location choices. Adapted to the audit setting, publicly traded firms have heterogenous benefits from choosing a BIG-4 auditor, and BIG-4 firms set prices to maximize profits taking this heterogeneity into account. Further details are provided in Appendix B.

the supply curve of services offered by the BIG-4. A more rigorous development of these economic forces is provided in Appendix B.[7]

Drawing on this decision model, our analysis focuses on examining whether supply side pricing decisions of the BIG-4 can explain the shifts in market shares across BIG-4 and NB-4 auditors or whether downward demand shifts (i.e. the greater propensity of client-firms to choose NB-4 auditors) have also played a significant role in driving these market share changes. These effects cannot be separated by studying the market as a whole; however, by studying the effects across individual industries where each industry exhibits a different relationship between premium shifts and market share changes, we find evidence *inconsistent* with pure supply side effects. Specifically, if market share changes are driven primarily by BIG-4 pricing strategies (that is, by cherry picking clients willing to pay high fees), we would expect to see a positive relationship between the size of the premium charged and loss in market share. However, we find that there is a negative relationship between the industry ranking by BIG-4 premium and industry ranking by loss of BIG-4 market share. This negative association is suggestive of a demand side shift (see Figure B1 Panel C of Appendix B).

To conduct this cross-industry test, we first construct a measure of the BIG-4 premium, based on the literature examining the determinants of audit fees. We use the pricing model from Blankley, Hurtt, and MacGregor (2012) and combine it with the industry fee effects analysis in Ashbaugh et al. (2003). We estimate a BIG-5/4*industry premium separately for the periods 2001-2002 and the periods 2003-2011. These estimates show that: (i) the BIG-4 premium is significantly different across industries; (ii) that the BIG-4 premium increased in *every* industry in the 2003-2011 period relative to 2001-2002 and (iii) there were differences in the premium increases across industries. We then construct three industry rankings related to the BIG-4 fee premium: Fee Premium Ranking I based on the median BIG-4 excess fees *after controlling for average industry and BIG-4 effects*; Fee Premium Ranking II based on the increase in (the average) BIG-4*industry coefficient across the two periods; and Fee Premium Ranking III based on the level of the BIG-4*Industry coefficient in the period 2003-2011.[8] We next construct three rankings of these industries related to BIG-4 percentage market share losses based on three different ways of computing market share: (i) the proportion of clients choosing BIG-4 in that industry (ii) the proportion of fees collected by the BIG-4 relative to the total industry fees; and (iii) the ratio of BIG-4 fee share (above) divided by BIG-4 market share. The third measure captures the pricing power of the BIG-4 in that industry. We then examine the correlations of each of the fee rankings with each of the market share rankings.

[7] There is of course the possibility that firms may decide to go private because of increases in audit fees. This does not pose significant empirical difficulties for our study for two reasons. First, the decision to go or not go public is influenced by many other more weighty factors than audit fees so the market of publicly traded firms is more or less inelastic in audit fees. Second, it is likely that firms that weigh these fees heavily are small firms that would disproportionately choose NB-4 auditors if they were present in the market and this would only strengthen our results.

[8] We do not use separate BIG-4 and Industry dummies in these last two regressions because of the fact that the BIG-4 hold such a large market share making the BIG-4*Industry dummy highly correlated with the industry dummy; the sum of all the BIG-4*Industry dummies is collinear with the BIG-4 dummy so a BIG-4 dummy cannot be included as an independent regressor.

The correlation between the rankings based on excess fee premia (or increase in fee premia) charged by the BIG-4 with the rakings based on their loss of market share is negative in all the nine cases based on a Spearman Rank Correlation Test. That is, the BIG-4 lost *less* market share in industries where the excess fee has a higher median (Fee Premia ranking I) or, increased the most post-SOX (Fee Premia ranking II) or had the highest level (Fee Premium III). This finding is inconsistent with the market equilibrium being driven purely by BIG-4 pricing strategies -- greater selectiveness in choosing high-fee paying clients should lead to a higher market share losses as the selectiveness increases. We then repeat the analysis using the market share of AA in each of these industries to see if the BIG-4 premium increases are related to AA's market share in 2001. The underlying economic argument is that the competitive strength of the BIG-4 would be higher in industries with a larger proportion of AA clients, and hence, these industries would have seen a greater increase in BIG-4 premium. We find that AA rankings have a less significant, but mainly positive relationship with the premium rankings, that is, excess premia are larger in industries where AA held a greater share pre-2002.

It is important to underline the motivation behind our choice of industry and rank correlation tests to examine the effects of SOX. Given just one observation, it is impossible to determine whether an equilibrium shift is driven by demand or supply effects. However, the heterogeneity in supply and demand curves *across industries* allows us to treat each industry as a separate observation on the effects of SOX on the market equilibrium.[9] The overall pattern suggests that the effects of SOX and AA were broadly similar across industries resulting in an increase in the BIG-4 premium and a reduction in BIG-4 market share, but differed in terms of magnitude. We exploit these cross-sectional differences to test for the relative effects of BIG-4 fee strategies as compared to NB-4 competitive power. In addition, there has been considerable current literature on the effects of factors such as office location (Craswell, Donald and Laughton 2002) or state regulation (Anatharaman and Wans 2012) on audit fees. The choice of the average (or median) industry premium should, at least in theory, diversify away such "microstructure" effects making it possible to draw inferences about market-wide relations between BIG-4 premia and market shares.

Our second test uses a Logit switching model, based on Landsman, Nelson, and Rountree (2009), to examine the effect of (firm-specific) BIG-4 premium (estimated in the first test) on the propensity to switch to an NB-4 auditor. The idea here is that if the reason for switching to an NB-4 auditor is due to supply side effects, that is due to an increase in the BIG-4 premium, we should expect to see firms which are charged a high premium (in the year before the change) switching more often to NB-4 auditors. On the other hand, if the client-firms are deciding to switch to NB-4 auditors because of a higher perceived value for NB-4 auditors, a proxy for NB-4 market power will also be significant. We use the industry-

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[9] While we consider the enactment of SOX and the collapse of AA as the primary shocks that occurred in this period, we note that there were also other changes such as rule FIN 48 or AS-5 or market-wide effects such as the 2007 recession that might have affected audit fees and/or auditor choice. Our approach does not separate out the effects of these other shocks in any specific way. We do show (Table 6, panel C) that our findings are robust across different time periods so it is likely that the enactment of SOX was the main cause for the market shifts. In any case, this has no bearing on our main empirical findings that demand shifts took place and prior literature has mainly attributed such demand shifts as a consequence of SOX.

market-share of NB-4 auditors *prior to 2002* as a proxy. In other words, we examine whether the competitive position of the NB-4 pre-SOX has any effect on the switching behavior post-SOX *after controlling for the effects of BIG-4 premium changes.*

Firms that pay a larger *residual premium* (after controlling for mean industry fee and BIG-4 effects) are *less* likely to switch to an NB-4 auditor in the following year. This finding suggests a self-selection bias where only firms with above average market benefits from choosing BIG-4 auditors stay with them and (pay a higher fee). It is inconsistent with switching being driven primarily by a BIG-4 auditors requiring a higher risk premium, for if this were the case, firms whose fees have risen (perhaps due to greater audit risk) *above* their market benefits would be the ones who switch to NB-4 auditors leading to a positive relationship between firms-specific pricing and probability of switch. The Logit model also shows that firms are more likely to switch to NB-4 auditors over the period 2003-2011 in industries where the NB-4 had a low market share *prior to 2002.* This is additional evidence that NB-4 market power has played a role in attracting clients -- industries where the NB-4 were more competitive pre-SOX and AA demise are also the ones where the NB-4 are more likely to capture clients in the post-SOX era.

We also examine both our tests for demand shifts on a size quintile-by-quintile basis. As is to be expected, there is very little switching to NB-4 auditors in the highest quintile. However both our main empirical findings hold up in the middle quintiles. The Logit model shows that the effects of fees and NB-4 market power is significant in size quintiles 2, 3, and 4 where there is active competition between the BIG-4 and NB-4 for clients but is not significant in the lowest and highest quintiles. In other words, the effects of SOX and the collapse of AA has realigned economic incentives for medium sized firms but has had relatively little influence on the smallest firms that have historically provided clientele for NB-4 auditors or the largest firms that typically benefit from hiring large auditors.

There are several papers analyzing changes in the levels of audit fees post-SOX (Ghosh and Pawlewicz 2009; Griffin and Lont 2007; Huang, Raghunandan, and Rama 2009). There is also analysis in the prior literature about the types of firms that switched from BIG-4 to NB-4 auditors after the enactment of SOX (Landsman, Nelson, and Rountree 2009). Our analysis adds to these prior papers in three ways. First, we focus on the BIG-4 *premium* rather than *fees* as theory suggest that the premium rather than the level of fees determines client-firm choice of a BIG-4 or NB-4 auditor. Second we exploit potential heterogeneity in the effects of SOX (and the demise of AA) across industries by correlating the premium (and changes in the premium) with changes in market shares across industries. Last, we analyze the effects of the BIG-4 premium and 2001 NB-4 market share on the probability of an individual firm switching from a BIG-4 to an NB-4 auditor post-2003 adding to earlier research on client-firm behavior.

While we do not directly depend on them, the studies by Maher, Tiessen, Colson, and Broman (1992) and Menon and Williams (1991) had a significant impact on our methodology. Maher et al. (1992) report declining audit fees from 1977 to 1981 because the profession dropped many of its restrictions against competition. Menon and Williams find that audit fees increased in the 1980s but stayed flat in the 1990s. There is a significant increase in 1988 because The Auditing Standards Board issued the "expectation gap" standards. Menon and Williams (1991) also mentioned that BIG-8 mergers had a short-run, instead of a long run, effect on fees. Our focus is on similar economic phenomena in the period 2000-2011. In these years, we find a significant jump in fees due to the enactment of SOX. As in Menon and Williams (1991) we have a reduction in the number of large audit firms (due to the exit of AA rather than mergers). The post-SOX increase in audit fees and the drop in BIG-4 market share is so significant that descriptive statistics establish the trend. Our focus is on trying to establish whether the changes were primarily driven by changes in BIG-4 pricing strategies post-SOX and the collapse of AA or by other changes in the economic structure resulting from SOX. Our results suggest that SOX also influenced the competitive position of NB-4 auditors and this is reflected in the shifts in fees as well as market shares.

We contribute the prior literatures in three ways: i) We explore the long-term effects on audit market structure arising from the enactment of SOX and the collapse of AA; (ii) we show that there is a negative correlation between BIG-4 audit fee increase and market share decrease suggesting that these changes may be driven by factors other than BIG-4 pricing strategies; and (iii) we show a relationship between prior NB-4 market share and firm switching behavior after controlling for the effects of audit fees. We lay out these findings by first discussing related literature (Section II), developing Hypotheses (Section III) and presenting the sample, methodology and results in (Section IV). Section V offers concluding remarks.

2. Related literature

We review prior literature on the BIG-4 premium and the effects of SOX and AA's collapse on the post-SOX market share held by the BIG-4. Cross-sectional differences in audit fees can represent either the effect of quantity differences (in terms of hours of audit) or price differences in terms of hourly fee (Simunic 1980a). In addition, there may be quality differences in terms of differentiation of services (DeAngelo 1981) and the association between high fees and high quality may not be straightforward (Choi, J., J. Kim, and Y. Zang. 2010a). As noted earlier, audit quality is generally unobservable to investors and has to be inferred through differences in prices (Simunic 1980a). It is primarily the unobservability of audit quality interacting with auditor wealth that supports a BIG-4 premium in equilibrium as argued in both empirical studies (Simunic 1980a; Carcello and Palmrose 1994; Danos and Eichenseher 1986) as well as theoretical studies (Dye 1993).

Because wealthy auditors have more to lose from litigation consequent to audit failure, they can be expected to exercise a higher level of control over audit quality (Simunic and Stein 1996b). The higher expected litigation losses of BIG-4 would, in equilibrium, result in higher fees relative to NB-4 auditors. In addition, the fact that the inferred quality of BIG-4 audits is higher should also translate to additional rents for BIG-4 auditors. For both these reasons, we expect that BIG-4 firms would charge a premium to compensate them for the extra litigation risk and that client-firms would be willing to pay this premium because of the perceived higher quality of audits conducted by BIG-4 firms There are also extensive empirical studies about market differentiation across BIG-4 and NB-4 auditors.

Empirical tests of the existence of a BIG-4 auditor premium include Palmrose (1986) and Beatty (1989). Palmrose found that the BIG-8 audit firms charge higher audit fees and explained it as arising from their monopoly powers. Beatty (1989) however argued that reputation led to better pricing of IPO's audited by the BIG-8. Francis (1984) also found that the BIG-8 charged higher audit fees than non BIG-8 firms while Blokdijk, Drieenhuizen, Simunic and Stein (2006b) found that NB-4 audit firms are less efficient in their work than BIG-4 firms, which reflect low audit quality. Shockley and Holt (1983) provide evidence that auditors whose client firms represent the highest market value are perceived as providing higher quality audits. However, Dopuch and Simunic (1980a) and DeAngelo (1981) found that the quality of audit services is very difficult to measure. Danos and Eichenseher (1986) found that clients choose auditors for good economic reasons, based on both the (perceived) quality of auditor services and the audit fee as well as client specific factors. For example, they assume a link between audit firm market share and comparative advantages for larger clients (Dopuch and Simunic 1980a, Danos and Eichenseher 1986). A 2006 GAO (Government Accountability Office) report suggests auditees don't want to be audited by NB-4 firms because of the recognized difference in reputation.

In summary, both the theory literatures and the empirical literatures suggest that big auditors have (or are perceived to have) an advantage that should be reflected as a pricing premium. Whether perceived or real, there is a long-stream of literatures on audit fee determinants that include a component for the BIG-4 premium. We rely on this long precedent in assuming that a BIG-4 premium is present in audit fees and is determined primarily by the belief that BIG-4 auditors generate market value for their clients.

We rely on the literature on the determinants of audit fees (Simunic 1980a; Francis 1984; Maher et al. 1992; Ashbaugh, LaFond, and Mayhew 2003; Kealey, Lee, and Stein 2007; Ghosh and Pawlewicz 2009) in order to empirically isolate the BIG-4 premium. We use one of the latest published papers in this stream of literature (Blankley et al. 2012), to estimate both an overall BIG-4 premium and an industry-by-industry BIG-4 premium. We emphasize that our goal is not to study the BIG-4 premium *per se,* but to see how this premium is related to changes in market share across BIG-4 and NB-4 auditors. Our methodology is discussed in more depth when developing our hypotheses in the next section.

The effect of SOX in increasing audit fees has been documented in many earlier studies (Asthana, Balsam and Kim 2009; Griffin and Lont 2007; Huang 2009) while the increase in the BIG-4 premium has been documented in Ghosh and Pawlewicz (2009). The possibility that SOX has increased NB-4 competitiveness has been studied indirectly in Cassell, Giroux, Myers, and Omer (2013). This paper finds a post-Andersen improvement in the perceived financial reporting credibility of clients of Second-Tier (NB-4) auditing firms relative to clients of BIG-4 auditing firms. Also, they find that BIG-4 clients had a lower *ex-ante* cost of equity in the period before AA collapsed suggesting that some of the BIG-4 reputation for audit quality had eroded due to the negative publicity surrounding the Enron scandal.

Our sample takes this analysis up to 2011. While there has been a small downward trend following the 2006 recession, audit fee increases have remained high over a long-horizon. Simunic (1980a) argues that if the BIG-8 firms collude to increase prices in the "large" auditee segment, their NB-8 competitors would seek to expand market share and price consistent with their own cost conditions, rather than to maintain the cartel price. Using the same argument, we argue that the increase in the BIG-4 premium has led to increased market share for NB-4 auditors but that other factors have also contributed to this increase. Danos and Eichenseher (1986) indicated a more generalized movement to the BIG-8 across all client firms from 1973 to 1980. They argue that the observed change in market share reflects a long-term adjustment to a fairly stable equilibrium distribution of clients across large and small audit firms. In contrast, the enactment of SOX and the collapse of AA disrupted supply and demand patterns in the audit market. This led to both the increases in prices discussed earlier and to other effects as well. We draw on the evidence in Cassell et al. (2013) to reinforce the popular sentiment that SOX has strengthened NB-4 auditors relative to BIG-4 auditors. We bring both these strands of literatures together to analyze whether the shifts in market share can be viewed as primarily driven by new price strategies adopted by the BIG-4 (Choi, Doogar, and Ganguly 2004b) or whether SOX has shifted the preference of client-firms, at least in some section of the markets, towards NB-4 auditors *after controlling* for the effects of price on market share.

While the overall pattern of shifts in pricing and market shares suggests that SOX was the major event over the long-window 2003-2011, the effects of the collapse of AA also had significant impact particularly in the period 2003-2004. Several prior studies have examined the switching behavior of Arthur Andersen clients (for example, Blouin, Grein, and Rountree 2007). While the reputation of AA suffered, Krishnamurthy, Zhou and Zhou (2006) found that firms which were former audit clients of Andersen and then switched to other BIG-4 audit firms had higher returns suggesting these were either intrinsically better quality firms (and signaled the high quality by staying with a BIG-4 auditor). Our focus is somewhat different but related to this finding. We argue that the supply curve was disrupted to a greater extent in industries where AA held a larger share and consequently, that the shift in equilibrium audit prices and BIG-4 market shares should be influenced by AA's pre-2001 footprint in that industry.

Our second test builds on the literature regarding auditor choice. We use the "mismatch" variable developed in Shu (2000) (see Appendix A for details) and the model in (Landsman et al. 2009) to control for firm-specific factors that may induce switching from a BIG-4 auditor to an NB-4 auditor. After controlling for these factors, we examine whether excess fees (measured after adjusting for an average BIG-4 effect and Industry effect) increase or decrease the probability of switching from a BIG-4 to an NB-4 auditor. In addition to fees, we examine whether the competitive position of NB-4 auditors in the prior equilibrium (measured by pre-2002 NB-4 market share) has any relationship to the new equilibrium post-SOX and demise of AA. That is, we see whether switching behavior of individual firms had any relation to NB-4 competitiveness after controlling for other factors and the effects of BIG-4 pricing strategies.

3. Hypotheses development

We outline again the basic economic factors that motivate our study. The audit market involves a complex fee and quality structure where audit quality is credence good. For this reason, BIG-5/4 auditors are able to set up a quasi-oligopoly and charge a higher fee than NB-4 auditors. We abstract away from within BIG-4 competition and view this as a Stackelberg Oligopoly Equilibrium with the BIG-4 acting as leaders and NB-4 as followers (Vives 1999, 200–205). Firms are willing to pay this premium as they recover the costs through a better price in the stock market (e.g. through a lower cost of capital). Despite the premium charged, large audit firms also held a preponderant share of the market for audit services, generally increasing their market share over a long period prior to 2000. However, this process was interrupted by two major events in 2002 – the collapse of AA and the enactment of SOX. Our hypotheses pertain to shift in the market equilibrium after these two events.

Because the total market for audit services is (almost) inelastic with regard to audit fees,[10] an increase in the BIG-4 premium should result in a reduction in market share for big auditors. However such a market share reduction could be further enhanced if the competitive position of NB-4 auditors has been strengthened due to SOX. The main focus of our analysis is to try and see if we can find evidence for stronger market competition from NB-4 auditors post-SOX through a careful analysis of the relationship between premium increases and changes in market share.

An increase in the premium suggests either that the BIG-4 had greater pricing power post-SOX and AA collapse or that they raised fees due to some other reasons such as a differential increase in Litigation costs (as compared with NB-4). Under the first argument, there would typically be very little erosion of market share due to the increase in the premium. However, the data show that there was a sharp fall in the market share of BIG-4 auditors. This suggests the premium increase could have been a deliberate strategy to shed less profitable clients perhaps as a reaction to increased risk post-SOX for BIG-4 auditors (relative to NB-4 auditors).

It is also possible that the loss of market share was due to the fact that the benefits associated with a BIG-4 audit declined post-SOX and the collapse of AA. This would lead directly to a loss in market share for the BIG-4. However, it would also typically lead to a reduction in the premium as BIG-4 auditors reacted to the reduction in their perceived value by reducing fees. At the very least, the reduction in market share and changes in premium would be positively correlated, that is, the greater the increase in NB-4 market power, the more downward pressure would be exerted on the BIG-4 premium coupled with a greater loss in market share.

Summing up these arguments, the relationship between the BIG-4 premium and market-share losses could be either positive or negative depending on the relative effects on the supply side and the demand side. Exploiting the fact, established in earlier studies, that there are significant industry differences in both audit fees and market shares (Cahan, Jeter and Naiker 2011) we can treat each industry as a "separate" experiment on the effects of the BIG-4 premium increase on BIG-4 market share losses, or equivalently, NB-4 market share gains. As we document in Table 3 Panels F & B, the premium increased in every industry and the NB-4 gained market share in every industry, but there was variation both in terms of the premium increase and market share decrease. If the primary driver of the market realignment post-SOX was the fee strategies set by the BIG-4 auditors, we would typically expect that industries where the premium increased the most are also the ones where the BIG-4

[10] The cost of going private and avoiding the need for an independent audit generally involves costs that are much larger than audit fees, so the effect of an increase in audit fees on the total number of publicly traded firms is generally small.

eliminated a larger share of clients, that is, that industry market share losses and industry premium increases are positively correlated. Note that there is a clear alternative possibility here – that NB-4 market share increased because of an increase in client-demand for NB-4 services. Under this second scenario, the increase in the BIG-4 premium will be lowest in industries where NB-4 power increased the most and we would also see a greater market share loss in these industries, in other words, that premium increases and market share losses would be negatively correlated.

In order to further examine the effects of competitive factors, we introduce two empirical variables that may plausibly affect the ability of the NB-4 to attract clients in the post-SOX environment: (i) the proportion of the market held by AA (*pre*-SOX) and (ii) the proportion of the market held by NB-4 auditors *pre-SOX*. Each of these factors could influence the equilibrium post-SOX, but the direction of influence is unclear from a theoretical perspective. For example, if AA held a larger share in an industry in 2001, the collapse of AA would disrupt the supply curve but could also lower the demand curve because the perceived value of a BIG-4 audit may have fallen due to the Enron scandal. Analogously, the enactment of SOX may have strengthened NB-4 auditors uniformly across all industries, more in industries where they were previously *more* competitive or more in industries where they were *less* competitive. For these reasons, we do not have directional predictions based on theory as to which way AA market share and pre-SOX NB-4 market share will influence client-switching behavior from BIG-4 to NB-4 post-SOX (H2, H3, and H4).

Out first hypothesis (in null form) is that the shift in market shares is primarily attributable to the fee strategies of the BIG-4 post-SOX and AA. If this were the case, industries where the BIG-4 is more selective should see both higher BIG-4 premia and greater losses in market share:

H1: *The fee premium charged by the BIG-4 post-SOX will be higher in industries where their market share declined more (i.e., fee premium will be positively correlated with (NB-4) BIG-4 market share losses (gains)).*

The second hypothesis is connected with the joint effects of the collapse of AA and SOX. The premise is that the larger AA's market share in that industry in 2001, the greater will be the increase in pricing power for the surviving BIG-4 firms. In addition, the lower the shift in competitive advantage to NB-4 auditors, the less the pricing power for BIG-4. This leads to our second hypothesis (in null form):

H2: *The fee premium charged by the BIG-4 post-SOX in any industry will bear the same relationship to the SOX effect (as in H1) irrespective of AA's market share in that industry in 2001.*

The last two hypotheses are associated with the probability of switching from a BIG-4 firm to NB-4 firm in the period 2003-2011. If cherry picking by the BIG-4 is the main significant factor driving the switch to NB-4 auditors, we expect that firms that are being charged a high premium by the BIG-4 (in the prior year) are more likely to switch to NB-4 auditors. In null form, this reduces to:

H3: *A high fee premium charged by the BIG-4 (in the previous year) will not affect the probability of switching to an NB-4 auditor.*

Our last conjecture related directly to the hypothesis that the enactment of SOX and the overall perception that all auditors were now required to do a better job mitigated concerns about the overall quality of audits. Given an increase in audit quality (either real or perceived) the role of reputation and/or deep pockets as a proxy for audit quality would be muted. Therefore, we would expect more switching to NB-4 in industries where the market power of the NB-4 auditors increased the most. To test for this possibility, we use the competitive position of the NB-4 in the pre-SOX period as an instrumental variable for measuring the strength of NB-4 auditors in that industry. We conjecture that SOX helped the competitive position of NB-4 auditors but that it was differential across industries.

H4: *The industry strength of NB-4 auditors prior to SOX does not change the probability of switching to an NB-4 auditor post-SOX.*

We now describe our methodology and statistical tests to try and reject the null hypotheses H1-H4.

4. Sample, methodology and results

Sample and Descriptive Statistics

To form the sample, we collected data from audit analytics covering the period from 2000 to 2011. This resulted in a total of 150,908 observations. If a client has two or more auditors in a sample year (but did not change auditors), we sum the audit fees for the specific year. Therefore we have a single fee observation for each client-firm for each year. If a client-firm switched auditors, we delete these observations eliminating 6,701 observations from the sample. Next, we merge with Compustat to collect financial data. 55,723 observations were deleted because the financial data was not available. In addition, 26,703 observations did not have information about business segments and were deleted. We use the industry analysis methodology of Ashbaugh et al. (2003) and eliminate the financial services industry (SIC 6000-6999) losing 10,040 observations in this process. In the final step, we exclude firm years with missing Compustat data in the auditor switch model and as a consequence, 6,714 observations were deleted. Our final sample for the audit fee model consisted of 51,732 observations. 8,636 firm year observations are before 2003, while 43,096 firm year observations are after 2002. In addition, for the switching model, we delete 2,020 observations before 2001, because of missing data regarding auditor switches. Then we delete 6,735 firm year observations before 2002, because we focus on the influence of fee premium after 2002. Our final sample for switching model is 28,263.[11] The representation of each industry in our sample is closely aligned with the overall industry composition listed in COMPUSTAT.

[11] If the firm was a foreign filer or failed to issue a SOX 404 Internal Control report, we define going concern, material weakness and modified opinion as 0, so we did not lose observations in this process.

Table 3 Panel A describes the ratio of audit fees by NB-5/4 audit firms divided by total fees from 2000 to 2011 in different industries. While this also shows the same time-trend, what is striking is that the share of revenues does not exceed 13% in any industry showing the enormous market-share advantage held by the BIG-4. Table 3 Panel B shows the market share audited by NB-5/4 from 2000 to 2011. From this table, it is obvious that the market share of NB-4/5 firms increased significantly post-SOX and AA. (See also Figure 1). Table 3 Panel F shows the increase in the size of BIG-4 firms over the period 2001-2007. The panel shows that firms grew rapidly in the years 2001-2004 when they absorbed the former clients of AA but this expansion slowed in the years 2005-2007 and reversed slightly in the period 2007-2011. Table 3 Panel G shows the number of firms audited by BIG-5/4 on an industry basis from 2000 to 2011. From the evidence in Table 3, it is obvious that the market share of NB-4/5 firms increased significantly post-SOX and AA. (See also Figure 1 Panel B).

Methodology

Our methodology involves two different approaches. In both approaches, our goal is to first construct measures for the post-SOX "excess fee" charged by BIG-4 auditors. Then our second step is to see if these excess fees determine the propensity of client-firms to choose NB-4 auditors post-SOX, or whether other factors are also influential. In the first approach, we use an industry based model similar to Numan and Willekens (2012). In this approach, we use three measures of differential pricing across BIG-4 and NB-4 auditors in each industry to capture the effects of BIG-4 pricing strategies post-SOX. Then we measure the relationship between BIG-4 premium increases and industry market-share changes using a Spearman Test. Specifically, we examine the relationship between industry rankings related to the BIG-4 premium with both the market-share gains of NB-4 auditors and the market share held by AA before their collapse. In this first set of tests, the underlying idea is that if the increase in the premium was the main factor driving market-share shifts, the industries with the largest premium increases (or levels) should also see the greatest market share reductions.

The second test follows Landsman et al. (2009) and uses an auditor choice model. Here, we restrict the sample to BIG-4 clients and use the residual from an audit fee regression as a measure of the firm-specific abnormal fees charged by BIG-4 auditors. We then see if a large residual in one year increases the probability of switching in the following year. Our second test variable is the 2001 market share held by the NB-4 firms. The underlying idea here is that the competitive position of NB-4 auditors pre-SOX should change post-SOX and affect the switching behavior of firms.

In both set of tests, we do not specifically adjust for firms that may have entered or exited the market. Overall, the total number of firms entering or exiting the market is very small relative to the total sample and keeping or removing these firms has no effect on the measure of market shares or the measure of the premium. In our switching model, we only use firms that are BIG-4 clients and then switch to an NB-4 auditor. The length of the audit engagement is a control variable in this model and adjusts for the fact that a new entrant may have a lower probability of switching auditors. In summary, the entry and exit of firms has minimal or zero effects on our tests.

Audit Fee Models

One of our primary goals is to get an estimate of the fee premium charged by the BIG-4 on an industry-by-industry basis. To isolate the BIG-4 fee premium, it is necessary to estimate what the fee "would be" based on firm and industry characteristics had the firm been audited by a small auditor. Models that tie audit fees with firm characteristics have been extensively developed starting with Simunic (1980a). Most of the models in the following years have used variations of Simunic's model. In particular, the models are log-linear in audit fees and firms' assets. Other variables such as account receivables are used to control for risk. Many recent models extend and improve on Simunic's original model. We use the following model from Blankley et al. (2012) as it provides a convenient reference point for our subsequent industry based analysis:

$$\begin{aligned} LAF_{i,t} = {} & \alpha_0 + \alpha_1 LTA_{i,t} + \alpha_2 CR_{i,t} + \alpha_3 CA\_TA_{i,t} + \alpha_4 ARINV_{i,t} + \alpha_5 ROA_{i,t} + \alpha_6 LOSS + \alpha_7 FOREIGN \\ & + \alpha_8 MERGER + \alpha_9 BUSY_{i,t} + \alpha_{10} LEV_{i,t} + \alpha_{11} INTANG_{i,t} + \alpha_{12} SEG + \alpha_{13} OPINION_{i,t} \\ & + \alpha_{14} MATWEAK_{i,t\text{-}(t\text{-}1)} + \alpha_{15} BIG5/4_{i,t} + \alpha_{16} INDCON_{i,t} + \varepsilon_{i,t} \end{aligned} \quad (1)$$

We take the natural log of audit fees.[12] If a firm is audited by Arthur Andersen, Deloitte & Touche, Ernst & Young, KPMG, or PricewaterhouseCoopers (or just the last 4 after AA's collapse), the BIG-5 Dummy equals 1 and 0 otherwise; The control variables are consistent with prior research (Simunic 1980a; Palmrose 1986; Whisenant, Sankaragurusuvamy, and Raghunandan 2003; Francis, Reichelt, and Wang 2005; Hay, Knechel, and Wong 2006). The audit effort measures are assets (LTA); the presence of mergers (MERGER) or foreign operations (FOREIGN); the number of business segments (SEG); and the auditors issue a going concern opinion (OPINION).Further, Audit risk measures are CR; CA_TA; ARINV; ROA; LOSS; and INTANG. Financial leverage (LEV) captures long-term financial structure of the client. We also include industry dummies following Ashbaugh et al. (2003), since our analysis is based on industry premium. To control for internal control quality, we also use a variable as the company has material weakness in the current year (Ettredge, Li, and Sun 2006; Doyle, Ge, and McVay 2007). Finally, we include a variable if the company's fiscal year end is December 31st. The BIG-4 coefficient estimated over the period 2003-2011 in our sample is significantly higher than a similar BIG-5 dummy coefficient estimate over the years 2000-2002 suggesting that the BIG-4 "premium" increased significantly post-SOX (as documented for a different sample by Ghosh and Pawlewicz 2009).

Industry Effects

Audit fees vary significantly across industries. Different patterns of production, raw materials and intangible assets change the nature of the external auditor's verification process. Less clear are arguments as to how auditor specialization in industry affects fees. Both Palmrose

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[12] An alternative to transforming the fee variables by their natural log is to scale the fee variables by total assets. (Ashbaugh et al. 2003) We do not use this transformation because our focus is the magnitude of fees instead of the relative cost of audit-related services to the client.

(1986) and Menon and Williams (1991) find no association is observed between audit fees and industry specialization. Other scholars suggest that fee differences across BIG-4 and NB-4 as well as fee differences within the BIG-4 should vary across industries. Danos and Eichenseher (1986) said that market share differentials are maintained in the public utility, oil and gas, and railroad industries from 1950 to 1980 due to client regulation. They found a significant positive correlation between industry-specific auditor concentration levels and the percentage of industry members listed on the American and New York Stock Exchanges. Previous researches also pointed out the possibility that large audit firms have comparative advantages in highly regulated industries (Danos and Eichenseher 1986). Craswell, Francis, and Taylor (1995) found that BIG-6 auditors could charge a higher price than non specialist BIG-6 auditors. They attribute this effect to the fact that industry specialists make investments in order to achieve their industry specific expertise.

Based on these earlier results, we expect to see significant differences across industries in terms of the mean BIG-4 premium and in terms of the effects of SOX. To test this, we run the same regression as (1) with industry coefficients.

$$\begin{aligned} LAF_{i,t} = {} & \alpha_0 + \alpha_1 LTA_{i,t} + \alpha_2 CR_{i,t} + \alpha_3 CA\_TA_{i,t} + \alpha_4 ARINV_{i,t} + \alpha_5 ROA_{i,t} + \alpha_6 LOSS + \alpha_7 FOREIGN \\ & + \alpha_8 MERGER + \alpha_9 BUSY_{i,t} + \alpha_{10} LEV_{i,t} + \alpha_{11} INTANG_{i,t} + \alpha_{12} SEG + \alpha_{13} OPINION_{i,t} \\ & + \alpha_{14} MATWEAK_{i,t-(t-1)} + \alpha_{15} BIG4{*}INDCON_{i,t} + \varepsilon_{i,t} \qquad (2) \end{aligned}$$

We do not use a separate BIG-4 dummy in this regression because it is the sum of the BIG4*INDCON interactive dummies. We also do not use a separate industry dummy because it is highly correlated with the interactive dummy as the BIG-4 hold a preponderant market share in every industry. The results are tabulated in Table 4 and show that the coefficients varied significantly across industries, that is, the BIG-4 premium was industry dependent. The t-statistics are adjusted for clustering and the F-test after Table 4 rejects the equality of the BIG-4 dummy coefficient across industries.

Fee Premium Measures

We use the residual from Equations (1) and the BIG-4*Industry coefficient in Equation (2) to construct our empirical measures of the excess fees charged by the BIG-4. As the right-side regressors in Equation (1) include both firm characteristics as well as average BIG-4 and industry effects, the residual measures firm-specific excess fees. If this residual is large, it is indicative of being charged high "excess" fees by the BIG-4 (due to unobservable firm specific factors). To the extent that the market equilibrium is being driven by BIG-4 pricing strategies, we would expect the firms being charged high excess fees to be the ones that switch to NB-4 auditors. We test this in two ways: first, by determining the correlation between market share changes and excess BIG-4 fees on an industry-by-industry basis, and second, by examining switching probabilities at the firm level.

For the first test, we rank industries with regard to the BIG-4 premium in three ways: (i) based on the median residual from Equation 1; (ii) based on the *change* in the BIG-4*Industry coefficient across the periods 2000-2002 and 2003-2011 in Equation 2; and (iii) based on the *level* of the BIG-4*Industry coefficient in Equation 2. We compare each of these industry rankings based on the BIG-4 premium with three Industry rankings defined through the percentage loss of BIG-4 market share measured either (i) in terms of the number of firms, or, (ii) by the total fees charged, or, (iii) as a ratio of these variables. Then we test to see if the rankings of industry based on fee premia corresponds positively or negatively with those on NB-4 market share losses. If fee strategies of the BIG-4 were primarily responsible for market share shifts, we would expect that a positive correlation between BIG-4 excess fee rankings and NB-4 market share gains (H1).

We now turn to the industry-specific market share changes arising out of the effects of exit of AA. We measure the influence of the exit of AA on the market equilibrium based on their market share (either in terms of firms audited or in terms of revenues). We then examine how the rankings of industries based on AA's market share correlate with the post-SOX shifts in market share across BIG-4 and NB-4 (H2).

Audit Switch Model

For the second test, we build on the auditor switch model from (Landsman et al. 2009). The structure of that model and our test variables are described below in Equation 3.

$$\begin{aligned}SWITCH_{i,t} = {} & \alpha_0 + \alpha_1 ABAFEE_{i,t-1} + \alpha_2 {*} TestVar + \alpha_3 GROWTH_{i,t-1} + \alpha_4 ABSDACC_{i,t-1} + \alpha_5 ARINV_{i,t-1} \\ & + \alpha_6 GC_{i,t-1} + \alpha_7 MODOP_{i,t-1} + \alpha_8 TENURE_{i,t-1} + \alpha_9 ROA_{i,t-1} + \alpha_{10} LOSS_{i,t-1} \\ & + \alpha_{11} LEVERAGE_{i,t-1} + \alpha_{12} CASH_{i,t-1} + \alpha_{13} BIG4{*}MISMATCH_{i,t-1} + \alpha_{14} EXPERT_{i,t-1} \\ & + \alpha_{15} SIZE_{i,t-1} + \alpha_{16} MERGER_{i,t-1} + \varepsilon_{i,t} \end{aligned} \tag{3}$$

TestVar

1.NB-4MarketShare in 2001

2.AAMarketShare in 2001,ABAFEE*AAMarketShare2001

3.AAFeeShare in 2001,ABAFEE*AAFeeShare2001

To control for audit risk, we include GROWTH, ABSDACC, INVREC, GC, MODOP, and TENURE (Stice 1991; DeFond and Subramanyam, 1998). We include other variables to control for client-specific aspects of the audit engagement related to audit risk, like INVREC, GC, MODOP and TENURE (Dopuch, Holthausen, and Leftwich 1987b; Stice 1991; Krishnan 1994a; Krishnan and Krishnan 1997b; Johnstone and Bedard 2004). To control for financial risk, we include ROA, LOSS, CASH, and LEVERAGE. We also include the MISMATCH variable as a proxy for misalignment (Shu 2000; Landsman et al. 2009) as a further control. Finally, we include industry fixed effects, EXPERT, SIZE and MERGER as additional control variables. (Hogan and Jeter 1999), because companies are more likely to switch auditors after a merger or acquisition if the two companies involved had different auditors prior to the merger. After controlling for all these factors that have been advanced as influencing switching behavior in earlier papers, we focus on the effects of our test variables that measure the effects of fees and market share variables on switching behavior.

The GAO (2006) report suggests that audit firms are more sensitive to client risk after Arthur Andersen collapsed, so we expect that BIG-4 auditors increased the premium more for clients with high-risk characteristics. However, assuming that their benefits from going to a BIG-4 auditor did not change (or did not increase commensurate with the fee increase), they are more likely to switch to NB-4 auditors. Even otherwise, if the increase in BIG-4 fees were driving firms to the NB-4, we would expect that large *abnormal* fees (after controlling for mean BIG-4 and Industry effects) encourage switching (H3). In addition, if the fee strategies are mainly driving switching behavior, we should see no influence of NB-4 market power on switching behavior. For this reason, we use the NB-4 industry market share in 2001 as a test variable to see if it influences the probability of choosing an NB-4 auditor post 2003 (H4). For similar reasons, we test whether AA's pre 2001 market share either influences the probability of switch directly, or in interaction with the abnormal fee.

Results

Before presenting our results, we outline some statistics that form the background for our analysis. The BIG-4 market share reduced significantly over the period 2003-2011. The descriptive statistics are compelling. [13] The results documented in Tables 3 – 4 show that the cross-sectional variation both in market share losses and BIG-4 premia increases are considerable across industries. Our fundamental economic premise is that the enactment of SOX and the demise of AA affected both the demand and supply curves for audit services (as a function of the BIG-4 premia). In particular, we wish to study how strongly changes in the demand curve have affected market structure. If the primary force for change has been cherry picking of profitable clients by the BIG-4 through their fee strategies, we would expect to see a positive association between the level of fee premia and changes in market share. If however, demand curve shifts have also been influential, we would expect to see more negative correlations between the industry premium and industry market share declines (Appendix B B1). Table 5 shows that the correlation between each of the fee rankings and each of the market share rankings is significantly negative (using a non-parametric Spearman test), that is, H1 is rejected. Although the premium has gone up and may have reduced the BIG-4 market share, other factors besides the increase in premium are necessary to explain the negative correlation (such as a downward shift in the demand curve for BIG-4 services for at least a portion of the market).

Analogously, if the demise of AA disrupted the supply curve more than the demand curve, we would expect to see higher premia in industry where AA had a larger market share. In contrast, if NB-4 auditors were better able to compete in industries where AA initially had a greater market share (because the remaining BIG-4 was weaker), we would expect to see a negative association. The results are not very conclusive using a non-parametric Spearman test (Table 5 Panel C), positively significant with regard to Fee Premium III but not the others. The finding suggests that the premium is higher in industries where AA had a larger footprint and at least in this case, supply side effects have led to larger absolute fee levels in industries where AA had a stronger presence. We also examined the relationship between fee premia and the proportion of AA clients switching to NB-4 auditors in the industry (AA-

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[13] Although we do not report them here, we formally tested and rejected null hypotheses that there was no change in NB-4 market share from 2001 to 2011 both at an industry level and in aggregate.

switch-share in Table 5). Again, the results are not very strong but suggest a negative association between high fees and NB-4 auditor choice. That is, industries where larger numbers of AA clients switched to NB-4 auditors also had low excess fees, perhaps as a consequence of the fact that NB-4 auditors were more competitive in these industries.

Table 6 documents the tests on switching behavior by BIG-4 clients to NB-4 auditors during the years 2001-2011. Although our main focus is on columns C and D which cover the years 2003-2011, we include the period 2001-2002 for comparison purposes. First, we show that the audit fee residual from Equation 1 has a negative coefficient in the switch model. The inference is that firms with larger residual (i.e., larger abnormal fees paid to BIG-4 auditors) were less likely to switch to NB-4 auditors. This is inconsistent with an assumption that customers were dropped or driven away from the BIG-4 by the use of large audit fees. If firms realized that they were paying excess fees *after adjusting* for the mean industry and BIG-4 premium, they should be more willing to consider an NB-4 auditor. Instead, we find that such firms are less likely to switch auditors. One possible explanation is that of a survivorship bias. Firms that continue to retain BIG-4 auditors perceive some special benefit from this relationship above and beyond that implied by their observable characteristics.

In this table, it is also shown that industries in which the NB-4 had higher market share in *2001* (the last variable in Table 5 termed as NB-4 market share in 2001) also had a lower probability of switching in the period *2003-2011*. The inference from this finding is that NB-4 market power also influences switching behavior. More precisely, SOX seems to have improved the ability of the NB-4 to compete more effectively in industries where they had less influence prior to SOX. To sum up, the overall findings in Table 6, Columns C and D are that switching behavior seems to be influenced by demand-side factors such as a greater attractiveness for BIG-4 audits for some firms (who are willing to pay high excess premia) or a greater preference for NB-4 audits for other firms in industries where the NB-4 were less competitive pre-SOX.

It is also instructive to compare the differences between the coefficients over the period 2001-2002 as compared with 2003-2011 (Table 6, Columns B compared to Columns C and D). We note that the fee residual here has a positive coefficient. Our interpretation is that fees were already starting to rise in this period and firms that were fee sensitive switched in 2002. Note also that in Column A, the AA-market share variable is negative and significant at the 10% level, suggesting that firms in industries where AA held a larger share were more likely to stay with other BIG-4 auditors. In other words, we find that the demand for BIG-4 auditing did not shift sharply due to the failure of AA.

We note that all the results in the switching model are derived after controlling for the mismatch variable (Landsman et al. 2009). This variable is determined based on optimal cut-off score (based on certain firm characteristics; see Appendix A) that creates the least misclassification of auditor selection. In other words, the optimal cutoff score is chosen in such a way that a specification that all firms below the cutoff should choose an NB-4 auditor whereas firms above the cutoff should choose BIG-4 produces the smallest number of auditor-auditee misclassifications. Then firms below the cutoff that choose BIG-4 or firms that are above the cutoff but choose NB-4 are classified as mismatched firms. As in Landsman et al. (2009) we find that mismatched firms are more likely to switch but the negative effect of the residual fee holds even after controlling for mismatched firms.

In order to better understand both aspects of the change, we analyze the switching model on a size quintile-by-quintile basis. As may be expected, we find that the switching model, with one or two minor exceptions, is stable across the middle quintiles but is significantly different in the highest and lowest quintiles. First, the key variable of abnormal fee is significantly negative in the middle quintiles suggesting that higher than normal (lagged) audit fees do not induce these firms to switch. In addition, the level of market share held by NB-4 auditors prior to 2001 also significantly influences switching post-SOX, that is, more switching has taken place in industries where NB-4 were more competitive prior to 2001. Firms that were "mismatched" with the BIG-4, that is, firms whose observable characteristics suggested that they would be better off with NB-4 auditors, were significantly more likely to switch in these middle quintiles quintiles (insignificant in the two extreme quintiles). Combining the findings on the explanatory variables: (i) abnormal fees (ii) and 2001 NB-4 market share, analysis of the switching model by size-quintiles confirms the influence of demand side shifts in the market post-SOX and AA.

While not pertinent to our hypotheses, we comment briefly on some of the other firm-specific control variables in Table 6 Panel A. Growth is negative (or insignificant) in all quintiles suggesting that growing firms are less likely to switch to BIG-4 auditors. Interestingly, Cash is also negative suggesting that cash-rich firms are less willing to pay for a BIG-4 audit. Audit tenure is also negative suggesting that firms who have been with a BIG-4 auditor for longer are less willing to switch to an NB-4 auditor. This is intuitive for two (related) reasons: (1) most firms will stick with an auditor for several years before investigating the possibility of change and (2) firms that are deriving value from BIG-4 audits may become less certain about this (lack of value) over time and thus be less open to switching to an NB-4 auditor. Somewhat surprisingly, the loss variable is not stable in sign suggesting that multiple economic factors may affect the auditor choice of loss-making firms. While such firms may be unwilling to switch to an NB-4 auditor because of the negative signal it sends to the market place, they may also be more sensitive to fees (and hold less readily available cash).

Our results show that although the BIG-4 premium has risen significantly, the relative competitive position of NB-4 auditors has strengthened with regard to a significant proportion of the market. To augment this finding, we run the switching model separately on each quintile (Table 5 Panel B). The results are consistent with the overall findings across the lowest eight quintiles. In the largest quintiles, there is almost no switching from BIG-4 to NB-4 auditors. This result confirms the common-sense conclusion that the competitiveness of NB-4 auditors has been the dominant feature for about 80% of the market whereas the largest firms are contributing to the significant increase in the BIG-4 premium even after employing the standard controls for size used in prior literatures.

Sensitivity Tests

Statistical issues

We tested for potential multicollinearity problems by examining the Variable Inflation (VIF) statistic. The VIF for equation (2) is 1.37 and 3.24 in equation (3) so multicollinearity is not a concern. We used several different statistics (such as the Ramsey RESET test) to test the robustness of our results to potential omitted variables. The Breusch-Pagan and White test for heteroskedasticity were positive. However, using heteroskedasticity- robust standard errors did not change the ranking of the Industries based on the BIG-4 incremental premium. We did not find any significant changes in the ranking of the industries by BIG-4 pricing power although there were some occasions when industries changed places with the ones immediately above or below. These changes had some effect on the Spearman ranking correlation score but the effects were small and did not suggest any changes in the conclusion of a negative association between industry-premium increases and market share changes.

Alternative audit fee models

We also checked for alternatives in the Ashbaugh et al. pricing model, but the quantitative impact of these changes were small and were not worth reporting. In particular, the documented increase in the BIG-4 price premium from the 2000-2002 periods to the 2003-2011 periods and the ranking of industries by the level of premium changes was robust across alternative pricing models. We also checked an alternative measure of the premium using a fitted fee model. That is, we estimated a fee model for NB-4 auditors and then measured the premium as the excess charged by the BIG-4 over the predicted fee that would have obtained for an NB-4 auditor using the estimated regression coefficients. Again, the industry fee-premium rankings were stable and did not change the negative coefficient in the Spearman Test. In the switching model, this alternative measure was used to calculate the ABAFEE (here, simply the estimated BIG-4 premium) and it did not change the negative coefficient on this variable or the 2001 NB-4 market share.

Second tier auditors

We examine whether the shift to NB-4 is concentrated in Second Tier auditors (See Cassell, Giroux Myers and Omer 2013 for a list of auditors that are considered to be second-tier). Table 3 Panel D&E show that second tier auditors market share increase, either measured as a proportion of fees or as a proportion of client-firms accounted for a very small portion of the shift away from the BIG-4. Therefore, the growth in market share is spread broadly across all NB-4 firms and not just second-tier firms.

Switching model robustness

Another robustness check was to run the switching model on all the firms in the sample rather than restricting the sample to only the firms that were with the BIG-4 in 2003. The results were qualitatively unchanged though the significance increased with the inclusion of firms that switched from NB-4 to BIG-4 in the years 2004-2011 (i.e., using the sample of all firms that were with a BIG-4 auditor in at least one of the years from 2003-2011). This set consisted of 545 firms and a total of 2337 firm-year observations which was small relative to the total sample of 28,263 firm-year observations. None of these firms switched back to an NB-4 auditor.

Capacity constraints

The collapse of AA led to a sudden shift in demand to the surviving BIG-4 auditors. As documented in Table 3 Panel C, the surviving BIG-4 grew very rapidly in 2003-2004. However, this expansive trend slowed down sharply in 2005-2006 and seems to even have reversed in later year. Viewing this evidence from a longer perspective of the entire period 2003-2011, there is little evidence that capacity constraints were a significant economic force in terms of lost market share at least in the later years. To ensure that our findings are robust to capacity constraints, we run our model over different time periods and find that our results are qualitatively similar whether we run it over the period to 2006 when capacity constraints may have been stronger or over longer time periods when these constraints would no longer be part of the economic pressures.

Time-Sensitivity

In addition to checking the capacity constraints, we also tested our model over different time periods. Using time periods 2003-2006, 2003-2007 or 2003-2009 did not change any of the results of the switching model (Table 6 Panel C). In particular, the 2001 market share continued to be positive and significant over each of these time periods suggesting that the role of NB-4 market power has exerted a long-term influence on changes in market shares.

Other Regulatory Effects

The period covered by our study also saw other changes in regulation both on the market side and on the accounting side. Some of these other events may also have played a part in changing the BIG-4 premium. Specific examples are the requirement of fair value disclosures (Fin 48) or Auditing standard 5. Such disclosures inevitably involve estimates that may increase audit failure costs, imposing greater risk on the BIG-4. While we acknowledge this possibility, it does not affect our basic analysis of whether premium increases have resulted in market share shifts or whether NB-4 market power has also played a role. In summary, while there is a legitimate argument that other events besides the enactment of SOX may have added to the increase in the BIG-4 premium, these effects do not affect the main empirical findings of our analysis that market share shifts have been affected by NB-4 market power as well as BIG-4 pricing strategies.

5. Conclusion

The market for auditing services is highly concentrated with BIG-4 audit firms. In 2002, one of these auditors, Arthur Andersen, went out of business. In addition, a comprehensive set of new regulations concerning auditing (SOX) went into effect. Subsequently, in the period 2003-2011, there were significant increases in audit fees (both for BIG-4 and NB-4 auditors) as well as significant decreases in market share for BIG-4. Prior literature has advanced two possible explanations for these shifts in market structure: (i) a deliberate attempt by BIG-4 auditors to concentrate on (fewer) more profitable clients (characterized in our paper as "cherry picking"); and (ii) that better regulation and enforcement post-SOX has increased confidence in the reports of NB-4 auditors (characterized as "NB-4 market power"). By examining cross-industry correlation between reductions in market share and the size of the BIG-4 premium, as well as the relationship between audit fees and switching behavior, we are able to provide some new insights on these two effects.

An increase in NB-4 market power should typically lead to a *decrease* in the BIG-4 premium (the excess oligopoly or other rents) extracted by BIG-4 auditors. However, the BIG-4 premium increased significantly over this period suggesting that the combined effects of the demise of AA and the increased requirements of SOX enhanced the pricing edge for BIG-4 auditors. In addition, the market share of the BIG-4 decreased significantly. Taken together, this pattern suggesting that cherry-picking of high-fee paying clients by the BIG-4 may have been the driving force in reshaping the market for audit services. However, if cherry picking were the dominant influence, we would expect to see that the more selective the BIG-4 became, the higher would be the premium and lower the market share. In contrast, if the increased NB-4 market power played a significant role, then the BIG-4 would lose market share even if they reduced the premium they charged over NB-4 auditors. An industry-by industry analysis shows that BIG-4 industry premium and market share losses are inversely related (higher premium associated with smaller market share losses) showing that market changes were driven by factors additional to pricing strategy shifts by BIG-4 auditors.

To cross-check this finding, we examine whether higher *residual* fees (after controlling for firm characteristics), affect the probability of a client-firm switching from BIG-4 to an NB-4 auditor. The underlying logic is that if firms are essentially switching because of high fees, we would expect to see a positive association between high firm-specific (lagged) fees and switching to NB-4 auditors. However, if what is happening is that firms which see high (firm-specific) values for BIG-4 audits continue to retain them, it is possible that increases in the BIG-4 premium reflect a capture of this value and that there may be a lower likelihood of switching for firms that pay a high BIG-4 premium. Our results show that high residual fees reduce the probability of a switch to an NB-4 auditor suggesting that firms that see less value in BIG-4 audits have already switched to NB-4 auditors whereas firms that see high value in BIG-4 audits have remained with them despite the high fees (i.e., a demand side effect). This finding is further confirmed by the fact that there has been more switching in industries where the NB-4 were weakest *pre-2002* suggesting that the enactment of SOX has made it easier for NB-4 to compete in these industries.

While the collapse of AA and enactment of SOX were major economic events, there have been many other changes in the audit environment over the period 2003-2011 as well as a major market recession. We do not examine these features individually but do show that our results are stable across different time windows within this period, and in particular, that excluding or including the recession does not affect our findings. In addition, SOX have changed many other aspects of corporate structure including governance. Although we control for many firm-specific features connected to audit fees, we do not study the role of governance or management incentives on the decision to retain a BIG-4 auditor. Managers (and/or the board) may see value in hiring a BIG-4 auditor even if the extra premium is not recovered through the equities market. One of the challenges for the future is to examine whether agency conflicts may lead to the retention of BIG-4 auditors even if such retention does not directly benefit shareholders.

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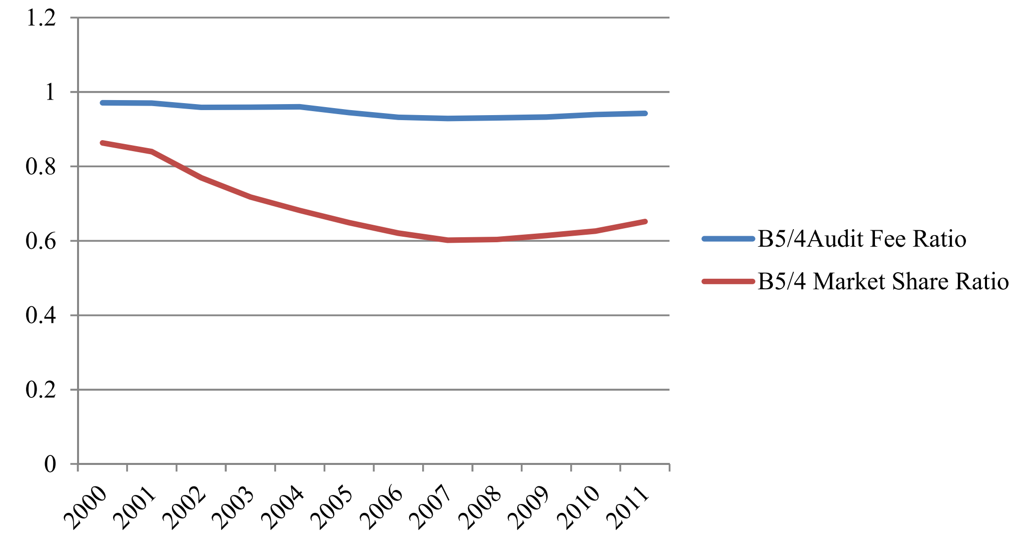
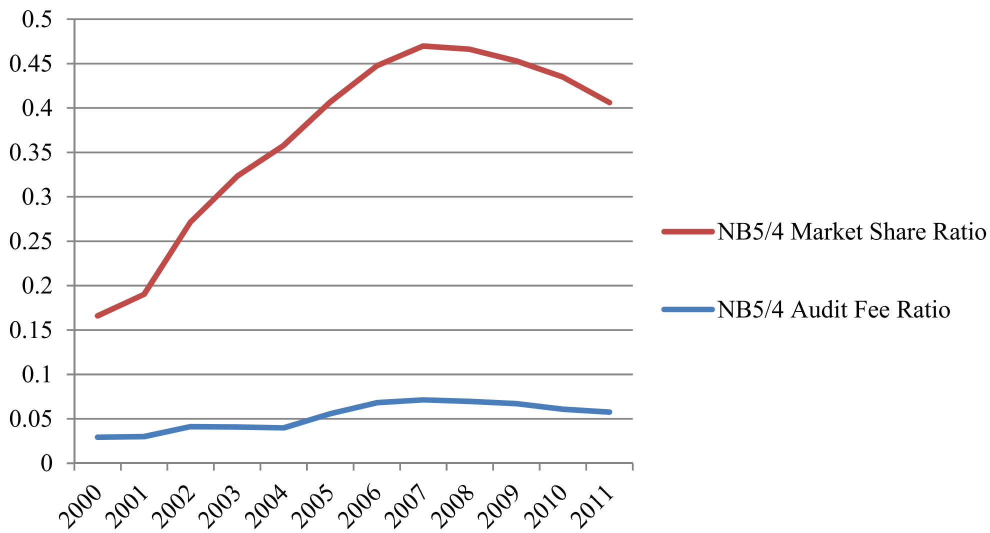
Figure 1

Trends in BIG-5/4Market Share Ratio and Fee Ratio

Panel A: BIG-5/4 Audit Fee Ratio and Market Share Ratio



Panel B: NB-5/4 Audit Fee Ratio and Market Share Ratio



Panel A plots BIG-5/4 Market Share Ratio and BIG-5/4 Fee Ratio from 2000-2011. BIG-5/4 Market Share Ratio is the number of firms audited by BIG-5/4divided by the total number of firms in the audit market. BIG-5/4 Fee ratio is audit fee from BIG-5/4's clients divided by the total audit fees in the audit market from 2000 to 2011. Panel B plots NB-5/4 Market Share Ratio ad Fee Share Ratio for the same time period.

Table 1

Sample Composition and Attrition

	Audit Fee Model	Switch Model
Firms year observations from Audit Analytics	**150,908**	
Less:	(6,701)	
One firm one year has more than one audit fee observation in a fiscal year		
No financial data	(55,723)	
No business segment	(26,703)	
Financial Industries have been deleted	(10,040)	
Final firm year observations	**51,732**	
Missing Compustat data		(14,714)
Final firm year observations		37,018
Firm year observations in 2001		(2,020)
Firm year observations after 2001		**34,998**
Firm year observations before 2002	(8,636)	(6,735)
Final firm year observations after 2002	43,096	28,263

We start with 150,908 firm year observations collected from Audit Analytics covering the period 2000-2011. Then we deleted 55,723 observations since financial data was not available on COMPUSTAT and 26,703 observations were deleted because business segments data was missing. Then we deleted 10,040 observations which belong to financial institutions. Our final sample consists 51, 732 firm year observations. 14,714 of these observations have been deleted for missing value in the audit switching model. Our final sample for the audit switching model consists of 34,998 observations. Our subsample has 2,020 observations in 2001, and 6,735 observations in 2002.

Table 2
Descriptive Statistics

Panel A: Univariate Statistics

Variable	Mean	Std	Q1	Median	Q3
LAF	12.98	1.58	11.86	13.02	13.07
NB-4 MARKET SHARE	14.58	4.89	11.83	16.5	16.8
AA MARKET SHARE	0.18	0.06	0.14	0.17	0.23
AA FEE SHARE	0.18	0.1	0.13	0.16	0.23
LTA	5.31	2.75	3.58	5.46	7.20
BIG-5/4	0.69	0.46	0.29	0.5	0.72
CR	3.52	20.71	1.14	1.88	3.24
CA_TA	0.50	0.27	0.25	0.6	0.78
ARINV	0.24	0.20	0.07	0.2	0.35
ROA	-0.79	15.87	-0.23	0.01	0.12
LOSS	0.41	0.50	0.00	0.00	1.00
FOREIGN	0.54	0.50	0.00	1.00	1.00
MERGER	0.15	0.35	0.00	0.00	1.00
BUSY	0.70	0.46	0.00	1.00	1.00
LEV	0.24	3.34	0.00	0.09	0.27
INTANG	0.15	0.20	0.00	0.07	0.24
SEG	1.29	0.00	0.00	0.00	1.10
GOING_CONCERN	0.02	0.67	0.81	0.92	1.91
MATERIAL_WEAKNESS	0.02	0.14	0.00	0.00	0.00
AUDITOR SWITCH	0.01	0.08	0.00	0.00	0.00
GROWTH	0.05	0.04	-0.09	0.04	0.21
ABSDACC	-8.96	13.27	-7.08	-9.95	-0.8
MODOP	0.003	0.06	0.00	0.00	0.00
TENURE	7.49	3.37	5.00	8.00	10.00
CASH	0.23	0.25	0.03	0.13	0.34
EXPERT	2.44	2.59	0.00	2.00	3.00
SIZE	2.50	11.23	0.35	2.12	3.50

Panel B: Correlation among Audit Fee, and Control Variables

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1)LAF	**-0.01**	**0.12**	**0.06**	**0.85**	**0.55**	**-0.08**	**-0.26**	**-0.03**	**0.01**	**-0.33**	**0.46**	**0.14**	**0.08**
(2)NB-4 MARKET SHARE		**0.32**	**-0.04**	**-0.02**	**-0.02**	**-0.04**	**0.01**	**0.09**	**0.00**	**0.03**	**-0.02**	**0.01**	**-0.01**
(3)AA MARKET SHARE			**0.79**	**0.23**	**0.09**	**-0.07**	**-0.38**	**-0.12**	**-0.01**	**-0.11**	**0.03**	**-0.02**	**0.11**
(4)AA FEE SHARE				**0.16**	**0.04**	**-0.04**	**-0.35**	**-0.15**	**-0.01**	**-0.12**	**-0.03**	**-0.02**	**0.11**
(5)LTA					**0.61**	**-0.06**	**-0.40**	**-0.09**	**0.03**	**-0.44**	**0.45**	**0.14**	**0.08**
(6)BIG-5/4						**-0.03**	**-0.16**	**-0.10**	**0.01**	**-0.24**	**0.29**	**0.09**	**0.08**
(7)CR							**0.11**	**-0.05**	0.00	**0.04**	**-0.04**	**-0.02**	**-0.02**
(8)CA_TA								**0.44**	**-0.01**	**0.16**	**-0.09**	**-0.11**	**-0.12**
(9)ARINV									**0.01**	**-0.12**	**0.08**	**-0.01**	**-0.17**
(10)ROA										**-0.01**	**0.01**	0.00	0.00
(11)LOSS											**-0.26**	**-0.08**	**0.03**
(12)FOREIGN												**0.11**	**0.01**
(13)MERGER													**0.02**
(14)BUSY													
(15)LEV													
(16)INTANG													
(17)SEG													
(18)GOING_CONCERN													
(19)MATERIAL_WEAKNESS													
(20)AUDITOR SWITCH													
(21)GROWTH													
(22)ABSDACC													
(23)MODOP													
(24)TENURE													
(25)CASH													
(26)EXPERT													
(27)SIZE													

Panel B (countd.): Correlation among Audit Fees, and Control variable

	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
(1)LAF	**-0.02**	**0.23**	**0.42**	**-0.18**	**-0.05**	**-0.03**	**0.01**	**-0.28**	0.00	**0.44**	**-0.24**	**0.35**	**0.35**
(2)NB-4 MARKET SHARE	0.00	**-0.03**	**0.00**	0.00	**0.01**	**0.01**	0.00	**0.03**	**0.00**	**0.01**	**-0.05**	**0.00**	**-0.01**
(3)AA MARKET SHARE	**0.01**	**-0.06**	**0.11**	**-0.03**	**-0.01**	**0.00**	0.00	**-0.11**	0.00	**0.04**	**-0.29**	**0.01**	**0.01**
(4)AA FEE SHARE	**0.01**	**-0.01**	**0.11**	**-0.02**	**-0.01**	**-0.01**	**0.00**	**-0.05**	**-0.01**	**0.03**	**-0.26**	**-0.02**	-0.03
(5)LTA	**-0.05**	**0.19**	**0.43**	**-0.23**	**-0.09**	**-0.02**	**0.01**	**-0.30**	**-0.01**	**0.44**	**-0.33**	**0.36**	**0.36**
(6)BIG-5/4	**-0.02**	**0.08**	**0.22**	**-0.17**	**-0.11**	**0.05**	**0.01**	**-0.11**	**-0.03**	**0.44**	**-0.07**	**0.62**	**0.15**
(7)CR	**-0.01**	**-0.05**	**-0.04**	**-0.01**	**-0.01**	**0.00**	0.00	**0.02**	**0.00**	**-0.01**	**0.16**	**-0.01**	**-0.02**
(8)CA_TA	**-0.01**	**-0.37**	**-0.20**	**0.03**	**0.02**	**0.01**	**-0.01**	**0.14**	0.00	**-0.12**	**0.68**	**-0.05**	**-0.11**
(9)ARINV	**-0.01**	**-0.13**	**0.07**	**-0.01**	**0.02**	**0.00**	0.00	**0.08**	**0.01**	**-0.05**	**-0.33**	**-0.07**	**-0.06**
(10)ROA	**-0.02**	**0.01**	**0.01**	**0.00**	0.00	0.00	0.00	**0.00**	0.00	**0.01**	**-0.01**	**0.01**	0.00
(11)LOSS	**0.02**	**-0.05**	**-0.26**	**0.14**	**0.07**	**0.02**	**0.00**	**0.04**	**0.02**	**-0.24**	**0.25**	**-0.12**	**-0.15**
(12)FOREIGN	**-0.02**	**0.11**	**0.27**	**-0.12**	**-0.03**	**-0.01**	**0.00**	**-0.11**	0.00	**0.20**	**-0.16**	**0.15**	**0.15**
(13)MERGER	0.00	**0.27**	**0.09**	**-0.02**	**-0.01**	**0.01**	**0.01**	**-0.03**	**-0.01**	**0.05**	**-0.10**	**0.06**	**0.04**
(14)BUSY	0.00	**0.03**	**0.01**	0.00	0.00	0.00	**0.00**	**-0.03**	**0.00**	**0.05**	**0.01**	**0.06**	**0.01**
(15)LEV		**0.00**	**-0.01**	**0.05**	**0.02**	**0.00**	0.00	0.00	0.00	**-0.01**	**-0.01**	**-0.01**	**0.00**
(16)INTANG			**0.13**	**-0.02**	**0.00**	0.00	**0.01**	**-0.04**	**0.01**	**0.06**	**-0.28**	**0.06**	**0.08**
(17)SEG				**-0.09**	**-0.03**	0.00	**0.01**	**-0.15**	**0.00**	**0.24**	**-0.26**	**0.11**	**0.18**
(18)GOING_CONCERN					**0.27**	**0.02**	0.00	**0.02**	**-0.01**	**-0.17**	**0.02**	**-0.11**	**-0.03**
(19)MATERIAL_WEAKNESS						**0.08**	0.00	**0.02**	**0.24**	**-0.15**	0.00	**-0.07**	**-0.03**
(20)AUDITOR SWITCH							0.00	**0.00**	**0.00**	**-0.08**	**0.01**	**0.04**	**-0.01**
(21)GROWTH								**-0.01**	0.00	0.00	**0.00**	0.00	**0.01**
(22)ABSDACC									**0.01**	**-0.08**	**0.09**	**-0.06**	**-0.46**
(23)MODOP										**-0.06**	**-0.01**	**-0.02**	**-0.01**
(24)TENURE											**-0.07**	**0.35**	**0.17**
(25)CASH												**0.03**	**-0.07**
(26)EXPERT													**0.09**
(27)SIZE													

Table 2 Panel A shows the descriptive statistics of audit fee, test variable and other control variables. Panel B shows the correlation among these variables. Bold indicates statistical significance at 10% level or higher.

TABLE 3

SOX Effect in Industries

Panel A: Specific Industry Audit Fees Shares for NB-5/4 (2000-2011)

Year	Agri	Mining	Food	Textile	Chem	Pharm	Extrac	Durabl	Transp	Utility	Retail	Service	Compu	Total
2000	0.00	6.37	1.73	5.93	1.04	3.03	1.01	2.65	2.82	0.89	4.60	3.28	3.28	0.00
2001	1.45	1.48	2.13	5.04	2.74	3.71	1.73	2.92	2.34	0.82	3.48	4.37	2.36	1.45
2002	1.27	3.90	1.78	4.31	2.19	5.39	9.02	3.89	4.81	0.52	5.83	4.79	3.39	1.27
2003	2.21	3.32	2.33	4.05	1.86	7.41	9.71	3.77	2.44	0.92	5.91	5.86	3.76	2.21
2004	1.57	6.39	2.05	3.90	1.55	9.28	3.55	3.58	1.75	1.32	7.04	4.31	4.89	1.57
2005	1.20	5.87	1.68	3.35	3.48	11.33	4.83	5.49	3.51	3.16	6.41	7.08	6.94	1.20
2006	3.25	6.13	3.32	4.34	4.05	9.75	7.51	6.87	3.99	3.70	8.07	9.68	8.98	3.25
2007	4.18	7.55	3.95	4.94	5.14	9.84	9.04	6.82	4.23	3.53	9.20	10.38	8.77	4.18
2008	11.95	7.18	5.19	4.28	4.24	9.47	7.14	6.82	3.89	3.82	9.37	10.46	8.99	11.95
2009	10.57	8.47	5.02	5.43	3.67	8.92	7.33	6.56	3.99	3.48	7.75	9.59	8.57	10.57
2010	7.33	8.34	4.58	5.24	3.53	8.44	5.95	6.05	3.94	2.88	7.32	8.88	7.30	7.33
2011	6.52	7.03	4.58	6.11	3.62	5.84	6.29	5.52	3.80	2.88	8.10	7.99	7.14	6.52

TABLE 3-Continued

Panel B: Specific Industry Number of Firms Shares for NB-5/4 (2000-2011)

Year	Agri	Mining	Food	Textile	Chem	Pharm	Extrac	Durabl	Transp	Utility	Retail	Service	Compu
2000	0.00	25.93	25.81	15.58	13.21	13.53	12.64	12.86	6.45	6.74	15.67	15.38	12.98
2001	7.69	17.78	22.95	14.17	20.51	16.80	22.88	16.50	9.49	8.47	13.50	19.01	11.83
2002	23.81	30.93	24.44	14.38	24.79	23.73	34.50	24.09	14.07	9.18	18.09	26.91	21.06
2003	28.57	40.31	30.00	17.65	28.06	28.53	43.90	30.01	17.87	11.26	21.58	30.96	25.52
2004	28.57	46.58	31.31	19.89	31.03	32.37	46.64	33.82	20.40	14.35	24.01	33.80	30.35
2005	19.05	49.39	33.03	20.00	33.33	35.11	47.39	37.26	22.53	16.88	27.49	38.63	35.33
2006	31.82	45.30	34.86	22.16	36.54	36.78	50.92	40.94	25.25	18.26	31.45	39.83	39.31
2007	42.86	50.54	39.09	26.92	41.18	38.19	50.92	43.62	26.56	19.51	33.12	41.99	39.17
2008	57.14	50.84	43.27	26.54	43.26	38.21	46.79	45.98	23.50	21.23	32.77	40.05	38.12
2009	48.00	51.46	40.38	27.16	41.18	41.87	43.90	44.89	25.43	19.05	29.87	40.09	35.78
2010	46.15	53.00	44.76	25.32	38.28	41.79	42.26	43.63	24.71	17.48	27.64	39.35	34.64
2011	50.00	49.38	40.22	25.53	36.84	38.07	39.66	40.62	19.87	14.21	25.61	36.34	34.65

Panel C: Growth of Number of Firms Shares BIG-5/4 Clients (2000-2011)

Year	Market Shares Change				
	Ernst & Young LLP	Deloitte & Touche LLP	PricewaterhouseCoopers LLP	KPMG LLP	Arthur Andersen LLP
2001-2003	163.11	184.54	157.07	184.47	-100.00
2003-2007	102.46	102.09	84.85	91.43	0.00
2011-2007	85.01	85.23	86.44	86.75	0.00

TABLE 3-Continued

Panel D: Audit Fee Percentage audited by Second Tier Auditors (2000-2011)

Year	Agri	Mining	Food	Textile	Chem	Pharm	Extrac	Durabl	Transp	Utility	Retail	Service	Compu
2000	0.00	3.97	1.12	4.15	0.68	1.75	0.61	1.65	1.31	0.58	2.55	1.51	1.80
2001	0.00	0.50	1.70	3.61	0.47	2.25	0.52	1.64	1.61	0.52	2.09	1.97	1.18
2002	0.12	0.54	1.07	2.96	0.20	2.18	0.53	2.06	2.95	0.28	3.27	1.73	1.44
2003	0.18	0.61	0.98	2.81	0.15	3.39	0.93	1.71	1.70	0.45	3.69	2.46	1.68
2004	0.00	4.21	0.80	3.05	0.15	4.66	1.64	2.04	0.94	0.97	4.77	2.24	2.50
2005	0.00	3.46	0.50	1.85	1.46	6.04	2.25	2.86	2.00	2.53	4.36	3.26	3.97
2006	0.00	3.02	1.06	2.82	2.11	5.72	4.53	3.56	2.35	2.80	5.41	4.20	5.15
2007	0.00	3.73	1.53	3.38	2.21	5.28	4.65	3.94	2.26	2.60	5.68	6.16	5.32
2008	3.90	3.52	2.50	2.95	0.54	4.79	3.99	3.82	2.00	2.59	5.87	6.58	4.65
2009	3.66	4.71	2.12	3.94	0.66	4.60	3.93	3.59	2.08	2.24	5.07	5.55	4.47
2010	2.64	2.79	1.17	2.73	0.53	2.33	2.44	2.65	1.53	1.62	3.29	2.89	2.64
2011	2.59	2.27	1.48	2.53	0.44	1.24	2.96	2.53	1.56	1.84	2.42	2.18	2.29

TABLE 3-Continued

Panel E: Percentage of firms audited by Second Tier Auditors (2000-2011)

Year	Agri	Mining	Food	Textile	Chem	Pharm	Extrac	Durabl	Transp	Utility	Retail	Service	Compu
2000	0.00	7.41	12.90	6.49	5.66	6.47	6.90	6.90	0.81	4.49	6.72	5.49	5.34
2001	0.00	2.22	14.75	5.51	3.85	6.97	5.93	6.80	3.80	5.08	6.11	6.34	4.93
2002	4.76	3.09	8.89	4.38	2.48	8.54	5.85	8.00	4.07	2.90	6.72	6.23	5.45
2003	4.76	2.33	8.00	4.71	2.16	9.60	6.34	9.27	4.08	3.90	7.91	6.63	6.94
2004	0.00	4.11	7.07	4.97	1.38	9.42	8.52	10.05	4.82	4.78	8.39	7.28	8.96
2005	0.00	4.27	5.50	4.74	4.00	8.89	8.84	10.30	6.08	5.19	9.74	9.71	9.98
2006	0.00	3.87	5.50	6.70	5.13	9.50	9.89	10.82	6.19	5.02	10.90	10.27	11.56
2007	0.00	4.35	5.45	9.89	3.92	9.28	9.89	12.04	6.25	5.37	10.11	12.19	11.29
2008	9.52	4.47	6.73	8.64	2.84	9.20	10.19	12.55	5.74	5.19	11.08	13.51	11.14
2009	8.00	6.43	5.77	10.49	3.68	10.05	10.98	11.62	6.29	4.29	9.37	12.59	10.68
2010	7.69	4.00	4.76	7.14	3.13	6.52	6.79	9.02	4.07	2.91	7.04	7.52	7.32
2011	7.69	4.32	5.43	7.80	2.63	5.68	7.76	9.95	3.97	3.68	5.39	6.76	7.20

TABLE 3-continued

Panel F: Total audit fee table for different industries for BIG-5/4 (2000-2011)

Year	Agri	Mining	Food	Textile	Chem	Pharm	Extrac	Durabl	Transp	Utility	Retail	Service	Compu
2000	4,489,000	5,188,605	28,327,147	54,613,767	47,706,490	50,986,620	62,971,233	212,759,956	69,591,055	65,182,115	42,363,690	71,214,547	91,294,671
2001	6,702,886	17,409,901	51,452,004	75,037,095	84,948,778	85,736,615	73,334,586	373,367,310	100,081,944	100,671,491	122,118,431	99,199,385	220,853,774
2002	16,913,267	34,790,136	84,343,876	128,509,167	167,016,826	158,158,338	130,926,946	601,865,909	316,294,284	232,688,674	153,453,638	156,993,580	324,913,352
2003	12,756,418	50,638,380	104,252,681	165,976,071	218,493,450	183,253,263	168,401,567	879,445,839	401,179,144	278,025,180	195,153,909	201,769,517	445,018,135
2004	25,848,954	89,677,840	136,287,636	257,105,978	335,034,201	288,781,052	323,778,231	1,465,735,851	612,845,372	458,146,783	292,745,671	442,490,111	708,472,222
2005	29,610,815	112,457,738	213,534,169	309,972,073	358,046,941	351,000,205	384,162,849	1,719,456,092	699,531,230	456,478,147	477,291,134	547,245,077	938,138,942
2006	35,739,218	149,428,569	208,214,695	373,395,466	433,066,440	406,700,952	466,039,877	1,911,116,134	801,449,741	432,282,058	525,736,552	537,949,499	1,118,682,426
2007	35,476,170	194,513,936	195,201,801	321,442,092	323,749,042	420,651,011	461,086,800	1,919,911,262	763,443,678	419,210,122	516,171,058	498,597,970	1,189,518,764
2008	23,423,780	215,011,703	184,604,418	319,143,421	309,970,135	407,295,929	478,802,955	1,866,496,865	745,589,887	444,419,391	481,841,667	483,627,160	1,212,841,814
2009	27,163,039	191,866,525	189,240,229	280,417,687	280,668,018	382,224,344	441,332,908	1,746,561,025	672,681,041	414,015,391	476,429,842	455,208,889	1,069,287,024
2010	35,436,198	184,598,898	182,619,072	274,253,269	272,122,081	413,761,995	470,462,088	1,675,586,959	647,124,436	396,891,117	474,163,015	449,171,519	1,094,718,111
2011	34,279,904	183,974,237	171,394,021	247,289,024	252,725,227	408,773,028	460,768,178	1,681,624,963	637,196,806	395,481,490	438,406,263	432,335,465	1,063,084,238

Panel G: The number of firms in the audit market by different industries for BIG-5/4 (2000-2011)

Year	Agri	Mining	Food	Textile	Chem	Pharm	Extrac	Durabl	Transp	Utility	Retail	Service	Compu
2000	6	20	23	65	46	147	76	366	116	83	113	154	228
2001	12	37	47	109	62	203	91	602	143	108	269	230	447
2002	16	67	68	137	91	241	112	712	232	188	317	258	536
2003	15	77	70	140	100	268	115	702	262	205	327	281	569
2004	15	78	68	145	100	280	119	724	281	197	326	282	560
2005	17	83	73	152	100	292	131	719	306	192	335	278	551
2006	15	99	71	151	99	306	134	688	302	179	327	287	562
2007	12	91	67	133	90	293	134	623	282	165	311	257	528
2008	9	88	59	119	80	262	141	551	280	167	279	253	500
2009	13	83	62	118	80	243	138	555	261	170	277	257	499
2010	14	94	58	115	79	241	153	544	259	170	288	242	500
2011	13	82	55	105	72	218	140	519	242	163	276	226	445

Panel A&B describes the market shares (the ratio of the NB-5/4 market share divided by the total market share) and fee shares (the ratio of fee share divided by the total audit fee) by each industry from the 2000 to 2011(in percentage), which we define as SOX effect. Panel C indicates the declines of market share for surviving BIG-4 firms. Panel D&E shows the market share and fee share for second tier audit firms (in percentage). Panel F&G shows the whole market audit fees and number of clients for BIG-5/4.

Table 4

Determinants of Fee Premium Metrics(2000-2011)

Dependent Variable: LAF	Exp	Full Sample 2000-2011 (A)	2003-2011 (B)	Sub Sample 2000-2002 (C)	2003-2011 (D)
Test Variables					
BIG-5/4	+			**0.07****	**0.40*****
				(2.25)	**(20.82)**
BIG-4*AGRICULTURE	?		0.26**		
			(1.98)		
BIG4*MININGANDCONSTRUCTIO N	?		0.11*		
			(1.89)		
BIG-4*FOOD	?		0.33***		
			(4.93)		
BIG-4*TEXTILE	?		0.36***		
			(7.90)		
BIG-4*CHEMICALS	?		0.59***		
			(10.95)		
BIG-4*PHARMA	?		0.32***		
			(10.21)		
BIG-4*EXTRACTIVE	?		0.33***		
			(6.99)		
BIG-4*DURABLE	?		0.46***		
			(17.81)		
BIG-4*TRANSPORTATION	?		0.21***		
			(5.34)		
BIG-4*UNILITIES	?		0.05		
			(1.10)		
BIG-4*RETAIL	?		0.20***		
			(5.93)		
BIG-4*SERVICES	?		0.40***		
			(12.01)		
BIG-4*COMPUTER	?		0.43***		
			(15.37)		
Control Variables					
LTA	+	0.48***	0.45***	0.43***	0.45***
		(116.89)	(90.82)	(60.69)	(90.54)
CR	+	-0.00***	-0.00***	-0.01***	-0.00***
		(-3.13)	(-3.18)	(-2.71)	(-3.36)
CA_TA	+	0.61***	0.64***	0.19***	0.54***
		(16.15)	(17.14)	(2.78)	(13.86)
ARINV	+	-0.05	0.02	0.39***	0.07*
		(-1.24)	(0.43)	(5.68)	(1.70)
ROA	+	-0.00***	-0.00***	-0.00***	-0.00***
		(-3.47)	(-3.50)	(-2.32)	(-3.66)
LOSS	+	0.20***	0.22***	0.26***	0.23***
		(16.60)	(17.64)	(13.56)	(18.44)
FOREIGN	+	0.23***	0.20***	0.20***	0.20***
		(16.06)	(13.16)	(9.14)	(13.44)
MERGER	?	-0.03**	-0.00	-0.01	-0.00
		(-2.08)	(-0.35)	(-0.54)	(-0.02)

BUSY	+	0.08***	0.09***	0.12***	0.08***
		(5.45)	(5.61)	(5.86)	(5.31)
LEV	+	0.01***	0.01***	0.00	0.01***
		(3.48)	(3.98)	(-0.96)	(4.18)
INTANG	+	0.66***	0.69***	0.40***	0.61***
		(16.65)	(17.70)	(6.21)	(14.89)
SEG	+	0.15***	0.15***	0.12***	0.16***
		(12.53)	(12.39)	(7.93)	(12.95)
GOING_CONCERN	+	0.11***	0.08**	0.25***	0.07**
		(3.34)	(2.17)	(3.74)	(2.12)
MATERIAL_WEAKNESS	+	0.12***	0.08**	1.00*	0.09***
		(3.80)	(2.53)	(1.78)	(2.76)
INTERCEPT		9.57***	9.58***	9.51***	9.60***
		(193.40)	(262.82)	(132.61)	(190.41)
INDUSTRY DUMMY		YES	NO	YES	YES
N		51732	43096	8636	43096
Adjusted R^2 (%)		75.25	78.54	72.64	78.81
F Test: Column (C) equals Column (D) (p-value)				4.89(<0.01)	
F Test: Industry Dummy equals (p-value)				5.43(<0.01)	

This table shows the results of audit fee model in different samples. Sample A is from 2000 to 2011. We get the similar results as Blankley et al. (2012). We add BIG-4*Industry in Sample B, we would like to show that after SOX, BIG-4 auditors charge a higher premium over some industries, while charge a lower premium over some other industries. We add Big-4 dummy in Sample C&D. We would like to show that after SOX, Big-4 auditors charge a higher premium. Our results prove the hypothesis. F test shows that the coefficient of BIG-5/4 is significantly different before and after SOX at 10% level. ***, **, * Indicate statistical significance at 1%, 5% and 10% level, respectively.

Table 5: Spearman Rank Order Test

Panel A: Fee Premium Rank Table

Industry	Rank Fee Premium I	Rank Fee Premium II	Rank Fee Premium III
Agriculture	11	7	9
Chemicals	1	5	1
Computers	3	11	3
Durable manufactures	4	4	2
Extractive	5	1	7
Food	8	13	6
Mining and Construction	12	12	12
Pharmaceuticals	7	3	8
Retail	10	9	11
Services	2	2	4
Textiles and Printing/Publishing	6	10	5
Transportation	9	6	10
Utilities	13	8	13

Panel B: Independent Variable Rank Table

Industry	Rank					
	Fee/Market	Market Share	Fee Share	AA Switch Share	AA Market Share	AA Fee Share
Agriculture	11	1	2	12	1	1
Chemicals	8	9	13	8	10	12
Computers	6	4	3	2	11	11
Durable manufactures	9	3	7	3	9	9
Extractive	2	8	5	6	2	6
Food	5	7	8	1	13	13
Mining and Construction	3	2	1	7	6	7
Pharmaceuticals	12	5	9	5	12	10
Retail	4	10	4	9	7	8
Services	7	6	6	4	5	3
Textiles and Printing/Publishing	13	11	12	11	8	5
Transportation	10	12	11	10	4	4
Utilities	1	13	10	13	3	2

Table 5 - Continued

Panel C: Spearman Rank-Order Correlation

	Fee Premium I				Fee Premium II	Fee Premium III
	With Agriculture*		Without Agriculture**		With Agriculture*	With Agriculture*
	Coeff.	4AT***	Coeff.	4AT	Coeff.	Coeff.
Fee/Market	**-0.374**	**-0.221**	**-0.73**	**-0.302**	**-0.220**	**-0.374**
Market Share	**-0.786**	**-0.204**	**-0.755**	**-0.411**	-0.016	**0.214**
Fee Share	**-0.626**	**-0.310**	**-0.588**	**-0.312**	**-0.192**	**-0.264**
Arthur Andersen Switch Share I	**-0.231**		**-0.434**		**-0.231**	0.011
Arthur Andersen Switch Share II	-0.071		-0.022		-0.071	**0.621**
Arthur Andersen Market Share	-0.126		0.035		-0.126	**0.313**
Arthur Andersen Fee Share	-0.159		0.007		-0.159	**0.242**

Panel A shows three measures of Fee Premium. Fee Premium I is ranking based on the median of the Industry residual in Table 4 Column D; Fee Premium II is ranking based on the change in the coefficient of BIG-4*INDUSTRY before 2002 and after 2002 in equation (2); Fee Premium III is ranking based on the magnitude of the coefficient of BIG-4*INDUSTRY after 2002 in table 4 Column (B).

Panel B presents three measures of SOX effect and AA effect. Fee/Market is ranking based on the difference of NB-4 Audit Fee divided by Market Share in 2001 and with the same ratio in 2011. Market Share is ranking based on the increase in NB-4 market share between 2001 and 2011; Fee Share is ranking based on the increase in NB-4 fee share between 2001 and 2001. Arthur Andersen Switch Share I is ranking based on prior AA clients in the industry switching to NB-4 as a proportion of AA clients in the industry in 2003. Arthur Andersen Switch Share II is ranking based on prior AA switching to NB-4 clients as a proportion of total clients switching from BIG-4 to NB-4 in 2003; Arthur Andersen Market Share is ranking based on Arthur Anderson's market share in 2001; Arthur Andersen Fee Share is ranking based on Arthur Anderson's fee share in 2001;

Panel C presents the Spearman rank test results, which is used in this table to indicate the relationship between Fee premium, SOX effect, and Arthur Andersen collapse effect.

*means including agriculture industry; ** means excluding the agriculture industry because it consisted of only seven firms; ***4AT is the first four asset quintiles. Bold indicates statistical significance at 10% level or higher.

TABLE 6

Auditor Switch Model

Panel A: Audit Switching Model

	Full Sample	Sub Sample		
	2001-2011	2001-2002	2003-2011	
	(A)	(B)	(C)	(D)
Test Variables				
ABAFEE	0.01	0.30**	-0.18***	-0.19***
	(0.1)	(2.32)	(-2.94)	(-2.77)
NB-4 MARKET SHARE in 2001	-0.16**	-0.03	-0.22***	-0.23***
	(-2.36)	(-0.13)	(-2.86)	(-2.83)
AA MARKET SHARE in 2001	-0.43	-2.90*	0.31	
	(-0.87)	(-1.71)	(0.54)	
ABAFEE*AAMARKET2001	-0.05	0.33	-0.15	
	(-0.42)	(1.01)	(-1.26)	
AA FEE SHARE in 2001				0.28
				(0.74)
ABAFEE*AAFEE2001				-0.14
				(-1.25)
Control Variables				
GROWTH	-0.00	-0.00	-0.00	-0.00
	(-0.91)	(-0.51)	(-0.96)	(-0.88)
ABSDACC	0.00**	-0.00***	0.00***	0.00***
	(2.37)	(-3.78)	(2.85)	(2.85)
ARINV	0.36**	-1.37***	0.57***	0.56***
	(2.37)	(-3.00)	(3.27)	(3.14)
GOING_CONCERN	0.47***	-0.43	0.51***	0.49**
	(2.71)	(-0.87)	(2.6)	(2.38)
MODOP	0.98***	0.00	0.81**	0.80**
	(2.83)	(0.00)	(2.29)	(2.27)
TENURE	-0.40***	-1.21***	-0.44***	-0.44***
	(-29.26)	(-4.25)	(-28.77)	(-28.06)
ROA	-0.00	-0.00	-0.00	-0.00
	(-0.97)	(-1.22)	(-0.99)	(-1.16)
LOSS	-0.04	0.18	-0.01	0.00
	(-0.52)	(0.72)	(-0.09)	(-0.05)
LEVERAGE	-0.01	-0.19*	0.00	0.00
	(-0.78)	(-1.88)	(-0.87)	(-0.88)
CASH	-0.36***	-0.94**	-0.34**	-0.34**
	(-2.74)	(-2.31)	(-2.32)	(-2.24)
MISMATCH*BIG-5/4	1.89***	2.84***	1.89***	1.85***
	(21.96)	(7.93)	(20.31)	(19.55)
EXPERT	0.14***	0.06	0.14***	0.14***
	(11.66)	(1.54)	(10.45)	(10.21)
SIZE	-0.16***	-0.39***	-0.15***	-0.15***
	(-10.34)	(-5.44)	(-7.87)	(-7.93)
MERGER	-0.14	-0.40	-0.08	-0.12
	(-1.25)	(-1.14)	(-0.64)	(-0.93)
INTERCEPT	-1.79***	0.16	-1.60***	-1.54***
	(-11.46)	(0.23)	(-9.29)	(-9.18)
N	34998	6735	28263	27367
Pseudo R^2 (%)	27.75	45.14	29.76	29.52
F Test: Column(B)≠Column(C) (p-value)		5.67(0.01)		

Panel B: Auditor Switch Model by 5 Asset Quintiles

Switch Model 2003-2011	AT 1	AT 2	AT 3	AT 4	AT 5
Test Variables					
LAG RESIDUAL	-0.09	-0.20**	-0.18*	-0.49***	-1.15
	(-0.79)	(-2.24)	(-1.81)	(-3.38)	(-1.45)
NB-4 MARKET SHARE	0.04	-0.46***	-0.34**	0.05	1.78
	(0.24)	(-3.24)	(-2.26)	(0.22)	(1.29)
LAG MISMATCH	0.00	4.20***	0.32*	-0.17	6.49
	(0.00)	(10.83)	(1.86)	(-0.37)	(0.03)
Control Variables					
STAND BY CONTROL VARIABLES ARE INCLUDED	Yes	Yes	Yes	Yes	Yes
INTERCEPT	1.13***	-2.86***	-0.95***	-2.10***	-4.18
	(2.97)	(-6.50)	(-2.77)	(-3.70)	(-2.82)
N	2706	5372	6617	7158	6410
Pseudo R^2 (%)	23.20	29.58	18.00	21.09	31.66

Panel C: Auditor Switch Model by Year Trends

Switch Model 2003-2011	2003-2006	2003-2007	2003-2008	2003-2009	2003-2010	2003-2011
Test Variables						
LAG RESIDUAL	-0.16***	-0.18***	-0.16***	-0.19***	-0.20***	-0.22***
	(-2.65)	(-3.24)	(-2.97)	(-3.62)	(-3.94)	(-3.99)
NB-4 MARKET SHARE	-0.14	-0.18**	-0.19**	-0.23**	-0.21***	-0.21***
	(-1.48)	(-2.16)	(-2.33)	(-2.87)	(-2.75)	(-2.74)
LAG MISMATCH	1.78***	1.77***	1.81***	1.85***	1.88***	1.89***
	(15.93)	(17.56)	(18.46)	(19.51)	(20.15)	(20.30)
Control Variables						
STAND BY CONTROL VARIABLES ARE INCLUDED	Yes	Yes	Yes	Yes	Yes	Yes
INTERCEPT	-1.29***	-1.27***	-1.30***	-1.38***	-1.49***	-1.54***
	(-7.12)	(-7.66)	(-8.30)	(-9.19)	(-10.08)	(-10.72)
N	13219	16507	19617	22637	25557	28263
Pseudo R^2 (%)	34.99	33.31	32.04	31.16	30.38	29.73

This table shows the results of auditor choice model over the years 2001-2011 (we omit 2000 because the model uses lagged fees). Panel A Sample A covers the period 2001 to 2011 whereas Samples C & D shows the clients switching behavior across 2003-2011. Sample B considers the period 2001-2002 to examine whether switching behavior changed after SOX. ABAFEE is the residual from Table 4 Column A in the year *before* they switch. The Mismatch variable is based on Landsman et al. (2012) in Appendix A. As we only consider BIG-4, we use Mismatch*BIG-5/4 in our regressions (i.e., to see if mismatched clients with the BIG-5/4 were more likely to switch to NB-5/4). Our sample exhibits properties similar to the previous study (see Appendix). Our results show that clients are *less* likely to switch if they are paying a *higher* premium (in the post-SOX period) and *less* likely to switch in the years *2003-2011* in industries where NB-4 had a large market share *in 2001*. Panel B shows the audit switch behavior broken out for 5 assets quintiles. The results show that NB-4 2001 market share decreases the probability of switching in the low size quintiles. Panel C shows the same results across different time period. F test shows that the difference of abnormal fees on audit switching model before and after SOX is significant at 1% level. ***, **, *, indicate statistical significance at 1%, 5% and 10% level, respectively.

APPENDIX A

ESTIMATION OF CLIENT MISALIGNMENT

We follow the methodology in Shu (2000) to indicate the probability a firm is misaligned with its current auditor. Specifically, we estimate the following model separately for each year in the sample period, using all available observations from Compustat:

$$BigN_t = \alpha + \alpha_1 Size_t + \alpha_2 Acquisition_t + \alpha_3 ExFinance_t + \alpha_4 \Pr ofitability_t + \alpha_5 MktBk + \varepsilon_t \quad (A1)$$

Where,

BigN=1 if the company had a Big N auditor, and 0 otherwise 1[14];

TABLE A1
Estimation of Client Misalignment

Panel A: Coefficient Estimate Summary Statistics from Annual Estimations of the Client Misalignment Model

Variable	Mean	Standard Error	P-Value
INTERCEPT	-2.18	0.0270	<.0001
SIZE	0.58	0.005	<.0001
ACQUISITION	-0.03	0.11	0.77
EXFINANCE	-0.02	0.02	0.19
PROFITABILITY	-0.00007	0.0007	0.92
MKTBK	-0.00006	0.00004	0.15

Panel B: Estimated Cut-Off Probabilites

Year	N	Estimated Cut-Off Probability
2000	4,717	0.64
2001	6,495	0.63
2002	8,069	0.63
2003	8,517	0.64
2004	8,434	0.64
2005	8,329	0.64
2006	8,164	0.64
2007	7,824	0.73
2008	7,350	0.74
2009	7,199	0.72
2010	7,049	0.73
2011	6,335	0.73

The coefficient estimates from this regression are utilized to estimate the probability of having a Big N auditor in a certain year. The point at which the BIG-N and NB-N auditor distributions cross is an estimate of the optimal cut-off level. If the probability of having a BIG-N auditor falls below the cut-off point, the client is expected to have an NB-N auditor. So if the client has a BIG-N auditor, then we define MISMATCH equals to 1. We choose different cut-off levels until we get the best cut-off level which will minimize the MISMATCH. Our results before 2005 is different from Shu (2000) and Landsman (2009), we think the difference comes from the limitation about the data.

[14] Shu (2000) defines the dependent variable to include all "large "auditors, defined as Big-N auditors and any auditor identified by an individual auditor code on Compustat, Because our analysis is to find the probability that if the client is misaligned with a Big-N auditor. So we follow Landsman et al (2009), utilize the Big-N auditor as the dependent variable.

APPENDIX B: A Model of Demand and Supply for Audit Services

We combine a consumer choice model with a litigation driven model to arrive at demand and supply curves for audit services in a competitive market. Recall that these curves are written in terms of proportion of market share held at a particular premium by a BIG-4 auditor. The demand curve is based on a client-side trade-off of the extra fee charged and the extra value generated by the BIG-4 auditor relative to the NB-4 auditor. The supply curve is based on the need of the BIG-4 auditor to charge enough to compensate for the risk of the firm relative to the NB-4 auditor. Therefore, our models are formulated in terms of the differences in fees, extra market value and financial risk across BIG-4 and NB-4 auditors.[15]

B1. The Audit Demand Curve

A client firm has certain observable characteristics, X, and an unobservable private value for a BIG-4 audit denoted by the random variable $\tilde{\varepsilon}$. This is the equivalent of heterogeneous tastes in the classic paper of Hotelling (1929). The client-firm will choose the BIG-4 auditor provided that the premium π charged by the BIG-4 auditor is less than the additional value provided by the BIG-4 auditor, that is if $\pi \leq V(X) + \varepsilon$ where $V(X)$ denotes the value of a BIG-4 audit based on the observable characteristics, X. Let $F(\text{ò})$ denote the cumulative distribution function of $\tilde{\varepsilon}$.[16] Then the probability of a client-firm with characteristics X having a big auditor is:

$$\text{Prob}\{\pi - V(X) \leq \text{ò}\} = 1 - F(\pi - V(X)) \tag{B1}$$

Assuming that the empirically observed market share is close to this true probability,[17] the market share of the BIG-4 auditor across clients of characteristics X at a premium π is given by the right-hand-side of (B1). The aggregate market share is given by averaging across all client-firms.

Given this formulation, we consider changes in the demand curve resulting from shifts in the distribution function $F(\text{ò})$. In particular, consider a change to a new distribution function $F_{new}(\text{ò})$ where:

$$F(\text{ò}) \text{ first-degree stochastically dominates } F_{new}(\text{ò}). \tag{B2}$$

[15] Such a profit function can also be written in terms of fees but this simply introduces additional terms related to audit cost. Intuitively, we assume that the NB-4 sets a certain fee structure based on audit costs and "normal profit" whereas the BIG-4 auditor charges an "excess BIG-4 premium" that recaptures some of the market benefits obtained by going to such an auditor.

[16] Making the private value conditional on X does not lead to any qualitative differences in the analysis.

[17] This is a law of large numbers argument. If there are many firms with observed characteristics X, then the empirically observed market share of BIG-4 auditors will approximate the true underlying probability for each value of X.

In other words, consider a reduction (in a distributional sense) of the private value for BIG-4 audit service. By the definition of first-degree stochastic dominance,

$$F_{new}\left(\pi - V(X)\right) \quad \geq \quad F\left(\pi - V(X)\right) \text{ for every } \pi \text{ and } X$$

showing from (Figure BI) that the market-share for the BIG-4 auditor falls for every client characteristic and every choice of premium. Therefore, the market share shifts downward in the premium as illustrated in Figure B1, Panel A.

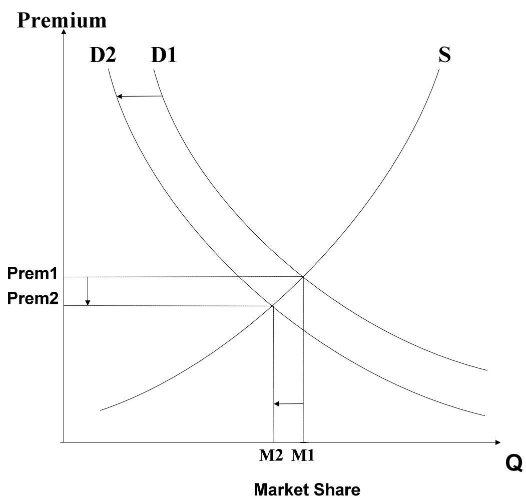
B2. The Audit Supply Curve

The focus of our analysis is to examine whether the changes in audit market shares result from a downward shift in the demand curve as described in the previous paragraph or due to a deliberate policy by BIG-4 firms to limit services to risky clients. In order to capture this tension, we introduce the excess expected litigation cost for a firm of characteristics X to a BIG-4 auditor which is denoted by $L(X)$. The BIG-4 auditor will accept a client-firm of characteristics X.provided that the excess fee offsets the excess litigation risk, that is if $\pi \geq L(X)$. (Simunic and Stein 1996b). The advent of SOX is supposed to have increased the financial risk of certain client firms so as to make them unattractive for the BIG-4 audit firms. In order to capture this notion, we consider a new expected litigation risk function denoted by $L_{new}(X)$ where $L_{new}(X) > L(X)$ for every client-firm characteristics X. Under such circumstances, the supply curve will shift upwards after the enactment of SOX as described in Figure B1 Panel B.

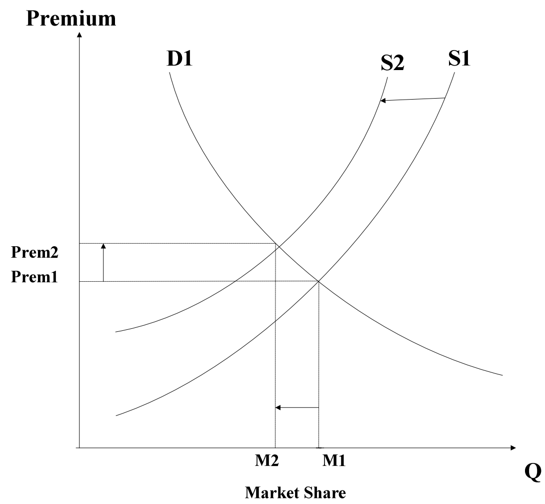
Figure B1

Economic Equilibrium for fee premium and market-share for BIG-4 firms

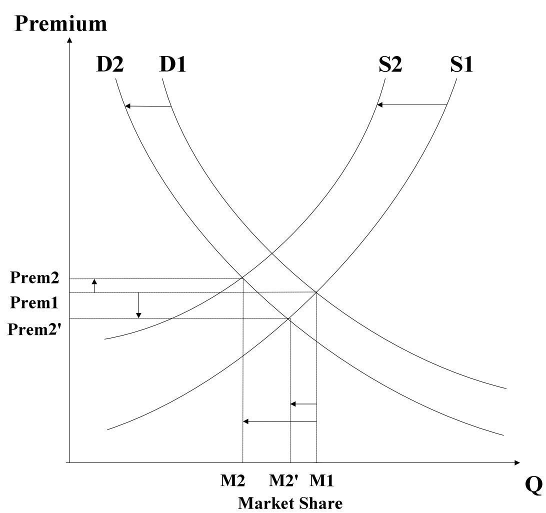
Panel A: Only Demand Curve for BIG-4 Shifts down



Panel B: Only Supply Curve for BIG-4 Shifts up



Panel C: Supply Curve shifts down and Demand Curve Shifts down



This figure shows the effects of demand and supply curve shifts in the BIG-4 premium. Panel A shows the effects of the demand curve shifting down. Panel B shows the effects of the supply curve shifting up while the demand stays constant. Panel C shows that the pattern we observe is consistent with both curves shifting, that is, the changes in market share and premium being inversely correlated (compare Premium 1 with Premium 2).

TABLE B1 SUPPLY AND DEMAND FUNCTION

Panel A: Reasons for Demand Curve Shifts

Trends of Demand for BIG-4 Auditors	Reasons	Market Share & Premium for BIG-4
Down	Tarnished reputation as a result of AA collapse & scandals	
Down	Work of regulators & others to increase NB-4 reputation	Drop
Down	Overall fees going up with addition of 404 requirement	
Up	"Tried and true" in face of new regulatory requirements	Increase

Panel B: Reasons for Supply Curve Shifting up

Trends of Supply for BIG-4 Auditors	Reasons	Market Share & Premium for BIG-4
Up	Capacity constraints (Excess demand shifts pricing curve up)	
Up	Fewer BIG auditors more Oligopoly power	Market Share drops, but less clear what happens with fees and premiums
Up	Cost of risky audits have gone up—charge higher risk-premium for clients	

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□ □ □ □ □ □ Selective Disclosure: The Case of Nikkei Preview Articles

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Nihon Keizai Shinbun (Nikkei for short) is a leading Japanese daily newspaper specializing in economy and business. It is also the largest vendor of Japanese financial and economic databases. During earnings announcement season, the Nikkei morning edition often publishes “preview” articles that are about companies’ sales and earnings. However, these pre-date the actual company announcements, and forecast more accurately the actual results than the existing forecasts, making the Nikkei forecasts value-relevant information. We identify 2,899 preview articles in the newspaper from 2000 to 2010. We examine the circumstances under which these preview articles are written and the impact they have on the market. Our (preliminary) findings show that the market reacts to the information even before the preview articles are printed, suggesting some leakage of the information to market participants. The costs and benefits (or incentives) for companies, Nikkei, and investors are investigated using changes in returns and information content around the events.

> "If you wanted to find out what Toyota Motor Corp., NTT Docomo Inc. and Canon Inc. earned last year before they reported results, the best guide wasn't analyst or company predictions. It was the Nikkei newspaper….. Of the 45 Nikkei articles analyzed by Bloomberg News that contained profit figures that preceded the formal release results, 37 gave a number that was within 10 percent of the company's result, or predicted a range that turned out to be correct."[1]

> "… But in Japan, regulators seem to have turned a blind eye to the "Nikkei previews," allowing stories appear and then, within a few hours, letting companies issue rote statements saying the stories are not based on anything they have announced….. Last year the Nikkei announced it would no longer supply instant English translations of stories to its 364,000 online subscribers. But given that between 60 and 70 per cent of trading in Tokyo stocks is by foreigners, the effect of publishing earnings previews in the local language only is akin to "insider trading", says Mr. [Nicholas] Smith of CLSA [in Tokyo]"[2]

1. Introduction

With about three million subscribers (in 2008), Nihon Keizai Shinbun ("Nikkei Newspaper," or "Nikkei" for short) has the 4th largest printed and on-line circulation in Japan. It specializes in business and economy and is almost a "must" read for business people in Japan.[3] There is a curious institutional phenomenon that has existed for a number of years in the Japanese market. In earnings announcement season, highly accurate sales and/or earnings numbers are reported by Nikkei before the firms' official announcement. These preview announcements appear exclusive to Nikkei, and as we show below, the Nikkei's preview articles are generally more accurate than managements' own most recent publicly disclosed forecasts. In short, they contain value-relevant information.

Regulation Fair Disclosure (Reg FD) was enacted in 2000 in the United States. Its

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[1] Tom Redmont, Toshiro Hasegawa, and Aaron Clark, "Newspaper Has Lock on Prescience Covering Japan Earnings," *Bloomberg News*, August 7, 2014.

[2] Ben McLannahan, "'Nikkei previews' spur complaints of home advantage in Tokyo," *Financial Times*, August 5, 2014.

[3] The ranking of Japanese newspapers on circulation is as follows: 1. Yomiuri (circulation: 10 million); 2. Asahi (8 million); 3. Mainichi (3.9 million); and Nikkei (3 million); source: *World Press Trends 2008*, World Association of Newspapers. In comparison, the circulation of The Wall Street Journal is 2.3 million, and Financial Times is 650,000. Source: The Alliance for Audited Media and Deloitte.

intent was to create a level informational playing field for participants in the U.S. equities markets. The regulation stopped selective disclosure of value-relevant information about publicly traded companies. Corporations could no longer favor specific analysts or disclosure channels. Prior to its enactment, large institutional investors raised objections to Reg FD. Selective disclosure presumably gave large investors an edge – the potential to trade on information before it became widely known. Cohen, Frazzini, and Malloy (2010) find evidence that Reg FD significantly impacted returns to well-connected U.S. mutual fund managers, suggesting that selective disclosure was one source of excess return. Research on the effects of Reg FD suggests that it improved liquidity and increased trading volume (Heflin, Subramanyam, and Zhang 2003; Bushee, Matsumoto, and Miller 2004 and Bailey, Karolyi, and Salva 2006). Researchers have found that cost of capital and liquidity effects have led to voluntary adoption of Reg FD standards by cross-listed firms even though they are explicitly exempt (Francis, Nanda, and Wang 2006; Crawley, Ke, and Yu 2011). Chen and Matsumoto (2006) find that analysts' forecasts were more accurate prior to the barring of selective disclosure and document a correlation between favorable recommendations and selective disclosure; suggesting a quid pro quo relationship based on information.

In general, the empirical evidence on selective disclosure, gleaned from studies around the promulgation of Reg FD in the year 2000 indicate that, prior to the law, publicly traded firms faced a tradeoff between liquidity and price efficiency. The research literature has not yet completely explored this tradeoff.

One of the challenges in studying the effect of selective disclosure on market prices, volatility and liquidity around Reg FD is that there is little cross-sectional variation. When the law was enacted, it applied universally across firms with respect to information affecting the value of their common stock (except for cross-listed companies). In contrast to the U.S. market, in Japan, there is heterogeneity in the institutional structure for information disclosure. Some firms choose to regularly communicate with Nikkei for preview articles prior to the official release of earnings and sales information while others do not. This heterogeneity provides us an opportunity to examine corporate tradeoffs between liquidity and price efficiency.

The fact that selective disclosure is intermediated by a single news source introduces an additional level of usefulness. Nikkei – rather than the corporation – may realize the benefits of intermediating value-relevant information. Once Nikkei reporters have met with corporate executives to gather information for the preview article, they effectively share the potential value of this non-public information.

As a newspaper/news service, Nikkei presumably disseminates information to all subscribers simultaneously, however in doing so, it creates a potentially exploitable event – a disclosure date that is likely to have an effect on stock prices. Nikkei revenues derive from circulation to individual investors and subscriptions to data feeds to institutional clients. Both groups would recognize the potential benefits of an accurate preview of an adjustment to prior earnings forecast. However, if one group knew before-hand the content of the preview, the potential for exploiting other Nikkei subscribers is significant. In this study we are not able to discern how some investors become aware of Nikkei previews prior to publication, and furthermore this is not the focus of the paper. Rather we are interested in using these events as a means to understand which firms find selective disclosure more beneficial and why.

We hypothesize that firms held widely by institutional investors have an incentive to do previews that would allow fund managers to generate positive alpha. Jiang and Sun (2014) provide evidence consistent with this hypothesis for U.S. mutual funds. Stocks held by firms taking unusually high positions in the company around earnings announcements experience positive returns. The authors interpret this as evidence that some fund managers in the U.S. trade on private value-relevant information about earnings surprises. On the other hand, firms that are closely held – for which adverse selection is a significant concern for uninformed investors – are more likely to eschew selective disclosure which would exacerbate bid-ask spreads and illiquidity.

We further hypothesize that the particular information structure we identify in the Japanese market allows informed investors to exploit pre-earnings announcement previews in order to trade in an environment that is less suspicious of adverse selection. Unlike earnings announcement dates which are known in advance, Nikkei previews are not pre-scheduled and thus can be scheduled unexpectedly prior to announcement at a time when noise-traders and market-makers are less likely to expect to trade against informed traders.

Some accounting research has approached selective disclosure from the behavioral angle. DellaVigna and Pollet (2009) attribute attenuated price response around earning announcements on Fridays to investor inattention. Neissner (2014) finds that managers strategically exploit the inattention effect by disclosing negative information on Fridays. Hand (1990) showed that market prices reacted to the disclosure in annual filings of events disclosed in prior quarters, suggesting that markets only partially react to value-relevant news.

This is the main hypothesis behind the well-documented post-earnings announcement drift phenomenon (Bernard and Thomas 1989) and the subject of papers by Hirshleifer and Teoh (2003), Hirshleifer, Lim, and Teoh (2009, 2011) and others. One broad result of their analysis of accounting anomalies is that these are consistent with limited investor attention and capacity for analysis. In a setting where a large quantity of potentially value-relevant information is disclosed around the same time, the Hirshleifer et al. framework would predict sub-optimal reaction to the news. If, for example, investors use a pecking order to decide which of many securities to trade after a joint earnings announcement, this would lead to trades for which information is considered timely, reliable and significant enough to overcome the cost (in money and attention) of exploiting. Knowing this, the manager of a publicly traded firm who believes the market price fails to incorporate private, positive information would choose to shift the timing of value-relevant news to times when investor information overload is less, to choose a venue in which the disclosure is most credible (i.e., the risk of "cheap talk" is minimal). The management would also prefer disclosure to sophisticated investors who understood its relevance, and for whom the motivation – in terms of trading profits to speculators – is non-trivial.

Recent research has explored corporate use of alternative communication channels to increase awareness about firms around key events such as insider sales and earnings announcements. Bushee, Core, Guay, and Hamm (2009) show that media coverage around earnings announcements mitigate asymmetric information concerns. Fang and Peress (2009) find media coverage is a component of security prices. Lou (2014) documents an increase in advertising expenditure in the year before negative earnings surprises and around a period of insider sales. Madsen and Neisner (2014) use observed advertising to rule out reverse causality as a potential explanation for the association between insider sales and advertising expenditures.

Not having Reg FD (as in Japan) presents a set of opportunities for management disclosure strategies. For example, giving one news source with a broad subscriber base an "exclusive" is a means to ensure that the disclosure will be highlighted and will attract sufficient investor attention. Disclosing big changes that are worth the transactions cost to exploit will motivate trading. Finally, and perhaps most controversially, it may be in the interest of a firm whose price suffers from the market's failure to incorporate information, to allow information to leak in advance of a public (and even an exclusive) announcement to ensure that some market participants with the capacity to move prices are sufficiently incentivized to trade.

This strategy may seem contrary to the interest of shareholders, however price inefficiency due to behavioral limitations of the market also presents problems for the corporation and its shareholders. These include higher cost of capital, segmented cost of capital across financing forms and locations, inaccurate compensation rules and categorization at the margins of the firm as a small cap or value stock, with further costs of capital. Selective disclosure that results in speculative profits by informed traders at the expense of uninformed shareholders may be the cost of insuring that the market fully impounds good news.[4]

Although Reg FD and the zero-tolerance enforcement of insider trading laws in the

[4] There is a long literature about the costs and benefits of allowing insider trading (Fishman and Hagerty 1992; Leland 1992).

U.S. restrict the ability to examine the instances and effects of strategic disclosure, the structure of information dissemination around earnings announcements of Japanese companies allows us to test what is lost and what is gained with Reg FD. While insider trading is against the law, it is not uncommon to see unusual price movement and volume prior to significant events in many markets. This might be a consequence of a free rider problem. Grossman and Stiglitz (1980) point out that a market must compensate investment research through trades that are profitable enough to support it. In such a market, the majority of investors (and firms) can enjoy the benefits of free-riding on price efficiency. However removing channels for profitable research such as private discussions with management reduces the arbitrage in expectations that enforce markets. Information leakage prior to announcements may be one strategy to address free-riding.

In this paper we collect data on Japanese firms around earnings announcements and identify a large sample of preview news articles that report accurate sales and/or earnings numbers. Using this sample we test the following hypotheses using an event study methodology.

First, we test whether preview announcements actually contain value-relevant information. We find that stock returns around positive preview articles are positive and significant, consistent with the hypothesis that firms release value-relevant information prior to the official earnings announcement. We also ask whether – consistent with management seeking to reduce market under-reaction to good news – Nikkei previews that report positive earnings surprises are more frequent. We find that they are: the ratio of positive to negative earnings news in preview articles is 1.63. Looking more closely at the preview forecasts, we find that positive previews are relatively conservative (they are less likely to report numbers higher than those subsequently officially released) and negative forecasts are relatively optimistic (they are more likely to report numbers higher than those subsequently officially released).

In terms of stock price reactions, for non-previewing firms we find that prices rise significantly around release of positive earnings news and drop around release of negative earnings news. For previewing firms we find only a positive price reaction. This is consistent with an endogenous choice made by firms to preview. Firms may only release bad news via a preview when they believe it will not hurt stock price (or will not induce short-selling), and they may release good information via a preview when they believe it will cause a positive price jump.

For previewing firms the significant price movement occurs around the date of the preview article. There is little evidence of a "double reaction" i.e., first at preview, and then once again at the official release of earnings information. In other words, there is little evidence of under-reaction to recent prior news released via Nikkei.

One interesting difference between the reactions around preview articles vs. earnings announcements by non-previewing firms is that the spread in cumulative average residuals (CAR) is persistent over the next two weeks for previewing firms but converges for non-previewing firms. If anything, this is evidence for market over-reaction to the official earnings announcement as opposed to the widely documented post earnings announcement under-reaction. This differential is consistent with the hypothesis that the firms use the Nikkei channel to disseminate value-relevant information to sophisticated investors who will correctly interpret it and react quickly and permanently to it.

We also document evidence that the value-relevant information is released prior to both official earnings announcements for non-previewers and also for Nikkei previews. Price changes measured from open to open on the day prior to the official announcement (made during trading hours) or the Nikkei preview (available prior to market open) indicates leakage of news. For both groups, the returns on announcement day itself are flat. This is consistent with the hypothesis that information when it appears in the news is already impounded in stock prices.

Taken together, the evidence suggests that Japanese firms use selective disclosure to strategically incentivize market participants to impound positive information into stock prices. Nikkei previews are evidently an important channel. They serve as a coordinating event around which (i.e., before which) informed investors trade and move stock prices. This strategy results in permanent changes to firm market value that are positive, on average. In contrast, price increases due to informed trading in shares of firms that do not preview their results appear to be temporary.

This paper proceeds as follows. In Section 2, we describe the data. Sections 3 through 6 characterize the preview articles in terms of their role as a disclosure medium of information to the market. In Section 7, we examine market's reactions to the Nikkei preview articles. Section 8 investigates incentives and costs/benefits for all parties (Nikkei, companies, investors and regulators). Section 9 concludes.

2. Data

During the annual corporate earnings announcement season, all listed firms' announcements are published in the Nikkei Morning Edition in the form of tables. In this table, financial results (sales, operating income, ordinary income, net income, earnings per share, and per share dividends) of the most recent year are tabulated, as well as the numbers from the previous year and management forecast for the next year. Similar announcements are made and tables are published, at the half-year point, again on the day following the announcement. The management forecast of the coming half-year may be updated, based on the information available to the firm at this time. This management forecast is reported by almost all listed firms (Kato, Skinner, and Kunimura 2009). Management forecasts may be revised, not only in half-year intervals, but also when there is a substantive new information about corporate performance. These "stand-alone" revisions of management forecasts are also reported in Nikkei the next day. Due to the internationalization of the Japanese equity market, beginning in 2004, the Tokyo Stock Exchange started to encourage its listed firms to report quarterly figures, in addition to half-year results. Quarterly reporting became mandatory from October, 2008. Now all firms announce cumulative quarterly results. Management forecasts, however, are not on quarterly basis, and announced only on a half-year basis and stand-alone basis.

In addition to the tables of corporate financial reporting, Nikkei writes text articles on some selected firms. In another paper, Goetzmann, Hamao, and Takahashi 2014) we use sentiment analysis applied to the text content of these articles in order to examine the interaction between price, sentiment and news.

Like all news organizations, Nikkei also writes about companies as other news occurs.

However, before the annual, semi-annual or quarterly financial performance is officially announced by a firm, Nikkei often writes articles that effectively "preview" the results.

We extract all news articles that appear to have information on performance figures that are about to be announced from a database of over a million Nikkei text articles from 2000 to 2010, using text searches. We rely on keywords that refer to fiscal year, unit (Japanese Yen), and expressions pertinent to previews such as "about" or "likely to be."[5] As a result, we obtain more than 8,000 potential previews, although the actual number may be more. After extraction, we read all of them and isolate articles that preview financial results, prior to actual announcements. These articles explicitly discuss forthcoming figures on sales and/or operating income and/or ordinary income and/or net income. Also, we exclude articles that mention other accounting matters such as cash flow or asset turnover, but do not mention earnings related figures. Although some firms announce both consolidated and parent-only results, especially in the early years of our sample, we put priority on consolidated financial reporting over parent-only. We look at annual (full-year) and second quarter (half-year) earnings reports. For cumulative quarterly figures, net income is mostly not written up on preview articles. Therefore, we take numbers in the following order of priority: 1. Net income; 2. Ordinary income; and 3. Operating income.

We set the following rules to capture preview articles. First, the preview article has to appear after the last management forecast update (published the next day by Nikkei) prior to the annual (full-year), or half-year earnings announcement. Second, we take a conservative 60 calendar day period before the actual earnings announcement date (including the

[5] For instance, Nikkei article reports that "(*Firm name*)'s net income at (*fiscal year*) is likely to be about (*preview figure*), and this figure is the best ever for this firm."

announcement day itself). We drop preview-like articles written about firms' financial performance appearing a long time before the announcement, since they are not immediately value-relevant. Note that we do include "zero day" preview articles that are published on the day of announcement, a few hours ahead of the actual release by the firm. Third, we do not include preview-like articles that discuss only sales, but not income (ordinary, operating, or net) figures. As a result, our final sample contains 2,899 preview articles. Table 1 shows the details of the number of articles.

To our knowledge, the "preview" phenomenon has not yet been documented in the academic literature. We thus characterize our data in a descriptive fashion below. Some summary statistics are therefore deferred to sections below as needed.

3. Timing of the Preview Articles

First, we calculate the number of days before the actual announcement (calendar day difference between Actual Announcement Date minus Nikkei Preview Printed Date). We also calculate days after the latest management update, which is the calendar day difference between Preview Publishing Date minus Management Forecast Update Announcement Date (Nikkei publishes these updates in the next day's paper).

Figure 2 shows the number of preview articles. The horizontal axis represents that calendar days prior to the announcement date. From 60 days prior to the announcement date, the frequency of preview articles increases gradually, but from 7 calendar days before the announcement, it increases above 100 per day. On the day of the announcement (Day 0), the number of preview articles peaks.

Figure 3 shows the frequency of appearance of preview articles over time, from

January 2000 to December 2010. The articles appear more frequently from 2008, reflecting the fact that quarterly reporting (numbers reported are cumulative) became mandatory from that year.

Table 2 summarizes the timing of the preview articles. These articles are written close to the actual company announcement. The mean and median number of days before the announcement are 19.44 and 14 days respectively, but many appear on the day of the announcement (the mode is 0, i.e., the morning of official announcement), and after the update of the latest official management forecast (mean of 120 days, median of 85 days).

4. Are the Previews Biased?

In this paper we make the assumption that the firm itself voluntarily communicates with Nikkei prior to the official announcement. We have no explicit evidence on the precise nature of this information channel. Under the assumption that selective disclosure by the firm (via whatever channel) is a strategic decision, it is of interest to see if preview articles have a bias toward positive or negative forecasts. Kato, Skinner, and Kunimura (2009) find a positive bias in initial management forecasts, issued at the time of the release of the most recent year's results. We test to see if this is true of the Nikkei previews as well.

We divide the preview sample to two groups: (1) the figures actually announced turned out to be strictly better than the most recent management forecast update; and (2) the announced figures came out to be worse than (or equal to) the most recent management forecast. We use the management forecast as a benchmark because in Japan analysts do not conduct earnings forecasts actively, and there is no average or consensus forecast.[6] In case (1) above, we count the number of preview articles as "over" forecasting if they state numbers higher than the actual announcements, "under" forecasting if they are below the management forecasts, and "between" if they are in between the actual and management figures. In case (2), the "over" forecasts are when the preview articles point to numbers above the management forecasts, "under" forecasts are when previews mention estimates below the forthcoming announcements, and "between" when the previews lie below the management forecasts but above the actually announced numbers. If a preview article mentions two or more of sales, operating, ordinary, and net income, they are counted as separate reports (thus the total number of previews is 5,119).

Table 3 shows the breakdown of counts of the preview articles. Information contained in the previews is more often "good news." Out of 5,119 reports, 3,155 (61.6%) of them are written when actual performance is going to be better than the most recent management forecast (i.e., positive earnings surprise); whereas 1,964 (38.4%) of them are written when the announcement is going to be below the forecast (i.e., negative earnings surprise). Within the "good news" cases, about 70% of them are "modestly optimistic" and do not over-shoot in a sense that the previews report numbers in between the prior management forecast and the actual announcement. About 23% of the articles report higher number than actual, and only 7% of them under-forecast performance (i.e., the preview forecast is in the wrong direction). On the other hand, for bad news 50% of previews report numbers in between the recent management forecast and the actual (i.e., bad news is softened, or under-played in the

[6] Ota (2006) finds that Japanese analyst forecast is generally of less quality than management forecast.

preview articles), and 44% of them report worse figures than the actual (i.e., overplay bad news). Only 6% of the articles go in wrong direction (over-forecast).

The ratio of good-news to bad-news articles is consistent with management taking action to highlight positive earnings surprises, as opposed to a journalistic desire to attract readership by equally reporting both positive and negative surprises. To the credit of both management and Nikkei, 38.4% of articles are bad-news. This is a substantial fraction, and strong evidence of a functional, efficient information structure in Japan. The imbalance is also not surprising in light of the long-documented phenomenon in the U.S. that analysts upgrades of stocks are much more common than downgrades. This imbalance in the U.S. was generally attributed to selective analyst access to management prior to Reg FD, presumably based on a strategic choice by firm management. The ratio of positive to negative earnings surprises in Japan is also consistent with the strategic choice by the firm and the press. Of course there are other possible explanations that may be tested; e.g., prior management forecasts may be conservative or Nikkei subscribers prefer news about positive earnings surprises (perhaps due to the relative difficulty in exploiting negative news).

The asymmetry in the over- vs. under-prediction has the result of rendering the official announcement following the Nikkei preview article relative good news in the case of both positive and negative earnings surprises. In the case of the positive earnings surprises, the official announcement has a 70% probability of being better the Nikkei preview. In the case of negative earnings surprises, the official announcement has a 44% of being better than the Nikkei preview. This is consistent with a strategic prior management forecast. For example, Cheng and Lo (2006) find that U.S. firms strategically manipulate forecasts to reduce share prices prior to insider purchases. As we discuss below, we examine various theories about the extent to which the market properly adjusts for strategic information release. In simple terms, however, is the market "fooled" by the bias in over- or under-prediction in the previews?

5. Which Firms Are the Subject of Previews?

Nikkei does not write preview articles on all publicly traded firms. We examine which firms are written-up and how persistent it is. This is important, because investor reaction to the news is based upon expectations conditional upon the information channel and potentially understanding and relying on repeated patterns of disclosure. If management uses Nikkei previews in a strategic game of selective disclosure, do the market participants understand and rely on the rules of this game?

There are 1,065 firms that are previewed at least once by Nikkei (the numbers of listed firms are 3,488 in December, 2000 and 3,693 in December, 2010). Table 4 shows the yearly counts of preview articles for the most frequently written-up firms. While some of the names of those firms may be familiar due to their widely known consumer products, it is not obvious from inspection of the table what types of firms are more frequently previewed. For the analysis we develop below, we single out firms that was previewed in the prior year, and then previewed again in the current year. For these firms, investors may expect the preview articles to appear in the current year as well, and so it indeed appears. We examine these firms in comparison to firms that are never previewed by Nikkei in terms of market reactions to the events such as preview publications and company announcements. We find 800 firm-year observations of these firms, which we call "serially-previewed" firms. As a control, we create a sample of market-cap matched firm-year observations for the firms that have no previews published in 2001 – 2010. Table 5 reports firm characteristics of "serially-previewed" and "never-previewed" firms.

Table 6 presents the results of a probit regression on the characteristics that distinguish "serially-previewed" from "never-previewed" firms. The table shows that larger firms with relatively high turn-over (i.e., liquidity) are more likely to be previewed. This is not surprising in light of Nikkei subscribers and market position. Big, widely held and traded companies are obviously of interest. From the perspective of traders who have the benefit of selective disclosure, the higher relative liquidity of these firms means that price impact is lower and hence trading profits on private information more profitable. The different specifications of the regression in Table 6 are also instructive. Not controlling for size, the proportion of foreign ownership (as opposed to Japanese domestic institutional ownership) is a positive predictor of previewing behavior. This is interesting in light of Nikkei's recent decision to release preview articles in Japanese language only – presumably giving domestic investors a slight edge in interpretation of the subtlety accompanying and interpreting the numbers (a more complete analysis of this soft information component is the subject of our on-going research).

6. Accuracy of Previewed Results

The Nikkei preview articles are equivalent to "selective disclosure" in the pre-Reg FD U.S., except that they are published (solely) by Nikkei. A natural question is whether such previews are more accurate than previously available forecasts. We compute and compare forecast errors for the most recent management forecast and the forecast in preview articles. Table 7 reports the results.

Since there are relatively more preview articles published from seven calendar days before to the day of firms' announcements, we also look at the accuracy of the [−7, 0] previews. Table 7 shows that these preview forecasts are much more precise than the updated management forecast. Further, within the [−7, 0] previews, we separate "serially-previewed" firms. This table essentially documents that the preview news is potentially value-relevant. Tables 8-1 and 8-2 report the accuracy of the preview forecast, compared with that of the latest management forecast. Table 8-1 is for all previews; 8-2 is for serial previewers, 8-3 is for the non-serial previewers. Table 8-4 is a test of the difference between the serial previewers and the non-serial previewers. Serially previewers have consistently more accurate information.

7. Price Effects around Previews and Company Announcements

Kyle (1985) is the main theoretical framework for empirical predictions about rational investor behavior in a market with asymmetric information – as trading goes to continuous time, prices are fully revealing and martingale, and speculators make positive profits thanks to "noise traders." As a first step we test whether price dynamics around information events allow profits to informed investors. As a second step we examine the dynamics of various proposed microstructure measures. If, for example, strategic disclosure has benefits for the firm and its shareholders by improving price efficiency, there might be tradeoffs along other dimensions such as bid-ask spreads, lower volume and/or higher volatility.

Figures 4A and 4B illustrate the basic price results. For previewing firms (Figure 4A) we find a positive price reaction to positive news but no negative price reaction to negative news. For non-previewing firms, 4B, prices rise significantly around the release of positive earnings news and drop around the release of negative earnings news. We also document evidence that the value-relevant information is released prior to both official earnings announcements for non-previewers and also for Nikkei previews. Price changes measured from open to open on the day prior to the official announcement (made during trading hours) or the Nikkei preview (available prior to market open) indicates likely leakage of news. For both groups, the returns on announcement day itself are flat. As pointed out above, this is consistent with the hypothesis that information when it appears in the news is already impounded in stock prices, and with a rational model of investor decision-making in the presence of asymmetric information where the probability of informed trade is correctly estimated by uninformed investors.

The flat CARs for bad news are consistent with the hypothesis discussed above that firms may only release bad news via a preview when it is not expected to hurt stock price (or to not induce short-selling). The figures also show that the spread in CARs is persistent over the next two weeks following preview announcements but it converges for non-previewing firms around the official announcement. This suggests that the market may over-react rather than under-react to the official earnings announcement.

The post-earnings announcement drift is documented in other countries, most prominently in the U.S., but is less prevalent in the Japanese market. It is generally believed to be associated with behavioral limitations of investors. Given the regulatory structure of the U.S. market it makes it difficult to test cross-sectional differences in post earnings announcement drifts (PEAD) dependent upon different strategies for selective information disclosure by firms. The Japanese evidence suggests that firms use the Nikkei channel to disseminate value-relevant information to investors around earnings announcements, and these are effective at addressing potential under or over-reaction. The over-reaction around the official announcement days is a puzzle and the subject of further analysis.

Figure 5 shows the price dynamics for previewing firms sorted out by the number of days separating the preview announcement and the official announcement. CARs are synchronized around the event day defined by the official news announcement. It shows no evidence of a "double reaction" i.e., first at preview, and then once again at the official release of earnings information. There is little evidence of under-reaction to recent prior news released via Nikkei.

8. Incentives, Costs and Benefits of the Nikkei Previews for Related Parties

Market microstructure research (Admati and Pfleiderer 1988) predicts that the presence of asymmetric information should be empirically manifested in lower volume (i.e., buyers and sellers trading on their disagreement between about the economic value of the security), higher volatility (arguably a measure of disagreement), and an increase in bid-ask spreads (indicative of concerns about adverse selection by market-makers), as informed and uninformed investors strategically adjust the timing of their trades to maximize profitability or minimize adverse selection.

Our hypothesis is that preview articles provide an opportunity for informed traders to exploit an environment with lower spreads (hence less concerns about adverse selection).

As earnings season approaches, investors will naturally anticipate increasing probability of informed trades. News services provide an earnings calendar with expected dates for earnings releases. Investors use this information to assess the likelihood of informed trading. Krinsky and Lee (1996) show that spreads related to adverse selection increase prior to earnings announcements in the U.S. market. In contrast, the dates of the appearance of preview articles are not public, thus spreads may not increase as much in days prior to previews, making informed trading more profitable. In other words, the preview – particularly if it is not by a serially previewing firm, may be a strategy for allowing more profitable exploitation of private information. In the spirit of Admati and Pfleiderer (1988), the preview can be used to create an information event before which informed traders can trade in a less-suspicious environment.

Table 9 reports average daily bid-ask spreads for three intervals abound previews and official announcement days. For official announcement day spreads we construct a matched sample of non-previewing firms based on size in the same fiscal year. We divide the table into good news and bad news events. We first test whether the spreads around preview days are higher or lower than the spreads for a matched sample of non-previewing firms on the days around official earnings announcement days.

Our null hypothesis is that the spreads are the same. Our alternative is that the bid-ask spreads for the day of the release of value-relevant information to informed traders -- when the date is known ex-ante -- are greater than when the date is not known ex-ante. For good-news announcements, we find that spreads are significantly lower for previewers compared to non-previewers prior to and around the event date. Evidence reported above helps us assess market expectations about the timing of information released to informed traders. For official earnings announcement days, we show above that prices move a day or two before the release date. If the timing of this selective disclosure is common knowledge, then we would expect spreads due to adverse selection to increase over the same time interval. In contrast, if the day of the selective disclosure prior to a preview is unknown, or at least less predictable than disclosure dates preceding announcement days, then this would imply a significantly lower adverse selection-based bid-ask spread prior to previews compared to official announcements.

We find strong evidence against the null. For the −3 to −1 day window, in which stock prices have been shown to move in the direction of earnings revisions, the difference in the bid-ask spread is significant for both good news and bad news events. For good news events, the difference in spreads are significant in all three intervals: t-10 to 1-4, t-3 to t-1 and $t = 0$. For bad news events, the t-10 to t-4 and t=0 intervals are not significant. [check one-tailed test].

Table 9 shows several other interesting things. Note the change in spreads from the period t-10 to t-4 to t-3 to t-1. For previews, this increase is small. For the matched sample, the increase is large. Spreads widen considerably in the three days prior to the official announcement compared to the preview sample, consistent with a rational anticipation of leakage in the days immediately preceding the announcement. The difference between the spreads in these two event windows is significant for the matched sample and not for the preview sample (check). Another feature of note is that the average spreads are significantly higher for bad news than for good news for all reported windows, for both the preview and matched samples. This is a puzzle. It is consistent with the hypothesis that investors are more sensitive to negative disclosures compared to positive disclosures, however it is inconsistent with the hypothesis that firms are more likely to disclose positive information. In a "game" of selective disclosure we noted above that companies appear to allow positive information to reach the market prior to preview or announcement, which would increase the probability of private information rather that decrease it when that information is good news.

One additional complicating factor relevant to the interpretation of Table 9 results is that the decision to preview may be conditional upon price trends or bid-ask spread trends. For example, a firm planning to preview might not do it if the spreads or prices suddenly spike upwards, eliminating the benefit or necessity of selective disclosure via management-related channels.

9. Discussion and Conclusion

The Nikkei preview phenomenon provides a unique opportunity to examine the selective disclosure strategies that differ from the current practice in the U.S., which is constrained by Regulation FD, and from the disclosure practice that prevailed in the U.S. prior to the enactment of Reg FD. Nikkei's virtual monopoly on media release of earnings numbers prior to official announcement allows us to use one specific channel of press disclosure.

The structure of information release in Japan offers a means to more sharply differentiate the response by investors to different types of information. Prior research on investor response to the probability of information asymmetry. has relied on more general information structures. Vega (2006) for example, uses the Easley and O'Hara (1992) PIN measure to show that post-earnings announcement drift is lower when the probability of informed trading is higher. Our results are consistent with hers, but support the hypothesis that firms may play a decisive role in moving prices towards efficiency. Our also results provide additional insight into those reported by Tetlock (2010). While he also detects evidence of informed trading prior to the news, and documents a negative association with a liquidity, which is mitigated upon the news release. We are able to separate the release of information into two types: one for which the date of release is well-anticipated, and one for which it is less-so. We find that this leads to different patterns of investor behavior, and consequently different behavior of asset prices.

We are able to document several features of the Nikkei preview phenomenon that suggest that it is strategically used by corporations to improve price efficiency. Preview numbers are more accurate than prior forecasts, which themselves may be strategically formed to ensure that the Nikkei updates are more likely to be perceived as good news. Price reactions around previews are positive for good news and flat for bad news. The company stock price on average benefits from this disclosure event and the benefits are permanent – in contrast to temporary effects around official earnings releases. This suggests that the prices discovered via the Nikkei preview process are efficient.

We find evidence that an early disclosure via Nikkei preview is accompanied with leakage prior to the preview event, resulting in a rise in share price before article publication. Price dynamics indicate that leakage occurs for official earnings announcements as well. By the same token, the absence of price movements on the actual day of information release suggests that uninformed as well as informed investors adjust their priors about the probability of informed trading. Evidently the fact that one sees something in the news is *prima facia* evidence that prices already incorporate it. We find some evidence that uniformed investors are motivated to trade by a company appearing in the news – evidence documented in earlier markets. We also find that prices that were moved by the news (around the official earnings announcements) later revert – suggesting that there were not based on value-relevant economic fundamentals.

Taken together, these phenomena suggest that the previews play a role in a complex strategic interaction among several parties. We conjecture that previews allow informed agents to trade in advance of wider spreads associated with adverse selection concerns around the official earnings announcement. The company may use Nikkei as the informational intermediary to facilitate this trading, and in doing so may weigh the costs and benefits of informed trading in its shares when selecting whether to preview.

The natural question is why this particular information revelation structure suits the various parties: firms, Nikkei, investors and regulators. From the firm's perspective, the benefits to informed trading enumerated in Leland (1992) are straightforward: stock prices are higher, cost of capital lower, market prices are more fully revealing and investor risk is reduced. The cost to shareholders who sell shares at an adverse price may be small compared to the net benefits to long-term shareholders of the firm.

Viewed through the lens of behavioral finance, previews provide opportunities for firms to reduce investor inattention and its adverse effects on share price and liquidity – to the extent that one component of liquidity is a consequence of breadth of ownership and awareness. Barber and Odean (2008) document the strong positive price effects of awareness due to stocks being in the news.

From Nikkei's perspective, the ability to provide timely, accurate and exclusive information about corporate performance is the hallmark of a leading financial news provider. By serving as the principal medium for selective corporate disclosure they make themselves highly valuable to subscribers and to companies.

From the perspective of various investor clienteles, the incentives are mixed. For investors who trade prior to news release, there is a potential enforcement risk if indeed their trades violate insider trading laws, however the performance benefits may be significant. We have not yet examined changes in institutional holdings to understand which clienteles exploits these opportunities. Bris (2005) documents a trade-off between profitability and enforcement of insider trading laws. In the Japanese case the sustained evidence of informed trading prior to the event may thus be associated with modest profitability.

From a regulator's perspective, one of the principal motivations of Reg FD was the promotion of liquidity through the reduction of information asymmetry. Improved liquidity seems like a good think, although as the volume of trade by uninformed speculators increases, so do uncompensated transactions costs. In our study, since the decision to use previews is endogenous, liquidity differences between previewing and non-previewing firms will not likely be informative, and thus this paper does not address net welfare benefits of a non-Reg FD environment.

The case of Japan's Nikkei preview articles demonstrates that, in the absence of Reg FD, a richer strategy space for information disclosure, timing of trades and avoidance of adverse selection emerges.

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Figure 1. Example of Earnings Announcement on Nikkei Newspaper

An example of earnings announcement (based on Tan-Shin – Early Reports) published in Nikkei Newspaper.

Nikkei Morning Section, January 30, 2014:

キヤノン (7751)米国基準						3.28
12.12	34797	342557	224564	191.3	記 130.0	
13.12	37313	347604	230483	200.8	130.0	
14.12 予	38500	360000	240000	179.9	130.0	

Legend of the above:

キヤノン: Canon, 7751: Japanese security code or SEDOL, 米国基準: US GAAP, Date of SH mtg.

Yr. Mo.	Sales	Cur. Inc.	Net Inc.	EPS	Dividends/share
	100M	¥M	¥M	¥	¥

14.12 予: Management forecast for the fiscal year ending December 2014

記 stands for "commemorative dividends"

Figure 2. Number of Preview Articles Over Time

This figure shows the time-series distribution of the Nikkei Preview articles, relative to the date of company's announcements. The announcements are on sales and/or operating income and/or ordinary income and/or net income. Our priority rule is to take the last (net income) and go reverse, if not available.

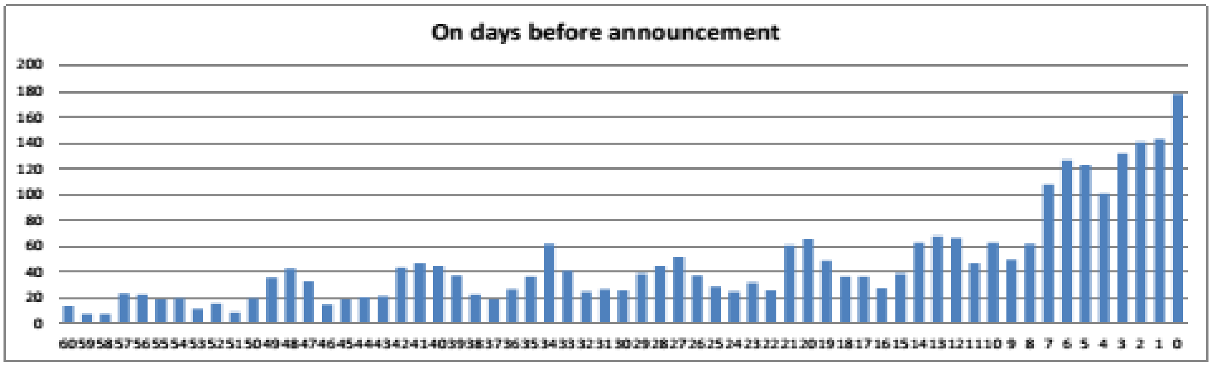

Figure 3. Preview Articles over Time

The figure shows the time-series distribution of the Nikkei Preview. The announcements are on sales and/or operating income and/or ordinary income and/or net income. Our priority rule is to take the last (net income) and go reverse, if not available.

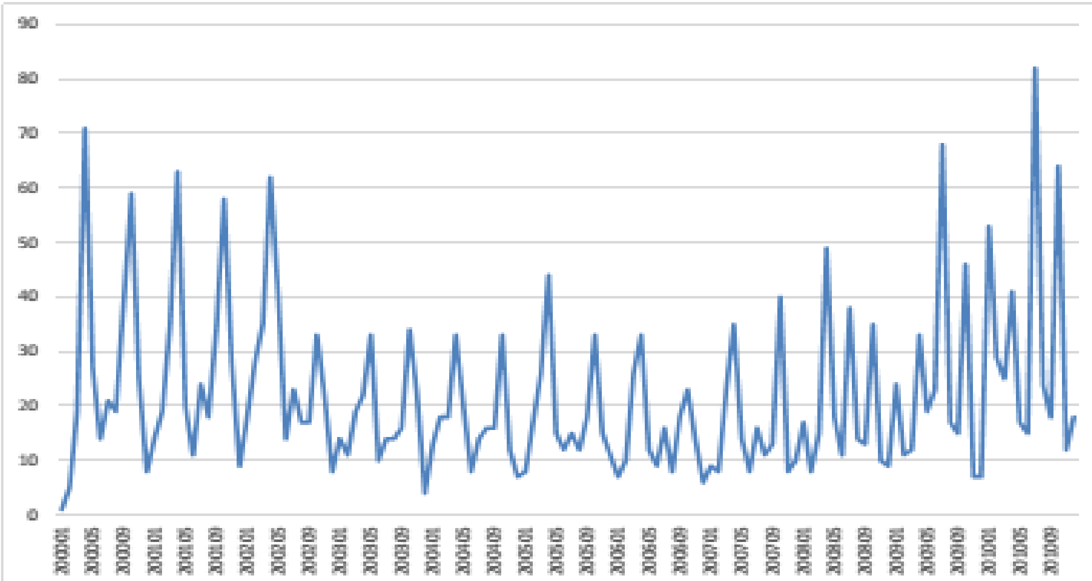

Figure 4A. CARs for Preview Article Publications

"Day0"is the day of the preview article publication.

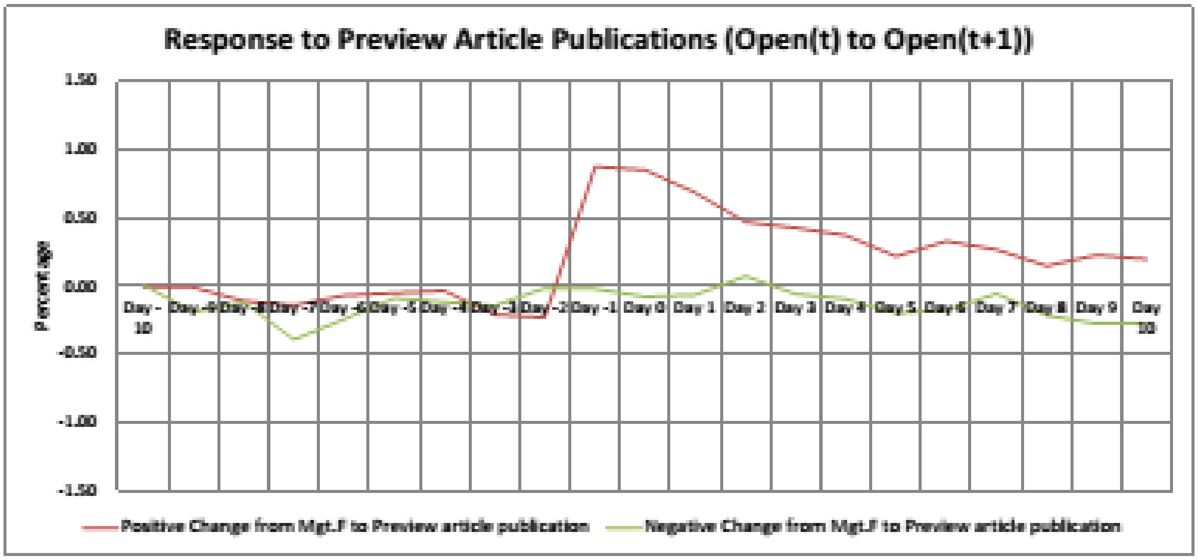

Figure 4B. CARs for Company Announcement Publications (for Non-Previewers)

"Day 0" is the day of publication of company announcement.

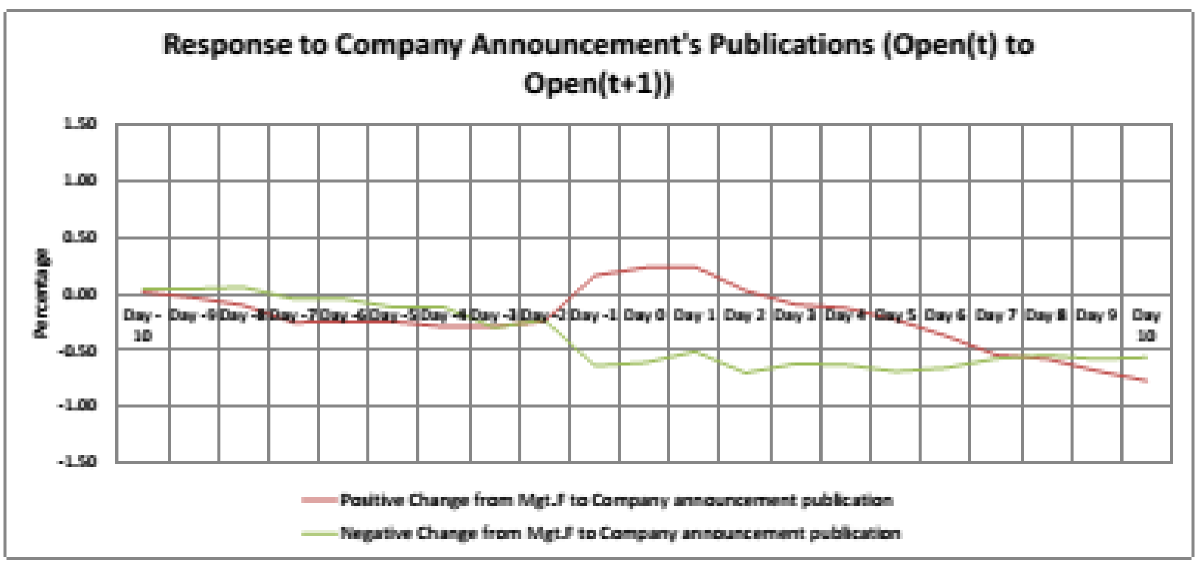

Figure 5. CARs for [-7, 0] Preview Publications

"Day0"is the day of the preview article publication.

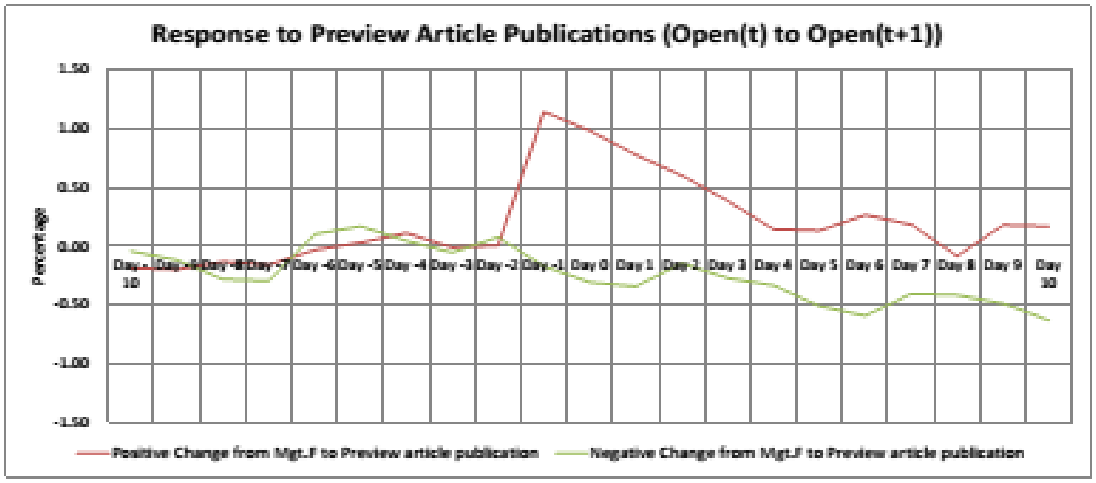

Figure 6. Responses to Company Announcement for [-7, 0] Previews

This figure reports CARs plotted from 10 days before to 3 days after the company announcement for previewed firms whose articles appeared 7 days before to the day of the announcement. Vertical axis is in percentage. "0" is the previews published on the day of the announcement, "-1" is the previews published one day before the announcement, etc.

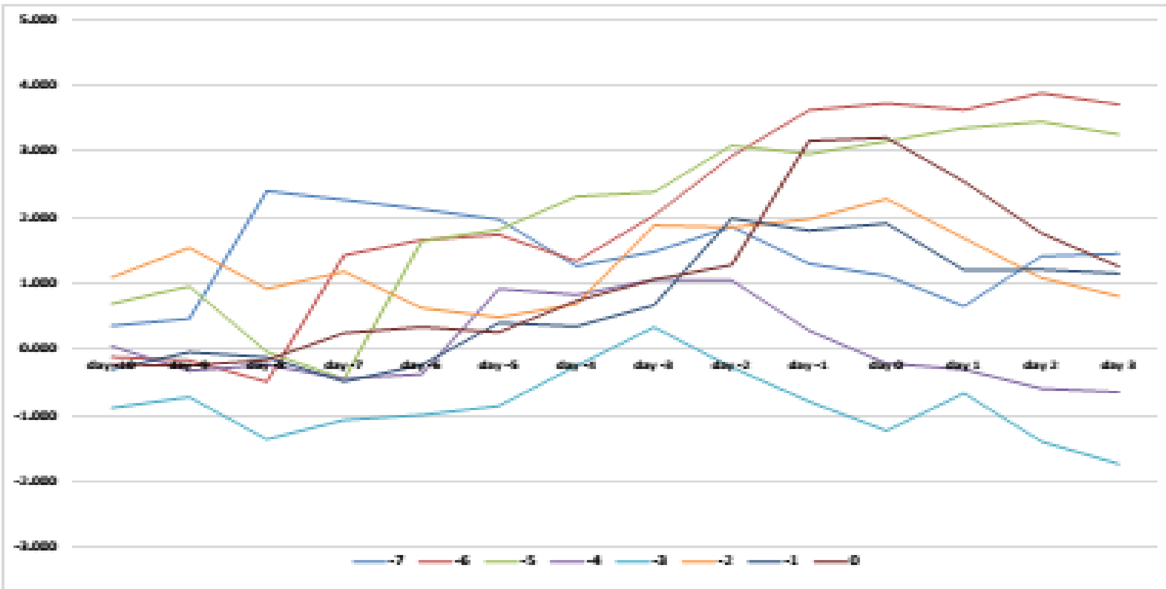

Table 1. Number of Preview Articles

	Number of articles				
Preview about	Total	Annual (12 month period)	Quarterly (9 month period)	Quarterly (6 month period)	Quarterly (3 month period)
Sales	2,563	1,117	166	957	323
Operating income	1,799	734	132	679	254
Ordinary income	1,684	794	73	671	146
Net income	1,512	800	51	587	74
Total	2,899	1,286	181	1,085	347
Grand Total		2,889			

Table 2. Timing of Publication of Preview Articles

Variable	N	Mean (days)	p25	Median (days)	p75	Min. (days)	Max. (days)	Mode (days)
Days_before_company_ann	2,899	19.44	5	14	33	0	60	0
Days_after_mgt_update	2,280	120.22	79.5	123	161	3	374	85
Days_between_update_and_company_ann	2,280	141.91	93	167	182	7	377	182
Days_after_prior_company_ann	619	353.67	349	358	362	302	380	362

Table 3. "Biases" in Preview Articles

	Actual > Mgt.forecast						Actual < Mgt.forecast					
	"Over"	Fraction	"Between"	Fraction	"Under"	Fraction	"Over"	Fraction	"Between"	Fraction	"Under"	Fraction
Sales	286	26.7%	734	68.6%	50	4.7%	49	5.2%	488	52.1%	399	42.6%
Operating income	48	19.5%	184	74.8%	14	5.7%	6	6.4%	54	57.4%	34	36.2%
Ordinary income	221	21.5%	761	74.0%	46	4.5%	14	3.5%	182	45.2%	207	51.4%
Net income	179	22.1%	579	71.5%	52	8.2%	41	7.7%	260	49.1%	229	43.2%
Total	734	23.3%	2,258	71.6%	162	6.7%	110	5.6%	984	50.1%	869	44.3%
Grand Total			3,155	61.6%					1,964	38.4%		

Table 4. Most Frequently Previewed Firms

	Name	y2000	y2001	y2002	y2003	y2004	y2005	y2006	y2007	y2008	y2009	y2010	Row Total
1	Canon Inc.	1	0	1	2	3	3	3	2	2	2	3	22
2	Obic Co., Ltd.	0	2	1	1	1	1	3	3	3	4	2	21
3	Kao Corp.	1	1	2	2	2	2	2	2	2	2	2	20
4	Aeon Mall Co., Ltd.	0	0	0	1	2	3	4	2	2	3	3	20
5	Shimamura Co., Ltd.	1	2	2	2	2	2	2	0	1	2	4	20
6	NTN Corp.	2	1	0	1	2	2	4	3	0	0	1	16
7	Nachi-Fujikoshi Corp.	1	2	1	1	2	1	2	1	1	2	2	16
8	Terumo Corp.	0	1	2	1	1	1	0	3	2	3	2	16
9	Mitsubishi Shokuhin Co., Ltd.	2	2	2	2	2	2	0	2	2	0	0	16
10	Mitsubishi Logistics Corp.	0	0	2	0	0	1	2	1	4	2	3	15
11	Toho Co., Ltd.	2	2	1	1	1	1	2	3	1	0	1	15
12	Sekisui House, Ltd.	1	2	1	2	2	2	2	2	0	0	0	14
13	Yamazaki Baking Co., Ltd.	1	1	2	1	2	0	2	1	2	2	0	14
14	Asahi Group Holdings, Ltd.	1	1	0	1	1	2	1	2	1	2	2	14
15	Takeda Pharmaceutical Co., Ltd.	0	1	2	2	2	0	1	2	0	2	2	14
16	Toyota Motor Corp.	0	0	0	1	1	2	3	2	1	2	2	14
17	Computer Engineering & Consulting Ltd.	0	0	1	2	1	2	3	2	3	0	0	14
18	Kirin Holdings Co., Ltd.	1	2	1	2	2	1	0	1	1	1	1	13
19	FamilyMart Co., Ltd.	1	0	1	1	1	1	1	3	2	1	1	13
20	Saizeriya Co., Ltd.	2	1	1	0	1	0	0	1	3	1	3	13
21	Calpis Co., Ltd.	2	2	1	2	1	2	2	0	0	0	0	12
22	Oji Holdings Corp.	2	1	0	0	0	0	2	1	2	2	2	12
23	Showa Denko K.K.	2	1	1	2	0	1	1	2	1	0	1	12
24	Shin-Etsu Chemical Co., Ltd.	1	1	2	1	2	2	1	1	0	0	1	12
25	Yamato Holdings Co., Ltd.	1	1	1	1	0	0	0	1	0	4	3	12
26	Oricon Inc.	0	0	2	4	2	1	1	0	0	1	1	12
27	Daiwa House Industry Co., Ltd.	2	0	0	1	1	2	2	1	0	1	1	11
28	Kaneka Corp.	1	2	2	2	1	2	1	0	0	0	0	11
29	Lion Corp.	1	1	2	1	1	1	1	1	1	0	1	11
30	KDDI Corp.	1	0	0	0	0	0	1	2	3	4	0	11
31	Otsuka Kagu, Ltd.	1	2	2	1	1	4	0	0	0	0	0	11
32	Fujifilm Holdings Corp.	1	2	1	0	0	0	0	1	1	2	2	10
33	Unicharm Corp.	1	0	1	2	0	1	0	2	1	1	1	10
34	Tokyo Tatemono Co., Ltd.	0	2	0	1	2	2	0	2	0	1	0	10
35	Sumitomo Realty & Development Co., Ltd.	0	0	0	0	1	1	0	3	2	3	0	10
36	Nomura Research Institute, Ltd.	0	0	0	0	0	0	2	3	2	2	1	10
37	LIXIL Group Corp.	2	0	1	0	0	1	1	2	1	0	2	10
38	Mandom Corp.	0	0	2	1	0	0	2	0	1	2	2	10
39	Daiichikosho Co., Ltd.	0	1	1	1	0	0	0	0	2	2	3	10

Table 5. Firm Characteristics of Serially Previewed vs. Non-Previewed Firms

Firms with preview are the ones that are written up in Nikkei preview articles in year t and $t + 1$ during 2000 – 2010. Firms without preview are the ones that were never written up in the same period (sample starts in 2001), and matched with firms with preview by market cap. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Firm-year obs. with preview						Firm-year obs. without preview						Mean Test (With - W/O)		Median Test (With - W/O)	
Variable	N	Mean	Std.dev.	Median	Min.	Max.	N	Mean	Std.dev.	Median	Min.	Max.	Difference	t-value	Difference	Z-value
Market cap. (million yen)	800	648,663	1,883,088	162,787	1,225	27,300,000	800	375,108	605,340	163,586	1,227	5,452,056	273,556	3.91 ***	-799	1.00
Proportion of individual investors (%)	800	29.68	19.71	24.44	1.43	97.59	800	30.08	17.56	27.16	2.37	96.07	-0.40	-0.43	-2.72	-1.54
Proportion of institutional investors (%)	800	53.31	16.89	54.09	2.12	94.41	800	56.81	17.41	57.31	1.73	97.38	-3.50	-4.08 ***	-3.22	-4.13 ***
Proportion of foreign investors (%)	800	16.91	12.82	15.70	0.00	68.82	800	12.86	12.78	9.07	0.00	73.30	4.05	6.33 ***	6.63	7.31 ***
Proportion of the special few SHs (%)	800	45.11	18.49	42.93	0.00	92.15	800	43.01	20.01	40.37	0.00	118.07	2.10	2.18 **	2.56	3.30 ***
Floating shares (%)	800	3.52	7.87	0.00	0.00	45.32	800	4.32	9.45	0.00	0.00	60.29	-0.80	-1.83 *	0.00	-0.47
Turnover	800	0.08	0.15	0.06	0.00	3.21	800	0.07	0.10	0.04	0.00	0.99	0.01	1.97 **	0.02	5.65 ***
Listing on TSE 1st section	800	0.81	0.39	1.00	0.00	1.00	800	0.83	0.38	1.00	0.00	1.00	-0.01	-0.65	0.00	-0.65

Table 6. Regression on Which Firms Are Previewed

This table reports the regressions coefficients for a probit model. Standard errors (in parentheses) are clustered around firms. The dependent variable is equal to one if the firm-year with preview is the firm-year that has preview articles in that year (t) and year t-1. There are 800 such firm-year observations. Market-cap matched observations of "never previewed" firms are added. The independent variables and their definitions of the independent variables are as follows: the logarithm of market capitalization (in million yen), proportion of individual investors is the number of shares owned by individual investors relative to the total number of shares, proportion of institutional investors is the number of shares owned by financial institutions, financial product dealers, and other corporations relative to the total number of shares, proportion of foreign investors is the number of shares owned by foreign corporations relative to the total number of shares, proportion of the special few shareholders is the number of shares owned by insiders and closely-affiliated firms relative to the total number of shares, floating shares is the number of freely floating shares relative to the total number of shares, turnover is the monthly average of the number of shares traded divided by the total shares outstanding, listed on TSE 1st section equal to one if the firm is listed on the first section of the Tokyo Stock Exchange. The estimation includes industry fixed effects and year fixed effects. The sample includes between 2000 and 2010. ***, **, and * denote coefficient estimates significantly different from zero at the 1%, 5%, and 10% levels (two-sided), respectively.

Variable	Dependent variable: Preview coverage (0, 1) variable			
Log(Market cap.)	0.171***	0.172***		
	(0.033)	(0.033)		
Proportion of individual investors (%)	0.005**		0.001	
	(0.003)		(0.002)	
Proportion of institutional investors (%)		-0.005**		-0.001
		(0.003)		(0.002)
Proportion of foreign investors (%)	0.007*	0.002	0.015***	0.014***
	(0.004)	(0.004)	(0.004)	(0.003)
Proportion of the special few SHs (%)	-0.002	-0.002	-0.004*	-0.004*
	(0.002)	(0.002)	(0.002)	(0.002)
Floating shares (%)	0.008	0.008	0.005	0.005
	(0.008)	(0.008)	(0.008)	(0.008)
Turnover	0.076	0.076	0.158	0.157
	(0.278)	(0.278)	(0.282)	(0.282)
Listing on TSE 1st section	-0.008	-0.007	0.220**	0.222**
	(0.113)	(0.113)	(0.103)	(0.103)
Constant	-3.705***	-3.186***	-1.712***	-1.615***
	(0.483)	(0.424)	(0.286)	(0.293)
Industry fixed effect	Yes	Yes	Yes	Yes
Year fixed effect	Yes	Yes	Yes	Yes
Number of observations	1,600	1,600	1,600	1,600
Pseudo R-squared	0.240	0.240	0.227	0.228

Table 7. Accuracy of Previews vis-à-vis Management Forecast

Management Forecast Error = |latest management forecast - realized figure|*100/Market cap [million yen] at the end of the month prior to preview release.
Preview Error = |preview figure - realized figure|*100/Market cap [million yen] at the end of the month prior to preview release.

	N	Mean	p25	Median	p75	Min.	Max.
Panel A: Management Forecast Error - Comparing latest management forecast with realized figures							
Sales	2,278	6.861	0.568	1.703	5.015	0.000	856.146
Operating Income	468	1.161	0.280	0.673	1.325	0.000	19.974
Ordinary Iincome	2,275	1.409	0.224	0.577	1.333	0.000	64.167
Net Income	2,278	1.680	0.153	0.379	0.920	0.000	232.062
Panel B. Preview Error - Comparing preview numbers with realized figures							
Sales	2,008	2.432	0.120	0.417	1.405	0.000	659.878
Operating Income	1,356	1.048	0.042	0.139	0.413	0.000	419.900
Ordinary Iincome	1,432	0.405	0.038	0.123	0.341	0.000	20.514
Net Income	1,344	0.752	0.031	0.107	0.340	0.000	173.348

Table 8 – 1. Accuracy of [-7, 0] Day Previews – All Previewed Firms

Management Forecast Error = |latest management forecast - realized figure|*100/Market cap [million yen] at the end of the month prior to preview release.

Preview Error = |preview figure - realized figure|*100/Market cap [million yen] at the end of the month prior to preview release.

	N	Mean	p25	Median	p75	Min.	Max.
Panel A: Management Forecast Error - Comparing latest management forecast with realized figures							
Sales	700	5.309	0.571	1.575	4.588	0.000	146.019
Operating Income	168	1.104	0.280	0.624	1.229	0.000	16.740
Ordinary Iincome	700	1.150	0.189	0.504	0.991	0.000	64.167
Net Income	700	1.253	0.122	0.326	0.707	0.000	136.824
Panel B: Preview Error - Comparing preview numbers with realized figures							
Sales	624	1.434	0.066	0.256	0.818	0.000	91.019
Operating Income	394	0.915	0.022	0.077	0.219	0.000	216.110
Ordinary Iincome	446	0.194	0.018	0.054	0.164	0.000	15.272
Net Income	400	0.565	0.019	0.044	0.136	0.000	132.492

Table 8 – 2. Accuracy of [-7, 0] Day Previews – "Serially" Previewed Firms

Only preview articles of serially previewed firms within a week prior to company announcement (i.e., between -7 to 0).

	N	Mean	p25	Median	p75	Min.	Max.
Panel A: Management Forecast Error - Comparing latest management forecast with realized figures							
Sales	496	4.449	0.534	1.435	4.148	0.000	134.219
Operating Income	121	0.865	0.181	0.555	1.020	0.000	8.424
Ordinary Iincome	496	0.842	0.172	0.425	0.788	0.000	45.608
Net Income	496	0.883	0.102	0.294	0.631	0.001	127.587
Panel B: Preview Error - Comparing preview numbers with realized figures							
Sales	457	1.272	0.065	0.242	0.742	0.000	91.019
Operating Income	299	0.204	0.021	0.069	0.195	0.000	5.822
Ordinary Iincome	312	0.194	0.017	0.050	0.145	0.000	15.272
Net Income	300	0.555	0.016	0.037	0.112	0.000	132.492

Table 8 – 3. Accuracy of [-7, 0] Day Previews – "Non-Serially" Previewed Firms

Only preview articles of non-serially previewed firms within a week prior to company announcement (i.e., between -7 to 0).

	N	Mean	p25	Median	p75	Min.	Max.
Panel A: Management Forecast Error - Comparing latest management forecast with realized figures							
Sales	204	7.400	0.665	1.975	5.972	0.001	146.019
Operating Income	47	1.718	0.429	0.871	1.383	0.043	16.740
Ordinary Iincome	204	1.899	0.281	0.663	1.562	0.000	64.167
Net Income	204	2.152	0.195	0.436	1.002	0.000	136.824
Panel B: Preview Error - Comparing preview numbers with realized figures							
Sales	167	1.877	0.070	0.319	1.093	0.000	53.330
Operating Income	95	3.153	0.024	0.104	0.407	0.000	216.110
Ordinary Iincome	134	0.196	0.022	0.082	0.187	0.000	2.984
Net Income	100	0.594	0.029	0.093	0.254	0.000	20.333

Table 8 – 4. Tests for Difference between "Serially" and "Non-Serially" Previewed Firms

	Difference in mean	Difference in median
Panel A: Management Forecast Error - Comparing latest management forecast with realized figures		
Sales	-2.951 ***	-0.540 **
Operating Income	-0.853 **	-0.315 ***
Ordinary Iincome	-1.058 ***	-0.238 ***
Net Income	-1.269 **	-0.142 ***
Panel B: Preview Error - Comparing preview numbers with realized figures		
Sales	-0.606	-0.077
Operating Income	-2.949 **	-0.035 **
Ordinary Iincome	-0.002	-0.033 **
Net Income	-0.039	-0.056 ***

Table 9. Abnormal Returns, Volatilities, and Volumes, and Spreads

Cumulative abnormal return is the value of daily abnormal returns, summed over the window indicated. Daily abnormal returns during the event window are defined as the raw return minus the expected return, which is estimated using market model. Abnormal return volatility is the absolute value of daily abnormal returns, summed over the window indicated. Abnormal trading volume is the difference between trading volume and the mean of daily volume for that stock over the pre-preview (or pre-announcement) publication window [-270,-21], normalized by the mean volume, then summed over a window. Spread is defined as end of the day quoted (ask-bid)*100/((ask+bid)/2) (averaged over the window indicated). Panel A presents the results of abnormal returns, volatilities, volumes, and spreads response to good news. Panel B presents the results response to bad news. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Panel A. "Good news" (positive surprise) cases							
	Preview publication date			Matched company announcement publication date			Mean test	
Variable	Number of Observations	Mean	Testing Mean = 0	Number of Observations	Mean	Testing Mean = 0	Difference	t-value
Cumlative Abnormal Return (-10, -4)	665	-0.055		1,238	-0.181		0.127	0.525
Cumlative Abnormal Return (-3, -1)	669	0.875	***	1,253	0.460	***	0.415	1.799 *
Cumlative Abnormal Return (-1, +1)	675	0.918	***	1,256	0.480	***	0.437	1.644
Abnormal Return day 0	680	-0.024		1,279	0.074		-0.098	-0.704
Abnormal Return Volatility (-10, -4)	665	10.573	***	1,238	9.807	***	0.766	2.141 **
Abnormal Return Volatility (-3, -1)	669	5.291	***	1,253	5.372	***	-0.082	-0.337
Abnormal Return Volatility (-1, +1)	675	5.656	***	1,256	6.020	***	-0.363	-1.424
Return Volatility day 0	680	1.795	***	1,279	1.988	***	-0.193	-1.836 *
Abnormal Trading Volume (-10, -4)	682	0.421		1,317	1.058	**	-0.637	-0.824
Abnormal Trading Volume (-3, -1)	682	-0.010		1,317	0.681	**	-0.691	-1.773 *
Abnormal Trading Volume (-1, +1)	682	1.137	***	1,317	2.077	***	-0.940	-1.584
Abnormal Trading Volume day 0	682	0.719	***	1,317	1.028	***	-0.309	-1.021
Averaged spread (-10, -4)	639	0.569	***	1,239	0.596	***	-0.027	-0.814
Averaged spread (-3, -1)	655	0.578	***	1,267	0.674	***	-0.097	-2.448 **
Averaged spread (-1, +1)	654	0.564	***	1,254	0.672	***	-0.108	-2.687 ***
Spread day 0	668	0.578	***	1,277	0.684	***	-0.106	-2.239 **

	Panel B. "Bad news" (negative surprise) cases							
	Preview publication date			Matched company announcement publication date			Mean test	
Variable	Number of Observations	Mean	Testing Mean = 0	Number of Observations	Mean	Testing Mean = 0	Difference	t-value
Cumlative Abnormal Return (-10, -4)	444	-0.072		1,057	-0.107		0.035	0.113
Cumlative Abnormal Return (-3, -1)	445	0.075		1,079	-0.523	***	0.599	2.196 **
Cumlative Abnormal Return (-1, +1)	447	-0.049		1,089	-0.261		0.212	0.721
Abnormal Return day 0	450	-0.059		1,098	0.028		-0.087	-0.515
Abnormal Return Volatility (-10, -4)	444	11.249	***	1,057	10.980	***	0.269	0.562
Abnormal Return Volatility (-3, -1)	445	5.435	***	1,079	5.573	***	-0.137	-0.534
Abnormal Return Volatility (-1, +1)	447	5.711	***	1,089	6.208	***	-0.497	-1.770 *
Return Volatility day 0	450	1.815	***	1,098	2.042	***	-0.227	-1.777 *
Abnormal Trading Volume (-10, -4)	461	0.604	*	1,129	1.107		-0.503	-0.300
Abnormal Trading Volume (-3, -1)	461	-0.034		1,129	0.491		-0.524	-0.892
Abnormal Trading Volume (-1, +1)	461	0.889	***	1,129	1.575	***	-0.686	-0.758
Abnormal Trading Volume day 0	461	0.559	***	1,129	0.811	***	-0.252	-0.677
Averaged spread (-10, -4)	431	0.645	***	1,051	0.658	***	-0.013	-0.295
Averaged spread (-3, -1)	441	0.632	***	1,080	0.729	***	-0.097	-1.995 **
Averaged spread (-1, +1)	440	0.639	***	1,070	0.716	***	-0.077	-1.591
Spread day 0	450	0.634	***	1,089	0.713	***	-0.080	-1.453

THE IMPACT OF TRANS-PACIFIC PARTNERSHIP AGREEMENT TO TEXTILE ENTERPRISES EXPORTS TO THE UNITED STATED MARKET

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This paper focuses on the impact of a Trans-Pacific Partnership (TPP) Agreement on Vietnamese textile and garment industry to the United States (U.S) market. This study also analyzes the opportunities as well as challenges facing by Vietnamese textile and garment industry upon its integration into the U.S market through TPP. Based on reference research papers and conducting online survey with 65 Vietnamese textile and garment enterprises, the research has successfully identified the factors contributing to Vietnamese enterprises' levels of consensus for the country's membership application to TPP. Of all the factors, tariff rates factor generates the greatest concern among the business circles. In addition, the research suggests some recommendations for boosting Vietnamese textile and garment producers' export performance into the U.S market in the case of Vietnam official participation on TPP.

Keywords: textile and garment, TPP, export, levels of consensus.

1. Introduction

Through many years of negotiation, the countries participating in negotiating the Trans-Pacific Partnership Agreement (TPP) is accelerating progress towards the end of negotiation in 2015. Compared to the previous agreements such as BTA, AFTA, and WTO, TPP expanded strongly in investment, trade in goods, trade in services, and intellectual property. It also includes many other issues such as government procurement, environment, and labor unions. The participation of Vietnam in TPP will lead to more opportunities and challenges to domestic enterprises as well.

TPP has a wide scope adjustment. With the trend of strong liberal negotiations, tariff has to reduce most of the tariff lines (at least 90%) in implementation immediately or in a very short progress; Service sector should increase the degree of openness, particularly in financial services; Investments need to strengthen the regulations related to foreign investment and investor protection; Intellectual property rights have to enhance the level of protection of intellectual property rights so that it can be higher than the that of the WTO; Competition and public procurement should enhance competition, especially in the field of public procurement; The labor issues, especially the issue of the right of association (union), the right to aggregate and negotiate of general laborers should prohibit the use of all forms of forced labor and exploitation of child labor. Regulations fighting against discrimination in the workforce are governed by the Agreement; The non-trade issues such as increasing environmental requirements for the TPP participants.

Textile industry is one of the most affected sector when Vietnam takes part in TPP, as this is a sector accounting for a large proportion of exports, creating jobs for labors. By joining TPP, Vietnam's garment industry will have more opportunities to entrance foreign market through exporting way. However, it has to face significant challenges, particularly when exporting to the U.S market. Therefore, it is necessary to conduct a research to find out the impact of TPP as well as analysis of the opportunities and challenges for Vietnamese textile and garment industry to the U.S market.

2. Methodology

This research uses the secondary data which collected from the General Department of Customs from 2008 to 2013, and the primary data which collected through surveys 65 textile enterprises of Vietnam by using the online questionnaire from January to March 2014. Descriptive statistics and regression analysis methodology are used to analyzed the results.

3. The current situation of Vietnamese garment and textile industry

3.1. *The export situation from 2008 to 2013*

In the 2008-2013, the U.S was always a major exporting market of Vietnam garment. The export turnover of Vietnam's garment to the U.S market increased over the years with the top value and proportion in all the export markets of Vietnam. For example in 2009, exports reached US $4,995 billion, gaining 97.9% compared with 2008, accounting for 55.1%; in 2010 was 6.12 billion US dollars, an increase of 122.5%, accounting for 54.6%; 2011 was 6.92 billion US dollars, an increase of 113.1%, the proportion was 49.3%; 2012 was $ 7.6 billion, an increase of 108.9%, accounting for 44.2% is; 2013 was $ 8.6 billion, an increase of 111.6%, the proportion was 43% (Table 1).

The average of import turnover of textiles is about 80 billion U.S dollars per year. With current export turnover, Vietnam is ranked as a 2nd supplier of textiles (after China) in the U.S market. Structure of Vietnam's garment exports to the US includes garments, fibers, fabrics, towels, curtain, etc which team apparel accounts for approximately 95% of total exports.

Table 1. Exports of Vietnam textiles 2008-2013 periods.

Unit: billion US dollars

Market	2008		2009		2010		2011		2012		2013	
	value	%	value	%	value	%	value	%	value	%	value	%
America	5.1	55.92	4.99	55.13	6.12	54.59	6.92	49.29	7.6	44.19	8.6	43.00
EU	1.7	18.64	1.65	18.22	1.92	17.13	2.57	18.30	2.5	14.53	2.7	13.50
Japan	0.82	8.99	0.95	10.53	1.15	10.26	1.69	12.04	2.0	11.63	2.4	12.00
Turnover		9.12		9.06		11.21		14.04		17.2		20.0

Source: General Department of Vietnam Customs, 2008-2013

3.2. *The current situation of raw materials import*

Vietnam's garment industry is heavily dependent on imported raw materials from abroad. The garment manufacturers in Vietnam are imported mainly from China, Korea, Taiwan or Hong Kong, etc. with the value of import raw materials accounts for nearly 70-80% than the value of export turnover. Most of the countries and territories that Vietnam imported raw materials accounted for a large proportion do not join TPP such as China, Taiwan, Hong Kong, while Korea only intends to join TPP.

In 2013, Vietnam imported textile fabric which worth 8,397 million U.S dollars, up 19.28% compared with the same period last year. China is the main market supplying textile fabrics for Vietnam, the total import turnovers from China was up to 3,887 million U.S dollars, accounting for 46.2% of the total value of imports of textiles and garments in 2013. China now plays a huge role in governing the issue of providing raw materials for the Vietnam textile industry, providing about 50% of all textile materials for Vietnam. TPP is likely to be signed in the coming years. When being take part in TPP, Vietnam’s garment and textile enterprises must comply the rules of origin from the fibers proposed by U.S to get the benefit from tax incentives of TPP while exports to the U.S market, which is not imported raw materials from countries not participating in TPP, including China. This is one of the major challenges for Vietnam's garment industry.

Table 2. The value of import raw materials import 2012 to 2013

Market	2012 (USD)	2013 (USD)	+/- (%)
China	3,040,772,008	3,887,791,400	27.86
Korea	1,409,747,353	1,713,007,408	21.51
Taiwan	1,073,407,119	1,241,484,802	15.66
Japan	599,123,789	563,562,276	-5.94
Hong Kong	353,348,106	350,110,174	-0.92
Malaysia	48,174,107	62,832,748	30.43
America	26,872,428	24,054,073	-10.49
Singapore	2,867,697	3,679,702	28.32

4. The opportunities for Vietnam textile industry exports to the U.S market when Vietnam participates in TTP

4.1 Expansion of export markets

Although TPP is in the negotiation process, the contents remain confidential, but in the field of trade in goods, TPP is expected to have the commitment of strong trading liberalization, the tax rates 0% immediately. Studies on International Trade affirmed TPP will increase trade between countries. Petri (2011) has applied general equilibrium model to calculate and show the benefits of each country participating in TPP. GDP of Vietnam could reach 235 billion US dollars, up 28% and income by 36 billion in 2025; GDP of U.S could reach 20 337 billion, up 0.7% additional income and $ 39 billion.

Table 3. Expected results TPP in 2025

Unit: billion dollars

Country	New Zealand	Singapore	Australia	Japan	Malaysia	Mexico	Peru	America	Viet Nam
GDP in 2025	206	386	1,426	5,332	422	1,999	311	20,337	235
GDP (%)	1	0.6	0.4	1	2.7	0.6	2.5	0.7	28

Table 4. Opportunity in increasing exports to the other markets

Country	(%)
America	90.63
Australia	46.88
New Zealand	34.38
Chile	31.25
Peru	28.13
Singapore	28.13
Malaysia	21.88
Brunei	15.63

Source: Survey of 65 textile enterprises

In particular, the survey results on 65 textile enterprises have shown that more than 90% of firms expecting to join the TPP will get a opportunity to boost exports of textiles to the U.S market. Meanwhile, the number of other markets are much lower (Table 4). This expectation has basement and be reasonable when an average tariff on textiles Vietnam in the U.S market today is quite high as 13.69% [2]. When this tax rate equals 0%, there is a large opportunity for garment enterprises exports to the U.S market.

4.2 Enhancing capacity of production

Besides export flows, the increase in imports from TPP countries to Vietnam are not only challenging but also containing many opportunities. When Vietnam joins TPP, Vietnam's garment and textile enterprises will import garment products from TPP countries with a large volume and competitive prices. This reduces production costs, improve the competitiveness of Vietnam's products as well as enhance production capacity of Vietnam.

Table 5. Opportunity increase in imports of raw materials and machinery

Country		America	Peru	Chile	Australia	New Zealand	Singapore	Brunei	Malaysia
Business (%)	Raw materials	46.88	34.38	31.25	37.50	37.50	28.13	18.75	34.38
	Machines, devices	81.25	12.50	9.38	43.75	37.50	28.13	53.13	9.38

The U.S is a country that Vietnam surplus. If Vietnam increases in imports from the United States, Vietnam will restrict imports from China. The local enterprises hope that reduction of import tariffs will enable them to import raw materials, machinery and equipments from the member countries of TPP, especially from the U.S. There are 81% of enterprises expect to import machinery and equipment from the U.S market when they participate in TTP; 47% of enterprises expect to be able to import raw materials from the U.S. Obviously, the technological level of the U.S would be an opportunity for Vietnam enterprises.

5 Challenge of Vietnam's textile industry when export to the U.S market

5.1 Rules of origin

The first challenge is that Vietnam must comply with the principals of the origin of goods from the U.S yarn onwards to enjoy preferential tariffs under the TPP. This forces textile enterprises use raw materials produced domestically or imported from other countries which joining in TPP, not allow to use materials from countries that do not join in TPP. Currently, in the production chain from cotton, fiber, spinning, weaving, dyeing, finishing, garment products, Vietnam is only dominant in the end of the garment process. While weaving, dyeing, and finishing are still very weak and fail to meet the requirements. But an ongoing paradox is that Viet Nam still imports most of the fabric overseas in spite of the redundancy of yarn and 60% - 70% exporting value of the yarn produced in the country. Thus, with the current strength of ancillary domestic industries, it is obvious that requirements of origin given by the U.S is a disadvantage of Vietnam's garment industry because the main material for production of textile production Vietnam's garment was imported mainly from countries which are not members of TPP, especially China. If Vietnam do not solve this issue in the negotiations, joining TPP will bring no benefit to Vietnam textile industry when exporting to the U.S market.

5.2 Enterprise is no longer protected by the government

When TPP was officially signed, Vietnam will reduce tariffs and remove non-tariff barriers for products imported from TPP member countries. A deep level of commitment of the participating countries TPP will certainly force domestic firms to compete on equal terms with the main imported products even in countries where the market is no longer entitled the protective measures of the state. At that time, Vietnamese enterprises have to rely on the competitiveness of its own to compete.

Table 6. The challenge of competing against imported products

Country	Ability of competitiveness
Brunei	3.38
Chile	3.13
Malaysia	3.06
Singapore	2.69
New Zealand	2.66
Australia	2.44
Peru	2.34
America	2.13

(1: low competitiveness, ..., 5: high competitiveness).

Source: Survey of 65 textile enterprises

The results showed that Vietnamese enterprises evaluate the competitiveness of themselves at 2.13 on products imported from the U.S; 2.44 and 2.69 for imported products from Australia and Singapore, which is competitive at low (2-3 points / 5 points). Therefore, the Vietnam textile enterprises need to actively improve their products to meet the competition with foreign products in the domestic market.

5.3 The level of understanding of the business about TPP and the ability to meet the conditions of TPP

As Vietnam is ready to join in TPP, the requirement is that Vietnamese enterprises need to have savvy about the TPP to proactively take steps promptly to take advantage of the opportunities and challenges that limit the TPP offers. For instance, to satisfy the condition of 0% tax when importing goods into the U.S market, Vietnam garment enterprises have to ensure criteria on rules of origin. When having timely insight, enterprises can be early proactive to solve input materials, look for new suppliers of raw materials in joining the TPP countries to qualify for incentives. However, the survey results in Table 7 showed that the level knowledge of TPP agreement and ability to meet the conditions which give TPP agreement of enterprises are not high, just above average. This is also a limiting problem of the textile and garment enterprises in Vietnam. For understanding, the level at 2.86 and the ability to meet the conditions are at 2.52 with 5 points scale (1: low competitiveness, ..., 5: high competitiveness).

Table 7. Level of understanding of the business and the ability to meet the conditions

Target	**Level**
Level of understanding	2.86
The ability to meet the conditions	2.52

Source: Survey of 65 textile enterprises

6. Factors affecting the level of agreement of the textile enterprises when Vietnam joins the TPP

Table 8. Results of regression models

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	0.964	0.929	0.923	0.22079	1.963

ANOVA

Model		Sum of Squares	Df	Mean Square	F	Sig.
	Regression	37.524	5	7.505	153.955	0.000
	Residual	2.876	59	0.049		
	Total	40.400	64			

Coefficients

	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta	B	Std. Error
Coefficient	1.271	0.103		12.296	0.000
Tax rate reduction (X_1)	0.250	0.037	0.395	6.757	0.000
Expanding markets (X_2)	0.150	0.044	0.202	3.394	0.001
Understanding of enterprises (X_3)	0.186	0.043	0.234	4.350	0.000
Competitiveness (X_4)	0.123	0.038	0.135	3.277	0.002
Ability to meet of enterprises (X_5)	0.177	0.044	0.218	3.986	0.000

According to Muthen and Kaplan (1985). Demaris (2004). the Likert 5-points scale upwards can fit regression model. Thus. this research uses Liker 5 points scale to collect data in order to analyze factors such as the level of tax reduction. expanding export markets. understanding of enterprise. competitiveness. ability to meet the conditions in an aspect that how it affect the degree to join in TPP of Vietnam's garment enterprises through regression model.

The results analyzed in Table 8 showed that the factors included in the model were significant in impacting on the level of agreement to join in TPP of the Vietnam textile enterprises. In which. the factor X_1 (tax reduction) is the most powerful factor to the degree of consensus (0.25). it means that when the other factors remain unchanged. assuming use tax rate is reduced by 1%. the level of agreement increases by 0.25; next is an understanding of the business impacting to the degree of consensus 0.186; ability to meet the conditions. expanding markets. and competitiveness of enterprises respectively have an impact on the level of consensus at 0.177; 0.150; and 0.123. The result is appropriate with fact when tax rate is reduced. the Vietnam textile enterprises will not have to pay tax arising on the US market. reducing the cost of this will help Vietnam businesses saves charges and makes the product cheaper which make increase accumulation to expand production.

7 Some recommendations for the Vietnam textile industry exports to the U.S market

To increase the exports to the U.S market when TPP affects, Vietnam's textile and garment industry needs to solve following problems which are still stagnant in the industry, namely:

For source of raw materials: Vietnam textile enterprises should invest in establish local sources of raw materials or find joint venture partners to produce domestic raw materials or govern policies to attract foreign investment, especially from the TPP member countries, into production of raw materials of textile industry to generate high-quality, stable, low cost materials, and meet the requirements of the U.S market.

The firms in the industry have to link together: form chains and improve linking chain together, close production process from fiber - textile - dyeing and finishing –sew, move away from a form of processing to do FOB (purchase of raw materials, semi-finished products) and ODM (design, production and sale of products). This will help increase the localization of industries, enhance the adding value of products, reduce deficit. etc. When Vietnam textile industry gets the localization rate of about 60% - 70%, the tax benefit truly prove effect.

In addition, an important issue is that enterprises should actively learn about TPP and join in commenting on the negotiations. TPP is an open agreement, which means that in the negotiations of the agreement, all of the issues negotiated and agreed by TPP countries have been discussed by business representatives, associations and experts participating comments. If Vietnam textile enterprises know how to take advantage of this condition, it will be able to affect the content of negotiations, leading to the results achieved by favorable direction which fits to the capacity of the textile industry in Vietnam.

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Deferred Compensation: Alignment or Agency?

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Due to the paucity of disclosed information, especially prior to 2006, deferred compensation is the least understood among various categories of executive pay. This paper fills this gap and provides a comprehensive analysis of the nature of deferred compensation and tests several hypotheses explaining why firms use deferred compensation and why CEOs would make voluntary contributions. The unique properties of deferred compensation (pay at retirement, low transparency) allow us new approaches to test several hypotheses with respect to both Optimal Contracting (alignment) and Managerial Power (agency theory). We find some support for Optimal Contracting. While we do not find any evidence of ex-post settling up, we do show that firms' contributions increase with leverage, which is consistent with using firms using deferred compensation to increase alignment with debtholders (the inside debt hypothesis). We also find evidence that is consistent with Managerial Power hypothesis. Our results suggest that boards utilize deferred compensation, which is less transparent, in order to avoid having to report excess pay in periods of high investors outrage toward executive pay. We also find evidence that firms use deferred compensation to at least partially offset the cuts in current compensation.

1. Introduction

Prior to 2006 firms were not required to disclose information on post-retirement benefits; as a result there are relatively few studies examining deferred compensation.[1] In 2006 the SEC issued new regulations which now require firms to disclose all post-retirement benefits, including pensions and deferred compensation (see SEC Release No. 33-8732A). While several studies have examined the impact of pensions on CEO incentives and investor behavior, ours is the first to examine the determinants of non-qualified deferred compensation.

There are three components to non-qualified deferred compensation, and each component makes up a significant portion of the executive's annual earnings. The first element is the amount the executive elects to defer ("executive contribution") from his base salary and bonus. The average executive contribution is $244,000 per year (or approximately 6.5% of his total annual compensation). The second component is any additional amounts promised by the firm ("firm contribution") and can take the form of fixed matching or can be based on firm performance. On average, firms that participate in deferred compensation make annual contributions of $156,000 per year (approximately 2.95% of annual compensation). Finally, the third component is the "above-market earnings" on deferred compensation ("earnings"). Above-market earnings result from the firm guaranteeing a fixed rate of return which exceeds the amount the executive would have received had the deferred compensation been invested in the market or in the firm's securities. The average executive in our sample received "above-market" earnings of $195,000 per year (about 4.5% of total annual pay).

In this paper we examine the determinants of firm's contribution to deferred compensation using the post-2006 data and test two competing theories: alignment ("optimal contracting") and agency problems ("managerial power"). According to the Optimal Contracting theory, compensation should be designed to align the CEO's interests with those of the firm's stakeholders, which include both shareholders and bondholders. Many executive compensation plans focus primarily on incentivizing executives to maximize shareholder value, often at the expense of total firm value. For example, stock and option grants increase the executive's equity stake in the firm, thereby encouraging him to focus on maximizing *shareholder* value rather than total firm value. Management has the incentive to engage in risk behavior because he bears the upside potential, while the bondholders bear the downside. Sundaram and Yermack (2007) note how using deferred compensation and pensions ("inside debt") greatly alters the CEO's payoff and corporate decision making. By including deferred compensation, which is tied to the long-term prospects of the firm (and remains subject to the reach of the firm's creditors in the event of bankruptcy), firms can better align the interests of management with both shareholders and bondholders. Our results suggest this may be a partial explanation. We find a positive relationship between leverage (both the firm leverage and the CEO's "inside" leverage) and firm contributions to deferred compensation. The more levered firms tend to pay more deferred compensation.

[1] Deferred compensation and pensions are often lumped together as "inside debt". Most studies examining inside debt focus primarily on pensions. See, for example, Sundaram and Yermack (2007), who examine how pensions affect management incentives and decision-making. Other studies examine both pensions and deferred compensation together. See Wei and Yermack (2011); Cen (2012).

Another problem is that the short-term nature of annual compensation may lead management to focus on short-term profits in order to maximize their annual pay. Fama (1980) suggests that any rent extraction in one period should be resolved in future periods through the wage revision process, or ex-post settling up. We explore whether deferred compensation can be used for ex-post settling up. Contrary to annual compensation, which is difficult for firms to recover once it has been paid out, amounts allocated to deferred compensation are withheld until the executive retires and remain the property of the firm. To encourage better pay-for-performance alignment, firms could make annual adjustments to the deferred compensation balance based on long-term firm performance. Under the alignment hypothesis, we expect firms to increase the firm contributions to deferred compensation following positive firm performance and to decrease or make negative adjustments following poor firm performance. Our results suggest that firms do not use deferred compensation as a means of ex-post settling up. While the amount of firm contributions tends to increase following positive firm performance, there is no evidence to suggest that firms make downward adjustments following negative firm performance.

The second, competing theory is Managerial Power. Under this theory the CEO seeks to maximize his total compensation, regardless of firm performance.[2] Prior to 2006 firms were not required to disclose most elements of deferred compensation. Thus there existed the potential for firms to hide large amounts of compensation from shareholders. Following the rule change in 2006, there still exists the possibility to obscure total compensation due to the non-standard reporting requirements. Although all compensation (both current and deferred) is now required to be disclosed in the proxy statement, firms still have control over how the information is presented. Firms are required to disclose deferred compensation in the Non-Qualified Deferred Compensation Tables (NQDC), but not all elements of deferred compensation are required to be reported in the Summary Compensation Tables (SCT): firms are not required to disclose the firm contribution or total earnings on the deferred balance in the Summary Compensation Table. Thus the "Total Compensation" as reported in the Summary Compensation Tables may be understated. That is, firms may still be able to hide some elements of deferred compensation or use deferred compensation to offset current compensation in bad years. There are two implications to this: (1) firms may use deferred compensation, which is less scrutinized by investors, as a means of hiding compensation or (2) firms may use deferred compensation to substitute for current compensation following a pay cut. Our results indicate that Managerial Power hypothesis is a stronger explanation for firm contributions. We find some evidence that firms shift compensation away from current compensation and toward deferred compensation in periods of high outrage over executive compensation. Further, we find support for our substitution hypotheses: CEOs who suffer "extreme pay cuts" (defined as more than 25% decrease from prior year bonus) are at least partially offset by an increase in firm contributions to deferred compensation. Thus firm may be reducing annual compensation, but are at least partially offsetting this reduction with an increase in deferred compensation.

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[2] The only constraint is "outrage costs". Bebchuck and Fried (2003) use the term "outrage costs" to denote costs associated with (a) reputational harm to the executive in future employment or (b) costs associated with shareholder activism, including proxy contests and take-over bids.

The remainder of this paper is organized as follows: Section II provides a background on deferred compensation. The hypotheses are outlined in Section III. Section IV describes the data and sample selection and provides summary statistics. The methodology and results are presented in Section V. Section VI concludes.

2. Background on Deferred Compensation

Section 409A of the Internal Revenue Code ("Non-Qualified Deferred Compensation") allows the CEO and other "key executives" to defer taxes on a portion of their salary and bonus that is set aside for future payment (executive contributions). Because the plan is "non-qualified" (i.e. does not meet the tax requirements of qualified plans such as 401(k)), it is not subject to many of the requirements of "qualified" plans, such as participation or contribution limits. Thus firms are given wide latitude in designing their executive deferred compensation arrangements and can have separate plans for the CEO and the Vice President, each with different contribution policies. Unlike other post-retirement compensation arrangements, the firm does not get a tax deduction for deferrals under Section 409A for either the executive contribution or the firm contribution. Although these amounts are non-deductible for tax purposes, the firm must still report both the executive contribution and the firm contribution as an expense on the income statement and as a liability on the balance sheet.[3] Thus from the firm's perspective, there is little, if any, benefit to nonqualified deferred compensation.

The finance literature often refers to deferred compensation as "inside debt" because it represents a liability the firm owes to the executive(s). In order to qualify for tax-deferral status under 409A the plan must be unfunded, meaning that the firm cannot set aside funds in a separate account for the benefit of any particular employee. Further, to the extent that the firm does set aside funds for a group of employees, the funds are still subject to the reach of the firm's creditors in the event of bankruptcy.[4] There are, however, several distinct differences between deferred compensation ("inside debt") and other forms of debt: contributions to deferred compensation and earnings on deferred compensation can vary with firm performance, there is generally not a fixed payment schedule, and non-payment will not result in bankruptcy.

There are three components to deferred compensation:the executive contribution, the firm contribution, and earnings on the deferred compensation balance. The executive contributions are amounts promised to the executive as annual compensation that the executive elects to defer until retirement. These amounts are reported in both the Summary Compensation Table (as salary or bonus) and the Non-Qualified Deferred Compensation (NQDC) Table. Firm contributions are additional amounts above and beyond annual compensation which can be

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[3] FASB ASC 710-10-25-9 indicates that all income should be expensed in the year *earned* rather than in the year paid out.

[4] In practice, firms often set aside money in a rabbi trust or use life insurance policies to indirectly fund these obligations, but any proceeds as still subject to reach of the firm's creditors. Firms are able to get around the "unfunded" requirement by purchasing an insurance policy such as a Corporate Owned Life Insurance (COLI). The policy cannot be for the benefit of a particular employee, but the policy guarantees the funds will be available when due to the employee (retirement or separation, death or disability, change in control). See Fidelity https://www.fidelity.com/viewpoints/personal-finance/nqdcfdsa

based on firm performance or matching contributions. Firms are only required to report these amounts in the NQDC, but may choose to also report these amounts in the SCT.[5] Finally, while all earnings on the deferred balance are required to be reported in the NQDC table, only the "above-market" earnings are required to be reported in the SCT. Thus the "Total" column of the SCT may not include all elements of compensation.

There is also a timing issue with deferred compensation. In order to meet the requirements of IRC 409A, the executive must decide what portion of salary and bonus to defer before the compensation is earned or received. As to salary, the election must be made prior to the beginning of the fiscal year in which it was earned and for bonuses the election must be made at least six months before the end of the fiscal year in which it was earned. Further, once the election is made for the year it cannot be changed or revoked. The firm then selects whether or not to make a contribution towards deferred compensation.[6] Firm contributions are often based, at least in part, on some performance metric such as return on assets, net income, return on equity, or stock returns.

Firms can offer additional deferred compensation in the form of earnings on the deferred balance. While a typical "qualified" plan will invest in the company stock or an index fund, earning market returns, "non-qualified" plans can offer fixed or guaranteed earnings. Since deferred compensation is an unfunded liability the firm does not need to set aside the money in stocks or other investments in order to generate returns. Rather, "imputed" earnings may be credited based on the returns of the target fund or some guaranteed rate of return. In either case the firm must report annually the total earnings on the deferred compensation balance in the Non-Qualified Deferred Compensation Table, but need only report the "above market" earnings in the Summary Compensation Table.[7]

Prior to 2006 firms were not required to disclose post-retirement compensation to shareholders. As a result, firms were able to hide large amounts of compensation from shareholders. In 2006 the SEC updated its disclosure requirements. As noted in the Final Rule (SEC Release No. 33-8732A), the new Summary Compensation Table is intended to disclose all elements of executive compensation (current and deferred) and includes a column for "Total Compensation".[8] However, neither the firm contributions to deferred compensation nor the total earnings on the deferred balance are required to be reported in the Summary Compensation Table.[9]Instead, firms are required to report these amounts in the Non-

[5] SEC regulations require that firms report the amount of firm (registrant) contribution in the Non-Qualified Deferred Compensation Table (NQDC). Firms are not required to report the amount of firm contributions in the Summary Compensation Table (SCT). However, footnotes are required to the extent that these amounts are reported in both tables so as to avoid double-counting. See SEC Release No. 33-8732A; 17 CFR 228.

[6] The Internal Revenue Code does not specify the timing of the firm's contribution. Performance-based firm contributions generally made at the end of the fiscal year.

[7] "Above market" means earnings generated from a guaranteed fixed rate that exceeds 120% of the applicable federal rate (AFR). To the extent that earnings are less than 120% of AFR, such earnings are not required to be disclosed in the Summary Compensation Table. See Donahue (2006).

[8] The Total Compensation column is intended to include all current and deferred compensation. See Summary Compensation Table in Appendix B.

Qualified Deferred Compensation ("NQDC") Table. Because of the discrepancy in reporting requirements, the "Total Compensation" column in the Summary Compensation Table may be significantly understated. Shareholders must carefully read the footnotes to determine how Total Compensation is calculated. This presents a potential means of hiding excess compensation by executives.

3. Hypothesis Development

There are two standard theories of executive compensation: optimal contracting and managerial power. The optimal contracting approach views executive compensation as a remedy to agency problems. See Jensen and Meckling (1976), Jensen and Murphy (1990), Coles et al., (2006), and Cassell et al., (2011). Under this approach, boards use executive compensation as an alignment tool to help motivate management to maximize shareholder value.[10] Under the managerial power approach executive compensation is viewed as *creating*, rather than solving, an agency problem, see Shleifer and Vishny (1989), Yermack (1997), Bertrand and Mullainathan (2001), Bebchuck and Fried (2004), Bebchuck and Jackson (2005), Lee and Tang (2011). This theory suggests that powerful executives receive more compensation than they would otherwise under an arms-length bargaining. We examine these two theories in light of deferred compensation.

3.1. *Optimal Contracting: Deferred Compensation as Alignment*

Jensen and Meckling (1976) propose using equity incentive compensation to align management interest with shareholders. One problem, however, is that equity compensation rewards risk-taking, often at the expense of long-term firm value (Denis et al., 2006; Efendi et al., 2007; Bergstressor and Philippon, 2006). Jensen and Murphy (1990) suggest that compensation should be structured in a way that rewards positive performance but also penalizes poor performance. Ex ante, the board cannot observe firm performance when designing compensation. Ex-post the remedies include termination, which prior research has shown to be relatively rare,[11] or pay cuts.[12] Fama (1980) indicates that this problem can largely be overcome through the wage revision process (ex-post settling up), whereby pay and performance, including the long term consequence of the CEO's decisions, would be finally balanced at the end of the CEO's career with the firm. The process requires a process to adjust pay over a CEO's career; one that can positive as well as negative adjustments. Bebchuck and Fried (2010) and Bhagat and Romano (2009) suggest restricting an executive's ability to sell his shares until post-retirement. We examine whether firms use deferred compensation as a means of ex-post settling up. Deferred compensation has a desirable property that would make it uniquely suitable to make managers be responsible for the

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[10] Survey papers on optimal contracting include Murphy (1999) and Core et al. (2001). See also Jensen and Meckling (1976), Edman and Liu (2010) Cassell et al. (2011).

[11]See Coughlan and Schmidt, 1985; Warner et al., 1988; Denis and Denis, 1995; Parrino, 1997; Huson et al., 2001; Brookman and Thistle, 2009; Ang et al., 2013. The termination rate is typically around 10%.

[12]Gao et al. (2012) examine "extreme pay cuts" of greater than 25% reduction in total compensation from the prior year compensation

consequences of their actions. This is because unlike other components of pay such as salary and bonus where once given getting back would be very difficult in practice. The same goes for options and restricted stocks in which the executives could exercise before retirement. If an executive receives annual compensation in one period based on some performance metric, which turns out to be less than expected, the firm cannot easily recover the "extra" compensation paid out. However, because deferred compensation is simply an accounting entry and is not a realized expense until the executive retires, which allows the firm to make book adjustments to deferred compensation based on ex post firm performance. Thus our first hypothesis is stated as follows:

> *H1: Deferred compensation is used as a means of ex-post settling up.*

If the hypothesis is true, we would expect to see the firm contribution increase following positive firm performance and decrease following negative firm performance.

Jensen and Meckling (1976) also suggest that executives should be compensated in a manner similar to overall firm structure in order to reduce excessive risk taking and align management with the overall firm. That is, they should be aligned with both shareholders *and* bondholders. Eaton and Rosen (1983) suggest firms use "delayed compensation" to bond executives to the firm (rather than just shareholders).[13]Little research has been done on the relationship between deferred compensation and firm leverage. Wei and Yermack (2010) examine the market response upon disclosure of "inside debt" and finds evidence to suggest that the market perceives inside debt holding as alignment with debt holders. Upon disclosure bond prices rise (increased perception of alignment with debt holders) and stock prices drop (decreased perception of alignment with shareholders). We test the relationship between firm leverage and deferred compensation. Our second hypothesis suggests there should be a positive relationship between firm leverage and deferred compensation.

> *H2: Highly levered firms pay a higher percentage of total compensation as deferred compensation (firm contributions) than less levered firms.*

3.2. *Managerial Power: Deferred Compensation as an Agency Problem*

Under the managerial power approach, executives use their position and power to extract more compensation than they otherwise would under an arm's length bargaining. However, due to "outrage costs", management prefers to receive compensation in a way that obscures total compensation. Bebchuck and Fried (2004) suggest that firms use deferred compensation and other retirement benefits to "camouflage large amounts of executive compensation".[14]

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[13]Sundaram and Yermack (2007) also support using inside debt as a means to bond the executive to the firm, noting that "inside equity aligns managers with equity holders in good states, but inside debt aligns managers with debt holders in bad states". See also Edmans and Liu (2010).

[14] Cen (2012) finds that "powerful" CEOs and firms with lower board efficiency tend to pay more inside debt, suggesting that inside debt is evidence of managerial power or rent extraction.

They note that as disclosures on current compensation increased,[15] firms shifted compensation away from bonuses and equity and instead towards post-retirement compensation (pensions, deferred compensation, post-retirement perquisites, and consulting fees). Andrews et al. (2009) find that prior to the 2006 disclosure requirements firms used perquisites to hide large amounts of compensation. Upon disclosure, firms that hid large perks suffered negative stock market reaction, with poorly governed firms suffering a greater decline.[16] We can expect similar tactics by these boards by using deferred compensation.

The 2006 compensation disclosure rule were intended to make executive compensation more transparent. The Total Compensation column in the Summary Compensation Table is supposed to include *all* compensation (current and deferred). However, because not all elements of deferred compensation are required to be disclosed in the Summary Compensation Tables, even under the new disclosure rules there is still the opportunity for firms to hide or obscure total pay. If deferred compensation is a way for firms to obscure total compensation then we would expect to see a shift in deferred compensation during periods of high attention on executive compensation or periods of high outrage. The third hypothesis is stated as follows:

> *H3: Firms use deferred compensation to hide total compensation from shareholders; firm contributions increase in periods of high outrage*

Weak board/ powerful CEO may use deferred compensation as a means to (partially) offset a pay cut but giving the appearance of doing so. Gerakos (2007) suggests that firms use "inside debt" to substitute for other forms of compensation.[17] If deferred compensation substitutes for other forms of compensation in period of 'apparent pay cut after poor performance' for cosmetic purpose, we would expect to see a positive relationship between pay cuts and firm contributions.

> *H4: Firms use deferred compensation to substitute for current compensation following a pay cut.*

4. Data and Sample Selection

4.1. *Sample Selection and Data Description*

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[15] In 1938 the SEC first adopted rules that firms must disclose compensation in their annual report or proxy statement. SEC Release No. 34-1823 (August 11, 1938) [3 Federal Register 1991]. Firms were free to choose *how* to disclose, and many firms choose long narratives. In 1992, the SEC amended the requirement that firms disclosure compensation in a standardized table format. See Executive Compensation Disclosure, Release No. 33-6962 (October 16, 1992) [57 Federal Register 48126]. Deferred compensation and other post-retirement compensation was not required to be disclosed until 2006. See Executive Compensation and Related Person Disclosure, Release No. 33-8655 (DATE) [17 CFR 228-274]

[16] The authors interpret the negative stock market reaction as consistent with managerial power. See also Yermack (2006), who finds negative market reaction of -1.65% when firms disclose executive use of company jets.

[17] He looks primarily at pensions, not deferred compensation

Our sample includes all CEOs in the S&P 1,500 for fiscal years 2006-2012. We have 11,244 firm-year observations for 2,164 individual CEOs. Annual and deferred compensation data come from Execucomp Annual Compensation and Deferred Compensation files. Annual compensation consists of salary, bonus, non-equity incentive awards, and stock and option grants. Deferred compensation consists of executive contributions, firm contributions, and earnings on the deferred balance. We include only the deferred compensation and exclude pensions and other post-retirement benefits.

Firm characteristics and performance variables come from Compustat and CRSP. Governance variables are constructed using Risk Metrics and hand-collected from the firm's proxy statement (DEF 14A) in SEC EDGAR. Because executive compensation is generally linked to firm size (Rosen, 1982; Smith and Watts, 1992) we include the log of total assets to proxy for firm size. We use several performance measures, including return on assets (ROA), net income (NI), and one-year buy-and-hold stock returns (BHR).

4.2. *Summary Statistics*

Summary statistics are displayed in Table 1. All variables are winsorized at the 1st and 99th percentile. The average firm in the S&P 1500 pays $776,000 in salary, $194,000 in bonus, and over $5.1 million in total compensation. Less than half of the CEOs in the sample receive any form of deferred compensation (executive contributions, firm contributions, or earnings). Of those who do receive deferred compensation, the average CEO defers $244,000 each year (approx. 14.2% of his annual cash pay, or 6.5% of his total annual compensation), and the average firm contribution is $156,000 per year (8.3% of annual cash pay, or 2.9% of total annual compensation).

The sample is further broken down into "Contributors" and "Non-Contributor" based on whether the firm makes a contribution to deferred compensation. When we compare Contributors to Non-Contributors we see that on average, Contributor CEOs are from larger firms (total assets), more profitable firms (net income, ROA), and invest more heavily in long-term assets (CAPX). However, these firms also tend to have higher leverage (debt/equity ratio) and are lower liquidity (cash/assets ratio). Additionally, CEOs from Contributor firms receive more current compensation (salary, bonus, total compensation) and are more likely to serve as the Chairman of the Board of Directors (duality).

5. Results for Firm Contributions to Deferred Compensation

To test whether deferred compensation is different from other forms of compensation, we examine which variables explain the various components of annual compensation (bonus, stock grants, option grants, and total compensation) and what factors explain deferred compensation (firm contributions). We then test whether the coefficients between the regressions are significantly different. The results are displayed in Table 2.

As we see in Table 2, the coefficients that load significant on each annual compensation component are significantly different from the coefficients for firm contributions, thus establishing that firm contribution are, in fact, different from other forms of compensation. The coefficients on firm contributions are most similar to the coefficients on bonus.

Comparing Firm Contributions to Bonus, we see that total assets, return on assets (ROA), asset turnover, and capital expenditures load significantly for both bonus and firm contributions. A test of the coefficients, however, shows that these variables have different impact on Bonus than on Firm Contributions (i.e., the coefficients are significantly different). Comparing other elements of annual compensation to firm contributions we find similar results – the variables that load significantly in both regressions load significantly different. The fact that deferred compensation does not duplicate other pay type provide a reason to understand better it, as there have been few in depth studies of this item.

[Insert Table 2 Here]

5.1. *Firm Contributions as an Alignment Tool*

Next we look at firm contributions to deferred compensation. Our first hypothesis predicts firms can use deferred compensation as a mechanism to achieve ex-post settling up. Fama (1980) indicates that although an executive may be overpaid relative to performance in one period, over the executive's tenure the wage revision process will result in ex-post settling up at the end of the executive's career. Relatively few studies have empirically tested whether the ex-post settling up mechanism has been applied in practice.[18] Bebchuck and Fried (2010) and Bhagat and Romano (2009) suggest firms restrict the ability of executives to cash out stock and options until after retirement. While deferred compensation need not be invested in the firm's stock, the idea is the same – to hold back some compensation until after retirement, when the manager's performance can be evaluated over his tenure. The ideal form of ex-post settling up would be for firms to make positive contributions when firm performance is good and make negative adjustments in periods when performance is poor. The data, however, could not support this stronger version of ex post settling up. An examination of the data shows that there is no instance of reduction in the deferred compensation cumulative balance after a poor performance.[19] Thus we proceed to test a weaker version of the hypothesis, which is to see whether firms decrease their contributions or not in periods when firm performance is poor.

In univariate analysis (Table 4) we examine the relationship between the change in firm performance from the prior year (increase, decrease, or same (within 5%)) and the change in firm contributions from the prior year (increase, decrease, or same (within 5%)). We use return on assets (ROA), net income (NI), and one-year buy-and-hold stock returns (BHR) to proxy for firm performance. The results are displayed in Table 4. Approximately 42.5% of the sample (2,940 firm-year observations) has an increase in ROA. Not surprisingly, the majority of this group (66.5%) increases firm contributions to deferred compensation. Nearly 40% of the sample has a decrease in ROA. If firm contributions work as an alignment tool we would expect to see most firms decrease firm contributions. However, only 27.2% of this

[18] Gao et al. (2012) examine Fama's ex-post settling up in the context of extreme pay cuts. Harford (2012) examines ex-post settling up in the director labor market.

[19] Three observations have negative values for firm contributions. On closer examination, the negative adjustments were due to the CEO leaving prior to vesting, thereby forfeiting his deferred compensation.

group actually decreases firm contributions. The results are consistent using either net income or stock returns as the performance metric: most firms increase deferred compensation following an increase in firm performance but relatively few firms decrease deferred compensation following a decrease in firm performance.

[Insert Table 4 Here]

In multivariate analysis we model firm contributions as a function of firm size, firm performance, tenure, governance, and other controls. We use both current performance (ROA), as well as lagged performance variables. Further, because several studies have shown an asymmetric relationship between positive and negative firm performance (see, for example, Gaver and Gaver (1998), Leon Wu and Zimmerman (2006)), and because we want to highlight pay reduction in periods of low performance, we also examine the positive and negative impact of these variables separately. ROA_Pos is equal to ROA if positive and zero otherwise. Likewise, ROA_Neg is equal to the absolute value of ROA if negative and zero otherwise. We follow the same method for lagged performance variables. The results are displayed in Table 5. A notable result is that firm contribution is a negative function of firm cash ratio, consistent with cash constrained firms using deferred contribution as a non cash means to pay executives. However, this explanation begs the question why the firms do not choose to use the other non cash pay such as options and restricted stocks that are more tax efficient (as in tax deductible in the current period).

According to Fama (1980), ex-post settling up (wage revision process) should occur over the executive's tenure. Thus current pay should be a function of both current and prior performance. We find little evidence to support this. In nearly all models lagged ROA is insignificant (the exception is ROA_{t-4}, significant at the 10% level). Further, when we break the performance variable into positive and negative, we see that while positive ROA increases firm contributions, there is no evidence that negative ROA decreases firm contributions. ROA_Neg (Models 3-5) positive (sometimes significant) coefficients. Because ROA_Neg is the absolute value of ROA, the positive coefficient indicates that the more negative performance, the higher the firm contributions.

[Insert Table 5 Here]

Fama's ex-post settling up theory suggests that performance and pay will equalize over the CEO's tenure. If deferred compensation were a means of ex-post settling up, we would expect firms to set aside more money in the early years (increase the holdback balance), and this amount would decrease over time as the holdback balance built up. To test this relationship we include a variable "Retire" which is the estimated number of years to retirement. We would expect to see a positive relationship between the time to retirement and the amount of firm contributions. We find the opposite. In Models 2 and 5 we see there is a negative relationship between years to retirement and firm contributions, suggesting the farther away (closer to) retirement, the less (more) deferred compensation. In unreported results we also examine the interaction between years to retire and the performance variables (ROA_Pos, ROA_Neg, and lags). We find the interaction terms insignificant and therefore do not report in our main analysis. Based on the results in Table 5 we do not find evidence to support the ex-post settling up hypothesis as related to deferred compensation.

Our second hypothesis tests whether firms use deferred compensation as a form of "inside debt". Jensen and Meckling (1976) suggest that a manager holding debt and equity compensation in similar proportion to the overall firm would be perfectly aligned with the firm and would have no incentive to shift resources from shareholders to bondholders or visa versa. To test whether firm contributions to deferred compensation are "inside debt" we regress firm contributions on the firm's leverage ratio (Total Debt divided by Total Assets). Model 1 looks only at the relationship between firm leverage and deferred compensation. The coefficient on firm leverage (Firm D/E) shows there is a positive and significant relationship between firm leverage and deferred compensation. Cen (2010) finds a non-linear relationship between inside debt and the firm's leverage ratio. For this reason we also include squared term in Model 2. We see across all models that as leverage increase, so does firm contributions to deferred compensation. Overall the results suggest that deferred compensation may be used as "inside debt" to align the CEO's incentives with the whole firm, rather than just the shareholders.

[Insert Table 6 Here]

5.2. *Firm Contributions as an Agency Problem*

Our third and fourth hypotheses indicate that firm contributions to deferred compensation represent an agency problem, in that executives use their power to extract additional rents. Bebchuck and Fried (2004) suggest that firms use deferred compensation as a means to "camouflage" total compensation. Although firm contributions are required to be reported in the NQDC tables, it is not required to be reported in the SCT, and thus not included in the "Total Compensation" column. Further, Bebchuck and Fried (2004) suggest executives use deferred compensation to hide excess compensation due to "outrage costs".

We test our third hypothesis by examining whether firms that pay "excess" current compensation also pay high deferred compensation, and whether the incentive to hide excess pay increases in periods of high outrage (or attention). Our hypothesis suggests that in periods of high outrage (attention), firms will increase contributions to deferred compensation as a means of obscuring total pay. Under this hypothesis we would expect to see that when the outrage (attention) index is high, firms that pay high excess current compensation will shift some to deferred compensation.

Excess Pay is defined as the difference between total annual compensation less 125% of the size/industry median.[20] For example, suppose a CEO earns $500,000 in total compensation. If the size/industry median is $350,000 then the excess compensation would be $500,000 – (125% * $350,000), or $125,000 excess compensation. The Outrage Index measures sentiment towards excessive executive compensation and is calculated using search volume in Google Trends. This measure captures how often a particular term is searched,

[20]Size/Industry median compensation is calculated by scaling compensation by total assets and then taking the median ratio by industry.

relative to the highest search over a specified period. We search key words such as "excess CEO compensation", "overpaid CEOs" and "say-on-pay" to see how often these words are searched on Google. We annualize the weekly search measures from Google Trends. Figure 2 shows that there is a positive relationship between excess compensation and deferred compensation. Further, the level of firm contributions relative to excess compensation is greater in periods of high outrage (sentiment, attention) than during periods of low outrage (sentiment, attention).

[Insert Table 7 Here]

We regress firm contributions on Excess Pay, the Outrage Index, and controls for firm size, tenure, and governance. The results are displayed in Table 7. In Model 1 we see there is a positive and significant relationship between Excess Pay and Firm Contributions; that is, firms that pay large amounts of excess current compensation also pay more deferred compensation. In Model 2 we add Outrage, which is also positive and significant, suggesting that firms pay more deferred compensation during periods of high outrage towards executive compensation. This is consistent with the hiding hypothesis. In Model 3 we include an interaction term to test the simultaneous relationship between excess pay during periods of high outrage. Although we lose significance on both our primary measures, we do see the interaction term is positive and significant (at the 1% level). Together with the negative coefficient on Excess Pay, these results suggest firms that pay high excess pay shift compensation towards deferred compensation in periods of high outrage. Finally, in Model 4 we include our primary controls and see the relationship between Firm Contributions, Excess Pay, and Outrage holds. Thus we find some support for the hiding hypothesis.

Our fourth hypothesis suggests that firms use deferred compensation to offset pay cuts. To test this, we study whether the executive had an "extreme pay cut". We follow Gao et al. (2012) in defining "extreme pay cut" as a decrease of more than 25% from the prior year compensation. We use Bonus as our measures for pay cuts. To control for firms that pay bi-annual bonuses we also require that the executive not have more than 25% increase from the prior year. Thus restrictions are as follows: $Bonus_t < 0.75*Bonus_{t-1}$ and $Bonus_{t-1} < 1.25*Bonus_{t-2}$. We find that approximately 16.3% of the sample experience an extreme pay cut. Pay Cut is a binary variable equal to 1 if the executive had an extreme pay cut in year t and 0 otherwise. We regress firm contributions on Pay Cut and our other control variables.

[Insert Table 8 Here]

The results are displayed in Table 8. The odd specifications look at the relationship between pay cuts (1/0) and the dollar amount of deferred compensation, while the even specifications examine the relationship between the dollar amount of pay cut and the dollar amount of deferred compensation following a pay cut. Controlling only for pay cut and size (Model 1), we see there is a positive and significant relationship between pay cut and deferred compensation. This relationship holds when we add out other control variables (Model 3). When we include Bonus and an interaction term (Model 5) we see that there is an insignificant relationship between Bonus and deferred compensation; however, the positive coefficient on the interaction term suggests that the greater the magnitude of the bonus cut, the more firms put towards deferred compensation. Thus where the executive has a pay cut, the firm increases contribution to deferred compensation. In the even models we include the absolute value of the dollar amount of the pay cut. Controlling for the amount of the pay cut (Model 2), we see a positive and significant coefficient, indicating that the greater the pay cut, the more the firm pays toward deferred compensation. The results are virtually unchanged when we include our control variables (Model 4). When we include Bonus and the interaction term (Model 6) we see the same positive relationship between the dollar amount of pay cut and firm contributions to deferred compensation. Further, we continue to see the positive coefficient on the interaction term. Overall, the results suggest that Firm Contributions to deferred compensation are used to at least partially offset the impact of a bonus cut.

6. Conclusion

In this paper we examine several hypotheses related to deferred compensation. We test whether deferred compensation is used to align managerial interests with the firm (Optimal Contracting) or is evidence of agency problems (Managerial Power). Under the alignment theory, we examine whether firms use deferred compensation as a means of ex-post settling up. We find no evidence to support this theory. Under the ex-post settling up, there should be a symmetric relationship between firm performance and deferred compensation. We find that while deferred compensation increases following positive firm performance, there deferred compensation does not decrease following negative firm performance. We also look at whether firm use deferred compensation “inside debt” to align managerial interest with the whole firm (not just the shareholders). We find some evidence to support this hypothesis. There is a positive relationship between the firm’s leverage and the amount of firm contributions to deferred compensation. Further, there is a positive (although non-linear) relationship between the CEO’s leverage and firm contributions to deferred compensation.

We also examine whether deferred compensation represents additional agency problems. We look at whether firms used deferred compensation as a means to hide excess pay or to substitute for cuts in bonus. We find support for both. Firms tend to pay more deferred compensation and shift from current compensation to deferred compensation in periods of high outrage (or periods of high attention on executive compensation). We also see evidence that firms increase deferred compensation in periods where the CEO experiences a bonus cut. Overall, our results indicate there is an inherent agency problem in deferred compensation.

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Table 1: Summary Statistics

This table displays the summary statistics for the sample period 2006-2012. The first line under each variable shows the summary statistics for the full sample, while the second and third line break the sample into whether the firm made contributions to deferred compensation (Firm Contributions) or not (No Firm Contributions). Values are winsorized at the 1st and 99th percentiles and are scaled in thousands of dollars. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Variable	N	Mean	Median	Min (1%)	Max (99%)	Std. Dev.
Salary						
Full Sample	11,244	776.14	740.24	0.00	2,000.00	353.19
Firm Contributions	3,773	929.19	900.00	0.00	2,000.00	343.38
No Firm Contributions	7,471	698.84	650.00	0.00	2,000.00	332.27
Bonus						
Full Sample	11,244	194.70	0.00	0.00	4,000.00	621.63
Firm Contributions	3,773	222.12	0.00	0.00	4,000.00	720.84
No Firm Contributions	7,471	180.85	0.00	0.00	4,000.00	564.49
Total Compensation (TDC1)						
Full Sample	11,235	5,154.15	3,451.58	169.76	29,124.01	5,249.66
Firm Contributions	3,767	6,891.33	5,232.92	169.76	29,124.01	5,839.71
No Firm Contributions	7,468	4,277.89	2,706.71	169.76	29,124.01	4,687.44
Firm Contributions						
Full Sample	11,244	52.35	0.00	0.00	1,094.61	151.25
Firm Contributions	3,773	156.00	72.69	0.01	1,094.61	228.07
No Firm Contributions	7,471	0.00	0.00	0.00	0.00	0.00
Executive Contributions						
Full Sample	11,244	122.01	0.00	0.00	2,445.89	373.66
Firm Contributions	3,773	244.04	56.18	0.00	2,445.89	503.66
No Firm Contributions	7,471	60.38	0.00	0.00	2,445.89	265.95
Earnings on Deferred Comp						
Full Sample	11,244	103.62	0.00	-99,832.13	78,014.36	2,173.43
Firm Contributions	3,773	195.91	41.32	-99,832.13	78,014.36	3,142.72
No Firm Contributions	7,471	57.02	0.00	-40,964.00	45,635.38	1,454.64

Variable	N	Mean	Median	Min (1%)	Max (99%)	Std. Dev.
Balance of Deferred Comp						
Full Sample	11,244	2,337.88	45.59	0.00	224,872.93	8,835.58
Firm Contributions	3,773	4,661.84	1,415.78	0.00	224,872.93	11,726.13
No Firm Contributions	7,471	1,164.23	0.00	0.00	201,669.01	6,630.28
Firm Contr / (Salary + Bonus)						
Full Sample	4,581	0.0687	0.0270	0.0000	1.1819	0.1534
Firm Contributions	3,772	0.0835	0.0369	0.0000	1.1819	0.1653
No Firm Contributions	809	0.0000	0.0000	0.0000	0.0000	0.0000
Exec Contr / (salary + Bonus)						
Full Sample	4,559	0.1473	0.0447	0.0000	1.0000	0.2434
Firm Contributions	2,860	0.1421	0.0511	0.0000	1.0000	0.2258
No Firm Contributions	1,699	0.1562	0.0126	0.0000	1.0000	0.2702
Tenure (as CEO)						
Full Sample	11,244	7.14	5.00	1.00	61.79	6.62
Firm Contributions	3,773	6.47	5.00	1.00	50.12	5.71
No Firm Contributions	7,471	7.47	5.00	1.00	61.79	7.01
Total Assets						
Full Sample	9,148	6,726.01	1,718.47	45.82	90,248.00	13,757.71
Firm Contributions	3,115	11,047.04	3,779.32	107.40	90,248.00	17,800.71
No Firm Contributions	6,033	4,494.95	1,100.75	45.82	90,248.00	10,431.55
Net Income						
Full Sample	9,138	338.82	71.90	-1,497.50	6,490.00	978.72
Firm Contributions	3,115	616.64	168.00	-1,497.50	6,490.00	1,298.99
No Firm Contributions	6,023	195.13	46.11	-1,497.50	6,490.00	721.28
Return on Assets (ROA)						
Full Sample	11,109	0.0837	0.0775	-0.2652	0.3756	0.0922
Firm Contributions	3,741	0.0929	0.0846	-0.2652	0.3756	0.0759
No Firm Contributions	7,368	0.0790	0.0736	-0.2652	0.3756	0.0991

Variable	N	Mean	Median	Min (1%)	Max (99%)	Std. Dev.
Stock Returns (BHR)						
Full Sample	10,452	0.1267	0.0740	-0.9911	28.0952	0.6911
Firm Contributions	3,570	0.1108	0.0861	-0.9744	28.0952	0.6542
No Firm Contributions	6,882	0.1349	0.0661	-0.9911	25.0800	0.7095
Debt/Equity Ratio						
Full Sample	8,582	0.6576	0.3736	-4.5500	10.3317	1.5219
Firm Contributions	2,969	0.8439	0.5390	-4.5500	10.3317	1.6541
No Firm Contributions	5,613	0.5591	0.2648	-4.5500	10.3317	1.4374
Cash/Asset Ratio						
Full Sample	8,619	0.1647	0.1052	0.0009	0.7175	0.1666
Firm Contributions	2,974	0.1029	0.0693	0.0009	0.7175	0.1058
No Firm Contributions	5,645	0.1973	0.1406	0.0009	0.7175	0.1828
Asset Turnover						
Full Sample	8,620	1.0716	0.8946	0.1612	3.7088	0.7006
Firm Contributions	2,974	1.0796	0.9315	0.1612	3.7088	0.7030
No Firm Contributions	5,646	1.0674	0.8759	0.1612	3.7088	0.6994
Capital Expenditures (CAPX)						
Full Sample	8,617	330.01	59.60	0.50	4,808.00	762.01
Firm Contributions	2,973	577.27	138.30	0.50	4,808.00	1,047.61
No Firm Contributions	5,644	199.76	35.88	0.50	4,808.00	509.29
Duality (1/0)						
Full Sample	11,244	0.5187	1.0000	0.0000	1.0000	0.4997
Firm Contributions	3,773	0.5955	1.0000	0.0000	1.0000	0.4909
No Firm Contributions	7,471	0.4799	0.0000	0.0000	1.0000	0.4996

Table 2: Preliminary Analysis

In this table we test to see whether firm contributions to deferred compensation are significantly different from other forms of compensation.. The dependent variable is the amount of firm contributions and independent variables are factors common to executive compensation. We test whether the coefficients are significantly different for the two equations using the lincom command in stata. Z-scores

	Regressions					Difference in Coefficients			
	Bonus	Stock	Options	Total	Firm Contr	Bonus	Stock	Options	Total
Total Assets	0.0056***	0.0725***	0.0997***	0.2170***	0.0016***	0.0039***	0.0709***	0.0980***	0.2153***
	[7.07]	[16.30]	[23.77]	[35.77]	[7.85]	[2.45]	[9.44]	[4.66]	[18.28]
ROA	179.9321***	1,178.1611***	2,293.9009***	5,684.4180***	99.1758***	80.7562	1,078.9850***	2,194.7250***	5,585.2420***
	[2.76]	[3.24]	[6.69]	[11.45]	[5.78]	[1.27]	[2.35]	[6.72]	[11.19]
Debt/Equity	3.5091	41.8132*	24.2669	85.9358***	2.2236**	1.2858	39.5896*	22.0433	83.7123***
	[0.90]	[1.92]	[1.18]	[2.89]	[2.17]	[0.26]	[1.91]	[1.00]	[2.80]
Cash/Assets	-48.1003	-614.1724***	180.8804	-1,466.5023***	-63.8247***	15.7244	-550.3476***	244.7051	-1,408.678***
	[-1.21]	[-2.77]	[0.87]	[-4.85]	[-6.11]	[0.46]	[-2.95]	[1.27]	[-4.59]
Asset Turnover	-60.5408***	-192.4307***	-307.0881***	-562.8691***	-6.8097**	-53.7311***	-185.6211***	-300.2784***	-556.0594***
	[-5.64]	[-3.21]	[-5.44]	[-6.89]	[-2.41]	[-5.45]	[-3.61]	[-7.00]	[-7.22]
Cap. Expenses	0.0028	0.4063***	-0.7908***	-0.003	0.0251***	-0.0222	0.3813**	-0.8158***	-0.028
	[0.19]	[4.85]	[-10.91]	[-0.03]	[6.34]	[-0.78]	[2.33]	[-2.69]	[-0.14]
Tenure (as CEO)	4.7300***	-23.6409***	17.3375***	-36.6017***	0.1239	4.6061***	-23.7643***	17.2136	-36.7257***
	[5.38]	[-4.82]	[3.75]	[-5.47]	[0.54]	[4.77]	[-5.13]	[1.21]	[-5.17]
Duality	2.4323	303.0875***	-7.5974	1,020.8138***	17.3101***	-14.8778	285.7773***	-24.9076	1,003.5040***
	[0.20]	[4.39]	[-0.12]	[10.85]	[5.32]	[-1.30]	[4.16]	[-0.21]	[10.11]
Observations	8,578	8,574	8,572	8,571	8,578				
R-squared	0.0853	0.1967	0.1242	0.4153	0.1182				

Table 3: Probability of Firm Contributions

This table examines the probability that a firm will make a contribution to deferred compensation in a given year as a function of firm size, profitability, and other control variables. Contribution equal 1 if the firm made a contribution in the fiscal year and zero otherwise. The equation is as follows:

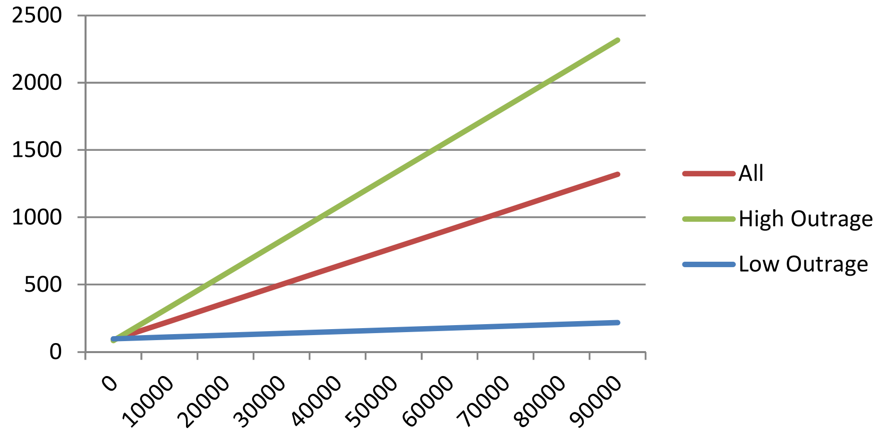
$$Pr(Contributions_t) = a + b_1 log(Assets) + b_2 ROA + b_3 D/E + b_4 (Controls)$$

where log(Assets) is the natural log of total assets, ROA is the return on assets, which proxies for firm performance, D/E is the firm's debt-to-equity ratio, and controls include free cash flow, asset turnover, capital expenditures, tenure (the number of years the individual has served as CEO), and duality (whether the CEO is also the chairman of the board). ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively. Z-scores are shown in brackets.

	Probability of Firm Contribution		**Probability of Increase**	
Variable	Model 1	Model 2	Model 3	Model 4
Log(Assets)	0.2463***	0.2486***	0.1771***	0.1722***
	[17.98]	[17.24]	[11.45]	[10.30]
ROA	1.3311***	1.3518***	0.9521***	1.0946***
	[6.86]	[6.70]	[4.30]	[4.65]
D/E Ratio	0.009	.0173*	0.0117	0.0131
	[0.94]	[1.75]	[1.10]	[1.17]
Cash/Assets	-1.8290***	-1.8355***	-1.1879***	-1.2304***
	[15.26]	[-13.89]	[-8.58]	[-7.85]
Asset Turnover	0.0909***	0.1406***	0.0661***	0.1007***
	[4.11]	[4.94]	[2.67]	[3.00]
CAPX	0.0001	0.0001	-0.0003	-0.0001
	[0.52]	[0.66]	[-1.21]	[-0.51]
Tenure	-0.0178***	-0.0168***	-0.0061**	-0.0084***
	[-7.35]	[-6.80]	[-2.24]	[-2.88]
Duality	0.1671***	0.1388***	0.1319***	0.1161***
	[5.22]	[4.22]	[3.62]	[3.01]
Year FE	No	Yes	No	Yes
Ind. FE	No	Yes	No	Yes
N	8,578	8,578	8,578	8,578
R2	0.1414	0.1648	0.0705	0.1314

Figure 1: Excess Current Compensation and Deferred Compensation

Model: Firm Contributions (Y) = Excess Pay (X)



This figure graphs the relationship between excess pay (X) and deferred compensation (Y). Excess Pay is defined as the difference between actual pay minus 125% of size/industry median pay. The Outrage Index is a measure based on how often searches on “excess compensation” “overpaid CEO”, “say-on-pay” etc. are searched. High outrage indicates periods of high search volume on these and similar terms that indicate dissatisfaction with excess executive compensation.

Table 4: Univariate Analysis on Firm Contributions and Ex-Post Settling Up

Firm Contributions to Deferred Compensation
Number of Firm-Year Observations

	Increase		Same (within 5%)		Decrease		Total	
	Number	% of Sample	Number	% of Sample	Number	% of Sample	Number	% of Sample
ROA Increase	1067	66.52%	269	16.77%	268	16.71%	1604	42.52%
ROA Same (within 5%)	415	60.85%	135	19.79%	132	19.35%	682	18.08%
ROA Decrease	841	56.56%	242	16.27%	404	27.17%	1487	39.41%
	2323		646		804		3773	
NI Increase	1329	65.15%	337	16.52%	374	18.33%	2040	54.07%
NI Same (within 5%)	216	61.02%	77	21.75%	61	17.23%	354	9.38%
NI Decrease	778	56.42%	232	16.82%	369	26.76%	1379	36.55%
	2323		646		804		3773	
BHR Increase	968	57.55%	301	17.90%	413	24.55%	1682	44.58%
BHR Same (within 5%)	164	70.09%	25	10.68%	45	19.23%	234	6.20%
BHR Decrease	1191	64.14%	320	17.23%	346	18.63%	1857	49.22%
	2323		646		804		3773	

Table 5: Multivariate Regression Analysis on Firm Contributions and Ex-Post Settling Up

This table examines the relationship between firm contributions to deferred compensation and firm performance. We use return on assets (ROA) as our primary measure of firm performance and include lags of return on assets. Return on Assets (ROA) is defined as Net Income divided by Total Assets. Panel A examine the relationship between the dollar value of deferred compensation and firm performance while Panel B examines the probability that a firm will increase deferred compensation based on firm performance. T-stats are shown in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Log(Assets)	14.6552***	14.3433***	15.5778***	15.6423***	15.2227***
	[10.17]	[10.09]	[11.19]	[11.17]	[11.00]
ROA	67.9262**	67.2291**			
	[2.55]	[2.52]			
ROA_Pos			129.8506***	101.9991***	100.8507***
			[5.72]	[2.88]	[2.85]
ROA_Neg			104.3573**	87.2252	80.9097
			[2.19]	[1.56]	[1.45]
ROA_1	42.1621	43.5034			
	[1.55]	[1.60]			
ROA_2	-14.0311	-13.3826			
	[-0.52]	[-0.50]			
ROA_3	6.0756	7.1322			
	[0.23]	[0.27]			
ROA_4	-43.1849*	-41.6014*			
	[-1.77]	[-1.70]			
ROA_5	2.3294	1.882			
	[0.15]	[0.12]			
D/E Ratio	1.0807	1.1847	1.3081	1.3367	1.4337
	[1.22]	[1.12]	[1.27]	[1.30]	[1.39]
Cash/Assets	-39.0031***	-36.8212***	-41.5480***	-42.2087***	-39.5925***
	[-3.39]	[-3.20]	[-3.73]	[-3.78]	[-3.54]
Asset	-2.8968	-3.1411	-3.5009	-3.5009	-3.6899
	[-0.98]	[-1.06]	[-1.22]	[-1.22]	[-1.28]
CAPX	0.0339***	0.0340***	0.0324***	0.0323***	0.0325***
	[11.90]	[11.93]	[11.67]	[11.59]	[11.65]
Tenure (as	0.3234		0.3314	0.3351	
	[1.36]		[1.43]	[1.44]	
Duality	14.0033***	12.0387***	14.0668***	14.0066***	12.3984***
	[4.12]	[3.60]	[4.30]	[4.28]	[3.86]
Yrs to Retire		-0.9255***			-0.8574***
		[-4.01]			[-3.88]
Year FE	Yes	Yes	Yes	Yes	Yes
Ind FE	Yes	Yes	Yes	Yes	Yes
N	8,220	8,210	8,578	8,575	8,565
R2	0.1251	0.1267	0.1251	0.1252	0.1266

Table 6: Inside Debt

This table examines the relationship between firm contributions and leverage. We examine both firm leverage (Firm D/E) and CEO leverage (CEO D/E). Firm leverage is defined as Total Debt divided by Total Assets. CEO Leverage is defined as the percentage of CEO holdings that is deferred compensation relative to total debt and equity holdings. We measure firm contributions as a function of firm size, performance, firm leverage, CEO leverage, and controls. T-stats are displayed in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Variable	Model 1	Model 2
Log(Assets)	14.6178***	14.5854***
	[10.66]	[10.62]
ROA	71.6468***	71.8922***
	[4.14]	[4.15]
D/E Ratio	1.2238*	1.945*
	[1.72]	[1.69]
D/E Ratio^2		-0.1165
		[-0.61]
Cash/Asset	-32.8927***	-32.4568***
	[3.01]	[-2.96]
Asset Turnover	-2.3409	-2.2613
	[-0.82]	[-0.79]
CAPX	0.0336***	0.0336***
	[12.14]	[12.13]
Tenure (as CEO)	0.2912	0.2862
	[1.26]	[1.23]
Duality	13.9174***	13.9407***
	[4.25]	[4.26]
Year FE	Yes	Yes
Ind FE	Yes	Yes
Observations	8,578	8,578
R-squared	0.1235	0.1235

Table 7: Hiding Hypothesis

This table examine the relationship between firm contributions, excess compensation, and outrage over executive compensation. Excess Pay is defined as the difference between actual pay minus 125% of size/industry median pay. The Outrage Index is a measure based on how often searches on “excess compensation” “overpaid CEO”, “say-on-pay” etc. are searched. High outrage indicates periods of high search volume on these and similar terms that indicate dissatisfaction with excess executive compensation. All values are in thousands of dollars. T-stats are shown in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Variable	Model 1	Model 2	Model 3	Model 4
Excess Pay	0.0036**	0.0037**	-0.0009	-0.0051
	[2.21]	[2.23]	[-0.40]	[-1.88]
Outrage		0.0022*	0.0019	0.0014
		[1.78]	[0.87]	[0.63]
Excess Pay * Outrage			0.0068***	0.0013**
			[2.65]	[2.39]
Log(Assets)	23.6748***	23.7176***	23.7656***	14.8307***
	[24.33]	[24.38]	[24.41]	[10.77]
ROA				71.3314***
				[416]
Firm D/E				1.2246*
				[1.59]
Cash/Asset				-32.8819***
				[-3.01]
Asset Turnover				-2.2691
				[-0.79]
CAPX				0.0342***
				[12.27]
Tenure (as CEO)				0.2912
				[1.26]
Duality				13.9628***
				[4.27]
Year FE	Yes	Yes	Yes	Yes
Ind FE	Yes	Yes	Yes	Yes
N	9148	9148	9148	7850
R2	0.0951	0.0951	0.0958	0.1249

Table 8: Substitution Hypothesis

This table examine the relationship between pay cuts and firm contributions to deferred compensation. We defined pay cut as a 25% or more decrease in bonus from the prior year. However, to ensure that we are not simply capturing firms that pay bi-annual bonuses we also require that the bonus had not increase more than 25% from the prior year. Thus $Bonus_t < 0.75*Bonus_{t-1}$ and $Bonus_{t-1} < 1.25*Bonus_{t-2}$.The odd specifications examine whether a pay cut (1/0) impacts the dollar value of deferred compensation using OLS regression. The even specifications estimate the magnitude of the substitution effect using the dollar amount of the pay cut as an explanatory variable. All values are in thousands of dollars. T-stats are shown in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Variable	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Pay Cut (1/0)	5.9811***		5.5811***		10.5860***	
	[2.69]		[3.06]		[2.78]	
Pay Cut ($)		0.00685***		0.00677***		0.0071***
		[5.54]		[5.37]		[5.49]
Bonus					0.0022	0.0017
					[1.62]	[1.24]
Cut*Bonus					0.0031**	0.0003**
					[2.44]	[2.35]
Log(Assets)	23.9195***	24.9980***	14.5723***	14.6318***	14.5704***	14.5601***
	[24.81]	[23.69]	[10.61]	[9.80]	[10.60]	[9.47]
ROA			72.2212***	79.0003***	72.5725***	78.7503***
			[4.17]	[4.17]	[4.19]	[4.16]
D/E Ratio			1.1991	1.4051	1.1894	1.396
			[1.17]	[1.26]	[1.16]	[1.25]
Cash/Asset			-33.0106***	-38.0213***	-33.0004***	-38.0534***
			[-3.02]	[-3.18]	[-3.02]	[-3.18]
Asset Turnover			-2.4692	-2.7639	-2.4863	-2.6713
			[-0.86]	[-0.89]	[-0.87]	[-0.87]
CAPX			0.0337***	0.0347***	0.03334***	0.0344***
			[12.15]	[11.69]	[11.99]	[11.54]
Tenure (as CEO)			0.3041	0.0853	0.3062	0.0613
			[1.31]	[0.34]	[1.32]	[0.25]
Duality			13.9210***	14.0739***	13.9022***	14.0749***
			[4.26]	[3.99]	[4.25]	[3.99]
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Ind FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,148	8,270	8,578	7,803	8,578	7,803
R-squared	0.095	0.101	0.124	0.129	0.124	0.129

Credit Valuation Adjustment of Cap and Floor with Counterparty Risk: A Structural Pricing Model for Vulnerable European Options

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This study develops a structural pricing model based on the Black 76 formula (Black, 1976) for the evaluation of the Credit Value Adjustment (CVA) of OTC traded caps and floors, which is mandated as an integral part of Basel III (Basel III, 2011). The proposed structural pricing model improves the existing structural pricing models for vulnerable European options by Klein and Inglis (Journal of Banking and Finance 25: 993-1012, 1999) and Liao and Huang (Quantitative Finance 5 (5): 443-457, 2005) by allowing payments made after the exercise of the options. Four crucial determinants of caps' and floors' CVAs are identified by the proposed structural model, they are: the cap's/floor's tenor, the correlation between the cap's/floor's underlying and the writer's asset value, the volatility of the writer's asset value, and the writer's aggregate liabilities. Numerical examples are given to demonstrate the effects of the four parameters. Compared to the market practice of CVA calculation based on reduced-form models, the four crucial parameters are the unique features of the proposed structural model.

Keywords: Structural pricing model; Credit Value Adjustment (CVA); Cap; Floor; Basel III; Tenor; Aggregate liabilities; Reduced-form model.

1. INTRODUCTION

After the 2008 financial crisis, the Basel Committee on Banking Supervision noted that roughly two-thirds of credit losses were due to counterparty's creditworthiness deterioration and only one-third were due to counterparty defaults. For this reason, accurate valuation of the market value of counterparty credit risk is now mandated as an integral part of accounting rules and Basel III (Basel III 2011). Under these regulatory initiatives, larger institutions need to calculate the Credit Value Adjustment (CVA), which is the difference between the values of the OTC derivatives calculated with and without counterparty credit risk exposures, respectively (Basel III 2011).

The market practice often adopted the reduced-form models to calculate the CVAs (Sorensen and Bollier 1994; Picault 2005; Cespedes, Rosen and Saunders 2010; Rebonato et al. 2010; Pengelley 2011; Basel III 2011; Hull and White 2012; Rosen and Saunders 2012; and Cherubini 2013). According to the Basel III, the counterparty's default probability is assumed to be independent of the market variables that underlie the derivative exposures, which is in line with the assumption made by the pioneering paper on the credit risk in swap contracts by Sorensen and Bollier (1994). In practice, however, the market variables and the counterparty's default probability are not independent. If the market value of the derivative exposure increases as the counterparty's credit quality deteriorates, the associated risk is referred as the wrong-way risk (WWR) (Cespedes, Rosen and Saunders 2010; Rosen and Saunders 2012; Hull and White 2012; Cherubini 2013). To the contrary, if the value of the derivative exposure decreases as the counterparty's credit quality deteriorates, right-way risk (RWR) occurs.

The wrong-way risk (WWR) can represent a significant increase in the CVAs, as compared to the CVAs calculated under the assumption that the market variables and the counterparty's credit risk are independent (Rosen and Saunders 2012; Hull and White 2012; Cherubini 2013). To handle the WWR, the simplest way is to use the alpha multiplier approach (Cespedes, Rosen and Saunders 2010), in which the market values of the derivative exposures are enlarged by the alpha multiplier and the CVA is calculated under the framework that the market variables and the counterparty's default probability are independent. Alternatively, one can increase the counterparty's default probability to reflect the positive relationship between the market value of the derivative exposure and the counterparty's default probability (Hull and White 2012). The third approach to handle WWR is to employ the copula technique to evaluate the CVAs, in which the unobservable dependence structure between the market values of derivative exposures and the counterparty's default probability is built based on a flexible copula function (Rosen and Saunders 2012; Cherubini 2013).

Instead of a reduced-form model, this study develops a structural model for the evaluation of OTC traded caps' and floors' CVAs, which are amongst the largest and most liquid derivatives market (Gupta and Subrahmanyam 2005). Being a strip of caplets/floorlets, the market practice of pricing non-vulnerable caps/floors is based on the Black 76 formula for European call/put options (Black, 1976; Brace, Gatarek, and Musiela 1997; Jamshidian 1997). To take into consideration of the counterparty's credit risk, this study adopts the framework of the existing structural models for vulnerable European options (John and Stulz 1987; Klein 1996; Klein and Inglis 1999;

Klein and Inglis 2001; Cherubini 2002; Liao and Huang 2005), in which the counterparty's asset value is dynamically modelled by a stochastic process. In addition, as the transactions of a cap (floor) might be only a small part of the counterparty's OTC book, a default threshold that represents the sum of all the liabilities in the counterparty's OTC book is assumed (Klein 1996; Klein and Inglis 1999; Liao and Huang 2005). In this way, the possible default due to other liabilities in the counterparty's OTC book (Rosen and Saunders 2012) is also considered.

Compared to the existing structural pricing models for vulnerable European options (John and Stulz 1987; Klein 1996; Klein and Inglis 1999; Klein and Inglis 2001; Cherubini 2002; Liao and Huang 2005), which are mainly developed for options with payments made upon the exercises of the options, the proposed structural model improves the existing structural models by allowing payments to be made one period of time after the exercise of the option. In this way, the proposed structural model fits into the purpose of the valuation of the caplet/floorlet in which the payment is made one tenor after the exercise of the caplet/floorlet at its reset date.

Four parameters that are crucial determinants of caps' and floors' CVAs are identified by the proposed structural model, they are: the cap's/floor's tenor, the correlation ρ between the cap's/floor's underlying and the writer's asset value V, the volatility σ_V of the writer's asset value V, and the writer's aggregate liabilities D. Numerical examples are given to demonstrate the effects of the four parameters. In summary, this study finds that: 1) Caps and floors having longer tenors have larger CVAs; 2) The correlation ρ has a negative effect on a cap's CVAs, and a positive effect on a floor's CVAs. The effect of the correlation ρ is most pronounced for the out-of-money caps or floors; 3) The volatility σ_V of the writer's asset has a positive effect on the CVAs: for a cap contract, the effect of the volatility σ_V is most (least) significant as the correlation $\rho = -0.9$ ($=0.9$). On the other hand, for a floor contract, the effect of the volatility σ_V is most (least) significant as the correlation $\rho = 0.9$ ($= -0.9$).

4) The aggregate liabilities D has a positive effect on the CVAs, however, the shorter the tenor, the less sensitivity of the CVAs to the aggregate liabilities D.

This paper is organized as follows. Literature review of the pricing of vulnerable European options is given in Section 2. A structural pricing model for vulnerable European options with deferred payment is developed in Section 3. The CVA of a cap or a floor is derive in Section 4. Numerical examples that illustrate the calculation of the CVAs are given in Section 5. Section 6 concludes.

2. REVIEW OF PRICING MODELS OF VULNERABLE EUROPEAN OPTIONS

In literature, there are two types of pricing models for vulnerable options subject to pre-settlement default events, they are the reduced-form and structural models, respectively (John and Stulz 1987; Klein 1996; Hull and While 1995; Jarrow and Turnbull 1995; Klein and Inglis 1999; Klein and Inglis 2001; Liao and Huang 2005). In the reduced-form approach, default occurs if a vector of exogenously determined state variables ϕ reaches a specified default boundary for the first time before the option's maturity date (Hull and White 1995; Jarrow and Turnbull 1995). In case of default, the option holder was paid by the nominal amount of the option times a stochastic paid-out ratio that is determined by the state variables ϕ. Usually, two independent diffusion processes are assumed for the option's underlying and the vector of state variables ϕ. Nevertheless, the independent assumption is only sensible when the option writer's total asset is well-diversified or fully-hedged (Hull and White 1995). For most situations, the assumption is not realistic. In particular, when firms issue options to hedge their price risks, it is almost certain the option issuer's total asset is correlated with the option's underlying (Klein 1996).

In contrast to the reduced-form models, the structural models address the correlation between the option's underlying and the writer's total asset. Johnson and Stulz (1987) pioneer the work in developing a structural model for the pricing of vulnerable call options. By assuming the option is the only liability of the option writer and default occurs when the writer's total asset value is less than the option's payoff at the maturity date T_m, Johnson and Stulz's model explains the substantial reduction in the prices of vulnerable European call (put) options when the writer's asset is strongly positively (negatively) correlated with the option's underlying asset.

Since in most business settings, the liability attributed to the option takes only a very small proportion of the option writer's aggregate liabilities, Klein (1996) extends Johnson and Stulz (1987) by allowing the option writer to have other liabilities which rank equally with the underlying option. It is assumed the aggregate liabilities at the maturity date T_m of the option is a constant D and default occurs if the option writer's total asset value is less than D at T_m. In the event of default, a proportion of the nominal claim is paid out, which depends on the bankruptcy cost and the option writer's total asset at the maturity T_m. Later, Klein and Inglis (1999) generalize the framework of Klein (1996) by incorporating a stochastic interest rate (Vasicek 1977). Klein and Inglis (2001) consider a stochastic default barrier which is the sum of the stochastic default barrier of Johnson and Stulz (1987) and the deterministic default barrier of Klein (1996) to account for the situation that the option represents a significant proportion of the writer's aggregate liabilities and the outgrow of the option's value may be the primary cause of the writer's financial distress.

All the aforementioned structural models assume that default can occur only at the maturity T_m. Liao and Huang (2005) extend the structural model of Klein and Inglis (1999), in which default is allowed to occur prior to the maturity T_m with default boundary modeled as the discounted value of the writer's aggregate liabilities at the maturity T_m. In the following, a structural model that extends Liao and Huang (2005) by allowing the default to occur prior to the maturity T_m as well as during the maturity T_m and the payment date T_p, T_m<T_p, is developed.

3. VALUATION OF VULNERABLE OPTIONS WITH DEFERRED PAYMENT

In this section, the traditional Black-Scholes economy is followed to value a vulnerable European option issued by a writer subject to credit risk under the assumption of no arbitrage. For $0<t<T_p$, let $P(t, T_p)$ be the time-t price of a discount zero-coupon bond paying \$1 at time T, and Q be the T_p-forward measure that uses $P(t, T_p)$ as the numeraire. Under the T_p-forward measure Q, $X(t)/P(t, T_p)$ is a martingale for the price $X(t)$ of any traded asset (Harrison and Kreps 1979), and therefore

$$X(t)=P(t,T_p)E_Q\left[\frac{X(T)}{P(T,T_p)}\bigg|\mathcal{F}_t\right] \tag{3.1}$$

for $0\le t<T\le T_p$, the expectation E_Q is taken with respect to the T_p-forward measure Q, and $\mathcal{F}_t$ is the information set up to the time t.

Suppose an option writer has competing liabilities outstanding of equal rankings and the aggregate amount of the liabilities at the payment date T_p is D. Similar to Liao and Huang's structural model for vulnerable European option (Liao and Huang 2005), default occurs as soon as the option writer's total asset $V(t)$ is less than the default boundary, which is the discounted value of the aggregate liability $P(t, T_p)D$. Let τ_D be the default time and α represents the percentage of the deadweight costs associated with the default event. If no default occurs, the payoff $X(T_p)$ at the payment date T_p is the full payment $(S(T_m)-K)^+$ for the call and $(K-S(T_m))^+$ for the put options, where $S(T_m)$ is the price of the underlying asset at the maturity date T_m and K is the option's strike price. As default occurs, the scrap value of the writer's asset is $(1-\alpha)V(\tau_D)$ and the option's payoff $X(T_p)$ at the payment date T_p is $(1-\alpha)(S(T_m)-K)^+$ for the call and $(1-\alpha)(K-S(T_m))^+$ for the put, respectively. Therefore at the payment date T_p, the option's value is

$$C(T_p)=(S(T_m)-K)^+-\alpha(S(T_m)-K)^+1_{\{\tau_D\le T_p\}} \tag{3.2}$$

$$P(T_p)=(K-S(T_m))^+-\alpha(K-S(T_m))^+1_{\{\tau_D\le T_p\}} \tag{3.3}$$

for the call and put, respectively, $1_{\{\}}$ is the indicator function. According to (3.1), the time-0 value $C(0)$ of a vulnerable European call and time-0 value $P(0)$ and of a vulnerable European put with payoff $X(T_p)$ at the payment date T_p are respectively

$$C(0)=B(0,T_p)\left(E_Q\left[(S(T_m)-K)^+\middle|\mathfrak{F}_0\right]-\alpha E_Q\left[(S(T_m)-K)^+1_{\{\tau_D\le T_p\}}\middle|\mathfrak{F}_0\right]\right) \tag{3.4}$$

$$P(0)=B(0,T_p)\left(E_Q\left[(K-S(T_m))^+\middle|\mathfrak{F}_0\right]-\alpha E_Q\left[(K-S(T_m))^+1_{\{\tau_D\le T_p\}}\middle|\mathfrak{F}_0\right]\right) \tag{3.5}$$

Since the option's underlying asset $S(t)$ is a martingale under the T_p-forward measure Q, and the evolution of $S(t)$ follows

$$dS(t)=\sigma_S S(t)dW_S(t) \tag{3.6}$$

where W_S is a standard Brownian motion under the T_p-forward measure Q. If assuming the option writer's asset $V(t)$ is tradable, then the evolution of the writer's forward asset value

$$V_F(t)=V(t)/P(t,T_p) \tag{3.7}$$

is a martingale and its evolution follows

$$dV_F(t)=\sigma_V V_F(t)dW_V(t) \tag{3.8}$$

where W_V is a standard Brownian motion under the T_p-forward measure Q, which is correlated with W_S and has the instantaneous correlation ρ. The time-0 values $C(0)$ and $P(0)$ are derived explicitly as follows.

Lemma 3.1. Under the framework (3.6)-(3.8), the time-zero prices $C(0)$ and $P(0)$ of a vulnerable European call and put options with maturity and payment dates at T_m and T_p, $T_p>T_m$, are respectively

$$\begin{aligned}C(0)=&\ P(0,T_p)\int_{-\infty}^{\infty}h_1(f)g(f)df\\ &-\alpha P(0,T_p)\int_{-\infty}^{\ln D}h_1(f)\times\left[1-Pr\{U(T_m)>\ln D\mid L_F=f\}\right]g(f)df\\ &-\alpha P(0,T_p)\int_{\ln D}^{\infty}h_1(f)Pr\{U(T_p)\le\ln D\mid U(T_m)>\ln D, L_F=f\}\times Pr\{U(T_m)>\ln D\mid L_F=f\}g(f)df\end{aligned}$$

$$
\begin{aligned}
P(0) = {} & P(0,T_p)\int_{-\infty}^{\infty} h_2(f)g(f)df \\
& - \alpha P(0,T_p)\int_{-\infty}^{\infty} h_2(f)\times\left[1 - Pr\{U(T_m) > \ln D \mid L_F = f\}\right]g(f)df \\
& - \alpha P(0,T_p)\int_{\ln D}^{\infty} h_2(f)Pr\{U(T_p) \le \ln D \mid U(T_m) > \ln D, L_F = f\}\times Pr\{U(T_m) > \ln D \mid L_F = f\}g(f)df
\end{aligned}
$$

where $g(f)$ if the probability density function of a normal distribution with mean

$$\mu(f) = \ln S(0) - \sigma_S^2 T_m / 2 + \rho\sigma_S[f - \ln V(0) + \ln P(0,T_p) + \sigma_V^2 T_m / 2]/\sigma_V$$

and variance $\sigma_m^2 = \sigma_S^2(1-\rho^2)T_m$. The functions

$$
\begin{aligned}
h_1(f) = {} & E_Q\left[(S(T_m) - K)^+ \mid L_F = f\right] \\
& = e^{\mu(f)+\sigma_m^2/2}\Phi\left(\frac{-\ln K + \mu(f) + \sigma_m^2}{\sigma_m}\right) - K\Phi\left(\frac{-\ln K + \mu(f)}{\sigma_m}\right) \\
h_2(f) = {} & E_Q\left[(K - S(T_m))^+ \mid L_F = f\right] \\
& = -e^{\mu(f)+\sigma_m^2/2}\Phi\left(\frac{\ln K - \mu(f) - \sigma_m^2}{\sigma_m}\right) + K\Phi\left(\frac{\ln K - \mu(f)}{\sigma_m}\right)
\end{aligned}
$$

Proof. In Appendix A and B.

4. CREDIT VALUATION ADJUSTMENT OF CAP/FLOOR

The standard model of credit valuation adjustment (CVA) was first proposed by Sorensen and Bollier (1994) for vanilla swap contracts, in which the fixed-rate paying party, namely A, pays a stream of fixed-rate coupons and receives payments indexed to a reference floating interest rate such as EURIBOR or LIBOR. For a general derivative, let T be the maturity and α be the constant lose given default. Then

$$CVA = \alpha\int_0^T Y(t)h(t)dt \tag{4.1}$$

where $h(t)$ is the probability density function of the counterparty's time τ to default, $Y(t) = E[max\{v(t),0\} \mid \tau = t]$ is the time-t conditional expected value of the exposure, where $v(t)$ is the time-t value of the derivative. Here the probability density function $h(t)$ of the counterparty's time to default is usually estimated from the counterparty's credit spreads observed in the market.

For a cap contract, the holder of the cap, say party A, can be considered as the fixed rate payer, while the writer of the cap can be considered as the fixed-rate receiving party B. Suppose the cap has n caplets with n payment dates $T_1 < \cdots < T_n$, and B defaults during the times T_{j-1} and T_j, that is, $T_{j-1} < \tau_B \le T_j < \cdots < T_n$, where τ_B is the default time of B. In such a case, the exposure to loss of party A at time τ_B will be the sum of the values of the $(n-j+1)$ caplets with payment dates $T_j < \cdots < T_n$, i.e.,

$$FE_j^A(\tau_B) = \Delta \sum_{i=j}^{n} P(\tau_B, T_i) E_{\tau_B}\left[max\{f(T_{i-1}, T_{i-1}, T_i) - K, 0\}\right] \tag{4.2}$$

where $f(t, T_{i-1}, T_i)$ is the forward EURIBOR or LIBOR rate at time t, $P(t, T)$ is the time-t price of a discount zero-coupon bond paying \$1 at time T. By the Black 76 model, (4.2) is the sum of the prices of $(n-j+1)$ non-vulnerable European call option with strike K and underlyings $f(t, T_{i-1}, T_i)$, $j \le i \le n$. The time-0 CVA is

$$\begin{aligned} \text{CVA} &= \alpha\Delta \sum_{j=1}^{n}\left[\int_{T_{j-1}}^{T_j} P(0,\tau_B) FE_j^A(\tau_B) h(\tau_B) d\tau_B\right] \\ &= \alpha\Delta \sum_{i=1}^{n} P(0,T_i)\left[\int_0^{T_i} E_{\tau_B}\left[max\{f(T_{i-1}, T_{i-1}, T_i) - K, 0\}\right] h(\tau_B) d\tau_B\right] \end{aligned} \tag{4.3}$$

where α is the loss given default, $h(\tau_B)$ is the probability density function of the default time τ_B. In (4.3), the CVA can be decomposed as the losses corresponding to n vulnerable European call options, with the loss of the i^{th} option as

$$\alpha\Delta P(0,T_i)\left[\int_0^{T_i} E_{\tau_B}\left[max\{f(T_{i-1}, T_{i-1}, T_i) - K, 0\}\right] h(\tau_B) d\tau_B\right] \tag{4.4}$$

where T_{i-1} is the exercise date and T_i is the payment date T_i, $1 \le i \le n$. For the i^{th} vulnerable European option, $1 \le i \le n$, suppose default occurs as soon as the option writer's total asset $V(t)$ is less than the discounted aggregate liability $P(t, T_i)D$, where D is the aggregate liabilities at the payment date T_i. Then (4.4) can be rewritten as

$$\alpha\Delta P(0,T_i) E\left[max\{f(T_{i-1}, T_{i-1}, T_i) - K, 0\} \times 1_{\{\tau_B < T_i\}}\right] \tag{4.5}$$

Compared to (3.4), by letting $T_{i-1} = T_m$ and $T_i = T_p$, one can see that (4.5) is the difference between the time-0 price of a non-vulnerable European call and $C_i(0)$, i.e.,

$$\Delta P(0,T_i)E\left[max\left(f\left(T_{i-1},T_{i-1},T_i\right)-K,0\right)\right]-C_i(0)$$

where $C_i(0)$ is the price of a vulnerable European call option with deferred payment given in Lemma 3.1. Together with (4.2), it is concluded that CVA is the difference between the time-0 prices of a non-vulnerable cap and the corresponding vulnerable cap, respectively. Similarly, the CVA of a floor can be obtained as the difference between the time-0 prices of the non-vulnerable floor and vulnerable floor, respectively. In the following, numerical examples will be given to illustrate the calculation of the cap's CVA.

5. NUMERICAL EXAMPLE OF VULNERABLE CAP/FLOOR

This Section uses numerical examples to illustrate the calculation of the CVAs of two caps and two floors with the floating EURIBOR as the underlying. The reset frequencies (tenors) of the two caps (floors) are 6-month and 1-month, respectively. The starting date of the 6-month cap (floor) and 1-month cap (floor) are July 3, 2013 and Jan 3, 2013, respectively. Both caps (floors) have the same starting reset date as of July 3, 2013, strike rate K=1%, and the notional amount of 100. The payment dates of the 6-month tenor cap (floor) are Jan. 2, 2014, July 2, 2014, Jan. 2, 2015, July 2, 2015, Jan. 4, 2016, July 4, 2016, Jan. 2, 2017, July 3, 2017, respectively. The payment dates of the 1-month tenor cap (floor) are Aug. 2, 2013, Sep. 2, 2013, Oct. 2, 2013, Nov. 4, 2013, Dec. 2, 2013, Jan. 2, 2014, respectively. The 6-month and 1-month forward EURIBOR rates and discount rates derived from the forward curve starting from July 3, 2013 are given in Table 1. The volatilities of the 6-month caplet/floorlet and the 1-month caplet/floorlet, calibrated by a Stochastic Alpha, Beta, Rho model (SABR) model (Hagan et al. 2002) using Bloomberg EUR Caps/Floors implied volatility surface on 06/28/2013, are given in Panel A and B, respectively, of Table 2.

The writer's initial asset value and the ratio of bankruptcy cost are assumed to be $V(0)$=100,00 and α=0.5, respectively. Four aggregate liabilities D are assumed:

D=2000, D=4000, D=6000, and D=8000, respectively. Three different volatilities of the writer's asset $V(t)$ are considered: σ_V=0.15, σ_V=0.30, σ_V=0.45, σ_V=0.60, respectively. The correlation ρ between the cap/floor underlying, i.e., the forward EURIBOR and the writer's asset $V(t)$ is set to -0.9, -0.6, -0.3, 0.0, 0.3, 0.6, 0.9, respectively.

Tables 1-2 provide the CVAs of the aforementioned 6-month and 1-month caps, respectively, under various combinations of the three parameters: aggregate liabilities Ds, volatilities of the writer's asset σ_Vs, and correlations ρs between the cap's underlying, i.e., the forward EURIBOR rate, and the writer's asset $V(t)$. For a cap contract, the CVA increases as the correlation ρ decreases. This is due to the fact that a negative correlation ρ between the forward rate and the writer's asset value implies a positive relationship between the forward rate and the writer's default probability. As higher forward rate implies higher exposure of the cap contract, together with the higher default probability, one can thus conclude that negative correlation ρ leads to a higher CVA. Figures 1-2 illustrate this negative relationship for the 6-month and 1-month caps under four aggregate liabilities D=2000, D=4000, D=6000, and D=8000, respectively. Note the volatility σ_V of the writer's asset is held fixed at σ_V=0.45. Note Figures 1-2 also indicate a positive relationship between the CVAs and the aggregate liabilities D. For the 1-month cap in Figure 2, the CVAs are negligible at the lower levels of aggregate liabilities: as D=2000, the CVAs are all negligible, while the CVAs are negligible for higher correlations with as D=4000. To the contrary, the CVAs of the 6-month cap in Figure 1 are all significant. This indicates the shorter the tenor, the l+ess sensitivity of the CVAs to the aggregate liabilities D. This also holds for the 1-month floor as illustrated in Figure 4.

Tables 3-4 provide the CVAs of the aforementioned 6-month and 1-month floors, respectively, under various combinations of the three parameters: aggregate liabilities Ds, volatilities of the writer's asset σ_Vs, and correlations ρs between the cap's underlying, i.e., the forward EURIBOR rate, and the writer's asset $V(t)$. To the contrary of the cap contracts, the relationship between the CVAs and the correlation ρ is positive for the floor contracts. This is due to the fact that a positive correlation ρ between the forward rate and the writer's asset value implies a negative relationship between the forward rate and the writer's default probability. As a lower forward rate implies higher exposure of the floor contract, together with the higher default probability, one can thus conclude that a positive correlation ρ leads to a higher CVA.

The CVAs of the 1-month cap in Figure 2 are the most sensitive to the correlation ρ, as compared to the 6-month cap in Figure 1, and the 6-month and the 1-month floors in Figures 3-4, respectively. This is due to the fact that the 1-month cap is an out-of-money cap with all its caplets out-of-money. The price of an out-of-money caplet (floorlet) is more sensitive to a negative (positive) correlation ρ as a significant increase (decrease) in the underlying is required to increase the value of the cap (floor), which significantly increases the default probability simultaneously. For this reason, the reduction in the value of a cap (floor), i.e., the CVA, will be significant for an out-of-money cap (floor).

Figures 5-8 illustrate the positive relationship between CVAs and the volatility σ_V of the writer's asset for the 6-month and 1-month caps and floors under seven correlations -0.9, -0.6, -0.3, 0.0, 0.3, 0.6, 0.9, respectively. Note the writer's aggregate liabilities D is held fixed at $D=4000$. From Figures 5-8, certain degrees of interaction effects between the correlation ρ and the volatility σ_V are exhibited. This can be seen from Figures 5-8 that the effect of the correlation ρ on the CVAs is most prevalent as the volatility $\sigma_V=0.60$, while the effect of the correlation ρ are negligible as the volatility $\sigma_V=0.15$. For a cap contract, the effect of the volatility σ_V is most (least) significant as the correlation $\rho=-0.9$ $(=0.9)$. On the other hand, for a floor contract, the effect of the volatility σ_V is most (least) significant as the correlation $\rho=0.9$ $(=-0.9)$.

For higher aggregate liabilities D (D>4000), the positive relationship between the CVAs and the volatility σ_V for all the four contracts is more significant. At the same time, the corresponding interaction effect between the correlation ρ and the volatility σ_V is also more significant.

6. SUMMARY AND CONCLUSION

A structural model with analytic pricing formulas is derived for the valuation of the Credit Value Adjustment (CVA) of the caps and floors, which play important roles in the interest rate derivatives market. The proposed structural model improves the existing structural models for vulnerable European options by allowing the payments made one period of time (tenor) after the exercise of the options. Four parameters in the proposed structural model in determining the CVAs are identified, they are: the cap's/floor's tenor, the correlation ρ between the cap's/floor's underlying and the writer's asset, the volatility σ_V of the writer's asset, and the writer's aggregate liabilities D. Compared to the market practice of calculating the CVAs based on the reduced-form models, the four crucial parameters of CVAs are the unique features of the proposed structural model. It is hoped the proposed structural model can be extended for more complicated interest rate derivatives in the market, e.g., swap contracts. This will be the future work of this study.

Table 1. Forward EURIBOR and discount rates

Start date	End date	Discount factor Start	Discount factor End	Forward rate
A. Six month forward EURIBOR rates and discount factors				
03/07/2013	02/01/2014	1.0000	0.9983	0.00344
03/01/2014	02/07/2014	0.9983	0.0056	0.00537
03/07/2014	02/01/2015	0.9956	0.9921	0.00705
03/01/2014	02/07/2015	0.9921	0.9878	0.00866
03/07/2015	04/01/2016	0.9878	0.9824	0.01110
05/01/2016	04/07/2016	0.9824	0.9762	0.01276
05/07/2016	02/01/2017	0.9762	0.9684	0.01593
03/01/2017	03/07/2017	0.9684	0.9597	0.01818
B. One month forward EURIBOR rates and discount factors				
03/07/2013	02/08/2013	1.0000	0.9999	0.00138
03/08/2013	02/09/2013	0.9999	0.9998	0.00142
03/09/2013	02/10/2013	0.9998	0.9996	0.00158
03/10/2013	04/11/2013	0.9996	0.9995	0.00182
05/11/2013	02/12/2013	0.9995	0.9993	0.00167
03/12/2013	02/01/2014	0.9993	0.9992	0.00212

Note. Forward rates derived from forward curve, and the corresponding discount rates.

Table 2. 6-month and 1-month Caps/Floors Implied Volatilities

A. Volatilities of the 6-month caplet/floorlet							
0.5y	1y	1.5y	2y	2.5y	3y	3.5y	4y
0.7081	0.6663	0.6651	0.6755	0.6359	0.5554	0.4725	0.4570
B. Volatilities of the 1-month caplet/floorlet							
0.5 y	0.583 y	0.667 y	0.75y	0.833 y	0.917 y	1 y	1.083 y
1.3256	1.3561	1.4374	1.4515	1.4648	1.5032	1.2335	1.2467

Note. The volatilities of the 6-month caplet/floorlet and the 1-month caplet /floorlet, calibrated by SABR model using Bloomberg EUR Caps/Floors implied volatility surface on 06/28/2013.

Table 3 Credit Valuation Adjustment of 6-month-tenor Cap

		D			
	ρ	2000	4000	6000	8000
σ_V=0.15	-0.9	0.000	0.165	2.856	6.798
	-0.6	0.000	0.081	1.827	5.654
	-0.3	0.000	0.034	1.061	4.422
	0.0	0.000	0.011	0.536	3.196
	0.3	0.000	0.002	0.214	2.069
	0.6	0.000	0.000	0.052	1.125
	0.9	0.000	0.000	0.003	0.431
σ_V=0.30	-0.9	0.582	4.131	6.769	7.370
	-0.6	0.315	2.828	5.594	6.978
	-0.3	0.150	1.785	4.345	6.326
	0.0	0.058	1.000	3.112	5.466
	0.3	0.016	0.463	1.989	4.455
	0.6	0.002	0.145	1.054	3.361
	0.9	0.000	0.013	0.375	2.259
σ_V=0.45	-0.9	3.433	6.567	7.312	7.418
	-0.6	2.278	5.296	6.716	7.247
	-0.3	1.384	4.011	5.845	6.881
	0.0	0.741	2.790	4.789	6.323
	0.3	0.321	1.714	3.631	5.588
	0.6	0.089	0.852	2.463	4.702
	0.9	0.005	0.257	1.377	3.703
σ_V=0.60	-0.9	5.791	7.217	7.403	7.428
	-0.6	4.384	6.422	7.103	7.342
	-0.3	3.106	5.389	6.536	7.120
	0.0	1.999	4.222	5.740	6.745
	0.3	1.112	3.017	4.758	6.210
	0.6	0.471	1.873	3.649	5.521
	0.9	0.093	0.881	2.479	4.689

Note. A cap with notional amount 100,00, reset dates at 0.5 y, 1.0 y, 1.5 y, 2.0 y, 2.5 y, 3.0 y, 3.5 y; payment dates are the 1.0 y, 1.5 y, 2.0 y, 2.5 y, 3.0 y, 3.5 y, 4.0 y. The differences ($\times 10^{-1}$) between the prices of the vulnerable cap by the proposed model and by Black (1976), which is 1.4862, under various correlation ρ between the option's underlying and the writer's total assets, various aggregate liabilities D of the writer at the final payment date 4 y, and various volatility σ_V of writer's total asset are shown.

Table 4. Credit Valuation Adjustment of 1-month-tenor Cap

		D			
	ρ	2000	4000	6000	8000
σ_V=0.15	-0.9	0.0040	0.0040	0.0060	2.5330
	-0.6	0.0010	0.0010	0.0010	1.2410
	-0.3	0.0000	0.0000	0.0000	0.4150
	0.0	0.0000	0.0000	0.0000	0.0830
	0.3	0.0000	0.0000	0.0000	0.0060
	0.6	0.0010	0.0010	0.0010	0.0010
	0.9	0.0040	0.0040	0.0040	0.0040
σ_V=0.30	-0.9	0.0040	0.0280	2.1550	2.8250
	-0.6	0.0010	0.0060	0.8650	2.6090
	-0.3	0.0000	0.0010	0.2470	1.7870
	0.0	0.0000	0.0000	0.0410	0.8240
	0.3	0.0000	0.0000	0.0020	0.2100
	0.6	0.0010	0.0010	0.0010	0.0190
	0.9	0.0040	0.0040	0.0040	0.0050
σ_V=0.45	-0.9	0.0050	1.3090	2.8110	2.8250
	-0.6	0.0010	0.4060	2.1040	2.7670
	-0.3	0.0000	0.0920	1.0360	2.3020
	0.0	0.0000	0.0110	0.3200	1.4250
	0.3	0.0000	0.0000	0.0450	0.5720
	0.6	0.0010	0.0010	0.0020	0.1190
	0.9	0.0040	0.0040	0.0040	0.0190
σ_V=0.60	-0.9	0.1940	2.5910	2.8250	2.8250
	-0.6	0.0470	1.3420	2.5540	2.8010
	-0.3	0.0070	0.4720	1.6660	2.5140
	0.0	0.0010	0.1000	0.7190	1.7980
	0.3	0.0000	0.0080	0.1650	0.9160
	0.6	0.0010	0.0010	0.0110	0.2910
	0.9	0.0040	0.0040	0.0040	0.0720

Note. A cap with notional amount 100,00, strike 1%, reset dates 0.5 y, 0.5833 y, 0.6667 y, 0.75 y, 0.833 y, 0.9167 y, 1.00 y, 1.0833 y; payment dates are the 0.5833 y, 0.6667 y, 0.75 y, 0.833 y, 0.9167 y, 1.00 y, 1.0833 y, 1.1667 y. The differences ($\times 10^{-4}$) between the prices of the vulnerable cap and the non-vulnerable cap by Black (1976), which is 5.647×10^{-4}, under various correlation ρ between the option's underlying and the writer's assets, various aggregate liabilities *D* of the writer, and various volatility σ_V of writer's total asset are shown.

Table 5 Credit Valuation Adjustment of 6-month-tenor Floor

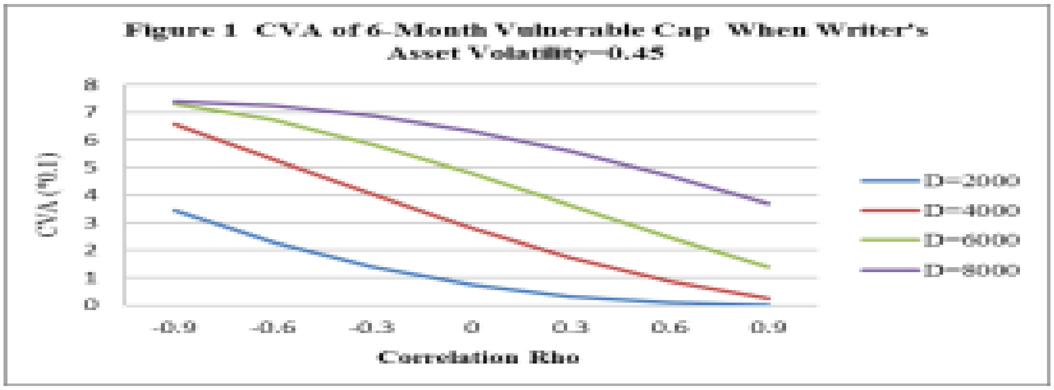
		D			
	ρ	2000	4000	6000	8000
σ_V=0.15	-0.9	0.000	0.000	0.001	0.452
	-0.6	0.000	0.000	0.021	0.881
	-0.3	0.000	0.001	0.080	1.295
	0.0	0.000	0.002	0.168	1.703
	0.3	0.000	0.006	0.277	2.118
	0.6	0.000	0.009	0.402	2.553
	0.9	0.000	0.012	0.533	3.036
σ_V=0.30	-0.9	0.000	0.005	0.338	2.613
	-0.6	0.000	0.066	0.745	3.109
	-0.3	0.004	0.185	1.144	3.538
	0.0	0.013	0.340	1.539	3.937
	0.3	0.028	0.519	1.942	4.320
	0.6	0.044	0.720	2.365	4.698
	0.9	0.058	0.945	2.833	5.081
σ_V=0.45	-0.9	0.001	0.187	1.472	4.069
	-0.6	0.034	0.528	2.027	4.423
	-0.3	0.113	0.883	2.503	4.741
	0.0	0.226	1.244	2.945	5.037
	0.3	0.361	1.616	3.374	5.317
	0.6	0.515	2.010	3.804	5.585
	0.9	0.685	2.448	4.251	5.838
σ_V=0.60	-0.9	0.044	0.804	2.682	4.937
	-0.6	0.234	1.339	3.173	5.185
	-0.3	0.479	1.806	3.597	5.418
	0.0	0.750	2.245	3.986	5.636
	0.3	1.040	2.676	4.357	5.840
	0.6	1.356	3.115	4.717	6.031
	0.9	1.713	3.578	5.070	6.203

Note. A cap with notional amount 100,00, reset dates are 0.5 y, 1.0 y, 1.5 y, 2.0 y, 2.5 y, 3.0 y, 3.5 y; payment dates are the 1.0 y, 1.5 y, 2.0 y, 2.5 y, 3.0 y, 3.5 y, 4.0 y. The differences ($\times 10^{-1}$) between the prices of the vulnerable cap by the proposed model and by Black (1976), which is 1.3869, under various correlation ρ between the option's underlying and the writer's total assets, various aggregate liabilities D of the writer at the final payment date 4 y, and various volatility σ_V of writer's total asset are shown.

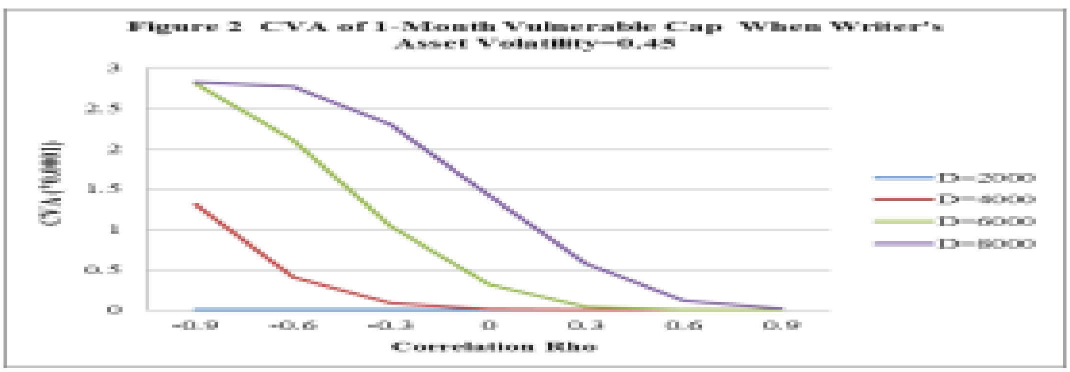
Table 6. Credit Valuation Adjustment of 1-month-tenor Cap

		D			
	ρ	2000	4000	6000	8000
σ_V=0.15	-0.9	0.0000	0.0000	0.0000	0.0105
	-0.6	0.0000	0.0000	0.0000	0.0175
	-0.3	0.0000	0.0000	0.0000	0.0225
	0.0	0.0000	0.0000	0.0000	0.0262
	0.3	0.0000	0.0000	0.0000	0.0287
	0.6	0.0000	0.0000	0.0000	0.0303
	0.9	0.0000	0.0000	0.0000	0.0312
σ_V=0.30	-0.9	0.0000	0.0000	0.0036	0.2943
	-0.6	0.0000	0.0000	0.0074	0.3194
	-0.3	0.0000	0.0000	0.0102	0.3427
	0.0	0.0000	0.0000	0.0122	0.3637
	0.3	0.0000	0.0000	0.0135	0.3822
	0.6	0.0000	0.0000	0.0143	0.3980
	0.9	0.0000	0.0000	0.0147	0.4106
σ_V=0.45	-0.9	0.0000	0.0005	0.0734	0.6704
	-0.6	0.0000	0.0016	0.0905	0.6947
	-0.3	0.0000	0.0025	0.1042	0.7199
	0.0	0.0000	0.0032	0.1152	0.7451
	0.3	0.0000	0.0036	0.1237	0.7696
	0.6	0.0000	0.0038	0.1300	0.7930
	0.9	0.0000	0.0039	0.1343	0.8142
σ_V=0.60	-0.9	0.0000	0.0134	0.2331	0.9678
	-0.6	0.0000	0.0212	0.2572	0.9881
	-0.3	0.0001	0.0270	0.2790	1.0105
	0.0	0.0001	0.0312	0.2983	1.0343
	0.3	0.00016	0.0341	0.3148	1.0589
	0.6	0.00016	0.0359	0.3286	1.0836
	0.9	0.00017	0.0371	0.3393	1.1078

Note. A cap with notional amount 100,00, reset dates are 0.5 y, 0.5833 y, 0.6667 y, 0.75 y, 0.833 y, 0.9167 y, 1.00 y, 1.0833 y; payment dates are the 0.5833 y, 0.6667 y, 0.75 y, 0.833 y, 0.9167 y, 1.00 y, 1.0833 y, 1.1667 y. The differences ($\times 10^4$) between the prices of the vulnerable floor and the non-vulnerable floor by Black (1976), which is 0.4163, under various correlation ρ between the option's underlying and the writer's total assets, various aggregate liabilities D of the writer, and various volatility σ_V of writer's total asset are shown.



Note. This figure illustrate the relationship between CVA and the correlation ρ (Rho) between the option's underlying and the writer's assets under four different aggregate liabilities D of the writer for a 6-month cap with strike 1%. The writer's initial asset value $V(0)$=10,000, and the asset volatility σ_V =0.45.



Note. This figure illustrate the relationship between CVA and the correlation ρ (Rho) between the option's underlying and the writer's assets under four different aggregate liabilities D of the writer for a 1-month cap with strike 1%. The writer's initial asset value $V(0)$=10,000, and the asset volatility σ_V =0.45.

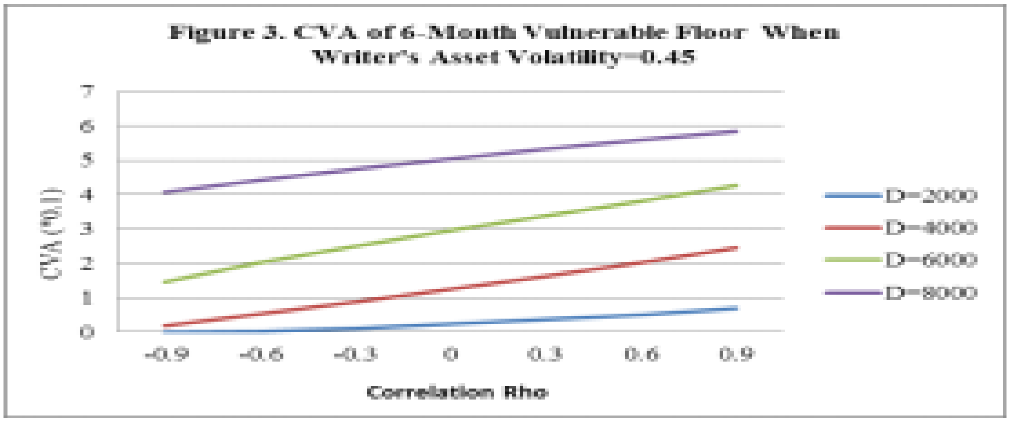


Figure 3. CVA of 6-Month Vulnerable Floor When Writer's Asset Volatility=0.45

Note. This figure illustrate the relationship between CVA and the correlation ρ (Rho) between the option's underlying and the writer's assets under four different aggregate liabilities D of the writer for a 6-month floor with strike 1%. The writer's initial asset value $V(0)$=10,000, and the asset volatility σ_V =0.45.

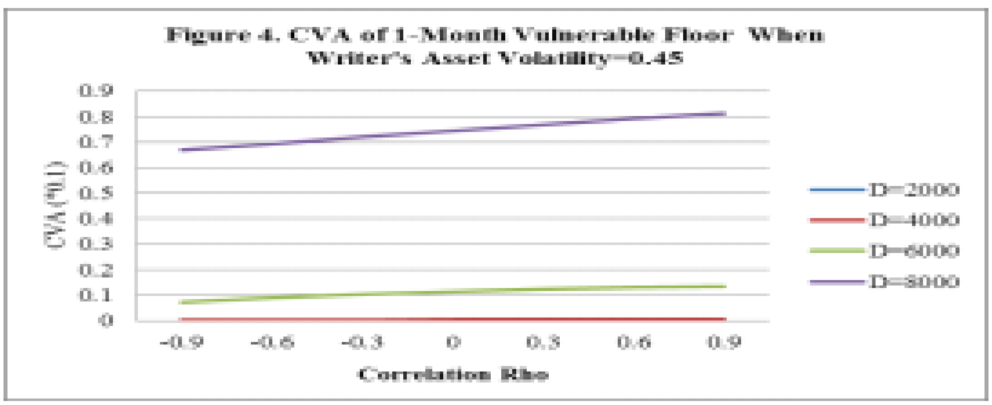
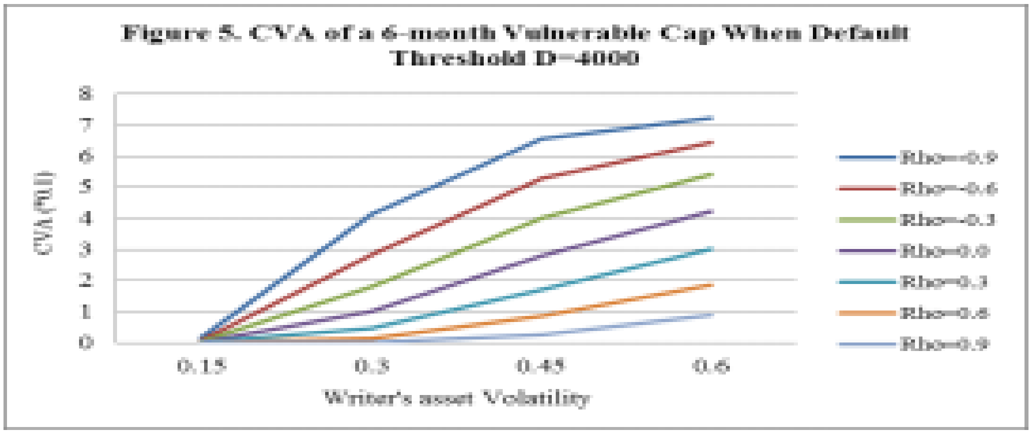
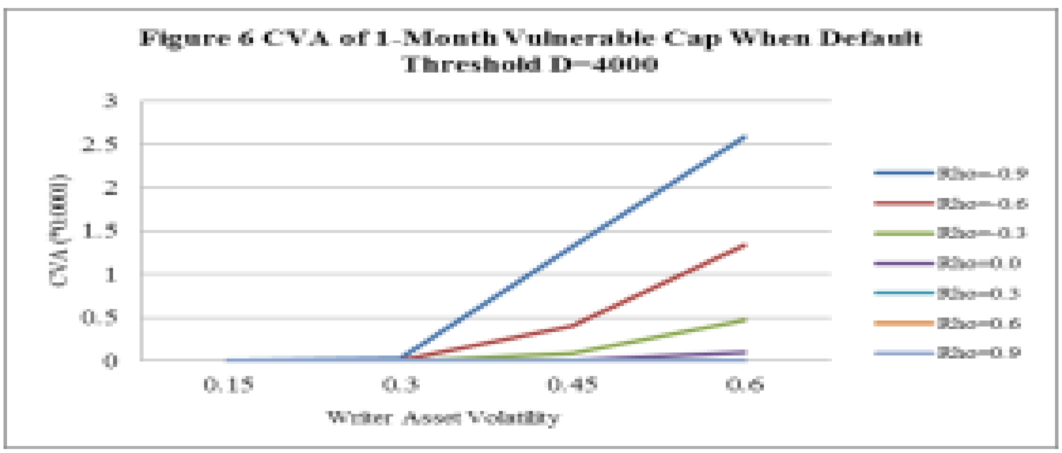


Figure 4. CVA of 1-Month Vulnerable Floor When Writer's Asset Volatility=0.45

Note. This figure illustrate the relationship between CVA and the correlation ρ (Rho) between the option's underlying and the writer's assets under four different aggregate liabilities D of the writer for a 1-month floor with strike 1%. The writer's initial asset value $V(0)$=10,000, and the asset volatility σ_V =0.45.

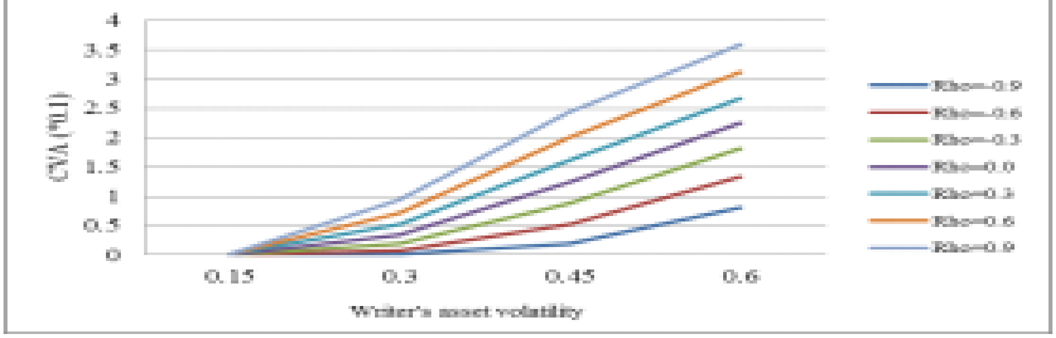


Note. This figure illustrate the relationship between CVA and the volatility of the writer's asset under seven different correlation ρ (Rho) between the option's underlying and the writer's assets of the writer for a 6-month cap with strike 1%. The writer's initial asset value $V(0)$=10,000, and the aggregate liabilities D=4000.



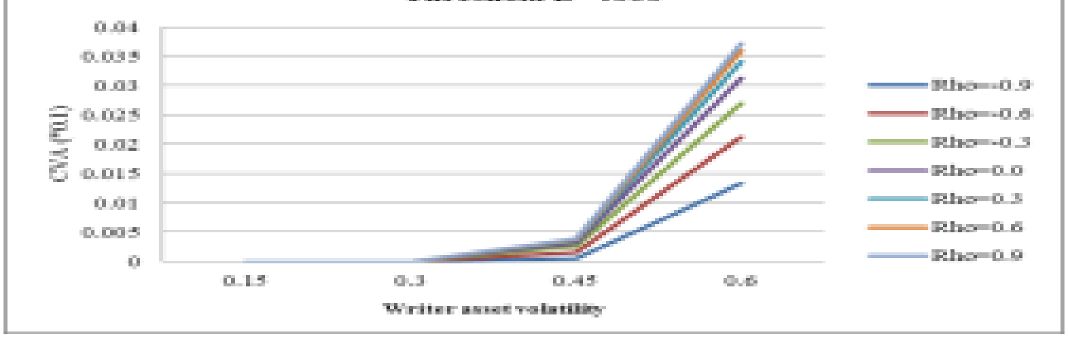
Note. This figure illustrate the relationship between CVA and the volatility of the writer's asset under seven different correlation ρ (Rho) between the option's underlying and the writer's assets of the writer for a 1-month cap with strike 1%. The writer's initial asset value $V(0)$=10,000, and the aggregate liabilities D=4000.

Figure 7. CVA of 6-Month Vulnerable Floor When Default Threshold D=4000



Note. This figure illustrate the relationship between CVA and the volatility of the writer's asset under seven different correlation ρ (Rho) between the option's underlying and the writer's assets of the writer for a 6-month floor with strike 1%. The writer's initial asset value $V(0)$=10,000, and the aggregate liabilities D=4000.

Figure 8.CVA of 1-Month Vulnerable Floor When Default Threshold D=4000



Note. This figure illustrate the relationship between CVA and the volatility of the writer's asset under seven different correlation ρ (Rho) between the option's underlying and the writer's assets of the writer for a 1-month floor with strike 1%. The writer's initial asset value $V(0)$=10,000, and the aggregate liabilities D=4000.

APPENDIX A

Suppose the initial asset value $V(0)$ exceeds the discounted default threshold D, i.e., $V(0)>P(0,T_F)D$. For the discussion hereto, set $L_F=lnV_F(T_m)$, where $V_F(t)$ is the option writer's time-t forward asset value defined in (3.7). Define the auxiliary random process associated with $V_F(t)$ as

$$U(t)=min\{\ln V_F(u): 0\le u\le t\}\ ,\ t>0 \tag{A1}$$

Lemma A.1 Given $L_F=f$, the logarithm of the underlying asset's value $lnS(T_m)$ is independent of the auxiliary random process $\{U(t): 0\le t\le T_F\}$ and is normally distributed with mean

$$\mu(f)=lnS(0)-\sigma_S^2T_m/2+\rho\sigma_S[f-lnV(0)+lnP(T_m,T_F)+\sigma_V^2T_m/2]/\sigma_V$$

and variance $\sigma_m^2=\sigma_S^2(1-\rho^2)T_m$.

Proof. By the evolution (3.8) of the forward asset value $V_F(t)$, the logarithm $lnV_F(t)$ can be expressed as

$$lnV_F(t)=lnV(0)-lnP(t,T_F)-\sigma_V^2t/2+\sigma_VW_V(t) \tag{A2}$$

Given the constraint $L_F=f$, it implies that

$$W_V(T_m)=[f-lnV(0)+lnP(T_m,T_F)+\sigma_V^2T_m/2]/\sigma_V \tag{A3}$$

Consider an orthogonal decomposition of the standard Brownian motion W_S, which drives the option's underlying asset value $S(t)$ in (3.6),

$$W_S(t)=\rho W_V(t)+\sqrt{1-\rho^2}\ W_0(t) \tag{A4}$$

where W_0 is a standard Brownian motion that is independent of W_V. Plugging in (A3) into (A4), one has

$$W_S(T_m)=\rho[f-lnV(0)+lnP(T_m,T_F)+\sigma_V^2T_m/2]/\sigma_V+\sqrt{1-\rho^2}\ W_0(T_m) \tag{A5}$$

Set $c=\rho[f-lnV(0)+lnP(T_m,T_F)+\sigma_V^2T_m/2]/\sigma_V$. (A5) implies that given $L_F=f$, the random variable $W_S(T_m)$ is the sum of a constant c and the random variable $\sqrt{1-\rho^2}\ W_d(T_m)$. Since the underlying asset value $S(t)$ is a martingale (from (3.6)), therefore the logarithm $lnS(T_m)$ satisfies

$$lnS(T_m) = lnS(0) - \sigma_S^2 T_m / 2 + \sigma_S W_S(T_m) \tag{A6}$$

Plugging in (A5) into (A6), one has

$$lnS(T_m) = lnS(0) - \sigma_S^2 T_m / 2 + \sigma_S c + \sqrt{1-\rho^2}\ \sigma_S W_d(T_m) \tag{A7}$$

Set $\mu(f) = lnS(0) - \sigma_S^2 T_m / 2 + \sigma_S c$

$$= lnS(0) - \sigma_S^2 T_m / 2 + \sigma_S \rho[f - lnV(0) + lnP(0, T_p) + \sigma_v^2 T_m / 2]/\sigma_V$$

It follows that given $L_p = f$, $lnS(T_m)$ is the sum of a constant $\mu(f)$ and the random variable $\sqrt{1-\rho^2}\ \sigma_S W_d(T_m)$. As $W_d(T_m)$ is normally distributed with mean zero and variance T_m, from (A7), thus $lnS(T_m)$ normally distributed with mean $\mu(f)$ and variance σ_m^2.

The logarithm of the underlying asset value $lnS(T_m)$ and the auxiliary process $\{U(t)\text{: } 0<t\leq T_p\}$ and are independent conditional on $L_p = f$ is due to the following. From (3.8), the logarithm of the forward asset value $\{\ln V_p(t)\text{: } 0<t\leq T_p\}$ is driven by the Brownian motion $\{W_v(t)\text{: } 0<t\leq T_p\}$, so is the auxiliary random process $\{U(t)\text{: } 0<t\leq T_p\}$, where $U(t) = min\{\ln V_p(u)\text{: } 0\leq u\leq t\}$. Recall the Brownian motions W_v and W_d are independent, it follows the auxiliary process $\{U(t)\text{: } 0<t\leq T_p\}$ is independent of $\{W_d(t)\text{: } 0<t\leq T_p\}$. Recall that given $L_p = f$, $lnS(T_m)$ is the sum of a constant d and the random variable $\sqrt{1-\rho^2}\ \sigma_S W_d(T_m)$, it follows the auxiliary process $\{U(t)\text{: } 0<t\leq T_p\}$ is independent of $lnS(T_m)$ given $L_p = f$. □

Lemma A.2. For any Brownian motion W with drift μ and diffusion σ, the joint distribution function of $W(t)$ and the minimum $M(t) = min\{W(u)\text{:}0\leq u\leq t\}$ is

$$\Pr\{W(t) = w,\ M(t) > a\} = \frac{1}{\sigma\sqrt{t}}\phi\left(\frac{w-\mu t}{\sigma\sqrt{t}}\right)\left(1 - e^{-\left(2a^2 - 2wa\right)/\sigma^2 t}\right) \quad \text{for } w\geq a,\ a\leq 0$$

The distribution function of the minimum $M(t)$ is

$$\Pr\{M(t)\le a\}=1-\Phi\left(\frac{-a+\mu t}{\sigma\sqrt{t}}\right)+e^{2a\mu/\sigma^2}\Phi\left(\frac{a+\mu t}{\sigma\sqrt{t}}\right)\quad \text{for } a\le 0$$

where ϕ is the standard normal density, and Φ is the corresponding distribution function.

***Proof*.** The results follow from (He et al. (1995), p3-4) directly. □

LemmaA.3. Given $L_y=f\ge lnD$, the conditional probability

$$\Pr\{U(T_m)>lnD|L_y=f\}=\left(1-e^{-(2(lnD-f)\times(lnD-lnV(0)+lnP(T_m,T_y)))/\sigma_V^2T_m}\right)$$

***Proof*.** Recall from (A2), the logarithm of the forward asset value

$$lnV_F(t)=lnV(0)-lnP(t,T_y)-\sigma_V^2t/2+\sigma_VW_1(t)$$

Set $W(t)=lnV_F(t)-lnV(0)+lnP(t,T_y)$, then the process $\{W(t): 0\le t\le T_m\}$ obeys a Brownian motion with drift $\mu=-\sigma_V^2/2$ and diffusion σ_V. Define $M(t)=min\{W(u):0\le u\le t\}$, and

$$a=lnD-lnV(0)+lnP(T_m,T_y) \tag{A8}$$

$$w=f-lnV(0)+lnP(T_m,T_y) \tag{A9}$$

By the assumption the initial asset value $V(0)$ exceeds the discounted default threshold D, it follows that $V(0)>P(T_m,T_y)D$ and $a<0$. Also $f\ge lnD$ implies $w\ge a$. Using lemma A.2, for $w\ge a$ and $a<0$, one has the joint probability

$$\Pr\{W(T_m)=w, M(T_m)\ge a\}$$

$$=\frac{1}{\sigma_V\sqrt{T_m}}\phi\left(\frac{w+\sigma_V^2T_m/2}{\sigma_V\sqrt{T_m}}\right)\left(1-e^{-(2a^2-2wa)/\sigma_V^2T_m}\right)$$

As $\{W(t): 0\le t\le T_m\}$ obeys a Brownian motion with drift $\mu=-\sigma_V^2/2$ and diffusion σ_V, thus $W(T_m)$ is normally distributed with mean $-\sigma_V^2T_m/2$ and standard deviation $\sigma_V\sqrt{T_m}$.

It follows the conditional probability is

$$\Pr\{M(T_m)>a\,|W(T_m)=w\}=\left(1-e^{-(2a^2-2wa)/\sigma_V^2T_m}\right)$$

Plugging in a and w in (A8)-(A9), respectively, one has

$$\Pr\{U(T_m)>\ln D|L_p=f\}=\left(1-e^{-(2(\ln D-f)(\ln D-\ln V(0)+\ln P(T_m,T_p)))/\sigma_V^2 T_m}\right)$$

The Lemma is proved. □

LemmaA.4. For $f\geq\ln D$, the conditional probability $\Pr\{U(T_p)\leq\ln D|\Xi\}$ is

$$1-\Phi\left(\frac{-2b-\sigma_V^2(T_p-T_m)}{2\sigma_V\sqrt{T_p-T_m}}\right)+e^{-b}\Phi\left(\frac{2b-\sigma_V^2(T_p-T_m)}{2\sigma_V\sqrt{T_p-T_m}}\right)$$

where the event $\Xi=\{U(T_m)>\ln D,\ L_p=f\}$ and $b=\ln D-f$.

Proof. Define the process $R(t')=\ln V_p(t'+T_m)-L_p$ for $0<t'\leq T_p-T_m$. By the logarithm of the forward asset value $\ln V_p(t)$ in (A2), one has

$$R(t')=-t'\sigma_V^2/2+\sigma_V\{W_p(t'+T_m)-W_p(T_m)\} \tag{A10}$$

By the characteristics of a Brownian motion, the increment $W_p(t'+T_m)-W_p(T_m)$ is independent of the information set $\mathfrak{F}_{T_m}$ up to the maturity date T_m for all $t'>0$. Thus the process $\{R(t'): 0<t'\leq T_p-T_m\}$ is independent of $\mathfrak{F}_{T_m}$ and the minimum

$$M(T_p-T_m)=min\{R(t'): 0<t'\leq T_p-T_m\}$$

is also independent of $\mathfrak{F}_{T_m}$. By the definition of the event Ξ and the random variable $L_p=\ln V_p(T_m)$, one has $\Xi\in\mathfrak{F}_{T_m}$. In addition, conditional on the event $\Xi=\{U(T_m)>\ln D,\ L_p=f\}$, where $f\geq\ln D$, the event $\{U(T_p)\leq\ln D\}$ implies that $M<b$, where $b=\ln D-f$. As $M(T_p-T_m)$ is independent of $\mathfrak{F}_{T_m}$, thus

$$\Pr\{U(T_p)\leq\ln D|\Xi\}=\Pr\{M(T_p-T_m)<b\}$$

where $b=\ln D-f<0$. From (A10), $\{R(t'): 0<t'\leq T_p-T_m\}$ is a Brownian motion with drift $\mu=-\sigma_V^2/2$ and diffusion σ_V. Using Lemma A.2, the probability

$$\Pr\{M(T_p-T_m)<b\}=1-\Phi\left(\frac{-b+\mu t}{\sigma\sqrt{t}}\right)+e^{2b\mu/\sigma^2}\Phi\left(\frac{b+\mu t}{\sigma\sqrt{t}}\right)$$

Plugging in $b=\ln D-f$, $\mu=-\sigma_V^2/2$ and diffusion $\sigma=\sigma_V$, the Lemma follows directly.

APPENDIX B

By the definition of a default event, τ_D is the first passage time the asset value $\{V(s)\colon 0<s\le T_p\}$ first reaches the default boundary $P(t, T_p)D$, that is, the forward asset value $V_p(\tau_D)=lnD$.

Three possibilities are associated with the default time τ_D: (a) No default occurs, i.e., $\tau_D>T_p$; (b) Default occurs prior to or at the maturity date T_m, i.e., the default time $\tau_D\le T_m$; and (c)Default occurs after the maturity but before the payment date, i.e., $T_m<\tau_D\le T_p$. By the definition of the auxiliary process $\{U(t)\colon 0\le t\le T_p\}$ in (A1), the events $\{\tau_D\le T_m\}$ and $\{T_m<\tau_D\le T_p\}$ are equivalent to the events $\{U(T_m)\le \ln D\}$ and $\{U(T_m)>\ln D, U(T_p)\le \ln D\}$, respectively. The time-zero option values $C(0)$ and $P(0)$ in (3.4)-(3.5) can now be rewritten as

$$
\begin{aligned}
X(0) = {} & P(0,T_p)E_Q\left[G(T_m)\middle|\mathfrak{F}_0\right] - \alpha P(0,T_p)E_Q\left[G(T_m)1_{\{U(T_m)\le \ln D\}}\middle|\mathfrak{F}_0\right] \\
& - \alpha P(0,T_p)E_Q\left[G(T_m)1_{\{U(T_m)>\ln D, U(T_p)\le \ln D\}}\middle|\mathfrak{F}_0\right]
\end{aligned}
\qquad \text{(B1)}
$$

where $X(0)=C(0)$ and $G(T_m)=(S(T_m)-K)^+$ for the call option; and $X(0)=P(0)$ and $G(T_m)=(K-S(T_m))^+$ for the put option. In the following, the dependency on the information set $\mathfrak{F}_0$ is omitted and rewrite (B1) as

$$
\begin{aligned}
X(0) = {} & P(0,T_p)\int_{-\infty}^{\infty} E_Q\left[G(T_m)\middle|L_F = f\right]g(f)df \\
& - \alpha P(0,T_p)\int_{-\infty}^{\infty} E_Q\left[G(T_m)1_{\{U(T_m)\le \ln D\}}\middle|L_F = f\right]g(f)df \\
& - \alpha P(0,T_p)\int_{lnD}^{\infty} E_Q\left[G(T_m)1_{\{U(T_m)>\ln D, U(T_p)\le \ln D\}}\middle|L_F = f\right]g(f)df
\end{aligned}
\qquad \text{(B2)}
$$

where $L_F=lnV_F(T_m)$ and $g(f)$ is the probability density function of $L_F=f$. Since

$$lnV_F(T_m)=lnV(0)-lnP(T_m, T_p)-\sigma_V^2T_m/2+\sigma_V W_F(T_m)$$

Thus $g(f)$ is the $p.d.f.$ of a normal distribution with mean $lnV(0)-lnP(T_m, T_p)-\sigma_V^2T_m/2$ and variance $\sigma_V^2T_m$. By Lemma A.1, conditional on $L_F=f$, the logarithm of the underlying asset $lnS(T_m)$ is independent of the process $\{U(t)\colon 0\le t\le T_p\}$. Thus (B2) can be expressed as

$$
\begin{aligned}
X(0) &= P(0,T_p)\int_{-\infty}^{\infty} h_i(f)g(f)df \\
&- \alpha P(0,T_p)\int_{-\infty}^{\infty} h_i(f) Pr\{U(T_m) \le \ln D | L_F = f\} g(f)df \\
&- \alpha P(0,T_p)\int_{\ln D}^{\infty} h_i(f) Pr\{U(T_m) > \ln D, U(T_p) \le \ln D | L_F = f\} g(f)df
\end{aligned} \tag{B3}
$$

where i=1 for the call option with $h_1(f)= E_Q\left[(S(T_m)-K)^+ \middle| L_F = f\right]$, and i=2 for the put option with $h_2(f)= E_Q\left[(K - S(T_m))^+ \middle| L_F = f\right]$. Now the conditional probability

$$\Pr\{U(T_m)>\ln D,\ U(T_p)\le\ln D|L_F=f\} = \Pr\{U(T_p)\le\ln D|\Xi\} \times \Pr\{U(T_m)>\ln D\ |L_F=f\}$$

where $\Xi=\{U(T_m)>\ln D,\ L_F=f\}$. Thus, (B3) can be rewritten as

$$
\begin{aligned}
X(0) &= P(0,T_p)\int_{-\infty}^{\infty} h_i(f)g(f)df \\
&- \alpha P(0,T_p)\int_{-\infty}^{\infty} h_i(f)\times\left[1 - Pr\{U(T_m) > \ln D | L_F = f\}\right] g(f)df \\
&- \alpha P(0,T_p)\int_{\ln D}^{\infty} h_i(f) Pr\{U(T_p) \le \ln D | \Xi\}\times Pr\{U(T_m) > \ln D | L_F = f\} g(f)df
\end{aligned} \tag{B4}
$$

$\Pr\{U(T_p)\le\ln D|\Xi\}$ and $\Pr\{U(T_m)>\ln D|L_F=f\}$ can be obtained using Lemmas A.3-A.4. The functions $h_1(f)$ and $h_2(f)$ are derived in the following Lemma.

Lemma B.1. The functions

$$h_1(f)= E_Q\left[(S(T_m)-K)^+ \middle| L_F = f\right]= e^{\mu(f)+\sigma_m^2/2}\Phi\left(\frac{-\ln K + \mu(f) + \sigma_m^2}{\sigma_m}\right) - K\Phi\left(\frac{-\ln K + \mu(f)}{\sigma_m}\right)$$

$$h_2(f)= E_Q\left[(K - S(T_m))^+ \middle| L_F = f\right]= -e^{\mu(f)+\sigma_m^2/2}\Phi\left(\frac{\ln K - \mu(f) - \sigma_m^2}{\sigma_m}\right) + K\Phi\left(\frac{\ln K - \mu(f)}{\sigma_m}\right)$$

where $\mu(f)$ and σ_m^2 are given in Lemma A.1.

Proof. By Lemma A.1, given L_F=f, $lnS(T_m)$ is normally distributed with mean $\mu(f)$ and variance σ_m^2. Therefore,

$$h_1(f)= E_Q\left[(S(T_m)-K)^+ \middle| L_F = f\right]= \int_{\ln K}^{\infty}(e^u - K)\frac{1}{\sqrt{2\pi}\sigma_m}exp\left(-\frac{(u-\mu(f))^2}{2\sigma_m^2}\right)du$$

$$h_2(f)= E_Q\left[(K - S(T_m))^+ \middle| L_F = f\right]= \int_{-\infty}^{\ln K}(K - e^u)\frac{1}{\sqrt{2\pi}\sigma_m}exp\left(-\frac{(u-\mu(f))^2}{2\sigma_m^2}\right)du$$

The Lemma is proved. □

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□ □ □ □ □ □ Liquidity Providing in Arbitrage by Trader Types: Evidence from the Taiwan Index Option Market

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Using put-call futures parity violations to measure asynchronous adjustments in asset prices, this study explores how arbitrage trading affects equity liquidity and which trader types provides liquidity in the period of arbitrage exploitation in Taiwan index option market. Our results show that an increasing in limit order submission improves liquidity during times of before violating PCFP but increases bid-ask spread to deteriorate liquidity during times of after violating PCFP. Individual traders play an important role to drive option prices to violate the PCFP and then market makers provide liquidity during law of one price breaking down. Our results suggest that market markers do their formal market making obligation as the TXO market demand unexpected liquidity.

Keywords: Arbitrage; Put call futures parity; Trader type; Liquidity provision; Index option market;

JEL Classification: G10; G11; G14.

1. Introduction

The impact of arbitrage on liquidity supply has received considerable attention within the recent literature. Because financial liberalization and growth in cross-border capital movements lead to increase financial markets variation, arbitrageurs play an important role and in enforcing the law of one price in the financial market. Increasing computerized trading technology and high frequency trading in the recent year eases arbitrage to buy the cheaper asset and selling the expensive one when law of one price breaks down. However, how arbitrage affects equity liquidity is still unclear.

Gromb and Vayanos (2010) argue from a theoretical perspective that if arbitrage opportunities arise from non-fundamental demand shocks, such as fire sales by funding constraint, arbitrage trading could correct missing price and improve liquidity to the market and thereby causing a positive relation between arbitrage and equity liquidity. However, arbitrage opportunities are due to different information sets (Domowitz, Glen, and Madhavan, 1998) and asynchronous price adjustments to information (Focault, Kozhan, and Tham, 2015), arbitrageurs have an information advantage and arise adverse selection cost for market makers, leading to deteriorate liquidity.

This study considers a simple no-arbitrage relation, the well-known put-call futures parity (PCFP) that the payoff of a futures contract can be synthetically replicated using call options, put options, and bonds. The option market relies heavily on arbitrage to ensure that prices do not deviate substantially from fair value for long period of time. However, the PCFP violations caused by asynchronous adjustments in option prices should occur more frequently as new information shocks since options with a lot of distinct exercise prices and contract months are traded simultaneously in the marketplace.[1] Although option market is

[1] Most literature on price discovery, documented by the speed at which prices react to new information, finds that index futures lead both index options and the spot index (e.g., Stoll & Whaley, 1990; Fleming, Ostdiek, & Whaley, 1996).

dynamically efficient,[2] previous empirical literature finds that PCFP violations are frequent and substantial violations at short-lived term.[3] Because different markets receive different information over time, lags in the transmission information and interpretation of prices lead to PCFP violations. If arbitrage traders interpret price information faster than market makers, then arbitrage is possible and thereby increasing adverse selection cost and decreasing equity liquidyt (Kumar and Seppi, 1994; Focault et al., 2015). Given above reasons, PCFP violations provide us an opportunity to capture asynchronous adjustments in asset prices with new information.

Understanding liquidity provision is very important as traders in limit order markets encounter the choice of order type every time they trade since the electonic limit order market is one of the major trading venues in equity and futures exchanges around the world. In this trading platform, market orders come with execution certainty, but traders pay an implicit price for immediacy. On the other hand, limit orders allow traders to set a limit price at which the order can be filled, but traders run the risk of nonexecution and adverse selection risk. Prior literature on the study of arbitrage focuses primarily on the size of profits and its impact on liquidity. In contrast, such research in liquidity supply as violating the LOP is still lacking. Furthermore, most studies regarding the supply of liquidity mainly examine the stock, foreign exchange, and futures markets[4] while the liquidity supply in option market is less well addressed. This paper attempts to fill this gap by exploring the liquidity provision of option market in the period of arbitrage exploitation.

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[2] Lee and Nayar (1993), and Fung and Chan (1994) find that both the S&P 500 option and futures markets, in general, are efficient by testing put-call-futures parity using S&P 500 index options and futures contracts. Based on put-call-futures parity, Fung and Fung (1997), and Fung, Cheng, and Chan (1997) report that markets are dynamically efficient by using Hong Kong' Hang Seng Index futures and options.

[3] Many empirical studies show that despite the put-call parity usually holds, there are frequent, substantial violations of put-call parity (Stoll, 1969; Gould and Galai, 1974; Klemkosky and Resnick, 1979; Evnine and Rudd, 1985; Kamara and Miller, 1995). For put-call-futures parity tests, Fung and Mok (2001) find significant arbitrage profitability by using the quotes of Hang Seng Index options and futures.

[4] See, for example, Biais, Hillion, and Spatt (1995), Chung, Van Ness, and Van Ness (1999), Ahn, Bae, and Chan (2001), Anand, Chakravarty, and Martell (2005), Bjonnes, Rime, and Solheim (2005), Bloomfield, O'Hara, and Saar (2005), Menkhoff, Osler, and Schmeling (2010), and Chiu, Chung, and Wang (2014).

In addition to the theoretical studies previously discussed, recent empirical studies reveal an increased focus on the relation between arbitrage and equity liquidity. Roll, Schwartz, Subrahmanyam (2007) consider no-arbitrage relations between stock market and futures index and explore the joint dynamic structure of the futures-cash basis and stock market liquidity. Their empirical results show that deviations from no-arbitrage relations can increasing bid-ask spread and help in predicting market liquidity on subsequent days. In addition, the deviations from the law of one price are forecasted by liquidity. Their results suggest that liquidity plays an important role in moving markets toward an efficient outcome. Hence, the deviations from no-arbitrage relations could provide information to investors, leading to be valuable in affecting equity liquidity.

Using triangular arbitrage opportunities in the FX market, Focault et al. (2015) examine how arbitrage affects liquidity. Foucault et al. (2015) argue that asynchronous price adjustments in asset prices following new information arrival can cause toxic arbitrage opportunities due to created adverse selection costs for liquidity providers. This is because as enforcing these toxic opportunities, arbitrageurs expose the liquidity providers to the risk of trading at stale quotes, i.e., being picked off. As a result, the liquidity providers with stale quotes will incur a loss on the trade as if they have been trading with better informed investors. Their results suggest that arbitrage opportunity from asynchronous price adjustments in asset price leads to decreasing equity liquidity. Moreover, Rosch (2015) examines how arbitrage opportunity from Depositary Receipts (DRs) affects liquidity from the U.S. and five different home markets. His results show that around 70% of the arbitrage opportunities in DRs are due to non-fundamental demand shocks and an increasing in arbitrage activity is associated with a reduction in market order imbalance and increase in liquidity. His empirical results suggest a theoretical perspective of Gromb and Vayanos (2010).

Using a unique data set that identifies order submission by trader types, this study investigates how arbitrage opportunity from PCFP violation affects liquidity provision and which trader types provides liquidity in the period of arbitrage exploitation in Taiwan index option market. We first examine whether the PCFP violation is due to asynchronous adjustments in option prices. We examine whether the futures price and order flow change at the origin of this opportunity reverts after the opportunity terminates. We then divide traders into four groups (individual traders, foreign institutional firms, domestic institutional traders and market makers) to examine who drives option prices to violate the PCF parity. We finally invistiage how arbitrage opportunity from PCFP violation affects bid-ask spread and which trader types provides liquidity in the period of arbitrage exploitation in Taiwan index option market.[5] To the best of our knowledge, the literature focus on the differences among foreign institutional investors and other types of traders in the liquidity provision at arbitrage opportunity is very small. Understanding the liquidity supply of option market by different trade types in arbitrage shocks is of high importance because of increased investor interest and regulator concern for this toxic arbitrage.

(Results & contributions)

Our empirical results provide evidence that option price violations related to the PCFP are mainly driven by individual traders. In terms of initially violating PCFP, the orders on the opposite side of arbitrageurs are submitted most by market makers, followed by individual traders, and least by foreign and domestic institutional traders. The market makers respond most limit orders centralized on best 5 quotes, but least market orders. In contrast, individual traders use most of market orders.

[5] This study only sheds light on option market because the futures market is more liquid and high pricing efficiency relative to option market. The liquidity, transaction costs, pricing efficiency, and price discovery in the TXO market have been explored by Roope and Zurbruegg (2002), Hsieh (2004), Huang (2004), and Chou and Wang (2006). Generally, evidence confirms that the market of index futures is good in quality in every perspective.

For liquidity providing by trader types, we find that market makers dominate the response of liquidity supply in arbitrage shocks whereas individual traders and domestic institutional traders respond less. This result is robust even using aggressive orders with highly executed probability instead of orders submitted. However, our results provides evidence that market markers do their formal market making obligation as option market demands unexpected liquidity. It also supports the results of Mayhew (2002), and Eldor, Hauser, Pilo, and Shurki (2006) who find the contribution of market makers to the liquidity in the option market.

In terms of before and after violating PCFP, the effect of submitted limit orders on liquidity is different. Overall, an increase in submitted limit orders improves option liquidity during times of before violating PCFP, consistent with Chung et al. (1999) who find a negative relation between the number of outstanding limit orders and spread. Inversely, more limit orders reduce liquidity during times of after violating PCFP, reflecting an unaggressive order submission by market traders. The evidence supports the result of Kamara and Miller (1995), Kumar and Seppi (1994), Roll et al. (2007), and Foucault et al. (2014) that arbitrage deteriorates liquidity. Also, for most of different trader types we find negative relations between submitted limit orders and liquidity during period of after violating PCFP.

Our results are related to a recent strand of literature that shows the difference in supply and use of market liquidity between informed and liquidity traders (or patient and impatient traders) in the limit order book. These studies are analyzed by both theoretical model such as Glosten (1994), Chakravarty and Holden (1995), Seppi (1997), Hariss (1998), and Kaniel and Liu (2006) and by empirical work like as Keim and Madhavan (1995), Bloomfield et al. (2005), and Foucault, Kadan, and Kandel (2005). In addition, Chiu et al. (2014) find that institutional traders use more limit orders than market orders in the Taiwan index futures market. Bjonnes et al. (2005) explore the liquidity supply of non-financial customers in the foreign exchange market (Swedish Krona market).

Our study is organized as follows. Section 2 describes the Taiwan option market structure and presents our data source. Section 3 estimates PCFP violation and investigates how option price and order flow change during the PCFP violation. Section 4 examines the relation between PCFP violations and equity liquidity. Section 5 provides the concluding remarks.

2. Market structure and data set

2.1. Taiwan Index Options market structure

The TXO option market is a hybrid market like as the NYSE and Amex, in which both market makers and limit order traders establish prices. The Taiwan Stock Exchange (TWSE) was one of the major exchanges in the world. Furthermore, the Taiwan index options (hereafter TAIEX options), the underlying asset of which is the TWSE Capitalization Weighted Stock Index, are ranked the fourth most frequently traded index option on a global scale. The designated market makers in the TXO option market must reflect in their quotes the highest bid price and the lowest ask price posted in the limit-order book as they provide the bid and ask price quotations in response to inquiries by market participants.[6]

The TXO with European style and Taiwan stock index futures (TX) both traded in Taiwan Futures Exchange (TAIFEX) share the same underlying asset, the Taiwan Stock Exchange Capitalization Weighted Stock Index (TAIEX)[7], and expiration date, the third Wednesday of the delivery month of each contract[8]. The preopen session of TXO and TX is from 8:30 a.m. to 8:45

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[6] Upon receiving the quote request message, a quote is a two-way (bid and ask) limit order placed by a market maker. His bid-ask spread must be within the range stipulated by TAIFEX, and the quantity ordered (i.e. the minimum quantity ordered) must comply with relevant requirements as well. In addition, a market maker can also give a quote without being asked.

[7] The TAIEX is a value-weighted index of all common stocks.

[8] For the delivery months, the futures contracts are spot month, the next calendar month, and the next three quarterly months, and the option contracts are spot month, the next two calendar months, and the next two quarterly months.

a.m. During this period, investors can submit orders to the electronic limit-order book, and the exchange uses the single-price action system to establish the opening prices of regular trading hours. The regular trading hours conducted on weekdays excluding public holidays are from 8:45 a.m. to 1:45 p.m. (Taipei time). In real time, the TAIEX disseminates order and transaction prices to the public. Investors can observe on the screen the specific anonymous best five bid and best five ask prices with the number of contracts.

2.2. Data source and sample selection

In our analysis, we use intraday tick-by-tick data of the TXO and TX obtained from the TAIFEX. The data cover the period from January 1, 2007 to December 31, 2008 and contain detailed information on consolidated transactions, quotes and order flows, and order book. For each order, the date and time of order submission, order type and quantity, trade direction (buy or sell), limit price, and trader identification are recorded. The trader identification enables us to categorize four types of traders: market makers (MM), individual traders (IT), foreign institutional traders (FIT), and domestic institutional traders (DIT). In addition, the three month time deposit of the postal saving system, retrieved from TEJ, is used to be a proxy for the risk-free interest rate. The source files are checked whether there are typographical problems to avoid large pricing problem. We also eliminate price limit day, time periods without limit order information, and days with missing trading data.[9]

3. PCFP violation and asynchronous adjustments in option prices

3.1. PCFP violation and its arbitrage profits

We follow the data-matching procedure adopted by Fung and Mok (2001) to match the futures and options prices within 15-second time interval. Firstly, every bid (ask) quote of call option is matched with ask (bid) quote of the put option with same exercise price and

[9] Futures data are missing for eight days in June 2008 and three days in December 2008.

maturity. Next, the option pair is then matched with ask (bid) quote of futures contract. To reduce the impact of illiquid trade on our test results, this study only use the data of spot month contract. The options and futures with time to maturity less five trade days are switched from first deferred contracts to nearby contracts.

Tucker (1991) documents that if the European options and futures contracts share the same underlying asset and expiration, the payoff of a futures position can be synthesized by a call option and a put option with the same exercise. However, PCFP needs to hold exactly at any point in time, otherwise investors may benefit from arbitrage trading until the mispricing is eliminated. The arbitrage profits incorporating the costs are given in Equations (1) and (2), which separately represent the ask price of futures ($F_{ask,t}$) under the bid price of synthesized futures ($F_{bid,t}^{syn}$) and the bid price of futures ($F_{bid,t}$) over the ask price of synthesized futures ($F_{ask,t}^{syn}$).

$$F_{bid,t}^{syn} - F_{ask,t} = [(C_{bid,t} - P_{ask,t}).e^{r\tau} + K] - F_{ask,t} - \Psi_t - M_t \tag{1}$$

$$F_{bid,t} - F_{ask,t}^{syn} = F_{bid,t} - [(C_{ask,t} - P_{bid,t}).e^{r\tau} + K] - \Psi_t - M_t \tag{2}$$

in which $C_{bid,t}$ and $C_{ask,t}$ ($P_{bid,t}$ and $P_{ask,t}$) denote the bid and ask prices of calls (puts) at time t. $F_{bid,t}$ and $F_{ask,t}$ are the bid and ask prices of futures at time t. K is the option exercise price. τ denotes the time to maturity. r is the risk-free interest rate. M and Ψ denote the opportunity costs of margin deposits and trade costs.

The total costs for establishing arbitrage portfolio (i.e., arbitrage costs) consist of opportunity costs of margin deposits (M)[10], and trade costs (Ψ)[11]. We consider the

[10] Fung and Fung (1997) find that the effect is small when differential borrowing and lending rates are used.

opportunity costs (*M*) since cash is primarily used for margin deposits of options and futures. Following Fung and Fung (1997), the financing cost on margin deposits is calculated as $TMD.(e^{rt}-1)$, in which *TMD* is the total margin deposits. The trade costs for arbitrage (Ψ) constructed on the hold-to-expiration strategy involve the opening trade costs for one pairs of call and put options and a futures contract, and the settlement costs for a futures contract and an option (call or put)[12]. No charge is levied for out of the money options on expiration.

Equation (1) also implies that a call option is overvalued, a put option is undervalued, or both. The arbitrage profit in Equation (1) is equivalent to the difference between a bid price of call and a ask price of synthesized call, and the difference between a bid price of synthesized put and a ask price of put.[13] Moreover, in practice, the speed at which futures prices react to new information is faster than that of option (Stoll & Whaley, 1990; Fleming, Ostdiek, & Whaley, 1996). Consequently, the call's bid price over the ask price of synthesized call and the put's ask price under the bid price of synthesized put reflect an overvalued call or an undervalued put, or both. Similarly, Equation (2) implies an undervalued call or an overvalued put, or both. In this paper, we analyze the liquidity providing in these four categories of PCFP violations, i.e., call and put options with overvalued and undervalued prices.

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[11] In the TXO market, transaction tax is 0.025% for the futures contract value, and 0.125% for the option premium. At expiration, an in-the-money option is subject to 0.025% tax of the settlement value if it is closed out by settlement instead of by offsetting trading. An out-of-the money option is not taxed because no transaction would be made. In addition, since settlement price is not available in time t, here we use futures price instead of settlement price.

[12] Because the multipliers for the futures and option contracts are NT$200 and NT$50 per index point, respectively, every four pairs of calls and puts, thus, can be hedged by one futures (FITX) contract. For simplification, this study represents the arbitrage profits by NT$50 per index point, consistent with the option's multiplier. Therefore, one pair of call and put options is only hedged by one FITX contract. However, despite the difference in multiplier values, the PCFP condition still holds.

[13] Based on the PCFP, a call can be synthesized by long a put, long a futures contract, and short a risk free bond. Similarly, a put can be synthesized by long a call, long a risk free bond, and short a futures contract.

Table 1 reports the statistics of arbitrage profits involved trading costs. Using the option and futures data from January 1, 2007 to December 31, 2008, there is 0.14% percentage of option prices to violate the PCFP in all samples. We further divide options violating PCFP into three groups by call option's moneyness (*myn*): (1) for in-the-money options with *myn* below 0.975 (ITM), (2) at-the-money options with *myn* above 0.975 and below 1.025 (ATM), and (3) out-of-the-money options with *myn* below 1.025 (OTM). The moneyness is calculated as $K/(S*e^{r\tau})$, in which K is exercise price, S is the underlying index price, τ is time to maturity, and r is risk-free interest rate. The measure unit for arbitrage gain is an index point, with each index point valued at NT$50. As shown in Table 1, the arbitrage profit averages 3.5244. On average, the arbitrage profit for OTM options is slightly above those in ITM and ATM options by about 2 index point, respectively with average profits of 5.6227, 3.3920, and 3.4083. They are positively skewed and exhibit leptokurtosis. Given the above empirical results, investors could get potential profits by rapidly submitting orders to build their arbitrage portfolios when PCFP is violation and law of one price breaks down.

[TABLE 1 ABOUT HERE]

3.2. PCFP violation and option price

In order to examine whether PCFP violation could be due to asynchronous price adjustments in asset price following new information arrival or reflect non-fundamental demand shocks, we tract option price during the PCFP violation period. According to Schultz and Shive (2010), we posit that arbitrage opportunities as situations in which asynchronous adjustment in option prices are eventually followed by permanent shifts in futures option prices.[14] We posit that if

[14] As an illustration, suppose that liquidity providers in the futures market receive a string of buy orders due to good information arrival and raise their bid and ask quotes. If this price move is large enough and liquidity providers in the option market are slow to adjust their quotes to reflect this information, then an arbitrage opportunity in PCFP violation appears. When arbitrage opportunity vanishes, the futures prices do not revert to

arbitrage opportunities reflect non-fundamental demand shocks, the futures option price change at the origin of this opportunity reverts after the opportunity terminates.

Figure 1 shows the plot of correlation coefficients between the return of index futures at 15-second (30-second) time interval of just violating PCFP at time t=0 and the cumulative index futures return from time t=0 to the tth time interval of after violating PCFP, in which t=1, 2, …, 12 (2, 4, …, 12) for 15-second (30-second) time intervals. A positive (negative) correlation coefficient indicates that the price in index futures moves in the same (opposite) direction before and after violating PCFP. Our results show that both the correlation coefficients for 15- and 30-second time intervals are all positive with significance at 1% level. During times of arbitrage shocks, the correlation coefficients for 15-second (30-second) time intervals range from 0.41 to 0.80 (0.5 to 0.79), suggesting that arbitrage opportunities in PCFP violations are inclined to be generated by asynchronous adjustments in option prices.

In addition, for each PCF violation, we compare the futures option prices at the onset of arbitrage opportunity (time t=0) and at time t=1, 2, 3, and 4. If the move direction of future price is same, we regard it as a toxic arbitrage opportunity. Our analysis reveals that on average, the fractions of toxic arbitrage opportunities over all PCFP violations are 67.07%, 63.39%, 60.58%, and 58.00% (72.83%, 69.29%, 62.00%, and 59.67%) in 1st, 2nd, 3rd, and 4th time intervals of 15 seconds (30 seconds) of after violating PCFP. Overall, our empirical results show that option prices are not easy to revert after violating the PCFP 6 minutes, indicating that arbitrage opportunities from PCFP violation could not reflect non-fundamental demand shocks and could be the asynchronous adjustment in option prices.

[FIGURE 1 ABOUT HERE]

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their position before the arbitrage opportunity because the initial shock is a shock to fundamentals.

3.3. PCFP violation and order submission

Our prior empirical results show that investors could get potential profits and option prices are not easy to revert by rapidly submitting orders to build their arbitrage portfolios when PCFP is violation. Using complete limit order book information, we investigate the new order submission after violating PCFP. If order imbalance occurs after violating PCFP, market makers raise higher inventory risk and thereby decreasing equity liquidity.[15]

Based on the best five bid and ask prices recorded in the limit order book exposed to the screen, we use the following rules to classify five levels (categories) of increasing order aggressiveness: (a) Market Orders (MO) = market orders that demand liquidity and are executed immediately at the best prices currently standing in the market (i.e., most aggressive); (b) Better Best 1 (BB1Q) = marketable limit orders and prices of limit orders are submitted at better than best one quote; prices of buy (sell) orders are greater (less) than the best bid (ask) quote; (c) Best 1 (B1Q) = limit orders that are submitted to the best one quote; that is, submission of limit buy (sell) orders is equal to the best bid (ask) quote; (d) Best 2–5 (B2-5Q) = limit orders that are submitted behind the best one quote but at or before the best five quotes; and (e) Behind Best 5 (BB5Q) = limit orders that are submitted behind the best five quotes (i.e., least aggressive).

We first calculate the average number of new order submission and cumulative average number of new order submission at five order aggressive levels after violating PCFP 15 and 30 second time intervals. We then calculate the ratios of the cumulative average number of submitted bid orders to ask orders. We divided PCFP into four types: overvalued call, overvalued put, undervalued call, and undervalued put. We could expect that

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[15] See O'Hara and Oldfield (1986), Chordia et al. (2002), and Roll, et al. (2007).

As exhibited in Panel A of Table 2, in 15-second time interval of initial arbitrage shocks, the ratios of cumulative average number of submitted bid orders to ask orders by quote types (A/B) are almost less than one for overvalued calls and puts, but almost greater than one for undervalued options. This provides empirical evidence in favor of that arbitrage introduces newly submitted bid-ask order imbalances.

More specifically, the largest difference between cumulative bid and ask orders, reported in columns of Cum. (A) and Cum. (B), occurs at best quote, B1Q (e.g., with the averages of -2.56 and -33.83 contracts separately for overvalued calls and puts). The asymmetric number of bid-ask orders clustering on the prices better than the best 2–5 quotes reflects that market participants place unaggressive orders in the side of liquidity supply during times of arbitrage shocks. Besides, on the side of arbitrageurs we find more aggressive ask (bid) orders in MO and BB1Q for overvalued (undervalued) options. These aggressively asymmetric quotes may create order imbalances on trade since these two quote types of MO and BB1Q are almost executed immediately. Similarly, Panel B reported a 30-second time interval of initially violating PCFP also obtain same results.

[TABLE 2 ABOUT HERE]

Overall, Table 2 find that overvalued (undervalued) options generates more ask (bid) orders than bid (ask) orders and results in order imbalances. We further estimate the average excess order imbalances (AEOIB) of mispriced options during the 12 successive time intervals of 15 seconds after violating PCFP (at time t=0). The PCFP violations are divided into four categories: overvalued calls, overvalued puts, undervalued calls and undervalued puts. For the AEOIB of each category in each 15-second interval, we first calculate the AEOIB and then average them. The AEOIB is calculated as order imbalance less the mean of order imbalances in 360 successive time intervals of 15 seconds prior to the occurrence of arbitrage opportunity. We use the algorithm proposed by Lee and Ready (1991) to determine whether the transactions are buyer or seller initiated. The algorithm classifies a trade as a buyer (seller) initiated trade if the traded price is higher (lower) than the midpoint of the bid and ask price. We assign a value of +1 (-1) to each transaction to indicate that the trade is buyer (seller) initiated and multiply the assigned value by trading dollar.

In Figure 2, we find negative (positive) AEOIB for overvalued (undervalued) options after PCFP is violated. The magnitude of AEOIB increases at first 15-second time interval, and decreases until the fourth 15-second time interval, then level off. This suggests that arbitrage generates persistent order imbalances due to completing with others for the same trade. The negative (positive) AEOIB for overvalued (undervalued) options reflects a trade direction on sell (buy) side, consistent with that of arbitrageurs. Also, it suggests that liquidity suppliers absorbed imbalances on buy (sell) side cannot adjust their inventories easily during period of arbitrage shocks.[16]

[FIGURE 2 ABOUT HERE]

3.4. Who drives option prices to violate the PCF parity?

An interesting and important question arising from temporary mispricing of options is who drives option prices to violate the PCFP. Bollen and Whaley (2004), Ni, Pan, Poteshman (2008), and Gârleanu, Pedersen, and Poteshman (2009) document that the net buy (sell) demand drives option price upward (downward). Following their argument, we use the net buy volume of options by each trader type to investigate this issue. We estimate net buy volume for 24 successive time intervals of 15 seconds before and after violating PCFP (at time t=0). For each time interval, we calculate average net buy volumes of mispriced options,

[16] The order imbalances can be used to measure both direction and degree of buying or selling pressure (Chordia et al., 2002; Chordia & Subrahmanyam, 2004).

measured by buy volume less sell volume, by each of trade types. The results are exhibited in Figure 3.

[FIGURE 3 ABOUT HERE]

Figure 3 shows the plot of average net buy volume of options by trader types around PCFP violations. Figures A and D (C and B) represent the average net buy volumes by each trader type separately for overvalued (undervalued) calls and puts. For overvalued options (shown in Figures A and D), we find an increasing net buy volume for individual traders but an increasing net sell volume for market makers prior to PCFP violations. Inversely, individual investors for undervalued options (shown in Figures C and B) have an increasing net sell volume, while market makers have an increasing net buy volume. For individual traders, the corresponding t-values from t=-4 to t=2 are 2.02, 2.00, 5.34, 10.46, 18.50, 16.72, and 3.13 (-5.40, -3.66, -3.89, -13.44, -15.57, -11.60, and -3.20) on the overvalued (undervalued) calls, and 6.83, 7.33, 7.58, 9.00, 10.48, 9.62, and 6.13 (-19.49, -19.98, -21.86, -23.08, -26.74, -27.88, and -22.05) on the overvalued (undervalued) puts, respectively.[17] Besides, regardless of overvalued options and undervalued options, the net buy volumes of foreign and domestic institutional investors are almost invariant around PCFP violations.

The finding that the process of option price to violate the PCFP accompanies with increased net buy (or sell) volume of non-market makers is consistent with Bollen and Whaley (2004), Gârleanu et al. (2009), and Ni et al. (2008) who document that option net buy (sell) demand of non-market makers increases (decreases) its price. However, these results provide evidence supporting that individual traders drive option prices to violate the PCFP.

[17] For market makers, the corresponding t-values from t=-2 to t=2 are 9.33, 8.44, 5.42, 1.37, -7.21, -3.93, and 8.13 (7.45, 6.14, 5.18, 12.14, 14.42, 11.38, and 3.8), respectively, for overvalued (undervalued) calls, and -7.35, -7.55, -7.97, -10.19, -11.35, -11.02, and -7.49 (10.73, 8.67, 11.94, 15.15, 20.75, 22.53, and 14.50) for overvalued (undervalued) puts.

4. PCFP violations and equity liquidity

4.1. The impact of PCFP on bid-ask spread

However, in practice, the bid-ask spread is an indicator of liquidity and directly associated with transaction costs of all market participants. We further examine the variation in liquidity of options established by submitted limit orders (*NLO*) of different trader types around PCFP violations. We employ the following unbalanced panel regression as an empirical investigation on the impact of limit orders on liquidity. For each trade type and each type of PCFP violations, we estimate the panel regression controlling on trade volume of option ($OVol$) and liquidity at prior time interval. $D_{M,t}$ is a dummy variable that equals 1 if it is in 12 successive time intervals of 15 seconds of after violating PCFP.

In addition, the negative (positive) β_1 indicates that liquidity rises (falls) following increased limit orders during times of before violating PCFP. A negative (positive) sum of β_1 and β_2 shows that increased limit orders narrow (widen) the percentage spread during times of after violating PCFP.

$$\begin{aligned} Liq_{i,t} &= \alpha + \beta_1 * NLO_{i,t} + \beta_2 * D_{M,t} * NLO_{i,t} + \beta_3 * OVol_{i,t} + \beta_4 * Liq_{i,t-1} + \varepsilon_t \\ &, i = 1,2,3,\ldots,N, t = -a,\ldots,0,\ldots,b, \text{ and } a,b \in [3,12] \end{aligned} \tag{3}$$

where Liq_t is the liquidity of option at the end of time interval t, which is measured as bid-ask spread divided by the midpoint of quote. N is the number of PCFP violations. NLO_t is the number of newly submitted limit bid and ask orders during time t interval (i.e., the sum of bid and ask orders in quote types of B1Q, B2-5Q, and BB5Q). $OVol_t$ is the option trade volume during time t interval.

The coefficients in Equation (3) are estimated using the two stages least square (2SLS) panel regression due to possibly endogenous problem between liquidity, submitted limit orders, and trade volume.[18] In the process of calculating the estimates, we use lagged values of number of submitted limit orders (*NLO*), trade volume (*OVol*), realized volatility (*RV*), net buy pressure (*NBP*), arbitrage size (*ArbSz*), and return of futures (*FRet*) as instrument variables.

Table 3 gives the results of the impact of limit orders (*NLO*) on liquidity by each trader type around violating PCFP. Panels A-D report the results for overvalued calls, overvalued puts, undervalued calls, and undervalued puts, respectively. During times of before violating PCFP, our results reveal that, in general, an increase in limit orders submitted by all market traders improves liquidity evidenced by the significantly negative coefficients of *NLO* (respectively with t-values of -4.04, -6.18, and -4.10 for overvalued puts and undervalued calls and puts), except for overvalued calls. This result supports the finding of Chung et al. (1999) who find a negative relation between the number of outstanding limit orders and spreads.

Furthermore, the effect of limit orders submitted by different trade types on liquidity is likely to be distinct in different types of PCFP violations. In four types of PCFP violations, we find that both market makers and domestic institutional traders have three significant and negative coefficients of *NLO* while individual and foreign institutional traders have two significantly negative coefficients of *NLO*, respectively. This suggests that market makers and domestic institutional traders play a crucial role to narrow the spread of options during times of before violating PCFP.

In the time intervals of after violations of PCFP, we find that the coefficients of *D*NLO* for market traders are all positive and significance at 1% level in four types of PCFP violations. Specifically, the sum of coefficients for *NLO* and *D*NLO* are all positive with

[18] Chung et al. (1999) argue that there exists an endogenous problem between the limit order spread, the quantity of limit orders, and the execution rate of limit orders.

0.00005 and 0.00013 (0.00009 and 0.00007) for overvalued (undervalued) callas and puts, showing that liquidity of option is reduced as increasing limit orders. These results also reflect an unaggressive order submission strategy by market traders. However, this evidence provides support for the results of Copeland and Galai (1983), Kumar and Seppi (1994), Kamara and Miller (1995), Roll et al. (2007), and Foucault et al. (2014) that arbitrage deteriorates liquidity. In addition, we also find that the negative relation between liquidity and newly submitted limit orders almost holds for four trader types during times of after violating PCFP. Only the limit orders placed by individual and foreign institutional traders are found to reduce the width of spreads when call or put options are overestimated.

[TABLE 3 ABOUT HERE]

4.2. Liquidity providing in PCFP violations by trader types

4.2.1 The percentage of change in the number of submitted orders

Prior to the analysis of liquidity supply by the change ratios of submitted orders and the panel regression, we first take a look at Table 2 about orders submitted on the side of liquidity supply in terms of initially violating PCFP. In Panel A, we find that, on the whole, investors who face arbitrage shocks in initial interval of 15 seconds favor to use orders with prices at best 5 quotes while using a little market orders. This is evidenced by submitted orders clustering at best 2–5 quotes or best quotes, but least for market orders. For instance, the ratios of orders submitted at best 5 quotes (market orders) to all quoted orders are 59.82% and 53.28% (1.64% and 0.59%) for overvalued calls and puts.

Regarding the orders submitted by trader types, the untabulated results reveal that the orders on the side of liquidity supply are submitted most by market makers, followed by individual traders, and least by foreign and domestic institutional traders. For example, the submitted bid orders of overvalued calls (puts) average 18.15, 9.15, 2.19, and 0.42 (49.12, 4.33, 3.11, and 2.50) respectively for MM, IT, FIT, and DIT. In contrast, the market orders are submitted most by IT, but rarely used by MM and FIT.

Also, we compare the order aggressiveness of trader types by calculating the ratio of orders over best quote to all orders which are submitted by each trader type itself. We find that IT are aggressive relative to MM. This is because IT have the largest ratios respectively with the ratios being 29.56% and 40.74% (33.04% and 39.24%) for overvalued (undervalued) calls and puts whereas the ratios are small for MM with 17.29% and 7.96% (9.69% and 26.61%) for overvalued (undervalued) calls and puts, respectively.

In addition, Panel B reported a 30-second time interval of initial arbitrage shocks also obtains similar results. The same findings in Panels A and B that market makers place most orders within the best 5 quotes but least market orders suggests that market makers seemly act like a role of liquidity trader who favors to place limit orders.

At the beginning, we use the ratios of change in submitted orders on the opposite side of arbitrageurs to measure the liquidity supply in arbitrage shocks. For each type of PCFP violations and each trader type, we compute the ratios of change in submitted orders accumulated by quote types, which are defined as the difference between average numbers of submitted orders accumulated by quote types to average numbers of all orders submitted at prior time interval of violating PCFP. More specifically, we first calculate the differences between cumulative numbers of submitted orders by quote types in two time intervals of just before and after violating PCFP and average them. Then, they are divided by the average number of all orders submitted in one time interval of just before violating PCFP. However, the advantages of using this measure do not only reflect the change of liquidity supply but also order aggressiveness.

The results are reported in Table 4. Panel A and Panel B respectively present the results of mispriced options in two 15-second time intervals and in two 30-second time intervals of just before and after violating PCFP.

Panel A shows that the ratios at BB5Q, i.e., indicating a percentage change in the number of all submitted orders, for MM are almost positive with values of 1.1%, 2.29%, and 0.09% separately for overvalued puts, and undervalued calls and puts, except the overvalued calls with value of -0.54%. But, the ratios at BB5Q for IT, FIT, and DIT are almost negative, especially for IT. In contrast to other trader types, the increased ratio for MM indicates that more orders on the side of liquidity supply are placed by MM in arbitrage shocks.

Specifically, the ratios for maker makers raise in quote types with high level of execution probability and switch to decrease afterward. The largest ratios of an increase in submitted orders occurs at best quote (B1Q) with values of 1.52% and 10.97% for overvalued calls and puts and with values of 10.14% and 2.45% for undervalued calls and puts. This indicates that market makers place more orders with highly executed probability relative to those submitted at the prior time interval of violating PCFP. The evidence of an increase in use of aggressively-priced orders supports that market makers provide liquidity to option market in arbitrage shocks.

The results in Panel B for a 30-second time interval of initial arbitrage shocks are also similar to those in Panel A. Market makers still place more aggressive orders, but individual traders cut down their submitted orders. Consequently, we conclude that market makers dominate the response of liquidity supply to arbitrage shocks while individual traders respond little.

[TABLE 4 ABOUT HERE]

To further test whether market markers do their formal market making obligation as violating PCFP, we divide the options violating the PCFP into three groups based on the moneyness of option : for OTM, ATM, and ITM options. Then, for each of PCFP violations and each trader type, we recalculate the change ratios of submitted orders by each moneyness group. Here, only the results during period of initial 15-second arbitrage shocks are plotted in Figure 4: Figures A-C for overvalued calls (OC), Figures D-F for undervalued calls (UC), Figures G-I for overvalued put (OP), and Figures J-L for undervalued puts (UP). In the x-axis, the number 1, 2, 3, 4, and 5 respectively correspond to the MO, BB1Q, B1Q, B2-5Q, and BB5Q of quote types, which are arranged in highly executed probability order.

Figure 4 exhibits the plot of the change ratios of orders submitted by trader types for different moneyness groups. A visual inspection shows that the ratios for market makers vary enormously, but the variations in orders submitted by other trader types are relatively small. The change ratios for market makers in three moneyness groups and four types of PCFP violations are all positive at best quote (corresponding to the number 3 in the x-axis) and almost positive at behind best 5 quote (corresponding to the number 5 in the x-axis). More specifically, the OTM and ATM options have large change ratios of submitted orders. In contrast, the orders submitted by individual traders are generally reduced more in initial arbitrage shocks, especially for ATM options.

The similar results are obtained in the initial 30-second time interval of arbitrage shocks (unreported). However, regardless of option moneyness and types of PCFP violations, the finding that market makers place more orders on the opposite side of arbitrageurs and with highly executed probability provides in support of liquidity supply by market makers as option market demands unexpected liquidity.

[FIGURE 4 ABOUT HERE]

4.2. 2. Liquidity providing in PCFP violations by trader types

Arbitraging in PCFP violations decreases liquidity. A liquidity provider should be who provides more bid (ask) quotes in the option order book when option prices are overvalued (undervalued). This is because that more orders placed on the opposite side of arbitrageurs may raise the execution probability of orders (Chung et al., 1999), i.e., increasing liquidity supply. As a result, we define the supply of liquidity during times of arbitrage shocks as an increase in bid (ask) orders for overvalued (undervalued) options.

This study particularly interests in liquidity supply of option during period of arbitrage exploitation. However, in practice, arbitrage opportunity is short-lived. For each violation, we select the option data within before and after 3-minute time period of violating PCFP (i.e., 24 successive time intervals of 15 second) as data set to test liquidity supply by different trader types.[19] Furthermore, the violations with less than three successive time intervals of 15 seconds in before or after of violating PCFP are excluded from the sample (i.e., violations occurs in before 8:45:30 a.m. or after 1:44: 30 p.m.).

Our empirical analysis for liquidity supply to option market are in two ways. First, we analyze the percentage of change in the number of orders submitted by each trader type on the opposite side of arbitrageurs just before and after violating PCFP.

Second, we adopt an unbalanced panel regression to analyze the variation in the number of bid (ask) orders, NLM_t, of overvalued (undervalued) options. For each trader type and each type of PCFP violations, options (calls and puts) with overvalued and undervalued prices, we individually use the panel regression to investigate the supply of liquidity. In addition, the Hausman test statistic (1978) with asymptotical chi-squared distribution (χ^2) is used to differentiate between fixed effect model and random effect model in panel data. A rejection

[19] Cheng, Fung and Pang (1998) find that arbitrage profitability, based on the PCFP, declines and subsequently disappears within 5 minutes. Fung and Draper (1999) analyze the mispricing of the Hong Kong Seng Index. They find that arbitrage profit opportunities exist within 5 minutes and become smaller or disappear as the time lags increase. Consequently, here we use the average value of 3 minutes.

of the null hypothesis indicates that the fixed effect model is suitable for the panel data. The empirical model is specified as

$$
\begin{aligned}
NLM_{i,t} &= \alpha + \beta_1 * NBP_{i,t-1} + \beta_2 * RV_{t-1} + \beta_3 * ArbSz_{i,t-1} + \beta_4 * FRet_{t-1} + \beta_5 * OVol_{i,t-1} \\
&+ \beta_6 * OSpd_{i,t-1} + \beta_7 * TolBid_{i,t-1} + \beta_8 * TolAsk_{i,t-1} + \beta_9 * Myn_{i,t} + \gamma_j * \sum_{j=1}^{12} D_{jt} + \varepsilon_t \qquad (4) \\
&, i = 1,2,3,\ldots,N, t = -a,\ldots,0,\ldots,b, \text{ and } a,b \in [3,12]
\end{aligned}
$$

The dependent variable, NLM_t, denotes the number of bid (ask) orders submitted on the opposite side of arbitrageurs for overvalued (undervalued) options during t time interval. N is the number of PCFP violations. The time interval $t=0$ indicates the occurrence of violating PCFP. ε_t is the error term. Myn_t is option moneyness at time t. $D_{j,t}$ is a dummy variable that equals 1 if it is in jth time interval of after violating PCFP, j=1,2,3,…, 12. This variable captures the intraday variation in the number of submitted orders with respect to the time of after violating PCFP. The coefficient of γ_i represents the difference between the mean of ith time interval and the mean of around the violations of PCFP. The other independent variables associated with market characteristics are specified as following.

NBP_{t-1} indicates option net buy pressure during $t-1$ time interval, which is measured in terms of the degree and direction of transaction (Chordia et al., 2002; Chordia & Subrahmanyam, 2004). The more NBP is often accompanied by a buy transaction due to its persistence (Chordia et al, 2002), suggesting that investors tend to submit bid orders rather than ask orders following a positive and large NBP. We calculate the NBP as the buyer-initialed trades less the seller-initialed trades during the $t-1$ time interval, in which every transaction is assigned using the Lee and Ready (1991) algorithm.

RV_{t-1} is the realized volatility of futures, which is calculated as the square root of the sum of squared return during *t-1* time interval. Handa and Schwattz (1996), Foucault (1999), Ahn et al. (2001), Bae et al. (2003), Goettler et al. (2005), and Menkhoff et al. (2010) find that price volatility affects order placement and execution. A rise in volatility is followed by an increase in the order placement and execution. We use the realized volatility to control the dynamic impact of volatility on order submission.

$ArbSz_{t-1}$ is the size of arbitrage profits, shown in Equations (1) and (2), at time *t-1*. In practice, large arbitrage profits can attract more arbitrageurs, thereby generating more imbalance between newly submitted bid orders and ask orders. This suggests that the size of deviations from PCFP is associated with order placement strategy. We thus use this variable to control the impact of PCFP deviation on order submission.

$OSpd_{t-1}$ denotes the average best bid-ask spread of options during *t-1* time interval, which the literature finds significant response of order placement to changes in spreads (Bae et al., 2003; Biais et al., 1995; Chung et al., 1999; Menkhoff et al., 2010). It is used to control for the effect of option spreads on order submission.

$TolBid_{t-1}$ and $TolAsk_{t-1}$ are the average of bid and ask volume submitted at the best 5 quotes during the *t-1* time interval, respectively. Numerous studies document that changes on depth in the buy and sell sides of the book affects order submission (Menkhoff et al, 2010; Ranaldo, 2004). A rise in the same side depth of the trade discourages the limit order at the same side depth while encouraging the limit order in the opposite side. Thereby, we use this variable to control the impact of market depth in the book on order submission.

$FRet_{t-1}$ and $OVol_{t-1}$ are the return of futures and trade volume of option during *t-1* time period, respectively. We include these two variables due to the probable influence on order submission.

The second way to analyze the supply of liquidity is the panel regression in Equation (3), which examines the variation in number of submitted orders by incorporating dummy variables. The dummy variables are used to capture the intraday variation in number of submitted orders with respect to the time intervals of after violating PCFP. A positive coefficient γ_j of dummy variable represents an increase in number of submitted orders on the jth time interval of arbitrage shocks. Inversely, the negative coefficient indicates less orders submitted. The regression results for overvalued and undervalued options (calls and puts) are reported in Tables 6-7, respectively.

[TABLE 5 ABOUT HERE]

[TABLE 6 ABOUT HERE]

Table 6 presents the regression results of liquidity supply on buy side by each trader type separately for overvalued calls and puts, controlling on market shocks such as net buy pressure, volatility, arbitrage size, option spreads, futures return, and depth in the book. The results of the Hausman test (1978) reported in the second row of Tables 6 shows that the fixed effect model is suitable for the panel data in every trader type. For the liquidity supply by all traders, in Table 6 we find significant evidence in support of an increase in number of submitted orders on the overvalued puts in first two time intervals of arbitrage shocks (with t-values of 4.59 and 2.92, respectively), whereas no evidence in Table 6 supports an increase in the number of submitted orders for overvalued calls.

For the liquidity providing in overvalued calls by trader types, however, in Table 6 we find significant and positive coefficient of D_1 for market makers (t-value = 2.06), but almost significantly negative coefficients for individual traders. In panel B of Table 6, we also find that market makers have two positive coefficients of D_1 and D_2 for overvalued puts with significance at 1% level in first two time intervals of arbitrage shocks (t-values = 5.79 and 2.88, respectively). For individual traders, we find only a significantly positive coefficient of D_2 (t-value =1.86) but significantly negative coefficients in the latter time intervals of arbitrage shocks. These results indicate that market makers submit more orders of calls and puts and then switch to usual or less orders afterwards in response to initial arbitrage shocks. In contrast, individual traders submit less orders except increased orders of puts in the second time interval of after violating PCFP.

In addition, both the coefficients of dummy variables for foreign and domestic institutional traders are insignificant (see Table 6) or significantly negative (see the results in panel B of Table 6 for domestic institutional traders). Therefore, we conclude that market makers dominate the liquidity supply during times of after violating PCFP.

We further specify the effect of market shocks on order submission by each of trader types from Tables 6. For option net buy pressure (NBP), all the coefficients are positive and most of them are statistically significant at 1% level, indicating that more bid orders are submitted by investors following an increased NBP. This evidence provides in support of the results of Chordia et al. (2002) and Chordia and Subrahmanyam (2004) that large NBP often accompanies with a buy transaction due to its persistence. Overall, we find that more orders are placed following a rising volatility evidenced by that the coefficients of realized volatility (RV) for all traders and most trader types are positive and highly significant at the 1% level. This finding is consistent with results in Handa and Schwattz (1996), Foucault (1999), Ahn et al. (2001), Bae et al. (2003), Goettler et al. (2005), and Menkhoff et al. (2010).

For the potential arbitrage profits ($ArbSz$), the coefficients with negative and highly significant at the 1% level show that large arbitrage profits stemming from overestimated options (calls and puts) attract market traders to place more ask orders, thus leading less bid orders submitted, i.e., on the opposite side of arbitrageurs.

Regarding the depth at best 5 quotes of bids ($TolBid$) on same side of liquidity supply, most of the coefficients for overvalued calls and puts lagged one period are found to have significant and negative signs. The result indicates that most traders place fewer orders on buy side when the state of the buy side order book is thicker and more orders when the buy side order book is thinner. This provides evidence in support of the crowding-out effect proposed by Parlour (1998) who documents that a rise in the same side depth discourages the orders submitted at the same side depth. This is because the orders with time priority already in the book lessens the execution probability of a new order on the same side. In contrast, the effect of the sell side order book ($TolAsk$) on order submission is ambiguous.

On the whole, lagged one-period return of futures ($FRet$) as well as trade volume of option ($OVol$) has a positive impact on bid order placement. One possible explanation is that investors favor to buy calls and hedgers tend to buy puts when a price of underlying futures rises, and large trade volume reflecting the quantity of option contracts bought and sold at the same time accompanies with more quotes in the book (Cohen, Maier, Schwartz, & Whitcomb, 1981; Chung et al., 1999). As a consequence, this leads to an increase in bid orders of calls and puts. Furthermore, for all traders and most trader types, we find significantly negative relation between option spread ($OSpd$) and order placement, indicating that traders place less orders on the same side of liquidity supply when intraday spread is wide.

In addition, order submission is associated with option moneyness. One possibility is that options with different degree of moneyness have distinct financial leverage (risk), hedging ratio, and liquidity risk (transaction costs) which in turn are correlated with the trading activity. In general, the newly submitted orders decreases with increased option moneyness (Myn). An out-of-the-money option (calls and puts) tends to decrease orders submitted while an in-the-money option (calls and puts) increases order submission.

The empirical analysis of liquidity supply on sell side of undervalued calls and puts, reported in Table 6, obtains several similar results with those in Tables 5. In brief, market makers still provide the liquidity to option market in the session of arbitrage shocks. Our finding supports the result of Mayhew (2002), and Eldor et al. (2006) who find the contribution of market makers to the liquidity in the option market.

4.3. Robustness results

In practice, the duration of arbitrage opportunities is short-lived and arbitrageurs face execution risk in forming their arbitrage portfolios (Kleidon, 1992; Kumar & Seppi, 1994; Holden, 1995; Kozhan & Tham, 2012). A high speed of trade execution is beneficial for traders to build their arbitrage portfolios and lowers their execution risk. Therefore, more active orders placed on the opposite side of arbitrageurs and with high execution probability may stimulate arbitrage activity and in turn remove mispricing.

To test the robustness of our empirical results, we redefine a provider of liquidity as a trader who places more active orders with highly executed probability on the opposite side of arbitrageurs. We use the number of submitted orders available at over best quote, i.e., market order (MO) and better best quote (BB1Q), instead of the number of all submitted orders. These orders are executed rapidly in the marketplace. Further, we also re-perform the unbalanced panel regression in Equation (3) to investigate the supply of liquidity by each trader type.

To save space, we only report the coefficients of dummy variables for mispriced options in Table 8. Panels A-D represent the results separately for overvalued calls, overvalued puts, undervalued calls, and undervalued puts.

[TABLE 7 ABOUT HERE]

For overvalued calls and puts, as reported in Panels A and B, we find that the significance of dummy variables (D_1–D_{12}) for market markets are comparable to the results in Table 5, with calls being significant for D_7 and D_8 and puts being significant for D_1, D_2, D_6,

D_9, and D_{10}. Results support that market makers respond more active orders during times of after violating PCFP. Similarly, in Panels C and D we also find similar results for undervalued calls and puts. We thus conclude that market makers play a significant role in providing liquidity when option market demands unexpected liquidity, supporting that they fulfill their exchange obligation of liquidity provision.

5. Conclusion

Arbitraging in put-call futures parity (PCFP) violations impairs liquidity due to created adverse select costs and order imbalances. This study investigates the liquidity supply of option providing in arbitrage exploitation. We use a unique data set of the Taiwan index option to separately examine the liquidity supply by market makers, individual traders, and foreign and domestic institutional traders. The data set includes order codes of identification, trading activity, and the real-time information in order book. Thus, our study is not subject to the trader-type error.

Our conclusions are specified as follows. First, individual traders play an important role in driving option prices to violate the PCFP. Second, in terms of initially violating PCFP, the orders on the side of liquidity supply are submitted most by market makers, followed by individual traders, and least by foreign and domestic institutional traders. Third, we find that market makers dominate the response of liquidity supply during times of after violating PCFP while individual and domestic institutional traders respond less. This finding provides evidence that market markers fulfill their obligation of liquidity supply when option market demands liquidity unexpectedly.

Next, for the effect of limit orders on liquidity, we find that on the whole, increased limit orders improves liquidity during period of before violating PCFP, consistent with Chung et al. (1999). Inversely, more submitted limit orders reduce liquidity during times of arbitrage exploitation. This evidence provides in favor of the results of Kamara and Miller (1995), Kumar and Seppi (1994), Roll et al. (2007), and Foucault et al, (2014) that arbitrage deteriorates liquidity. Finally, the characteristics of market and underlying asset affect the order placement strategy by different trader types.

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Table 1. Arbitrage profits

	All sample	In-the-money (ITM) (*myn* <0.975)	At-the-money (ATM) (0.975 <= *myn* <=1.025)	Out-the-money (OTM) (*myn* >1.025)
Obs.	27805	15318	10917	1570
Mean	3.5244	3.3920	3.4083	5.6227
Std	4.6958	3.7078	4.3851	10.8672
Median	2.6321	2.7848	2.5971	2.7949
Min	0.0002	0.0002	0.0025	0.0003
Max	178.5411	123.6421	160.4133	178.5411
Skewness	13.6965	11.1457	16.0534	7.4167
Kurtosis	332.7765	268.6778	450.7541	81.5309

Notes: The table reports the statistics of arbitrage profits as violating the put-call futures parity (PCFP). The data cover the period from January 1, 2007 to December 31, 2008. The total costs for building the arbitrage portfolio consist of trade costs and opportunity costs of margin deposits. The transaction costs include the pairs of call and put options and a futures contract. We further separate the options violating the PCFP into three groups by call option's moneyness: for in-the-money options, at-the-money options, and out-the-money options. The option moneyness (*myn*) is calculated as $K/(S*e^{r\tau})$, in which K is exercise price, S is the underlying asset price, τ is time to maturity, and r is risk-free interest rate.

Table 2. Submitted orders after violating the put-call futures parity

Panel A: In a 15-second time interval just after violating the put-call futures parity											
	Overvalued call						Overvalued put				
	Bid orders		Ask orders		Ratio		Bid orders		Ask orders		Ratio
	Vol.	Cum. (A)	Vol.	Cum. (B)	=(A/B)		Vol.	Cum. (A)	Vol.	Cum. (B)	=(A/B)
MO	0.49	0.49	0.81	0.81	0.60	MO	0.35	0.35	0.45	0.45	0.78
BB1Q	5.85	6.34	7.89	8.71	0.73	BB1Q	5.98	6.34	36.17	36.62	0.17
B1Q	8.11	14.45	8.31	17.02	0.85	B1Q	7.69	14.03	11.24	47.86	0.29
B2-5Q	9.78	24.24	8.22	25.24	0.96	B2-5Q	23.77	37.80	17.18	65.04	0.58
BB5Q	5.68	29.91	2.73	27.98	1.07	BB5Q	21.25	59.06	7.29	72.33	0.82
	Undervalued call						Undervalued put				
	Bid orders		Ask orders		Ratio		Bid orders		Ask orders		Ratio
	Vol.	Cum. (A)	Vol.	Cum. (B)	=(A/B)		Vol.	Cum. (A)	Vol.	Cum. (B)	=(A/B)
MO	0.66	0.66	0.32	0.32	2.04	MO	0.45	0.45	0.50	0.50	0.90
BB1Q	38.40	39.06	7.16	7.48	5.22	BB1Q	6.49	6.93	5.49	5.99	1.16
B1Q	13.26	52.32	8.02	15.50	3.38	B1Q	8.23	15.16	6.26	12.24	1.24
B2-5Q	21.01	73.33	25.15	40.65	1.80	B2-5Q	6.51	21.67	4.22	16.47	1.32
BB5Q	7.22	80.55	19.71	60.36	1.33	BB5Q	2.33	24.00	2.44	18.90	1.27
Panel B: In a 30-second time interval just after violating the put-call futures parity											
	Overvalued call						Overvalued put				
	Bid orders		Ask orders		Ratio		Bid orders		Ask orders		Ratio
	Vol.	Cum. (A)	Vol.	Cum. (B)	=(A/B)		Vol.	Cum. (A)	Vol.	Cum. (B)	=(A/B)
MO	0.98	0.98	1.60	1.60	0.61	MO	1.19	1.19	0.87	0.87	1.37
BB1Q	11.65	12.63	15.12	16.72	0.76	BB1Q	12.44	13.62	62.41	63.27	0.22
B1Q	16.69	29.31	16.25	32.97	0.89	B1Q	16.27	29.89	21.01	84.28	0.35
B2-5Q	20.16	49.47	15.87	48.84	1.01	B2-5Q	47.69	77.58	32.13	116.41	0.67
BB5Q	11.01	60.49	5.39	54.23	1.12	BB5Q	38.43	116.02	13.69	130.10	0.89
	Undervalued call						Undervalued put				
	Bid orders		Ask orders		Ratio		Bid orders		Ask orders		Ratio
	Vol.	Cum. (A)	Vol.	Cum. (B)	=(A/B)		Vol.	Cum. (A)	Vol.	Cum. (B)	=(A/B)
MO	1.23	1.23	0.69	0.69	1.80	MO	0.88	0.88	0.97	0.97	0.91
BB1Q	65.58	66.81	14.76	15.45	4.33	BB1Q	12.25	13.12	10.97	11.94	1.10
B1Q	25.27	92.08	17.99	33.44	2.75	B1Q	15.68	28.81	12.78	24.73	1.16
B2-5Q	38.50	130.58	49.95	83.38	1.57	B2-5Q	12.28	41.08	8.53	33.26	1.24
BB5Q	13.75	144.33	35.37	118.75	1.22	BB5Q	4.56	45.64	4.52	37.78	1.21

Notes: The table presents the ratios of the cumulative average number of submitted bid orders to ask orders by quote types in the initial arbitrage shocks. The results in first 15-second and 30-second time intervals of arbitrage shocks are reported in Panel A and Panel B, respectively. The quoted orders are divided into the following categories: MO (market order), BB1Q (better best quote), B1Q (best 1 quote), B2-5Q (best 2–5 quotes), and BB5Q (behind best 5 quotes). They are arranged in highly executed probability order. For each type of arbitrage opportunities (with 24976 observations for overvalued calls and undervalued puts, and with 2827 observations for undervalued calls and overvalued puts), we compute the ratio of submitted bid orders to ask orders (A/B) by each quote type. The ratios for quote types are calculated as the cumulative average number of submitted bid orders (A) to the cumulative average number of submitted ask orders (B). Vol. denotes the average number of submitted orders in all violations. Cum. (A) is the cumulative average number of submitted orders by quote types.

Table 3. **Regression results of limit orders on liquidity**

	Overvalued calls		Overvalued puts		Undervalued calls		Undervalued puts	
	Coeff.	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*
NLO_t	0.02	3.68***	-0.03	-4.04***	-0.02	-6.18***	-0.01	-4.10
D_{Mt}*NLO_t	0.03	5.79***	0.16	6.23***	0.11	6.04***	0.08	8.26 ***

Notes: The table presents the unbalanced panel regression results of limit orders on liquidity by each trader type around PCFP violations. We estimate the coefficients in Equation (4) using the two stages least square (2SLS) panel regression. The lagged values of number of submitted limit orders (*NLO*), trade volume (*OVol*), realized volatility (*RV*), net buy pressure (*NBP*), arbitrage size (*ArbSz*), and futures return (*FRet*) are used as instrument variables. The results for overvalued calls, overvalued puts, undervalued calls, and undervalued puts are reported in Panels A-D, respectively. In addition, the Hausman test (1978) is used to judge which the fixed effect model or the random effect model is suitable for the panel data. The empirical model is specified as

$$\begin{aligned} & Liq_{i,t} = \alpha + \beta_1 * NLO_{i,t} + \beta_2 * D_{Mt} * NLO_{i,t} + \beta_3 * OVol_{i,t} + \beta_4 * Liq_{i,t-1} + \varepsilon_t \\ & i = 1,2,3,\ldots,N, t = -a,\ldots,0,\ldots,b, \text{and } a,b \in [3,12] \end{aligned} \tag{4}$$

The dependent variable, Liq_t , is the liquidity of option at the end of time interval t, which is measured as bid-ask spread divided by the midpoint of quote. N is the number of violating PCFP. The time interval $t=0$ indicates the occurrence of violating PCFP. The limit orders (NLO_t) are calculated as the number of submitted bid and ask orders available at under better best quote during time t interval (i.e., the sum of bid and ask orders in quote types of B1Q, 2-5Q, and BB5Q). D_{Mt} is a dummy variable that equals 1 if it is during the period of after violating PCFP. $OVol_t$ is option trade volume during t time interval. Liq_{t-1} is lagged liquidity. In addition, for brevity, we only report the coefficients of *NLO* and D_{Mt}*NLO*. Both the coefficients are multiplied by 1000. ***, **, and * indicate that the t-values are significant at the 0.01, 0.05, and 0.1, respectively.

Table 4. Change ratios of order submission before and after violating PCFP

Panel A: In two 15-second time intervals before and after violating the put-call futures parity											
	Overvalued call: On bid side						Overvalued put: On bid side				
	MM	IT	FIT	DIT	TOSN		MM	IT	FIT	DIT	TOSN
MO	0.00%	-0.05%	0.00%	-0.02%	-0.08%	MO	0.00%	-0.23%	0.00%	0.04%	-0.19%
BB1Q	1.40%	0.32%	0.03%	-0.03%	1.73%	BB1Q	4.03%	0.48%	0.30%	0.16%	4.97%
B1Q	1.52%	-0.97%	-0.01%	-0.06%	0.48%	B1Q	10.97%	-1.30%	0.07%	0.11%	9.85%
B2-5Q	0.57%	-1.59%	-0.21%	-0.08%	-1.30%	B2-5Q	7.75%	-2.47%	0.13%	0.12%	5.53%
BB5Q	-0.54%	-1.69%	-0.24%	-0.11%	-2.59%	BB5Q	1.10%	-2.55%	-0.30%	-0.20%	-1.94%
	Undervalued call: On ask side						Undervalued put: On ask side				
	MM	IT	FIT	DIT	TOSN		MM	IT	FIT	DIT	TOSN
MO	0.00%	0.05%	0.00%	0.04%	0.09%	MO	0.00%	-0.04%	0.00%	0.00%	-0.04%
BB1Q	3.38%	0.41%	0.18%	0.17%	4.14%	BB1Q	1.50%	0.17%	0.00%	-0.06%	1.62%
B1Q	10.14%	-0.04%	-0.18%	0.12%	10.04%	B1Q	2.45%	-1.06%	-0.25%	-0.21%	0.92%
B2-5Q	8.34%	-0.42%	-0.28%	0.25%	7.89%	B2-5Q	1.07%	-1.39%	-0.39%	-0.26%	-0.98%
BB5Q	2.29%	-0.12%	-0.59%	0.03%	1.60%	BB5Q	0.09%	-1.59%	-0.36%	-0.34%	-2.20%
Panel B: In two 30-second time intervals before and after violating the put-call futures parity											
	Overvalued call: On bid side						Overvalued put: On bid side				
	MM	IT	FIT	DIT	TOSN		MM	IT	FIT	DIT	TOSN
MO	0.00%	-0.07%	0.00%	-0.03%	-0.10%	MO	0.00%	-0.14%	0.00%	0.04%	-0.09%
BB1Q	0.87%	0.00%	-0.01%	-0.04%	0.82%	BB1Q	3.58%	0.24%	0.13%	0.15%	4.10%
B1Q	1.29%	-0.99%	0.00%	-0.06%	0.24%	B1Q	10.05%	-0.67%	0.01%	0.15%	9.55%
B2-5Q	0.84%	-1.38%	-0.14%	-0.09%	-0.76%	B2-5Q	7.26%	-1.13%	-0.15%	-0.01%	5.97%
BB5Q	-0.20%	-1.54%	-0.17%	-0.09%	-2.01%	BB5Q	2.54%	-1.11%	-0.36%	-0.40%	0.67%
	Undervalued call: On ask side						Undervalued put: On ask side				
	MM	IT	FIT	DIT	TOSN		MM	IT	FIT	DIT	TOSN
MO	0.00%	0.06%	0.00%	0.01%	0.07%	MO	0.00%	-0.10%	0.00%	-0.01%	-0.11%
BB1Q	3.78%	0.32%	0.24%	0.08%	4.42%	BB1Q	1.02%	-0.13%	0.06%	-0.07%	0.88%
B1Q	10.82%	0.42%	0.26%	-0.06%	11.44%	B1Q	2.25%	-1.01%	-0.10%	-0.25%	0.90%
B2-5Q	9.43%	0.12%	0.30%	0.00%	9.86%	B2-5Q	1.23%	-1.30%	-0.18%	-0.24%	-0.49%
BB5Q	5.11%	0.20%	0.13%	-0.26%	5.18%	BB5Q	0.15%	-1.44%	-0.16%	-0.23%	-1.67%

Notes: The table presents the change ratios of submitted orders accumulated by quote types during times of before and after violating PCFP. Panel A and Panel B report the results in two 15-second time intervals and two 30-second time intervals just before and after PCFP violations, respectively. For each type of PCFP violations and each trader type, we compute the ratios of change in number of submitted orders accumulated by quote types. The ratios for quote types are calculated as the differences between average numbers of submitted orders accumulated by quote types to average number of all submitted orders at prior time interval. More specifically, we first calculate the differences between cumulative numbers of submitted orders by quote types in two 15-second (or 30-second) time intervals of just before and after violating PCFP and average them. Then, they are divided by the average number of all submitted orders in 15-second (or 30-second) time interval of just before violating PCFP. In addition, the quoted orders are selected on the opposite trade direction of arbitrageurs and divided into the following categories: MO (market order), BB1Q (better best quote), B1Q (best 1 quote), B2-5Q (best 2–5 quotes), and BB5Q (behind best 5 quotes). The order types are arranged in highly executed probability order.

Table 5. Regression results of liquidity provision by trader types for overvalued calls and puts

	All		MM		IT		FIT		DIT	
	Fixed effect		Fixed effect		Fixed effect		Fixed effect		Fixed effect	
	Coeff.	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*
Panel A: overvalued calls										
NBP_{nt}	0.11	51.58***	0.04	23.53***	0.06	59.37***	0.00	4.64***	0.00	29.28***
RV_{nt}	209.07	34.28***	187.92	40.07***	-2.22	-0.72	19.27	10.85***	4.11	9.36***
$ArbSz_{nt}$	-0.46	-24.80***	-0.28	-19.79***	-0.08	-8.62***	-0.09	-16.40***	-0.01	-6.27***
$FRet_{nt}$	210.16	71.89***	126.65	56.33***	54.63	36.95***	27.74	32.59***	1.13	5.35***
$OVol_{nt}$	16.10	83.61***	10.28	69.42***	4.47	45.87***	0.97	17.35***	0.38	27.37***
$OSpd_{nt}$	-0.23	-16.53***	-0.15	-14.05***	-0.03	-3.88***	-0.05	-12.81***	0.00	-0.47
$TolBid_{nt}$	-3.37	-32.63***	-1.27	-16.00***	-1.57	-30.07***	-0.55	-18.32***	0.02	2.97***
$TolAsk_{nt}$	-0.10	-1.03	0.81	10.61***	-1.10	-21.87***	0.19	6.40***	0.00	0.19
Mym_t	-473.22	-5.14***	-260.12	-3.67***	-154.56	-3.32***	-78.45	-2.93***	19.91	3.00***
D_1	0.27	0.90	0.47	2.06**	-0.22	-1.44	0.01	0.15	0.00	-0.08
D_2	-0.35	-1.19	0.06	0.25	-0.34	-2.28**	-0.05	-0.59	-0.02	-0.82
D_3	-0.37	-1.24	-0.03	-0.13	-0.32	-2.17**	0.00	-0.04	-0.01	-0.43
D_4	-0.50	-1.69*	-0.07	-0.31	-0.45	-2.99***	0.04	0.48	-0.02	-1.05
D_5	-0.41	-1.39	0.00	0.01	-0.42	-2.79***	0.01	0.17	-0.01	-0.55
D_6	-0.41	-1.39	-0.07	-0.30	-0.42	-2.80***	0.08	0.90	0.00	-0.06
D_7	-0.38	-1.30	0.10	0.45	-0.50	-3.32***	0.02	0.22	-0.01	-0.41
D_8	-0.42	-1.44	-0.02	-0.08	-0.44	-2.93***	0.05	0.55	-0.02	-0.74
D_9	-0.28	-0.95	0.02	0.08	-0.38	-2.54**	0.08	0.88	0.00	0.21
D_{10}	-0.48	-1.63	-0.17	-0.73	-0.37	-2.45**	0.07	0.80	-0.02	-0.90
D_{11}	-0.26	-0.90	0.13	0.59	-0.39	-2.61***	-0.02	-0.18	0.01	0.30
D_{12}	-0.34	-1.14	-0.05	-0.20	-0.33	-2.23**	0.04	0.42	0.01	0.27
α	0.33	3.86***	-0.03	-0.49	0.38	8.83***	-0.03	-1.09	0.01	1.23
$Adj\text{-}R^2$	3.32%		2.04%		1.57%		0.41%		0.34%	
Panel B: overvalued puts										
	Fixed effect		Fixed effect		Fixed effect		Fixed effect		Fixed effect	
NBPt-1	0.16	14.81***	0.00	0.18	0.15	33.05***	0.00	1.72*	0.00	3.23***
RVt-1	124.44	18.56***	121.38	22.01***	-10.50	-3.73***	3.59	2.54**	9.97	11.48***
ArbSzt-1	-0.12	-4.34***	-0.08	-3.53***	-0.03	-2.65***	0.00	-0.34	-0.01	-1.96**
FRett-1	25.85	7.28***	30.75	10.53***	-3.34	-2.24**	-2.65	-3.53***	1.09	2.36**
OVolt-1	19.47	18.52***	5.87	6.78***	12.90	29.22***	0.34	1.54	0.36	2.67***
OSpdt-1	-0.06	-3.81***	-0.05	-3.57***	-0.01	-1.21	-0.01	-1.55	0.00	-0.27
TolBidt-1	-1.49	-3.26***	-0.98	-2.62***	-0.17	-0.86	-0.35	-3.62***	0.01	0.13
TolAskt-1	0.62	0.93	1.32	2.41**	-0.89	-3.19***	0.06	0.41	0.14	1.61
Mymt	163.23	0.96	99.34	0.71	2.78	0.04	10.68	0.30	50.44	2.29**
D1	5.23	4.99***	5.42	5.79***	-0.42	-0.88	0.27	1.13	-0.05	-0.32
D2	3.21	2.92***	2.60	2.88***	0.86	1.86*	-0.05	-0.23	-0.20	-1.39
D3	-0.59	-0.54	0.31	0.34	-0.15	-0.33	-0.42	-1.84*	-0.32	-2.25**
D4	-2.08	-1.91*	-1.47	-1.64	-0.63	-1.38	0.13	0.58	-0.12	-0.82
D5	-1.84	-1.69*	-1.27	-1.42	0.05	0.11	-0.30	-1.30	-0.33	-2.32**
D6	-0.36	-0.33	-0.32	-0.35	-0.03	-0.07	0.16	0.68	-0.16	-1.15
D7	-0.80	-0.73	-0.34	-0.38	-0.26	-0.56	-0.06	-0.27	-0.14	-0.98
D8	-1.63	-1.50	-0.92	-1.03	-0.62	-1.35	0.14	0.60	-0.23	-1.61
D9	-1.40	-1.28	-0.67	-0.75	-0.71	-1.55	0.10	0.44	-0.11	-0.80
D10	-1.82	-1.67*	-0.75	-0.84	-1.13	-2.46**	0.23	1.00	-0.17	-1.20
D11	-2.11	-1.93*	-1.06	-1.18	-1.05	-2.28**	0.32	1.40	-0.33	-2.31**
D12	-3.98	-3.63***	-2.73	-3.03***	-0.97	-2.11**	-0.06	-0.25	-0.22	-1.58
α	0.69	2.18**	0.10	0.39	0.43	3.22***	-0.04	-0.58	0.20	4.89***
Adj-R2	1.50%		1.26%		2.41%		0.05%		0.28%	

Notes: The table presents the unbalanced panel regression results of liquidity supply on buy side by trade types for overvalued calls (in panel A) and overvalued put (in panel B) after violating PCFP. The second row reports the results of Hausman test (1978) for different trader types. The results indicate which the fixed effect model or the random effect model is suitable for these panel data. The empirical model is specified as

$$
\begin{aligned}
NLM_{i,t} = {} & \alpha + \beta_1 * NBP_{i,t-1} + \beta_2 * RV_{t-1} + \beta_3 * ArbSz_{i,t-1} + \beta_4 * FRet_{t-1} + \beta_5 * OVol_{i,t-1} \\
& + \beta_6 * OSpd_{i,t-1} + \beta_7 * TolBid_{i,t-1} + \beta_8 * TolAsk_{i,t-1} + \beta_9 * Myn_{i,t} + \gamma_j * \sum_{j=1}^{12} D_{j,t} + \varepsilon_t \qquad (3) \\
& i = 1,2,3,\ldots,N, t = -a,\ldots,0,\ldots,b, a,b \in \{3,12\}
\end{aligned}
$$

The dependent variable, NLM_t, denotes the number of submitted buy orders during t time interval. N is the number of violating PCFP. The time interval $t=0$ indicates the occurrence of arbitrage opportunity. $D_{j,t}$ is a dummy variable that equals 1 if it is in jth interval, j=1,2,3,…, 12. This dummy variable captures the intraday variation in the number of submitted bid orders with respect to the time of violating the PCFP. For control variables, NBP_{t-1} is option net buy pressure during $t-1$ time interval, which is measured in terms of its persistence on buy side. RV_{t-1} is the realized volatility of futures during $t-1$ time interval, which controls the impact of volatility on order placement. $ArbSz_{t-1}$ is the profit for arbitrage trade at time $t-1$. $OVol_{t-1}$ and $OSpd_{t-1}$ denote option trade volume and its average best bid-ask spread during $t-1$ time interval, which control for the effect of option volume and spread on order placements. $TolBid_{t-1}$ and $TolAsk_{t-1}$ are the average of option bid and ask volume at the best 5 quotes during the $t-1$ time interval, respectively. $FRet_{t-1}$ is the futures return during $t-1$ time period. Myn_t is option moneyness at time t. In addition, both coefficients of *TolBid* and *TolAsk* are multiplied by 100 and the coefficient of *FRet* is divided by 100. ***, **, and * indicate that the t-values are significant at the 0.01, 0.05, and 0.1, respectively.

Table 6. Regression results of liquidity provision by trader types for undervalued calls and puts

	All		MM		IT		FIT		DIT	
	Fixed effect		Random effect		Fixed effect		Fixed effect		Random effect	
	Coeff.	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*
Panel A: overvalued calls										
NBP_{nt}	-0.06	-4.98***	-0.06	-4.92***	0.00	-0.22	-0.01	-2.99***	0.00	-3.18***
RV_{nt}	195.25	25.56***	173.10	25.14***	10.18	3.99***	6.41	5.28***	8.63	11.07***
$ArbSz_{nt}$	-0.32	-10.69***	-0.10	-3.81***	-0.16	-15.40***	0.00	-0.48	-0.01	-3.77***
$FRet_{nt}$	19.98	4.95***	23.81	6.48***	-4.54	-3.36***	-2.83	-4.40***	3.74	9.01***
$OVol_{nt}$	10.33	8.65***	8.33	7.76***	0.65	1.63	1.07	5.64***	-0.12	-0.97
$OSpd_{nt}$	-0.05	-1.21	-0.13	-3.90***	-0.03	-2.68***	-0.01	-1.28	0.00	-0.14
$TolBid_{nt}$	-2.75	-4.23***	-0.57	-1.14	0.16	0.76	-0.04	-0.36	-0.04	-0.59
$TolAsk_{nt}$	-1.74	-2.68***	1.44	2.80***	-0.12	-0.55	-0.27	-2.66***	0.06	1.06
Mym_t	-301.78	-1.56	-114.37	-9.21***	-242.70	-3.75***	23.02	0.75	-11.32	-6.68***
D_1	7.28	5.63***	5.65	4.62***	1.01	2.33**	-0.16	-0.76	-0.22	-1.59
D_2	2.96	2.38***	3.01	2.55***	0.00	0.00	0.03	0.14	-0.46	-3.42***
D_3	-0.99	-0.80	-0.32	-0.27	-0.18	-0.43	-0.12	-0.60	-0.53	-4.00***
D_4	-1.05	-0.85	-0.55	-0.47	0.19	0.46	-0.36	-1.82*	-0.40	-3.05***
D_5	-1.06	-0.86	-0.51	-0.43	-0.24	-0.57	0.15	0.77	-0.49	-3.68***
D_6	-1.16	-0.94	-1.22	-1.04	0.36	0.87	0.20	1.03	-0.50	-3.77***
D_7	-2.69	-2.17**	-2.40	-2.04**	0.25	0.59	-0.20	-1.02	-0.36	-2.73***
D_8	-3.06	-2.47**	-1.72	-1.46	-0.68	-1.64	-0.12	-0.58	-0.57	-4.27***
D_9	-0.34	-0.27	0.56	0.48	-0.72	-1.75*	0.30	1.50	-0.51	-3.82***
D_{10}	-1.19	-0.96	-0.24	-0.21	-0.50	-1.22	0.03	0.18	-0.51	-3.87***
D_{11}	-0.79	-0.64	0.53	0.45	-0.69	-1.67*	-0.17	-0.88	-0.48	-3.63***
D_{12}	-3.29	-2.64***	-2.11	-1.79*	-0.63	-1.51	-0.16	-0.79	-0.38	-2.89***
α	0.45	1.26	150.53	11.86***	0.16	1.29	0.05	0.84	14.40	8.28***
$Adj\text{-}R^2$	1.57%		1.50%		0.51%		0.14%		0.54%	
Panel B: overvalued puts										
	Fixed effect		Fixed effect		Fixed effect		Fixed effect		Fixed effect	
NBP_{nt}	-0.06	-33.91***	-0.03	-22.32***	-0.03	-35.92***	0.01	21.20***	0.00	-14.59***
RV_{nt}	128.59	25.37***	92.71	22.16***	30.91	12.54***	-2.16	-2.17**	7.12	9.43***
$ArbSz_{nt}$	-0.12	-9.63***	-0.08	-7.44***	-0.04	-6.17***	-0.01	-3.17***	0.00	0.92
$FRet_{nt}$	73.34	30.40***	46.48	23.34***	25.76	21.96***	0.04	0.07	1.06	2.94***
$OVol_{nt}$	19.83	125.01***	14.53	110.92***	4.52	58.61***	0.45	14.44***	0.33	14.04***
$OSpd_{nt}$	-0.11	-4.56***	-0.12	-5.89***	0.00	0.13	0.00	-0.80	0.01	2.66***
$TolBid_{nt}$	-0.03	-0.50	-0.01	-0.12	-0.04	-1.24	-0.06	-5.05***	0.07	8.00***
$TolAsk_{nt}$	0.08	2.87***	0.11	4.59***	-0.02	-1.14	-0.01	-2.26**	0.00	0.53
Mym_t	219.99	2.87***	485.76	7.67***	-206.29	-5.53***	97.29	6.46***	-156.76	-13.72***
D_1	0.25	1.00	0.41	2.01**	-0.12	-0.98	-0.04	-0.74	-0.01	-0.27
D_2	-0.16	-0.65	0.05	0.25	-0.18	-1.51	-0.01	-0.22	-0.02	-0.53
D_3	-0.43	-1.73*	-0.16	-0.80	-0.20	-1.67*	-0.03	-0.66	-0.03	-0.90
D_4	-0.24	-0.97	-0.06	-0.29	-0.18	-1.50	0.04	0.88	-0.04	-1.17
D_5	-0.34	-1.40	-0.15	-0.73	-0.15	-1.23	0.00	-0.01	-0.05	-1.36
D_6	-0.37	-1.51	-0.20	-0.99	-0.09	-0.77	-0.07	-1.41	-0.01	-0.27
D_7	-0.14	-0.59	0.05	0.25	-0.17	-1.44	-0.01	-0.13	-0.02	-0.45
D_8	-0.46	-1.87*	-0.21	-1.03	-0.13	-1.08	-0.05	-1.04	-0.07	-1.95*
D_9	-0.45	-1.85*	-0.19	-0.93	-0.17	-1.43	-0.06	-1.15	-0.04	-1.05
D_{10}	-0.32	-1.30	-0.08	-0.40	-0.17	-1.46	-0.03	-0.66	-0.03	-0.85
D_{11}	-0.32	-1.30	-0.01	-0.04	-0.23	-1.91*	-0.05	-0.94	-0.04	-1.01
D_{12}	-0.09	-0.35	0.10	0.51	-0.19	-1.57	-0.02	-0.38	0.02	0.44
α	0.26	3.61***	0.04	0.63	0.16	4.78***	0.03	1.87*	0.03	2.71***
$Adj\text{-}R^2$	3.37%		2.53%		1.06%		0.11%		0.14%	

Notes: The table presents the unbalanced panel regression results of liquidity supply on sell side by trade types for undervalued calls (in Panel A) and undervalued puts (in Panel B) after violating PCFP. The second row reports the results of Hausman test (1978) for different trader types. The results indicate which the fixed effect model or the random effect model is suitable for these panel data. The empirical model is specified as

$$
\begin{aligned}
NLM_{i,t} = {} & \alpha + \beta_1 * NBP_{i,t-1} + \beta_2 * RV_{t-1} + \beta_3 * ArbSz_{i,t-1} + \beta_4 * FRet_{t-1} + \beta_5 * OVol_{i,t-1} \\
& + \beta_6 * OSpd_{i,t-1} + \beta_7 * TolBid_{i,t-1} + \beta_8 * TolAsk_{i,t-1} + \beta_9 * Myn_{i,t} + \gamma_j * \sum_{j=1}^{12} D_{j,t} + \varepsilon_t \qquad (3) \\
& i = 1,2,3,\ldots,N, t = -a,\ldots,0,\ldots,b, a,b \in [3,12]
\end{aligned}
$$

The dependent variable, NLM_t, denotes the number of submitted buy orders during t time interval. N is the number of violating PCFP. The time interval $t=0$ indicates the occurrence of arbitrage opportunity. D_{jt} is a dummy variable that equals 1 if it is in jth interval, j=1,2,3,…, 12. This dummy variable captures the intraday variation in the number of submitted bid orders with respect to the time of violating the PCFP. For control variables, NBP_{t-1} is option net buy pressure during $t-1$ time interval. RV_{t-1} is the realized volatility of futures during $t-1$ time interval. $ArbSz_{t-1}$ is the profit for arbitrage trade at time $t-1$. $OVol_{t-1}$ and $OSpd_{t-1}$ denote option trade volume and its average best bid-ask spread during $t-1$ time interval. $TolBid_{t-1}$ and $TolAsk_{t-1}$ are the average of option bid and ask volume at the best 5 quotes during the $t-1$ time interval, respectively. $FRet_{t-1}$ is the futures return during $t-1$ time period. Myn_t is option moneyness at time t. In addition, both coefficients of *TolBiid* and *TolAsk* are multiplied by 100 and the coefficient of *FRet* is divided by 100. ***, **, and * indicate that the t-values are significant at the 0.01, 0.05, and 0.1, respectively.

Table 7. Active liquidity provision for mispricing calls and puts

	All		MM		IT		FIT		DIT	
	Coeff.	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*	*Coeff.*	*t-stat.*
Panel A: Overvalued calls										
D_1	0.09	0.72	0.13	1.38	-0.03	-0.49	0.00	0.02	-0.01	-0.52
D_2	-0.15	-1.20	-0.06	-0.69	-0.07	-1.06	0.00	-0.14	-0.01	-0.71
D_3	-0.10	-0.79	0.02	0.23	-0.13	-1.92*	0.02	0.50	-0.01	-0.58
D_4	-0.11	-0.91	0.02	0.25	-0.13	-2.00**	0.01	0.23	-0.01	-0.65
D_5	-0.06	-0.51	0.07	0.74	-0.10	-1.47	-0.03	-0.96	0.00	0.44
D_6	-0.01	-0.07	0.07	0.72	-0.08	-1.17	0.01	0.32	-0.01	-0.66
D_7	0.15	1.23	0.19	2.14**	-0.06	-0.90	0.02	0.60	0.00	-0.41
D_8	0.17	1.36	0.21	2.28**	-0.05	-0.70	0.01	0.19	0.00	0.04
D_9	0.07	0.60	0.12	1.32	-0.05	-0.77	0.01	0.19	0.00	-0.15
D_{10}	0.09	0.71	0.07	0.76	-0.02	-0.32	0.04	1.13	0.00	-0.08
D_{11}	0.05	0.39	0.10	1.11	-0.08	-1.13	0.02	0.67	0.00	0.00
D_{12}	0.11	0.89	0.06	0.63	0.01	0.17	0.04	1.26	0.00	-0.45
Panel B: Overvalued puts										
D_1	1.18	2.80***	1.11	3.51***	0.03	0.12	0.02	0.22	0.06	1.10
D_2	1.78	4.39***	0.74	2.41**	0.96	3.70**	0.00	0.03	0.06	1.18
D_3	0.14	0.35	0.06	0.21	0.18	0.71	-0.10	-1.13	-0.01	-0.24
D_4	-0.28	-0.70	-0.32	-1.06	0.11	0.41	-0.05	-0.58	0.01	0.23
D_5	-0.66	-1.65*	-0.30	-0.98	-0.15	-0.59	-0.11	-1.28	-0.05	-1.06
D_6	0.37	0.91	0.52	1.71*	-0.10	-0.39	0.03	0.35	-0.02	-0.41
D_7	-0.23	-0.58	-0.42	-1.38	0.25	0.98	0.02	0.21	-0.05	-1.10
D_8	-0.23	-0.57	-0.30	-1.00	0.11	0.41	-0.02	-0.25	0.02	0.36
D_9	0.60	1.50	0.60	1.97**	-0.15	-0.58	0.10	1.10	0.08	1.63
D_{10}	0.45	1.11	0.66	2.18**	-0.33	-1.27	0.05	0.62	0.07	1.46
D_{11}	-0.20	-0.50	-0.10	-0.34	-0.13	-0.51	0.14	1.61	-0.09	-1.71*
D_{12}	0.22	0.53	0.38	1.24	-0.07	-0.28	-0.06	-0.70	-0.01	-0.11
Panel C: Undervalued calls										
D_1	1.60	2.84***	1.55	2.97***	0.05	0.31	-0.04	-0.41	0.05	1.20
D_2	0.64	1.18	0.52	1.03	0.08	0.52	0.09	0.85	-0.04	-1.21
D_3	-0.06	-0.12	0.08	0.16	0.01	0.09	-0.15	-1.54	0.00	-0.13
D_4	-0.29	-0.54	-0.11	-0.23	-0.05	-0.32	-0.09	-0.89	-0.04	-1.05
D_5	-0.34	-0.63	-0.04	-0.07	-0.36	-2.36**	0.02	0.21	0.03	0.89
D_6	0.15	0.28	0.07	0.14	-0.03	-0.18	0.04	0.40	0.07	1.90*
D_7	0.33	0.62	0.18	0.37	0.18	1.19	-0.03	-0.27	0.00	-0.05
D_8	-0.14	-0.26	0.34	0.67	-0.18	-1.18	-0.28	-2.82***	-0.02	-0.58
D_9	0.81	1.49	0.96	1.92*	-0.13	-0.88	-0.01	-0.07	-0.02	-0.42
D_{10}	0.71	1.30	0.68	1.36	-0.03	-0.18	0.07	0.67	-0.02	-0.42
D_{11}	1.36	2.51**	1.54	3.08***	-0.20	-1.30	0.00	-0.01	0.01	0.38
D_{12}	1.24	2.29**	0.98	1.95*	0.01	0.04	0.24	2.41**	0.02	0.42
Panel D: Undervalued puts										
D_1	0.10	0.74	0.08	0.72	0.04	0.56	-0.02	-0.67	-0.01	-0.61
D_2	-0.03	-0.23	-0.06	-0.56	0.02	0.34	-0.01	-0.19	-0.01	-0.24
D_3	-0.01	-0.10	0.04	0.40	-0.04	-0.55	0.00	0.07	-0.03	-1.31
D_4	-0.07	-0.56	0.02	0.17	-0.07	-0.99	-0.01	-0.51	-0.01	-0.69
D_5	-0.17	-1.24	-0.04	-0.39	-0.09	-1.23	-0.03	-0.97	-0.02	-0.72
D_6	-0.07	-0.52	0.03	0.29	-0.06	-0.77	-0.04	-1.34	-0.01	-0.55
D_7	0.01	0.08	0.14	1.74*	-0.11	-1.49	-0.02	-0.68	-0.01	-0.37
D_8	-0.07	-0.51	0.02	0.17	-0.05	-0.71	-0.01	-0.50	-0.03	-1.31
D_9	-0.20	-1.50	-0.06	-0.59	-0.10	-1.32	-0.03	-0.99	-0.02	-0.94
D_{10}	-0.13	-0.95	0.00	0.02	-0.13	-1.75	0.00	-0.02	-0.01	-0.32
D_{11}	-0.10	-0.76	0.08	0.77	-0.15	-1.99**	-0.03	-1.12	-0.01	-0.46
D_{12}	-0.03	-0.19	0.06	0.55	-0.08	-1.02	-0.02	-0.67	0.00	0.20

Notes: The table presents the unbalanced panel regression results of liquidity actively providing in the opposite side of arbitrageurs during times of after violating PCFP. We use the number of submitted orders available at over best quote (i.e., market order, MO, and better best quote, BB1Q) instead of the number of all submitted orders. These orders are executed rapidly in the marketplace. The results for overvalued calls, overvalued puts, undervalued calls, and undervalued puts are reported in Panels A-D, respectively. The Hausman test (1978) is used to judge which the fixed effect model or the random effect model is suitable for the panel data. The empirical model is specified as

$$NLM_{i,t} = \alpha + \beta_1 * NBP_{i,t-1} + \beta_2 * RV_{t-1} + \beta_3 * ArbSz_{i,t-1} + \beta_4 * FRet_{t-1} + \beta_5 * OVol_{i,t-1}$$

$$+ \beta_6 * OSpd_{i,t-1} + \beta_7 * TolBid_{i,t-1} + \beta_8 * TolAsk_{i,t-1} + \beta_9 * Myn_{i,t} + \gamma_j * \sum_{j=1}^{12} D_{j,t} + \varepsilon_t \qquad (3)$$

$$i = 1,2,3,\ldots,N, t = -a,\ldots,0,\ldots,b, a,b \in [3,12]$$

The dependent variable, NLM_t, is the number of submitted orders available at over best quote during t time interval. N is the number of violating PCFP. The time interval t=0 indicates the occurrence of violating PCFP. D_{jt} is a dummy variable that equals 1 if it is in jth interval, j=1,2,3,…, 12. This dummy variable captures the intraday variation in the number of submitted bid orders with respect to the time of violating the PCFP. For control variables, NBP_{t-1} is option net buying pressure. RV_{t-1} is the realized volatility of futures. $ArbSz_{t-1}$ is the profit for arbitrage trade at time t-1. $OVol_{t-1}$ and $OSpd_{t-1}$ denote option trade volume and its average best bid-ask spread during t-1 time interval. $TolBid_{t-1}$ and $TolAsk_{t-1}$ are the average of option bid and ask volume at the best 5 quotes during the t-1 time interval, respectively. $FRet_{t-1}$ is the futures return during t-1 time period. Myn_t is option moneyness at time t. In addition, ***, **, and * indicate that the t-values are significant at the 0.01, 0.05, and 0.1, respectively.

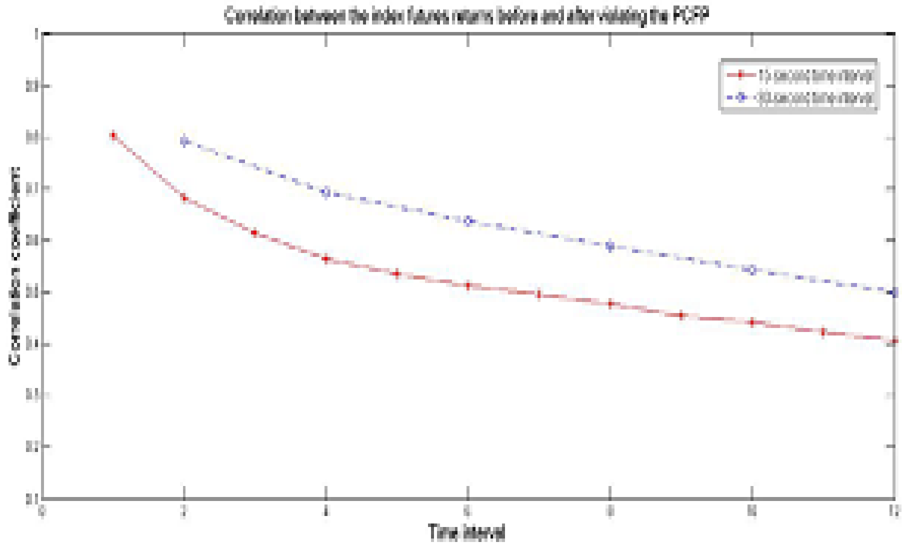

Figure 1. Correlation between the returns of index futures before and after violating PCFP. This figure depicts the correlation coefficient between the return of index futures at 15-second (30-second) time interval of just violating PCFP at time t=0 and the cumulative index futures return from time t=0 to the *j*th time interval of after violating PCFP, in which *j*=1, 2, …, 12 (2, 4, …, 12) for 15-second (30-second) time intervals. The correlation coefficients are used to judge whether the price in index futures moves in the same direction before and after violating PCFP.

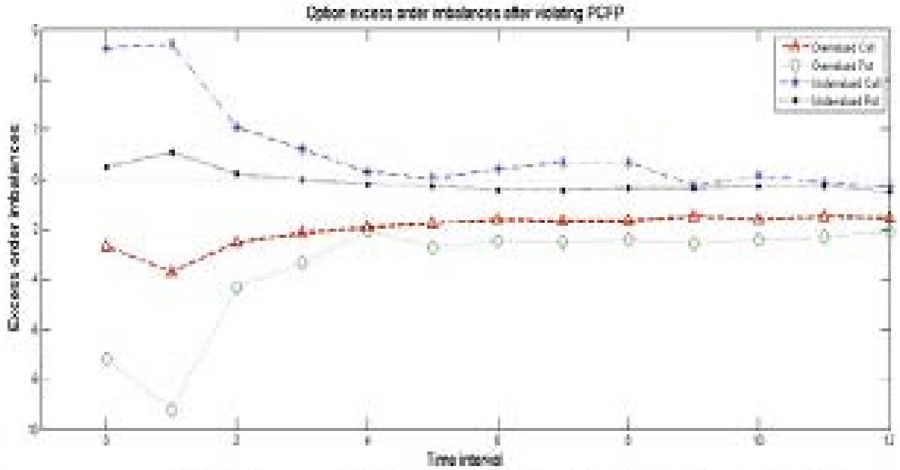

Figure 2. Average excess order imbalances of options after violating PCFP. This figure depicts the average excess order imbalances (AEOIB) of mispriced options during the 12 successive intervals of 15 seconds after violating PCFP (at time t=0). The PCFP violations are divided into four categories: for overvalued calls, overvalued puts, undervalued calls and undervalued puts. For the AEOIB in each time interval of 15 seconds for overvalued calls (overvalued puts, undervalued calls, and undervalued), we first calculate the AEOIB and then average them by each time interval. The AEOIB is calculated as the order imbalance less the mean of order imbalances in 360 successive time intervals of 15 seconds prior to the occurrence of arbitrage opportunity. We compute the order imbalances over all trades within each time interval. Following the Lee and Ready's (1991) algorithm, the order imbalance is measured as buyer-initiated trades less seller-initiated trades.

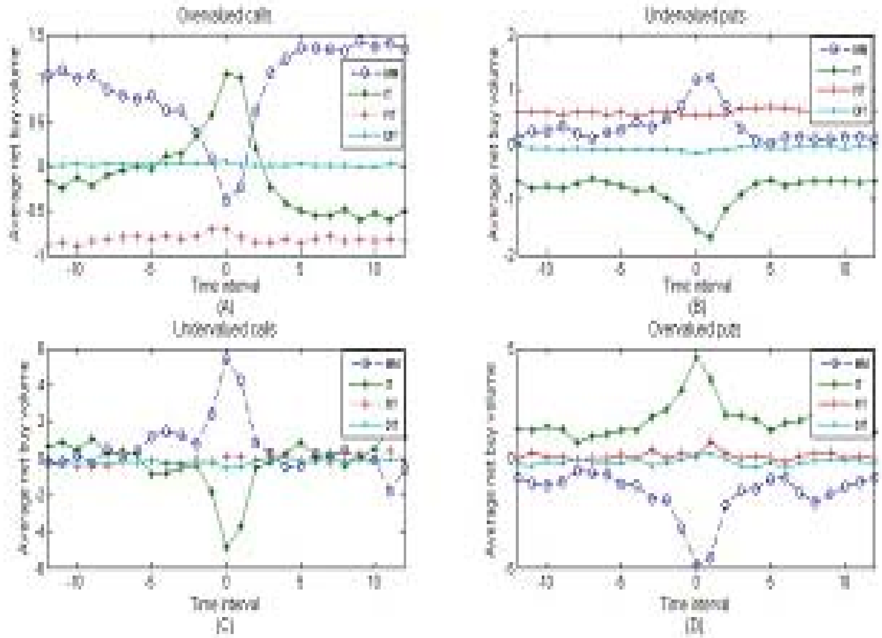

Figure 3. Average net buy volume of options around PCFP violations. This figure depicts the average net buy volumes of calls and puts by trader types within before and after 3-minute time intervals (24 successive 15-second time intervals) as arbitrage opportunities occur (at time t=0). The PCFP violations are divided into four classes, overvalued call and put options and undervalued call and put options. Figures A and D (C and B) show the average net buy volumes of overvalued (undervalued) calls and puts, respectively, around PCFP violations. For each of 24 time intervals, the average net buy volumes, defined as buy volume less sell volume, are calculated by trader types.

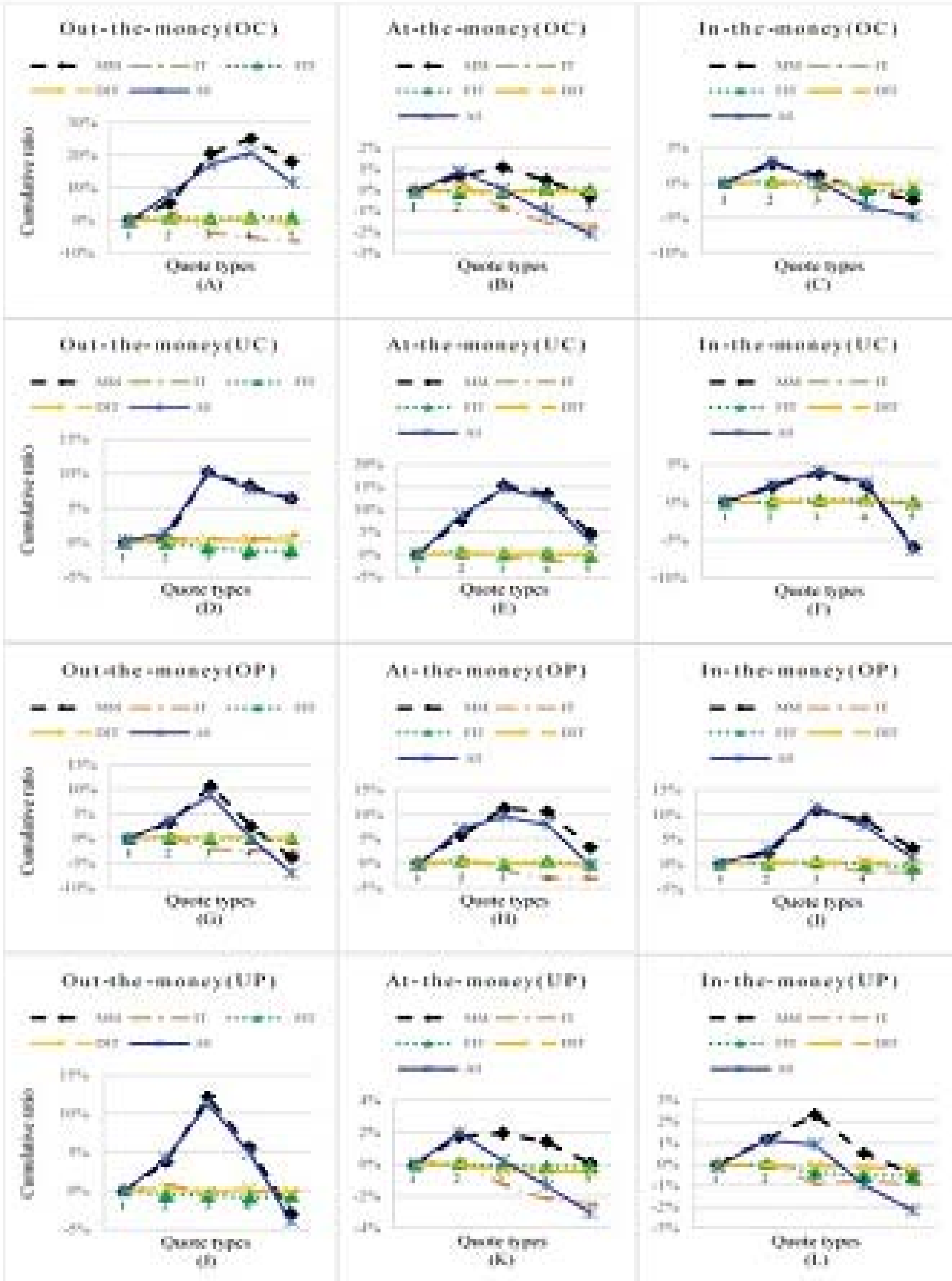

Figure 4. Change ratios of order submission for different moneyness groups. This figure depicts the ratios of change in submitted orders accumulated by quote types for different moneyness groups during two 15-second time intervals of just before and after violating PCFP. The numbers 1, 2, 3, 4, and 5 in the x-axis respectively correspond to the MO, BB1Q, B1Q, B2-5Q, and BB5Q of quote types. The quoted orders are selected on the opposite trade direction of arbitrageurs and divided into the following categories: MO (market order), BB1Q (better best quote), B1Q (best 1 quote), B2-5Q (best 2–5 quotes), and BB5Q (behind best 5 quotes). The order types are arranged in highly executed probability order. For each of overvalued calls (OC), undervalued calls (UC), overvalued puts (OP), and undervalued puts (UP), they are divided into three groups by option moneyness, including in-the-money options, at-the-money options, and out-the-money options. For each of PCFP violations and each trader type, we compute the change ratios of submitted orders each moneyness group.

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□ □ □ □ □ □ The Return Premiums to Accruals Quality

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Using a battery of look-ahead-bias free measures of accruals quality (AQ), we find a strong and long-lasting negative relation between future returns and AQ. In decile portfolios that rank on AQ, a hedge portfolio that goes long in the lowest decile and short in the highest decile generates an annualized, risk-adjusted return of 4–12% over one-month to five-year horizons, depending on the AQ measure and the portfolio weighting scheme. The return premiums associated with AQ are, i) robust to a wide range of AQ measures, ii) robust to a battery of return-informative variables, and iii) not driven by low-priced or small stocks, earnings shocks, or the fourth-quarter effect. The documented premiums are consistent with the information uncertainty effect where firm uncertainty is negatively related to future returns.

Keywords: Accruals quality, Stock returns, Return premium, Information uncertainty

JEL Classifications: G12, G14, M41

1 Introduction

Whether the quality of accounting information or its commonly used proxy, namely, accruals quality, is a priced risk factor has been a subject of much debate in recent years. Prior studies in this literature typically use the annual accrual-residual volatility of Dechow and Dichev (2002) (hereafter, "AQ") as the inverse accruals quality measure. In two widely cited papers, Francis, LaFond, Olsson, and Schipper (2004, 2005) (hereafter, "FLOS") show that AQ is positively associated with contemporaneous returns and argue that it is a priced factor. However, their interpretation is questioned by Core, Guay, and Verdi (2008) (hereafter, "CGV"), who demonstrate that poor accruals quality does not induce a positive return premium and that an accruals-quality mimicking factor[1] fails to explain the cross-section of asset returns such as returns on portfolios sorted on size and book to market. Nevertheless, the existence of an accruals quality pricing risk has been assumed in a large number of subsequent studies since FLOS (e.g., Ecker et al. 2006; Chen et al. 2007; Krishnan et al. 2008; Kravet and Shevlin 2010, to name just a few).

In this paper we revisit the pricing of accruals quality by examining whether there are robust return premiums associated with accruals quality. To ensure that investment strategies formed on AQ do not suffer from look-ahead biases, different from the prior literature, we construct AQ measures using information prior to portfolio formation. By examining return premiums associated with AQ, we are able to sharpen our focus on own-firm returns arising from a firm characteristic. If, as FLOS and others propose, high AQ (i.e., low accruals quality) increases information risk and decreases current firm value, AQ should be positively associated with returns in the future.

We, however, find that AQ is negatively associated with future returns. Importantly, we find that the relation between AQ and future returns is economically significant (in an order of 10% annually after risk-adjustment), spans return horizons over one month to five years, and survives a wide-range of robustness tests. Since a larger value of AQ implies lower accruals quality, our results indicate that higher accruals quality predicts higher returns. As a practical matter, our findings

[1]The mimicking factor is estimated as the difference in monthly excess returns of the top two quintiles and the bottom two quintiles of a sample of firms rank-ordered by AQ (FLOS 2005, p313).

suggest that firms that are able to produce higher accruals quality are subsequently rewarded by markets.

While our findings that there are positive return premiums associated with accruals quality seem at odds with the information risk literature used in FLOS that predicts the opposite (e.g., Easley and O'Hara 2004), they are nevertheless consistent with a recent stream of literature that documents an "information uncertainty" effect (Zhang 2006). In this literature, a number of historical information uncertainty proxies are shown negatively associated with future returns. These information uncertainty proxies include analyst forecast dispersion (Diether et al. 2002), idiosyncratic return volatility (Ang et al. 2006), and earnings volatility and cash flow volatility (Berkman et al. 2009; Huang 2009).[2] Since AQ is a standard deviation of accrual residuals, it is by design similar to these information uncertainty proxies. Given that "accruals are the product of judgments, estimates, and allocations (of cash flow events in other periods)" (FLOS 2005, p301), a larger accrual residual volatility, or larger value of AQ, indicates greater estimation errors and thus signals higher information asymmetry at the firm level. In fact, Chen et al. (2012) argue that AQ incorporates managerial discretion in the recognition of accruals and thus measures information quality, and Callen et al. (2012) show that measures of accounting quality such as AQ are negatively associated with the speed that stock prices adjust to information arrivals. A negative association between AQ and future returns is, therefore, consistent with the information uncertainty effect.

We assemble evidence of the negative AQ-future return association at both the firm and portfolio levels. At the firm level, we corroborate the return premiums to AQ using Fama and MacBeth (1973) cross-sectional regressions that control for not only the traditional Fama-French four factors of beta, size, market-to-book, and price momentum (hereafter "FF-4 factors"), but also a number of other related variables. These other control variables include illiquidity (to control for the liquidity risk of Pastor and Stambaugh (2003)), earnings surprise (to control for the earnings-surprise-driven

[2]The findings of these information uncertainty effects appear to be robust across different studies. For example, Ang et al. (2009) document that idiosyncratic volatility negatively predicts returns in international markets; and Huang (2009), similar to us, documents that cash flow volatility is negatively related to future stock returns over the horizons of one-month to five years.

accruals-quality effect), and earnings yield (to control for the level of earnings which may cause the pricing of accruals quality). The effect of AQ lasts for periods extending one month to five years ahead. Importantly, over these return horizons, the economic significance of AQ remains relatively stable: One decile increase in AQ leads to an annualized return reduction in the order of 40–80 basis points. At the portfolio level, the decile portfolio with the smallest AQ (highest accruals quality) outperforms the decile portfolio with the largest AQ by 4–12% a year in returns after controlling for the FF-4 factors, depending on the AQ measure and the portfolio weighting scheme. In addition, when the sample portfolios are partitioned into halves, the smoother AQ half outperforms the more volatile half by the order of 4% a year after adjusting for the FF-4 factors.

Our results hold with a number of accruals quality measures. We consider measures estimated from both annual and quarterly accounting data. For annual measures, we use two traditional FLOS measures: one following the definition used in FLOS, and the other adjusted for potential look-ahead bias using an out-of-sample approach. For quarterly measures, we use the counterpart of our out-of-sample annual measure, as well as a number of measures that are adjusted for quarterly seasonality (e.g., Brown 1993). These latter measures employ industry-mean adjustment for seasonality, or employ scaling by sales, which displays similar seasonality as quarterly working capital in the AQ calculation. We also consider absolute abnormal accruals to proxy for accruals quality (Warfield et al. 1995; Rajgopal and Venkatachalam 2011). Notwithstanding somewhat weaker results for the FLOS annual measure, our findings remain strong for all of the other measures.

We evaluate the robustness of our results to a number of alternative explanations provided in the AQ literature. In order to re-establish the findings of Francis et al. (2005), Kim and Qi (2010) argue that the presence of low-priced stocks causes the disappearance of the pricing of accruals quality, while Ogneva (2012) attributes such disappearance to negative earnings shocks experienced by firms. Our results are robust to controls of both low stock price and earnings surprise. Specifically, our conclusions do not change when we remove from our sample stocks that have prices less than \$5 (Kim and Qi 2010), or stocks that are at the bottom 30 percentiles of earnings surprise (Ogneva

2012). Furthermore, our findings are not driven by small firms, as the results are robust to removing firms at the bottom 30 percentiles of market capitalization. Our results are also robust to the so-called accrual anomaly that abnormal accruals negatively predict returns (Sloan 1996; Xie 2001): We control for abnormal accruals and find our results continue to hold.

We find evidence that the pricing of accruals quality is consistent with the information uncertainty literature. Information uncertainty measures such as idiosyncratic return volatility and cash flow volatility are not only highly correlated with AQ, but they also greatly reduce the pricing effect associated with AQ. We find that in some cases, the pricing of AQ is subsumed by a combination of information uncertainty measures such as idiosyncratic return volatility and cash flow volatility, a manifestation that the relation between AQ and returns is embedded in the overall firm information uncertainty.

This paper contributes to the literature by providing a novel insight into the contentious debate about the pricing of accruals quality. We examine the predictive ability of accruals quality for future returns. Different from the extant literature, we explicitly emphasize return-predictability of AQ by examining look-ahead-bias free AQ measures. One strength of this paper is that we provide evidence of strong, robust, and long-lasting return premiums related to accruals quality. If accruals quality reduces information risk and if information risk is a priced factor then AQ is predicted to be positively related to future returns. Our results are not consistent with this prediction. Rather, our results are consistent with the recent empirical regularity of the information uncertainty literature, where higher volatility tends to lead to lower returns.

The rest of the paper is organized as follows. Section 2 discusses the related literature. Section 3 describes the variable definitions, and Section 4 demonstrates the return premiums related to accruals quality. Section 5 evaluates explanations drawn from the accruals quality literature and the information uncertainty literature. Section 6 concludes.

2 Related Literature and Background

As previously discussed, our paper is related to two growing areas of the literature: the pricing of accruals quality and the pricing of information uncertainty. In this section we provide a further background review and discuss the relative positioning of our paper.

2.1 The Pricing of Accruals Quality

According to the information risk literature (e.g., O'Hara 2003; Easley and O'Hara 2004), investors bear an information risk when they have to rely on private information in the absence of adequate public information, and thus they must be compensated with higher returns. Following this line of argument, if a firm's accruals quality is poor, investors will have greater difficulty in forecasting its future performance and thus incur greater information risk. Motivated by this observation, FLOS examine the relation between the Dechow and Dichev (2002) accruals quality measure (AQ) and a number of return proxies, and find that firms with poorer accruals quality tend to have higher contemporaneous returns, costs of debt and equity market betas. FLOS conclude that their empirical evidence is consistent with the view that the risk related to accruals quality is a priced factor. FLOS's interpretation, however, is questioned by CGV. Using two-stage asset pricing tests based on Fama and MacBeth (1973) and Cochrane (2005), CGV show that the FLOS accruals-quality factor does not explain the cross-section of returns on various portfolios, such as the Fama-French 25 size/book-to-market portfolios. They conclude that there is no evidence that accruals quality serves as a risk factor. Despite the findings of CGV, a large number of subsequent studies have assumed the existence of an accruals quality price risk (e.g., Ecker et al. 2006; Chen et al. 2007; Krishnan et al. 2008; Kravet and Shevlin 2010).

Two recent papers attempt a reconciliation of FLOS and CGV. Ogneva (2012) constructs an accruals quality mimicking risk factor from returns orthogonal to earnings surprise, and Kim and Qi (2010) exclude low-priced stocks in their derivation of the accruals quality factor. Both studies show that the accruals quality factor explains returns on various accruals-quality portfolios.

However, the power of these tests can be an issue; for example, Lewellen et al. (2010) point out that pricing tests of a factor using assets based on the same factor characteristic tend to produce biases. In fact, Du (2011) finds that the pricing results of such an accruals quality factor is not due to accruals quality being a risk factor, but due to mispricing that arises from a spurious correlation between accruals quality characteristic and accruals quality beta in the fashion of Daniel and Titman (1997).

The risk-factor studies above typically construct an accruals quality mimicking risk factor and relate the factor to the cross section of returns on a wide-range of portfolios. In this paper, we choose to focus on own-firm returns arising from the firm characteristic of AQ. For the information risk factor to hold, a positive correlation between future returns and AQ must exist. Extant literature, which typically correlates one-year-ahead returns with annual accounting data, does not provide evidence of such a positive correlation (e.g., CGV, Kim and Qi 2010, Ogneva 2012). For example, Tables 7 and 8 of CGV provide mixed evidence by showing that AQ can be positively or negatively associated with future returns.[3]

Brousseau and Gu (2013), in a contemporaneous piece, report findings similar to ours, and attribute the observed accruals quality and return relation to large firms. Brousseau and Gu (2013) focus on equal-weighted, quintile portfolios sorted on FLOS's AQ measure predicting one-month-ahead returns. They show that the FLOS AQ-return relation in these portfolios is driven by smallest firms. Removing the smallest 20% of firms would result in a finding similar to ours. They further argue that liquidity and short-sale constraints are responsible for their findings. Our results appear to be more robust than those in Brousseau and Gu (2013). In particular, different from Brousseau and Gu (2013), we attempt i) one-month- to five-year-ahead returns, ii) equal- and value-weighted

[3]Table 7 of CGV presents 12 cases of portfolio-sorting test of the association between AQ and future returns; out of the 12 cases, the association is significant and positive for 6 cases, and significant and negative for one case. Table 8 of CGV presents two cases of regression test of the association between AQ and two to five-years-ahead buy-and-hold returns, and reports that the association is significant and negative for one case, and insignificant and negative for the other case. CGV do not examine if the relation is robust to controls but suggest that these results "are unlikely to be explained by noise in realized returns." We instead show that the negative association documented in this paper is very robust and survives controls of a large number of potentially confounding effects and a variety of accrual quality measures.

portfolios, iii) firm-level cross sectional regressions, iv) annual AQ measures with and without look-ahead bias, and v) a wide range of of quarterly AQ measures. Importantly, we show that our results survive after we remove the smallest 30% of firms, and also survive the controls of short-sale constraints proxied by measures such as liquidity and idiosyncratic volatility. Thus, the explanation proposed by Brousseau and Gu (2013) does not appear to compromise our results.

2.2 Information Uncertainty

A popular measure used to test the information risk suggested by O'Hara (2003) is the probability of informed trading (PIN) used in Easley et al. (2002). Empirical evidence on the pricing of PIN is mixed: for example, Easley et al. (2002) find supporting evidence, while Mohanram and Rajgopal (2009) and Duarte and Young (2009) question the robustness of this finding to factors such as sample period, additional risk factors, and limits to arbitrage. In fact, a growing literature on information uncertainty reports that a wide range of information uncertainty proxies negatively predict future returns (Zhang 2006). Such a negative relation exists for analyst forecast dispersion (Diether et al. 2002), idiosyncratic return volatility (Ang et al. 2006, 2009), cash flow volatility and earnings volatility (Berkman et al. 2009; Huang 2009), and accruals volatility (Bandyopadhyay et al. 2012).[4] These information uncertainty measures and AQ share a common feature that they are all standard deviation measures of firm-level variables.

The literature also establishes a positive link between idiosyncratic return volatility and managerial discretion-induced information quality. Chen et al. (2012) argue that the AQ measure reflects part of the quality of the information arising from managerial discretion, and relates it to the trends of idiosyncratic return volatility in the past four decades. Callen et al. (2012) show that accounting quality, as measured by AQ and a number of other variables, is negatively associated with the speed that prices adjust to information arrivals. These papers collectively show that AQ measures a firm's information asymmetry. Given that AQ is positively related to information

[4] Some of these results are debated. For example, Fan (2009) questions the findings of Ang et al. (2006), and shows that idiosyncratic return volatility estimated as out-of-sample forecasts of EGARCH models positively predicts future stock returns.

uncertainty, we expect that AQ would negatively predict future returns based on the information uncertainty effect (Zhang 2006). Our findings are consistent with this prediction; furthermore, we show that the return premiums to AQ may be subsumed by a combination of information uncertainty measures.

3 Sample and Variable Definitions

3.1 Accruals Quality Measures Using Annual Data

We follow the literature (e.g., FLOS, CGV, and Rajgopal and Venkatachalam (2011)) to derive the Dechow and Dichev (2002) accruals quality ("AQ") measure using annual accounting data. We select all NYSE/NASDAQ/AMEX-listed firms on the merged CRSP/Compustat database and extract annual accounting items. Specifically, *AQ_FLOS* involves estimating the following regression by fiscal year for each industry:

$$\begin{aligned} TCA_{i,j,y} = \quad & \beta_{0,j} + \beta_{1,j}CFO_{i,j,y-1} + \beta_{2,j}CFO_{i,j,y} + \beta_{3,j}CFO_{i,j,y+1} \\ & + \beta_{4,j}\Delta Sales_{i,j,y} + \beta_{5,j}PPE_{i,j,y} + \varepsilon_{i,j,y} \end{aligned} \tag{1}$$

where TCA is total current accruals (that is, operating accruals or change in working capital);[5] CFO is cash flow from operations, defined as earnings before extraordinary items minus TCA plus depreciation and amortization; PPE is property, plant and equipment; $\Delta Sales$ is the change in sales relative to the prior year; i indexes firm; j indexes industry; and y indexes fiscal year. Both sides of Equation (1) are scaled by total assets; and hence we remove observations with negative total assets. Equation (1) is estimated every fiscal year for each of the 48 Fama and French (1997) industries that has at least 20 observations. The residual obtained from Equation (1) is the so-called discretionary accruals (DA). A firm's *AQ_FLOS* is its five-year rolling standard deviation of DA

[5] Working capital is defined as (Current assets − Cash and short-term investment) − (Current liabilities − Debt in current liabilities).

from years $y-4$ to y. Larger values of *AQ_FLOS* indicate lower accruals quality. As is standard in the literature, we match *AQ_FLOS* to returns three months after fiscal year end. For example, *AQ_FLOS* for a firm with fiscal year-end of March is matched to returns from July of the same year. Our sample of *AQ_FLOS* covers the period of 1970–2012, in which the starting period of 1970 follows FLOS.

This paper examines whether there are return premiums to accruals quality. As such, it is important to ensure that investment strategies formed on AQ do not suffer from the so-called look-ahead bias. The construction of *AQ_FLOS* in Equation (1) and its association with returns could suffer from potential look-ahead bias in two ways. First, the alignment of firms by fiscal year ignores fiscal year end differences across firms, which may result in return realizations preceding accounting information when *AQ_FLOS* is matched to returns. Second, Equation (1) uses one-year-ahead *CFO* to estimate *AQ_FLOS*, which is in turn matched to returns of only three months ahead. To address these issues, we design an out-of-sample estimate of AQ. We first align accounting observations across firms by calendar month and assign the same annual observation to each month within the fiscal year. Once we create the monthly data, we modify Equation (1) to:

$$\begin{aligned} TCA_{i,j,t} = \quad & \beta_{0,j} + \beta_{1,j}CFO_{i,j,t-12} + \beta_{2,j}CFO_{i,j,t} + \beta_{3,j}CFO_{i,j,t+12} \\ & + \beta_{4,j}\Delta Sales_{i,j,t} + \beta_{5,j}PPE_{i,j,t} + \varepsilon_{i,j,t} \end{aligned} \tag{2}$$

where t denotes month. We use the same five-year window to estimate Equation (2) by industry. Specifically, for each month t, we estimate Equation (2) over month $t-60$ to $t-1$; we then substitute the slope coefficient estimates into Equation (2) for month t and calculate the predicted residual value at month t. Once we derive the time-series estimate of the residual, we estimate our second AQ measure, called *AQ_annual*, as the monthly rolling standard deviation of the predicted residual over the past five years. We further lag the estimate of *AQ_annual* by a year, and match returns three months thereafter. This out-of-sample estimate of *AQ_annual* ensures that when we use it to predict returns, the conditioning information (i.e. *AQ_annual*) is known to the market.

3.2 Accruals Quality Measures Using Quarterly Data

We also create a number of quarterly *AQ* measures based on quarterly accounting data from Compustat. We follow the same out-of-sample approach of Equation (2) to estimate the quarterly measures, except that, consistent with the extant literature (see, e.g., Dechow et al. 2011), we change lagged and lead *CFO*s to *CFO*s to those of the past and next quarters. Quarterly changes of variables, such as change in working capital, are defined relative to the same quarter of last year. We choose an estimation window of 16 quarters to estimate AQ for the quarterly data.[6] Quarterly data items that are necessary for computing accruals are reported in large scale in Compustat only from 1976; and allowing for four years of AQ estimation, our quarterly AQ measures start from 1980.

Compared to the low-frequency annual data, using quarterly data has the apparent advantage of increasing the data frequency by fourfold, and hence is more suitable for estimating time-series standard deviations. However, quarterly accounting items such as accruals exhibit seasonality (e.g., Brown 1993). Our data confirms the existence of quarterly seasonality. In our sample, the one-year apart autocorrelation of annual *DA* in Equation (2) is 0.05; however, the autocorrelation jumps to 0.19 for quarterly *DA*.

We adopt two ways to adjust for seasonality: (i) adjusting for industry mean (assuming that seasonality is common within the industry), and (ii) applying a scalar that is believed to display similar seasonality as quarterly working capital. For the first method, we keep total assets as the scalar, deduct the industry mean from each term in Equation (2), and estimate the industry-adjusted *DA* accordingly. For the second method, we choose sales instead of total assets as the scalar. Sales satisfies two criteria: (i) it has been used in the prior literature as a measure of firm size (e.g., Berk 1997), so it serves the purpose of scaling for cross-firm comparison, and (ii) it co-varies with earnings, cash flows and thus, working capital. The one-year apart autocorrelation for industry-adjusted quarterly *DA* reduces slightly to 0.18; and the autocorrelation of sales-deflated quarterly *DA* significantly reduces to 0.09, which is similar to the 0.05 autocorrelation of the assets-deflated

[6] Chen et al. (2012) use three, four and five years in their quarterly data to derive a similar measure; we choose a middle ground of four years. Our results are robust to estimation windows of three and five years. We require that at least half of the observations within this estimation window are not missing.

annual *DA* reported earlier. Thus, deflating by sales seems to be an effective way of addressing quarterly seasonality in our case. We hence use the sales-deflated quarterly AQ measure, called *AQ_qtr*, as our primary quarterly measure. We denote the corresponding quarterly measure deflated by total assets *AQ_qtr_A*, and the quarterly measure deflated by total assets and industry-adjusted *AQ_qtr_Ind*.

In robustness tests, we also address the fourth-quarter effect in quarterly data. There is evidence that fourth quarters demonstrate an elevated level of earning management activities relative to interim quarters (e.g., Francis et al. 1996; Dhaliwal et al. 2004; Das et al. 2009). If elevated earnings management in the fourth quarter biases the estimate of accruals quality, or if the return response to accruals is different in the fourth quarter, any empirical evidence that we glean could be driven by the fourth quarter effect. To address this concern, we remove all fourth-quarter observations from our estimation of *AQ_qtr*; we denote the AQ measure so estimated as *AQ_no4q*.

Our last AQ measure is the absolute value of accruals. The literature also uses absolute abnormal accruals to measure accruals quality (e.g., Warfield et al. 1995; Rajgopal and Venkatachalam 2011). We estimate abnormal accruals as the residual of the following performance-matched Jones (1991) model of Kothari et al. (2005):

$$ACC_{i,j,t} = \beta_{0,j} + \beta_{1,j}\Delta Sales_{i,j,t} + \beta_{2,j}PPE_{i,j,t} + \beta_{3,j}\text{Earnings}_{i,j,t} + v_{i,j,t} \tag{3}$$

where *ACC* is total accruals, scaled by sales as with *AQ_qtr*. We use the same out-of-sample technique of Equation (2) to estimate Equation (3) by each industry j using the past four years' data and take the predicted value of $v_{i,j,t}$, denoted as Abs(*AbAcc*), to be the abnormal accruals of firm i at month t. Similar to our other AQ measures, higher values of absolute Abs(*AbAcc*) indicate lower accruals quality.

3.3 Correlations

Tables 1 and 2 provide, respectively, the descriptive statistics and the time-series means of the cross-sectional correlations of the AQ measures. The different measures of AQ are all highly correlated. Within the annual measures, *AQ_FLOS* and *AQ_annual* have a correlation of 0.79; and within the quarterly measures, *AQ_qtr* has a correlation of around 0.50 with *AQ_qtr_A* and with *AQ_qtr_Ind*. Finally, *AQ_annual* and *AQ_qtr* have a correlation of 0.33.

[Tables 1 and 2 about here.]

We further validate the link between annual and quarterly AQ measures by examining the degree of potential misclassification of firm accruals quality as measured by these two families. We use *AQ_annual* and *AQ_qtr* as an illustration. Each month, we classify firms into deciles based on, respectively, *AQ_annual* and *AQ_qtr*. We then examine the degree of overlapping among these deciles. We find that 16.3% of firms are placed in exactly the same decile between *AQ_annual* and *AQ_qtr*. Further, 42.0% of the the firms have an *AQ_qtr*-decile one decile away from *AQ_annual*-decile, and 61.1% of the firms have an *AQ_qtr*-decile within two deciles away from *AQ_annual*-decile. These statistics further indicate that the probability of misclassification of accruals quality arising from our use of annual and quarterly AQ is likely to be small in our sample.

Since our accruals quality measures are estimated over a relatively long horizon, it is desirable to examine its relation to not only the one-month-ahead return, as is typical in the literature, but also longer-horizon returns. Following CGV, the longest horizon return that we examine is 5-year-ahead return. We thus examine future returns over horizons of one and six month(s), and one, two, and five year(s) as well. We control for the delisting survivorship bias by adjusting for delisting returns as per Shumway (1997) and Shumway and Warther (1999), and calculate returns of all horizons using monthly returns from CRSP. In order to reduce the effects of outliers, all returns are winsorized at the 1st and 99th percentiles over the full sample (see also, e.g., Skinner and Sloan 2002; Zhang 2007).[7] Table 2 shows that all of our AQ measures are negatively and significantly

[7]Our results remain qualitatively the same if we do not winsorize returns, or winsorize returns at extreme tails such as at the 0.1st and 99.9th percentiles.

correlated with returns of these horizons. These results provide first evidence that accruals quality positively predicts returns.

4 The Return Premiums to Accruals Quality

In this section we present evidence that accruals quality predicts future returns related to using both annual and quarterly data. We find that firms with poorer accruals quality suffer from lower returns subsequently, from one-month to five-year-ahead horizons. The negative return due to accruals quality is robust to the control of a battery of common risk factors.

4.1 Evidence from the Annual Accounting Data

4.1.1 Firm-Level Evidence from Cross-Sectional Regressions

We estimate return regressions at the firm level using the Fama and MacBeth (1973) cross-sectional methodology. Specifically, we first estimate the regression every month, and then average the monthly coefficient estimates to get the full-sample estimates and corresponding t-statistics. The independent variables include the traditional risk adjustments of Fama-French three factors of market, size and value, and Carhart's (1997) momentum factor. The cross-sectional multiple-regression for every month t is therefore:

$$R_{i,t+1} = \alpha_{i,t} + \gamma_{1,t} beta_{i,t} + \gamma_{2,t} \ln(ME)_{i,t} + \gamma_{3,t} \ln(BEME)_{i,t} + \gamma_{4,t} PMOM_{i,t} + \gamma_{5,t} \mathrm{AQ}_{i,t} + v_{it} \quad (4)$$

where the subscript i indexes stock, the subscript t indexes month, R is stock's return, ME is lagged market equity, $BEME$ is book-to-market equity, and $PMOM$ is price momentum (the past-12-month stock return). Note that the subscript $t+1$ in Equation (4) denotes future returns of one month to five years.[8]

[8]The t-statistics for longer-horizon return regressions are adjusted for the Newey and West (1987) autocorrelation with the number of lags corresponding to the degree of overlapping in returns. That is, standard errors in the regressions of six-month returns are adjusted for five lags, and so on and so forth upto the adjustment of 59 lags for the regressions

Table 3 presents the regression results of Equation (4) using one-month to five-year-ahead returns on *AQ_FLOS* and *AQ_annual*. The signs on the control variables in Table 3 are unremarkable. Briefly, beta is insignificant (e.g., Fama and French 1992); size is insignificant (consistent with the disappearing size effect after the 1980s); and the coefficients of book-to-market and price momentum are significantly positive most of the times, as expected. Importantly, we observe that both *AQ_FLOS* and *AQ_annual* negatively predict future returns over one month to five years. Note that part of the *AQ_FLOS* results are also reported in the literature; for example, CGV (Table 8) also report that buy-and-hold returns from year two to year five are negatively related to *AQ_FLOS* decile.

[Table 3 about here.]

In Table 4, we offer two schemes of robustness checks for the results in Table 3, namely subperiod analysis and adding a number of control variables. In Panels A and B of Table 4, we examine the pricing of AQ in a number of sample subperiods. We divide the full sample into two subperiods of 1970–1990 and 1991–2012. We also carve out a subperiod of 1980–2012, which corresponds to the sample period used in our subsequent quarterly analyses. We note that while *AQ_FLOS* loads significantly across all return horizons in the subperiod of 1980–2012 and across longer return horizons in other subperiods, it is not significant or only marginally significant (with a significance level of only 10%) in predicting one- and six-month returns for the subperiods of 1970–1990 and 1991–2012. The weaker results of *AQ_FLOS* in these subperiods perhaps explain why the negative relation between *AQ_FLOS* and returns previously documented in the literature (e.g. CGV) are somewhat obscured. In contrast, *AQ_annual* loads significantly in all three subperiods across all return horizons.

[Table 4 about here.]

In Panel C of Table 4 we add a number of return-informative variables to Equation (4). The additional variables that we include are earnings surprise (Chan et al. 1996), earnings yield (Haugen

of five-year returns.

and Baker 1996), and illiquidity (Amihud 2002; Pastor and Stambaugh 2003), as these variables are also widely used in return predictions. We present the results with *AQ_annual* since it is free of look-ahead bias. Compared with Table 3, the magnitude of the coefficient estimate of *AQ_annual* is about halved with the addition of these variables; however, the significance of *AQ_annual* is not lost. In sum, the evidence of Table 3 shows that AQ, in particular, *AQ_annual*, is negatively associated with future returns.

4.1.2 Portfolio-Level Evidence of *AQ_annual*

To examine return premiums, the literature also frequently uses the portfolio sorting approach to form hedging portfolios. Following the literature, we rank the sample firms based on the value of *AQ_annual* and then form 10 portfolios based on the ranks. After forming the portfolios, we examine one-month- to five-year-ahead buy-and-hold returns of these portfolios, based on either equal-weighting, or value-weighting by the beginning-of-the-month market value of equity.

We form two hedge portfolios from the decile portfolios. Our first hedge portfolio is long on the smallest decile portfolio and short on the largest decile portfolio. This hedge portfolio, however, ignores the returns of intermediate deciles. We address this issue in the second hedge portfolio, which is long on the smallest five decile portfolios and short on the largest five decile portfolios, with each decile portfolio receiving an equal weight. We consider risk-adjusted returns, or Jensen's alpha. We employ risk adjustments by the Fama-French four factors (i.e., market, size, value, and momentum). The monthly market return, risk free rate, and factor returns are all taken from Kenneth French's website.[9] To match returns of longer horizons, factors for horizons longer than one month are calculated as buy-and-hold returns based on the monthly factors.

Table 5 presents the alphas of the decile portfolios. In the table, the column labeled "D1 – D10" shows the spread between the smallest decile portfolio (D1) and the largest decile portfolio (D10), and the column labeled "D1:5 – D6:10" shows the spread between the simple average return of deciles 1 to 5 and the simple average return of deciles 6 to 10. We first observe a large, positive

[9] The website's URL address is: http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/.

D1 − D10 spread of alpha in both equal- and value-weighted portfolios. In Panel A, the D1 − D10 equal-weighted alpha spread is 0.73% (t = 4.15) per month for the one-month-ahead returns, corresponding to an annualized spread of 9% (≈ 0.73% × 12);[10] and in Panel B, the corresponding value-weighted return spread is 0.33% (t = 1.87) per month, corresponding to an annualized spread of 4% (≈ 0.33% × 12). Furthermore, the *AQ* effect identified in the case of one-month-ahead return does not abate over longer horizons. Over six-month to five-year horizons, the annualized D1 − D10 alpha spreads are about 8–10% for equal-weighted portfolios, and in the range of 4-10% for value-weighted portfolios. Lastly, the D1:5 − D6:10 alpha spreads are all significant; and the annualized D1:5 − D6:10 alpha spreads are about 4% for equal-weighted portfolios and 2% for value-weighted portfolios.

[Table 5 about here.]

4.2 Evidence from the Quarterly Accounting Data

We now turn to the evidence from the quarterly data for the period of 1980–2012. Table 6 reports the cross-sectional regressions of returns on *AQ_qtr*, our primary measure of quarterly AQ. Similar to the return regressions on *AQ_annual*, *AQ_qtr* significantly and negatively predicts returns from one month to five years, whether the control variables are the Fama-French four-factor variables or the augmented set that also includes *SUE*, *EY*, and *ILLIQ*.

[Table 6 about here.]

As previously discussed, we also consider other measures of quarterly accruals quality. Collectively, we consider the following alternative measures: *AQ_qtr_A* (out-of-sample measure of AQ using total assets as the scalar), *AQ_qtr_Ind* (out-of-sample measure of AQ using total assets as the scalar, and all quarterly data items used in the estimation are industry-mean-adjusted), *AQ_no4q* (similar as *AQ_qtr* except that all fourth-quarter observations are removed), and Abs(*AbAcc*) (ab-

[10] We define annualize spread as the spread of a given return horizon divided by the number of the years of the horizon.

solute level of abnormal accruals). Table 7 reports the regression results of returns on the Fama-French four-factor variables and one of these four alternative measures. We continue to observe negative significance of AQ on future returns over one month to five years across these alternative measures.

[Table 7 about here.]

Lastly, we replicate the portfolio sorting results for *AQ_qtr*, and present the results in Table 8. Here we observe that both D1 − D10 and D1:5 − D6:10 alpha spreads are highly significant for both equal- and value-weighted portfolios across all of the return horizons that we examined. The annualized D1 − D10 alpha spread is about 10% for equal-weighted portfolios, and about 8% for value-weighted portfolios. Compared with the case of annual AQ in Table 5, these spreads are higher, in particular, in cases of shorter-horizon returns. This is also true for D1:5 − D6:10 spreads. The increased spread of *AQ_qtr* relative to *AQ_annual* suggests that the information set contained in *AQ_qtr* is more timely relative to that contained in *AQ_annual*, and hence *AQ_qtr* is accompanied by a stronger market reaction.

[Table 8 about here.]

4.3 Economic Significance of the AQ Return Premium

Our portfolio sorting results earlier suggest the existence of a 4–10% alpha (abnormal return) annualized spread difference between extreme AQ deciles, depending on the AQ measure and the portfolio weighting scheme. We now show that this magnitude of spread difference is to a large extent corroborated in cross-sectional return regressions, despite the fact that the portfolio sorting performance is subject to how the portfolio is constructed. To this end, every month we transform *AQ_annual* and *AQ_qtr* into decile ranks and re-estimate Equation (4) with the decile variable replacing its continuous counterpart. Table 9 reports the results. We observe that the coefficients of *AQ_annual* decile or *AQ_qtr* remain significant and negative for all of the return horizons. *AQ_annual* decile has a coefficient of −0.04 on one-month-ahead returns (in percentage point); in other words, a decrease in *AQ_annual* by one decile rank would lead to an annualized return impact of 0.04% × 12 or about 50 basis points. The most extreme decile change of nine decile change would therefore result in approximately 4.5 percent return a year. This magnitude of economic significance is in the same order as the D1 – D10 alpha spread of *AQ_annual* in portfolio sorting in Table 5. We further observe that the annualized impact of *AQ_annual* remains roughly at the same order of magnitude for future returns of six months to five years, again similar to the longer-horizon portfolio sorting results in Table 5.

[Table 9 about here.]

The remainder of Table 9 presents the economic significance of *AQ_qtr*. We note that the annualized impact of one decile change in *AQ_qtr* is about 75 bps; this is equivalent to an 8% difference in an extreme decile movement. This is at par with the portfolio sorting results in Table 8. As with the case of portfolio sorting, the results in Table 9 suggest that *AQ_qtr* has a higher economic significance than *AQ_annual*, perhaps due to better information timeliness embedded in the former measure.

5 Evaluating Explanations

5.1 Evaluating Existing Explanations

In an attempt to re-establish the results of Francis et al. (2005), Kim and Qi (2010) argue that low-priced stocks cause the loss of pricing power of the accruals quality factor, and Ogneva (2012) argues that the loss is due to negative earnings shocks. Based on these findings, it is possible that our results are driven by low-priced stocks or negative earnings surprise. To address these concerns, we remove observations that are associated with low stock prices or negative earnings surprises. Panel A of Table 10 presents the results. We follow Kim and Qi (2010) and remove the observations with the beginning-of-the-month price less than \$5.[11] We then re-estimate Regression

[11] We also follow Kim and Qi (2010) to create a dummy variable for low-priced stocks and include it in regression Equation (4). Doing so barely changes our results.

(4) with these observations removed from the sample. For the negative earnings shocks, we create Ogneva's (2012) earnings surprise measure, *SURP_TS*, remove the observations with the bottom 30% of *SURP_TS* (i.e., the most negative earnings surprise), and re-estimate Regression (4) with this reduced sample. The results in Panels A of Table 10 shows that AQ continues to load negatively, with an order of magnitude comparable to those of the main results reported in Tables 3 and 6. Thus, our results are unlikely to be driven by low-priced stocks or negative earnings surprise.

[Table 10 about here.]

One common feature shared by low-priced firms and firms that experience negative earnings shocks is that they tend to be smaller firms. Brousseau and Gu (2013) show that the FLOS results, if any, are completely driven by smallest firms in the sample. Earlier in our portfolio sorting results, we showed that value-weighted alpha spreads in the AQ decile portfolios are generally smaller than their equal-weighted counterparts. Thus, size can be a driving factor for our results. To address this concern, in Panel A of Table 10 we also provide evidence that our results are not driven by small firms. There, we remove observations at the bottom 30 percentiles of the beginning-of-the-month market capitalization. We again observe negative coefficients for both *AQ_annual* and *AQ_qtr* in return regressions, with a similar magnitude to those of the main results reported earlier.

5.2 Robustness of the AQ Effect to the Accrual Anomaly

A large literature, pioneered by Sloan (1996), documents the existence of an accrual anomaly where large accruals lead to lower future returns. Fama and French (2008) confirm that the accrual anomaly is among the most persistent asset pricing anomalies. Xie (2001) finds that the accrual anomaly is largely concentrated in abnormal accruals. Given the mean reverting nature of accruals over the long run, a higher level of accruals implies higher accrual volatility and accrual volatility-related measures such as AQ. Therefore, the negative relationship between AQ and future returns documented earlier may merely be a rediscovery of the well-known accrual anomaly phenomenon. We now show that this is not the case.

Following the accrual anomaly literature (e.g., Sloan 1996; Xie 2001), we use the value of abnormal accruals (i.e., signed accruals, *AbAcc*) estimated earlier in Equation (3) to denote the level of accruals. We augment Equation (4) with *AbACC* and present the results in Panel B of Table 10. The results there first confirm that the accrual anomaly holds after controlling for AQ in our sample: Accruals are negatively related to future returns over one-month to five-year horizons in most cases. Importantly, the regression results in Panel B show that the accrual anomaly and the AQ effect exist side by side: All of the coefficients on *AQ_annual* and *AQ_qtr* remain significantly negative from one-month to five-year returns. In sum, the AQ effect is distinct from the accrual anomaly.

5.3 Information Uncertainty and Accruals Quality

We now relate the AQ effect to the recent literature on information uncertainty, which reports that future returns are negatively related to information uncertainty proxies. In particular, these information uncertainty measures include idiosyncratic return volatility (Ang et al. 2006), cash flow volatility (Huang 2009), and analyst forecast dispersion (Diether, Malloy and Scherbina 2002). These phenomena can be collectively referred to as the "information uncertainty" effect as in Zhang (2006).

Information uncertainty, in general, can be viewed as an attribute of publicly available information that reflects the degree of information asymmetry between the firm insiders (such as managers) and outside investors and other market participants. Arguably, earnings is among the most important performance measures used by market participants such as investors, analysts, senior executives, and board of directors. Accruals add noise to the earnings stream by imparting transitory components in the process of converting cash flows to earnings (Leuz et al. 2003; Schipper and Vincent 2003). Chen et al. (2012), for instance, show that managerial discretion-induced information quality such as accruals volatility drives the trend in idiosyncratic return volatility over the past four decades. Since accruals quality indicates the extent of uncertainty of the firm's financial information, it follows that AQ is related to information uncertainty.

We first examine the correlation between AQ and information uncertainty proxies used in the literature. We define idiosyncratic return volatility (*IRV*) as per Ang et al. (2006); and cash flow volatility (*CFV*) either as the standard deviation of cash flow to assets over the past five years to match *AQ_annual*, or the standard deviation of cash flow to sales over the past 16 quarters to match *AQ_qtr*. For ease of comparison with respect to economic significance, we transform all of these variables into deciles cross-sectionally. Over our sample period, the times-series mean of cross-sectional correlations between *AQ_annual* decile and, respectively, *IRV* and *CFV* deciles are 0.42 and 0.74; and those between *AQ_qtr* decile and, respectively, *IRV* and *CFV* deciles are 0.28 and 0.82. These correlations indicate that AQ is indeed highly correlated with information uncertainty.[12]

We then augment regression Equation (4) with information uncertainty proxies. In Panel A of Table 11, we use *AQ_annual* decile alongside i) *IRV* decile, ii) *CFV* decile, and iii) both *IRV* and *CFV* decile. In cases i) and ii), we note that while *AQ_annual* decile remains significant in predicting one month to five year returns, its economic significance is markedly reduced. For example, earlier in Table 9 the coefficient estimate of *AQ_annual* decile was −0.04 for one-month return and −0.19 for six-month return; and with the addition of *IRV* decile, these numbers reduce to −0.03 and −0.15 respectively. In untabulated results, we can report that these reductions are statistically significant. Adding *CFV* to the regression induces similar reductions. In case iii) when we add both *IRV* and *CFV* deciles, the coefficient estimate of *AQ_annual* decile is about halved over one-month to five-year horizons.

[Table 11 about here.]

Panel B of Table 11 replicates the results in Panel A but with *AQ_qtr*. Compared with Table 9, the coefficient estimate of *AQ_qtr* is only slightly reduced with the addition of *IRV* as an regressor.

[12]We also consider analyst forecast dispersion of earnings as per Diether et al. (2002) using data from I/B/E/S (available only from 1982). The correlation between forecast dispersion decile and *AQ_annual* decile is 0.16, and between forecast dispersion decile and *AQ_qtr* decile is 0.22. These correlations are lower than AQ's correlations with *IRV* and *CFV*. Nonetheless, our results remain robust to using forecast dispersion as the information uncertainty proxy.

The smaller reduction of the AQ coefficient relative to the case of *AQ_annual* is likely due to the fact that *AQ_qtr* is less correlated with *IRV* than is *AQ_annual*. *AQ_qtr*, however, is even more highly correlated with *CFV* than is *AQ_annual*. It turns out that when *CFV* decile is added to the regression, the significance of *AQ_qtr* decile is subsumed, as shown in the remainder of Panel B. Collectively, the results in Table 11 indicate that commonly used information uncertainty proxies can either greatly reduce or completely subsume the pricing effect of AQ. The evidence suggests that the pricing effect of AQ is part of the information uncertainty phenomenon.

6 Conclusions

Recent literature debates whether an accruals quality mimicking portfolio is a priced risk factor. A number of studies argue that investors are compensated with returns for holding risk reflected in AQ, the standard deviation of residuals from current accruals regressed on cash flows (Francis, LaFond, Olsson, and Schipper 2005; Kim and Qi 2010; Ogneva 2012). The validity of these findings and their methodologies are questioned by studies such as Core, Guay, and Verdi (2008) and Du (2011), who show that an accruals quality mimicking portfolio is not a risk factor. Accordingly, we examine the relation between future returns and accruals quality. We construct look-ahead-bias free measures of AQ to ensure return-predictability of these measures, and document strong and positive return premiums associated with accruals quality over both short- and long-terms. Firms with higher accruals quality (lower AQ measure) generate higher returns in the future.

The return premiums associated with accruals quality undergo extensive robustness checks in our study. In decile portfolios that rank on AQ, a hedge portfolio that goes long in the lowest decile and short in the highest decile generates an annualized, risk-adjusted return in the order of 4–12% from one-month to five-year horizons. The return premiums associated with AQ are: i) robust to a battery of return-informative variables, including the Fama-French three factors, price momentum, illiquidity, earnings momentum, and earnings yield; ii) economically significant to be ignored; and iii) robust to a number of accruals quality measures estimated from both annual and quarterly accounting data.

Our findings add to the recent literature that historical information uncertainty, as proxied by measures such as idiosyncratic return volatility and cash flow volatility, negatively predicts future returns. AQ measures firms' financial reporting quality and therefore reflects firms' information asymmetry. The return premiums to AQ are consistent with the information uncertainty literature; and we further show that these return premiums may be subsumed by a combination of information uncertainty measures.

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Table 1: **Summary Statistics**

Variable	# of Obs.	Mean	Std Dev	Minimum	Median	Maximum
AQ_FLOS	1,543,464	0.04	0.04	0.00	0.03	0.20
AQ_annual	1,552,658	0.04	0.04	0.00	0.03	0.19
AQ_qtr	1,274,184	0.21	0.35	0.01	0.09	2.12
AQ_qtr_A	1,284,404	0.02	0.02	0.00	0.02	0.11
AQ_qtr_Ind	1,283,356	0.02	0.02	0.00	0.02	0.10
AQ_no4q	1,024,258	0.18	0.32	0.00	0.07	2.00
Abs(*AbAcc*)	1,191,404	0.16	0.31	0.00	0.06	2.02
1-month return (%)	2,402,115	1.00	14.79	-38.89	0.00	57.35
6-month return (%)	2,375,501	6.47	38.41	-75.00	2.97	164.00
1-year return (%)	2,348,931	13.80	57.80	-87.57	6.45	267.50
2-year return (%)	2,294,974	28.30	87.40	-95.65	13.51	426.70
5-year return (%)	2,120,882	75.83	175.65	-99.03	32.18	954.97

The data covers all NYSE, NASDAQ, and AMEX-listed firms from COMPUSTAT from January 1970 to December 2012 for all variables except the quarterly measures of *AQ_qtr*, *AQ_qtr_A*, *AQ_qtr_Ind*, *AQ_no4q*, and Abs(*AbAcc*), whose coverage are from January 1980 to December 2012. The AQ measures using annual data are: *AQ_FLOS* (AQ measure following FLOS), and *AQ_annual* (a modified, out-of-sample measure of AQ). The AQ measures using quarterly data are: *AQ_qtr* (out-of-sample measure of AQ using sales as the scalar), *AQ_qtr_A* (out-of-sample measure of AQ using total assets as the scalar), *AQ_qtr_Ind* (out-of-sample measure of AQ using total assets as the scalar, and all quarterly data items used in the estimation are industry-mean-adjusted), *AQ_no4q* (similar as *AQ_qtr* except that all fourth-quarter observations are removed), and Abs(*AbAcc*) (absolute level of abnormal accruals). All returns are delisting-adjusted. All variables are winsorized at the 1st and 99th percentiles over the full sample.

Table 2: **The Time-Series Mean of Cross-Sectional Correlations of Variables**

	AQ_FLOS	*AQ_annual*	*AQ_qtr*	*AQ_qtr_A*	*AQ_qtr_Ind*	*AQ_no4q*	Abs(*AbAcc*)	Ret	Ret6	Ret12	Ret24	Ret60
AQ_FLOS	1											
AQ_annual	0.79	1										
AQ_qtr	0.33	0.35	1									
AQ_qtr_A	0.65	0.69	0.50	1								
AQ_qtr_Ind	0.64	0.68	0.48	0.96	1							
AQ_no4q	0.29	0.32	0.93	0.45	0.44	1						
Abs(*AbAcc*)	0.22	0.22	0.65	0.33	0.32	0.63	1					
1-month return (Ret)	-0.02	-0.02	-0.03	-0.02	-0.02	-0.02	-0.03	1				
6-month return (Ret6)	-0.03	-0.04	-0.06	-0.05	-0.05	-0.06	-0.06	0.40	1			
1-year return (Ret12)	-0.04	-0.05	-0.07	-0.06	-0.06	-0.07	-0.07	0.29	0.71	1		
2-year return (Ret24)	-0.05	-0.06	-0.09	-0.08	-0.08	-0.08	-0.09	0.20	0.48	0.69	1	
5-year return (Ret60)	-0.08	-0.09	-0.12	-0.12	-0.12	-0.11	-0.11	0.12	0.29	0.41	0.59	1

This table presents the time-series mean of the cross-sectional correlations of the variables. The *AQ* measures using annual data are: *AQ_FLOS* (*AQ* measure following FLOS), and *AQ_annual* (a modified, out-of-sample measure of *AQ*). The *AQ* measures using quarterly data are: *AQ_qtr* (out-of-sample measure of *AQ* using sales as the scalar), *AQ_qtr_A* (out-of-sample measure of *AQ* using total assets as the scalar), *AQ_qtr_Ind* (out-of-sample measure of *AQ* using total assets as the scalar, and all quarterly data items used in the estimation are industry-mean-adjusted), *AQ_no4q* (similar to *AQ_qtr* except that all fourth-quarter observations are removed), and Abs(*AbAcc*) (absolute level of abnormal accruals). All correlations are significant at the 5% level.

Table 3: **Fama and MacBeth (1973) Cross-Sectional Regressions of Returns on** ***AQ_FLOS*** **and** ***AQ_annual***

Panel A: ***AQ_FLOS*** **as the AQ measure**

Return	Intercept	*beta*	*ln(ME)*	*ln(BEME)*	*PMOM*	*AQ_FLOS*
1-month	1.08	0.14	-0.01	0.28	0.40	-2.05
	[5.14]***	[0.68]	[-0.21]	[7.21]***	[3.09]***	[-2.31]**
6-month	7.79	-0.10	-0.12	1.08	2.44	-10.93
	[5.88]***	[-0.15]	[-0.71]	[4.12]***	[3.32]***	[-2.27]**
1-year	17.48	-0.75	-0.30	1.71	1.94	-23.38
	[5.94]***	[-0.62]	[-0.84]	[2.85]***	[1.37]	[-2.47]**
2-year	36.84	-2.35	-0.42	4.50	1.18	-64.33
	[5.23]***	[-1.01]	[-0.5]	[3.35]***	[0.51]	[-3.81]***
5-year	97.96	-4.83	-0.22	14.18	3.64	-184.56
	[4.27]***	[-0.64]	[-0.08]	[4.79]***	[1.23]	[-4.67]***

Panel B: ***AQ_annual*** **as the AQ measure**

Return	Intercept	*beta*	*ln(ME)*	*ln(BEME)*	*PMOM*	*AQ_annual*
1-month	1.23	0.14	-0.02	0.26	0.38	-3.93
	[6.02]***	[0.69]	[-0.65]	[6.79]***	[2.94]***	[-3.98]***
6-month	8.48	-0.03	-0.19	0.96	2.41	-21.18
	[6.64]***	[-0.04]	[-1.2]	[3.85]***	[3.25]***	[-4.35]***
1-year	18.20	-0.49	-0.38	1.57	2.03	-39.48
	[6.47]***	[-0.39]	[-1.13]	[2.81]***	[1.42]	[-4.28]***
2-year	37.31	-1.76	-0.51	4.23	1.47	-80.59
	[5.58]***	[-0.74]	[-0.64]	[3.44]***	[0.64]	[-4.57]***
5-year	98.63	-4.39	-0.27	13.21	3.66	-220.36
	[4.46]***	[-0.55]	[-0.1]	[4.9]***	[1.16]	[-6.21]***

This table presents coefficient estimates from the Fama and MacBeth (1973) cross-sectional regressions of returns (multiplied by 100) on *AQ_FLOS* (Panel A) and *AQ_annual* (Panel B). The control variables are: *beta* (beta from CAPM estimated with returns of the past 60 months), ln(*ME*) (logarithm of lagged monthly equity), ln(*BEME*) (logarithm of the book-to-market ratio), and *PMOM* (price momentum, past twelve-month return). The estimates are the averages of the time-series coefficients of the monthly regression slopes for January 1970 to December 2012. Numbers in square brackets are *t*-statistics. All of the *t*-statistics are adjusted for the Newey and West (1987) autocorrelation with the number of lags corresponding to the degree of overlapping in returns; i.e., the adjusted serial lags are 5 for 6-month returns upto 59 for 5-year returns. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 4: **Robustness of the Pricing of the Annual AQ Measures**

Panel A: Coefficient estimate of *AQ_FLOS* in regressions using different subperiods

	1970–1990		1991–2012		1980–2012	
Return	Estimate	*t*-stat.	Estimate	*t*-stat.	Estimate	*t*-stat.
1-month	-2.58	[-1.71]*	-1.67	[-1.73]*	-1.79	[-2.28]**
6-month	-12.14	[-1.58]	-9.89	[-1.74]*	-10.86	[-2.35]**
1-year	-21.02	[-1.35]	-25.18	[-2.42]**	-26.03	[-3.17]***
2-year	-60.38	[-2.09]**	-67.28	[-4.28]***	-72.29	[-5.17]***
5-year	-182.03	[-2.60]***	-189.50	[-24.89]***	-231.92	[-5.28]***

Panel B: Coefficient estimate of *AQ_annual* in regressions using different subperiods

	1970–1990		1991–2012		1980–2012	
Return	Estimate	*t*-stat.	Estimate	*t*-stat.	Estimate	*t*-stat.
1-month	-4.00	[-2.39]**	-3.85	[-3.64]***	-4.15	[-4.89]***
6-month	-20.05	[-2.67]***	-21.67	[-3.55]***	-22.40	[-4.74]***
1-year	-35.40	[-2.38]**	-41.04	[-3.79]***	-43.30	[-5.28]***
2-year	-69.01	[-2.21]**	-85.67	[-5.66]***	-95.61	[-6.89]***
5-year	-236.98	[-3.95]***	-200.60	[-11.02]***	-248.15	[-5.62]***

Panel C: Regressions with more return-informative variables

Return	Intercept	*beta*	*ln(ME)*	*ln(BEME)*	*PMOM*	*SUE*	*EY*	*ILLIQ*	*AQ_annual*
1-month	1.33	0.19	-0.06	0.31	0.02	0.31	0.28	0.01	-1.99
	[6.06]***	[0.90]	[-1.89]*	[7.53]***	[0.17]	[18.45]***	[3.23]***	[0.76]	[-1.88]*
6-month	8.91	0.28	-0.36	1.07	1.15	1.18	2.00	0.05	-11.14
	[6.65]***	[0.40]	[-2.27]**	[3.33]***	[1.50]	[13.34]***	[4.75]***	[0.84]	[-2.07]**
1-year	19.86	0.12	-0.79	1.56	0.28	1.79	4.26	0.02	-18.04
	[6.5]***	[0.09]	[-2.19]**	[2.24]**	[0.19]	[10.5]***	[5.77]***	[0.19]	[-1.64]
2-year	42.44	-0.85	-1.45	4.44	-1.27	3.03	6.89	-0.18	-51.68
	[5.65]***	[-0.35]	[-1.57]	[3.08]***	[-0.52]	[12.33]***	[4.36]***	[-0.67]	[-2.78]***
5-year	115.88	-3.78	-3.19	12.46	-2.69	6.37	19.79	-1.59	-175.97
	[4.08]***	[-0.41]	[-0.86]	[4.90]***	[-0.71]	[8.67]***	[4.51]***	[-1.68]*	[-5.52]***

Panels A and B present the coefficient estimates of *AQ_FLOS* and *AQ_annual* from the Fama and MacBeth (1973) cross-sectional regressions of returns (multiplied by 100) over different subperiods. The control variables in Panels A and B are Fama-French four-factor variables of beta, size (ln(ME)), book-to-market (ln($BEME$)), and price momentum ($PMOM$); the results on the control variables are omitted for brevity. In Panel C, the additional control variables are SUE (standardized unexpected earnings in Chan et al. (1996)), EY (earnings yield, earnings to beginning-of-the-month price), and $ILLIQ$ (the illiquidity measure in Amihud (2002)). The estimates are the averages of the time-series coefficients of the monthly regression slopes. Numbers in square brackets are t-statistics. All of the t-statistics are adjusted for the Newey and West (1987) autocorrelation with the number of lags corresponding to the degree of overlapping in returns; i.e., the adjusted serial lags are 5 for 6-month returns upto 59 for 5-year returns. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 5: **Fama-French Four-Factor Alphas of Portfolios Sorted on *AQ_annual***

Decile	1 (S)	2	3	4	5	6	7	8	9	10(L)	D1-D10	D1:5-D6:10
Panel A: Equal-weighted portfolios												
Return												
1-month	0.25	0.23	0.19	0.19	0.19	0.10	0.02	-0.07	-0.13	-0.47	0.73	0.32
	[3.18]***	[2.82]***	[2.38]**	[2.28]**	[2.17]**	[0.95]	[0.23]	[-0.54]	[-0.89]	[-2.56]**	[4.15]***	[3.7]***
6-month	1.49	1.57	1.20	1.13	1.11	0.71	0.14	-0.67	-0.85	-3.12	4.61	2.06
	[3.6]***	[3.59]***	[2.97]***	[2.47]**	[2.29]**	[1.41]	[0.27]	[-1.13]	[-1.29]	[-4.97]***	[7.99]***	[6.57]***
1-year	2.73	3.07	2.83	2.18	2.15	1.55	0.93	-1.21	-1.21	-5.44	8.17	3.67
	[4.18]***	[4.56]***	[3.55]***	[2.37]**	[2.27]**	[1.51]	[0.83]	[-1.13]	[-1.04]	[-4.68]***	[7.41]***	[5.84]***
2-year	4.00	5.35	5.39	3.53	2.70	1.91	0.77	-3.68	-5.35	-12.79	16.79	8.02
	[2.33]**	[2.69]***	[2.48]**	[1.4]	[1.02]	[0.72]	[0.27]	[-1.24]	[-1.86]*	[-4.94]***	[7.21]***	[6.38]***
5-year	12.99	16.72	14.57	8.76	2.17	1.16	-6.99	-16.91	-22.87	-40.19	53.18	28.20
	[2.25]**	[3.11]***	[2.28]**	[1.34]	[0.4]	[0.22]	[-1.2]	[-2.92]***	[-3.4]***	[-8.05]***	[9.71]***	[9.79]***
Panel B: Value-weighted portfolios												
1-month	0.14	0.15	0.15	0.14	0.22	-0.04	-0.01	0.07	0.20	-0.18	0.33	0.15
	[1.73]*	[1.75]*	[1.8]*	[1.46]	[2.1]**	[-0.36]	[-0.07]	[0.58]	[1.48]	[-1.1]	[1.87]*	[2.17]**
6-month	1.01	1.17	1.05	1.12	1.20	0.26	0.92	0.02	1.35	-1.60	2.61	0.92
	[3.05]***	[3.27]***	[2.73]***	[2.34]**	[2.49]**	[0.58]	[1.79]*	[0.04]	[2.07]**	[-1.63]	[2.79]***	[3.02]***
1-year	2.41	2.87	3.23	3.35	2.47	1.60	2.79	0.54	1.58	-1.48	3.89	1.86
	[3.85]***	[4.8]***	[4.29]***	[4.64]***	[2.76]***	[1.72]*	[2.48]**	[0.59]	[1.27]	[-0.55]	[1.44]	[3.01]***
2-year	6.09	6.36	6.48	7.04	4.85	2.40	5.18	1.65	2.50	-8.82	14.91	5.58
	[4.28]***	[5.16]***	[4.06]***	[4.51]***	[2.51]**	[1.71]*	[1.95]*	[0.61]	[1.05]	[-2.51]**	[3.82]***	[4.6]***
5-year	24.94	26.38	27.47	18.67	10.14	9.93	7.78	0.63	5.06	-32.93	57.86	23.42
	[9.19]***	[4.42]***	[5.05]***	[4.59]***	[3.27]***	[2.95]***	[1.61]	[0.11]	[0.41]	[-4.69]***	[6.84]***	[3.71]***

This table reports alphas of the 10 portfolios formed with increasing *AQ_annual* breakpoints. The breakpoints are determined by the ranked values of *AQ_annual* of all stocks in the sample and are updated month by month. alpha is Jensen's alpha relative to Fama-French four-factors of market, SMB, HML and momentum, calculated from a system of equations consisting of the 10 portfolios. "D1−D10" is the spread between decile 1 and decile 10, and "D1:5−D6:10" is the spread between the mean of deciles 1–5 and the mean of deciles 6–10. Numbers in square brackets are robust *t*-statistics. All of the *t*-statistics are adjusted for the Newey and West (1987) autocorrelation with the number of lags corresponding to the degree of overlapping in returns; i.e., the adjusted serial lags are 5 for 6-month returns upto 59 for 5-year returns. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 6: **Fama and MacBeth (1973) Cross-Sectional Regressions of Returns on** *AQ_qtr*

Return	Intercept	*beta*	*ln(ME)*	*ln(BEME)*	*PMOM*	*SUE*	*EY*	*ILLIQ*	*AQ_qtr*
1-month	1.16	0.14	0.00	0.44	0.56				-0.57
	[4.41]***	[0.61]	[-0.05]	[9.66]***	[4.65]***				[-4.10]***
	1.17	0.17	-0.02	0.46	0.34	0.27	1.31	0.03	-0.49
	[4.44]***	[0.70]	[-0.45]	[10.25]***	[2.80]***	[14.17]***	[4.44]***	[2.44]**	[-3.57]***
6-month	8.25	0.02	-0.13	1.74	3.20				-3.40
	[4.73]***	[0.02]	[-0.63]	[5.4]***	[4.02]***				[-5.32]***
	8.18	0.15	-0.19	1.76	2.40	0.79	9.13	0.17	-3.03
	[4.86]***	[0.20]	[-0.97]	[5.37]***	[3.07]***	[7.91]***	[5.42]***	[2.70]***	[-4.80]***
1-year	17.72	-0.69	-0.26	3.22	3.37				-6.66
	[4.66]***	[-0.46]	[-0.61]	[4.95]***	[2.1]**				[-5.53]***
	17.72	-0.45	-0.37	3.17	2.31	0.93	16.47	0.23	-6.12
	[4.75]***	[-0.31]	[-0.89]	[4.66]***	[1.47]	[4.67]***	[5.63]***	[1.90]*	[-5.10]***
2-year	33.85	-2.94	0.24	7.05	3.12				-13.69
	[4.11]***	[-1.2]	[0.28]	[5.69]***	[1.11]				[-7.87]***
	34.94	-2.56	-0.10	7.08	1.00	1.53	30.25	0.18	-12.45
	[4.13]***	[-1.07]	[-0.11]	[5.47]***	[0.37]	[5.01]***	[7.6]***	[0.82]	[-7.43]***
5-year	75.36	-12.41	3.99	17.75	7.99				-34.66
	[3.42]***	[-1.4]	[2.5]**	[5.18]***	[1.97]**				[-8.69]***
	81.18	-11.50	2.74	18.08	3.78	2.78	61.87	-0.60	-31.33
	[3.37]***	[-1.31]	[1.39]	[5.06]***	[0.97]	[5.10]***	[7.85]***	[-0.87]	[-10.51]***

This table presents coefficient estimates from the Fama and MacBeth (1973) cross-sectional regressions of returns (multiplied by 100) on *AQ_qtr*. The control variables are: *beta* (beta from CAPM estimated with returns of the past 60 months), ln(*ME*) (logarithm of lagged monthly equity), ln(*BEME*) (logarithm of the book-to-market ratio), *PMOM* (price momentum, past twelve-month return), *SUE* (standardized unexpected earnings), *EY* (earnings yield, earnings to beginning-of-the-month price), and *ILLIQ* (the illiquidity measure in Amihud (2002)). The estimates are the averages of the time-series coefficients of the monthly regression slopes for January 1980 to December 2012. Numbers in square brackets are *t*-statistics. All of the *t*-statistics are adjusted for the Newey and West (1987) autocorrelation with the number of lags corresponding to the degree of overlapping in returns; i.e., the adjusted serial lags are 5 for 6-month returns upto 59 for 5-year returns. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 7: Robustness of the Pricing of Accruals Quality to Alternative Quarterly AQ Measures: Coefficient Estimate of AQ in Cross-Sectional Return Regressions

Return	*AQ_qtr_A*	*AQ_qtr_Ind*	*AQ_no4q*	Abs(*AbAcc*)
1-month	-5.53	-5.40	-0.53	-0.76
	[-3.00]***	[-2.60]***	[-3.30]***	[-5.62]***
6-month	-31.42	-30.85	-4.03	-4.29
	[-2.70]***	[-2.46]**	[-5.67]***	[-6.34]***
1-year	-64.91	-64.25	-7.36	-8.31
	[-3.00]***	[-2.72]***	[-5.22]***	[-6.33]***
2-year	-175.96	-178.64	-14.62	-16.42
	[-6.19]***	[-5.73]***	[-6.94]***	[-8.45]***
5-year	-559.05	-605.95	-36.29	-36.34
	[-5.79]***	[-4.54]***	[-8.38]***	[-8.69]***

This table reports the coefficient estimates of alternative quarterly *AQ* measures from the Fama and MacBeth (1973) cross-sectional regressions of returns (multiplied by 100) over 1980–2012. The control variables are Fama-French four-factor variables of beta, size (ln(*ME*)), book-to-market (ln(*BEME*)), and price momentum (*PMOM*); the results on the control variables are omitted for brevity. The alternative AQ measures using quarterly data are: *AQ_qtr_A* (out-of-sample measure of *AQ* using total assets as the scalar), *AQ_qtr_Ind* (out-of-sample measure of AQ using total assets as the scalar, and all quarterly data items used in the estimation are industry-mean-adjusted), *AQ_no4q* (similar as *AQ_qtr* except that all fourth-quarter observations are removed), and Abs(*AbAcc*) (absolute level of abnormal accruals). Numbers in square brackets are robust *t*-statistics. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 8: Fama-French Four-Factor Alphas of Portfolios Sorted on *AQ_qtr*

Decile	1 (S)	2	3	4	5	6	7	8	9	10(L)	D1-D10	D1:5-D6:10
Panel A: Equal-weighted portfolios												
Return												
1-month	0.18	0.23	0.26	0.22	0.12	0.20	0.09	-0.06	-0.40	-0.81	1.00	0.40
	[2.32]**	[2.74]***	[3.56]***	[2.69]***	[1.36]	[2.17]**	[0.79]	[-0.5]	[-2.54]**	[-3.94]***	[4.48]***	[3.85]***
6-month	1.05	1.12	1.38	1.02	0.52	0.92	0.55	-0.45	-2.19	-4.46	5.51	2.14
	[1.96]*	[2.19]**	[3.11]***	[2.41]**	[1.25]	[1.81]*	[0.97]	[-0.74]	[-2.94]***	[-4.45]***	[4.94]***	[3.74]***
1-year	1.13	0.97	1.54	1.17	0.79	1.42	0.49	-1.15	-4.25	-7.96	9.09	3.41
	[1.28]	[0.99]	[1.51]	[1.08]	[0.65]	[1.05]	[0.35]	[-0.75]	[-2.47]**	[-3.79]***	[4.32]***	[2.98]***
2-year	1.83	0.79	2.90	2.03	0.36	0.70	-0.90	-4.00	-11.24	-18.28	20.10	8.33
	[0.83]	[0.38]	[1.11]	[0.72]	[0.13]	[0.25]	[-0.3]	[-1.24]	[-3.98]***	[-4.54]***	[6.59]***	[6.6]***
5-year	5.50	6.05	11.30	7.33	0.82	-0.61	-7.99	-17.85	-26.32	-41.14	46.64	24.98
	[1.32]	[1.43]	[2.54]**	[1.79]*	[0.16]	[-0.1]	[-1.33]	[-3.3]***	[-7.93]***	[-9.31]***	[12.1]***	[12.84]***
Panel B: Value-weighted portfolios												
1-month	0.15	0.06	0.03	0.11	-0.01	0.26	-0.02	0.03	-0.32	-0.51	0.65	0.18
	[1.78]*	[0.79]	[0.32]	[1.25]	[-0.06]	[2.81]***	[-0.18]	[0.2]	[-2.23]**	[-3.02]***	[3.08]***	[2.06]**
6-month	1.33	0.38	0.43	0.73	0.40	1.11	0.11	0.15	-0.95	-2.23	3.56	1.02
	[3.31]***	[0.96]	[1.08]	[1.84]*	[0.66]	[2.41]**	[0.19]	[0.24]	[-1.45]	[-2.74]***	[3.42]***	[2.53]**
1-year	2.76	0.57	1.24	2.27	0.95	2.34	0.38	-0.13	-1.51	-4.75	7.51	2.29
	[4]***	[0.75]	[1.63]	[3.41]***	[0.8]	[2.49]**	[0.33]	[-0.1]	[-1.02]	[-3.15]***	[4.4]***	[3.2]***
2-year	5.55	2.44	5.21	4.67	2.83	3.83	4.53	1.31	-0.78	-8.33	13.88	4.03
	[3.84]***	[1.9]*	[3.29]***	[3.61]***	[1.48]	[2.26]**	[2.13]**	[0.48]	[-0.27]	[-2.74]***	[4.25]***	[4.15]***
5-year	17.42	18.14	25.97	16.89	10.55	10.07	9.88	13.07	3.15	-10.16	27.58	12.59
	[7.42]***	[5.74]***	[9.56]***	[5.31]***	[3.9]***	[1.35]	[2.15]**	[3.97]***	[0.5]	[-2.26]**	[4.68]***	[3.82]***

This table reports alphas of the 10 portfolios formed with increasing *AQ_qtr* breakpoints. The breakpoints are determined by the ranked values of *AQ_qtr* of all stocks in the sample and are updated month by month. alpha is Jensen's alpha relative to Fama-French four-factors of market, SMB, HML and momentum, calculated from a system of equations consisting of the 10 portfolios. "D1−D10" is the spread between decile 1 and decile 10, and "D1:5−D6:10" is the spread between the mean of deciles 1–5 and the mean of deciles 6–10. Numbers in square brackets are robust *t*-statistics. All of the *t*-statistics are adjusted for the Newey and West (1987) autocorrelation with the number of lags corresponding to the degree of overlapping in returns; i.e., the adjusted serial lags are 5 for 6-month returns upto 59 for 5-year returns. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 9: **Economic Significance of the Pricing of Accruals Quality**

Return	Coefficient estimate of *AQ_annual* Decile	Annualized impact of 1 decile change (bps)	Coefficient estimate of *AQ_qtr* Decile	Annualized impact of 1 decile change (bps)
1-month	-0.04	-49.20	-0.07	-81.58
	[-4.36]***		[-4.71]***	
6-month	-0.19	-37.53	-0.37	-74.78
	[-3.69]***		[-4]***	
1-year	-0.32	-32.48	-0.70	-70.49
	[-3.34]***		[-3.49]***	
2-year	-0.68	-34.19	-1.48	-73.79
	[-3.61]***		[-4.87]***	
5-year	-1.96	-39.15	-3.74	-74.87
	[-5.03]***		[-6.27]***	

This table presents coefficient estimates of *AQ_annual* and *AQ_qtr* deciles in cross-sectional return regressions. Each month we transform *AQ_annual* and *AQ_qtr* into decile ranks, and run return regressions of *AQ_annual* decile or *AQ_qtr* decile with the control variables of Fama-French four-factor variables of beta, size ($\ln(ME)$), book-to-market ($\ln(BEME)$), and price momentum (*PMOM*). The results on the control variables are omitted for brevity. The column "Annualized impact of 1 decile change (bps)" is the annualized impact of one decile change, expressed in basis points of return. Numbers in square brackets are robust t-statistics. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 10: Evaluating Existing Explanations: Low Prices, Negative Earnings Surprises, Small Firms, and Accrual Anomaly

Panel A: Samples with low prices, negative earnings surprises, or small firms removed

	Coefficient estimate of *AQ_annual* in Alternative Sample:			Coefficient estimate of *AQ_qtr* in Alternative Sample:		
Return	*Price* < $5 removed	Bottom 30% *SURP_TS* removed	Bottom 30% mkt cap removed	*Price* < $5 removed	Bottom 30% *SURP_TS* removed	Bottom 30% mkt cap removed
1-month	-4.00	-4.97	-3.89	-0.81	-0.52	-0.57
	[-3.68]***	[-3.79]***	[-3.95]***	[-5.26]***	[-3.19]***	[-4.1]***
6-month	-19.38	-22.02	-21.16	-4.25	-2.95	-3.40
	[-3.95]***	[-4.78]***	[-4.36]***	[-6.36]***	[-3.62]***	[-5.32]***
1-year	-32.98	-31.37	-39.53	-7.86	-5.49	-6.66
	[-3.62]***	[-4.03]***	[-4.3]***	[-6.3]***	[-3.44]***	[-5.53]***
2-year	-71.41	-60.96	-80.73	-14.96	-13.05	-13.69
	[-4.27]***	[-3.99]***	[-4.58]***	[-6.43]***	[-5.89]***	[-7.87]***
5-year	-174.84	-188.91	-220.52	-35.25	-33.23	-34.66
	[-4.62]***	[-4.05]***	[-6.22]***	[-7.75]***	[-10.47]***	[-8.69]***

Panel B: Controlling for the accrual anomaly

Return	Intercept	*beta*	*ln(ME)*	*ln(BEME)*	*PMOM*	*AbAcc*	*AQ_annual*
1-month	1.34	0.13	-0.04	0.19	0.42	-0.74	-4.19
	[5.64]***	[0.64]	[-1.29]	[4.31]***	[3.07]***	[-1.61]	[-2.88]***
6-month	8.15	-0.10	-0.18	0.85	1.97	-6.66	-17.32
	[6.04]***	[-0.14]	[-1.05]	[3.23]***	[2.47]**	[-3.17]***	[-2.98]***
1-year	18.08	-0.55	-0.44	1.27	1.40	-11.08	-34.67
	[5.86]***	[-0.39]	[-1.13]	[2.1]**	[0.94]	[-2.49]**	[-3.27]***
2-year	38.75	-2.25	-0.76	3.90	0.17	-16.51	-71.87
	[5.24]***	[-0.85]	[-0.81]	[2.74]***	[0.07]	[-2.02]**	[-3.08]***
5-year	106.67	-5.49	-1.51	14.00	2.16	-16.94	-180.90
	[4.23]***	[-0.63]	[-0.46]	[4.39]***	[0.61]	[-0.76]	[-2.82]***

Return	Intercept	*beta*	*ln(ME)*	*ln(BEME)*	*PMOM*	*AbAcc*	*AQ_qtr*
1-month	1.28	0.07	-0.01	0.33	0.60	-0.36	-0.70
	[4.26]***	[0.3]	[-0.27]	[6.1]***	[4.49]***	[-3.79]***	[-3.92]***
6-month	8.10	-0.11	-0.09	1.39	2.89	-2.17	-4.27
	[4.54]***	[-0.12]	[-0.41]	[4.02]***	[3.37]***	[-6.01]***	[-5.68]***
1-year	17.03	-0.84	-0.14	2.61	2.79	-2.59	-8.08
	[4.29]***	[-0.51]	[-0.32]	[3.78]***	[1.7]*	[-4.65]***	[-5.19]***
2-year	33.94	-3.47	0.29	5.84	1.71	-3.63	-15.77
	[3.83]***	[-1.2]	[0.3]	[4.28]***	[0.59]	[-3.87]***	[-5.88]***
5-year	82.58	-13.49	2.92	14.84	5.06	-8.25	-40.74
	[2.94]***	[-1.29]	[1.25]	[4.45]***	[1.33]	[-2.2]**	[-5.07]***

Panel A presents the coefficient estimates of *AQ* (*AQ_annual* and *AQ_qtr*) in various alternative samples in return regressions on the control variables of Fama-French four-factor variables of beta, size (ln(*ME*)), book-to-market (ln(*BEME*)), and price momentum (*PMOM*). The results on the control variables are omitted for brevity. These alternative samples include removing from the sample the following: observations with the beginning-of-the-month price of less than $5; observations with Ogneva's (2012) earnings surprise measure (*SURP_TS*) that fall into the bottom 30%; and observations with the beginning-of-the-month market capitalization that fall into the bottom 30%. In Panel B, *AbAcc* is the abnormal accruals (i.e. discretionary accruals or signed accruals) as per Rajgopal and Venkatachalam (2011). Numbers in square brackets are robust *t*-statistics. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

Table 11: **Accruals Quality and Information Uncertainty**

Panel A: Information uncertainty and *AQ_annual*

	(1)		(2)		(3)		
Return	*IRV* Decile	*AQ_annual* Decile	*CFV* Decile	*AQ_annual* Decile	*IRV* Decile	*CFV* Decile	*AQ_annual* Decile
1-month	-0.08	-0.03	-0.02	-0.03	-0.08	-0.01	-0.02
	[-5.34]***	[-3.79]***	[-1.94]*	[-3.00]***	[-5.25]***	[-1.48]	[-2.54]**
6-month	-0.25	-0.15	-0.07	-0.14	-0.25	-0.06	-0.11
	[-3.26]***	[-3.50]***	[-1.47]	[-2.82]***	[-3.19]***	[-1.35]	[-2.47]**
1-year	-0.31	-0.28	-0.10	-0.25	-0.30	-0.09	-0.22
	[-2.01]**	[-3.28]***	[-0.93]	[-2.42]**	[-1.95]*	[-0.88]	[-2.23]**
2-year	-0.56	-0.61	-0.20	-0.54	-0.54	-0.19	-0.48
	[-2.01]**	[-3.55]***	[-0.92]	[-2.17]**	[-1.93]*	[-0.89]	[-2.05]**
5-year	-1.81	-1.73	-1.42	-1.02	-1.76	-1.38	-0.83
	[-2.55]**	[-5.20]***	[-2.47]**	[-1.60]	[-2.44]**	[-2.40]**	[-1.40]

Panel B: Information uncertainty and *AQ_qtr*

	(1)		(2)		(3)		
Return	*IRV* Decile	*AQ_qtr* Decile	*CFV* Decile	*AQ_qtr* Decile	*IRV* Decile	*CFV* Decile	*AQ_qtr* Decile
1-month	0.00	-0.06	-0.06	-0.02	0.00	-0.06	-0.02
	[-0.16]	[-4.42]***	[-5.05]***	[-1.55]	[-0.16]	[-4.85]***	[-1.00]
6-month	-0.04	-0.34	-0.30	-0.14	-0.04	-0.31	-0.09
	[-0.55]	[-3.75]***	[-4.14]***	[-1.52]	[-0.56]	[-4.58]***	[-0.84]
1-year	-0.06	-0.65	-0.60	-0.23	-0.06	-0.61	-0.14
	[-0.44]	[-3.23]***	[-4.18]***	[-1.12]	[-0.45]	[-4.10]***	[-0.57]
2-year	-0.20	-1.37	-1.16	-0.54	-0.21	-1.04	-0.48
	[-0.91]	[-4.71]***	[-3.65]***	[-1.29]	[-0.92]	[-2.85]***	[-1.10]
5-year	-1.04	-3.52	-2.97	-1.32	-1.05	-2.88	-1.08
	[-1.70]*	[-5.92]***	[-2.35]**	[-1.03]	[-1.71]*	[-2.14]**	[-0.83]

This table reports the coefficient estimates of *AQ* and information uncertainty measures from the Fama and MacBeth (1973) cross-sectional regressions of returns (multiplied by 100). In each model, we regress returns on an *AQ* proxy (either *AQ_annual* or *AQ_qtr*), one or two information uncertainty proxies, and the control variables. Information uncertainty proxies and *AQ* proxies are all expressed in monthly decile rank for ease of comparison. In model (1), we include the information uncertainty proxy of idiosyncratic volatility (*IRV*, calculated as per Ang et al. (2006)). In model (2), we include the information uncertainty proxy of cash flow volatility (*CFV*, standard deviation of cash flow to assets over the past five years for *AQ_annual*, and standard deviation of cash flow to sales over the past 16 quarters for *AQ_qtr*). In model (3), we include both *IRV* and *CFV*. The control variables are Fama-French four-factor variables of beta, size ($\ln(ME)$), book-to-market ($\ln(BEME)$), and price momentum (*PMOM*); the results on the control variables are omitted for brevity. Numbers in square brackets are robust t-statistics. ***, **, and * indicate significance at the 1%, 5% and 10% levels, respectively.

□ □ □ □ □ □ The 52-Week High and the Anchoring Bias of Chinese Investors and Analysts

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Investors and analysts in the Chinese stock market anchor on a stock's 52-week high price when assessing information. Investors under-react to positive (negative) earnings surprises when a stock's price is near (far from) the 52-week high, generating positive (negative) price drift after earnings announcements. Analysts under-react to positive (negative) news and inadequately revise forecasts upward (downward) when a stock is near (far from) its 52-week high, generating positive (negative) price drift after the revised forecast is announced. No price drift follows announcements of earnings or of analysts' revised forecasts among stocks with unanchored prices. These findings suggest that post earnings announcement drift and post analyst forecast revision drift in the Chinese stock market are attributable to anchoring bias.

Keywords: Anchoring; 52-week high; Post earnings announcement drift; Post analyst forecast revision drift; Chinese stock market

JEL Descriptors: G12, G14, M41

Introduction

Post earnings announcement drift (PEAD) is the tendency for stock prices to move in the direction of unexpected earnings even after they are announced publicly. Post analyst forecast revision drift (PAFRD) is the tendency for prices to move in the direction of analysts' revised forecasts even after they are announced publicly. PEAD and PAFRD have been documented in various stock markets during different periods (Ball and Brown 1968; Bernard and Thomas 1989; Chan, Jegadeesh and Lakonishok 1996; Truong 2011). It is difficult to explain these phenomena in a manner consistent with rational pricing, so prior studies incorporate psychology into formal models to explain these and other anomalies. This study examines how one type of robust and measurable psychological bias—anchoring—generates PEAD and PAFRD in the Chinese stock market. Previous studies also suggest psychological bias is more severe in more uncertain environments (Daniel, Hirshleifer, and Subrahmanyam 1998; Hirshleifer 2001; Zhang 2006a, 2006b); Great uncertainty characterizes China's young and developing stock market, rendering it an excellent setting for this study.

Anchoring is a type of cognitive bias. It refers to people's tendency to rely on salient but irrelevant information (the anchor) when making decisions under uncertainty. Kahneman (2011, p. 119) describes anchoring as "…one of the most reliable and robust results of experimental psychology". In equities markets, 52-week high stock prices are salient but irrelevant information. Financial websites and newspapers almost universally report 52-week highs alongside current prices. Their prominence and ubiquity (i.e., salience) might convince investors to use them when formulating beliefs about a security's fundamental value, and previous studies suggest this is indeed the case. For example, George and Hwang (2004) consider an investment strategy, which involves buying the quintile of stocks with prices near 52-week highs and shorting stocks with prices distant from them, that ranks stocks by the nearness of their current prices to the 52-week high. Profits from this strategy in the U.S.

market are significant and even dominate profits generated by the return momentum strategies of Jegadeesh and Titman (1993). Liu, Liu, and Ma (2010) extend George and Hwang's strategy to international markets and find that its profitability is prevalent. In another study of the U.S. market, Li and Yu (2011) reveal a strong systematic element to this relation in a time series: Dow Index returns are predictable based on its proximity to its 52-week high. These studies present their findings as consistent with investors' anchoring on 52-week high. Investors are reluctant to push prices higher for stocks near the 52-week highs and to push them downward if far from the 52-week high.

George, Hwang, and Li (2014) examine the role of anchoring on the 52-week high in generating PEAD in the U.S. Their proposition is straightforward as follows: investors have difficulty estimating the dollar value of an earnings surprise when assessing whether securities are fairly priced; to avoid this difficulty, they might simply ask whether earnings information is already incorporated into the current price and assess whether the price has room to run. The 52-week high is a ready metric of the highest price others have recently paid for the stock. Therefore, if a current price is near that high, investors might infer that a positive earnings surprise is embodied in the current price and decide not to bid it higher. These investors' collective decisions would restrain the price reaction to positive earnings surprises for stocks priced near their 52-week highs. If current price is distant from the 52-week high and the surprise is negative, investors might infer that price already reflects the negative earnings surprise. Investors' collective behaviors restrain price reaction to the negative earnings surprises of stocks priced far from their 52-week highs. Consistent with their argument, George, Hwang, and Li (2014) find that PEAD in the U.S. market is attributable entirely to anchoring on the 52-week high. They, further, find that price reactions to extreme earnings surprises are more muted when the anchoring effect is stronger.

Following George, Hwang, and Li (2014), we examine the role of anchoring on the 52-week high in generating PEAD in the Chinese stock market. We find that in the absence of the anchoring effect, the difference between price drift during the 120 days after announcements of the top 20% most positive earnings surprises and price drift following announcements of the bottom 20% most negative earnings surprises is −0.61% (*t-statistic* = −0.29). In contrast, the difference is 12.76% (*t-statistic* = 9.40) when 52-week high anchoring is strongest. Mirroring results for the U.S., PEAD in the Chinese market is entirely attributable to anchoring. Furthermore, we find that the 120 days' PEAD unconditional on anchoring is 6.14%, which is approximately half of PEAD when the anchoring effect is the strongest. This result suggests that the profit from exploiting PEAD doubles by conditioning on stocks anchored to their 52-week highs.

Moreover, we find that among stocks with positive earnings surprises price reactions are less positive when the pre-announcement stock price is nearer its 52-week high (i.e., the anchoring effect is stronger). A corresponding pattern exists for negative earnings surprises. This finding directly demonstrates that investors' under-reaction to earnings news is influenced by anchoring, confirming our previous results regarding PEAD. Finally, we find that historical stock return is irrelevant to PEAD because they are not saliently presented as 52-week highs, a finding consistent with U.S. results in George, Hwang, and Li (2014).

Kahneman (2011, p.124) observes that the anchoring bias afflicts professionals alongside novices even though financial analysts are considered experts. Cen, Hilary, and Wei (2013) show that analysts anchor on industry norms (an industry's historically stable range of earnings per share (EPS)) when forecasting earnings. Since the 52-week high is more readily observable than industry EPS norms, analysts might also anchor on it when forecasting, in turn engendering PAFRD. Specifically, if a stock price is near its 52-week high, analysts might discount positive information, hesitant to believe its price should overshoot its52-week high. On the other hand, if the stock price is distant from its 52-week high, analysts might discount negative information because they are hesitant to believe its price can fall even lower.

Issuing revised forecasts is among the most important ways in which analysts update new information. They revise forecasts upward (downward) upon receiving new positive (negative) information. Anchoring on the 52-week high when assessing new information, as we hypothesize, their upward (downward) revisions will be more inadequate when stock price is nearer (further from) the 52-week high. If investors rely on analysts' revisions to make investment decisions, analysts' anchoring-induced under-reaction will be reflected in stock price, resulting in PAFRD. Hence, if our hypothesis is correct, PAFRD following upwardly (downwardly) revised forecasts should be more (negative) positive when price is nearer (farther from) the 52-week high.

This outcome is indeed what we find. We first confirm that PAFRD exists in the Chinese stock market. More importantly, we find that PAFRD in the Chinese market, similar to PEAD, is attributable entirely to anchoring. In the absence of the 52-week high anchoring effect, the difference between price drift during the 120 days after announcements of extremely positive revised forecasts and price drift following announcements of extremely negative revisions is −2.09% (*t-statistic* = −0.70). On the other hand, the difference is 11.16% (*t-statistic* = 5.48) when the anchoring effect is strongest. In comparison, the 120 days' PAFRD unconditioned on anchoring is 5.63%. Hence, the profit from exploiting PAFRD also almost doubles by conditioning on stocks anchored to their 52-week highs. Finally, we find that historical stock returns are irrelevant to PAFRD.

We also examine analysts' forecast errors and subsequent forecast revisions to test whether anchoring prompts analysts to under-react to new information when revising forecasts. If analysts anchor on the 52-week high when assessing new information, forecast errors and subsequent forecast revisions should exhibit distinctive patterns. When analysts receive positive news and revise forecasts upward, the closer the price is to its 52-week high, the less optimistic will be their current forecasts. The outcome is a greater number of negative forecast errors (defined as analyst forecasts minus actual EPS) and more positive subsequent forecast revisions. On the other hand, when analysts receive negative news and revise forecasts downward, the farther the price is from the 52-week high, the less pessimistic their current forecasts will be. The results are a greater number of positive forecast errors and more negative subsequent forecast revisions. We indeed find these patterns, suggesting that analysts anchor on the 52-week high in their decisions, supporting our finding concerning PAFRD.

We find no evidence that investors anchor on the 52-week high when reacting to announcements of analysts' revised forecasts. This might be because retail investors own more than 90% of the tradable shares on the Chinese stock market (Wang, Qian, and Chee, 2005), and retail investors might heed financial experts without second guessing.

China has become one of the fastest growing economies in the world and China's capital market has become central to its economy: Its capitalization exceeded 50% of China's GDP in 2000 (MacNeil 2002). This significance to one of the world's fastest-growing economies makes it important to decipher what promotes or deters efficient transmission of information in this market. This paper demonstrates that psychology is one important factor.

Further, China's stock market is relatively young and features greater uncertainty than mature markets. Since investors and analysts are more susceptible to psychological bias amid uncertainty (Daniel, Hirshleifer, and Subrahmanyam 1998; Hirshleifer 2001), China provides an ideal setting to test psychological bias in equity markets. This paper presents empirical evidence for the broad theme in behavioral finance that psychological biases systematically affect decision-making in capital markets.

2. Anchoring and PEAD

This section examines the role of anchoring on the 52-week high in generating PEAD in the Chinese market. Section 2.1 describes the data and methodology. Section 2.2 tests how anchoring influences PEAD. Section 2.3 examines how anchoring affects investors' reactions to earnings announcements.

2.1 Data and methodology

All data used in this section come from CSMAR. Its records of quarterly earnings begin in 2003, our sample spans 2003 to 2012. Fiscal quarters of all sampled stocks end in March, June, September, and December. For each fiscal quarter, we sorted stocks independently on the basis of their standardized unexpected earnings (*SUE*) and 52-week high anchoring measures (*PRC*) based on their earnings announcements for that quarter. *SUE* is calculated as $(e_q - e_{q-4})/\sigma_q$, where e_q is current-quarter EPS, e_{q-4} is EPS for the same fiscal quarter the previous year, and σ_q is the standard deviation of $(e_q - e_{q-4})$ over the prior eight fiscal quarters (we require at least four prior quarters of data).

We sorted stocks into quintiles based on *SUE* (SUE1–SUE5). SUE1 and SUE2 include stocks with extremely and moderately negative earnings surprises, respectively. These two groups are denoted SUE_{BB} and SUE_B. SUE5 and SUE4 include stocks with extremely and moderately positive earnings surprises, respectively. They are denoted SUE_{GG} and SUE_G. SUE3 includes stocks with the lowest magnitude of SUE. It is the no-earnings-surprises group.

PRC, our 52-week high anchoring measure, is calculated as the stock price (adjusted for splits and dividends) 10 days before the date of current quarterly earnings are announced, divided by the highest stock price during the past 52 weeks. The 20% of stocks with the lowest (highest) *PRC* occupy the group denoted LPRC (HPRC); the rest are in the group denoted MPRC. Combinations of the four earnings-surprise groups (SUE_{GG}, SUE_G, SUE_B,

SUE_{BB}) and the three PRC groups (LPRC, MPRC, HPRC) produce 12 groups. As explained later, stocks in the no-earnings-surprises group (SUE3) are used as benchmarks to calculate PEAD for stocks in groups with earnings surprises.

We are interested in whether anchoring on the 52-week high affects PEAD, given the sign and magnitude of announced earnings surprises. Therefore, we examine how *PEAD* changes with *PRC* within each of four earnings-surprises groups. If investors anchor when assessing earnings surprises, their under-reaction to positive (negative) surprises will be greater when stock price is nearer (farther from) its 52-week high, prompting greater positive (negative) price drift. Therefore, we expect *PEAD* to increase with *PRC* in each of the four earnings-surprises groups.

PEAD is measured as an abnormal return occurring two to 120 days after an earnings announcement. Care is warranted in defining abnormal return to capture the impact of anchoring on *PEAD*. George and Hwang (2004) show that stocks with higher *PRC* have higher future returns unconditioned on earnings surprises, indicating that even if investors do *not* anchor on 52-week highs when reacting to earnings news higher (lower) *PRC* stocks might still have more positive (negative) price drift. This pure anchoring effect, which is an effect of anchoring bias on price drift of *all* stocks irrespective of earnings surprises, must be controlled. We do so using stocks in the no-earnings-surprises group (SUE3) as benchmarks. The procedures are as follows.

Each fiscal quarter, for each stock *i* in the 12 groups, we choose one matching stock *im* from SUE3 using the following criteria: *PRC* of stock *im* is the closest to that of stock *i* among all stocks in its PRC group (LPRC, MPRC, and HPRC). Then *PEAD* of *i* is calculated using the formula:

$$PEAD_{i,} = Exret\,(2,\,120)_{it} - Exret\,(2{,}120)_{im},\qquad (1)$$

where *Exret* (*2, 120*)$_{i}$ is the size-adjusted and book-to-market-adjusted buy-and-hold return of stock *i* occurring two to 120 days after its earnings announcement. This return is calculated by subtracting the mean buy-and-hold return of an equal-weighted portfolio of stocks in the same 5×5 size and book-to-market group over the same holding period. The 5×5 independent sorting is performed at the beginning of the year.

Consider two stocks, *i* and *im*, which have the same high magnitude of *PRC*. The existence of the pure anchoring effect suggests identical positive price drift for both stocks. Subtracting the price drift of stock *im*, the pure anchoring effect is removed from price drift of stock *i*. Hence, $PEAD_i$ calculated using formula (1), emerges as the abnormal return adjusted by size, book-to-market, and anchoring. The relation between *PEAD* and *PRC* will reflect how *PRC* affects investors' under-reaction to earnings news.

Table 1 reports the summary statistics of stocks with earnings surprises (treatment stocks), together with the corresponding characteristics of their benchmark stocks from the no-surprises group. The statistics for benchmark stocks are presented in *italic* in Table 1. As the table shows, for treatment and benchmark stocks, average SUE values within each earnings-surprises group are little-affected by stocks' PRC ranks. The finding also is true of PRC values: They are insensitive to SUE rankings. This means that neither ranking is merely identifying extremes by the other ranking criterion. Independent variation in both criteria is available in the sample to explain returns if indeed such relations exist. Further, *PRCs* of the treatment stocks are almost the same as those of their benchmark stocks, which reinforces the validity of using these benchmark stocks to remove the pure anchoring effect.

2.2 Results on anchoring bias and PEAD

The results are reported in Panel A of Table 2. We first confirm the existence of PEAD in our sample. The first row labelled as 'ALL' reports the average *PEAD* in each of the four SUE groups. Average *PEAD* is 4.26% among stocks with extremely positive earnings surprises (SUE_{GG}) and it's -1.88% among stocks with extremely negative earnings surprises (SUE_{BB}). The difference is 6.14% and statistically significant (*t-statistic* = 8.96). Test statistic of the difference is based on standard errors clustered by stock and earnings announcement date.

We then report the average *PEAD* of stocks in each of the 12 groups stratified by SUE and PRC. As shown, within SUE_{GG}, average *PEAD* is positive in all three PRC groups. More importantly, it increases from 2.99% in LPRC to 7.97% in HPRC. The difference is 4.98% (*t-statistic* = 2.85). Similar patterns appear within SUE_{G}. These results suggest that investors are more likely to under-react to positive earnings surprises if stock price is nearer its 52-week high, generating more positive *PEAD*. Within SUE_{BB}, average *PEAD* is - 4.79% in LPRC and 3.60% in HPRC. Hence, the returns following extremely negative earnings surprise are more negative for stocks whose prices are farther from 52-week high; and are less negative (they are actually positive) for stocks whose prices are near 52-week high. Similar patterns appear within SUE_{B}. These results suggest that investors are more likely to under-react to negative earnings surprises if stock price is farther from its 52-week high, generating more negative *PEAD*.

Earnings surprises of stocks in the lower-right and upper-left corners are most vulnerable to anchoring bias. The difference in *PEAD* between these opposed corners represents price drift after earnings announcements when anchoring bias is strongest. The difference of 12.76% (= 7.97% + 4.79%) is statistically significant (*t-statistic* = 9.40). On the other hand, earnings surprises of stocks in the upper-right and lower-left corners are least vulnerable to anchoring bias, so the difference in *PEAD* represents price drift after earnings announcements when anchoring bias is absent. The difference of −0.61% (= 2.99% − 3.60%) is statistically insignificant (*t-statistic* = −0.29). This suggests there is almost no price drift after earnings surprises of unanchored stocks. In other words, the under-reaction to information contained in earnings surprises typified by PEAD is attributable entirely to anchored stocks. This conclusion reinforces that of George, Hwang, and Li (2014) in their investigation of PEAD in the U.S. market. Further, compared to the unconditional *PEAD* at 6.14%, this result suggests that the profitability of exploiting PEAD doubles by conditioning on the 20% most anchored stocks. .

In Panel A of Table 2, *PEAD* increases with *PRC* within each of the four earnings-surprises groups. Now we test whether this positive relationship is confirmed by regression, which allows for controlling other variables. The regression is specified as:

$$PEAD_i = b_0 + b_1\, SUE_i + b_2\, PRC_i + b_j\, controls_j + \varepsilon_i \tag{2}$$

PEAD, *SUE*, and *PRC* are defined in Section 2.1. We control for firm size (*LOGMV*) and book-to-market ratio (*LOGBM*) that are calculated at the beginning of the year wherein earnings are announced; both are transformed into logarithmic forms. We include time-fixed effects based on fiscal quarter.

We run regression (2) on stocks with positive earnings surprises (stocks in SUE_{GG} and SUE_G) and with negative earnings surprises (stocks in SUE_{BB} and SUE_B). Test statistics are based on standard errors clustered by firm and earnings announcement date. Results appear in Panel B of Table 2. Among sampled stocks with positive earnings surprises, the coefficient on *PRC* is positive and significant (*t-statistic* = 3.06). Among sampled stocks with negative earnings surprises, the coefficient of *PRC* is also positive and significant (*t-statistic* = 5.20). These results suggest that *PEAD* increases with *PRC* for a given *SUE*, a finding consistent with the stratified results in Panel A.

Panel C of Table 2 includes previous stock returns (*RETMOM*) in the regression to test whether they affect PEAD. *RETMOM* is calculated as the six months' buy-and-hold return ending 10 days before the announcement date. Among stocks with both positive and negative earnings surprises, coefficients on *RETMOM* are not statistically significant (*t-statistic* =0.70

for positive surprises, and *t-statistic* = −0.86 for negative surprises). This result suggests *PEAD* is unaffected by historical stock returns. The finding is consistent with results for the U.S. market that indicate investors do not anchor on historical return when assessing earnings surprises (George, Hwang, and Li 2014).

2.3 Returns around current earnings announcement

Besides PEAD, George, Hwang, and Li (2014) examine stock returns during the three days surrounding current earnings announcements. They argue that if the cause of PEAD is investors' anchoring their beliefs on the 52-week high when extreme earnings are announced, then daily returns surrounding current earnings announcements should exhibit specific patterns consistent with anchoring. For positive earnings surprises, price reactions should become more muted the closer stock price is to its 52-week high. For negative earnings surprises, price reaction should be more muted the further the price is from its 52-week high. Following George, Hwang, and Li (2014), we test whether earnings announcement returns exhibit these patterns in China. Earnings announcement returns are calculated as the size-adjusted and book-to-market-adjusted buy-and-hold stock return during the three days around earnings announcements. Results are reported in Table 3.

Panel A of Table 3 reports average earnings announcement returns in each of the 12 groups stratified by *SUE* and *PRC*. Within SUE_{GG} and SUE_G, differences in the average earnings announcement returns between HPRC and LPRC are −0.56% and −0.36% respectively (*t-statistic* = −2.50 for SUE_{GG} and −1.85 for SUE_G). Within SUE_{BB} and SUE_B, the corresponding differences are −0.19% and −0.54% (*t-statistic* = −0.87 for SUE_{BB} = −2.46 for SUE_B). These results suggest that price reaction generally is less affirmative (less negative) for positive (negative) earnings surprises when price is nearer (farther from) its 52-week high. This finding reinforces the patterns specified above.

Next, we use regression to examine the relation between *PRC* and earnings announcement returns. We again employ regression (2), except that the dependent variable is earnings announcement returns. Results appear in Panel B of Table 3. Among stocks with positive and negative earnings surprises, coefficients of *PRC* are negative and significant (*t-statistic* = −2.31 for positive surprises and −2.88 for negative). This finding is consistent with the stratified results in Panel A. These results provide direct evidence suggesting that investors' under-reaction to positive (negative) earnings surprise is greater when price is nearer (farther from) its 52-week high. They confirm findings in Section 2 regarding PEAD.

3. Anchoring and PAFRD

This section examines the role of anchoring in generating PAFRD. Section 3.1 describes the data and methodology, Section 3.2 how anchoring affects PAFRD, and Section 3.3 investigates how anchoring influences analysts' forecast errors and revisions.

3.1 Data and methodology

Data concerning analysts' forecasts are from I/B/E/S. Stock prices and returns are retrieved from CSMAR. I/B/E/S has records of analysts' forecasts for sizable number of firms from year 2003. Our sample period starts in 2003 and ends in 2012.

Observations of the sample in this section are specific to forecast revisions and are not firm-specific as in Section 2. A forecast revision (*FR*) is calculated as an analyst's current annual EPS estimate minus the most recent consensus forecast for that firm for the same fiscal year, scaled by the absolute value of the latter. We disregard price as the scalar because price is highly related to our variable of interest, the 52-week high anchoring measure (*PRC*). The consensus forecast is calculated on the date when anchoring (i.e., *PRC*) is measured and is referred to as the anchoring date. The consensus forecast is the average of the most recent forecast by each individual analyst before the anchoring date. *FR* reflects an analyst's assessment of new information received after the anchoring date.

As the anchoring date we use the start of the week before the week during which *FR* is issued. This choice assures at least one week's gap between the anchoring date and the *FR*'s issuance. This gap is not required in our hypothesis. In our theory, the anchoring date is immediately prior to the issue date. However, we are also interested in how *PRC* affects the price reaction to *FR* later, and that requires *PRC* to be exogenous to how price reacts to revised forecasts. Too narrow a gap might result in *PRC* being affected by the price reaction to *FR*.

All observations are sorted independently by *FR* and *PRC* based on the whole sample. Revisions with positive *FR* suggest that analysts received positive news after the anchoring date. Positive revisions are subdivided into groups FR_{GG} and FR_G, based on the magnitude of *FR*. FR_{GG} includes revised forecasts with extremely positive news. FR_G includes revised forecasts with moderately positive news. Revisions with negative *FR* suggest that analysts received negative news after the anchoring date and are subdivided into groups FR_{BB} and FR_B, based on the magnitude of *FR*. FR_{BB} includes forecast revisions based on extremely negative news. FR_B includes *FR*'s with moderately negative news. *PRC* is sorted into three groups. Twenty percent of the observations with the lowest (highest) *PRC* are included in LPRC (HPRC), and the remaining observations are included in the MPRC. Combinations of the four *FR* groups (FR_{GG}, FR_G, FR_B, FR_{BB}) and the three PRC groups (LPRC, MPRC, HPRC) produce 12 groups.

We are interested in how anchoring bias affects price drift after analysts announce revised forecasts (i.e., PAFRD), given the sign and magnitude of the revision. Therefore, we examine within each of the four revision groups how *PAFRD* changes with *PRC*. If analysts suffer from anchoring bias, their assessments will be inadequate when stock price is already near or far from its 52-week high. Particularly, if it is near (far from) its high on the anchoring date and an analyst receives positive (negative) news thereafter, she will under-react to either news out of reluctance to believe the stock's price will move higher (lower). This behavior leads to greater positive (negative) price drift post-revision. Therefore, if analysts' assessments are afflicted by anchoring bias, as we hypothesize, *PAFRD* will increase with *PRC* within each forecast revision group.

PAFRD is measured as abnormal returns occurring two to 120 days following the revision date. Similar to our investigation of *PEAD* in Section 2, we exercise caution in defining abnormal return to capture the impact of analysts' anchoring bias on *PAFRD*. That is, we control the pure anchoring effect by using stocks for which analysts do not issue forecasts as benchmarks to adjust the returns of stocks with revised forecasts. For each forecast revision of stock *i*, we choose one matching stock *im* from those for which no analysts issued forecasts during one year around the revision date of stock *i*. The benchmark stock is chosen using the following criteria: *PRC* of stock *im* is the closest to that of stock *i* among all stocks on the anchoring date. Then *PAFRD* of stock *i* is calculated as

$$PAFRD_i = Exret\ (2,\ 120)_i - Exret\ (2{,}120)_{im}, \tag{3}$$

where $Exret\ (2,\ 120)_i$ is the size-adjusted and book-to-market-adjusted buy-and-hold return of stock *i* from two to 120 days after the revision date. Similar to *PEAD*, *PAFRD* can be regarded as the abnormal return adjusted by size, book-to-market, and anchoring. The pure anchoring effect is removed from *PAFRD*.

Table 4 reports summary statistics of the sample of forecast revisions. Average *FR* values within each forecast revision group are little affected by stocks' PRC ranks. The same is true of PRC values; they are insensitive to forecast revision rankings. Further, *PRCs* of the treatment stocks are almost similar as their benchmark stocks, which ensure that these benchmark stocks can be relied on to remove the pure anchoring effect from *PAFRD*.

3.2 Results on anchoring bias and PAFRD

The results are reported in Panel A of Table 5. We first confirm the existence of PAFRD in our sample. The first row labelled as 'ALL' reports average *PAFRD* in each of the four FR groups. The difference in average *PAFRD* between forecast revisions with extremely positive news (FR_{GG}) and forecast revisions with extremely negative news (FR_{BB}) is 5.63% (*t-statistic* = 6.45).

We then report average *PAFRD* in each of the 12 groups stratified by *FR* and *PRC*. Within both positive forecast revision groups (FR_{GG} and FR_{G}), average *PAFRD* increases from low to high PRC groups. The difference in average *PAFRD* between HPRC and LPRC is 7.52% in FR_{GG} (*t-statistic* = 2.60) and 8.63% in FR_{G} (*t-statistic* = 3.71). In both negative forecast revision groups (FR_{BB} and FR_{B}), average *PAFRD* decreases from high to low PRC groups. The difference in average *PAFRD* between HPRC and LPRC is 5.73% in FR_{BB} (*t-statistic* = 2.45) and 10.17% in FR_{B} (*t-statistic* = 5.16). These results correspond with anchoring on the 52-week high causing under-reaction to information.

The difference in average *PAFRD* between lower-right and upper-left corners represents the price drift after forecast revision when the anchoring effect is strongest. The difference of 11.16% (= 7.63% + 3.53%) is statistically significant (*t-statistics* = 5.48). On the other hand, the difference in average *PAFRD* between upper-right and lower-left corners of −2.09% (= 0.11% − 2.20%) is statistically insignificant (*t-statistic* = −0.70). Because forecast revisions in these opposed corners are least susceptible to anchoring bias, this result suggests there is no *PAFRD* in the absence of anchoring. Further, compared to the unconditional *PAFRD* at 5.63%, this result suggests that the profitability of exploiting PAFRD almost doubles by conditioning on the 20% most anchored stocks.

Panel A of Table 5 reveals that *PAFRD* increases with *PRC* within each of the four forecast revision groups. We test whether positive relation between these two variables exists using a regression to control other variables. The regression is

$$PAFRD_i = b_0 + b_1\, FR_i + b_2\, PRC_i + b_j\, controls_j + e_i. \tag{4}$$

Similar to regression (2), we include firm size (*LOGMV*) and book-to-market ratio (*LOGBM*) as controls. In addition, we include time-fixed effects based on fiscal years for which forecasts are issued. Test statistics are based on standard errors clustered by firm and forecast revision date. We run regression (4) on upwardly revised forecasts (in FR_{GG} and FR_G) and downward revisions (in FR_{BB} and FR_B) separately. Panel B of Table 5 reports the results. In the sample of upward revisions, the coefficient on *PRC* is positive and significant (*t-statistic* = 3.50). In the sample of downward revisions, the coefficient on *PRC* is also positive and significant (*t-statistic* = 3.77). These results suggest that for a given forecast revision *PAFRD* increases with *PRC*, a finding consistent with the stratified results in Panel A.

Panel C of Table 5 includes historical stock return (*RETMOM*) in the regression to see whether it affects *PAFRD*. Coefficients on *RETMOM* are not statistically significant for both upward and downward revisions (*t-statistic* = −1.57 for upward and −1.21 for downward revisions). This result suggests that, unlike the 52-week high, past stock return is not an anchor in the generation of *PAFRD*, a finding similar to our analysis of *PEAD*.

3.3 Forecast error and subsequent forecast revision

If analysts' anchoring bias generates *PAFRD*, as we argue, their forecast errors and subsequent forecast revisions should exhibit patterns consistent with anchoring on the 52-week high. First, consider the case in which an analyst receives positive news and elevates her forecast. The closer the stock price is to its 52-week high, the more likely that the analyst will discount positive news, and the more pessimistic will be her upward revision. The result is greater negative forecast error (analyst forecast minus actual EPS) and greater positive subsequent forecast revision. When an analyst receives negative news and reduces her forecast, the further the stock price is from its 52-week high, the more likely the analyst will discount negative news, and less pessimistic her downward revised forecast will be. The result is greater positive forecast error and greater negative subsequent forecast revision. Forecast error is the difference between an analyst's current forecast and corresponding actual EPS announced by the firm later, scaled by the absolute value of the latter. Subsequent forecast revision is the difference between the analyst's next forecast and her current forecast, scaled by the absolute value of the latter.

As Panel A of Table 6 shows, average forecast errors are positive in all 12 cells, suggesting analysts' forecasts are generally optimistic, a finding consistent with previous studies. However, within both groups of upwardly revised forecasts (FR_{GG} and FR_G), average error decreases from LPRC to HPRC. The difference in forecast error between HPRC and LPRC within FR_{GG} is −0.90 (*t-statistic* = −7.65), and difference within FR_G is −0.51 (*t-statistic* = −6.93). These results suggest analysts' upwardly revised forecasts are less optimistic when stock price is nearer its 52-week high. On the other hand, within both groups of downwardly revised forecasts (FR_{BB} and FR_B), average forecast error increases from HPRC to LPRC. The difference in error between LPRC and HPRC within FR_{BB} is 0.54 (*t-statistic* = 7.14), and difference within FR_B is 0.44 (*t-statistic* = 7.15). These results suggest analysts' downwardly revised forecasts are more optimistic when stock price is farther from its 52-week high.

Opposite patterns appear in analysts' subsequent forecast revisions. Within both groups of upwardly revised forecasts, subsequent revisions are more positive if stock prices are near their 52-week highs, suggesting analysts' subsequent upwardly revisions become more inadequate as stock prices are nearer to 52-week highs. Within both groups of downward revisions, subsequent revisions become more negative as stock prices recede from 52-week highs, suggesting analysts' current downwardly revised forecasts are more insufficient as prices are further distant from 52-week highs. These results for forecast errors and revisions are consistent with analysts anchoring on 52-week highs when forecasting earnings.

Regression results reported in Panel B of Table 6 confirm findings in the stratified tables. Particularly, among both upwardly and downwardly revised forecasts, *PRC* is related negatively to forecast error and positively to subsequent forecast revisions. All relations are statistically significant.

Our assertion that *PAFRD* is generated by analysts' anchoring on 52-week highs when revising forecasts is supported empirically in Table 6. However, it is also likely that investors anchor on 52-week highs when reacting to announcements of analysts' forecast revisions, much like they react to firms' earnings announcements. Particularly, investors might under-react to analysts' upward forecast revisions when prices approach 52-week highs and under-react to downward forecast revisions when prices are far from 52-week highs. If either is the case, *PAFRD* also might be attributable to investors' anchoring bias.

To test whether this is the case, we examine the impact of anchoring bias on reactions of stock prices to analysts' revised forecasts. Price reaction is measured as the abnormal return during the three days around the forecast revision date, similar to how Section 3.3 estimated price reaction to earnings announcements. Results for price reactions appear in Table 6 under the heading "Announcement Return." We find no evidence that anchoring bias prompts investors to under-react to analysts' revised forecasts. The three forecast revisions FR_{BB}, FR_{B}, and FR_{G}, display no significant differences in price reaction between LPRC and HPRC. Within FR_{GG}, price reaction is actually stronger when price is nearer its 52-week high.

The regression result shows a similar pattern. These results suggest that, unlike their reaction to earnings announcements, investors do not anchor on 52-week highs when reacting to announcements of analysts' revised forecasts. One potential reason is that trading in the Chinese stock market is dominated by retail investors, who generally follow the advice of financial experts without second guessing.

4. Conclusion

This paper examined the role of anchoring on 52-week highs in generating PEAD and PAFRD in the Chinese stock market. We found evidence of PEAD only among stocks with anchored prices and no evidence of PEAD among stocks with unanchored prices. Further, we found that investors' reaction to positive (negative) earnings news is less positive (negative) when the price of the stock is nearer (farther from) its 52-week high. These findings suggest that PEAD is attributable to investors' anchoring on 52-week highs in assessing earnings announcements; they under-react to positive (negative) earnings surprises when the pre-earnings-announcement price is near to (far from) its 52-week high. This behavior generates price drift after earnings announcements.

Findings regarding PAFRD resemble those for PEAD. We find evidence of PAFRD only among stocks with anchored prices. When earnings forecasts are revised upward, the closer the stock is to its 52-week high, the more pessimistic the revised forecast. Opposite patterns characterize downward revisions. In addition, we found no evidence of anchoring bias in investors' reactions to analysts' revised forecasts. These results suggest PAFRD is attributable to analysts' anchoring on 52-week highs when assessing information; they under-react to positive (negative) news and do not sufficiently revise forecasts upward (downward) when stock prices are near (far from) 52-week highs. This behavior yields price drift after their revised forecasts.

The Chinese stock market is dominated by retail investors, who may be susceptible to cognitive bias. Also, China's market is relatively young, and new markets generally present greater uncertainty. Psychological biases are more likely in uncertain environments (Daniel, Hirshleifer, and Subrahmanyam 1998; Hirshleifer 2001; Zhang 2006a, 2006b). This study examines one type of psychological bias— anchoring on 52-week highs. Future study can investigate effects of other psychological biases.

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Table 1 Summary Statistics of the PEAD Sample

For each fiscal quarter, stocks are sorted independently on the basis of their standardized unexpected earnings (*SUE*) and 52-week high anchoring measures (*PRC*) based on their earnings announcements for that quarter. *SUE* is calculated as $(e_q - e_{q-4}) / \sigma_q$, where e_q is current-quarter EPS, e_{q-4} is EPS for the same fiscal quarter the previous year, and σ_q is the standard deviation of $(e_q - e_{q-4})$ over the prior eight fiscal quarters (we require at least four prior quarters of data). Stocks are sorted into quintiles based on *SUE* (SUE1–SUE5). SUE1 and SUE2 include stocks with extremely and moderately negative earnings surprises, respectively. These two groups are denoted SUE_{BB} and SUE_B. SUE5 and SUE4 include stocks with extremely and moderately positive earnings surprises, respectively. They are denoted SUE_{GG} and SUE_G. SUE3 includes stocks with the lowest magnitude of SUE. It is the no-earnings-surprises group. *PRC*, our 52-week high anchoring measure, is calculated as the stock price (adjusted for splits and dividends) 10 days before the date of current quarterly earnings are announced, divided by the highest stock price during the past 52 weeks. The 20% of stocks with the lowest (highest) *PRC* occupy the group denoted LPRC (HPRC); the rest are in the group denoted MPRC. Combinations of the four earnings-surprise groups (SUE_{GG}, SUE_G, SUE_B, SUE_{BB}) and the three PRC groups (LPRC, MPRC, HPRC) produce 12 groups. For each stock *i* in the 12 groups, we choose one matching stock *im* from SUE3 using the following criteria: *PRC* of stock *im* is the closest to that of stock *i* among all stocks in its PRC group (LPRC, MPRC, and HPRC). This table presents the average *SUE*, average *PRC* and total number of observations in each group. The characteristics of benchmark stocks (*im*) are in *italics*. *SUE* is winsorized at the 1st and 99th percentiles. The sample period is from year 2003 to 2012.

Table 1 Continued

	SUE				*PRC*				No. of observations			
	SUE_{BB}	SUE_B	SUE_G	SUE_{GG}	SUE_{BB}	SUE_B	SUE_G	SUE_{GG}	SUE_{BB}	SUE_B	SUE_G	SUE_{GG}
LPRC	-1.32	-0.32	0.64	1.65	0.56	0.58	0.59	0.60	1907	1542	1053	706
	0.09	*0.10*	*0.12*	*0.14*	*0.57*	*0.58*	*0.59*	*0.60*				
MPRC	-1.23	-0.32	0.62	1.71	0.73	0.74	0.75	0.76	3821	4030	3995	3651
	0.11	*0.11*	*0.10*	*0.11*	*0.73*	*0.74*	*0.75*	*0.76*				
HPRC	-1.16	-0.31	0.64	1.82	0.92	0.91	0.90	0.90	796	973	1497	2171
	0.16	*0.15*	*0.12*	*0.10*	*0.92*	*0.91*	*0.90*	*0.90*				

Table 2 Anchoring Bias and PEAD

Panel A reports the average *PEAD* of stocks in each of the 12 groups stratified by SUE and PRC. The first row labelled as 'ALL' reports the average *PEAD* of all stocks within each SUE group. *PEAD* of *i* is calculated using the formula: $PEAD_i = Exret\ (2,\ 120)_i - Exret\ (2,120)_{im}$. $Exret\ (2,\ 120)_i$ is the size-adjusted and book-to-market-adjusted buy-and-hold return of stock *i* occurring two to 120 days after its earnings announcement. This return is calculated by subtracting the mean buy-and-hold return of an equal-weighted portfolio of stocks in the same 5×5 size and book-to-market group over the same holding period. The 5×5 independent sorting is performed at the beginning of the year. $Exret\ (2,120)_{im}$ is the size-adjusted and book-to-market-adjusted buy-and-hold return of stock *im* occurring two to 120 days after its earnings announcement. Stock *im* is the benchmark of stock *i.* The selection criteria of *im* are specified in Table 1. Panel B and C report the results of the following regression: $PEAD_i = b_0 + b_1\ SUE_i + b_2\ PRC_i + b_j\ controls_j + \varepsilon_i$. The control variables (*controls*) in Panel B include firm size (*LOGMV*) and book-to-market ratio (*LOGBM*) that are calculated at the beginning of the year wherein earnings are announced; both are transformed into logarithmic forms. We also include time-fixed effects based on fiscal quarter. Panel C includes previous stock returns (*RETMOM*) as an additional control variable. *RETMOM* is calculated as the six months' buy-and-hold return ending 10 days before the announcement date. The regression is run separately on stocks with positive earnings surprises (stocks in SUE_{GG} and SUE_G) and with negative earnings surprises (stocks in SUE_{BB} and SUE_B). T-statistics (in parentheses) are based on standard errors clustered by stock and earnings announcement date. All variables in the table are winsorized at 1st and 99th percentiles.

Panel A Average *PEAD* in Stratified Groups				
	SUE_{BB}	SUE_B	SUE_G	SUE_{GG}
ALL	-1.88	-0.52	1.61	4.26
LPRC	-4.79	-2.89	0.10	2.99
MPRC	-1.58	-0.76	1.07	2.29
HPRC	3.60	4.19	4.09	7.97
HPRC - LPRC	8.39	7.08	3.99	4.98
	(4.71)	(4.39)	(2.67)	(2.85)

Table 2 Continued

Panel B Regression without *RETMOM*				
	Good Earnings Surprises		Bad Earnings Surprises	
	Coeff.	t-stat	Coeff.	t-stat
Intercept	0.03	(0.09)	-0.02	(-0.07)
SUE	2.31	(4.51)	0.49	(0.88)
PRC	14.59	(4.27)	17.84	(5.30)
LOGMV	-0.69	(-1.91)	-0.77	(-1.94)
LOGBM	-1.16	(-1.90)	0.43	(0.63)

Panel C Regression with *RETMOM*				
	Good Earnings Surprises		Bad Earnings Surprises	
	Coeff	t-stat	Coeff	t-stat
Intercept	0.03	(0.09)	-0.03	(-0.07)
SUE	2.29	(4.47)	0.50	(0.90)
PRC	12.77	(3.06)	20.11	(5.20)
LOGMV	-0.65	(-1.77)	-0.80	(-2.02)
LOGBM	-1.17	(-1.92)	0.42	(0.62)
RETMOM	1.49	(0.70)	-2.02	(-0.86)

Table 3 Returns around Current Earnings Announcement

Panel A reports the average earnings announcement return in each of the 12 groups stratified by SUE and PRC. Earnings announcement return is calculated as the size-adjusted and book-to-market-adjusted buy-and-hold stock return during the three days around earnings announcements. The first row labelled as 'ALL' reports the average earnings announcement return of all stocks within each SUE group. Panel B reports the result of a regression which is similar to that in Panel B of Table 2, except that the dependent variable is replaced by earnings announcement return. T-statistics (in parentheses) are based on standard errors clustered by firm and earnings announcement date. All variables in the table are winsorized at 1st and 99th percentiles.

Panel A Average Earnings Announcement Return in Stratified Groups

	SUE_{BB}	SUE_{B}	SUE_{G}	SUE_{GG}
ALL	-1.25	-0.64	0.35	1.05
LPRC	-0.98	-0.38	0.43	1.57
MPRC	-1.40	-0.67	0.43	0.97
HPRC	-1.17	-0.91	0.07	1.00
HPRC - LPRC	-0.19	-0.54	-0.36	-0.56
	(-0.87)	(-2.46)	(-1.85)	(-2.50)

Panel B Regression Result

	Good Earnings Surprise		Bad Earnings Surprises	
	Coeff	t-stat	Coeff	t-stat
Intercept	0.01	(0.19)	0.00	(-0.02)
SUE	0.59	(8.78)	0.53	(8.22)
PRC	-1.85	(-4.08)	-1.58	(-3.35)
LOGMV	0.11	(2.44)	-0.04	(-0.89)
LOGBM	0.07	(0.94)	-0.09	(-1.29)

Table 4 Summary Statistics of the PAFRD sample

All observations are sorted independently by *FR* and *PRC* based on the whole sample. A forecast revision (*FR*) is calculated as an analyst's current annual EPS estimate minus the most recent consensus forecast for that firm for the same fiscal year, scaled by the absolute value of the latter. The consensus forecast is calculated on the date when anchoring (i.e., *PRC*) is measured and is referred to as the anchoring date. We use the start of the week before the week during which *FR* is issued as the anchoring date. The consensus forecast is the average of the most recent forecast by each individual analyst before the anchoring date. Positive revisions ($FR > 0$) are subdivided into groups FR_{GG} and FR_G, based on the magnitude of *FR*. FR_{GG} includes revised forecasts with extremely positive news. FR_G includes revised forecasts with moderately positive news. Negative revisions ($FR < 0$) are subdivided into groups FR_{BB} and FR_B, based on the magnitude of *FR*. FR_{BB} includes forecast revisions based on extremely negative news. FR_B includes *FR*'s with moderately negative news. *PRC* is sorted into three groups. Twenty percent of the observations with the lowest (highest) *PRC* are included in LPRC (HPRC), and the remaining observations are included in the MPRC. Combinations of the four *FR* groups (FR_{GG}, FR_G, FR_B, FR_{BB}) and the three PRC groups (LPRC, MPRC, HPRC) produce 12 groups. For each forecast revision of stock *i*, we choose one matching stock *im* from those for which no analysts issued forecasts during one year around the revision date of stock *i*. The benchmark stock is chosen using the following criteria: *PRC* of stock *im* is the closest to that of stock *i* among all stocks on the anchoring date.). This table presents the average *FR*, average *PRC* and total number of observations in each group. The statistics of benchmark stocks (*im*) are in *italics*. *FR* is winsorized at the 1st and 99th percentiles. The sample period is from year 2003 to 2012.

Table 4 Continued

	FR				*PRC*				No. of observations			
	FR_{BB}	FR_B	FR_G	FR_{GG}	FR_{BB}	FR_B	FR_G	FR_{GG}	FR_{BB}	FR_B	FR_G	FR_{GG}
LPRC	-0.41	-0.06	0.04	0.34	0.41	0.45	0.45	0.45	3555	1742	907	956
					0.41	*0.45*	*0.45*	*0.45*				
MPRC	-0.31	-0.05	0.04	0.31	0.75	0.76	0.78	0.78	5463	6505	4910	4599
					0.75	*0.76*	*0.78*	*0.78*				
HPRC	-0.29	-0.05	0.05	0.29	0.96	0.96	0.96	0.96	1110	1881	1951	2217
					0.96	*0.96*	*0.96*	*0.96*				

Table 5 Anchoring Bias and PAFRD

Panel A reports the average *PAFRD* of stocks in each of the 12 groups stratified by FR and PRC. The first row labelled as 'ALL' reports the average *PAFRD* of all stocks within each FR group. *PAFRD* of *i* is calculated using the formula: $PAFRD_i = Exret\ (2,\ 120)_i - Exret\ (2,120)_{im}$. $Exret\ (2,\ 120)_i$ is the size-adjusted and book-to-market-adjusted buy-and-hold return of stock *i* occurring two to 120 days after the revision date. This return is calculated by subtracting the mean buy-and-hold return of an equal-weighted portfolio of stocks in the same 5×5 size and book-to-market group over the same holding period. The 5×5 independent sorting is performed at the beginning of the year. $Exret\ (2,120)_{im}$ is the size-adjusted and book-to-market-adjusted buy-and-hold return of stock *im* occurring during the same holding period. Stock *im* is the benchmark of stock *i*. The selection criteria of *im* are specified in Table 4. Panel B and C report the results of the following regression: $PAFRD_i = b_0 + b_1\ FR_i + b_2\ PRC_i + b_j\ controls_j + \varepsilon_i$. The control variables (*controls*) in Panel B include firm size (*LOGMV*) and book-to-market ratio (*LOGBM*) that are calculated at the beginning of the year wherein earnings are announced; both are transformed into logarithmic forms. We also include time-fixed effects based on fiscal year for which these forecasts are issued. Panel C includes previous stock returns (*RETMOM*) as an additional control variable. *RETMOM* is calculated as the six months' buy-and-hold return ending at the anchoring date. The regression is run separately on stocks with positive forecast revisions (stocks in FR_{GG} and FR_G) and with negative forecast revisions (stocks in FR_{BB} and FR_B). T-statistics (in parentheses) are based on standard errors clustered by stock and forecast revision date. All variables in the table are winsorized at 1st and 99th percentiles.

Panel A Average PAFRD in Stratified Groups

	FR_{BB}	FR_B	FR_G	FR_{GG}
ALL	-0.80	1.43	4.09	4.83
LPRC	-3.53	-3.85	-1.93	0.11
MPRC	0.37	1.43	4.18	4.47
HPRC	2.20	6.31	6.70	7.63
HPRC - LPRC	5.73	10.17	8.63	7.52
	(2.45)	(5.16)	(3.71)	(2.60)

Table 5 Continued

Panel B Regression without *RETMOM*				
	Upward Revisions		Downward Revisions	
	Coeff	t-stat	Coeff	t-stat
Intercept	-0.01	(-0.01)	0.01	(0.02)
FR	-0.26	(-0.14)	2.33	(1.32)
PRC	13.54	(3.50)	11.77	(3.77)
LOGMV	-2.03	(-5.19)	-0.63	(-1.64)
LOGBM	-2.00	(-2.65)	-1.91	(-2.74)

Panel C Regression with *RETMOM*				
	Upward Revisions		Downward Revisions	
	Coeff	t-stat	Coeff	t-stat
Intercept	-0.01	(-0.01)	0.01	(0.02)
FR	0.19	(0.10)	2.23	(1.26)
PRC	17.84	(3.61)	14.33	(3.74)
LOGMV	-2.09	(-5.31)	-0.67	(-1.71)
LOGBM	-1.94	(-2.52)	-1.81	(-2.61)
RETMOM	-3.17	(-1.57)	-2.05	(-1.21)

Table 6 Forecast Error, Subsequent Forecast Revision and Price Reaction to Current Forecast Revision

Panel A reports the average forecast error, average subsequent forecast revision and average price reaction to current forecast revision in each of the 12 groups stratified by FR and PRC. The first row labelled as 'ALL' reports the average of each variable based on all stocks within each FR group. Forecast error is the difference between an analyst's current forecast and corresponding actual EPS announced by the firm later, scaled by the absolute value of the latter. Subsequent forecast revision is the difference between the analyst's next forecast and her current forecast, scaled by the absolute value of the latter. Price reaction to a forecast revision is calculated as the size-adjusted and book-to-market-adjusted buy-and-hold stock return during the three days around the forecast revision date. Panel B reports the results of the regressions in which the dependent variables are forecast error, subsequent forecast revision and price reaction to a current forecast revision, separately. The definitions of the explanatory variables are the same as those in Table 5. The regression is run separately on stocks with positive forecast revisions (stocks in FR_{GG} and FR_G) and with negative forecast revisions (stocks in FR_{BB} and FR_B). T-statistics (in parentheses) are based on standard errors clustered by stock and forecast revision date. All variables in the table are winsorized at 1st and 99th percentiles.

Table 6 Continued

Panel A Stratified Results

	Forecast Error				Subsequent Forecast Revision				Price Reaction			
	FR_{BB}	FR_B	FR_G	FR_{GG}	FR_{BB}	FR_B	FR_G	FR_{GG}	FR_{BB}	FR_B	FR_G	FR_{GG}
ALL	0.48	0.22	0.19	0.48	-0.03	-0.02	-0.02	-0.08	-0.12	0.15	0.40	0.68
LPRC	0.67	0.52	0.57	1.09	-0.14	-0.09	-0.09	-0.17	-0.16	0.18	0.32	0.49
MPRC	0.42	0.18	0.18	0.49	0.01	-0.01	-0.01	-0.09	-0.12	0.11	0.42	0.54
HPRC	0.13	0.08	0.06	0.19	0.17	0.03	0.02	-0.02	-0.04	0.26	0.40	1.04
HPRC - LPRC	-0.54	-0.44	-0.51	-0.90	0.31	0.12	0.11	0.15	0.12	0.08	0.08	0.56
	(-7.14)	(-7.15)	(-6.93)	(-7.65)	(10.60)	(8.65)	(7.98)	(5.77)	(0.56)	(0.42)	(0.32)	(2.10)

Panel B Regression Results

	Forecast Error				Subsequent Forecast Revision				Price Reaction			
	Upward Revisions		Downward Revisions		Upward Revisions		Downward Revisions		Upward Revisions		Downward Revisions	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
Intercept	0.00	(0.00)	0.00	(0.02)	0.00	(0.28)	0.00	(-0.16)	0.00	(-0.01)	0.00	(-0.01)
FR	1.38	(11.42)	-0.26	(-2.42)	-0.29	(-8.99)	-0.01	(-0.20)	0.11	(0.54)	0.63	(3.44)
PRC	-1.11	(-8.45)	-0.88	(-5.46)	0.24	(7.64)	0.32	(7.92)	0.89	(2.02)	-0.28	(-0.86)
LOGMV	-0.05	(-4.07)	-0.04	(-2.15)	0.00	(1.32)	0.01	(1.24)	-0.09	(-1.89)	-0.10	(-2.72)
LOGBM	0.01	(0.56)	0.02	(0.47)	-0.01	(-1.17)	-0.03	(-3.04)	-0.11	(-1.31)	-0.06	(-1.02)

□ □ □ □ □ □ Investor Tastes, Corporate Behavior and Stock Returns: An Analysis of Corporate Social Responsibility

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We classify institutions into socially responsible institutions (SRI) and non-socially-responsible institutions (NSRI) based on the value weighted Corporate Social Responsibility (CSR) scores of their portfolio holdings. Controlling for CSR scores, stocks that experience an increase in NSRI ownership realize positive excess returns the following quarter. The positive relation between excess returns and NSRI ownership is stronger for stocks with higher CSR scores. We also find that CSR scores tend to increase more for stocks with lower NSRI holdings. These results, which are consistent with the existence of excess CSR expenditures that reduce firm values, suggest that the mix of institutional investors influences CSR choices.

Keywords: Corporate Social Responsibility, institutional investor, institutional ownership, shareholders activism.

JEL Classifications: M14, G23

There is a large and growing literature that examines how institutional investors evaluate and influence corporations.[1] The premise of most of this literature is that institutions encourage firms to make value maximizing choices. However, a number of institutions also attempt to influence the social responsibility of the firms in which they invest. Indeed, according to the US Social Investment Forum, $6.57 trillion in assets, or over 17.8% of total investment assets, were managed using Socially Responsible Investing guidelines at the beginning of 2014.

While very few institutional investors promote themselves as not being socially responsible,[2] there are a number of funds that put relatively little weight on the social responsibility of the firms in which they invest and are primarily focused on maximizing returns. If the portfolio choices of the socially responsible investors tend to bid up the stock prices of socially responsible firms, then those investors who are less interested in social responsibility, per se, may underweight these stocks.

The focus of this paper is on these "non-socially-responsible institutions" (NSRI), which we identify by weighting the corporate social responsibility scores of their portfolio holdings, as measured by the scores reported in the Kinder, Lyndenberg, and Domini (KLD) STATS database. As we show, the tendency of institutions to hold the stocks of firms with relatively low social responsibility scores is a persistent investor characteristic that tends to be correlated with institutional investor types. For example, hedge funds are much more likely than mutual funds to be a NSRI.

[1] See Gompers and Metrick (2001) and Sias, Starks, and Titman (2006) for evidence on the relation between institutional ownership and future stock returns and Karpoff (2001) for a review of the literature on institutional activism.

[2] We are aware of one mutual fund named the Vice Fund, which does focus on gambling, defense, tobacco and alcohol stocks.

As a first step, we examine the relation between the firms' KLD scores, NSRI holdings, and future stock returns. Specifically, against a null of zero excess returns, we test whether low KLD stocks have higher returns (i.e., they are underpriced because socially responsible investors avoid them) and whether stocks with high NSRI holdings have higher returns (i.e., they are held by investors who are presumably more focused on generating excess returns). After controlling for firm characteristics that are associated with excess returns (e.g., book-to-market ratios) we fail to find a reliable relation between KLD scores and future returns. We do find, however, that the stocks selected by NSRIs tend to realize higher returns on average and that these excess returns are especially strong for the stocks with high KLD scores.

One explanation for the latter finding is that the NSRIs are particularly good at identifying firms that implement social policies that "do well and do good." By this we mean that the NSRIs are good at identifying firms that are able to have high levels of CSR without destroying firm value. An alternative (but not mutually exclusive) explanation is that NSRIs tend to be good at identifying firms with value-reducing CSR policies and, through their ability to monitor and influence future choices, induce these firms to reduce the extent of these policies.

To distinguish between these alternatives we estimate a second set of regressions that examine the relation between CSR activities and ownership structure. In particular, we examine the relation between the types of institutions that own a firm's stock and future changes in its CSR activities. The "do well and do good" hypothesis provides no predictions about the relation between ownership structure and future changes in CSR activities, however, the monitoring hypothesis indicates that higher NSRI holdings will be associated with declines (or more moderate increases) in future CSR activities. Our evidence tends to support the latter hypothesis.

As we show, KLD scores tended to increase over our sample period, especially among the larger and better performing firms. This time series trend probably reflects the increased interest in socially responsible investing over this time period. We also find that the increase is higher among the larger and more profitable firms, which is consistent with the arguments of Jensen (1986) and others who suggest that managers of larger and more successful firms can more easily engage in excessive (from the perspective of value-maximization) CSR activities. However, consistent with the monitoring hypothesis, the tendency to increase KLD scores is mitigated when NSRI holdings are larger. This last finding is especially true for firms with higher earnings and stock returns, i.e., firms with managers that are expected to have more descretion.

As we mentioned at the outset, this research contributes to a large literature that examines how institutional investors influence corporate behavior. An early contributor, Bushee (1998), finds a relation between the amounts held by different types of institutional investors and R&D expenditures. Subsequent work by Hartzell and Starks (2003) consider the effect of concentrated institutional ownership and find stronger pay for performance sensitivity at firms with more concentrated institutional ownership and Chen, Harford and Li (2007) show that the concentrated holdings of independent long-term institutions are related to the performance of firms following major acquisitions.

Consistent with this earlier research we focus on a specific decision. However, the earlier studies all consider decisions that are assumed to be value-enhancing, and assume that institutions all want to encourage value-enhancing choices. In contrast, we provide evidence that different institutions have different tastes for corporate social responsibility, and consider how the decisions of firms are influenced by the tastes of the particular institutions that hold their stocks.[3]

Our analysis is also tangentially related to the literature that examines how CSR influences share prices. In theory, if a significant fraction of investors have a taste for Corporate Social Responsibility (CSR), they will push up the stock prices of high CSR firms, lowering their costs of capital, and thereby provide an incentive for all firms to improve social responsibility. Hence, firms can take socially responsible actions that reduce cash flows and still improve firm value if the cash flow decline is offset by a decline in the discount rate.

Unfortunately, detecting the empirical relation between CSR activities and firm values is challenging for a number of reasons. First, an increase in the presence of socially responsible investors will initially result in price increases for high CSR stocks, which will in turn cause their subsequent risk adjusted returns to be lower. Hence, the relation between socially responsible investing and future returns can be either positive or negative depending on whether returns are measured in the interval

[3] There is also a related literature that explicitly looks at the purchases of activist hedge funds. For example, Brav, Jiang, Partnoy, and Thomas (2008) (2008) and Klein and Zur (2009) show that stock prices respond positively to hedge funds' filing of 13D, which signifies that an activist hedge fund has accumulated at least 5% of the firm's stock. Some of these activist hedge funds are also in our NSRI sample, but do not drive our results.

in which socially responsible investors are accumulating the stock or in the period subsequent to the accumulation. Second, the endogeneity of CSR policy choices causes an additional inference problem if firms feel that they can afford the luxury of adopting strong CSR policies when their businesses are otherwise performing very well. Perhaps, because of these measurement issues, the results of existing studies of the relation between CSR activities and stock returns are somewhat mixed.[4]

In contrast, while our study does not attempt to provide direct evidence on how social responsibility affects stock returns, we present results that provide indirect evidence that there exist firms that engage in value-reducing socially responsible activities. Specifically, our evidence suggests that firms with high CSR expenditures tend to realize positive abnormal returns when these activities are likely to be curtailed in the future.

The rest of paper is organized as follows. Section 2 describes the data and methods to calculate the key variables and provides some summary statistics. Section 3 presents the main empirical results. Section 4 concludes the paper.

2. Data

2.1. Data and Sample

Our sample includes quarterly institutional holdings for all common stocks

[4] Deng, Kang and Low (2013) show that higher CSR firms that are involved in acquisitions perform better than their lower CSR counterparts, while Dhaliwal, Li, Tsang and Yang (2011) document a drop in cost of capital after they voluntarily disclose CSR activities. Brammer, Brooks and Pavelin (2006) find lower returns for UK stocks with higher social performance scores. In addition, Hong and Kacperczyk (2009) find that sin stocks, (those involved in producing alcohol, tobacco, and gaming) tend to have higher returns.

traded on NYSE, AMEX, and NASDAQ from the first quarter of 1980 to the fourth quarter of 2011. This data, obtained from Thomson Financial, come from the Securities and Exchange Commission (SEC)'s Form 13-F, which must be filed by all U.S. institutions with over $100 million in assets. Institutional ownership for each stock is defined as the number of shares held by institutional investors divided by the total number of shares outstanding.[5] The stock price, stock return, shares outstanding and turnover are from the Center for Research in Security Prices (CRSP) monthly database. The book value of equity, total assets, and cash dividends are from COMPUSTAT.

Corporate social responsibility data is from the Kinder, Lyndenberg, and Domini (KLD) STATS database. KLD annually reports approximately 80 indicators of corporate social responsibility that cover seven major areas that include strengths and concerns about Community, Corporate Governance, Diversity, Employee Relations, Environment, Human Rights and Product.[6] Most of the concerns that are reported by KLD relate to potential legal problems that are associated with environmental damages, product safety, marketing and contracting disputes and potential anti-trust violations. Since we do not think it is likely that institutions will target firms for having too few concerns of this type, our focus is on the strengths that are reported by KLD. Henceforth, we will use CSR, KLD and KLD strength interchangeably.

KLD provides this data starting in 1991 with a sample of about 650 firms that are in either the S&P 500 or Domini 400 Social Index. In 2001 KLD expanded its

[5] The observations with total institutional ownership greater than 100% are deleted.

[6] Details of the KLD strength indicators are presented in the appendix B.

coverage to about 1100 firms, which includes all firms in the Russell 1000. In 2003 KLD added full coverage of the Russell 3000, increasing coverage to about 3100 firms. Because our analysis requires a broad cross-section and available information about future changes in KLD scores our sample starts in 2003 and ends in 2011.

Appendix C reports the number of KLD strength indicators, and the minimum, median and maximum strength scores for the seven categories respectively. KLD strength rating includes 47 indicators. Although the median KLD strength score is only 1, some firms have very high strength scores. The maximum KLD strength score is 22 and the minimum score is 0 in our sample. We plot the value of average KLD in our sample over the years in Figure 1. As the figure indicates, average KLD scores have increased over time, which is consistent with the growing popularity of social responsible investments we mentioned earlier. Interestingly, despite a generally upward trend, KLD scores declined during the financial crisis in 2008 and 2009, which is consistent with the hypothesis that corporate social responsibility is viewed as a luxury good, i.e., firms tend to increase KLD scores when they are more profitable.

2.2. Non-Socially-Responsible Institutional (NRSI) Ownership Measures

We measure the taste for the social responsibility (SR) of institutional investors by aggregating the KLD scores of the firms whose stocks they hold to determine the SR rating for each institution. Since there is a strong positive relation between firms'

KLD scores and size,[7] an institution's SR rating is strongly determined by the average size of the firms in the institution's portfolio. In an effort to purge this size effect, we use size-adjusted KLD (*ADKLD*). Each quarter, we sort the stocks into 10 deciles based on size and calculate the average KLD rating of stocks for each size decile. A firm's size-adjusted KLD is its raw KLD rating minus the average KLD ratings of stocks in its decile.

Specifically, institutional social responsibility ratings (SR) are calculated as follows:

$$\mathrm{SR}_{i,t} = \sum_{j \in i} \omega_{j,t} ADKLD_j \qquad (1)$$

Where $\mathrm{SR}_{i,t}$ is the social responsibility rating for institution i at the end of quarter t, $\omega_{j,t}$ is the weight of stock j in institution i's portfolio at the end of quarter t and $ADKLD_j$ is the size-adjusted social responsibility strength rating for stock j at the previous year end. Stocks with missing ratings are removed when calculating the institutional SR ratings. Each quarter, we sort institutional SR ratings into three groups, with institutions in the bottom group, which have the lowest ratings, defined as NSRIs, and the rest of the institutions defined as SRIs. Finally, for each stock in each quarter, we measure the NSRI percentage ownership as the number of shares held by NSRI divided by the total number of shares outstanding.

[7] The correlation between KLD and logsize is about 0.50 reported in Panel B of Table 1.

2.3. Control Variables

As in Gompers and Metrick (2001), Baik, Kang and Kim (2010) and Yan and Zhang (2009), our return regressions include controls for a number of characteristics that are associated with stock returns. These include size, B/M, Age, Cash Dividend, Price, Turnover, Past Returns ($Ret_{t-3,t}$, $Ret_{t-12,t-3}$), Volatility, and an indicator of whether or not the stock is in the S&P 500. All variables except institutional ownership, returns, and the S&P500 dummy are expressed in natural logarithms.[8] In our CSR regressions, we control for factors that potentially affect firm CSR activities such as size and past ROA.

2.4. Summary Statistic

Panel A of Table 1 reports the time-series mean, median, standard deviation, minimum and maximum of the variables that we include in our regressions. The key variables in the regressions are the level and the change of institutional holdings. The average institutional ownership (*IO*) is 67.0% in our sample, and on average, NSRIs hold 15.30% of the share outstanding. On average, the change in total institutional ownership is 0.12% and the change in NSRI holdings is 0.06%.

Panel B reports the time-series average of the cross-sectional correlations. By construction, NSRIs tend to hold firms with lower CSR activities, so of course we find a negative correlation between NSRI ownership and firm KLD strength ratings. The positive correlations between KLD and size and age indicate that high KLD firms

[8] Details of variable constructions are in Appendix A.

are larger and older, which in turn implies that NSRIs tend to hold smaller and younger firms.

2.5 The Persistence of NSRI

In Table 2, we examine the persistence of our NSRI classification. Panel A shows the transition matrix between NSRI and SRI. Among all NSRIs in a particular quarter, approximately 90% are still classified as NSRI after one quarter, 78.9% after one year and 70.5% after 2 years. Similarly, the percentage of SRIs that continue to be SRI is about 93.6 after one quarter, 84.1% after one year and 76.4% after 2 years. In Panel B, we compare the KLD of stocks purchased by NSRIs and SRIs. In every quarter, we record the equally weighted average of the KLD scores of stocks purchased by NSRIs and SRIs, and report the time series averages. We further distinguish between the purchase of stocks they didn't hold in the preceding quarter (Newly Purchased) and those they already own (additional purchases of existing holdings). Panel B reveals that in both cases NSRIs tend to buy stocks with significantly lower KLD ratings on average. These results indicate that the NSRI classification and the taste of NSRI for low CSR stocks can be characterized as a persistent investment style.

2.6 Institutional Classifications

Consistent with earlier work by Hong and Kacperczyk (2009), who find that sin stocks tend to be held less by pension funds and more by mutual funds and different tastes for CSR. Specifically, at the end of each quarter we calculate (averaging across quarters and firms) the percent of the institutional ownership (*IO*) held by each of the five individual categories (*IO_T1* to *IO_T5*), as classified by Thomson Reuters.[9] We report these percentages in the first row of Table 3. Similarly, we calculate the percent of the total NSRI ownership (*NSRIO*) held by the different categories, which we report in the second row. Finally, within each type of institution, we calculate the percentage of institutional ownership that comes from NSRIs by taking the ratio of *NSRIO* to the ownership of each category of institution (*IO_T1* to *IO_T5*). These percentages are reported in the third row.

A few interesting patterns emerge from these calculations. First, from Panel A we see that more than half (52.94%) of the institutional ownership in our sample comes from what Brian Bushee classifies as Type 4 institutions. Second, NSRI ownership is dominated (84.74%) by Type 4 institutions. Type 4 institutions also constitute the largest percentage (36.40%) of *NSRI* ownership.

3. Empirical Results

3.1. Change in NSRI Ownership (ΔNSRIO) and Future Stock Returns

We start by examining the relation between corporate social responsibility,

[9] In its S34 database, Thomson Reuters classifies institutional investors into five regulated types. Type 1 includes bank trust; Type 2 includes insurance company; Type 3 includes investment company; Type 4 includes independent investment advisor; Type 5 includes corporate pension fund, public pension fund, university and foundation endowments and miscellaneous. As noted on the Thomson Reuters website, the type code variable is not reliable after 1998 and Brian Bushee has done a reclassification. We find that about 80% of all institutions are classified as Type 5 institutions based on S34 since most institutions are misallocated into Type 5 after 1998 in Thomson Financial. However, based on Bushee's new classification, Type 5 institutions are only 13.22% of the total institutions, and percentages of all other types increase, especially that of Type 4 institutions. We thank Professor Bushee for sharing his database.

institutional ownership, and stock returns. Specifically, we run the following regressions of returns on lagged institutional ownership and other firm characteristics:

$$r_{i,t+1} = \alpha_t + \beta_t NSRIO_{i,t-1} + \theta_t \Delta NSRIO_{i,t} + \gamma_t X_{i,t} + \varepsilon_t \qquad (2)$$

$$r_{i,t+1} = \alpha_t + \beta_t NSRIO_{i,t-1} + \theta_t \Delta NSRIO_{i,t} + \delta_t IO_{i,t-1} + \varphi_t \Delta IO_{i,t} + \gamma_t X_{i,t} + \varepsilon_t \qquad (3)$$

where $r_{i,t+1}$ is the one quarter ahead return of stock *i*, $IO_{i,t-1}$ and $NSRIO_{i,t-1}$ are total institutional ownership and NSRI ownership of stock *i* at the end of quarter *t-1*, $\Delta IO_{i,t}$ and $\Delta NSRIO_{i,t}$ are the quarterly changes in total and NSRI ownership respectively from quarter *t-1* to quarter *t*. Finally, $X_{i,t}$ is the vector of characteristics measured at the end of *quarter t*. These characteristics include the standard controls used in the literature, e.g., log of the book-to-market ratio and past 12 month returns, as well as the firms' KLD score measured at the end of the previous calendar year (since the KLD score is updated annually at the end of each year). These regressions, which are reported in Table 4, are estimated using the Fama-MacBeth (1973) methodology with Newey-West standard errors.

The first thing to note in Table 4 is that the coefficients of the KLD scores are not reliably different than zero. As we mentioned in the introduction, the coefficient of KLD is difficult to interpret. On one hand, high KLD scores can be associated with higher returns because of the increased interest in socially responsible investment, which could have pushed up the price of high KLD stocks in our sample period. On the other hand, the increased price (i.e., lower required rate of return) associated with social responsibility leads to lower future returns. The lack of a significant finding could imply that neither effect is important, or alternatively, that the two effects offset each other.

In contrast to the lack of significance of the KLD coefficients, our estimates of the coefficients of the NSRI variables reveals a strong and positive relation between the change in NSRI ownership ($\Delta NSRIO$) and next quarter's return. The average coefficient of $\Delta NSRIO$ is 0.0899 in model (1) and is statistically significant at the 1% level. When both change in total institutional ownership (ΔIO) and change in NSRI ownership ($\Delta NSRIO$) are included in the regression, shown in model (2), the average coefficient of $\Delta NSRIO$ increases while the coefficient of ΔIO is negative and significant. When we control for industry fixed effects, the results are very similar, as shown in column (3) and column (4). These results indicate that returns tend to be higher following an increase in NSRI holdings.

We also use a portfolio approach to evaluate the returns associated with NSRI holdings. At the end of each quarter, we allocate stocks into 5 equally-weighted portfolios based on the change in NSRI ownership ($\Delta NSRIO$) and the change in SRI ownership ($\Delta SRIO$). We report the holding period returns of each portfolio as well as the return on an investment strategy that buy stocks with the largest increase in NSRI (SRI) ownership (Group 5) and short stocks with largest decrease in NSRI (SRI) ownership (Group 1). In addition to raw returns, we report DGTW adjusted returns that control for the size, B/M and momentum of the individual stocks.

As shown in Table 5, the return of the portfolio that buys stocks with the largest increase in NSRI ownership ($\Delta NSRIO$) and shorts stocks with the largest decrease has a raw return of 1.54% per quarter (t=2.68), and a DGTW-adjusted return of 1.13% per quarter (t=2.80). In contrast, stocks with the largest increase in SRI ownership ($\Delta SRIO$) underperform those with the largest decrease by -2.63% per quarter (t=-2.20) with the DGTW adjusted difference of -2.30% (t=-2.36). The difference between these raw returns is 4.17% (t=2.79) and DGTW adjusted returns are 3.43% (t=3.04).

3.2. Are the Results Driven by the Type of Institution?

There are a number of potential explanations for the better performance of stocks held by NSRIs. The first is that these institutions have a singular focus on selecting stocks that outperform and are thus less distracted by other agendas that influence the choices of some of the other institutions. The second possibility is the monitoring hypothesis, which postulates that the NSRIs are good monitors who have the ability to mitigate the increase or reduce the future KLD scores of firms with excessive CSR activities.

To evaluate these possibilities, we first look more closely at the types of institutions that tend to be NSRIs. Both of the above explanations suggest that NSRIs are likely to be hedge funds and other active investors. Indeed, as we showed previously in Table 3, about 80% of NSRIs are Type 4 investors (i.e., independent advisors and hedge funds). While such a finding is consistent with our arguments, it creates a potential inference problem, since these institutions may outperform other institutions for reasons that have nothing to do with socially responsible investing.

To investigate this issue more closely, we first confirm that Type 4 institutions outperform other institutions in our sample period. To do this we estimate our base line regressions, model (1) and model (2) in Table 4, replacing $\Delta NSRIO$ and $NSRIO$ with ΔIO_T4 and IO_T4, the change and the level of the holdings of Type 4 institutions respectively. These regression estimates, reported as model (1) and model (2) in Table 6, indicate that changes in Type 4 institutional holdings do positively predict returns.

Next, we repeat our base line regressions, except we now separate the change of NSRI holdings, $\Delta NSRIO$, into those from Type 4 institutions ($\Delta NSRIO\_T4$) and those from non-Type 4 institutions $\Delta NSRIO\_NONT4$. The level of NSRI holdings from Type 4 and non-Type 4 institutions are similarly constructed and denoted as $NSRIO\_T4$ and $NSRIO\_NONT4$ respectively. These regression estimates are reported as model (3) and model (4) in Table 6. If the return predicting power of NSRI holdings comes from the fact that most NSRIs are Type 4 institutions, the coefficient of $\Delta NSRIO\_T4$ will be significantly larger than that of $\Delta NSRIO\_NONT4$. However, we find that these two coefficients are very similar in both model (3) and model (4), indicating that the return predicting power of $\Delta NSRIO$ is not generated solely from the Type 4 institutions.

3.3. How is NSRI Performance Related to KLD Scores?

If we believe the monitor hypothesis explains the positive association between NSRI holdings and returns, then the returns associated with NSRI holdings may be different for stocks with high and low KLD scores. Specifically, if the holdings reflect the influence of these institutions, the evidence of outperformance will be stronger in the high KLD subsample where there is likely to be a greater tendency for excess CSR expenditures. On the other hand, the alternative explanation that NSRIs have a singular focus on selecting stocks that outperform makes no such prediction.

We sort stocks independently by their prior period KLD strength ratings (above and below the median) and then estimate the regressions reported in Table 4 for each of the subsamples. As we show in Table 7, consistent with the monitoring hypothesis, the coefficients of $\Delta NSRIO$ are positive and marginal significant in the sample of low KLD firms but are highly significant in the sample with high KLD firms.

3.4. Are Changes in KLD Scores Predictable?

3.4.1. Do NSRIs' Holdings Predict Changes in KLD Scores?

In this section we explicitly examine whether the level of NSRI holdings predict changes in KLD scores. The monitoring hypothesis suggests that the presence of NSRIs can offset the tendency of firms to increase CSR activities over our sample period.

To test this hypothesis we regress changes in KLD scores on past NSRI holdings and other control variables. Because we assume that influencing a firm's tendency to act socially responsibly may take time, we examine the relation between NSRI ownership at the end of the second quarter in year t on changes in KLD scores over the following calendar year. For robustness, we replicate this analysis using NSRI ownership at the end of year t. We estimate these relationships for our full sample as well as for the sample of firms with above median KLD scores.

We start by sorting stocks into three portfolios based on *NSRI* ownership at the end of the second quarter of year t and record the average change in KLD scores from the end of year t to the end of year t+1 for the full sample as well as the high and low subsamples. These changes, reported in the columns marked "Full", "Low" and "High" in the upper panel of Table 8, reveal that KLD scores tend to increase over time, but increase less for firms with high KLD scores and less for firms with high NSRI ownership. We repeat the same procedure except that stocks are sorted by total institutional ownership (sum of NSRI ownership and SRI ownership) and report the results in the middle panel of Table 8. Unlike the pattern we see for NSRI ownership, KLD increases more for firms with high total institutional ownership than for firms with low total institutional ownership, suggesting the impact of NSRI ownership on KLD change is opposite to that of SRI ownership. The bottom panel of Table 8 reveals that NSRI ownership and SRI ownership have very different effects on KLD changes, especially for high KLD firms.

Table 9 examines these same relations with regressions that control for other factors that may influence CSR activities. We control for the asset size and the ROA in these regressions because larger and more profitable firms increased their engagement in CSR activities over our sample period. We also include the level of KLD in *year t* as a control variable to capture the possibility of mean reversion in a firm's KLD scores. In all regressions, we control for industry-year fixed effects and the t-statistics are calculated with standard errors clustered by firm.

Consistent with the monitoring hypothesis, we observe negative coefficients of *NSRIO* in model (1) in both the Full sample and the High KLD subsample, and as expected, the coefficients are more negative in the high KLD subsample. In model (2), we find that the coefficient of total *IO* (i.e. the sum of *NSRIO* and *SRIO*) is also significantly negative in both panels. But this effect mainly comes from *NSRIO;* in model (3), which includes both *NSRIO* and total *IO*, the coefficient of *IO* is significant only in the high KLD subsample and it has a positive sign.

3.4.2. The Relationship between Stock Returns and Future KLD Changes

Up to this point we documented two basic results that are consistent with the monitoring hypothesis. We showed in Table 4 that stocks experiencing an increase in NSRI ownership realize positive excess returns the following quarter, and then we showed in Table 9 that high *NSRIO* firms tend to reduce KLD scores (or increase them less) the following year. In this subsection we examine the relation between stock returns and future KLD scores.

To understand why stock returns may be related to future changes in KLD scores lets first consider the possibility that stock returns directly influence CSR choices. In particular, since firms with high stock returns are likely to have more favorable future prospects, they are better able to afford the luxury of increasing CSR expenditures. The evidence in Table 9, indicating that firms with higher ROA tend to have higher KLD scores, is consistent with the hypothesis that firms tend to spend more on CSR activities when they are doing relatively well.

The above argument suggests that high stock returns can lead to positive changes in KLD scores, which would create a positive correlation between these variables. Stock returns, however, may also be influenced by the anticipated changes in a firm's CSR activities, and this effect can create a negative correlation between these variables. In particular, if some firms have a tendency to over invest in CSR activities (relative to value maximization), higher anticipated future KLD scores can cause stock prices to decline and the lower anticipated future KLD scores can cause stock prices to rise. Hence, the correlation between stock returns and future changes in KLD scores can potentially be either positive or negative, depending on the importance of the two offsetting channels.

The tests that follow assume that the relative importance of these two channels depends on the ownership structure of the firm's stock. In particular, we test the hypothesis that when NSRIs are sufficiently influential, the causal channel running from stock returns to changes in CSR activity is substantially mitigated. Specifically, because of NSRI monitoring, the tendency of executives to increase CSR activity when stock returns are favorable is mitigated in firms with high NSRI ownership. In contrast, the relevance of the second channel does not depend on the ownership structure; if there is a tendency to overinvest in CSR activity, an increase (decrease) in anticipated KLD scores leads to lower (higher) values regardless of the firm's ownership structure. As a result, given the assumed tendency to overinvest in CSR activity, we expect to see a negative relation between stock returns and future KLD scores for the high NSRI ownership firms.

To test these predictions we add past stock returns and the interaction of past stock returns with NSRIO to the regressions reported in Table 9. Specifically, we measure NSRIO at the end of the second quarter of year t, and stock returns, *Qret(2)*, during the last two quarters of year t. We then interact these last two quarter stock returns with dummy variables for both high and low NSRIO (defined based on median yearly) and regress these variables, along with the variables described in Table 9, on future changes in KLD scores, i.e., the change from the end of year t to the end of year t+1.

Model (1) in Table 10 reports the regressions that include only past stock returns and ROA as predictors of changes in KLD scores. Consistent with the above arguments, we find that ROA is still positively associated with future changes in KLD scores, which is consistent with the Jensen (1986) free cash flow interpretation, i.e., firms invest more in CSR activities when they are generating more cash. On the other hand, stock return *Qret(2)* is insignificant, suggesting the effects from the two channels discussed above offset each other in the overall sample. However, after we separate the effects into those among high NSRIO firms and those among low NSRIO firms in model (2), a very different pattern emerges. Conditioned on high NSRIO, the positive effect of ROA on changes in KLD scores is mitigated as evidenced by the significantly positive Low NSRIO/ROA interaction and an insignificant High NSRIO/ROA interaction. The coefficients of the NSRIO and return interactions are similar, except for the very significant negative coefficient on the High NSRIO/return interaction variable, indicating that for High NSRIO firms, higher stock returns are associated with future reductions in KLD scores. This last result is consistent with the idea that expected CSR reductions are viewed favorably by market participants.

The Table 10 regressions are estimated separately for a sample that included only the firms with high KLD scores. A comparison of these regressions with the regressions on the entire sample reveals that the coefficient of ROA is twice as high in the estimates on the high KLD sample. This evidence is consistent with the idea that high KLD firms tend to overinvest in CSR activities, and that their tendency to do so is greater when ROA is higher. However, this subsample generates even stronger evidence that expected reductions in CSR activities are viewed favorably by market participants for high NSRIO firms.

4. Conclusion

We expect that all else equal, corporate executives prefer to be viewed as socially responsible, and are thus willing to sacrifice at least some value to achieve a higher social responsibility score. The tradeoff between being seen as socially responsible and acting to maximize shareholder value is also likely to be true for portfolio managers. Of course, different managers have different tastes for social responsibility and are likely to view these tradeoffs differently, leading to cross-sectional differences in the corporate responsibility scores of both firms and institutional investors. Consistent with this view, the evidence suggests that investors with relatively less focus on social responsibility, and implicitly, more focus on returns, achieve slightly higher returns on average.

Our evidence, which exploits observed differences in the tastes of institutional investors, also provides evidence that institutions can influence corporate behavior. In particular, we find that firms that are held more by the "not socially responsible institutions" tend to increase their socially responsible activities less than other firms. In addition, we provide indirect evidence, consistent with the above tradeoff, that higher levels of socially responsible activities tend to be negatively associated with firm value. Specifically, we find that on average, stock returns are positive following increases in the holdings of the NSRIs, and for those firms with higher NSRI holdings, higher stock returns are negatively associated with future changes in socially responsible activities.

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Appendix A: Variable Definitions

This appendix presents the detailed definitions of the variables used in the analyses and regressions. NSRI represents Non-Social Responsible Institution and SRI represents Social Responsible Institution.

Variables	Definitions
Institutional Ownership Variables	
IO_t	Total institutional ownership at the end of quarter t, which is defined as shares held by all institutions divided by total shares outstanding.
ΔIO	Change in total institutional ownership from quarter t-1 to t.
$NSRIO_t$	Total NSRI ownership at the end of quarter t, which is defined as shares held by all NSRIs divided by total shares outstanding.
$\Delta NSRIO$	Change in total NSRI ownership from quarter t-1 to t.
$SRIO_t$	Total SRI ownership at the end of quarter t, which is defined as shares held by all SRIs divided by total shares outstanding.
$\Delta SRIO$	Change in total SRI ownership from quarter t-1 to t.
$NSRIO\_NONT4_t$	Total non-type 4 NSRI ownership at the end of quarter t, which is defined as shares held by all non-Type 4 NSRIs divided by total shares outstanding.
$\Delta NSRIO\_NONT4$	Change in total non-type 4 NSRI ownership from quarter t-1 to t.
$NSRIO\_T4_t$	Total type 4 NSRI ownership at the end of quarter t, which is defined as shares held by all Type 4 NSRIs divided by total shares outstanding.
$\Delta NSRIO\_T4$	Change in total type 4 NSRI ownership from quarter t-1 to t.
IO_T4	Total type 4 institutional ownership at the end of quarter t, which is defined as shares held by all Type 4 institutions divided by total shares outstanding.
ΔIO_T4	Change in total type 4 institutional ownership from quarter t-1 to t.
Stock Return and Turnover Variables	
$Qret_{t+1}$	Firm's buy and hold stock returns from quarter t to t+1.
$Qret(2)$	Firm's buy and hold stock returns from quarter t to t+2.
$RET_{t-3,t}$	Firm's 3-month gross stock return from month t-3 to t.
$RET_{t-12,t-3}$	Firm's 9-month gross stock return from month t-12 to t-3.
Logturnover	The log of average monthly stock turnover over previous quarter.
Logprice	The log of quarter end stock price.
Logvol	The log of stock return volatility, which is calculated as the variance of monthly returns over previous two years.
Firm Characteristics Variables	
KLD	Firm's KLD strengths score.
Logage	The log of the number of months since the first return of the stock appears in CRSP.
SP500	A dummy variable indicating S&P 500 membership.
Financial Variables	
Logbm	The log of firm's book-to-market value, which is defined as the book value of the firm for the fiscal year ended before the most recent Jun 30, divided by firm size as of Dec 31 during that fiscal year.
Logsize	The log of firm size, which is defined as the quarter end market capitalization.
LogCDV	The log of scaled cash dividend, which is defined as the cash dividends for the fiscal year ended before the most recent Jun 30, scaled by firm size as of Dec 31 in that fiscal year.
LogAssets	The log of firm's total assets.
ROA	Return on asset, which is defined as $EBITDA_t$ divided by Total $Assets_{t-1}$.

Appendix B: Indicators of KLD Qualitative Issue Areas

This Appendix provides detailed definitions of KLD strength indicators in all seven major KLD Qualitative Issue Areas with 2008 scores for Coca-Cola Company and PepsiCo, Inc. for illustration purpose.[10] KLD indicates a score of positive one for a strength of a company in a particular issue. If the company did not have a strength in that issue, a score of zero will be indicated. A company's KLD strength score is the summation of all positive ones in the qualitative issues.

Indicators	Definitions	Coca-Cola	Pepsi
Community Indicators		**2**	**2**
Charitable Giving	The firm has consistently given over 1.5% of trailing three-year net EBT to charity, or has otherwise been notably generous in its giving.	0	0
Innovative Giving	The firm has a notably innovative giving program that supports nonprofit organizations.	0	0
Non-US Charitable Giving	The firm must make at least 20% of its giving, or have taken notably innovative initiatives in its giving program outside the US.	1	1
Support for Housing	The firm is a prominent participant in public/private partnerships that support housing initiatives for the economically disadvantaged.	0	0
Support for Education	The firm has been notably innovative in its support for primary or secondary school education, or job-training programs for youth.	1	1
Volunteer Programs	The firm has an exceptionally strong volunteer program.	0	0
Other Strength	The firm has either an exceptionally strong in-kind giving program or engages in other notably positive community activities.	0	0
Corporate Governance Indicators		**2**	**2**
Limited Compensation	Recently, total annual compensation is less than $500,000 for a CEO or $30,000 for outside directors.	0	0
Ownership	The firm owns between 20% and 50% of another firm KLD has cited as having an area of social strength, or is more than 20% owned by a firm that KLD as having social strengths.	0	0
Transparency	The firm is effective in reporting on social and environmental performance measures.	1	1
Political Accountability	The firm has shown markedly responsible leadership on public policy issues and/or has an exceptional record of transparency and accountability concerning its political involvement in state or federal-level U.S. politics, or in non-U.S. politics.	1	1
Other Strength	The firm has a unique and positive corporate culture, or has undertaken a noteworthy initiative not covered by KLD's other corporate governance ratings.	0	0
Diversity Indicators		**4**	**4**
CEO	The firm's CEO is a woman or a member of a minority group.	0	1
Promotion	The firm has made notable progress in the promotion of women and minorities.	1	0
Board of Directors	Women, minorities, and/or the disabled hold 4 seats or more on the board, or 1/3 or more if the board size less than 12.	0	1
Work/Life Benefits	The firm has outstanding employee benefits programs addressing work/life concerns like childcare, elder care or flextime.	1	0
Women & Minority Contracting	The firm does at least 5% of its subcontracting, or has a strong record on contracting with women/minority-owned businesses.	1	1
Employment of the Disabled	The firm has taken hiring programs for the disabled, or has a superior reputation as an employer of the disabled	0	0

[10] More information on KLD indicators of qualitative issue areas can be found in the manual provided in WRDS database. https://wrds-web.wharton.upenn.edu/wrds/support/Data/_001Manuals%20and%20Overviews/_070KLD/index.cfm

Appendix B (*Continued*)

Indicators	Definitions	Coca-Cola	Pepsi
Diversity Indicators ***(continue)***			
Gay & Lesbian	The firm has implemented notably progressive policies toward its gay and lesbian employees.	1	1
Other Strength	The firm has made a notable commitment to diversity not covered by other KLD ratings.	0	0
Employee Relations Indicators		**0**	**2**
Union Relations	The firm has taken exceptional steps to treat its unionized workforce fairly.	0	0
Cash Profit Sharing	The firm has a cash profit-sharing program and has recently made distributions to a majority of its workforce.	0	0
Employee Involvement	The firm strongly encourages worker involvement and/or ownership through stock options available to a majority of its employees.	0	1
Retirement Benefits	The firm has a notably strong retirement benefits program.	0	0
Health and Safety	The firm has strong health and safety programs.	0	1
Other Strength	The firm has strong employee relations initiatives not covered by other KLD ratings.	0	0
Environment Indicators		**3**	**3**
Beneficial Products & Services	The firm derives substantial revenues from innovative remediation products, environmental services, or products that promote the efficient use of energy, or it has developed innovative products with environmental benefits.	0	0
Pollution Prevention	The firm has notably strong pollution prevention programs including both emissions reductions and toxic-use reduction programs.	0	0
Recycling	The firm is a substantial user of recycled materials as raw materials in its manufacturing processes, or a major factor in the recycling industry.	1	0
Clean Energy	The firm has taken significant measures to reduce its impact on climate change and air pollution through use of renewable energy and clean fuels.	0	1
Management Systems	The firm has demonstrated a superior commitment to management systems through ISO 14001 certification and other voluntary programs.	1	1
Other Strength	The firm has demonstrated a superior commitment to management systems, voluntary programs, or other environmentally proactive activities.	1	1
Human Rights Indicators		**1**	**0**
Indigenous Peoples Relations	The firm has established relations with indigenous peoples near its proposed or current operations.	0	0
Labor Rights	The firm has great transparency on overseas sourcing disclosure and monitoring, or has particularly good union relations outside the U.S., or has undertaken labor rights-related initiatives.	0	0
Other Strength	The firm has undertaken exceptional human rights initiatives, or has shown industry leadership on human rights issues not covered by other KLD ratings.	1	0
Product Indicators		**0**	**0**
Quality	The firm has a long-term, well-developed, company-wide quality program, or it has a quality program recognized as exceptional in U.S. industry.	0	0
R&D/Innovation	The firm is a leader in its industry for R&D particularly by bringing notably innovative products to market.	0	0
Economically Disadvantaged	The firm has as part of its basic mission the provision of products or services for the economically disadvantaged.	0	0
Other Strength	The firm's products have notable social benefits that are highly unusual or unique for its industry.	0	0
Total		**12**	**13**

Appendix C: Summary of KLD Scores

This appendix presents the distribution of KLD strength indicators and scores of all the firms covered in KLD STATS from 2003 to 2011 across seven major qualitative issues.

KLD Strength Scores Summary				
	No. of Indicators	KLD strength Scores		
		Min	Median	Max
Community Issues	8	0	0	5
Corporate Governance Issues	6	0	0	3
Diversity Issues	9	0	0	7
Employee Relations Issues	8	0	0	5
Environment Issues	7	0	0	4
Human Rights Issues	4	0	0	1
Product Issues	5	0	0	3
All Strength Issues	47	0	1	22

Figure 1: Trend of KLD

This figure shows the trend of average KLD strength scores of firms in our sample from 2003 to 2011.

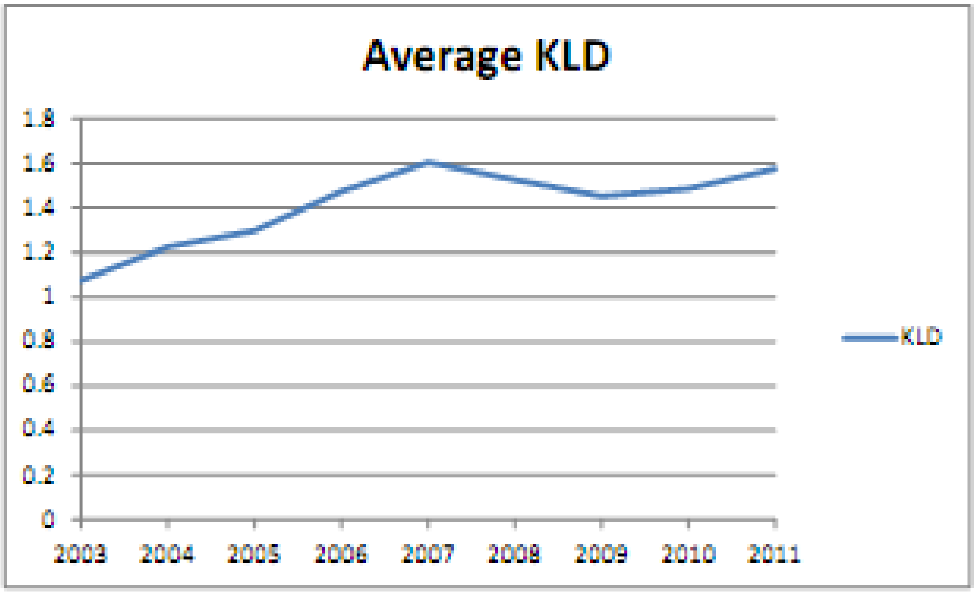

Table 1: Summary Statistics

This table shows the time-series average of cross-sectional values and correlations of institutional ownerships, change in institutional ownerships, firms' KLD strength scores and other stock and firm characteristics from 2003:Q1 to 2011:Q4. Panel A presents the time-series mean, median, standard deviation, minimum and maximum of the variables and Panel B presents the correlations between each variable. We obtained quarterly institutional ownership values from Thomason Financial database and calculated KLD strength scores based on the issues indicators provided by KLD STATS database. Each quarter, we sort institutions into three groups according to value weighted Corporate Social Responsibility (CSR) scores of their portfolio holdings, with the institutions in the bottom group, which have the lowest scores, defined as Non-Social Responsible Institutions (NSRIs) and the rest of the institutions defined as Social Responsible Institutions (SRIs). The definitions of all the variables are described in Appendix A. Superscripts ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

Panel A: Time-Series Average of Cross-Sectional Values

	Mean	Median	Standard Deviation	Minimum	Maximum
IO(%)	66.99	71.97	22.44	0.88	99.95
ΔIO(%)	0.12	0.20	6.01	-76.82	61.77
NSRIO(%)	15.30	13.43	11.33	0.03	88.06
ΔNSRIO(%)	0.06	0.02	4.62	-39.87	40.77
KLD	1.39	1.00	2.15	0.00	18.49
MV($mil.)	5823.43	1112.73	19913.89	14.10	379515.28
B/M	0.60	0.50	0.52	0.00	8.09
Price($)	35.02	22.84	304.53	0.49	14443.79
Volatility	0.02	0.01	0.05	0.00	2.11
Turnover	1.54	1.18	1.47	0.03	22.41
SP500	0.21	0.00	0.40	0.00	1.00
Age(months)	247.97	181.31	208.32	18.26	982.00
CDV(%)	0.02	0.00	0.04	0.00	0.81

Panel B: Time-Series Average of Cross-Sectional Correlations

	IO	*ΔIO*	*NSRIO*	*ΔNSRIO*	*KLD*	*Logbm*	*Logsize*	*Logvol*	*Logturnover*	*Logprice*	$RET_{t-1,t}$	$RET_{t-12,t-1}$	*Logage*	*SP500*
ΔIO	0.154***													
NSRIO	0.488***	0.091***												
ΔNSRIO	0.053***	0.355***	0.216***											
KLD	0.022**	-0.009	-0.313***	-0.004										
Logbm	-0.035***	-0.008	-0.007	0.000	-0.090***									
Logsize	0.303***	0.033*	-0.243***	0.002	0.504***	-0.202***								
Logvol	-0.049***	-0.016	0.191***	0.008	-0.208***	-0.016	-0.441***							
Logturnover	0.515***	-0.016	0.114***	-0.001	0.088***	-0.084***	0.339***	0.216***						
Logprice	0.305***	0.069***	-0.050***	0.007	0.180***	-0.136***	0.623***	-0.544***	0.117***					
$RET_{t-1,t}$	0.056***	0.158***	0.041***	0.066***	0.000	0.019	0.119***	0.005	0.036**	0.198***				
$RET_{t-12,t-1}$	0.106***	0.073***	0.043***	-0.005	-0.004	0.021	0.187***	-0.018	0.104***	0.286***	-0.008			
Logage	0.082***	-0.013	-0.242***	0.000	0.273***	0.034***	0.341***	-0.317***	0.079***	0.272***	0.017	0.011		
SP500	0.156***	-0.009	-0.342***	-0.004	0.523***	-0.138***	0.704***	-0.274***	0.247***	0.302***	0.007	0.013	0.344***	
LogCDV	-0.113***	0.002	-0.133***	-0.002	0.046***	0.162***	0.035***	-0.179***	-0.015	0.025	-0.003	-0.001	0.107***	0.038***

Table 3: Institutional Types of NSRI

This table reports the distributions of institutional types. Institutions are classified into 5 types (Type X=1, 2, 3, 4 and 5) based on Brian Bushee's institutional classifications. Each quarter, we calculate three percentage measures and report the time-series average of the percentages in the table. They are (1) Percentage of total institutional ownership that are from Type X institutions, calculated as the ownership of Type X institutions divided by the total institutional ownership, (2) Percentage of NSRI ownership that are from Type X institutions, calculated as the ownership of Type X NSRI divided by the NSRI ownership and (3) Percentage of Type X institutional ownership that are from NSRI, calculated as the ownership of Type X NSRI divided by the Type X institutional ownership.

Type X	1	2	3	4	5
Percentage of total institutional ownership that are from Type X institutions	18.06	5.08	15.37	52.94	7.90
Percentage of NSRI ownership that are from Type X institutions	0.24	1.16	4.35	84.74	9.49
Percentage of Type X institutional ownership that are from NSRI	0.31	5.21	6.44	36.40	27.33

Table 4: NSRI Ownership and Future Returns

This table examines the effects of change in NSRI ownerships in quarter t ($\Delta NSRIO$) on next quarter stock returns ($Qret_{t+1}$) using Fama-MacBeth regressions from 2003:Q1 to 2011:Q4. $NSRIO_{t-1}$ is the non-social responsible institutional ownership in a particular stock at the end of quarter t-1. IO_{t-1} is the total institutional ownership in a particular stock at the end of quarter t-1 and ΔIO is the change in total institutional ownership in quarter t. *KLD* is the KLD strength scores of a particular stock at the end of previous calendar year. Other variables including *Logbm*, *Logsize*, *Logvol*, *Logturnover*, *Logprice*, $Ret_{t-1,t-3}$, $Ret_{t-12,t-3}$, *Logage*, *SP500*, *LogCDV* and Fama-French 48 industries are also controlled and their definitions can be found in Appendix A. The Newey-West adjusted t-statistics are presented in the parenthesis and superscripts ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)
$\Delta NSRIO$	0.0899^{***}	0.1054^{***}	0.0769^{***}	0.1000^{***}
	(3.03)	(2.90)	(3.05)	(3.07)
$NSRIO_{t-1}$	0.0439^{*}	0.0298	0.0305^{**}	0.0314^{*}
	(2.00)	(1.56)	(2.16)	(2.01)
ΔIO		-0.0728^{**}		-0.0691^{**}
		(-2.09)		(-2.39)
IO_{t-1}		0.0115		-0.0025
		(1.33)		(-0.24)
KLD	0.0003	0.0002	0.0007	0.0006
	(0.38)	(0.30)	(1.08)	(1.02)
Intercept	-0.0015	-0.0034	0.0088	0.0078
	(-0.03)	(-0.07)	(0.13)	(0.12)
Control variables	Yes	Yes	Yes	Yes
Industry dummy	No	No	Yes	Yes
Observations	75,507	75,507	75,507	75,507
Adj-R^2	0.075	0.077	0.133	0.135

Table 5: Portfolio Returns for NSRI and SRI

The table reports the average holding period (quarter) returns of portfolios constructed based on the change in the NSRI ownership (ΔNSRIO) and SRI ownership (ΔSRIO) from 2003:Q1 to 2011:Q4. At the end of each quarter, we sort all stocks into 5 equally weighted portfolios based on $\Delta NSRIO$ and $\Delta SRIO$ respectively. Stocks in Portfolio 1 have the smallest change in ownership and stocks in Portfolio 5 have the largest change in ownership. Then we calculate and report the time-series average of both raw returns and DGTW benchmark adjusted returns for all the 5 portfolios. 'High-Low' is the average hedge portfolio return by purchasing portfolio 5 and shorting portfolio 1. 'HL($\Delta NSRIO$)-HL($\Delta SRIO$)' is the average difference between hedge portfolio return of $\Delta NSRIO$ and hedge portfolio return of $\Delta SRIO$. The Newey-West adjusted t-statistics are presented in the parenthesis and superscripts ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	Raw Return		DGTW Adjusted Return	
	$\Delta NSRIO$	$\Delta SRIO$	$\Delta NSRIO$	$\Delta SRIO$
1 (Low)	0.0283	0.0490	0.0024	0.0193
2	0.0269	0.0374	0.0021	0.0109
3	0.0283	0.0280	0.0052	0.0039
4	0.0368	0.0267	0.0099	0.0025
5 (High)	0.0437	0.0227	0.0137	-0.0037
High-Low	0.0154**	-0.0263**	0.0113***	-0.0230**
	(2.68)	(-2.20)	(2.80)	(-2.36)
HL($\Delta NSRIO$)-HL($\Delta SRIO$)	0.0417***		0.0343***	
	(2.79)		(3.04)	

Table 6: The Relation between Type 4 and Non-Type 4 NSRI Ownership and Next Quarter's Return

This table examines the effects of changes in Type 4 NSRI ownership ($\Delta NSRIO\_T4$) and Non-Type 4 NSRI ownership ($\Delta NSRIO\_NONT4$) in quarter t on quarter t+1 stock returns ($Qret_{t+1}$) using Fama-MacBeth regressions from 2003:Q1 to 2011:Q4. Institutions are classified into five types based on Brian Bushee's institutional classifications. $NSRIO\_T4_{t-1}$($NSRIO\_NONT4_{t-1}$) is the Type 4 (non-Type 4) non-social responsible institutional ownership in a particular stock at the end of quarter t-1. IO_{t-1} is the total institutional ownership in a particular stock at the end of quarter t-1 and ΔIO is the change in total institutional ownership in quarter t. IO_T4_{t-1} is the total type 4 institutional ownership in a particular stock at the end of quarter t-1 and ΔIO_T4 is the change in total Type 4 institutional ownership in quarter t. KLD is the KLD strength scores of a particular stock at the end of previous calendar year. Other variables including *Logbm*, *Logsize*, *Logvol*, *Logturnover*, *Logprice*, $Ret_{t-1,t-3}$, $Ret_{t-12,t-3}$, *Logage*, *SP500*, *LogCDV* and Fama-French 48 industries are also controlled and their definitions can be found in Appendix A. The Newey-West adjusted t-statistics are presented in the parenthesis and superscripts ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	(1)	(2)	(3)	(4)
ΔIO_T4	0.0541**	0.1790***		
	(2.72)	(2.90)		
IO_T4_{t-1}	0.0276	0.0205		
	(1.47)	(0.87)		
ΔIO		-0.1435**		-0.0782*
		(-2.35)		(-1.97)
IO_{t-1}		0.0063		0.0069
		(0.59)		(0.83)
$\Delta NSRIO\_T4$			0.1058***	0.1247***
			(3.21)	(3.06)
$NSRIO\_T4_{t-1}$			0.0370	0.0273
			(1.46)	(1.16)
$\Delta NSRIO\_NONT4$			0.1012**	0.1267**
			(2.24)	(2.48)
$NSRIO\_NONT4_{t-1}$			0.0592**	0.0529**
			(2.42)	(2.34)
KLD	-0.0000	-0.0001	0.0002	0.0002
	(-0.05)	(-0.10)	(0.28)	(0.21)
Intercept	0.0192	0.0203	0.0198	0.0185
	(0.35)	(0.38)	(0.36)	(0.35)
Control variables	Yes	Yes	Yes	Yes
Observations	68,390	68,390	68,390	68,390
Adj-R^2	0.074	0.075	0.074	0.076

Table 7: The Relation between NSRI Ownership and Next Quarter's Return: KLD Strengths Subsamples Analyses

This table presents Fama-MacBeth regressions of changes in NSRI ownerships in quarter t (*ΔNSRIO*) on next quarter's stock returns ($Qret_{t+1}$) on subsamples for stocks with above and below median KLD strength scores measured at the previous calendar year end. $NSRIO_{t-1}$ is the NSRI ownership in a particular stock at the end of quarter t-1. IO_{t-1} is the total institutional ownership in a particular stock at the end of quarter t-1 and *ΔIO* is the change in total institutional ownership in quarter t. *KLD* is the KLD strength score of a particular stock at the end of previous calendar year. Other variables including *Logbm*, *Logsize*, *Logvol*, *Logturnover*, *Logprice*, $Ret_{t-1,t-3}$, $Ret_{t-12,t-4}$, *Logage*, *SP500*, *LogCDV* and Fama-French 48 industries are also controlled and their definitions can be found in Appendix A. The Newey-West adjusted t-statistics are presented in the parenthesis and superscripts ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	Low KLD subsample		High KLD subsample	
	(1)	(2)	(1)	(2)
ΔNSRIO	0.0548*	0.0659*	0.1256***	0.1421***
	(1.70)	(1.76)	(3.27)	(3.01)
$NSRIO_{t-1}$	0.0289	0.0019	0.0563**	0.0551**
	(1.53)	(0.11)	(2.20)	(2.48)
ΔIO		-0.0587		-0.0832**
		(-1.45)		(-2.12)
IO_{t-1}		0.0240**		-0.0001
		(2.31)		(-0.01)
Intercept	0.0053	0.0042	-0.0156	-0.0171
	(0.09)	(0.07)	(-0.31)	(-0.34)
Control variables	Yes	Yes	Yes	Yes
Observations	32,755	32,755	42,752	42,752
Adj-R^2	0.069	0.072	0.085	0.087

Table 8: Change of Firm's CSR and NSRI Ownership

The table reports the change of KLD in t+1 for portfolios sorted on the $NSRIO_t$ (IO_t) and KLD. $NSRIO_t$ is the ownership of NSRI at the end of the second quarter and IO_t is the ownership of all the institutions at the end of the second quarter in the current calendar year t. KLD is the KLD strength score of a particular stock at the end of year t. Each year, we sort all stocks into 3 equally weighted portfolios based on the $NSRIO_t$ and IO_t, respectively. Stocks in Portfolio 1 have the smallest ownership and stocks in Portfolio 3 have the largest ownership. A firm is classified as low KLD if its KLD is lower than the cross-sectional median at the end of year t. Otherwise, it is classified as high KLD. The Full portfolio includes all stocks. We calculate and report the time-series average of the change in KLD from the end of year t to the end of year t+1 for all portfolios. 'High-Low' is the average change of KLD for the hedge portfolio that purchases portfolio 3 and shorts portfolio 1. '$NSRIO_t$ - IO_t' is the average difference between the change in KLD for the respective portfolios formed based on $NSRIO_t$ and IO_t. The Newey-West adjusted t-statistics are presented in the parenthesis and superscripts ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

		KLD		
		Full	Low	High
	1(Low)	0.235***	0.262***	0.224**
	2	0.026	0.173***	-0.086*
	3(High)	0.008	0.135***	-0.135
$NSRIO_t$				
	High-Low	-0.227*	-0.127***	-0.359*
		(-2.34)	(-4.21)	(-2.34)
	1(Low)	0.001	0.166**	-0.115
	2	0.139***	0.169***	0.119***
	3(High)	0.120***	0.186***	0.068***
IO_t				
	High-Low	0.120	0.020	0.183*
		(1.65)	(0.34)	(1.90)
	1(Low)	0.234*	0.096***	0.339*
	2	-0.113**	0.004	-0.205**
	3(High)	-0.112	-0.051**	-0.203*
$NSRIO_t$ - IO_t				
	High-Low	-0.346*	-0.147***	-0.542*
		(-2.06)	(-4.25)	(-2.18)

Table 9: The Effects of NSRI Ownership on Firm's CSR

This table reports pooled regressions of changes in KLD scores on lagged NSRI ownership and other control variables. $NSRIO_t$ is the ownership of NSRI at the end of the second quarter and IO_t is the ownership of all the institutions at the end of the second quarter in current calendar year t. *KLD* is the KLD strength score of a particular stock at the end of year t. The dependent variable is the change in a firm's KLD strength score from the end of year t to the end of year t+1. High KLD subsample includes all stocks whose KLD strength scores at the end of year t are above the cross-sectional median. Fama-French 48 industries and year dummies are included as controls and all the other control variables are defined in Appendix A. Standard errors are clustered by firms. The t-statistics are presented in the parenthesis and superscripts ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	Full sample			High KLD subsample		
	(1)	(2)	(3)	(1)	(2)	(3)
$NSRIO_t$	-0.5268***		-0.5803***	-0.7570***		-0.9136***
	(-9.19)		(-7.97)	(-7.35)		(-7.12)
IO_t		-0.1172***	0.0512		-0.0965*	0.1438**
		(-3.84)	(1.32)		(-1.96)	(2.35)
$LogAssets_t$	0.1409***	0.1547***	0.1376***	0.1858***	0.2049***	0.1765***
	(24.98)	(25.13)	(22.06)	(22.45)	(23.26)	(19.16)
ROA_t	0.1935***	0.2009***	0.1856***	0.3278***	0.3438***	0.3034***
	(4.99)	(5.10)	(4.75)	(4.86)	(4.99)	(4.48)
KLD_t	-0.0484***	-0.0450***	-0.0483***	-0.0387***	-0.0353***	-0.0380***
	(-9.18)	(-8.66)	(-9.14)	(-5.99)	(-5.47)	(-5.86)
Intercept	0.2349***	0.1584***	0.2079***	0.3445***	0.3916***	0.3027***
	(11.32)	(5.66)	(7.37)	(10.31)	(10.70)	(7.88)
Industry-year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17,329	17,329	17,329	9,892	9,892	9,892
Adj-R^2	0.111	0.108	0.111	0.161	0.158	0.161

Table 10: Do Stock Returns Predict Future Changes in CSR Activities?

This table reports pooled regressions of changes in CSR activities on NSRI ownership, lagged stock returns, the interaction of lagged stock returns and NSRI ownership and other control variables. $High\_NSRIO_t$ (Low_NSRIO_t) is a dummy variable which equals to 1, 0 otherwise, if the firm's $NSRIO_t$ is above (below) the cross-sectional median at the end of the second quarter in current calendar year t. *Qret(2)* is the last two quarters stock return in year t. *KLD* is the KLD strength score of a particular stock at the end of year t. The dependent variable is the change in a firm's KLD strength score from the end of year t to the end of year t+1. The High KLD subsample includes all stocks whose KLD strength scores at the end of year t are above the cross-sectional median. Fama-French 48 industries and year dummies are controlled and all the other control variables are defined in Appendix A. Standard errors are clustered by firms. The t-statistics are presented in the parenthesis and superscripts ***, **, * denote statistical significance at the 1%, 5% and 10% levels, respectively.

	Full sample		High KLD subsample	
	(1)	(2)	(1)	(2)
$High\_NSRIO_t$	-0.1169***	-0.0491***	-0.1346***	-0.0324
	(-8.96)	(-3.64)	(-6.41)	(-1.38)
Qret(2)	-0.0133		-0.0338	
	(-0.43)		(-0.69)	
$High\_NSRIO_t$*Qret(2)*		-0.1274***		-0.2233***
		(-3.99)		(-4.79)
Low_NSRIO_t*Qret(2)*		0.1639***		0.2523***
		(4.18)		(3.60)
ROA_t	0.1931***		0.3253***	
	(5.02)		(4.83)	
$High\_NSRIO_t{}^*ROA_t$		0.0608		0.0988
		(1.49)		(1.26)
$Low\_NSRIO_t{}^*ROA_t$		0.3447***		0.5385***
		(5.75)		(5.36)
$LogAssets_t$	0.1407***	0.1407***	0.1882***	0.1878***
	(24.67)	(24.46)	(22.33)	(22.15)
KLD_t	-0.0476***	-0.0478***	-0.0369***	-0.0372***
	(-9.06)	(-9.09)	(-5.75)	(-5.79)
Intercept	0.1704***	0.1626***	-0.2883***	-0.4224***
	(9.33)	(9.28)	(-8.61)	(-11.92)
Industry-year dummy	Yes	Yes	Yes	Yes
Observations	17,257	17,257	9,842	9,842
Adj-R^2	0.111	0.115	0.160	0.167

Do Spot Prices Predict Future Futures Prices?

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Futures prices reflect the price that both the buyer and the seller agree will be the price of a commodity upon delivery. Therefore, these prices provide direct information about investor's expectations about the future price of the commodity of interest. This purpose of this research is two-fold. First, the research investigates the predictive accuracy and biasedness of futures prices predictions from reverse regression using in-sample criteria as well as from the performance of the models based upon ex post forecasts generated by alternative time series models. Second, following earlier investigations, an effort is made to understand the extent to which the spot energy (oil) price contains information content in the current period useful for predicting the forward-looking variable. The working hypothesis is that both own-commodity spot prices and spot energy (oil) prices are significant predictors of future commodity prices at alternative leads (lags).

I. Introduction

Futures prices reflect the price that both the buyer and the seller agree will be the price of a commodity upon delivery. Therefore, these prices provide direct information about investor's expectations about the future price of the commodity of interest. This purpose of this research is two-fold. First, this research attempts to give insight into the relationship between futures and spot prices for commodities by evaluating the empirical forecasting performance of spot prices. The working hypothesis is that both own-commodity spot prices and spot energy (oil) prices are significant predictors of future commodity prices at alternative leads (lags).

This article reports on the predictive accuracy and biasedness of futures prices predictions from in- sample goodness-of-fit and from the performance of *ex post* forecasts generated by alternative time series models. Second, following earlier investigations an effort is made to investigate the contribution that the spot energy (oil) price makes to improving in-sample fit and *ex post* forecast performance.

In support of the these research interests, forecasting futures prices is understood to be a key input to a profitable futures trading strategy (Gradnitski and Osborn, 1993) and past research going back at least as far as Frank and Stengos (1989), Blank (1991), and DeCoster et al. (1992) has made clear that futures prices follow non-linear processes. The importance of energy markets in explaining volatility in agricultural commodities prices has been a topic of considerable interest. The oil price transmission to agricultural commodity prices states that a rise in oil prices results in higher agricultural commodity prices by increasing costs of production through its impacts on fertilizer, chemicals, transportation costs, and other inputs. Scholarly work focused on the relationship between the energy sector and agricultural commodities has been published by, Yu, Bessler and Fuller (2006), Baffes (2007), Zhang and Reed(2008), Muhammed, A. and Kebede, E. (2009), Balcombe(2010), Gilbert (2010a, 2010b), Saghaian (2010), Nazlioglu, S. (2011), Trujillo-Barrera, Mallory, and Garcia (2012), and Cartwright and Riabko (2015a, 2015b). Baffes (2007) reports that among non-energy commodities, oil prices have the highest pass-through to food commodities and fertilizers. Saghaian (2010) using time-series and directed graph theory approaches, finds a correlation between oil and commodity prices, but the evidence of a (Granger) causal link is mixed. Cartwright and Riabko (2015a, 2015b) find mixed results depending on temporal aggregation and model specification. Campiche, Bryant, Richardson and Outlaw (2007) examined the covariability between crude oil prices and corn, sorghum, sugar, soybeans, soybean oil and palm oil prices over the period 2003-2007. Issues concerning time series modelling of commodity prices, and oil prices in particular, can also be found in the papers by Bopp and Lady (1991), Chen, Kuo, and Chen (2010), Chen and Lin (2014). The literature indicates that indicates the relationship between oil prices and those of agricultural commodities if far from clear-cut justifying ongoing study.

In Section II, in order to clarify interest in this research, literature relevant to linkages between prices of arable crops and oil prices is summarized. Section III discusses the data used in the study and Section IV describes the methodology which is based on reverse regressions (Campbell and Shiller (1987), Engel and West (2005), and Chen, Rogoff and Rossi (2008)) this paper formulates time series models for prediction of commodity futures prices using the spot prices of the commodity in question as well as taking into consideration information content in the oil spot price at period t of use for predicting the future futures price. Following Engle (1982), Bollerslev (1986), Bollerslev, T., Engle, R.F. and Nelson (1994) and Engle (2002) the first models of interest in this research are the generalized autoregressive conditional heteroscedastic (GARCH) models. Second, exponential generalized autoregressive conditional heteroscedastic (EGARCH) models (Nelson (1991)) are considered.

Section V of the paper discusses the results in detail focusing, first, on the daily results and, second on models based on weekly specifications. Estimation results for the full sample are considered as well as the outcomes from *ex post* forecasting. Section VI provides a summary of the paper and conclusions.

II. Linkages between prices of arable crops and oil prices

In "Deconstructing Wheat Price Spikes: A Model of Supply and Demand, Financial Speculation, and Commodity Price Comovement" (Janzen, Carter, Smith, and Adjemian, 2014) it is recognized that wheat futures prices spiked in early 2008 before rapidly crashing, though this hardly makes wheat market unique. Other commodities such as crude oil, natural gas, corn, and cotton exhibited price spikes and crashes at around the same time. But the magnitude of the wheat price spike combined with the coincidence of these other extreme price movements' raises important questions. Specifically, it is of interest to know whether wheat, or other agricultural commodities prices, responds to the same of economic factors.

Taking wheat as a case of interest and one of five agricultural commodities studied in this research, the three mayor classes of wheat grown in the United States are traded on three separate futures markets (hard red winter, Kansas City, hard red spring, Minneapolis, and soft red winter, Chicago). Expiring futures prices, particularly in Chicago and Kansas City, are known to routinely far exceed the prevailing cash price in their respective delivery markets, a phenomenon known as non-convergence. Wheat specific factors that contribute to price volatility may have either supply or demand origins, but consistent with price variation for most agricultural commodities, supply shocks appear to dominate short run variation in wheat prices. Following Janzen, Adjemian and Smith (2012), once the crop is planted, supply is virtually perfectly inelastic, and shocks that shift the supply curve cause most price changes. Since 1960, the global wheat supply has grown steadily, nearly tripling during the period. The US share of global wheat production has declined over time, but the United States remains a major producer. Soft red wheat (SRW) analyzed in this research paper together with hard red spring (HRS) wheat made up 23 and 20 percent of US 2011 production, respectively. Since 2004, wheat prices have risen and reminded at historically elevated levels. The presence of three wheat futures contracts conflicts with the demand from wheat futures traders for market liquidity, especially among speculators (Silber, 1981). Futures trading volume in wheat has grown rapidly in the 2000s, especially in the CBOT market. In 2011, the traded wheat amounts in KCBT and MGEX increased as well. It is unclear whether this reflects the consolidation of trading on a single exchange, as trading volume has prices may be an alternative mechanism by which financial speculation and the presence of commodity index traders affect agricultural commodity prices. The same study finds correlation between many commodity prices and the price of crude oil, the most widely traded commodity futures contract, which rose over the period in which CIT trading became prevalent. This effect was stronger for commodities included in major indexes than for non-index commodities. According to Tang and Xiong (2012) after testing the linkage between returns for many non-energy commodities and crude oil they concluded that this co-movement among prices was driven by the inclusion of commodities into major indexes such as GSCI and the DJ-UBSCI.

According to Janzen, Carter, Smith and M.K. Adjemian (2014), to separate precautionary demand from co movement related to CIT's, one must recognize that financialization, or an increase in the influence of financial markets and institutions , affected many commodities at the same time including both wheat and crude oil prices. Their study measures the extent to which wheat prices move together with external commodities such as crude oil when movements are not explained by fluctuations in supply drivers such as weather, demand drivers related to economic activity or expectations about future price movement. If the implications of the financialization hypothesis are correct, it should follow that non-agricultural commodity prices have to some extent driven wheat prices changes. According to Tang and Xiong (2012), the strength of the relationship between wheat and crude oil prices should have increased since 2004. Their analysis is repeated using the value of the GSCI, introduced earlier as an alternate measure of external market price movement. It represents a basket of commodity prices with heavy weight placed on energy commodities. However, according to J.P. Janzen, C.A. Carter, A.D. Smith and M.K. Adjemian (2014) there is little evidence of co-movement-driven price effect associated with commodity index traders. These researchers suggest that wheat futures markets perform efficiently in the sense that wheat futures prices have reflected fundamental factors.

Baumeister and L. Kilian (2013) investigated evidence for a link from oil prices to food prices and they examine the transmission of oil price shocks to food prices both prior to and after the change in US biofuel policies in 2006. According to Baumeister and L. Kilian (2013), historically the food price increases associated with corn, wheat, soybeans and rice can be seen in response to prices paid by US farmers for agricultural inputs such as fuel, fertilizer and animal feed. The prices received by US farmers closely mirror the spot prices quoted on commodity exchanges and reported by the International Monetary Fund. The paper shows a stronger statistical relationship between oil prices and the grain crop prices received by US farmers pointing toward consideration of the degree of co- movement of agricultural products and oil prices and the extent to which this co-movement has strengthened in recent years.

After May 2006, the co-movement between the real price of oil and real agricultural product prices became more pronounced, but still weak overall. One possible explanation is that the increased co-movement reflects increased demand for oil in emerging economies. Another potential explanation is that higher oil prices are associated with increased prices for agricultural inputs that drive up crop prices. Other views suggest that US Agricultural policies created a tighter link from oil prices to agricultural product prices, or perhaps, the price movements are due to financialization of global commodity markets after 2003. Findings show that only the growth rate of wheat prices exhibit a similar increase in volatility as that for oil over the time period January 1974 to May 2013. In contrast, corn prices increase by only 10 percent, soybean prices actually fell by 5 percent and the price of rice declined by 30 percent. Moreover, comparing wheat and corn, evidence shows that the smaller volatility increases apply to the growth in the real price of corn, which one might expect to be most exposed to higher oil price volatility. Findings also show that the positive spike in the growth rate of real retail food prices coincides with the negative spike in the growth rate of the real price of oil; however, there is no large spike in either direction in the growth rate of the real price of corn. Thus, this finding shows that only fuel prices, but not fertilizer or animal feed prices, responded to this exogenous oil price shock. It follows that proponents of such a causal link must make the case that the hypothesized link between prices emerged only in recent years.

A natural candidate for a structural market shift is changes in US biofuel policies. Baumeister and Kilian (2013) suggest that the obvious source of higher food prices is increases in the prices of raw agricultural products driven by higher oil prices. More generally, the macroeconomic determinants of the real price of oil would also be expected to raise the real price of wheat and soybeans, although not to the same extent, as higher incomes in emerging economies alter food consumption patterns. From the viewpoint of US farmers and US consumers, the impact of excess variability in the price of diesel is similar to an oil price shock, except that it does not involve a simultaneous change in the global demand for food and agricultural crops by construction. This observation suggests that one could interpret the unexpected variation in the US diesel price spread as a domestic diesel price shock, which may reflect either exogenous variation in US refining or US specific variation in the demand for US diesel fuel. A finding that that food prices significantly respond to diesel price spread shocks, could lead to the conclusion that higher oil prices cause higher crop prices and food prices. In the absence of such evidence, earlier claims supporting such a link would seem to reflect shifts in the global demand with no independent role for oil prices. According to Kilian and Hicks (2013), Kilian and Murphy (2013), and Kilian and Lee (2013) the real oil price shocks since 2003 have primarily reflected global shocks to the flow demand for oil associated with unexpected industrial growth in emerging Asia. Thus, an alternative interpretation is that increases in the real price of oil and increases in real crop prices in recent years have shared a common component that is associated with fluctuations in the global real activity and incomes. Baumeister and Kilian (2013) point out that the increases in the real price of wheat in 2007 are not mirrored by similar increases in the real price of corn or soybeans, suggesting an idiosyncratic supply or demand shock in the wheat market in 2007 and 2008, which includes domestic supply shocks as well as fluctuations in foreign demand for US crops and in foreign supplies of crops competing with US crops. Finally, Baumeister and Kilian (2013) provide evidence that there has been no systematically increased food price volatility. Only for wheat is there any evidence of a noticeable increase in price volatility and the reasons appear to be idiosyncratic rather than systematic.

According to Baffes (2013), some models suggest that the direct energy component of agriculture alone is four to five times higher than for manufacturing sectors. As an energy-intensive sector, agriculture plays a big role on the demand-side of the energy equation. The sector is directly affected by high and volatile world oil prices that, in turn, affect the cost of agricultural production (Nazlioglu and Soytas, 2011). Over the last few decades, high energy prices increase the costs of producing agricultural products that yield food, feed, energy and fiber. Economic theory suggests that increasing crude oil prices directly affect agricultural prices through higher input and transportation costs (Gardebroek and Hernandez, 2013).

Recent empirical research suggests there is an indirect link of varying magnitude between the prices (Alghalith, 2010; Esmaeili and Shokoohi, 2011; Ciaian and Kancs, 2011). In contrast, Gohin and Chantret (2010) find a negative impact of petroleum prices on agricultural prices when employing a general equilibrium model with fully specified macroeconomic linkages. According to Nigatu, Hjort, Hansen, and Somwaru (2014), price expectations for those commodities where futures markets do not exist may be based on futures prices of closely related commodities and (or) on trends in domestic or regional prices. Similarly, producers in importing countries are more likely to develop price expectations based on trends in local or national market prices. The results of Nigatu, Hjort, Hansen, and Somwaru (2014) suggest two scenarios where the high petroleum price scenario begins with a 37 percent price increase in 2015, which climbs to about 61 percent above the reference price in 2018, and then declines gradually to 49 percent above the 2022 reference price. The low oil price projection is more uniform, with crude oil prices falling 25 percent in 2015, and then gradually declining to 36 percent below the base price in 2022. Price shocks of these magnitudes have significant impacts on corn, soybean, wheat and rice production costs. The projected high and low energy prices produce less than a 1 percent change in the production of major commodities in the United States by the year 2022.

Except for rice, US producers are expected to decrease the production of other crops in anticipation of high energy prices and vice versa. It is projected that there is relatively little or no change in the production of corn and soybeans, the two most important feed stocks for ethanol and biodiesel production, respectively. US wheat producers are somewhat more responsive to the changes in energy prices, reducing production by 0.6 percent with high oil prices.

According to the OECD report on food rising prices (2008), price for wheat, coarse grains, and rice and oilseed crops nearly doubled between the 2005 and 2007 marketing years. The causes are complex and due to a combination of mutually reinforcing factors including droughts in key grain producing regions, low stocks for cereals and oilseeds, increased feedstock use in the production of biofuels, rapidly rising oil prices and a continuing devaluation of the US dollar, the currency in which indicator prices for these commodities are typically quoted. The oil price, and energy prices in general, is a critically important contributing factor to the increase in production costs for agricultural commodities and food, and ultimately, in the market prices for these goods. Price projections discussed in the OECD report reflect the widely held belief that the oil price increases are permanent, lifting future prices to higher average levels. Demand for cereals for use as feed stocks in biofuel production is projected, under current policies, to almost double between 2007 and 2017, but the largest part of future growth in total use is explained by rising food and feed demand, particularly in countries outside the OECD area that are experiencing strong economic growth.

According to M. Patton, I. S. Kim, L. Zhang, J. Davis, J. Binfield and P. Westhoff (2012), there is a positive relationship between the crude oil price and the price of crops, but the rapeseed price is more correlated to oil price changes than wheat and barley. The oil market has always exerted an influence on the agricultural sector as an important determinant of input costs. A rise in the price of oil feeds through to the agricultural sector through higher costs of crop and livestock production, which leads to reductions in supply and hence, higher commodity prices. Ciaian and Kancs (2010) also demonstrate using co-integration analysis with world agricultural commodity prices and the world oil price that the influence of the energy market on the agricultural market has increased over time. The authors found limited evidence of co-integration pre-2004, but strong evidence of co-integration post-2004. Using impulse response functions the authors showed that the price transmission elasticity is higher for agricultural commodity goods that are also used for bioenergy purposes (sugar, soybeans, corn and wheat). As for the EU market, about 90 per cent of domestic bioethanol production is projected to come from wheat-based bioethanol. In response to increase of wheat-based bioethanol production, wheat demand for bioethanol production is projected to increase between 2010 and 2020. The expansion of the biofuels industry in the US mirrors that seen in the EU. In the US, however, it is ethanol that accounts for the majority of biofuels consumed and this is almost all produced from maize. At this time, as much maize goes into ethanol as goes into feed in the US, and this has increased the link between developments in oil markets and agricultural markets. M. Patton, I. S. Kim, L. Zhang, J. Davis, J. Binfield and P. Westhoff (2012) show in their research regarding the relationship between oil prices and maize prices for the US, increasing oil prices initially have no impact on maize prices, but higher oil prices make ethanol from maize competitive. Within this study, a partial equilibrium modelling system is used to examine the extent to which price volatility in the energy sector is transmitted to the biofuel and agricultural sectors. The stochastic results indicate that there is a positive correlation between crude oil prices, biofuels prices and feedstock prices.

The study by Nazlioglu extends the literature on the oil–agricultural commodity prices nexus, concentrating on nonlinear causal relationships between the world oil and three key agricultural commodity prices (corn, soybeans, and wheat). On the one hand, it is found that the agricultural commodity prices and oil prices do not cause each other, supporting the neutrality hypothesis (for instance, Yu et al., 2006; Zhang and Reed, 2008; Kaltalioglu and Soytas, 2009; Gilbert, 2010; Mutuc et al., 2010, Nazlioglu and Soytas, in press). On the other hand, a small number of studies find unidirectional causality from oil prices to agricultural commodity prices (for example, Hameed and Arshad, 2008; Cooke and Robles, 2009). It is argued that the volatile agricultural price dynamics during the recent years compared with the past are attributed to the instability of the energy prices (Saghaian, 2010). In order to cope with the negative effects of soaring and volatile agricultural prices on the agricultural markets, governments take different measures such as price controls and trade barriers. However, the common view is that the interventions to domestic agricultural markets further spur the rise in and volatility of the global prices of agricultural commodities. Therefore, while the agricultural commodity prices may gradually adjust to the oil prices in the past, an increase in the oil prices may be rapidly transmitted to the agricultural commodity prices during the recent years, implying an asymmetric price linkage between energy and agricultural markets. The study shows that the story for wheat–oil prices is slightly different than those of corn and soybeans. According to the trace statistics, the null of no co-integration between the wheat and the oil prices is rejected for all periods with the exception of the sub-period 1998–2004. Indeed, this result is expected since wheat requires an energy-intensive production process. With respect to the nonlinear causal linkages between the oil and the wheat prices, the results for raw data indicate two-way causal linkages. However, the nonlinear causality test on the residuals does not support the existence of nonlinear causality. One can infer that even though there may be an asymmetric price transmission between the oil and the wheat prices, this relationship does not seem to be persistent. The findings obtained from the linear and the nonlinear causality analyses provide different policy implications. The linear causality analysis does not show any feedback from the oil to the agricultural prices, which implies that the movements in the oil prices do not play a role on the fluctuations of agricultural commodity prices. On the other hand, the nonlinear causality analysis indicates that the changes in the oil prices have predictive power in determining the future dynamics of the agricultural commodity prices. The findings from the nonlinear causality analysis imply that the recent surge in the agricultural commodity prices can be attributed the changes in the oil prices. The findings also provide some policy implications. For example, government policymakers should design agricultural policies within the context of tendencies in energy markets and policies.

According to the European Commission (EC) study "High commodity prices and volatility ...what lies behind the roller coaster ride?" (2011), the relative increase in volatility for many products was greater in the European Union (E.U.) following successive policy changes towards enhanced market orientation of E.U. agriculture. However, in absolute terms, volatility remains higher on the world than on the E.U. markets for all products (except chicken where levels are comparable and relatively low). Contrary to popular belief, the analysis confirms that there is a global long-term trend of a slowdown in world consumption growth for agricultural products, in line with lower population growth. This is reflected in the decline for wheat, rice and total feed grains. Even taking account of rising demand for biofuels, this does not reverse the overall trend of declining growth in consumption of feed grains. Maize world consumption growth slightly accelerated in recent decades, long before the development of maize-based ethanol. The EC also conducted more detailed analyses by region confirming these findings. Both the EU and the US experienced a slowdown in demand growth over time, apart from vegetable oils where demand has accelerated recently. The same broad trend can be seen for emerging countries, which are considered to be underpinning growing world food demand. There's an impact of strong demand for oil on the cost of agricultural inputs, particularly fertilizers. During 2004-2010, average world agricultural prices grew by 50 percent compared to the average of 1986-2003. By comparison energy prices jumped by 220 percent and fertilizer prices by 150 presses over the period. An OECD report (2008) identifies a number of factors including fluctuations in demand for agricultural non-food commodities and the increasing correlation between oil and agricultural markets. Higher and more volatile oil prices filter through to agricultural prices (due to input costs and the biofuels outlet for agricultural commodities). This may also stem from a sharper linkage with financial investment in commodity markets. Since the causes of price volatility are multiple and varied, this does not lend itself to simple solutions. Despite some common factors that appear to be at play across and beyond commodity markets, there are specific factors related to agricultural production (linkage to food security and the environment, dependency on life cycles, weather and seasons, sanitary conditions) which further complicate the potential impact of policy.

According to Woods , et al. (2010), agricultural demand for fossil energy, while growing, represents a relatively insignificant and shrinking share of the overall fossil energy supply market. On the other hand, as yields and the inputs needed to support those yields increase, agriculture is becoming more dependent on fossil fuels, either directly for tillage and crop management or through the application of energy-intensive inputs, e.g., nitrogen fertilizer and pesticides. According to Woods , et al. (2010), cereals tend to follow the same pattern in terms of energy inputs and wheat is used here as a proxy for cereals in general. The dominant energy carrier in non-organic wheat production is thus natural gas, but it is crude oil in organic wheat production and in China it would be coal. The embodied energy in machinery is an overhead of about 40 percent of the energy used in diesel, reflecting the high wear environment of cultivating and harvesting, as well as continually high power demand on engines, compared with road transport. Woods et al. (2010) note that increasing fossil fuel prices could pose a major risk to agriculture as production costs increase, and also cause increased volatility in prices between the different major agricultural commodities.

III. Data

Daily data have been collected for all series of interest and weekly aggregates computed on a consistent basis across time series. On the daily basis, the data cover 14 November 2006 through 31 December 2013; 1861 daily observations. Spot and 30-day futures prices data were collected for US soy, wheat and maize contracts. Wheat futures data have been collected for France and corn 30-day futures and spot prices were collected for Brazil. Spot and futures price data for Brent oil have been collected on a consistent basis with the data for agricultural commodities. The daily spot rates and daily futures rates were taken from the International Grain Council (International Grain Council, 2013) data base which corresponds to International Exchange (ICE) data. The ICE Brent Crude Futures contract is a deliverable contract based on EFP delivery with an option to cash settlement. Aggregate weekly have been computed directly from the daily data series in order to guarantee correspondence between the series over time. The daily futures series are plotted in Figures 1-5. The daily spot price for Brent Crude is shown in Figure 6. The weekly series are plotted in Figures 7-12.

Figure 1. US Wheat Futures Price, 30 Day, Daily ($US, n=1861)

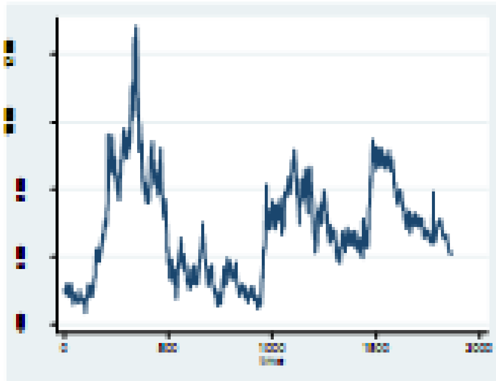


Figure 2. US Maize Futures Price, 30 Day, Daily (US$, n=1861)

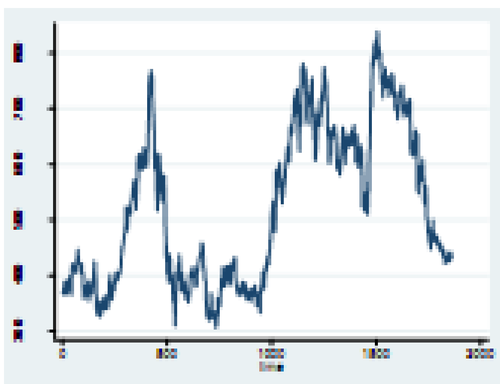


Figure 3. US Soy Futures Price, 30 Day, Daily (US$, n=1861)

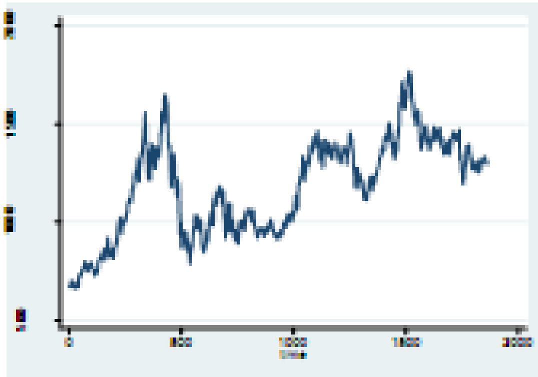


Figure 4. France Wheat Futures Price, 30 Day, Daily (€, n=1861)

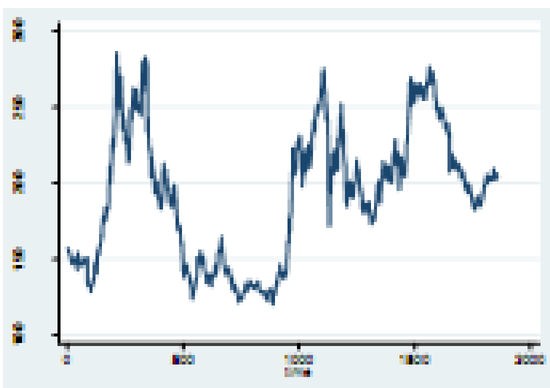


Figure 5. Brazil Corn Futures Price, 30 Day, Daily (R$, n=1861)

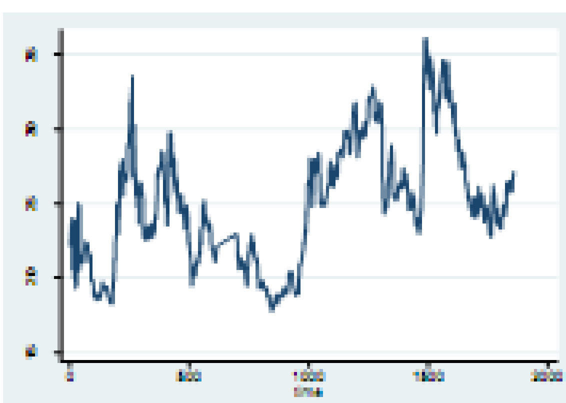


Figure 6. Brent Crude Oil Price, Daily (US$, n=1861)

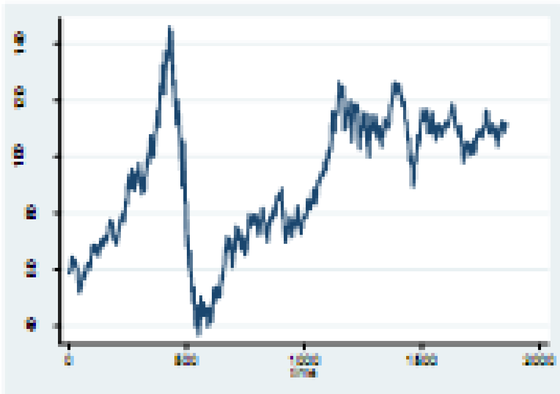


Figure 7. US Wheat Futures Price, 30 Day, Weekly (US$, n=372)

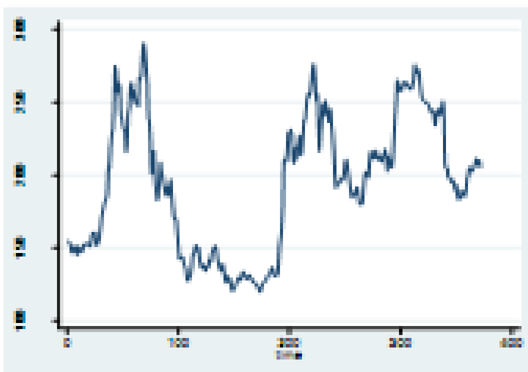


Figure 8. US Maize Futures Price, 30 Day, Weekly (US$, n=372)

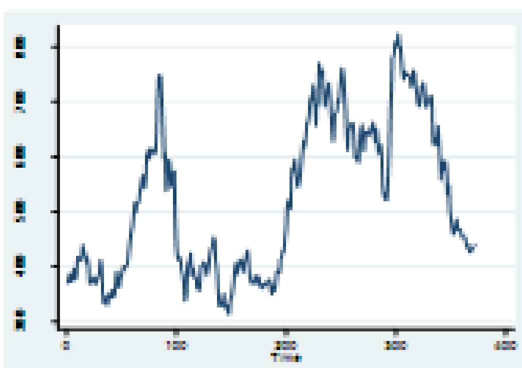


Figure 9. US Soy Futures Price, 30 Day, Weekly (US$, n=372)

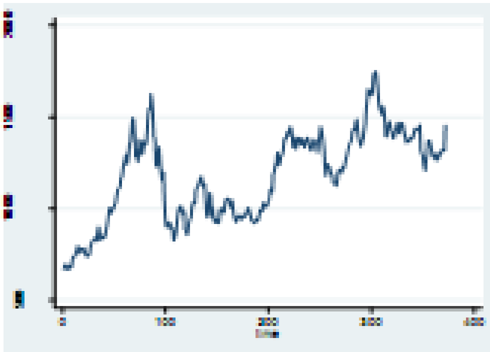


Figure 10. France Wheat Futures Price, 30 Day, Weekly (US$, n=372)

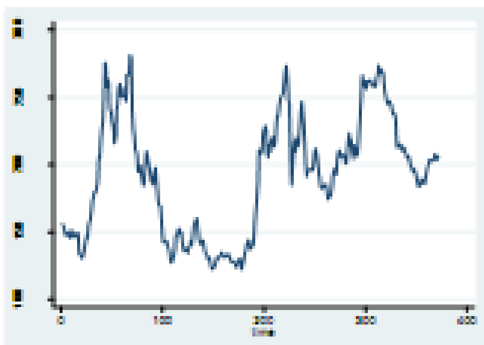


Figure 11. Brazil Corn Futures Price, 30 Day, Weekly (R$, n=372)

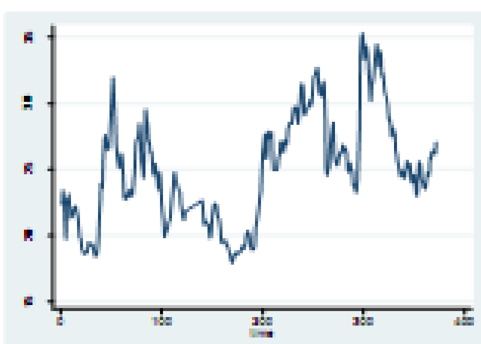
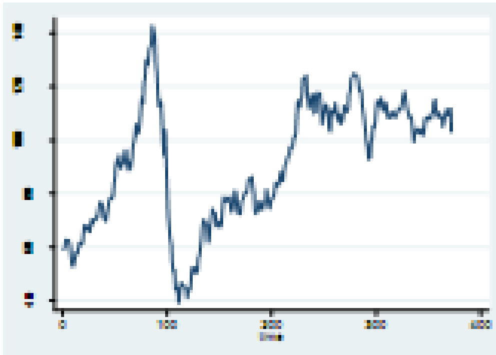


Figure 12. Brent Crude Oil Price, Daily (US$, n=372)



It is well-known that the situation of missing observations in financial time series is common. While it is not the primary focus of this study, the methodology used to replace or impute missing observations is important. Overall, the series were virtually complete having less than 5 percent of the observations missing. Missing observations were imputed using simple linear interpolation for missing observations was applied.

IV. Methodology

This paper tests two classes of time series models for prediction of commodity futures prices using the spot prices of the commodity in question as well as taking into consideration information content in the oil spot price at period t of use for predicting the future futures price. Interest is in the reverse regression (Campbell and Shiller (1987), Engel and West (2005), and Chen, Rogoff and Rossi (2008)). Fundamentally, the reverse regression points to the notion that today's market state (and past realizations in the dynamic case considered below) affects the forward-looking variable. More, technically, the idea is that the price today reflects expectations of future changes in market conditions, so it should be a useful predictor.

The empirical analysis is based on daily and weekly prices. The models are estimated over alternative levels of aggregation as Drost and Nijman (1993) have shown that classical GARCH assumptions are not robust to the specification of the sampling interval. The selection of these aggregation levels is based on work of Cartwright and Riabko (2015a, 2015b) indicating the reasonableness of the daily and weekly intervals relative to the monthly increment of temporal aggregation. The daily periodicity is highly volatile and poses modelling challenges owing to that volatility. However, daily prices are highly relevant for practioners. Based upon significance of parameter estimates, overall, Cartwright and Riabko (2015a, 2015b) favor the the daily and weekly periodicities. Monthly aggregations are not modelled in this research owing to the fact that aggregation eliminates considerable information content presumed useful for forecasting.

Following the earlier work, the basic model is given by

1) $f^{k}(t+n) = \Psi + \beta s(t) + \varepsilon(t+n)$

where

$f^{k}(t+n)$ = the average of the k-day forward contract price recorded at period t+n

$s(t)$ = the spot price on contracts of the commodity at period t

$\varepsilon(t)$ = error disturbance assumed distributed normal and independently with zero mean variance σ^2

n= number of periods into the future from the time period t

k= maturity of the futures contract in days.

It is well-known that intertemporal effects in financial models are prevalent. Intertemporal effects have been recognized at least since the work of Merton (1976) and Black (1976). The model of interest is of the form

2) $f^{k}(t+n) = \Psi' + \phi' f^{k}(t) + \beta' s(t) + \varepsilon'(t+n)$

where $f^k(t+n)$ indicates the futures contract with maturity k recorded at time period t. It is expected that the coefficient $0 \geq \phi < 1$ and the error term is assumed to have zero expectation and constant variance (Judge, Griffiths, Hill, Lütkepohl and Lee (1985)).[1]

Building on research by Cartwright and Riabko (2015a, 2015b) an effort is made to better under the transmission or spillover effects from energy (oil) prices onto futures contract prices. The model is augmented by including the spot oil price such that

3) $f^k(t+n) = \Psi'' + \phi'' f^k(t) + \beta'' s(t) + \delta'' o(t) + \varepsilon''(t+n)$

where

$o(t)$ = the spot price for oil (Brent) at period t.

All other variables are defined as indicated following equations 1) and 2).

Following Engle (1982), Bollerslev (1986), Bollerslev, T., Engle, R.F. and Nelson (1994) and Engle (2002) consider the time series, $y_t = E_{t-1}(y_t) + \varepsilon_t$, where $E_{t-1}(y_t)$ is the conditional expectation of y_t at time t-1 and ε_t is the error at time period t. The GARCH model of Bollerslev (1986) is given as

4) $\varepsilon_t = h_t^{1/2} \eta_t,\ \ \eta_t \sim N(0,1)$

5) $h_t = \omega + \sum_{j=1}^{p} \alpha_j \varepsilon^2_{t-j} + \sum_{j=1}^{q} \beta_j h_{t-j} = \omega + \alpha(L)\varepsilon^2_t + \beta(L)\sigma^2_t$

where

[1] Cartwright and Riabko (2015a) consider a simple one-period lagged dependent variable model (LDV) applying feasible generalized least squares for estimation. However, on average, the model has limited explanatory power.

$\omega > 0$, $\alpha_i \geq 0$ and $\beta_j \geq 0$ are sufficient to ensure that the conditional variance $h_t > 0$. L is the backshift operator. In Equation 5 α_i represents the ARCH effect, β_j captures the GARCH effects and $(\alpha_i + \beta_j)$ measures the persistence of the shocks to the variable of interest I to long-run persistence. Provided that the roots of $(1 - \alpha(L) - \beta(L))$ and $(1- \beta(L))$ lie outside the unit circle, then ε_t^2 exhibits stability and covariance stationarity.

Last, the proposed EGARCH of Nelson (1991) is used for this evaluation. EGARCH accommodates asymmetry between positive and negative shocks as well as leverage and interprets ARMA models for the logarithm of the condition variances such that

6) $ln\ h_t = \omega + \sum_{i=1}^{p} \alpha_i\ |\eta_{t-i}| + \sum_{i=1}^{p} \gamma_i\ \eta_{t-i} + \sum_{j=1}^{q} \beta_j\ ln\,h_{t-j}$.

In Equation 6) $|\ \eta_{t-i}\ |$ and η_{t-i} capture the size and sign effects, respectively, of the standardized shocks, i.e., $\eta_{t-i} = (\ \varepsilon_{t-i}/\ \sigma_{t-i})$. More specifically, 6) implies that the leverage effect allowing the variance to respond differently following negative or positive shocks of equal magnitude is exponential and that the forecasts of the conditional variance are necessarily non-negative. The presence of leverage effects can be tested by $\gamma_i < 0$. The impact is asymmetric if $\gamma_i \neq 0$. So, the model estimates both the sign and magnitude effects. McAleer (2005) and McAleer et al. (2007) provide a discussion of differences between GARCH and EGARCH models. Other methods and specifications such as GJR-GARCH (Glosten et al., 1992) are interesting, however, EGARCH has been applied to capture size and assign effects as the methods uses standardized residuals to capture conditional shocks and there are no restrictions on the parameters for the conditional variance.

Applying general procedures for time series methods, the autocorrelation (ACF) and partial autocorrelation functions (PACF) for the data series are estimated and the Phillips-Perron test for a unit root was applied. Consequently, all models are estimated with first differences of the time series of interest. Applying ARCH and EARCH specifications, model performance is evaluated considering two criteria and four metrics. First, models are estimated over the full sample and one-step prediction errors are calculated over the full sample. The metrics generated to assess model performance are bias given by mean error (ME) and accuracy measured by mean square error (MSE), AIC and BIC. Models of increasing leads (lags) of one incremental time period are estimated, the maximum lead (lag) being determined by the specification in which estimated coefficients on the futures contract price, the spot commodity price and the spot oil commodity price taken separately at time period t, respectively, are no longer significant at any reasonable confidence level or until the model specification is not estimable owing to violation of the invertibility conditions or the non-concavity of the likelihood function. Admittedly, this is *ad hoc*, but application of this method is intended to provide insight into 1) whether or not spot prices of interest contain information useful for predicting futures contract prices and 2) the time horizon relevant for forecasting.

Second, we conduct an *ex post* forecasting exercise. Models are estimated using the data up to a given split point, instead of the full sample, and forecasts are generated for the remaining hold-out periods. The issue of sample splitting in order to generate *ex post* forecasts is problematic. In this research it is acknowledged is that selection of a particular split point leaves researchers open to challenge that the split point was selected to favor a particular models (Hansen, P.R. and Timmermann, A., 2012). Further, there is a second concern that per series selection rules might well outperform approaches applying one method to all series under consideration (Fildes, R. and Petropoulos, F., 2013) . In this research, time horizons for daily data of 5 and 10 periods have been selected, while horizons of 4 and 8 steps have been selected for the weekly periodicity. The justification is simply that these horizons represent, respectively, 1 and 2 weeks and 1 and 2 months of activity.

Models are selected following the same process as used for the full sample although on the basis of results using the truncated sample. Diagnostics are calculated and reported for the 5 and 10 period hold-out samples. ME, mean absolute error (MAE) and mean square forecast error (MSFE) over the horizons indicated are considered out-of-sample. Baselines for evaluating forecast performance are given by diagnostics for random walk models generated using the STATA ucm command (STATA, *Time Series, Release 12 (1985-2011)*). Finally, forecasts are static, i.e., not dynamic or recursive.

V. Results

5.1 Daily Data

5.1.1 Full Sample Estimation

The first-differenced daily series including Brent oil are shown in Figures 7-12. The GARCH and EGARCH models are estimated autoregressive heteroscedastic model for daily observations using the arch procedure in STATA, *Time Series, Release 12 (1985-2011)*. In this procedure the conditional variances are modeled as univariate generalized autoregressive conditionally heteroscedastic models and the covariances are modeled as nonlinear functions of the conditional variances (Engle, 2002). While only the final selected specifications are reported, for the GARCH (p,q) models alternative values for p and q were tested. The popularity of the GARCH (1, 1) model is indicated by a significant body of literature, e.g. Nelson (1990). The GARCH (1, 1) model has often been found sufficient to capture the main features of the volatility process.

Figure 7. US Wheat Futures Price, 30 Day, First-Difference, Daily (n=1860)

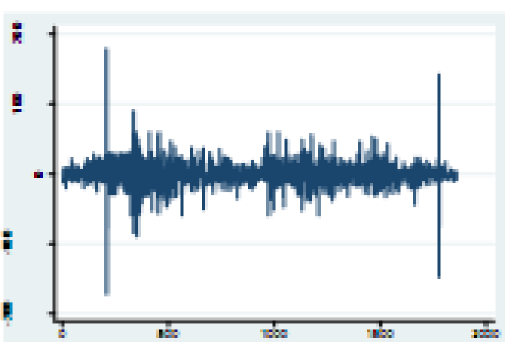


Figure 8. US Maize Futures Price, 30 Day, First-Difference, Daily (n=1860)

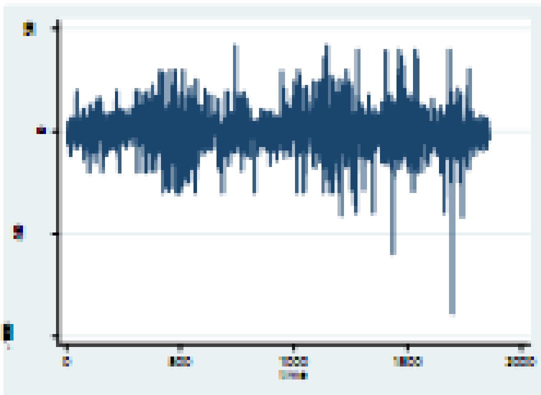


Figure 9. US Maize Futures Price, 30 Day, First-Difference, Daily (n=1860)

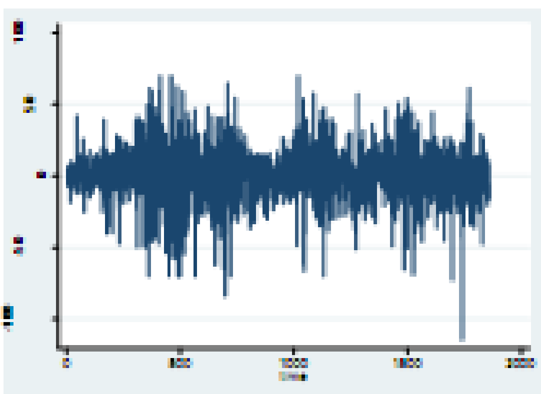


Figure 10. France Wheat Futures Price, 30 Day, First-Difference, Daily (n=1860)

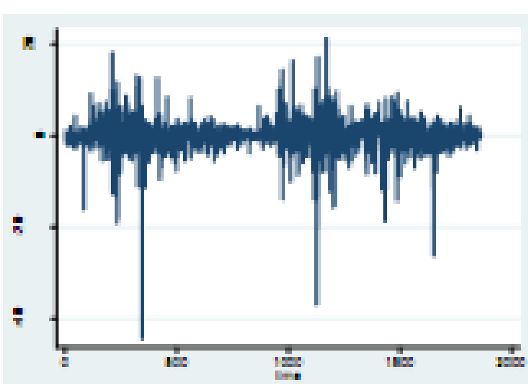


Figure 11. France Wheat Futures Price, 30 Day, First-Difference, Daily (n=1860)

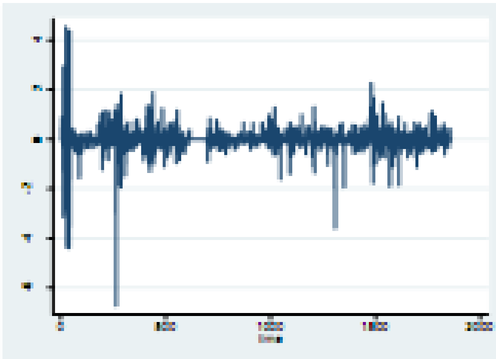
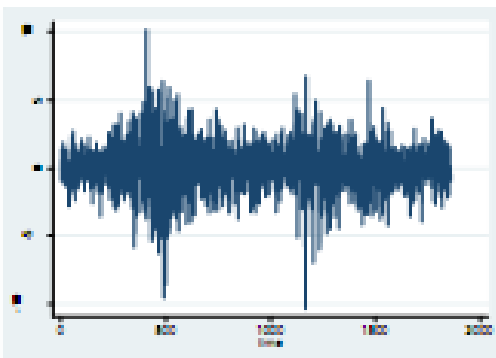


Figure 12. Brent Oil Spot Price, First-Difference, Daily (n=1860)



Models of increasing leads (lags) of one incremental time period are estimated as indicated in the previous section. Results are summarized in Tables 1, 2, and 3. Table 1 reports the detailed results for the models estimated. The most salient results are that, first, for the 49 models tested with respect to statistical significance at the 10 percent significance level or better, the parameter estimates on the dependent variable at time period t, the own-commodity spot price at t, and the spot oil price at period t are significant 45, 56, and 60 percent of time, respectively. The horizons over which the estimates are significant vary considerably with respect to commodity, pointing to the heterogeneity of the markets under analysis.

The estimated coefficient on the dependent variable at time period t is significant 22 times and the horizon varies between 11 periods (Brazilian corn) and being insignificant for cases such as US maize. Perhaps more interesting, the estimated coefficient on the differenced spot own-commodity spot rate is significant at the 90 percent confidence level or better out to 3 periods for US Wheat futures prices (GARCH and EGARCH), 3 periods for the US maize futures prices (EGARCH), and 3 periods for the US soy futures prices (GARCH and EGARCH). For French wheat futures the estimated coefficient on the differenced spot own-commodity price is statistically significant for the 3 period lag for the EGARCH model. For Brazilian corn futures, the spot own-commodity spot price is consistently significant 11 periods and 8 periods out for the GARCH and EGARCH models, respectively.

As concerns the spot Brent oil price, for the US wheat futures, the estimated coefficient is significant at the 90 percent confidence level or better out 1 period (GARCH) and out 5 periods for the EGARCH models. For the case of US Maize futures, the spot oil price variable is significant at the 1 period lag for GARCH and out to 3 periods for EGARCH. With respect to the US soy futures the spot oil price is shown to be significant at the 1 period lag (GARCH) and the 2 period lag (EGARCH). Further, for the French wheat futures, the spot oil price parameter is estimate is statistically significant at the 1 period land for GARCH and out to three periods for EGARCH. Finally, with respect to the Brazilian corn futures prices, the estimates on the own-commodity price are significant out as far as 11 periods (GARCH) and 9 periods (EGARCH). The estimated coefficients on the spot oil price are significant out to 11 periods for the GARCH specification and out to 8 periods for EGARCH.

As concerns the arch and garch parameter estimates, as indicated in Table 3, the signs of the coefficients are positive as expected the variance of the current period error is an increasing function of the magnitude of the lagged errors, hence, large errors tend to be followed by large errors irrespective of sign. The parameter estimates for earch, egarcha and egarch correspond to the sign effects, size effects and persistence effects as in equation 6). Overall, the results indicate that indicate that positive shocks tend to be more destabilizing than negative shocks (sign effects) . The size effects are positive indicating that lagged large market movements result in large movements in following period. For all models and specifications the errors show large persistence effects (eparch) indicating that the series have quite long memories.

The ME and MSE criteria vary considerably with respect to commodity, model specification, and time horizon indicating the heterogeneity of the processes associated with the markets, and therefore, importance of considering multiple models. For example, for the US Wheat GARCH models the ME closest to zero is Wheat-US+3, while the minimum MSE is reached for Wheat-US+1. For the US Wheat EGARCH models, I indicate a preference for Wheat-US+4, while minimum MSE is attained for Wheat-US+1.

Finally, the last columns of Table 1 show the AIC and BIC statistics. The model selection literature contains considerable debate about using AIC or BIC. The mathematical literature, e.g., Burnham and Anderson (2004) tends to favor BIC. Acknowledging that AIC and BIC model selection can both be derived as either frequentist or Bayesian procedures, for purposes of this research AIC is considered to address the question of which model is best or "least wrong", while BIC considers the question of which model is most likely to be "true". Irrespective of the interpretation, for the model test neither criterion found to be useful in the sense that with the exception of the Brazilian corn series, the AIC and BIC are minimized for models of maximum lead (lag) and for these cases , not all (if any) of the estimates of ϕ, β and δ are statistically significant. In the case of the Brazilian corn series, the AIC and BIC suggest models Corn-BR+4 (GARCH) and Corn-BR+2 (EGARCH).

Variable-Model	φ	β	δ	arch(1)	garch(1)	earch(1)	egarcha(1)	egarch(1)	ME	MSE	AIC	BIC
Wheat-US+1 GARCH	-.206** (.079)	.218** (.077)	-.807** (.225)	.163** (.011)	.783** (.019)				.375	202.773	15487.05	15525.75
Wheat-US+2 GARCH	-.150* (.080))	.148* (.077)	-.155 (.219)	.811** (.011)	.752** (.021)				.367	216.817	15488.77	15527.46
Wheat-US+3 GARCH	.167** (.066)	-.185** (.058)	.295 (.210)	.180** (.011)	.756** (.030)				.339	213.975	15477.69	15516.38
Wheat-US+4 GARCH	-.133* (.076)	.102 .069)	.303 (.214)	.178** (.011)	.760** (.030)				.359	215.131	15473.07	15511.75
Wheat US+5 GARCH	-.066 (.067)	.077 (.065)	.255 (.217)	.172** (.012)	.769** (.019)				.362	214.678	15467.78	15506.46
Wheat-US+1 EGARCH	-.116 (.078)	.146** (.074)	-.580** (.202)			.116** (.006)	.203** (.023)	.939** (.008)	-.365	205.943	15427.26	15471.48
Wheat-US+2 EGARCH	-.112* (.067)	.122** (.064)	-.402* (.206)			.124** (.006)	.216** (.023)	.933** (.009)	-.140	216.527	15425.92	15470.13
Wheat-US+3 EGARCH	.165** (.058)	-.176** (.051)	.393** (.200)			.119** (.006)	.229** (.025)	.932** (.009)	-.458	214.452	15411.78	15456.0
Wheat-US+4 EGARCH	-.118 (.072)	.060 (.064)	.472** (.206)			.112** (.010)	.218** (.024)	.930** (.047)	-.063	214.937	15408.38	15452.59
Wheat-US+5 EGARCH	-.011 (.091)	.022 (.086)	.558** (.202)			.122** (.010)	.205** (.022)	.940** (.007)	-.354	215.727	15399.21	15443.42
Wheat-US+6 EGARCH	-.032 (.103)	.076 (.098)	-.026 (.217)			.125** (.010)	.206** (.021)	.930** (.008)	-.431	214.681	15397.15	15441.35
Maize-US+1 GARCH	.048 (.070)	.010 (.065)	-.304** (.143)	.061** (.006)	.931** (.007)				-.142	116.665	12844.13	12882.83
Maize-US+2 GARCH	-.084 (.094)	.060 (.087)	-.136 (.139)	.059** (.006)	.933** (.007)				-.133	116.654	12844.06	12882.75
Maize-US+1 EGARCH	.035 (.064)	.029 (.060)	-.436** (.142)			.010 (.008)	.140** (.013)	.980** (.004)	-.096	116.655	12825.19	12869.41
Maize-US+2 EGARCH	-.085** (.025)	-.077** (.008)	-.220 (.136)			-.007 (.011)	.136** (.017)	.987** (.005)	-.043	116.733	12825.9	12870.11
Maize-US+3 EGARCH	.036** (.005)	-.032** (.008)	.172** (.068)			-.006 (.013)	.133** (.017)	.987** (.004)	-.046	116.752	12822.73	12866.95
Maize-US+4 EGARCH	-.034 (.033)	.034 (.031)	.133 (.142)			-.006 (.013)	.135** (.017)	.987** (.005)	-.018	116.865	12817.44	12861.65
Soy-US+1 GARCH	.041 (.033)	.024 (.035)	-.694** (.248)	.074** (.008)	.915** (.009)				-.350	276.676	15962.27	16000.96
Soy-US+2 GARCH	-.046 (.037)	.050 (.035)	-.348 (.254)	.073** (.007)	.917** (.009)				-.358	276.788	15963.38	16002.07
Soy-US+1 EGARCH	.029** (.015)	.033 (NA)	-.622** (.238)		-	.006 (.013)	.152** (.024)	.986** (.005)	-.477	276.602	15953.37	15993.06
Soy-US+2 EGARCH	-.044 (.038)	.063** (.036)	-.387 (.256)			.005 (.009)	.150** (.016)	.987** (.003)	-.473	279.289	15953.68	15997.9
Soy-US+3 EGARCH	.053 (.041)	-.050 (.033)	.233 (.255)			.007 (.009)	.149** (.016)	.987** (.004)	-.486	278.367	15947.85	15993.06
Wheat-FR+1 GARCH	.011 (.043)	.040 (.034)	-.078** (.030)	.120** (.006)	.869** (.004)				.084	12.551	9417.957	9456.652
Wheat-FR+2 GARCH	-.036 (.043)	.036 (.033)	-.058 (.036)	.114** (.007)	.863** (.004)				.083	12.577	9418.297	9456.988
Wheat-FR+1 EGARCH	.040 (.030)	.017 (.030)	-.071** (.034)			.066** (.003)	-.010** (.001)	1.001** (.001)	.175	12.587	9252.077	9296.299
Wheat-FR+2 EGARCH	-.065* (.038)	-.054 (.036)	-.247** (043)			.049** (.006)	.072 (NA)	.993** (.002)	-.035	12.641	9654.101	9692.791
Wheat-FR+3 EGARCH	-.164** (.041)	.133** (.036)	-.101** (.037)			.041** (.006)	.148** (.024)	.990** (.003)	-.136	12.907	9412.981	9457.194
Wheat-FR+4 EGARCH	.030 (.040)	.003 (.036)	.017 (.035)			.042** (.007)	.138** (.009)	.989** (.001)	.035	12.618	9377.422	9421.632
Corn-BR+1 GARCH	.136** (.022)	.030** (.006)	.001 (.001)	.631** (.018)	.680** (.006)	.002 (.001)	.682** (.007)		-.001	.260	1239.645	1278.339
Corn-BR+2 GARCH	.021 (.019)	-.030** (.005)	-.001 (.001)	.613** (.021)	.682** (.007)				-.015	.250	1263.949	1302.64
Corn-BR+3 GARCH	-.055** (.017)	.022** (.005)	.003** (.001)	.614** (.019)	.684** (.006)				-.003	.248	1248.719	1287.406
Corn-BR+4 GARCH	.025 (.019)	.017** (.004)	.004** (.001)	.651** (.017)	.673** (.006)				-.004	.249	1231.551	1270.234
Corn-BR+5 GARCH	-.016 (.019)	.022** (.005)	.003** (.001)	.636** (.017)	.681** (.006)				-.004	.249	1236.403	1275.081
Corn-BR+6 GARCH	-.050** (.014)	.020** (.003)	.003** (.001)	.651** (.018)	.671** (.007)				-.004	.252	1248.425	1287.101
Corn-BR+7	-.001	.019**	.004**	.641**	.675**				-.003	.250	1244.38	1283.063

GARCH	(.015)	(.004)	(.001)	(.017)	(.006)							
Corn-BR-8	-.045**	032**	.002**	.633**	.677**				-.004	.350	1233.365	1271.633
GARCH	(.012)	(.004)	(.001)	(.017)	(.005)							
Corn-BR-9	-.033**	.032**	.001	.647**	.672**				-.003	.346	1254.381	1293.045
GARCH	(.014)	(.004)	(.001)	(.017)	(.006)							
Corn-BR-10	-.021	.038**	.00002	.652**	.671**				-.004	.345	1250.032	1288.692
GARCH	(.013)	(.004)	(.002)	(.017)	(.006)							
Corn-BR-11	.056**	-.036**	.003**	.718**	.646**				-.013	.346	1244.384	1283.041
GARCH	(.011)	(.003)	(.008)	(.023)	(.009)							
Corn-BR-12	.008	-.0003	-.003	.581**	.680**				-.012	.340	1250.46	1286.113
GARCH	(.014)	(.010)	(.002)	(.017)	(.007)							
Corn-BR-1	-.113**	.100**	.017**			-.006**	.001	.983**	.0004	.344	2659.156	2703.379
EGARCH	(.011)	(.035)	(.008)			(.001)	(.002)	(.015)				
Corn-BR-2	-.005**	-.038**	0.00			-.004	.610**	.966**	-.011	.350	1215.365	1256.483
EGARCH	(.001)	.0001	(4e-06)			(.016)	(.034)	(.004)				
Corn-BR-3	-.065**	-.016**	-.001**			.001	.628**	.965**	-.012	.346	1223.992	1268.306
EGARCH	(.002)	(.0003)	(.00002)			(.006)	(.034)	(.004)				
Corn-BR-4	-.101**	.015**	.001**			-.006	.988**	.943	-.006	.351	1290.881	1335.061
EGARCH	(.037)	(.004)	(.0008)			(.033)	(.007)	(.011)				
Corn-BR-5	047	.021	.002**			.007	.616**	.968**	-.005	.350	1200.032	1227.66
EGARCH	(NA)	(NA)	(.0003)			(.006)	(.034)	(.004)				
Corn-BR-6	-.068**	.018**	.001**			013	.632**	.963**	-.005	.353	1216.438	1260.636
EGARCH	(.005)	(.0003)	(.0003)			(.016)	(.036)	(.004)				
Corn-BR-7	.036	-.040	4e-04**			.015	.458**	.973**	-.013	349	1245.486	1273.108
EGARCH	(NA)	(NA)	(.0001)			(.013)	(.027)	(.003)				
Corn-BR-8	.053	032**	.002**			.008	.617**	.965**	-.005	.350	1217.653	1250.767
EGARCH	(NA)	(.001)	(.0003)			(.016)	(.035)	(.004)				
Corn-BR-9	-.032**	-.033**	-.001			-.0003	.619**	.956**	-.013	.346	1248.063	1292.25
EGARCH	(.015)	(.006)	(.001)			(.005)	(.015)	(.004)				

* Indicates significance at the 90 percent confidence level
** Indicates significance at the 95 percent confidence level or better
standard errors shown in parentheses
NA indicates not estimable

Table 2. Significance of Parameter Estimates (ϕ, β, δ), In-Sample Results, First-Difference, Daily (n=1860)*

Commodity	Specification	Models	ϕ	β	δ
Wheat-US	GARCH	5	4	3	1
	EGARCH	6	2	3	5
Maize-US	GARCH	2	0	0	1
	EGARCH	4	2	2	2
Soy-US	GARCH	2	0	0	1
	EGARCH	3	1	1	1
Wheat-FR	GARCH	2	0	0	1
	EGARCH	4	2	1	3
Corn-BR	GARCH	12	6	11	7
	EGARCH	8	5	6	7
Total		49	23	28	29

*Significant at the 10 percent significance level or better.

Table 3. Signs and Significance of Parameter Estimates, GARCH and EGARCH, In-Sample Results, First-Difference, Daily (n=1860)*

Commodity	Sign	arch(1)	garch(1)	earch(1)	egarcha(1)	egarch(1)
Wheat-US	+	5	5	6	6	6
	-					
Maize-US	+	2	2		4	4
	-					
Soy-US	+	2	2		3	3
	-					
Wheat-FR	+	2	2	4	2	4
	-					
Corn-BR	+	12	12		7	7
	-			1		

*Significant at the 10 percent significance level or better

At this point, with respect to the key interests of this research, it is reasonable to conclude that based upon the results for the 49 tested models, that the reverse regressions are often useful in that today's market state captured by the spot own-commodity price effects the forward-looking variable . In fact, for the models tested, the estimated coefficient on the own-commodity spot price is significant in 23 of the 49 cases considered. Of considerable interest is the evidence that in 28 of the 49 models considered the spot oil price is significant at the 10 percent confidence level or better.

5.1.2 *Ex post* forecasts

For the purposed of providing a benchmark for comparing forecast performance, random walk models are estimated for the 5 and 10 period *ex post* forecasting horizons. Based on the process of model selection described in section 1.1 models are reported for the forecasting exercise, i.e., the maximum lead (lag) specification is based upon the significance of the estimated coefficients (ϕ, β, δ). As above, estimation of increased order models is terminated when parameter estimates on ϕ, β, δ are not significant at any reasonable confidence, the model specification is not estimable owing to violation of the invertibility conditions, or the model specification is not estimable owing to the non-concavity of the likelihood function.

Table 4. GARCH and EGARCH *Ex post* Forecast Performance, First-Difference, Daily (n=1860)

Variable-Model	Time *Ex Post* Forecast Horizon	φ	β	δ	arch(1)	garch(1)	earch(1)	egarcha(1)	egarch(1)	ME	MAE	MSFE
Wheat-US+1 GARCH	5	-.204** (.079)	.216** (.077)	-.608** (.226)	.163** (.011)	.780** (.016)				-.146	3.267	19.894
Wheat-US+1 GARCH	10	-.202** (.079)	.215** (.077)	-.617** (.227)	.163** (.011)	.778** (.016)				-1.140	3.466	19.317
Wheat-US+2 GARCH	5	-.152* (.080)	.151** (.077)	.157 (.220)	.181** (.011)	.749** (.021)				-.098	3.315	20.796
Wheat-US+2 GARCH	10	-.157** (.079)	;155** (.076)	-.151 (.220)	.182** (.011)	.749** (.022)				-1.235	3.548	19.110
Wheat-US+3 GARCH	5	.166** (.066)	-.185** (.058)	.295 (.211)	.180** (.011)	.756** (.021)				-.271	3.293	20.680
Wheat-US+3 GARCH	10	.164** (.066)	-.184** (.058)	.304 (.211)	.180** (.011)	.752** (.021)				-1.323	3.605	19.502
Wheat-US+4 GARCH	5	-.132* (.076)	.021 (.069)	.301 (.215)	..178** (.011)	.757** (.020)				-.251	3.261	21.408
Wheat-US+4 GARCH	10	-.131* (.076)	.010 (.069)	.292 (.216)	.178** (.011)	.754** (.021)				-1.40	3.405	18.124
Wheat-US+5 GARCH	5	-.066 (.097)	.078 (.095)	.247 (.218)	.172** (.012)	.766** (.016)				-.222	3.157	19.950
Wheat-US+5 GARCH	10	-.065 (.096)	.078 (.095)	.240 (.219)	.172** (.012)	.762** (.020)				-1.264	3.368	18.320
Wheat-US+1 EGARCH	5	-.115 (.078)	.145** (.074)	-.583** (.203)			.115** (.009)	.304** (.023)	.938** (.009)	-.740	3.165	20.889
Wheat-US+1 EGARCH	10	-.115 (.078)	.145** (.074)	-.587** (.204)			.116** (.009)	.305** (.024)	.936** (.009)	-1.811	3.638	21.484
Wheat-US+2 EGARCH	5	-.113* (.067)	.134** (.064)	-.402** (.207)			.124** (.009)	.316** (.023)	.932** (.010)	-.456	3.202	20.948
Wheat-US+2 EGARCH	10	-.033 (.076)	.052 (.078)	-.243 (.191)			.061** (.002)	-.005** (.001)	.999** (.001)	-1.614	3.168	19.792
Wheat-US+3 EGARCH	5	.164** (.015)	-.175** (.012)	.398** (.135)			.119** (.078)	.329** (.027)	.931** (.011)	-.896	3.262	21.611
Wheat-US+3 EGARCH	10	.161** (.058)	-.172** (.051)	.412** (.210)			.118** (.009)	.330** (.025)	.929** (.009)	-2.048	3.938	23.239
Wheat-US+4 EGARCH	5	-.116 (.072)	.058 (.064)	.468** (.207)			.114** (.010)	.317** (.025)	.934** (.009)	-.695	3.439	23.218
Wheat-US+4 EGARCH	10	-.113 (.073)	.055 (.064)	.458** (.208)			.113** (.010)	.318** (.025)	.933** (.009)	-1.836	3.60	19.861
Wheat-US+5 EGARCH	5	-.010 (.091)	.022 (.064)	.553 ** (.274)			.121** (.010)	305** (.022)	.939** (.007)	-1.066	3.335	20.066
Wheat-US+5 EGARCH	10	NA	NA	NA			NA	NA	NA	NA	NA	NA
Wheat-US+6 EGARCH	5	-.031 (.103)	.075 (.097)	-.016 (.218)			.124** (.010)	.306** (.022)	.934** (.008)	-.687	3.294	23.056
Wheat-US+6 EGARCH	10	-.031 (.102)	.074 (.097)	-.015 (.219)			.124** (.010)	.307** (.022)	.933** (.008)	-1.809	3.716	20.863
Maize-US+1 GARCH	5	.047 (.070)	.011 (.065)	-.399** (.143)	.060** (.006)	.931** (.008)				-2.603	3.135	11.393
Maize-US+1 GARCH	10	.047 (.070)	.012 (.065)	-.411** (.144)	.061** (.006)	.930** (.008)				-.663	2.800	10.407
Maize-US+2 GARCH	5	-.084 (.064)	.059 (.087)	-.131 (.140)	.059** (.006)	.932** (.007)				-2.309	2.789	10.061
Maize-US+2 GARCH	10	-.083 (.064)	.058 (.087)	-.131 (.140)	.059** (.006)	.932** (.008)				-.593	2.572	9.719
Maize-US+1 EGARCH	5	.034 (.064)	.031 (.059)	-.442** (.142)			-.010 (.009)	.140** (.012)	.986** (.004)	-2.548	3.099	11.121
Maize-US+1 EGARCH	10	034 (.064)	031 (.059)	-.460** (.143)			-.010 (.009)	140** (.012)	.985** (.004)	-.616	2.807	10.487
Maize-US+2 EGARCH	5	-.066 (.063)	.077** (.003)	-.214 (.151)			-.008 (.011)	.135** (.018)	.987** (.004)	-2.60	3.035	11.219
Maize-US+2 EGARCH	10	NA	NA	NA			NA	NA	NA	NA	Na	NA
Maize-US+3 EGARCH	5	.037** (.015)	-.020 (NA)	-.171 (.153)			.030 (.007)	.061 ** (.017)	.872 ** (.041)	-2.637	3.075	11.571
Maize-US+3 EGARCH	10	.036** (.007)	-.019** (.009)	.169** (.063)			-.007 (.013)	.133** (.017)	.986** (.005)	-1.553	3.655	15.665
Maize-US+4 EGARCH	5	-.014 (.035)	.025 (.076)	.138 (.146)			-.006 (.008)	.134** (.011)	.987** (.004)	-2.632	3.117	11.783

Maize-US+4 EGARCH	10	-.015 (.080)	.026 (.076)	.133 (.147)			-.007 (.008)	.134** (.011)	.986** (.004)	-.567	2.621	9.533
Soy-US+1 GARCH	5	.041 (.033)	.024 (.025)	-.702** (.249)	.075** (.008)	.915** (.006)				-6.715	10.06	115.898
Soy-US+1 GARCH	10	.043 (.033)	.024 (.025)	-.735** (.249)	.076** (.008)	.915** (.006)				-6.783	10.71	147.04
Soy-US+2 GARCH	5	-.046 (.037)	.051** (.025)	-.147 (-.255)	.073** (.008)	.917** (.006)				-6.858	9.946	113.97
Soy-US+2 GARCH	10	-.048 (.037)	.050** (-.025)	-.138 (.255)	.074** (.008)	.917** (.006)				-4.936	10.13	133.931
Soy-US+3 GARCH	5	.059 (.041)	-.057* (.033)	.300 (.265)	.074** (.007)	.916** (.006)				-6.763	9.90	113.31
Soy-US+3 GARCH	10	.056 (.043)	-.057* (.033)	.074** (.007)	.074** (.007)	.916** (.006)				-5.021	10.14	134.30
Soy-US+4 GARCH	5	.001 (.048)	-.017 (.041)	.190 (.268)	.073** (.007)	.918** (.006)				-6.852	9.913	113.21
Soy-US+4 GARCH	10	.001 (.048)	-.017 (.001)	.168 (.268)	.073** (-.007)	.917** (.006)				-5.032	10.03	133.61
Soy-US+5 GARCH	5	-.017 (.037)	-.004 (.027)	.281 (.244)	.073** (.008)	.917** (.006)				-7.013	10.06	115.98
Soy-US+5 GARCH	10	-.016 (.017)	-.005 (.027)	.291 (.244)	.074** (.008)	.917** (.006)				-5.031	10.30	135.51
Soy-US+1 EGARCH	5	.030 (.033)	.033 (.025)	-.635** (.249)			.006 (.010)	.152** (.016)	.986** (.004)	-6.847	10.13	117.18
Soy-US+1 EGARCH	10	.033 (.033)	.033 (.025)	-.670** (.251)			.005 (.010)	.153** (.016)	.986** (.004)	-6.847	10.41	117.40
Soy-US+2 EGARCH	5	-.044** (.022)	.063** (.020)	-.189 (.177)			.005 (.013)	.150** (.024)	.987** (.005)	-6.920	10.03	116.32
Soy-US+2 EGARCH	10	-.043 (.038)	.062** (.026)	-.176 (.257)			.005 (.009)	.151** (.016)	.986** (.004)	-5.035	10.18	135.75
Soy-US+3 EGARCH	5	.051 (.041)	-.050 (.033)	.339 (.255)			.007 (.009)	.148** (.016)	.986** (.004)	-6.940	9.983	114.22
Soy-US+3 EGARCH	10	-.010 (.035)	.002 (.029)	.708** (.241)			-.010** (.004)	.025** (.006)	.975** (.007)	-4.810	10.35	136.61
Soy-US+4 EGARCH	5	-.007 (.046)	-.010 (.038)	.191 (.253)			.007 (.009)	.147** (.016)	.987** (.004)	-6.979	9.983	114.88
Soy-US+4 EGARCH	10	-.007 (.046)	-.010 (.038)	.191 (.253)			.007 (.009)	.147** (.016)	.987** (.004)	-5.142	10.04	133.44
Wheat-FR+1 GARCH	5	.011 (.044)	.041 (.034)	-.079** (.031)	.119** (.009)	.880** (.004)				-.280	.634	.403
Wheat-FR+1 GARCH	10	.011 (.043)	.041 (.033)	-.082** (.031)	.119** (.006)	.886** (.004)				.209	.876	1.003
Wheat-FR+2 GARCH	5	-.035 (.043)	.025 (.003)	-.058 (.036)	.114** (.007)	.863** (.004)				-.281	.611	.387
Wheat-FR+2 GARCH	10	-.036 (.043)	.026 (.033)	-.057 (.036)	.114** (.007)	.863** (.004)				.224	.814	.900
Wheat-FR+1 EGARCH	5	.037 (.035)	.019 (.035)	-.065** (-.029)			.064** (.003)	.011** (.001)	.999** (.001)	-.334	.656	.436
Wheat-FR+1 EGARCH	10	.036 (.035)	.019 (.035)	-.066** (.029)			.064** (.003)	.010** (.001)	.999** (.001)	.153	.876	.956
Wheat-FR+2 EGARCH	5	-.012 (.039)	-.005 (.034)	-.052 (.036)			.043** (.007)	.136** (.010)	.999** (.001)	-.337	.646	.427
Wheat-FR+2 EGARCH	10	-.011 (.039)	-.005 (.034)	-.051 (.036)			.043** (.007)	.136** (.010)	.999** (.001)	.184	.839	.899
Corn-BR+1 GARCH	5	.132** (.022)	.030** (.006)	.001 (.001)	.636** (.016)	.681** (.006)				-.015	.027	.002
Corn-BR+1 GARCH	10	.158** (.023)	-.033 (.005)	.0001 (.001)	.652** (.017)	.672** (.006)				.080	.110	.027
Corn-BR+2 GARCH	5	-.008 (.016)	.024** (.004)	.002** (.001)	.606** (.021)	.686** (.007)				-.017	.033	.001
Corn-BR+2 GARCH	10	-.009 (.016)	.024** (.004)	.002** (.001)	.610** (.021)	.686** (.007)				.104	.124	.035
Corn-BR+3 GARCH	5	-.056** (.007)	.022** (.005)	.003** (.001	.613** (.019)	.685** (.006)				-.013	.033	.001
Corn-BR+3 GARCH	10	-.057** (.017)	.022** (.005)	.003** (.001)	.613** (.019)	.685** (.006)				.108	.125	.035
Corn-BR+4 GARCH	5	.027 (.016)	.017** (.004)	.004** (.001)	.650** (.017)	.674** (.006)				-.028	.033	.002
Corn-BR+4 GARCH	10	.028 (.016)	.017** (.004)	.004** (.001)	.650** (.017)	.674** (.006)				.101	.132	.036
Corn-BR+5 GARCH	5	-.013 (.016)	.022** (.005)	.003** (.001)	.636** (.017)	.682** (.006)				-.022	.003	.002
Corn-BR+5 GARCH	10	-.011 (.020)	.023** (.005)	.003** (.001)	.636**	.682** (.006)				.105	.126	.036
Corn-BR+6 GARCH	5	-.048** (.014)	.030** (.003)	.003** (.001)	.646** (.018)	.672** (.007)				-.012	.033	.001
Corn-BR+6 GARCH	10	-.047** (.014)	.030** (.003)	.003** (.001)	.646** (.018)	.672** (.007)				.107	.124	.035

Corn-BB+7 GARCH	5	.001 (.146)	.019** (.014)	.004** (.001)	.640** (.017)	.677** (.007)				-.023	.026	.003
Corn-BB+7 GARCH	10	.001 (.016)	.019** (.004)	.004** (.001)	.641** (.017)	.676** (.006)				.105	.120	.036
Corn-BB+8 GARCH	5	-.045** (.013)	.022** (.004)	.002** (.001)	.632** (.017)	.678** (.006)				-.018	.024	.001
Corn-BB+8 GARCH	10	-.044** (.013)	.022** (.004)	.002** (.001)	.632** (.017)	.678** (.006)				.105	.126	.035
Corn-BB+9 GARCH	5	-.033** (.014)	.032** (.004)	.001 (.001)	.646** (.017)	.673** (.006)				-.016	.022	.002
Corn-BB+9 GARCH	10	-.032** (.014)	.032** (.004)	.001 (.001)	.647** (.017)	.672** (.006)				.107	.126	.035
Corn-BB+10 GARCH	5	-.021 (.013)	.038** (.004)	.00004 (.002)	.651** (.017)	.671** (.006)				-.013	.021	.001
Corn-BB+10 GARCH	10	-.021 (.013)	.038** (.004)	.00003 (.002)	.651** (.017)	.671** (.006)				.108	.125	.035
Corn-BB+11 GARCH	5	.056** (.011)	-.036 (.002)	.002** (.001)	.717** (.023)	.647** (.006)				-.028	.031	.002
Corn-BB+11 GARCH	10	.056** (.011)	-.036** (.002)	.002** (.001)	.718** (.023)	.646** (.006)				.096	.126	.033
Corn-BB+12 GARCH	5	.003 (.014)	-.0002 (.010)	-.003 (.002)	.581** (.007)	.690** (.007)				-.027	.028	.002
Corn-BB+12 GARCH	10	.003 (.140)	-.0002 (.010)	-.003 (.002)	.582** (.007)	.690** (.007)				.098	.125	.034
Corn-BB+1 EGARCH	5	.147** (.027)	.0004** (.0002)	-.004** (.001)			.007 (.006)	.602** (.014)	.967** (.003)	-.024	.031	.002
Corn-BB+1 EGARCH	10	.141** (.027)	.0004** (.0002)	-.004** (.001)			.007 (.006)	.602** (.014)	.967** (.003)	.083	.110	.027
Corn-BB+2 EGARCH	5	.144** (.026)	.0004** (.0002)	-.004** (.001)			.008 (.006)	.603** (.014)	.967** (.003)	-.031	.034	.002
Corn-BB+2 EGARCH	10	-.026 (.016)	.0001 (.0002)	-.004** (.002)			.007 (.005)	.597** (.017)	.964** (.003)	.101	.127	.035
Corn-BB+3 EGARCH	5	-.051** (.013)	-.0005 (.0009)	-.004 (.009)			.013** (.0008)	-.008 (.002)	-.982** (.009)	-.008	.001	.001
Corn-BB+3 EGARCH	10	-.088** (.007)	-2e-04** 7.2e-06	.004** 5.4e-05			.014 (.012)	.606** (.034)	.969** (.004)	.109	.128	.036
Corn-BB+4 EGARCH	5	NA	NA	NA			NA	NA	NA	NA	NA	NA
Corn-BB+4 EGARCH	10	NA	NA	NA			NA	NA	NA	NA	NA	NA

* Indicates significance at the 90 percent confidence level
** Indicates significance at the 95 percent confidence level or better
standard errors shown in parentheses
NA Indicates not estimable

Generally, the model results do not differ significantly from the obtained using the full sample fit. On the basis of the hold-out sample, ME, MAE and MSFE are computed for both the 5 and 10 period daily horizons and the overall averages by commodity are calculated. The results are summarized in Table 4.

Table 5. Comparative Performance, Ex *Post* Forecasts, GARCH and EGARCH vs Random Walk, Daily

Variable-Model	m= *Ex Post* Forecast Horizon	ME	MAE	MSFE	ME Random Walk	MAE Random Walk	MSFE Random Walk	MAE/ MAE Random Walk	MSFE/ MSFE Random Walk
Wheat-US+1 GARCH	5	-.146	3.267	19.834	.60	4.10	22.75	.797	.872
Wheat-US+1 GARCH	10	-1.140	3.466	19.317	-.546	5.527	42.787	.627	.451
Wheat-US+2 GARCH	5	-.098	3.315	20.736	.50	5.30	31.875	.625	.651
Wheat-US+2 GARCH	10	-1.325	3.548	19.110	.625	3.825	19.781	.928	.966
Wheat-US+3 GARCH	5	-.271	3.293	20.680	.85	4.35	21.938	.757	.943
Wheat-US+3 GARCH	10	-1.333	3.605	19.503	1.325	3.525	15.589	1.023	1.251
Wheat-US+4 GARCH	5	-.251	3.291	21.408	2.20	4.30	26.30	.765	.814
Wheat-US+4 GARCH	10	-1.40	3.405	18.124	1.125	4.425	31.494	.769	.575
Wheat-US+5 GARCH	5	-.222	3.157	19.950	1.90	6.70	57.025	.471	.350
Wheat-US+1 EGARCH	5	-.740	3.165	20.839	.60	4.10	22.75	.772	.916
Wheat-US+1 EGARCH	10	-1.811	3.628	21.484	-.546	5.527	42.787	.656	.502
Wheat-US+2 EGARCH	5	-.456	3.202	20.948	.50	5.30	31.875	.604	.657
Wheat-US+2 EGARCH	10	-1.614	3.168	19.732	.625	3.825	19.781	.828	.998
Wheat-US+3 EGARCH	5	-.966	3.392	21.611	.85	4.35	21.938	.780	.985
Wheat-US+3 EGARCH	10	-2.048	3.928	22.339	1.325	3.525	15.589	1.114	1.436
Wheat-US+4 EGARCH	5	-.695	3.439	22.318	2.20	4.30	26.30	.800	.845
Wheat-US+4 EGARCH	10	-1.836	3.60	19.661	1.125	4.425	31.494	.814	.624
Wheat-US+5 EGARCH	5	-1.066	3.235	20.066	1.90	6.70	19.781	.486	1.014
Mean	5							.763	.800
Mean	10							.845	.849
Maize-US+1 GARCH	5	-2.603	3.125	11.362	-.35	3.502	16.371	.892	.696
Maize-US+1 GARCH	10	-.663	2.810	10.407	-.50	3.426	16.354	.820	.636
Maize-US+2 GARCH	5	-2.306	2.789	10.061	-1.7	3.20	16.989	.872	.592
Maize-US+2 GARCH	10	-.593	2.572	9.719	-.535	3.225	16.588	.798	.586
Maize-US+1 EGARCH	5	-2.548	3.099	11.131	-.35	3.502	16.371	.885	.679
Maize-US+1 EGARCH	10	-.616	2.827	10.487	-.50	3.426	16.354	.825	.641
Maize-US+2 EGARCH	5	-2.60	3.035	11.219	-1.7	3.20	16.989	.948	.660
Maize-US+3 EGARCH	5	-2.637	3.075	11.571	-3.536	4.674	31.80	.658	.364
Maize-US+3 EGARCH	10	-1.553	3.655	19.665	-.438	4.812	37.944	.760	.518
Mean								.851	.568
Mean								.796	.565
Soy-US+1 GARCH	5	-6.715	10.06	115.698	-2.60	12.0	213.70	.838	.541
Soy-US+1 GARCH	10	-4.783	10.71	147.04	-4.225	15.53	258.506	.676	.837
Soy-US+2 GARCH	5	-6.858	9.949	113.97	-3.30	8.0	107.475	1.244	1.06
Soy-US+2 GARCH	10	-4.939	10.13	132.931	-3.60	8.4	122.328	1.206	1.087
Soy-US+3 GARCH	5	-6.763	9.90	112.31	-6.003	13.70	216.894	.846	.518

Soy-US+3 GARCH	10	-5.031	10.14	134.30	-2.775	13.23	216.869	.838	.638
Soy-US+1 EGARCH	5	-6.847	10.13	117.18	-2.60	13.0	213.70	.844	.548
Soy-US+1 EGARCH	10	-6.847	10.41	117.40	-4.225	15.53	268.506	.670	.327
Soy-US+2 EGARCH	5	-6.920	10.03	116.33	-3.30	8.0	107.475	1.354	1.082
Soy-US+2 EGARCH	10	-5.035	10.18	135.75	-3.60	8.4	123.338	1.312	1.11
Soy-US+3 EGARCH	5	-6.940	9.983	114.33	-6.003	13.70	216.894	.739	.537
Soy-US+3 EGARCH	10	-4.810	10.25	136.61	-2.775	13.23	216.869	.838	.630
Mean								.858	.713
Mean								.807	.687
Wheat-FR+1 GARCH	5	-.380	.624	..403	.10	.732	.995	.852	.405
Wheat-FR+1 GARCH	10	.308	.876	1.003	.175	1.141	2.179	.768	.460
Wheat-FR+1 EGARCH	5	-.334	.656	.486	-.584	1.216	2.166	.539	.301
Wheat-FR+1 EGARCH	10	.153	.876	.656	-.092	1.708	3.608	.513	.265
Mean								.686	.353
Mean								.641	.363
Corn-BR+1 GARCH	5	-.015	.027	.003	-.064	.104	.019	.380	.105
Corn-BR+1 GARCH	10	.080	.110	.027	-.003	.155	.038	.730	.711
Corn-BR+2 GARCH	5	-.017	.023	.001	-.166	.174	.057	.134	.038
Corn-BR+2 GARCH	10	.104	.124	.035	.034	.236	.079	.535	.443
Corn-BR+3 GARCH	5	-.013	.023	.001	-.230	.230	.078	.105	.013
Corn-BR+3 GARCH	10	.108	.135	.035	.038	.262	.108	.477	.324
Corn-BR+4 GARCH	5	-.028	.033	.003	-.246	.246	.084	.134	.034
Corn-BR+4 GARCH	10	.101	.132	.036	.043	.299	.132	.441	.273
Corn-BR+5 GARCH	5	-.023	.003	.003	-.256	.256	.080	.008	.035
Corn-BR+5 GARCH	10	.105	.129	.036	.044	.300	.121	.430	.298
Corn-BR+6 GARCH	5	-.013	.023	.001	-.188	.213	.061	.108	.016
Corn-BR+6 GARCH	10	.107	.124	.035	.086	.286	.104	.434	.337
Corn-BR+7 GARCH	5	-.023	.026	.003	-.033	.186	.043	.133	.061
Corn-BR+7 GARCH	10	.105	.130	.036	.137	.251	.080	.518	.450
Corn-BR+8 GARCH	5	-.018	.024	.001	.030	.126	.030	.190	.786
Corn-BR+8 GARCH	10	.105	.126	.035	.143	.207	.070	.609	.500
Corn-BR+9 GARCH	5	-.016	.022	.003	.086	.130	.023	.169	.087
Corn-BR+9 GARCH	10	.107	.126	.035	.146	.171	.056	.737	.625
Corn-BR+10 GARCH	5	-.013	.021	.001	.068	.134	.033	.157	.030
Corn-BR+10 GARCH	10	.108	.125	.035	.161	.199	.054	.628	.548
Corn-BR+11 GARCH	5	-.028	.031	.003	.114	.134	.021	.331	.065
Corn-BR+11 GARCH	10	.096	.126	.033	.173	.182	.055	.662	.600
Corn-BR+1 EGARCH	5	-.024	.031	.003	.064	.104	.019	.368	.105
Corn-BR+1 EGARCH	10	.083	.110	.027	-.003	.155	.038	.730	.711
Corn-BR+2 EGARCH	5	-.031	.034	.003	-.166	.174	.057	.166	.035
Corn-BR+2 EGARCH	10	.101	.127	.035	.034	.236	.079	.538	.443

Corn-BR-3 EGARCH	5	-.008	.001	.001	-.230	.230	.078	.005	.013
Corn-BR-3 EGARCH	10	.109	.128	.036	.028	.262	.108	.468	.333
Mean								.050	.088
Mean								.080	-.478

With respect to *ex post* forecasting results summarized in Table 5, on a commodity-by-commodity basis, there is considerable variation in the extent to which the full models yield significant reductions in forecast error relative to the random walk formulations. In terms of MAE and MSFE, the French Wheat models perform best. The average reduction in relative MAE for the 5-step horizon is 30.4 percent and MSFE is reduced 68.7 percent. For the 10-step horizon MAE is improved by 35.9 percent and MSFE by 63.7 percent. The worst performing models are those for Brazilian corn futures. For the 5 period horizon MAE is reduced by 5 percent and MSFE is reduced by 8 percent. For the 10-step horizon, MAE is improved by 2 percent and MSFE by 52.2 Percent. This is an interesting result as the Brazilian corn series indicate the longest presence of statistically significant lead (lag) relationships between the futures price t+n steps forward and the own-commodity futures price, the own-commodity spot price and the spot oil price all at period t. Intermediate outcomes are reported for the other series. For example, the US Wheat series 5-steps out, on average the full models improve forecast accuracy in terms of MAE by 23.7 percent and by 20 percent in terms of MSFE. For the US Wheat series 10 steps out, in terms of MAE and MSFE, the full models yield and improvement of 15.5 and 15.1 percent, respectively.

5.2 Weekly Data

5.2.1 Full Sample Estimation

Models using aggregated weekly data are estimated following the same procedures applied to the daily data series. The first differences of the weekly data series are plotted in Figures 13 – 18. A generalization concerning this research thus far concerns the relative performance of the models with respect to time aggregation. The data are relatively smooth although the presence of heteroskedasticity remains clear. The weekly estimation results indicate a significant deterioration in the information content of the series at least with respect to the significance of the parameter estimates. It is also the case that that problems were encountered due to the failure of the optimization algorithms to converge owing to the non-convexity of the likelihood function. It is well-known that owing to the non-convexity and non-linearity of the models in this research that estimates can be difficult to compute. It is possible to compute estimates using nonlinear programming techniques, although this approach has not been taken in this current study (Altay-Salih, Pinar and Leyffer, 2003)

Figure 13. US Wheat Futures Price, 30 Day, First-Difference, Weekly (n=371)

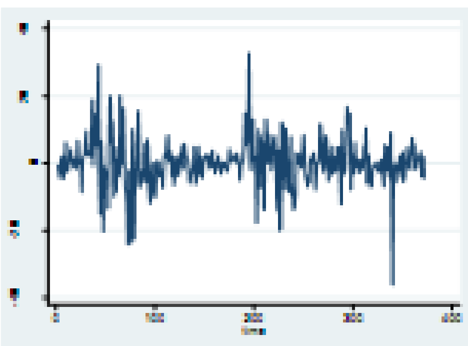


Figure 14. US Maize Futures Price, 30 Day, First-Difference, Weekly (n=371)

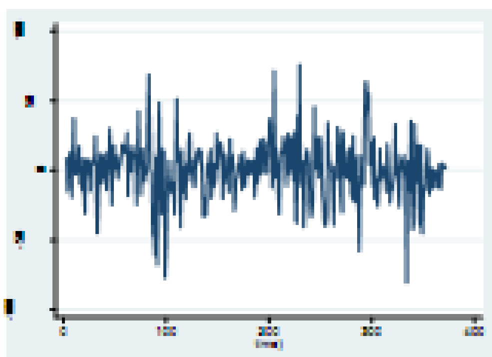


Figure 15. US Soy Futures Price, 30 Day, First-Difference, Weekly (n=371)

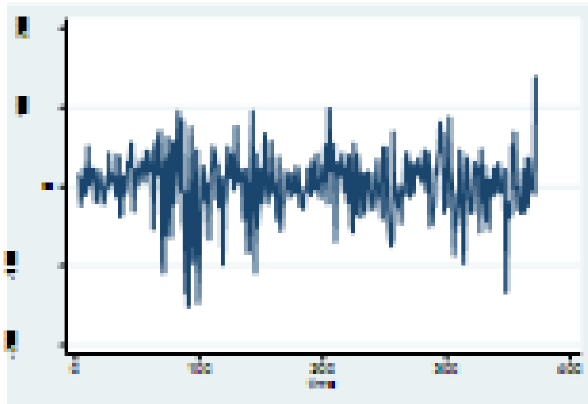


Figure 16. France Wheat Futures Price, 30 Day, First-Difference, Weekly (n=371)

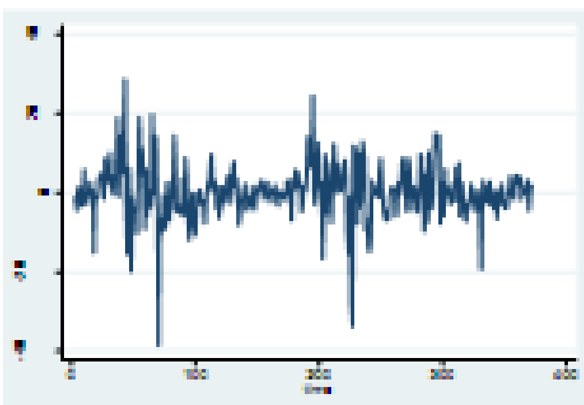


Figure 17. Brazil Corn Futures Price, 30 Day, First-Difference, Weekly (n=371)

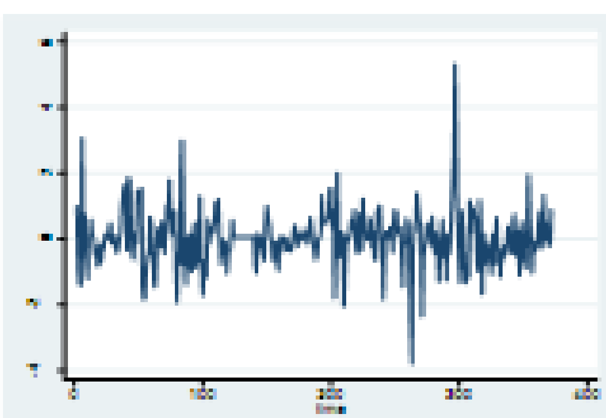
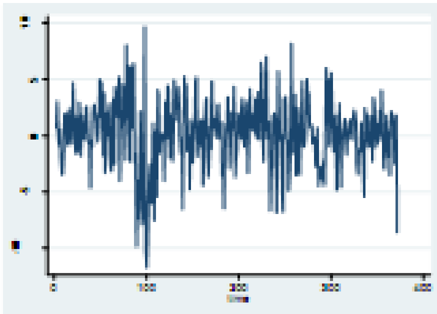


Figure 18. Brent Oil Spot Price, First-Difference, Weekly (n=371)



From Table 6, given the full sample results, the only case for which all of the estimates for the own-commodity futures price, the own commodity spot price and the oil spot price are statistically significant is US Wheat. However, significant coefficient estimates for the GARCH and EGARCH models are reported for other series at varied leads (lags). Overall, the daily models outperform weekly models with respect to bias (ME); however, the results for MSE are clearly mixed. For example, the MSE performance of the daily models is superior for US Wheat, but not for US Maize and US Soy.

Table 6. GARCH and EGARCH, In-Sample Results, Weekly (n=371)

Variable-Model	φ	β	δ	arch(1)	garch(1)	earch(1)	egarcha(1)	egarch(1)	ME	MSE	AIC	BIC
Wheat-US+1 GARCH	.276** (.079)	.030** (.016)	-.260** (.087)	.311** (.056)	.679** (.044)				.122	46.001	2362.071	2388.465
Wheat-US+2 GARCH	-.080 (.745)	.015 (.013)	-.070 (.078)	.373** (.053)	.644** (.042)				.163	49.903	2397.537	2424.612
Wheat-US+1 EGARCH	.240** (.053)	.035** (.005)	-.236** (.078)			.165** (.053)	.445** (.087)	.930** (.024)	-.151	45.837	2349.44	2376.835
Wheat-US+2 EGARCH	-.033 (.077)	.005 (.013)	-.080 (.074)			.153** (.040)	.459** (.052)	.932** (.017)	-.013	49.858	2387.318	2418.505
Maize-US+1 GARCH	.334 (.184)	.039 (.161)	-.480 (.371)	.116** (.039)	.787** (.067)				-.471	439.775	3276.667	3307.362
Maize-US+2 GARCH	.166** (.027)	.076** (.037)	-.261 (.383)			.035 (.048)	.233** (.064)	.925** (.040)	-.663	430.762	3281.083	3312.361
Maize-US+1 EGARCH	.047 (.145)	-.052 (.137)	-.149 (.370)			.058 (.043)	.251** (.073)	.935** (.036)	-.171	459.102	3289.876	3321.162
Soy-US+1 GARCH	.183** (.067)	.005 (.067)	.188 (.681)	.062** (.028)	.848** (.048)				-1.052	1465.101	3726.38	3753.674
Soy-US+2 GARCH	-.013 (.075)	.093 (.068)	-.385 (.798)	.100** (.031)	.836** (.046)				-1.366	1520.06	3726.909	3754.285

Soy-US-1 EGARCH	.212** (.046)	.002 (.050)	.893 (.619)			.097** (.039)	.080* (.049)	-.916** (.037)	-.312	1469.416	3746.332	3777.64
Soy-US-2 EGARCH	-.040 (.069)	.114 (.074)	-.099 (.820)			.080** (.033)	.130** (.040)	.989** (.013)	-1.80	1519.733	3722.362	3753.648
Wheat-FR-1 GARCH	.358** (.117)	.036 (.114)	-.214** (.100)	.201** (.042)	.772** (.042)				-.090	44.085	2360.335	2387.73
Wheat-FR-2 GARCH	.154 (.116)	-.061 (.111)	-.184** (.100)	.162** (.034)	.758** (.034)				-.148	48.141	2392.33	2419.605
Wheat-FR-3 GARCH	.031 (.106)	.004 (.107)	-.038 (.110)	.165** (.029)	.824** (.031)				.312	48.7864	2393.041	2420.368
Corn-BR-1 GARCH	.330** (.056)	-.008 (.046)	.007 (.010)	.365** (.051)	.706** (.014)				.009	.634	815.664	843.059
Corn-BR-2 GARCH	.046 (.070)	-.047 (.041)	-.003 (.010)	.317** (.052)	.646** (.060)				.030	.711	847.533	874.808
Corn-BR-1 EGARCH	.306** (.006)	.001 (.003)	.012 (NA)			.063 (.045)	.482** (.079)	.896** (.027)	.022	.334	797.889	821.38
Corn-BR-2 EGARCH	.001 (.017)	-.036** (.001)	.011** (.0002)			.102** (.051)	.589** (.088)	.850** (.038)	.003	.718	833.340	864.637
Corn-BR-3 EGARCH	-.033 (.068)	-.034 (.051)	.006 (.011)			.110** (.064)	.581** (.096)	.842** (.044)	.003	.712	831.332	862.587

* Indicates significance at the 90 percent confidence level
** Indicates significance at the 95 percent confidence level or better
Standard errors shown in parentheses
NA indicates not estimable

Table 7. Significance of Parameter Estimates, GARCH and EGARCH, In-Sample Results, Weekly (n=371)*

Commodity	Specification	Models	ϕ	β	δ
Wheat-US	GARCH	2	1	1	1
	EGARCH	2	1	1	1
Maize-US	GARCH	2	1	1	0
	EGARCH	1	0	0	0
Soy-US	GARCH	2	1	0	0
	EGARCH	2	1	0	0
Wheat-FR	GARCH	3	1	0	2
	EGARCH	0	0	0	0
Corn-BR	GARCH	2	1	0	0
	EGARCH	3	1	1	1
Total		19	8	4	5

*Significant at the 10 percent significance level or better.

As expected, where significant the signs on the ARCH and GARCH processes are positive. These results are summarized in Table 7 and Table 8. As is the case for the daily models, the weekly results indicate that indicate that positive shocks tend to be more destabilizing than negative shocks (sign effects) and that lagged large market movements result in large movements in following period. Large persistence effects (egarch) indicate that the series have quite long memories.

Table 8. Signs and Significance of Parameter Estimates, GARCH and EGARCH, In-Sample Results, First-Difference, Weekly (n=371)*

Commodity	Sign	arch(1)	garch(1)	earch(1)	egarcha(1)	egarch(1)
Wheat-US	+	2	2	2	2	2
	-					
Maize-US	+	1	1	0	2	2
	-					
Soy-US	+	2	2	2	2	1
	-					1
Wheat-FR	+	3	3	0	0	0
	-					
Corn-BR	+	2	2	2	3	3
	-					

*Significant at the 10 percent significance level or better

5.2.2. *Ex post* forecasts

With respect to the *ex post* forecasting models using weekly data, time forecast time horizon of 4 and 8 are selected corresponding to 1 and 2 month horizons, respectively. The results confirm that considerably fewer models at varied leads (lags) result in significant coefficient estimates for ϕ, β, δ. After shortening the estimation period for the hold-out series, the models for US Maize are dropped from consideration. The overall results for periods used or fitting the models are reported in Table 9 and the results are compared to random walk specification in Table 10. As with the daily models, generally, the weekly models outperform random walk specifications.

Table 9. GARCH and EGARCH *Ex post* Forecast Performance, First-Difference, Weekly (n=371)

-Model	The *Ex Post* Forecast Horizon	φ	β	δ	arch(1)	garch(1)	earch(1)	egarcha(1)	egarch(1)	ME	MAE	MSFE
Wheat-US+1 GARCH	4	.288** (.079)	.025 (.016)	-.252** (.087)	.214** (.056)	.676** (.044)				-1.197	3.425	13.221
Wheat-US+1 GARCH	8	.282** (.080)	.026 (.016)	-.258** (.088)	.213** (.057)	.677** (.045)				.514	2.761	9.10
Wheat-US+1 EGARCH	4	.245** (.065)	.035** (.014)	-.232** (.076)			.166** (.046)	.446** (.058)	.930** (.019)	-.093	2.922	9.847
Wheat-US+1 EGARCH	8	.129** (.064)	.042** (.017)	-.306** (.126)			-.040 (.027)	.0007 (.040)	-.900** (.106)	.634	2.728	8.520
Soy-US+1 GARCH	4	.182** (.066)	.012 (.066)	-.004 (.662)	.112** (.036)	.817** (.056)				32.994	40.12	4843.88
Soy-US+1 GARCH	8	.191** (.067)	.010 (.066)	.028 (.666)	.112** (.036)	.817** (.056)				20.359	35.04	2922.65
Soy-US+1 EGARCH	4	.211** (.048)	.011 (.051)	.772 (.620)			.088** (.029)	.074 (.048)	-.916** (.042)	34.561	40.72	4824.72
Soy-US+1 EGARCH	8	.217** (.049)	.006 (.051)	.815 (.620)			.092** (.030)	.081* (.049)	-.912** (.042)	20.60	36.22	2968.76
Wheat-FR+1 GARCH	4	.268** (.167)	.039 (.114)	-.234** (.100)	.207** (.044)	.767** (.042)				.248	2.455	14.886
Wheat-FR+1 GARCH	8	.271** (.116)	.036 (.114)	-.236** (.100)	.210** (.046)	.761** (.043)				.690	2.286	8.082
Wheat-FR+2 GARCH	4	.163 (.115)	-.062 (.110)	-.201** (.099)	.196** (.035)	.795** (.033)				.422	2.690	10.778
Wheat-FR+2 GARCH	8	.162 (.156)	-.068 (.110)	-.201** (.101)	.198** (.036)	.787** (.036				.692	1.991	6.459
Wheat-FR+1 EGARCH	4	.203** (.036)	.086** (.036)	-.111 (.079)			.164** (.020)	.038** (.022)	.992** (.005)	-.117	2.909	11.947
Wheat-FR+1 EGARCH	8	.205** (.074)	.114 (.070)	-.152** (.080)			.122** (.021)	.099 (NA)	.988** (.006)	.229	1.942	7.02
Corn-BR+1 GARCH	4	.222** (.055)	-.006 (.048)	.006 (.010)	.200** (.052)	.704** (.041)				.156	.307	.218
Corn-BR+1 GARCH	8	.222** (.056)	-.005 (.048)	.005 (.010)	.206** (.053)	.700** (.042)				.272	.466	.289

* Indicates significance at the 90 percent confidence level
** Indicates significance at the 95 percent confidence level or better
Standard errors shown in parentheses
NA indicates not estimable

Overall, the *ex post* forecasts show that the performance of the GARCH and EGARCH specifications relative to the random walk models is mixed. It is particularly interesting that with respect to MSFE the random walk models for US Wheat and US Soy perform better than the more complex specifications.

Table 10. Comparative Performance, *Ex Post* Forecasts, GARCH and EGARCH vs Random Walk, Weekly

Variable-Model	ms Ex Post Forecast Horizon	ME	MAE	MSFE	ME Random Walk	MAE Random Walk	MSFE Random Walk	MAE/ MAE Random Walk	MSFE/ MSFE Random Walk
Wheat-US+1 GARCH	4	-1.167	3.425	13.221	-2.163	5.127	5.127	.668	2.579
Wheat-US+1 GARCH	8	.514	2.781	9.10	.012	3.657	17.477	.763	.521
Wheat-US+1 EGARCH	4	-.093	2.922	9.847	-2.163	5.127	5.127	.570	1.921
Wheat-US+1 EGARCH	8	.624	2.728	8.530	.012	3.657	17.477	.746	.488
Mean	4							.619	2.246
Mean	8							.755	.505
Soy-US+1 GARCH	4	33.994	40.13	4842.88	34.487	46.77	4792.22	.858	1.011
Soy-US+1 GARCH	8	30.359	35.04	2922.65	30.5563	37.85	3133.49	.926	.933
Soy-US+1 EGARCH	4	34.561	40.72	4824.72	34.487	46.77	4792.22	.871	1.007
Soy-US+1 EGARCH	8	30.60	36.23	2968.76	30.5563	37.85	3133.49	.544	.947
Mean	4							.436	1.009
Mean	8							.735	.940
Wheat-FR+1 GARCH	4	.249	3.455	14.886	.105	4.98	27.402	.694	.543
Wheat-FR+1 GARCH	8	.890	1.991	6.459	.009	3.496	15.761	.570	.410
Wheat-FR+2 GARCH	4	.422	2.930	10.778	-1.07	2.645	8.309	1.108	1.297
Wheat-FR+2 GARCH	8	.892	1.991	6.459	-.816	2.129	6.280	.935	1.028
Wheat-FR+1 EGARCH	4	-.117	2.909	11.847	.105	4.98	27.402	.584	.436
Wheat-FR+1 EGARCH	8	.229	1.942	7.03	.009	3.496	15.761	.555	.445
Mean	4							.795	.759
MEAN	8							.687	.628
Corn-BR+1 Random Walk	4	.156	.307	.218	095	.535	.535	.574	.407
Corn-BR+1 Random Walk	8	.272	.466	.389	.036	.681	.711	.655	.547
Mean	4							.574	.407
Mean	8							.655	.655

VI. Summary and Conclusions

As indicated in the Introduction and the literature review in Section II, there is an extensive interest and literature in understanding the effects of energy-oil prices on prices of agricultural commodities and the transmission mechanisms for which an empirical relationship has been identified. It is thought that this paper represents a significant contribution to research done to-date.

Applying reverse regressions, this paper investigates the extent to which spot prices contain information content useful for predicting future futures prices. The working hypothesis is that both own-commodity spot prices and spot energy (oil) prices are significant predictors of future commodity prices at alternative leads (lags). The paper tests the hypothesized relationships using daily and weekly aggregates of daily data for five agricultural commodities. Both GARCH and EGARCH specifications are considered for testing.

Based on the results thus far, it is reasonable to conclude that the reverse regressions are often useful in that today's market state captured by the spot own-commodity price effects the forward-looking variable. For the daily models tested, the estimated coefficient on the own-commodity spot price is significant in 23 of the 49 cases considered. Of considerable interest is the evidence that in 28 of the 49 models considered the spot oil price is significant at the 10 percent confidence level or better. As concerns the weekly data, model performance is relatively poor with significant lead (lag) responsiveness being very short at best. In some cases the models are not estimable owing to "flat" likelihood functions.

Ex post forecasts are generated for 5 and 10-step daily horizons and 4 and 8-step weekly horizons. Again, the weekly models perform markedly worse than the daily models, which is somewhat surprising given the earlier results of Cartwright and Riabko (2015c) showing that weekly models perform at least as well as models estimated at the daily level of aggregation. Overall, however, the *ex post* forecasts at both the daily and weekly levels out-perform random walk models, although this observation is not unequivocally the case.

In short, the results thus far indicate that in some cases spot own-commodity prices and spot oil prices are useful for predicting prices of futures contracts although the lead-lag relationships vary considerably as between commodities considered as well as with respect to temporal aggregation.

Understanding the extent of the relationships and reasons for the differences forms the basis for continuing research.

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□ □ □ □ □ □ Income Diversification and Bank Efficiency: The Role of Ownership Structure

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This paper examines the relationship between income diversification and bank efficiency in across 83 countries over the period 2003–2012. We also evaluate how ownership structure varies the impact of bank diversification on cost efficiency. Using stochastic frontier approach to estimate bank's cost efficiency, we find the evidence that increased diversification tend to improve bank efficiency, and government-controlled banks with fewer volatile income sources are likely to have lower efficiency of income diversification. Our results also reveal that more diversified foreign-controlled banks tend to be less efficient in developed countries, while increased foreign ownership of banks appears to improve the diversification benefits in developing countries after the financial crisis. Our findings highlight the implications of bank income diversification and ownership for efficiency and are relevant to bank regulators who are considering additional regulations on bank efficiency.

Keywords: Income diversification, ownership structure, efficiency, banking

1. Introduction

What drives bank efficiency? Understanding the determinants of bank efficiency is important because bank efficiency establishes banks' health and is important drivers of economic growth (Allen and Gale, 2000; Levine, 2005). A growing literature takes up this task, documenting positive and negative empirical links between bank efficiency and various bank and market characteristics. With financial deregulation and market integration, the scope of banks' activities has been completely reshaped, from traditional intermediation products to an array of new businesses (Clark and Siems, 2002). These trends have led to substantial consolidation in the banking industry and, consequently, to significant changes in ownership structure. However, this literature contains few empirical studies examining the link among bank efficiency, income diversification and ownership structure. We contribute to this nascent literature by examining the effects of the two interrelated dimensions of bank income diversification and ownership structure on efficiency.

However, while that literature has provided considerable understanding of the effects of bank frontier efficiency, its primary focus is mostly based on traditional balance sheet figures (e.g., Lensink et al., 2008). Siems and Clark (1997) and Rogers (1998) argued that models that ignored non-traditional outputs penalized against banks that are heavily involved in such activities, because resources used to produce these non-traditional services were included in the input vector without accommodating the relevant variables in the output vector. Therefore, there is no general consensus in the literature as regards the definition of the relevant output vector. Furthermore, relatively few studies provide a comparison of models developed both with and without proxies for non-traditional activities, thereby offering a bleak picture of their relative significance in bank efficiency estimates. Most of the studies report that ignoring measures of non-traditional activities in the estimation of bank efficiency can be misleading, although at least two studies in the literature find little or no impact of off-balance sheet (OBS) activities (Jagtiani et al., 1995; Pasiouras, 2008) while the results of Clark and Siems (2002) are mixed, dependent on examination of cost or profit efficiency.

Additionally, bank strategies differ because of differences in customer preferences, information quality and production methods, which could be driven by differences in bank ownership structure. In few studies of the benefits of state ownership have the efficiency arguments for state ownership been supported (e.g., police and prison ownership, see Hart et al., 1997). In contrast, most studies have found that state-owned firms do not better serve the public interest (i.e., Grossman and Krueger, 1993) and, in fact, that state-owned firms are typically extremely inefficient (i.e., Boycko et al., 1995; Dewenter and Malatesta, 2001). On the other hand, there is a tendency for foreign-owned institutions or foreign banks to be more oriented toward transactions lending and provide financial services to large corporate clients rather than to lend to smaller firms, more likely catered by domestic banks. Empirical studies show that foreign banks tend to have wholesale orientation and may favorably lend to large corporate affiliates of their customers in their home nation (Grosse and Goldberg, 1991; DeYoung and Nolle, 1996). In addition, foreign banks are more exposed to developed country banking markets, which tend to be more competitive and use more sophisticated information and communication technologies (Claessens et al., 2001). These advantages could favor foreign banks in managing operating and financial leverage when diversifying toward non-interest activities. Despite the extensive literature on bank efficiency (see Berger and Humphrey, 1997; Berger, 2007), a comprehensive study on whether bank income diversification and ownership enhance or impede efficiency does not yet exist.

The purpose of this paper is to contribute to the assessment of the types of bank income diversification and ownership that work best to achieve well-functioning banking systems. To our knowledge, no research has addressed whether bank efficiency may be different for privately owned banks and publicly held banks under specific ownership profiles. Thus, our aim herein is to assess banks' efficiency levels by combining the two interrelated dimensions of bank diversification and ownership structure. Particularly, our cross-country analysis is able to compare the impact of bank income diversification and ownership across different levels of economic development (e.g. advanced and developing) and across different geographic regions. Furthermore, we are able to incorporate other country-based characteristics such as the relative presence of foreign and government-owned banks in the market, the degree of information sharing, and the degree of bank regulation. Policymakers can surely make more informed decisions about the income diversification of banks when they know the likely effect of those decisions on bank performance.

This study contributes to the existing literature in several ways. First, the existing literature mostly based on the relationship between bank income diversification and performance (DeYoung and Roland, 2001; Stiroh, 2004; Stiroh and Rumble, 2006). In contrast, we estimate bank efficiency using a stochastic frontier technique and it is superior compared to traditional measures of performance because efficient frontier approach could account simultaneously for a variety of output/input specifications (Berger and Humphrey, 1997). Second, while there is a related study of Lozano-Vivas and Pasiouras (2010) that examines the effect of non-traditional activities in bank efficiency. Unlike Lozano-Vivas and Pasiouras (2010), we use both income diversification and non-interest income as two main independent variables to investigate the impact of a shift toward non-interest activities on bank's cost efficiency. This allows us to clarify the framework that decomposes the effect of strategic shifts into a "direct exposure effect" of an increased share of non-interest income and an "indirect diversification effect" of a resultant variation in income concentration. In addition, this paper also shifts the focus to banks and to the question of whether the ownership structure of banks influences their efficiency levels.

Finally, our paper is to provide international evidence about relevance of bank income diversification and ownership in the estimation of bank efficiency levels. As some related studies investigate mainly the US (e.g., Siems and Clark, 1997; Rogers, 1998; Stiroh, 2000) and a few developed countries such as Spain (Tortosa-Ausina, 2003), Switzerland (Rime and Stiroh, 2003), Taiwan (Lieu et al., 2005), and Greece (Pasiouras, 2008), our knowledge with regard to a broader range of countries, in particular the transition and less developed countries of the world, remains limited.

We investigate the effects of ownership structure on the relation between income diversification and bank efficiency using data for more than 7533 bank-year observations in 83 countries over the period 2003–2012. We obtain the following main findings. First, we find that increases in income diversification are positively associated with bank efficiency, but these benefits of diversification are offset by increasing exposure to volatile non-interest activities. Second, state-controlled banks tend to have lower diversification benefits than their private-controlled counterparts, even though they have low costs of diversification. Third, we find that the more the proportion of foreign shareholders owned, the less the benefits of bank diversification in developed countries, but these gains are likely to be higher for foreign-controlled banks located in developing countries after the financial crisis. Finally, banks with foreign-controlled ownership located in developed countries are able to mitigate better the costs of diversity compared to domestic private banks, while the opposite is true for their participation in developing countries.

The rest of the paper is organized as follows. Section 2 reviews the existing literature on bank efficiency, ownership structure and income diversification. Section 3 presents our measures of bank efficiency, ownership structure and income diversification, and analyzes how ownership structure affects the income diversification-bank efficiency nexus. Section 4 describes the data sources and estimated efficiency scores. Section 5 analyzes empirical results and discusses their implication. Finally, section 6 concludes the paper with a concise discussion on the policy implications.

2. Literature review and hypothesis development

2.1 Effects of income diversification on bank efficiency

The spreading activities across different products and economic environments may help banks reduce their expected costs of financial distress/bankruptcy (Boot and Schmeits, 2000). As screeners or monitors of borrowers, banks with a better diversified intermediary can minimize their cost of monitoring information and thus lower total costs, even in a risk neutral economy. In models of delegated investment monitoring (Diamond, 1984; Boyd and Prescott, 1986), diversification within the financial institutions serves an important role in providing a sufficient loan proceeds to repay a fixed debt claim to depositors, in which well-diversified financial intermediaries reduce their chance of costly financial distress. Similarly, Stiroh (2004) reveals that banks can reduce cyclical variations of profit by shifting its total income toward non-interest income, depending less on general business conditions. To investigate whether income diversification affects bank efficiency levels, Lozano-Vivas and Pasiouras (2010) find that, on average, cost efficiency increases in case non-interest income is used as an output in the global best-practice frontier model. As suggested by the studies of Gamra and Plihon (2011) and Meslier et al. (2014), greater competition in financial markets leads to increasing need for banks to diversify. Banks with various diversification strategies can produce information that enhances their loan making by such activities as securities underwriting, brokerage and other trading services. Indeed, activities that generate non-interest income are believed to be imperfectly associated with those that generate interest income, thereby producing profitable growth and providing a better risk-return trade-off.

Although the diversification plays an important role in the desirable efficiency for a bank, the costs of diversification might are associated with higher income volatility, implying higher risk. This argument is supported by some empirical studies. Notably, DeYoung and Roland (2001) conclude that a shift toward non-interest income is related to higher leverage and increased revenue volatility, which may increase bank earnings' volatility. One possible reason is that commercial banks tend to easily lose clients from fee-based activities because of high witching costs for borrowers associated with lending relationships. Moreover, banks tend to increase operating leverage to additional investment in human resources and technology infrastructure as it shifts towards fee-based activities, leading a high earning's volatility. In a sample of US commercial banks, Morgan and Samolyk (2003) investigate the nexus between geographic diversification and bank performance, and report that diversification is not associated with increased returns or reduced total risk. Similarly, focusing on loan portfolio diversity, Acharya et al. (2006) also find that loan's diversification is not associated with better performance while increasing the risk in Italian banking industry. Stiroh (2006) and Stiroh and Rumble (2006) show that the benefits from diversification are offset by an increase in exposure to non-interest income business, which increases the volatility of equity market returns. More recently, using a sample of small US credit unions, Goddard et al. (2008) find a negative association between diversification and both the unadjusted and risk-adjusted profitability. This is true in particularly in terms of cost and profit efficiency from the study of Berger et al. (2010), who show diversified banks are less profitable than focused Chinese banks.

2.2 Effects of ownership structure on bank efficiency

In addition to bank income diversification, another important dimension of ownership structure is state ownership, foreign ownership versus private ownership structure. Megginson and Netter (2001) present a survey of studies that have provided evidence on the relative performance of state-owned and privately-owned firms.). Reasons for different ownership forms leading to different efficiency levels have been extensively explored in the literature; and the dominant model to consider the effect of ownership utilizes the principal agent framework and public choice theory to highlight the importance of management being constrained by capital market discipline. In few studies of the benefits of state ownership have the efficiency arguments for state ownership been supported (e.g., police and prison ownership, see Hart et al., 1997). In contrast, most studies have found that state ownership is inherently inefficient. Firstly, the agent-principal problem becomes more prominent under state ownership. When there is a separation between ownership and management controls, managers (agents) may pursue their own interests rather than acting in the best interest of owners (principals) (Berle and Means, 1932), which may result in negative effects on performance. Secondly, the free-rider problem also becomes more common. State ownership theoretically means that all citizens are co-owners who in practice have no power and incentive to influence and monitor the management of state banks, leaving governments as the only effective representative (Huibers, 2005). Governments, however, have multiple (often conflicting) goals. Thirdly, soft-budget constraints faced by state banks may induce moral hazard problems leading to poor performance. State banks act as government agents to finance state-owned enterprises (SOEs) based on political preference rather than commercial considerations.[1] When banks are in difficulties, they expect help from governments. Therefore, managers of state banks have the little incentive to minimize costs or maximize profit. Finally, other reasons also explain poor performance of state banks, including the general view of "too big (important) to "fail", the "quiet life" hypothesis, poor monitoring and lack of market discipline (Megginson, 2005).

On the other hand, the most common findings for developing nations are that on average, foreign banks are more efficient than or approximately equally efficient to private domestic banks. Both groups are typically found to be significantly more efficient on average than state-owned banks, but there are variations on all of these findings. To illustrate, some research using data from the transition nations of Eastern Europe finds foreign banks to be the most efficient on average, followed by private domestic banks, and then state-owned banks (Bonin et al., 2005a; b). However, another study of transition nations finds the mixed result that foreign banks are more cost efficient, but less profit efficient than both private domestic and state-owned banks (Yildirim and Philippatos, 2007). A study using 28 developing nations from various regions finds foreign banks to have the highest profit efficiency, followed by private domestic banks, and then state-owned banks (Berger et al., 2004). For cost efficiency, the private domestic banks rank higher than the foreign banks, but both are still much more efficient than state-owned banks. Two studies using Argentine data (prior to the crisis in 2002) find roughly equal efficiency for

[1] For example, Sapienza (2004) finds that the party affiliation of state-owned banks' chairpersons in Italy has a positive impact on the interest rate discount given by state-owned banks in provinces where the associated party is stronger. The empirical results in Dinc (2005) indicate that government-owned banks increase their lending in election years relative to private banks in major emerging markets in the 1990s, and these actions are influenced by political motivations other than differences between privately-owned banks and government-owned banks in efficiency and objective.

foreign and private domestic banks, and that both are more efficient on average than state-owned banks (Delfino, 2003; Berger et al., 2005). A study of Pakistani data finds foreign banks are more profit efficient than private domestic banks and state-owned banks, but all of these groups have similar average cost efficiency (Bonaccorsi di Patti and Hardy, 2005). Finally, a study of Indian banks finds that foreign banks are more efficient on average than private domestic banks (Bhattacharyya et al., 1997).

3. Methodology

3.1 Measuring bank efficiency: Parametric SFA

This study employs the stochastic frontier approach (SFA) to generate cost efficiencies for each bank along the sample during the period under analysis. More specifically, we estimate bank efficiency using the Battese and Coelli (1995)'s SFA model to obtain an unbiased systematic measure of efficiency across countries, based on the assumption that efficiency differences between banking industries are determined by country-specific characteristics.[2] This specification allows us to control for general environmental factors by estimating simultaneously the parameters of the stochastic frontier and the inefficiency model. Particularly, cost efficiency measures how close to the minimum cost a bank is, where the minimum is determined by banks with the best performance in the sample. In its general form, the cost function model can be written as follows:

$$TC_{it} = f_1\left(Y_{it}, W_{it}\right) + v_{it} + u_{it}, v_{it} \sim N\left(0, \sigma_v^2\right), u_{it} \sim N^+\left(\mu_{it}, \sigma_{it}^2\right) \quad (1)$$

where: TC_{it} is total costs for the i^{th} bank in year t, and Y_{it}, W_{it} are the vectors of the output and the price of input, respectively. The u_i represents technical and allocative inefficiency aspects that can be influenced by management, while v_i is the stochastic error term with *i.i.d.* normal distribution represented for other uncontrollable factors. As regards the cost function techniques,

[2] We follow recent cross-country studies (e.g., Dietsch and Lozano-Vivas, 2000; Lozano-Vivas et al., 2002) that account for differences arising from country-specific aspects of technology, macroeconomic conditions, and regulatory conditions by including indicators of these environmental factors in a more comprehensive definition of a common frontier.

the u_{it} error is the non-negative inefficiency effect in the model, having a truncate normal distribution with an observation-specific mean $(\mu_{it} = \delta_0 + z_{it}\delta)$ and variance (σ_{it}^2) which are assumed a function of some determinants (z_{it}) of its pre-truncated distribution. The parameters of equation (1) are estimated by using maximum likelihood (ML) method. We estimate efficiency levels by specifying the commonly-used translog functional form which results in an empirical cost frontier model of the following format:

$$\ln(TC / w_2TA) = \alpha + \sum_{i=1}^{4}\beta_i \ln(Y_i / TA) + \sum_{k=1}\psi_k \ln(W_k / w_2) + \frac{1}{2}\sum_{i=1}^{4}\sum_{j=1}^{4}\beta_{ij}\ln(Y_i / TA)\ln(Y_j / TA)$$
$$+\frac{1}{2}\sum_{k=1}\sum_{m=1}\psi_{km}\ln(W_k / w_2)\ln(W_m / w_2) + \sum_{i=1}^{4}\sum_{k=1}\phi_{ik}\ln(Y_i / TA)\ln(W_k / w_2) + \textit{year dummies}_t$$
$$+\ln u_{it} + \ln v_{it} \qquad (2)$$

where TC is the bank's total costs in a given year; TA is the bank's total assets in a given year; Y_i are outputs; W_k are input prices (w_1: price of capital, w_2: price of fund); and α, β, ψ, ϕ are parameters to be estimated. The translog cost function is estimated using the $(\ln u_{it} + \ln v_{it})$ as a composite error term.

Following Bonin et al. (2005a) and Berger et al. (2009), we choose the following four outputs: total loans *(Y_1)*, other earning assets *(Y_2)*, total deposits *(Y_3)*, and liquid assets *(Y_4)*. In addition, widely consistent with previous studies on bank efficiency we use the following two input prices: price of capital *(w_1)*, calculated as the ratio of non-interest expenses to total fixed assets; and price of funds *(w_2)*, defined by the ratio of interest expenses to total deposits. The total costs *(TC)* of banks are defined as the summation of interest expenses and non-interest expenses. In addition, we impose linear homogeneity restrictions by normalizing by using the price of fund *(w_2)*. Following Jiang et al. (2013), we also normalize total costs and output variables by total assets to control for scale biases and heteroskedasticity. The cost (in)efficiency scores of each bank (INE_i), estimated from the stochastic frontier technique would take a value between one and infinity. However, in order to make our results comparable across banks we follow the same procedure employed by Pasiouras et al. (2009) to calculate the index of cost efficiency as follows: $CE_i = 1/INE_i$. Therefore, efficiency is always positive and it is equal to one for the best practice or zero inefficient bank.

3.2 Measuring bank ownership

The procedure used to calculate a bank's proportion of state ownership is similar to La Porta et al. (2002). That is, the first measure identifies large bolckholder ownership of banks. A large blockholder is any shareholder owning more than 10% of the shares in a bank, and use the 10% threshold from La Porta et al. (1999). Then, we calculate the proportion of government ownership for bank *(GO)* by first multiplying the share of each blockholder shareholder in that bank by the share the government owns in that shareholder, and then sum the resulting products over the shareholders of the bank:

$$GO_{ic} = \sum_{j=1}^{J} s_{ji} s_{gj}; \text{ where } s_{ji} s_{gj} > 0.1, \tag{3}$$

where $c = 1...83$ indexes the 83 countries in the sample, $i = 1...10$ indexes the 10 largest banks in the country, $j = 1... J$ indexes banks' shareholders, s_{ji} is the share of bank i owned by shareholder j and s_{gj} is the share of shareholder j that is owned by a government shareholder. GO_{ic} stands for the total share of bank i in country c that is owned by large government shareholders at the end of each year.

Similar to Dinc (2005), a bank is classified as state-owned if government ownership is at least 20%. The 20% threshold is used here and by Dinc (2005) following the corporate control literature which suggests that 20% ownership is often sufficient to control a company. We use a similar procedure to construct the domestic private (DO_{ic}), and foreign (FO_{ic}) blockholder ownership variables.

3.3 Measuring income diversification

In line with the studies of Stiroh and Rumble (2006) and Sawada (2013), this paper primarily utilizes non-interest income share as an income structure to measure functional diversification of banks. The measure of non-interest income share is defined as the ratio of non-interest income to total operating income, and is expected to capture non-traditional business of banks. The income diversification, *INCDIV*, is measured by constructing Herfindahl–Hirschman Index (HHI) for each bank, in which total operating income is decomposed into two categories: net interest income, *NET*, and non-interest income, *NON*. The non-interest income includes fee and service income, trading income, fiduciary income and other banks' non-interest income shares. Following this procedure, the bank's income diversification is calculated as

$$INCDIV = 1 - \left(NETSHARE^2 + NONSHARE^2 \right), \tag{4}$$

where $NETSHARE = \dfrac{NET}{NET + NON}$ and $NONSHARE = \dfrac{NON}{NET + NON}$ are interpreted as the shares of net interest income and the share of non-interest income from total operating income, respectively. *INCDIV* measures the degree of diversification in a bank's net operating revenue. A higher value indicates a more diversified mix: 0 means that all revenue comes from a single source (complete concentration), while 0.5 is an even split between net interest income and non-interest income (complete diversification).

3.4 Basic model

$$\begin{aligned} Bank\ Efficiency_{i,c,t} = {} & \beta_0 + \beta_1\ INCDIV_{i,c,t} + \beta_2\ NONSHARE_{i,c,t} \\ & + \beta_3\ Ownership\ Structure_{i,c,t} \\ & + \alpha'\ Bank\ Regulation\ Control_{c,t} \\ & + \gamma\ Information\ Sharing_{c,t} \\ & + \lambda'\ Bank\ Controls_{i,c,t} \\ & + \rho'\ Macro\ Controls_{c,t} \\ & + Country\ Dummies + Year\ Dummies + e_{i,j,t}, \end{aligned} \tag{5}$$

where *Bank Efficiency*$_{i,j,t}$ is the cost efficiency scores of bank i in country c in time t. *Bank Efficiency* is always positive and it is equal to one for the best practice or zero inefficient bank. *INCDIV* is the value of income diversification followed the basic HHI-type approach. *NONSHARE* is the share of non-interest income. *Ownership Structure* serves as proxies for ownership types of banks, including government ownership (*D20GO*) and foreign ownership (*D20FO*). *D20GO* is a dummy variable that value one if a bank is state owned (we define ownership using the 20% threshold),[3] *D20FO* is a dummy variable that takes value one if a bank is foreign-owned (private domestically owned is the excluded dummy).

The vector of bank regulation control variables, *Bank Regulation Control*, includes the following variables from Barth et al. (2013) datase: overall capital stringency *(OCS)* and official supervisory power *(OSP)*. While *OCS* reflects the extent of regulatory requirements regarding the amount of capital banks must hold, and deducts the certain market value losses from the determinants of capital adequacy, *OSP* represents the extent to which bank supervisory authorities possess the power to take specific actions against violations of bank regulations for preventing and correcting problems. We also use *Information Sharing* variable to control for the effects of each country's information channel on bank efficiency. *Information Sharing* is defined as a dummy equal to one if a country has either a public or a private registry, and zero otherwise. The vector of bank control variables, *Bank Control*, includes bank size defined as the logarithm of the bank's total assets *(Size);* and bank equity captured by the total equity to total asset ratio *(Equity)*. Furthermore, *Macro Controls* is a vector of macroeconomic controls including economic growth *(GDP)* and inflation *(CPI)*. Finally, *Countries Dummies* is a set of country dummy variables and *Year Dummies* is a set of time dummy variables.

A statistical issue arises, since values of our *Bank Efficiency* in the regression range from 0 to 1, making this dependent variable a truncated distribution. Ordinary least squares (OLS) regression parameter estimates for truncated variables would be biased upwards because OLS assumes a normal and homoskedastic distribution (Maddala, 1983). To resolve this data censor problem, we carry out our regressions using the Tobit maximum likelihood procedure. Use of a Tobit model can handle the characteristics of the distribution of efficiency scores and thus provide unbiased estimates of the coefficients.

[3] We also refer to Micco et al. (2007) and define ownership using the 50% threshold in our robustness test.

It is worth noting that $\hat{\beta}_1$ measures the impact of diversification and $\hat{\beta}_2$, the direct effect of a shift from interest activities to non-interest activities. If income diversity leads to higher efficiency, one would expect $\hat{\beta}_1$ to be positive. We are interested in the relationship between banks' income diversification and efficiency, but it is important to include the *NONSHARE* directly as an independent variable because we would like to control for the correlation between income diversification and non-interest income share.[4] We follow here the methodology developed by Stiroh and Rumble (2006) in order to assess the effects of diversification toward non-interest activities. The impact of a change in non-interest income on efficiency is measured using the first derivative of our dependent variables with respect to non-interest income:

$$\frac{\partial Bank\ Efficiency}{\partial NONSHARE} = \hat{\beta}_1 \frac{\partial INCDIV}{\partial NONSHARE} + \hat{\beta}_2 \qquad (6)$$

The first term on the right-hand side of Eq. (6) measures the effect of a change in the non-interest income share through its effect on diversification. As in Stiroh and Rumble (2006), we refer to this as the indirect effect of a change in non-interest income. As this effect depends both on the sign of $\hat{\beta}_1$ and the magnitude of the non-interest income share, the indirect is calculated accordingly for different levels of non-interest income. Meanwhile, $\hat{\beta}_2$ captures the direct effect of a shift from interest effect. Using a portfolio-style interpretation, $\hat{\beta}_1$ measures the covariance effect, while $\hat{\beta}_2$ measures the variance effect. The net effect, which is the sum of the direct and indirect effects, determines how efficiency varies with an increase in the share of non-interest income.

The dependence, however, between $\hat{\beta}_1$ and $\hat{\beta}_2$ raises econometric issues since *NONSHARE* and *INCDIV* are collinear. Although both estimates may be unbiased, their variance and covariance are overestimated (Chiorazzo et al., 2008). Wald tests need to be conducted to check the joint statistical significance of $\hat{\beta}_1$ and $\hat{\beta}_2$ in the various estimations. Moreover, we also estimate the equation by using only *NONSHARE* to check for robustness.

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[4] For example, a bank with 0.25 of its non-interest income share and a bank with 0.75 would appear the same value of income diversification, but it implies a very different range of strategies among banks.

3.5 The interrelated dimensions of bank income diversification and ownership

Based on the main implications of income diversification and ownership structure, and allowing for other factors to influence bank's overall efficiency, the basic empirical specification is formulated as follows:

$$\begin{aligned} \textit{Bank Efficiency}_{i,c,t} = {} & \beta_0 + \beta_1\ \textit{INCDIV}_{i,c,t} + \beta_2\ \textit{NONSHARE}_{i,c,t} \\ & + \beta_3\ \textit{INCDIV}_{i,c,t} \times \textit{Ownership Structure}_{i,c,t} \\ & + \beta_4\ \textit{NONSHARE}_{i,c,t} \times \textit{Ownership Structure}_{i,c,t} \\ & + \beta_5\ \textit{Ownership Structure}_{i,c,t} \\ & + \alpha'\ \textit{Bank Regulation Control}_{c,t} \\ & + \gamma\ \textit{Information Sharing}_{c,t} \\ & + \lambda'\ \textit{Bank Controls}_{i,c,t} \\ & + \rho'\ \textit{Macro Controls}_{c,t} \\ & + \textit{Country Dummies} + \textit{Year Dummies} + e_{i,j,t}, \end{aligned} \tag{7}$$

where $\textit{Bank Efficiency}_{i,j,t}$ is the cost efficiency scores of bank i in country c in time t. All other variables are defined in Eq. (5), and we continue to impose the sample restrictions, country and year fixed effects used in the model specifications. Notably, the coefficient on the interaction term $\textit{INCDIV}_{i,c,t} \times \textit{Ownership Structure}_{i,c,t}\ (\beta_3)$ will explain whether the income diversification and ownership enhance or impede bank efficiency. In other words, β_3 indicates the differential in income diversification benefits between government, domestic private and foreign-controlled banks. If one ownership group (i.e., government or foreign-controlled banks) has more benefits of diversification than their private-controlled counterparts, we would expect β_3 to be significant and positive. Similarly, β_4 measures the effects of government, foreign ownership expressed as a difference from the increase exposure to volatile non-interest activities of domestic private banks. If government-controlled banks (or foreign-controlled banks) perform better in mitigating the drawback effect of a shift towards non-interest activities than domestic private banks, the coefficient on the interaction term β_4 would be also expected to be significant and positive.

4. Data

4.1 Data sources

This study examines year-end financial statement data from 2003 through 2012 for 83 countries obtained from BankScope database. Unconsolidated data were selected but where these were not available, we chose consolidated data instead. For each bank in the database, state and foreign ownership information is hand collected from a variety of sources. We first gather information from the section "Shareholder Information" in the BankScope database. When BankScope's shareholder database does not have enough information for us to determine the percentage of state, foreign or domestic private ownership, we use bank ownership information from additional sources as used by La Porta et al. (2002). These sources include the Europa World Yearbook, the Banker's Almanac, Thomson Bank Directory, Asian Company Handbook, the Euromoney Bank Register, Bankers Handbook for Asia, Moody's International Company Data, World Scope Global Disclosure, and the MFC Investment Handbook.

Information on bank regulation and supervision variables was obtained from the World Bank (WB) database developed by Barth et al. (2001) and updated by Barth et al. (2006; 2008; 2013). Furthermore, Specifically, data for the indicator of information sharing were obtained from the Djankov et al. (2007). Finally, data for country-specific variables were collected from the WB database and the International Monetary fund (IMF). Also, we use International Monetary Fund (2012) report to classify countries according to analytical criteria of their development level, in which the sample will be divided into two major groups: developed countries and developing countries.[5] These analytical criteria are based on the compositions of (1) the source of export earnings and other income from abroad named analytical criteria; and (2) the

[5] As used here, the terms "developed countries" and "developing countries" refer to two groups of countries named "advanced economies" and "emerging and developing economies", respectively, in International Monetary Fund (2012) report.

financial criteria focusing on external financing sources and experience with external debt services.[6]

4.2 Efficiency scores

Table 1 provides a summary statistic of variables used in bank efficiency estimations. On average, the commercial banks have a higher amount of their total deposits than total loans. The average total costs of the sample banks is $2.865 billion. The mean values of price of capital and price of funds are about 4.665 and 0.042, respectively. These values are higher than the 2.82 of price of capital reported by Sun and Chang (2011), and are lower the 0.21 of price of funds reported by Berger et al. (2009). Notably, the standard deviations of our output variables are very high, which reflect that there exist the large differences in the bank sizes in the cross-country sample.

[Insert Table 1 here]

We present average *Bank Efficiency* scores by country in Table 2. The *Bank Efficiency* involves minimizing total cost of production for a given output level. Based on our measures in Panel A and B of Table 2, means of the *Bank Efficiency* score in each country range from 34.9 percent to 89.6 percent from year 2003 to 2012, while the overall mean presents at 70.6 percent. These explain that, on average, all banks could have produced their outputs by using 34.9 percent to 89.6 percent of the inputs that they actually consumed during the period 2003 – 2012. The results in Panel C reveal that there is no difference in average bank efficiency between prior and posterior GFC. In contrast, Panel D indicates that cost efficiency in developed markets (73.5 percent) is higher than those of developing markets (69.2 percent), and the difference is statistically significant at the 1 percent level.

[6] Countries are categorized into one of the related groups when their main source of export earnings exceeds 50 percent of total export values on average between 2005 and 2009. Countries are placed in the net debtor category when their current account balance accumulations from 1972 to 2009 are negative. Net debtors are grouped in the external financing category when 65 percent or more of their total debt, on average between 2005 and 2009, is funded by official creditors.

Table 2 also provides descriptive statistics of the government and foreign block ownership by country. During 2003 to 2012, the means of government, domestic private and block foreign ownership of banks for the 83 countries in the sample are 9.31 percent, 25.6 percent and 33.5 percent, respectively. The results in Panel C also show that government ownership of top ten banks has been declining during the aftermath of GFC, although the difference in *GO* between before and after GFC is insignificant. The opposite is true for the cases of domestic private and foreign ownership. After the financial crisis, the average foreign ownership increases about 4.19 percent relative to the prior period, while the difference of private ownership is 1.08 percent (but not statistically significant). It would be not surprising that these changes are consistently influenced by the evolution of the privatization and liberalization process. We also group countries by their economic development in Panel D, and find that both means of government and foreign ownership show higher values for developing countries, while the average private ownership in developing countries presents a significantly lower level than that of developed ones.

We report the mean values of the income diversification and banks' non-interest income share variables disaggregated by a financial crisis, as well as by an economic development. Panel C of Table 2 compares mean values of non-interest income share and bank diversification between before and after GFC. It appears that before the crisis, on average, these values both experience higher levels than those after GFC period. The differences are statistically significant at 1 percent level, indicating a downtrend of bank's activities toward non-interest income. Our univariate results in Panel D show that bank diversification in developing countries tends to be higher than that of developed countries, although it is still questionable to figure out whether the benefits of diversification are improved or reduced by changes in ownership structure mentioned above.

[Insert Table 2 here]

Table 3 shows summary statistics of bank efficiency, ownership structure, income diversification, bank regulations, and bank-level and country-level control variables. The mean value of income diversification in the whole sample is 0.40, while the overall mean of non-interest income share presents at 0.37. On average, the dummy variables of both government ownership (13.47 percent) and foreign ownership (41.74 percent) with the threshold of 20 percent are higher than those of 50 percent threshold (9.13 percent and 33.29 percent, respectively). The mean and standard deviation of the overall capital stringency present at 3.95 and 1.61, respectively, whereas those of official supervisory power index are 10.89 and 2.38. Also, the mean values of log of bank total assets and log of GDP per capita are 3.76 and 4.06, respectively corresponding to the standard deviations of 1.06 and 0.48. These suggest fairly low cross-country variation. Finally, we found that the average value of deflated *CPI* is 119, higher than the value of 100 with base year 2005.

[Insert Table 3 here]

The pair-wise correlation values between independent variables in the pre-crisis period are reported in Table 4. The matrix explaining the correlation between *D20GO* and *INCDIV* is negative and statistically significant, while the correlation between *D20FO* and *INCDIV* shows a positive relationship (although not statistically significant). These correlations explain that banks with high government ownership present a lower level of income diversification than their non-government counterparts, whereas banks with high foreign ownership are not likely to have a greater diversification. A significantly positive association is shown for correlation between *INCDIV* and bank regulatory variables, indicating that the economies with more requirements in bank supervisory and regulatory systems are likely to enlarge their banking diversification. Similarly, *INCDIV* is positively correlated with *Size*, which suggests that banks with larger assets tend to have a higher level of diversification. The opposite is true for the relation between bank diversification and *Equity*. In addition, the positive correlation between *NONSHARE* and *Equity* shows that the higher the ratio of total equity to total assets, the more the share of bank's non-interest income. The matrix correlation also indicates that an increase in *GDP* will increase banks' non-traditional activities, while an increase in domestic inflation *(CPI)* will improve income diversification.

[Insert Table 4 here]

5. Empirical results

5.1 Determents of efficiency

As discussed earlier, to test for the potential effect of the Global Financial Crisis of 2008 in changing the bank's investment behavior and risk exposure, our regressions should be interpreted separately for before and after crisis periods. As banks located in developed and developing economies are likely to have different performance (see Micco et al., 2007), we also split our sample into two country groups. Models 1, 2 and 3 of Table 5 report estimations of the parameters from the Eq. 5 prior GFC by using cost efficiency scores as a dependent variable. The coefficient of income diversification, *INCDIV* is positive and significant in all cases of the pre-crisis period, explaining that increased income diversification enhances bank efficiency. In contrast, the negative coefficients on the share of the non-interest income *(NONSHARE)* across these regressions imply that a larger portion in non-interest income is associated with reduced efficiency. Based on the portfolio framework, the coefficient of *INCDIV* is interpreted as the benefit of diversification from a covariance effect, while that of *NONSHARE* denotes the negative effect from increased exposure to the more non-interest income activities (volatile investments). These results are consistent with the double-edged nature of the trend toward non-interest income reported by Stiroh and Rumble (2006), who suggest that an increase in revenue diversity will lead to higher potential gains for banks, but these benefits are offset by the increased exposure to volatile non-interest income share. This evidence is also similar to the view that banks use up their diversification benefits through increasing their financial leverage or holding less equity capital, hence making more risky loans (Demsetz and Strahan, 1997; DeYoung and Roland, 2001).

Table 5 also reports our baseline results with the differences of bank efficiency across ownership groups. The first model shows that banks with large government ownership tend to have lower cost efficiency than comparable domestic private banks. The effect is quantitatively substantial, explaining that the average state-controlled bank has an efficiency level that is 0.035 points lower than that of the average private-controlled bank. However, we find no statistically significant difference between the bank efficiency of foreign-controlled banks and that of similar domestic private banks. When we look at the effects of ownership structure on bank efficiency across countries, we find only differences in the developing countries, not the developed countries during the pre-crisis period. The result of model 3 shows that state-controlled banks located in developing economies tend to have lower efficiency than their private-controlled counterparts. In developed economies, we find no significant difference in bank efficiency between government, domestic private and foreign-controlled banks. These results are consistent with previous findings that banks with high government ownership tend to be less efficient and less profitable than banks with high private ownership in developing countries (e.g., Bonin et al., 2005a; Berger et al., 2009), but that is not the case in developed countries (Micco et al., 2007).

Models 4, 5 and 6 of Table 5 show the results after the financial crisis. The coefficients on *INCDIV* and *NONSHARE* continue to provide the significantly positive and negative impacts, respectively, on bank efficiency for all these model specifications. These evidences suggest that the benefits of diversification and the dark sides of non-interest exposure are more pronounced even during the financial crisis period. Although income diversification is positively associated with bank efficiency across countries, it shows a lower magnitude of diversification gains in developing countries. Based on our analysis in models 5 and 6, banks in developed economies that experienced a one percent increase in diversification could improve their efficiency about 0.231 percent, higher than that in developing countries (0.114 percent). In contrast, the offsetting effect of non-interest income share on bank efficiency in developed countries (-0.275) is greater than that in developing ones (-0.131). Notably, after the financial crisis, the diversification benefits between developed and developing countries display the opposite magnitudes with those reported in pre-crisis sample. This may be derived from government intervention for the allocation of credit in banking industry, as well as the possible obstacles in operating financial services concerning bank ownership structure, especially in the aftermath of the financial crisis.

We also find different results when we compare the efficiency between foreign-controlled banks and their domestic private counterparts in the aftermath of the financial crisis. There is no difference in cost efficiency between state-controlled and domestic private banks, while foreign-controlled banks tend to have a higher efficiency than comparable private banks in developing countries (model 6 of Table 5). More interestingly, the previous insignificant coefficient of *D20FO* before the financial crisis becomes positively significant in developing countries, while the negative coefficient of *D20GO* becomes statistically insignificant after the crisis period. This indicates that the foreign-controlled banks located in developing countries tend to be more effective in cost management than those of comparable private banks during the crisis aftermath (a result that is consistent with what was found by Micco et al. (2007)).

Notably, the coefficient of foreign ownership dummy in developing countries is very large and indicates that the differential between the cost efficiency of foreign-controlled banks and private-controlled banks more than triples when compared with that of developed countries during the post-crisis period (the two values are 0.066 and 0.020, respectively). On the other hand, the result of *D20GO* also suggests that it is not necessarily true that banks with more government ownership are less efficient than banks with more domestic private ownership and are in the line with Altunbas et al. (2001), who find no evidence that private-owned banks are more efficient and perform better than mutual and state-owned banks in case of Germany. They also argue that the public banks with lower funding costs based on "less interest rate sensitive" retail depositors as a fundamental reason to explain their superior performance over the domestic private banks.

To assess the net effect between positive impact of income diversification and negative impact from the increased non-interest income share, we regard estimates both coefficients together as discussed in Section 3. Table 6 shows results of the indirect, direct and net effect from the bank efficiency regression, regressed at various percentile ranks (10th, 25th, 50th, 75th, and 90th percentile) of non-interest income share.[7] Estimates are based on the result of income diversification regression from the first column and the fourth column of Table 5. The first row of Panel A presents the indirect effect before the financial crisis, which alters monotonically from over 0.002 for a bank with a non-interest income share at the 10th percentile to about 0.001 for a bank at the 90th percentile.[8] The results indicate that banks with relatively smaller non-interest income shares (the 10th and 25th percentile) have greater potential diversification gains from a shift toward non-traditional activities, whereas banks with relatively larger non-interest income shares (the 75th and 90th percentile) have fewer potential diversification benefits. The second row shows the direct effect, which indicates that one percent increase in share of non-interest income is associated with 0.18 percent decline in bank efficiency. The net effect in the final line of Panel A shows that the costs associated with increased income diversification offset the positive gains from a more diversified revenue stream. Interestingly, the potential diversification benefits are significantly smaller when banks tend to be more diversified (the 75th and 90th percentile), explaining that increased shifts toward non-interest income are related to lower bank efficiency.[9] The evidence from net effect confirms again the double-edge nature of the shift toward non-traditional activities: increased income diversification does bring benefits for banks, but these gains from diversify are likely to be offset by the extra costs associated with the more volatile activities. This result supports the strategic focus hypothesis, consistent with the findings of DeYoung and Roland (2001) and Stiroh and Rumble (2006) in earlier periods.

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[7] The 10th, 25th, 50th, 75th, and 90th percentile correspond to the non-interest income shares of 0.18, 0.27, 0.37, 0.48, and 0.65, respectively for Panel A (before financial crisis), and 0.17, 0.24, 0.32, 0.44, and 0.59 for Panel B (after financial crisis).

[8] Similar to Stiroh and Rumble (2006), the effects are estimated at a 1% increase in the share of non-interest income.

[9] We also report the indirect, direct and net effect of non-interest income share after the financial crisis in Panel B, which the results are almost similar to those of Panel A when the fourth column of Table 5 is used.

5.2 The interrelated dimensions of bank income diversification and ownership

We are now interested in whether the influence of income diversification may vary with different characteristics of countries that have experienced the most considerable changes in ownership structure of commercial banks. In particular, we examine the role of ownership structure in determining the benefits of income diversification. Table 7 presents estimates of regressions with the bank diversification and share of non-interest income variables interacted with dummy government ownership, and with dummy foreign ownership. The coefficients on interaction *INCDIV*D20GO* are significant and negative for both full and subsample cases, indicating that the efficiency of increased diversification is significantly lower for banks having more government ownership. Specifically, models 1 through 3 of Table 7 show that, compared with domestic private banks, a one percentage point increase in income diversity is associated with about 0.155 percentage point lower efficiency level for state-controlled banks. The result is also similar to that obtained in developed countries (-0.286) and developing countries (-0.147), and that is consistent with what was found by Berger et al. (2010) in the regression of cost efficiency. However, the negative effects of government ownership on bank diversification are mitigated by low costs of diversity. All coefficients on *NONSHARE*D20GO* are positive and significant in the pre-crisis period, implying that government-controlled banks perform better in declining the drawback effect of an increased share of non-interest income on bank efficiency than their domestic private counterparts.

When we focus on foreign ownership before the financial crisis, we find that the coefficient on interaction term *INCDIV*D20FO* is negative in the developed countries, but in the developing countries this coefficient is not statistically significant. Model 2 of Table 7 explains that, compared with domestic private banks, foreign-controlled banks located in developed countries tend to have a lower efficiency of income diversification. For developed economies experiencing a one percent increase in income diversification, annual cost efficiency of banks with high foreign ownership is 0.261 percent, lower than that of comparable private banks. In other words, the negative effect of foreign ownership on diversification benefits indicates that foreign-controlled banks seem to be hard to maximize the advantage of management's expertise and reduce agency problems in developed countries. In contrast, the coefficient on *NONSHARE*D20FO* is positive and significant, explaining that foreign-controlled banks can mitigate better the negative impact of an increased share of non-interest activities on bank efficiency than their private-owned banks. This finding is in the line with Berger et al. (2010), who suggest that foreign ownership may play an important role in reducing the bank's diversification discount.

After the financial crisis, most ownership interactions in Table 7 are statistically significant, implying that benefits of diversification and potential risks of non-interest income vary with bank ownership structure. We find that government ownership continues to provide a negative impact on the relation between income diversification and bank efficiency. Results show that cost efficiency of state-controlled banks is lower than cost efficiency in domestic private banks when experiencing an increase in income diversification. Take, for instance, models 5 and 6 of Table 7 reports that the differential in diversification effectiveness between average state-controlled and domestic private banks located in developed countries is approximately -0.325 basis points, while in developing countries the estimated points yield a difference of approximately -0.149 basis points relative to the benchmark of private banks.

It is interesting to note that, the previous coefficient of the interaction *INCDIV*D20FO* is negatively insignificant (-0.202) to become positive and statistically significant (0.110) for the subsample of developing countries after the GFC. The coefficient suggests that, compared with domestic private banks, foreign-controlled banks located in developing countries tend to be more efficient in diversified activities during the post-crisis period. The opposite is true for the foreign-controlled banks in developed countries. One possible reason is that foreign-controlled banks are more exposed to financial markets in developed countries. They tend to be more competitive by using greater communication technology and better risk management while operating in developing countries. These advantages in financial services could favor foreign banks in expanding total leverage for diversification target, and thus enhance their profitability (Claessens et al., 2001). Unlike foreign presence in developed markets, the presence of foreign ownership in developing countries generally represents a monitoring of professionalism at the top management level. Moreover, foreign-owned banks located in developing countries are also often associated with good information networks and wide partnerships, and even have an advantage in affiliation with conglomerates; therefore, their diversified activities can improve the efficiency better than the comparable non-foreign counterparts (Berger et al., 2010).

On the other hand, models 5 and 6 of Table 7 also report that the interaction terms concerning volatile non-interest activities of foreign-owned banks *(NONSHARE*D20FO)* enter a regression positively in developed countries, inversely to a significantly negative coefficient found in developing countries. Not surprisingly, the coefficient of interaction *NONSHARE*D20FO* remains positively significant in the post-crisis sample of developed countries, indicating the role of foreign ownership in mitigating the negative effect of diversified activities that are inherently more volatile. On the contrary, this interaction term shows a negative coefficient (statistically significant at the 5% level) for the subsample of developing countries, explaining that foreign-controlled banks with high degree of non-traditional activities tend to be less effective than their private counterparts. This evidence is also consistent with Pennathur et al. (2012), who show that the foreign banks with a pursuit of fee-based income tend to increases risk, as measured by the earning volatility.

5.3 Robustness tests

In this section, we examine the robustness of our results to an alternative ownership measure. Because we are primarily interested in whether our results are robust to an alternative ownership structure, we replace dummy ownership variables of 20% threshold in previous section with those of 50% threshold. Following Iannotta et al. (2007) and Shen and Lin (2012), we consider a bank as being owned by a large shareholder if the shareholder owning more than 50% of total shares is an individual or company. For this, we set dummy variables, *D50GO* and *D50FO*, attempting to capture the extent of bank controls of government and foreign ownership, respectively (domestic private ownership is the excluded dummy variable).

[Insert Table 8 and 9 here]

We report the estimation results using alternative ownership structure in Table 8 and 9. The findings presented here are similar to the key findings reported in both Table 6 and 7. We continue to find that income diversification still provides a positive association with bank efficiency, whereas the opposite is true for share of non-interest income, suggesting a very robust relationship. The coefficients of government ownership interactions also confirm our prior findings that state-owned banks tend to have a lower benefit of income diversification than comparable private-owned banks, although these banks are likely to have lower costs of diversified activities. Compared to domestic private banks, foreign-owned banks in developed countries are likely to have lower diversification gains, while their presence in developing countries shows the opposite results during the post-financial crisis period. The robustness test once again implies that foreign-owned banks located in developed countries are better in reducing the diversification discount from the shift toward non-interest activities when compared with their domestic private counterparts, and that the opposite is true for the case of developing countries.

6. Conclusion

This paper explores the impact of ownership structure on the relationship between income diversification and bank efficiency using the sample of 83 countries over the period 2003–2012. The cost efficiency scores are estimated by parametric stochastic frontier approach to represent a bank's efficiency. We could summarize our main findings as follows. Firstly, banks with greater income diversification improve their efficiency, even though the diversification gains are offset by the increase exposure to volatile non-interest activities. Secondly, state-controlled banks tend to have lower benefits of diversification than comparable domestic private banks, although an increase in government ownership can help banks to have lower costs of income diversification. Thirdly, foreign-controlled banks located in developed countries are likely to have lower diversification effectiveness than their domestic private counterparts, while in developing countries their participation shows the opposite results during the aftermath of the financial crisis. Finally, banks with foreign-controlled ownership located in developed countries can mitigate better the negative impact of an increased share of non-interest activities on bank efficiency, whereas the opposite is true for their ownership in developing countries.

We provide evidence supporting for the strategic focus hypothesis that commercial banks should be aware of the potential increased costs from a strategy of expanding more non-traditional business lines. Our findings are consistent with the evidence of recent study on the performance–diversification nexus (e.g. DeYoung and Roland, 2001; Stiroh and Rumble, 2006; Berger et al., 2010). Assessing the effects of ownership structure and volatile earnings for financial institutions' efficiency has direct implications in the context of this debate. Because the benefits and dark sides of diversification vary with different forms of bank ownership, as well as with different nation's economic development, our study highlights the importance of designing an appropriate investment strategy and supervisory framework to reduce operation risks and to achieve a better performance for banks.

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Table 1
Descriptive statistics of variables used in *Bank Efficiency* estimations.

	Mean	SD	Median	Minimum	Maximum
Interest expenses (in billion US $)	1.647	5.683	0.142	0.000	138.483
Non-interest expenses (in billion US $)	1.218	3.900	0.134	0.000	52.298
Total costs (in billion US $)	2.865	8.840	0.302	0.000	147.100
Outputs (in billion US $)					
Y_1 = Total loans	37.121	110.255	2.888	0.000	1,399.722
Y_2 = Other earning assets	36.111	147.664	1.403	0.000	2,240.273
Y_3 = Total deposits	62.636	200.277	4.364	0.001	2,537.282
Y_4 = Liquid assets	19.811	85.922	0.955	0.000	1,416.301
Input prices					
w_1 = Price of capital	4.665	22.920	1.846	0.073	787.000
w_2 = Price of funds	0.042	0.080	0.032	0.000	3.870

Notes: Price of capital is the ratio of non-interest expenses to total fixed assets. Price of funds is the ratio of interest expenses to total deposits. Total costs are the summation of interest expenses and non-interest expenses. Data source: BankScope, 2003–2012.

Table 2

Measures of bank efficiency, ownership structure, share of non-interest income, and income diversification around the world for the year 2003 –2012. *CE* is cost efficiency estimated by stochastic frontier approach (SFA). *INCDIV* is the value of income diversification followed the basic Herfindahl- type approach. *NONSHARE* is share of non-interest income. Panel A and B show the percentage of assets owned by the government *(GO)*, private domestic *(DO)* and foreign-held block shareholders *(FO)* which is classified by the 10% threshold from La Porta et al. (1999). Panels C and D show the results of tests of mean values across economies experienced the 2008 Global Financial Crisis, and across economic development (developed vs. developing). The economic development classification follows World Economic Outlook reported by International Monetary Fund (2012). Numbers of banks in each country are presented in brackets.

Countries	*CE*	*GO*	*DO*	*FO*	*NON-SHARE*	*INCDIV*
Panel A – Developed countries						
Australia (10)	0.833	0.000	0.347	0.084	0.415	0.399
Austria (10)	0.837	0.213	0.376	0.279	0.334	0.423
Belgium (7)	0.847	0.093	0.505	0.359	0.263	0.346
Canada (10)	0.747	0.000	0.072	0.103	0.465	0.459
Cyprus (9)	0.784	0.100	0.251	0.353	0.301	0.391
Czech (10)	0.675	0.000	0.090	0.852	0.306	0.385
Denmark (10)	0.723	0.000	0.332	0.111	0.329	0.420
Finland (7)	0.721	0.000	0.498	0.232	0.531	0.396
France (10)	0.847	0.000	0.580	0.080	0.493	0.430
Germany (8)	0.839	0.078	0.260	0.213	0.363	0.400
Greece (10)	0.673	0.019	0.126	0.455	0.336	0.390
Ireland (10)	0.779	0.026	0.000	0.654	0.408	0.336
Italy (10)	0.734	0.000	0.172	0.078	0.331	0.426
Japan (9)	0.509	0.000	0.346	0.020	0.256	0.330
Korea (10)	0.835	0.126	0.401	0.247	0.308	0.362
Luxembourg (10)	0.673	0.105	0.000	0.861	0.405	0.402
Netherlands (10)	0.792	0.000	0.542	0.340	0.376	0.400
Norway (10)	0.784	0.000	0.241	0.250	0.344	0.334
Portugal (10)	0.815	0.102	0.380	0.354	0.379	0.412
Singapore (7)	0.707	0.000	0.464	0.217	0.495	0.411
Slovakia (10)	0.576	0.006	0.021	0.887	0.291	0.385
Slovenia (10)	0.734	0.096	0.171	0.405	0.362	0.435
Spain (10)	0.771	0.000	0.191	0.246	0.386	0.407
Sweden (9)	0.642	0.011	0.472	0.188	0.438	0.363
Switzerland (10)	0.623	0.000	0.599	0.310	0.615	0.382
Taiwan (10)	0.721	0.254	0.612	0.000	0.332	0.402
United Kingdom (9)	0.758	0.000	0.905	0.095	0.433	0.459
United States (10)	0.456	0.000	0.619	0.087	0.431	0.455
Developed countries average	**0.735**	**0.045**	**0.340**	**0.299**	**0.382**	**0.400**
Developed countries median	**0.806**	**0.000**	**0.000**	**0.000**	**0.353**	**0.434**
Panel B – Developing countries						
Argentina (10)	0.543	0.244	0.250	0.303	0.667	0.386
Armenia (10)	0.631	0.000	0.114	0.591	0.350	0.417
Azerbaijan (10)	0.696	0.101	0.433	0.190	0.430	0.353
Bahrain (8)	0.764	0.095	0.107	0.413	0.336	0.405
Bangladesh (9)	0.859	0.124	0.429	0.035	0.468	0.456
Belarus (9)	0.684	0.141	0.050	0.660	0.584	0.450
Bolivia (8)	0.383	0.049	0.352	0.438	0.373	0.387
Bosnia and Herzegovina (10)	0.523	0.000	0.025	0.787	0.390	0.417
Brazil (10)	0.842	0.167	0.420	0.246	0.277	0.357
Bulgaria (10)	0.707	0.000	0.220	0.618	0.326	0.412
China (10)	0.792	0.291	0.178	0.118	0.136	0.222
Colombia (10)	0.599	0.002	0.254	0.498	0.458	0.452
Costa Rica (9)	0.705	0.278	0.433	0.111	0.296	0.400
Croatia (10)	0.739	0.102	0.003	0.684	0.338	0.434

Countries	*CE*	*GO*	*DO*	*FO*	*NON-SHARE*	*INCDIV*
Panel B – Developing countries (continued)						
Dominican (6)	0.730	0.000	0.436	0.000	0.404	0.398
Ecuador (10)	0.472	0.075	0.446	0.192	0.412	0.416
El Salvador (8)	0.694	0.000	0.259	0.709	0.218	0.275
Ethiopia (7)	0.774	0.286	0.341	0.000	0.540	0.461
Georgia (7)	0.658	0.000	0.223	0.502	0.315	0.410
Honduras (10)	0.615	0.000	0.304	0.512	0.250	0.362
Hungary (10)	0.758	0.000	0.074	0.811	0.417	0.437
India (10)	0.858	0.443	0.069	0.077	0.350	0.431
Indonesia (10)	0.778	0.326	0.071	0.317	0.238	0.349
Jordan (10)	0.770	0.056	0.119	0.165	0.333	0.426
Kenya (10)	0.519	0.095	0.269	0.201	0.376	0.445
Latvia (10)	0.646	0.109	0.299	0.441	0.469	0.424
Lebanon (10)	0.843	0.000	0.457	0.227	0.280	0.390
Malaysia (10)	0.876	0.032	0.410	0.400	0.328	0.415
Mauritius (10)	0.819	0.082	0.105	0.526	0.326	0.404
Moldova (10)	0.706	0.022	0.069	0.244	0.462	0.460
Nepal (9)	0.812	0.000	0.159	0.180	0.253	0.372
Nigeria (10)	0.513	0.000	0.074	0.090	0.459	0.461
Pakistan (10)	0.753	0.218	0.104	0.350	0.262	0.370
Panama (9)	0.774	0.096	0.292	0.554	0.249	0.350
Paraguay (6)	0.881	0.000	0.141	0.689	0.596	0.389
Peru (10)	0.529	0.102	0.222	0.574	0.269	0.364
Philippines (10)	0.620	0.042	0.398	0.185	0.540	0.436
Poland (10)	0.668	0.119	0.099	0.570	0.434	0.479
Qatar (7)	0.814	0.087	0.091	0.094	0.293	0.388
Romania (10)	0.739	0.114	0.008	0.692	0.348	0.425
Russian (10)	0.693	0.231	0.304	0.302	0.411	0.360
Saudi Arabia (10)	0.589	0.158	0.070	0.154	0.339	0.425
South Africa (10)	0.802	0.005	0.659	0.265	0.473	0.427
Sri Lanka (10)	0.815	0.282	0.176	0.020	0.293	0.392
Tanzania (10)	0.516	0.093	0.120	0.534	0.379	0.451
Thailand (10)	0.656	0.113	0.245	0.277	0.255	0.361
Tunisia (10)	0.760	0.092	0.130	0.253	0.342	0.441
Turkey (10)	0.794	0.000	0.363	0.275	0.343	0.406
Ukraine (10)	0.718	0.100	0.217	0.395	0.400	0.432
United Arab Emirates (10)	0.829	0.318	0.158	0.020	0.347	0.418
Uruguay (10)	0.413	0.172	0.000	0.705	0.478	0.420
Uzbekistan (8)	0.621	0.336	0.147	0.111	0.577	0.458
Venezuela (10)	0.644	0.040	0.325	0.250	0.271	0.376
Vietnam (10)	0.896	0.325	0.018	0.091	0.249	0.324
Zambia (10)	0.349	0.102	0.166	0.636	0.475	0.447
Developing countries average	**0.692**	**0.117**	**0.215**	**0.353**	**0.368**	**0.405**
Developing countries median	**0.744**	**0.000**	**0.000**	**0.124**	**0.343**	**0.437**
Full sample mean	**0.706**	**0.093**	**0.256**	**0.335**	**0.373**	**0.403**
Full sample median	**0.767**	**0.000**	**0.000**	**0.000**	**0.346**	**0.436**

Panel C – Means by countries experiencing a financial crisis between 2003-2007 and 2008-2012 (t-statistics in italics are for differences in means)

	CE	*GO*	*DO*	*FO*	*NON-SHARE*	*INCDIV*
Before crisis	0.708	0.096	0.251	0.314	0.389	0.408
After crisis	0.705	0.090	0.262	0.356	0.357	0.398
Difference	-0.003	-0.006	0.011	0.042	-0.032	-0.010
t-stats (Before vs. After)	*-0.72*	*-1.10*	*1.28*	*4.37****	*-7.91****	*-4.39****

Panel D – Means by country characteristics (t-statistics in italics are for differences in means)

	CE	*GO*	*DO*	*FO*	*NON-SHARE*	*INCDIV*
Developed economies	0.735	0.045	0.340	0.299	0.382	0.400
Developing economies	0.692	0.117	0.215	0.353	0.368	0.405
Difference	-0.043	0.072	-0.125	0.054	-0.014	0.005
t-stats	*-8.17****	*12.04****	*-14.09****	*5.25****	*-3.12****	*1.95**

Notes: *** Significant at the 1% level; ** Significant at the 5% level; * Significant at the 10% level

Table 3

Descriptive statistics of independent and control variables used to estimate the impact of income diversification and ownership structure on bank efficiency. *Bank Efficiency* is cost efficiency estimated by stochastic frontier approach. *D20GO (D20FO)* is dummy variable, takes a value of one if the percentage owned by government (foreign) block shareholders of a bank is above the threshold of 20%, zero otherwise. Similarly, *D50GO (D50FO)* is dummy variable, takes a value of one if the percentage owned by government (foreign) block shareholders of a bank is above the threshold of 50%, zero otherwise. *INCDIV* is the value of income diversification followed the basic Herfindahl- type approach. *NONSHARE* is the shares of non-interest income. Bank regulatory variables, including *OCS* and *OSP* represent for overall capital stringency and bank's official supervisory power, respectively. *Size* controls for economy of scale which calculated by log of bank total assets. *Equity* is denoted as the total equity to total asset ratio. *Information Sharing* is defined as a dummy equal to one if a country has either a public or a private registry, zero otherwise. *GDP* is defined as log of Gross Domestic Product (GDP) per capita based on Purchasing Power Parity, while *CPI* is the deflated Consumer Price Index (CPI) for each country with the base year 2005.

Variable	Mean	SD	Median	Minimum	Maximum
Bank Efficiency	0.706	0.193	0.767	0.007	0.973
INCDIV	0.403	0.102	0.436	0.001	0.500
NONSHARE	0.373	0.180	0.346	0.000	0.999
GO	0.093	0.249	0.000	0.000	1.000
DO	0.256	0.366	0.000	0.000	1.000
FO	0.335	0.417	0.000	0.000	1.000
D20GO	0.135	0.341	0.000	0.000	1.000
D20FO	0.417	0.493	0.000	0.000	1.000
D50GO	0.091	0.288	0.000	0.000	1.000
D50FO	0.333	0.471	0.000	0.000	1.000
OCS	3.950	1.607	4.000	0.000	7.000
OSP	10.890	2.375	11.000	3.000	14.000
Information Sharing	0.713	0.452	1.000	0.000	1.000
Size	3.758	1.057	3.713	0.640	6.476
Equity	0.102	0.071	0.087	0.001	0.864
GDP	4.063	0.475	4.103	2.687	4.961
CPI	1.187	0.329	1.098	0.634	4.379

Notes: The overall sample is an unbalanced panel which consists of 7533 bank-year observations (783 commercial banks), covering 10 years period – 2003–2012.

Table 4

This table provides the correlation coefficient matrix of main independent variables. The sample includes 783 banks from 83 countries, and the statistics based on annual data for the pre-financial crisis period 2003 –2007.[10] *D20GO (D20FO)* is dummy variable, takes a value of one if the percentage owned by government (foreign) block shareholders of a bank is above the threshold of 20%. *INCDIV* is the value of income diversification followed the basic Herfindahl- type approach. *NONSHARE* is the shares of non-interest income. Bank regulatory variables, including *OCS* and *OSP* represent for overall capital stringency and bank's official supervisory power, respectively. *Size* controls for economy of scale which calculated by log of bank total assets. *Equity* is denoted as the total equity to total asset ratio. *Information Sharing* is defined as a dummy equal to one if a country has either a public or a private registry, zero otherwise. *GDP* is defined as log of Gross Domestic Product (GDP) per capita based on Purchasing Power Parity, while *CPI* is the deflated Consumer Price Index (CPI) for each country with the base year 2005.

	INCDIV	*NONSHARE*	*D20GO*	*D20FO*	*OCS*	*OSP*	*Information Sharing*	*Size*	*Equity*	*GDP*	*CPI*
INCDIV	1.000										
NONSHARE	0.290***	1.000									
D20GO	-0.033**	-0.047***	1.000								
D20FO	0.022	-0.050***	-0.209***	1.000							
OCS	0.091***	0.075***	0.048***	-0.111***	1.000						
OSP	0.048***	-0.011	0.058***	0.065***	0.156***	1.000					
Information Sharing	-0.089***	-0.001	-0.155***	0.019	-0.123***	-0.114***	1.000				
Size	0.041**	-0.018	0.056***	-0.177***	-0.073***	-0.051***	0.395***	1.000			
Equity	-0.028*	0.083***	0.012	0.066***	0.056***	0.045***	-0.164***	-0.477***	1.000		
GDP	0.000	0.031*	-0.117***	0.001	-0.012*	-0.078***	0.443***	0.590***	-0.186***	1.000	
CPI	0.031*	0.003	0.009	0.019	0.027	-0.013	0.040**	0.066***	0.004	0.022	1.000

Notes: Significance at 1%, 5% and 10% level is denoted by ***, ** and *. The figures in parentheses indicate *t*-values.

[10] To conserve space, the descriptive statistic for the post-financial crisis period 2008 – 2012 is not reported, but is available upon request.

Table 5

This table reports the differential impact of income diversification on the bank efficiency, which is estimated by Tobit regressions. Statistics are based on an unbalanced panel for the year 2003 – 2007 (before financial crisis) and year 2008 – 2012 (after financial crisis). *D20GO (D20FO)* is dummy variable, takes a value of one if the percentage owned by government (foreign) block shareholders of a bank is above the threshold of 20%, zero otherwise (private domestic ownership is the excluded dummy). *INCDIV* is the value of income diversification followed the basic Herfindahl- type approach. *NONSHARE* is the shares of non-interest income. Bank regulatory variables, including *OCS* and *OSP* represent for overall capital stringency and bank's official supervisory power, respectively. *Size* controls for economy of scale, which is calculated by log of bank total assets. *Equity* is denoted as the total equity to total asset ratio. *Information Sharing* is defined as a dummy equal to one if a country has either a public or a private registry, zero otherwise. *GDP* is defined as log of Gross Domestic Product (GDP) per capita based on Purchasing Power Parity, while *CPI* is the deflated Consumer Price Index for each country with the base year 2005. Models 1 through 3 report the basic regression results that include main independent variables and bank-specific control variables prior the financial crisis, while models 4 through 6 provide regression results after the financial crisis.

	Dependent variable: Cost efficiency					
	Before financial crisis			After financial crisis		
Independent variables	Full	Developed	Developing	Full	Developed	Developing
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.595*	0.445	0.656***	-0.555	1.067	0.153
	(1.888)	(0.715)	(2.706)	(-1.043)	(1.128)	(1.505)
INCDIV	0.115***	0.112**	0.126***	0.158***	0.231***	0.114**
	(3.755)	(2.136)	(3.103)	(3.909)	(4.818)	(2.290)
NONSHARE	-0.176***	-0.176***	-0.187***	-0.207***	-0.275***	-0.131***
	(-9.150)	(-5.355)	(-7.324)	(-7.026)	(-7.596)	(-3.604)
D20GO	-0.035**	0.002	-0.045**	0.010	0.021	0.009
	(-2.157)	(0.047)	(-2.324)	(0.455)	(0.718)	(0.364)
D20FO	0.005	0.029	0.008	0.039**	0.020	0.066***
	(0.497)	(1.522)	(0.657)	(2.518)	(0.942)	(2.830)
OCS	-0.016	0.028**	-0.013	-0.001	0.003	0.000
	(-0.856)	(2.021)	(-0.634)	(-0.369)	(1.222)	(0.053)
OSP	0.005	-0.005	0.007	0.001	0.001	-0.003
	(0.324)	(-0.338)	(0.640)	(0.753)	(0.381)	(-1.348)
Size	0.060***	0.063***	0.032***	0.079***	0.086***	0.051**
	(7.373)	(5.330)	(2.729)	(5.754)	(4.615)	(2.426)
Equity	-0.386***	-0.866***	-0.190***	-0.047*	-0.413***	0.142
	(-7.544)	(-6.194)	(-3.017)	(-1.854)	(-3.035)	(1.275)
Information Sharing	0.011	-0.017	0.019**	0.037**	0.007	0.018
	(1.358)	(-0.659)	(2.101)	(1.978)	(0.367)	(0.711)
GDP	0.027	-0.094	0.013	0.174	-0.280	0.094**
	(0.574)	(-0.543)	(0.177)	(1.286)	(-1.445)	(2.214)
CPI	-0.019	0.289	0.020	0.033**	0.412**	0.012
	(-1.377)	(1.459)	(0.465)	(2.120)	(2.307)	(0.761)
Country fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Log pseudo likelihood	2494.54	984.30	1442.91	1383.69	836.05	955.52
Observations	2996	1138	1858	3232	1174	2058

Notes: Significance at 1%, 5% and 10% level is denoted by ***, ** and *. The figures in parentheses indicate *t*-values.

Table 6

Estimation of impact of a change in the non-interest income share on bank efficiency. The estimates of the indirect, direct and net effects are based on the results of efficiency regression in the first column of Table 5 for Panel A and second column of Table 5 for Panel B. The coefficients are evaluated at the 10th, 25th, 50th, 75th, and 90th percentile of non-interest income share corresponding to the non-interest income shares of 0.18, 0.27, 0.37, 0.48, and 0.65, respectively for Panel A, and 0.17, 0.24, 0.32, 0.44, and 0.59 for Panel B. Both indirect and indirect effects are estimated effect of a 1% increase in income diversification from a 1% increase in the share of non-interest income. The net effect is measured by sum of indirect and direct effects.

	The percentiles of non-interest income share				
	10th	25th	50th	75th	90th
Panel A – The impact of change in non-interest income share before financial crisis					
Indirect effect	0.0018***	0.0016***	0.0013***	0.0010***	0.0007***
	(3.755)	(3.754)	(3.754)	(3.753)	(3.751)
Direct effect	-0.0018***	-0.0018***	-0.0018***	-0.0018***	-0.0018***
	(-9.150)	(-9.150)	(-9.150)	(-9.150)	(-9.150)
Net effect	0.0000	-0.0002	-0.0005*	-0.0008**	-0.0011***
	(0.089)	(-0.552)	(-1.728)	(-2.540)	(-3.711)
Panel B – The impact of change in non-interest income share after financial crisis					
Indirect effect	0.0026***	0.0023***	0.0019***	0.0016***	0.0012***
	(3.909)	(3.909)	(3.908)	(3.908)	(3.907)
Direct effect	-0.0021***	-0.0021***	-0.0021***	-0.0021***	-0.0021***
	(-7.026)	(-7.026)	(-7.026)	(-7.026)	(-7.026)
Net effect	0.0005*	0.0002	-0.0002	-0.0005*	-0.0009***
	(1.757)	(0.722)	(-0.852)	(-1.825)	(-3.998)

Notes: Significance at 1%, 5% and 10% level is denoted by ***, ** and *. The figures in parentheses indicate *t*-values.

Table 7

This table reports the differential impact of ownership structure on the relation between income diversification and bank efficiency, which is estimated by Tobit regressions. Statistics are based on an unbalanced panel for the year 2003 – 2007 (before financial crisis) and year 2008 – 2012 (after financial crisis). *D20GO (D20FO)* is dummy variable, takes a value of one if the percentage owned by government (foreign) block shareholders of a bank is above the threshold of 20%, zero otherwise (private domestic ownership is the excluded dummy). *INCDIV* is the value of income diversification followed the basic Herfindahl- type approach. *NONSHARE* is the shares of non-interest income. Bank regulatory variables, including *OCS* and *OSP* represent for overall capital stringency and bank's official supervisory power, respectively. *Size* controls for economy of scale, which is calculated by log of bank total assets. *Equity* is denoted as the total equity to total asset ratio. *Information Sharing* is defined as a dummy equal to one if a country has either a public or a private registry, zero otherwise. *GDP* is defined as log of Gross Domestic Product (GDP) per capita based on Purchasing Power Parity, while *CPI* is the deflated Consumer Price Index for each country with the base year 2005. Models 1 through 3 report the basic regression results that include main independent variables and bank-specific control variables prior the financial crisis, while models 4 through 6 provide regression results after the financial crisis.

	Dependent variable: Cost efficiency					
	Before financial crisis			After financial crisis		
Independent variables	Full	Developed	Developing	Full	Developed	Developing
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.574*	0.416	0.629**	-0.510	1.186	0.135
	(1.821)	(0.663)	(2.584)	(-0.960)	(1.259)	(1.307)
INCDIV	0.181***	0.185***	0.160***	0.178***	0.349***	0.149***
	(4.462)	(3.263)	(2.858)	(3.150)	(5.383)	(3.180)
NONSHARE	-0.224***	-0.267***	-0.222***	-0.240***	-0.377***	-0.139***
	(-8.660)	(-6.855)	(-6.175)	(-5.749)	(-7.771)	(-3.587)
*INCDIV*D20GO*	-0.155***	-0.286**	-0.147**	-0.230***	-0.325**	-0.149**
	(-2.657)	(-2.508)	(-2.095)	(-3.054)	(-2.419)	(-1.989)
*NONSHARE*D20GO*	0.164***	0.274***	0.151**	0.129*	0.170*	0.014
	(3.002)	(2.612)	(2.254)	(1.697)	(1.662)	(0.203)
*INCDIV*D20FO*	-0.123**	-0.261***	-0.023	0.011	-0.202**	0.110**
	(-2.018)	(-3.058)	(-0.294)	(0.131)	(-2.131)	(2.158)
*NONSHARE*D20FO*	0.073*	0.283***	0.030	0.031	0.207***	-0.114**
	(1.933)	(3.526)	(0.614)	(0.545)	(3.047)	(-2.359)
D20GO	-0.035*	0.026	-0.043*	0.003	0.084	-0.013
	(-1.725)	(0.694)	(-1.782)	(0.087)	(1.596)	(-0.599)
D20FO	0.028	0.030	0.006	0.019	0.039	-0.021
	(1.087)	(1.345)	(0.176)	(0.593)	(1.062)	(-1.142)
OCS	-0.015	0.025*	-0.012	-0.001	0.003	0.000
	(-0.826)	(1.846)	(-0.615)	(-0.280)	(1.236)	(0.162)
OSP	0.005	-0.006	0.006	0.001	0.001	0.007
	(0.323)	(-0.394)	(0.597)	(0.714)	(0.598)	(0.313)
Size	0.060***	0.063***	0.033***	0.081***	0.079***	0.102***
	(7.397)	(5.531)	(2.810)	(5.868)	(4.236)	(5.999)
Equity	-0.383***	-0.910***	-0.181***	-0.044*	-0.430***	0.045
	(-7.504)	(-6.594)	(-2.868)	(-1.717)	(-3.171)	(0.581)
Information Sharing	0.011	-0.016	0.019**	0.038**	0.005	0.000
	(1.406)	(-0.627)	(2.112)	(2.027)	(0.261)	(0.006)
GDP	0.029	-0.083	0.020	0.164	-0.307	0.079***
	(0.612)	(-0.474)	(0.267)	(1.213)	(-1.595)	(2.915)
CPI	-0.017	0.276	0.015	0.032**	0.437**	0.016
	(-1.240)	(1.380)	(0.366)	(2.059)	(2.460)	(1.545)
Country fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Log pseudo likelihood	2500.67	993.46	1445.68	1389.29	843.75	1710.83
Observations	2996	1138	1858	3232	1174	2058

Notes: Significance at 1%, 5% and 10% level is denoted by ***, ** and *. The figures in parentheses indicate *t*-values.

Table 8

This table reports the differential impact of income diversification on the cost efficiency, which is estimated by Tobit regressions. Statistics are based on an unbalanced panel for the year 2003 – 2007. *D50GO (D50FO)* is dummy variable, takes a value of one if the percentage owned by government (foreign) block shareholders of a bank is above the threshold of 50%, zero otherwise (private domestic ownership is the excluded dummy). *INCDIV* is the value of income diversification followed the basic Herfindahl- type approach. *NONSHARE* is the shares of non-interest income. Bank regulatory variables, including *OCS* and *OSP* represent for overall capital stringency and bank's official supervisory power, respectively. *Size* controls for economy of scale, which is calculated by log of bank total assets. *Equity* is denoted as the total equity to total asset ratio. *Information Sharing* is defined as a dummy equal to one if a country has either a public or a private registry, zero otherwise. *GDP* is defined as log of Gross Domestic Product (GDP) per capita based on Purchasing Power Parity, while *CPI* is the deflated Consumer Price Index for each country with the base year 2005. Models 1 through 2 report the basic regression results that include main independent variables and bank-specific control variables prior the Global Financial Crisis of 2008. Models 3 through 4 show estimated results of developed countries, while models 5 through 6 provide regression results of developing countries.

	Dependent variable: Cost efficiency before financial crisis (2003 – 2007)					
	Full		Developed countries		Developing countries	
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.597*	0.588*	0.465	0.413	0.657***	0.625**
	(1.895)	(1.866)	(0.782)	(0.660)	(2.710)	(2.572)
INCDIV	0.114***	0.161***	0.111**	0.185***	0.126***	0.150***
	(3.744)	(4.587)	(2.126)	(3.269)	(3.089)	(2.811)
NONSHARE	-0.177***	-0.227***	-0.177***	-0.258***	-0.187***	-0.208***
	(-9.169)	(-8.815)	(-5.371)	(-6.643)	(-7.340)	(-6.041)
*INCDIV*D50GO*		-0.150**		-0.279**		-0.139**
		(-2.567)		(-2.442)		(-1.977)
*NONSHARE*D50GO*		0.163***		0.268**		0.137**
		(2.983)		(2.551)		(2.057)
*INCDIV*D50FO*		-0.078*		-0.244***		-0.002
		(-1.954)		(-2.853)		(-0.030)
*NONSHARE*D50FO*		0.077**		0.255***		0.000
		(2.056)		(3.147)		(0.005)
D50GO	-0.034**	-0.037*	0.000	0.031	-0.049**	-0.046*
	(-2.080)	(-1.817)	(0.007)	(0.820)	(-2.513)	(-1.895)
D50FO	0.007	0.007	0.029	0.034	0.000	0.001
	(0.732)	(0.606)	(1.623)	(1.393)	(0.029)	(0.028)
OCS	-0.016	-0.016	0.032**	0.026*	-0.013	-0.012
	(-0.856)	(-0.840)	(2.030)	(1.901)	(-0.639)	(-0.623)
OSP	0.005	0.005	-0.009	-0.006	0.006	0.005
	(0.323)	(0.287)	(-0.788)	(-0.375)	(0.559)	(0.518)
Size	0.060***	0.060***	0.064***	0.062***	0.032***	0.033***
	(7.387)	(7.404)	(5.391)	(5.382)	(2.725)	(2.791)
Equity	-0.386***	-0.384***	-0.873***	-0.897***	-0.190***	-0.183***
	(-7.546)	(-7.503)	(-6.251)	(-6.484)	(-3.027)	(-2.889)
Information Sharing	0.011	0.011	-0.016	-0.017	0.019**	0.019**
	(1.359)	(1.371)	(-0.628)	(-0.689)	(2.079)	(2.088)
GDP	0.026	0.030	-0.067	-0.089	0.016	0.024
	(0.563)	(0.634)	(-0.428)	(-0.512)	(0.215)	(0.319)
CPI	-0.019	-0.017	0.247	0.303	0.020	0.016
	(-1.372)	(-1.238)	(1.355)	(1.507)	(0.475)	(0.370)
Country fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Log pseudo likelihood	2494.69	2500.27	984.45	992.15	1442.70	1445.29
Observations	2996	2996	1138	1138	1858	1858

Notes: Significance at 1%, 5% and 10% level is denoted by ***, ** and *. The figures in parentheses indicate *t*-values.

Table 9

This table reports the differential impact of income diversification on the cost efficiency, which is estimated by Tobit regressions. Statistics are based on an unbalanced panel for the year 2008 – 2012. *D50GO (D50FO)* is dummy variable, takes a value of one if the percentage owned by government (foreign) block shareholders of a bank is above the threshold of 50%, zero otherwise (private domestic ownership is the excluded dummy). *INCDIV* is the value of income diversification followed the basic Herfindahl- type approach. *NONSHARE* is the shares of non-interest income. Bank regulatory variables, including *OCS* and *OSP* represent for overall capital stringency and bank's official supervisory power, respectively. *Size* controls for economy of scale, which is calculated by log of bank total assets. *Equity* is denoted as the total equity to total asset ratio. *Information Sharing* is defined as a dummy equal to one if a country has either a public or a private registry, zero otherwise. *GDP* is defined as log of Gross Domestic Product (GDP) per capita based on Purchasing Power Parity, while *CPI* is the deflated Consumer Price Index for each country with the base year 2005. Models 1 through 2 report the basic regression results that include main independent variables and bank-specific control variables after the Global Financial Crisis of 2008. Models 3 through 4 show estimated results of developed countries, while models 5 through 6 provide regression results of developing countries.

	Dependent variable: Cost efficiency after financial crisis (2008 – 2012)					
	Full		Developed countries		Developing countries	
Independent variables	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.587	-0.508	0.993	1.225	0.151	0.107
	(-1.115)	(-0.970)	(1.050)	(1.297)	(1.489)	(1.032)
INCDIV	0.157***	0.237***	0.234***	0.334***	0.115**	0.160***
	(3.913)	(4.062)	(4.872)	(5.325)	(2.315)	(3.292)
NONSHARE	-0.203***	-0.242***	-0.275***	-0.363***	-0.131***	-0.145***
	(-6.922)	(-5.998)	(-7.604)	(-7.682)	(-3.613)	(-3.732)
*INCDIV*D50GO*		-0.516***		-0.323**		-0.216**
		(-4.529)		(-2.303)		(-2.385)
*NONSHARE*D50GO*		0.312***		0.191*		0.002
		(3.730)		(1.827)		(0.026)
*INCDIV*D50FO*		-0.023		-0.191**		0.108**
		(-0.279)		(-1.967)		(2.051)
*NONSHARE*D50FO*		-0.002		0.177***		-0.105**
		(-0.035)		(2.717)		(-2.117)
D50GO	0.033	0.102**	0.033	0.036	0.020	0.050
	(1.180)	(2.050)	(0.825)	(1.101)	(0.613)	(1.162)
D50FO	0.119***	0.131***	0.016	0.029	0.068***	-0.002
	(6.147)	(3.670)	(0.628)	(0.707)	(2.895)	(-0.100)
OCS	-0.001	-0.001	0.003	0.003	0.000	0.000
	(-0.444)	(-0.287)	(1.226)	(1.234)	(0.046)	(0.051)
OSP	0.002	0.001	0.001	0.001	-0.003	0.005
	(0.870)	(0.836)	(0.357)	(0.573)	(-1.342)	(0.316)
Size	0.090***	0.090***	0.086***	0.080***	0.050**	0.100***
	(6.368)	(6.379)	(4.580)	(4.255)	(2.381)	(5.834)
Equity	-0.054**	-0.054**	-0.417***	-0.436***	0.142	0.026
	(-2.136)	(-2.133)	(-3.065)	(-3.211)	(1.279)	(0.324)
Information Sharing	0.038**	0.040**	0.006	0.007	0.018	0.003
	(2.055)	(2.178)	(0.349)	(0.391)	(0.717)	(0.185)
GDP	0.166	0.142	-0.267	-0.313	0.095**	0.081***
	(1.243)	(1.063)	(-1.379)	(-1.619)	(2.216)	(2.971)
CPI	0.031**	0.030*	0.429**	0.426**	0.012	0.017
	(2.019)	(1.931)	(2.408)	(2.409)	(0.761)	(1.542)
Country fixed effects	YES	YES	YES	YES	YES	YES
Year fixed effects	YES	YES	YES	YES	YES	YES
Log pseudo likelihood	1400.10	1414.49	835.89	842.29	955.64	1679.53
Observations	3232	3232	1174	1174	2058	2058

Notes: Significance at 1%, 5% and 10% level is denoted by ***, ** and *. The figures in parentheses indicate *t*-values.

□ □ □ □ □ □ Does Money Illusion Delude Investors? Evidence from Anomalies

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This paper investigates the role of money illusion in the anomaly-based strategies. To the extent that anomalies reflect mispricing, I examine whether money illusion predicts anomaly returns. I find that, following high inflation, anomalies are stronger and the returns on the short-leg portfolios are lower. These findings indicate that money illusion leads to mispricing in the stock market. I explore the source of money illusion-driven mispricing. I find that money illusion negatively predicts forecast errors and dispersion. These results suggest that investors overestimate the upside potential of stock returns following high inflation and are subsequently surprised by the return reversal.

Keywords: Money Illusion, Inflation, Anomalies, Mispricing

JEL Classification: G02, G12, E31

1. Introduction

Whether the inflation, namely money illusion, affects stock prices is a question of long-standing interest to researchers. As early as Fisher (1928) defines money illusion as "the failure to perceive that the dollar, or any other unit of money, expands or shrinks in value", numerous papers have examined the existence of money illusion in the equity market. In early works, equities had often been regarded as a claim against physical assets whose real returns remain unaffected by inflation.[1] However, contrary to the conventional view, many empirical studies find a negative relation between inflation and stock returns.[2]

In recent years, many papers have documented the renewed interests in the existence of money illusion in the capital market. For example, Cohen, Polk, and Vuolteenaho (2005) revisit the issue of money illusion and provide a strong support for Modigliani and Cohn (1979) hypothesis.[3] Brunnermeier and Julliard (2008) find that housing market trends are largely explained by variations in the inflation.[4] These recent studies suggest that money illusion possibly leads to mispricing in the stock market. In this paper, motivated by controversial findings in earlier works and recent renewed interests in money illusion, I investigate the role of money illusion in the stock market by testing anomaly returns.

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[1] Many researchers thought that the Fisher (1930) hypothesis that a nominal interest rate fully reflects the available information concerning the future values of the rate of inflation might also hold for the stock return-inflation relation. Regarding this, Tobin (1972) described: "An economic theorist can, of course, commit no greater crime than to assume money illusion". See Fehr and Tyran (2001) for the detailed discussion.

[2] For example, see Bodie (1976), Jaffe and Mandelker (1976), Nelson and Schwert (1977), Fama and Schwert (1977), Gultekin (1983), Modigliani and Cohn (1979) Kaul (1987, 1990), and Kaul and Seyhun (1990).

[3] Modigliani and Cohn (1979) propose the hypothesis that stock market investors are subject to inflation illusion. Modigliani and Cohn (1979) assume that the valuations of the assets differ from their fundamental values because of two inflation-induced errors in judgments.

[4] In addition, Sharpe (2002), Ritter and Warr (2002), Campbell and Vuolteenaho (2004), Chen, Lung, and Wang (2009), Lee (2010), Birru and Wang (2014), and Warr (2014) have studies the effect of money illusion in the capital market.

The objective of this paper is to examine whether money illusion plays an important role in affecting the degree of mispricing in the stock market. At the simplest level, money illusion occurs when investors mix real growth rates with nominal discount rates. This valuation error can induce significant impacts in the stock prices. The key explanation of money illusion effects is that, following high inflation periods, money-illusioned investors are overly optimistic for the past performance of equities and excessively extrapolate into the future when they value firms. To the extent that firms' stock price can reflect the views of investors who are most optimistic, a presence of money-illusioned investors can cause a stock price departs from its fundamental value.

I start by testing the relation between money illusion and stock market returns to explore the role of money illusion in the stock market. Consistent with the findings in previous literatures, I find that the money illusion is a negative predictor for stock market returns during the period of 1965-2010. The magnitude of predictability is statistically significant and economically large. In the univariate regression, I find that a one standard deviation increase in money illusion is associated with about 0.5% decline in one month-ahead market returns. In the multivariate regressions, I control for three predictive variables related interest rates and find that the effect of money illusion remains significantly negative.[5] These findings suggest that investors may overestimate the upside potential of stock returns following high inflation periods and subsequently experience negative returns.

To examine whether money illusion leads to mispricing, I entertain the possibility that anomalies at least partially reflect mispricing in the stock market. In previous studies, Stambaugh, Yu, and Yu (2012) explore the role of investor sentiment in a broad set of anomalies in cross-

[5] The three predictive variables are: *T-bill* is the 3-month T-bill rate. *Term* is the difference between yield on 10-year bond and the T-bill. *Default* is the difference between Baa and Aaa-rated corporate bonds.

sectional stock returns.[6] Similar to Stambaugh, Yu, and Yu (2012), I investigate the role of money illusion in the stock market by examining the anomaly-based strategies associated with mispricing. I consider 11 well-documented anomalies in the previous literatures. Theses anomalies include size, value (book-to-market equity), financial distress, net stock issues, earnings quality, gross profitability, returns-on-assets (ROA), investment-to-assets, external financing, and asset turnover. It is worthwhile to emphasize that, while this study shares a similar setting with Stambaugh, Yu, and Yu (2012), I focus on the inflation to investigate whether money illusion affects the degree of mispricing in the stock market.[7] To the best of my knowledge, this is the first paper to examine the relation between money illusion and anomaly returns.

Two main empirical implications are tested to explore the role of money illusion in the stock market. The first hypothesis is that anomalies are stronger following high inflation periods. The first hypothesis indicates that the long-short spread should be larger following high inflation. Consistent with the first hypothesis, I find that each of the long-short anomaly-based strategies presents higher average returns following high inflation. In the predictive regressions, I find the positive relation between money illusion and the long-short spread. These results imply that mispricing is stronger following high inflation periods. The estimate of combination strategy on the benchmark-adjusted returns presents that one standard deviation increase in money illusion is associated with $0.0061 of an additional monthly profit in each long-short spread. Clearly, these

[6] Stambaugh, Yu, and Yu (2012) combine the presence of market-wide sentiment with the Miller (1977) short-sale argument.

[7] Many fundamental mechanisms, including the divergence of opinions and short-sale constraints (Miller (1977), Hong and Sraer (2012)) and sentiment (Baker and Wurger (2006), Stambaugh, Yu, Yuan (2012)), can potentially lead to mispricing in the stock market. In this study, I simply use money illusion as a proxy for mispricing.

findings suggest that money illusion plays an important role in affecting the degree of mispricing in the stock market.

The second hypothesis is that stock returns on the short-leg portfolios should be lower following high inflation. To the extent the anomaly reflects mispricing, the stocks in the short leg should be relatively overpriced compared to the stocks in the long leg. This indicates that the stocks in short leg should be more overpriced following high inflation, as a result, present lower returns. Consistent with the second hypothesis, I find that the short leg of all anomaly-based strategies presents lower excess returns following high inflation periods. The short leg of the combined strategy earns 177 bps less per month following high inflation periods than low inflation periods. In the predictive regressions, I find that the slope coefficients for the short-leg returns of all anomalies are negative. These results suggest that investors overly extrapolate past performance into the future when they value firms and subsequently experience negative returns. The combination strategy implies that one standard deviation increase in money illusion is related to 0.6% decrease in monthly excess return on the short-leg portfolio. These findings clearly provide the evidence that money-illusioned investors overestimate the upside potential of stock returns following high inflation periods.

To better understand the results of this study, I empirically investigate the possible source of money illusion-driven mispricing. I examine two prominent explanations: the risk-based explanation and the behavioral-based explanation. The risk-based explanation argues that the omitted risk factor's premium may explain the required correlation with money illusion. The behavioral-based explanation argues that investors excessively extrapolate on past performance when they value firms and surprised by the subsequent return reversal. I examine the potential for a risk-based explanation by controlling for an additional set of variables. I find that the effect of money illusion remains largely unchanged: the predictive power of money illusion for anomaly returns does not weaken after controlling for macro-variables and firm level predictive variables.[8] In addition, to access the potential for a behavioral-based explanation for previous results, I examine the relation between money illusion and forecast errors and dispersion. I find that money illusion negatively predicts forecast errors and dispersion.[9] The results indicate that investors' ex-ante expectation of future performance was too optimistic and subsequently surprised by the return reversal. This indicates that the behavioral-based explanation may support the results of this study.

Lastly, I extend the exploration of money illusion effects by examining sentiment and other commonly use measure for predicting stock returns. Many previous studies indicate that sentiment captures market-wide impacts in the stock market.[10] I control for the effect of sentiment to investigate whether money illusion plays an additional role in cross-sectional stock returns. I find that the effect of money illusion remains largely unchanged after controlling for sentiment and many additional variables.[11] The results suggest that money illusion can provide the complementary power for cross-sectional stock returns beyond the commonly used variables. Overall, this study contributes to the literatures on money illusion and mispricing by providing novel evidence that money illusion can lead to mispricing in the stock market.

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[8] The variables are: T-bill as the 3-month T-bill rate, Term as the difference between yield on 10-year bond and the T-bill, Default as the difference between Baa and Aaa-rated corporate bonds, the earnings-to-price ratio, the dividend-to-price ratio, and the equity variance.

[9] The results are consistent with the prediction of Stambaugh, Yu, and Yu (2012) that investors' views must be sufficiently disperse to include rational valuation when sentiment is low.

[10] For example, Baker and Wugler (2006) provide strong evidence that investor sentiment have significant effects on the stock returns. Stambaugh, Yu, and Yu (2012) find evidence that anomaly returns are larger following high levels of sentiment.

[11] I control for an additional set of macro-related variables that seem reasonable to entertain as being correlated with the risk premium. I control for yield premium, term premium, and default premium, earnings-to-price ratio, the dividend-to-price ratio, and the equity variance.

This paper is organized as follows. Section 2 discusses related literatures and develops hypotheses. Section 3 introduces data and presents descriptive statistics. Section 4 reports main results. Section 5 investigates the source of money illusion-drive mispricing. Section 6 examine whether money illusion provides the complementary power to explain the cross-sectional stock returns. Section 7 concludes.

2. Related Literature and Hypothesis Development

2.1 Related Literature

Whether the inflation, namely money illusion, affects stock prices is a question of long-standing interest to researchers. The concept of money illusion was analyzed in detail for the first time by Fisher (1928). As Fisher (1928) defines money illusion as "the failure to perceive that the dollar, or any other unit of money, expands or shrinks in value", numerous papers have examined the existence of money illusion in equity markets. Among many papers, it is worth referring to the survey conducted by Shafir, Diamond, and Tverky (1997). Shafir, Diamond, and Tverky (1997) find that money illusion is a persistent phenomenon among economic and non-economic agents. In a same vein, Fehr and Tyran (2001) present that a presence of money-illusioned agents can cause significant impacts in capital markets.

The relation between stock returns and inflation has been studied for many years. Equities had traditionally been regarded as a hedge against inflation because equities are claims against physical assets whose real returns should remain unaffected by inflation. Numerous researchers thought that the Fisher (1930) hypothesis, which posit that a nominal interest rate fully reflects the available information concerning the future values of the rate of inflation, might also hold for the stock return-inflation relation. However, contrary to the conventional view and the Fisher hypothesis, many empirical studies find a negative relation between inflation and real stock returns.

There is an extensive literature documenting that realized returns are negatively influenced by inflation. (See, for example, Bodie (1976), Jaffe and Mandelker (1976), Nelson and Schwert (1977), Fama and Schwert (1977), and Gulteken (1983)) Several hypotheses have been proposed to explain the observed negative relation between stock returns and inflation.[12] Modigliani and Cohn (1979) propose the inflation illusion hypothesis that stock market investors are subject to inflation illusion. Modigliani and Cohn (1979) assume that the valuations of the assets differ from their fundamental values because of two inflation-induced errors in judgment. To explain the inverse relation, Fama (1981, 1983) proposes the proxy hypothesis. The proxy hypothesis suggests that a rise in expected inflation rationally induces investors to reduce expected future real dividend growth prices and expected real discount rates, subsequently lowers stock prices and realized returns. Later on, Amihud (1996) tests the relationship between unexpected inflation and stock returns in Israel and conclude that his results support only the proxy hypothesis explanation.

In recent years, several papers have documented the renewed interests in the existence of money illusion, suggesting the possibility of money illusion-induced mispricing in capital markets. For example, Ritter and Warr (2002) find that the bull market starting in 1982 was due in part to equities being undervalued, whose cause is cognitive valuation errors of levered stocks in the presence of inflation and mistakes in the use of nominal and real capitalization rates. Campbell and Vuolteenaho (2004) revisit the issue of the stock price-inflation relation based on

[12] Additionally, Geske and Roll (1983) and Kaul (1987) argue that the relationships are driven by links between expected inflation and expected real economic performance. Feldstein (1980) proposes the tax hypothesis to explain the inverse relation between higher inflation and lower share prices. Brandt and Wang (2003) propose the time varying risk aversion hypothesis.

the time-series decomposition of the log-linear dividend yield model and provide strong support for Modigliani and Cohn (1979) hypothesis.[13] Cohen, Polk, and Vuolteenaho (2005) present cross-sectional evidence supporting Modigliani and Cohn's hypothesis by simultaneously examining the future returns of Treasury bills, safe stocks, and risky stocks. Cohen, Polk, and Vuolteenaho (2005) find that money illusion causes the market's subjective expectation of the equity premium to deviate systematically from the rational expectation.

Other recent studies about money illusion have examined earnings forecasts, bubbles, dividend announcements and house prices. Sharpe (2002) find that analysts suffer from money illusion in their forecasts. Chordia ans Shivakumar (2005) find that money illusion causes firms whose earnings are positively related to inflation to be undervalued because investors fail to incorporate the effect of inflation on the earnings growth rate. Focusing on asset bubbles, Chen, Lung, and Wang (2009) find that while inflation illusion can explain the level of mispricing, it does not explain the volatility of mispricing. Brunnermeier and Julliard (2008) test the effect of the Modigliani and Cohn hypothesis on house prices and show that housing market trends are largely explained by variations in the inflation, suggesting that home buyers suffer from inflation illusion.

Given the discussion of numerous literatures, the impact on the economy and stock returns arising from the effects of inflation are indisputable. Motivated by controversial findings in earlier works and recent renewed interests in money illusion, I explore the role of money illusion in the mispricing of stock returns and anomalies.

2.2 Hypotheses Development

[13] Campbell and Vuolteenaho (2004) use the Campbell and Shiller (1988) valuation model to decompose the dividend yield to examine the effect of inflation.

To test whether money illusion plays an important role in affecting the degree of mispricing in the stock market, I entertain the possibility that anomalies at least partially reflects mispricing related to money illusion. In previous studies, combining the impediments to short selling as in Miller (1977), Stambaugh, Yu, and Yu (2012) explore the role of investor sentiment in a broad set of anomalies in cross-sectional stock returns. Similar to Stambaugh, Yu, and Yu (2012), I examine the relation between money illusion and its role in a broad set of anomaly-based strategies.

Two main empirical implications are tested to investigate the effect of money illusion on mispricing. The first implication is that mispricing should be stronger following high inflation. At the simplest level, money illusion occurs when investors mix real growth rates with nominal discount rates. This implies that a presence of money-illusioned investors can cause a stock price depart from its fundamental value. The key explanation of money illusion effects is that, following high inflation periods, money-illusioned investors are overly optimistic for the past performance of equities and excessively extrapolate into the future when they value firms. This valuation error can induce significant impacts in market prices in that a firm's stock price can reflect the view of investors who are overly optimistic. In contrary, during low inflation periods, the most optimistic views about stocks tend to be those of rational investors, and thus mispricing during those periods is less likely. Therefore, the first hypothesis is that anomalies are stronger following high inflation periods. This indicates that the long-short spread should be larger following high inflation. The positive profit on each long-short strategy reflects the unexplained cross-sectional difference in stock returns that constitutes an anomaly.

The second implication is that the stocks in short leg should be more overpriced following high inflation. Stocks in short leg are relatively overpriced compared to the stocks in the long leg. Specially, overpricing becomes more difficult to eliminate with impediments to short selling. If the primary form of mispricing is overpricing, such overpricing can occur for many stocks during high inflation periods. This implies that the stocks in short leg should be more overpriced following high inflation. In this regard, the second hypothesis is that stock returns on the short-leg portfolios should be lower following high inflation. This indicates that investors may overestimate the upside potential of stock returns following high inflation periods and subsequently experience negative returns.

It is worthwhile to emphasize that, while this study shares a similar setting with Stambaugh, Yu, Yuan (2012), I focus on inflation to examine whether money illusion plays an important role in affecting the degree of mispricing. Many fundamental mechanisms, including the divergence of opinions and short-sale constraints (Miller (1977), Hong and Sraer (2011)) and sentiment (Baker and Wurger (2006), Stambaugh, Yu, Yuan (2012)), can potentially lead to mispricing in the stock market. In the current study, I simply use money illusion as a proxy for mispricing.

3. Data

This section describes the data used in this study. I obtained the data from several sources. I compile market returns and S&P 500 returns from CRSP. Four measures of stock market returns are used: the value-weighted raw returns, the value-weighted excess returns, the S&P 500 raw returns, and the S&P excess return. The accounting information is obtained from COMPUSTAT. The sample period is 1965 to 2010. I also conduct sub-sample analysis over period 1970-1990 to ensure the robustness of results.

Inflation, namely money illusion, is defined as the change in Consumer Price Index (CPI) from year $t-1$ to t,

$$Money\ Illusion_t = (CPI_t - CPI_{t-1})/CPI_{t-1}$$

The data for CPI is obtained from the Bureau of Labor Statistics. Figure 1 plots *money illusion* and CPI (Consumer Price Index) from 1965 and 2010. The inflation is relatively high and volatile during 1970-1980. After 2000, the inflation is getting more volatile: The inflation peaked in 2005 once and immediately plummeted. It reached a peak again in 2006 then it crushed in 2008.

Interest rates data including 10-year and 3-month Treasury bills are downloaded from Federal Reserve Economic Data (FRED). I use three predictive variables related to interest rates. I use the excess returns on an index of 10-year bonds issued by the U.S. treasury as a *Term*. I use the excess returns on an index of investment grade corporate bonds as a *Default*. The one-period change in the option adjusted credit spreads for Moody's Baa-rated corporate bonds is used as the investment grade corporate bond rate. To compute excess returns, I use the three-month Treasury bill (*T-bill*) rate as the risk-free rate.

3.1 Descriptive Statistics

Table 1 report the descriptive statistics for the market returns and inflation from 1965 to 2010. Panel A shows that money illusion has an average of 0.35% and a standard deviation of 0.36% monthly. Monthly average of the value-weighted raw return is 0.87% and the monthly average of value-weighted excess returns is 0.43%, with standard deviations of 4.58% and 4.59%. The monthly average raw return on S&P 500 is 0.59% and the excess returns is 0.14%, with standard deviation of 4.42% and 4.43%. Panel B presents the correlations between stock market returns and inflation. All correlations of stock market returns with inflation are negative and the magnitudes are around -10%. This negative relation is consistent with the expected cross-sectional correlation between stock market returns and money illusion.

4. Results

4.1 Univariate Regression

I run predictive regression of one-month-ahead market returns on inflation. Table 2 presents the results of univariate regressions. Panel A reports the results over the periods 1965-2010 and Panel B reports the results over the sub-period 1970-1990. I use four measures of stock market returns: the value-weighted raw returns, the value-weighted excess returns, the S&P 500 raw returns, and the S&P excess return. The independent variable, money illusion, is standardized to have zero mean and unit variance, in order to interpret the economic significance of the predictability.

I find that money illusion is a negative predictor of the stock market returns. The magnitude is economically large: a one standard deviation increase in inflation is associated 0.53% decline in one-month-ahead value-weighted excess returns. For returns on value-weighted raw returns, the coefficient estimate is -0.42%. For returns on S&P 500, the slope estimates are larger and still economically big: -0.56% for S&P 500 excess return and -0.45% for S&P 500 raw return. Turing to Panel B, money illusion more significantly negatively predicts stock market returns for the subsample period with adjusted R^2 varying from 3.4% to 4.5%. The OLS estimates on money illusion are -0.96 % for the value-weighted raw return and -1.05% for the value-weighted excess return monthly. For Returns on S&P 500 excess return, the coefficients are -0.99% for S&P raw return and -1.07% for S&P excess return monthly. In sum, Table 2 indicates that the relation between money illusion and stock market returns is consistently negative.

4.2 Multivariate Regression

To examine whether money illusion has incremental power to predict market returns, I include three predictive variables related to interest rates. The variables are: T-bill is the 3-month T-bill rate. Term is the difference between yield on 10-year bond and the T-bill. Default is the difference between Baa and Aaa-rated corporate bonds.

Table 3 presents the results of multivariate regressions. Panel A reports the results over the periods 1965-2010 and Panel B reports the results over the sub-period 1970-1990. I use four measures of stock market returns: the value-weighted raw returns, the value-weighted excess returns, the S&P 500 raw returns, and the S&P excess return. The independent variable, money illusion, is standardized to have zero mean and unit variance, in order to interpret the economic significance of the predictability. I find that the estimates on money illusion remain negative and significant. The magnitudes of the coefficient on money illusion are almost same in the univariate regression: a one standard deviation increase in Inflation is associated with the 0.4% decrease in one-month-ahead market returns. These results indicate that adding interest variables has little effect on the ability of money illusion to predict returns. In Panel B, I perform sub-period analysis. The results are similar. The adjusted R^2 in the multivariate regressions ranges from 8.9% to 10.1%, higher than those in the univariate regressions. In sum, money illusion remains a negative predictor of stock market returns.

4.3 Money Illusion and Anomaly

I find that money illusion is a negative predictor for stock market returns during the period of 1965-2010. These findings suggest that investors may overestimate the upside potential of stock returns following high inflation periods. The key explanation of money illusion effects is that, following high inflation periods, money-illusioned investors are overly optimistic for the past performance of equities and excessively extrapolate into the future when they value firms. This valuation error can induce significant impacts in market prices.

To test whether money illusion leads to mispricing in the stock market, I entertain the possibility that anomalies at least partially reflect mispricing. In previous studies, Stambaugh, Yu, and Yu (2012) explore the role of investor sentiment in a broad set of anomalies in cross-sectional stock returns. Similar to Stambaugh, Yu, and Yu (2012), I examine the relation between money illusion and anomaly-based strategies.

4.3.1 Anomaly- based Strategy

I consider 11 well-documented anomalies to explore the money illusion-driven mispricing. Theses anomalies include size, value (book-to-market equity), financial distress, net stock issues, earnings quality, gross profitability, ROA (return on assets), investment-to-assets, external financing, and asset turnover. The explanation for each anomaly is as follows:

Size: Banz (1981) first documents the size effect by showing that small firms had higher risk-adjusted returns than large firms during the 1936-1977 period. Essentially, this anomaly indicates that small capitalization stocks outperform large capitalization stocks.

Value: Rosenberg, Reid, and Lanstein (1985) first suggest the value (book-to-market) strategy. This strategy is well-described in Fama and French (1993) that high book-to-market firms earn more than low book-to market firms.

Financial distress: Campbell, Hilscher, and Szilagyi (2008) find that firms with high financial distress have lower subsequent returns. The failure probability (financial distress) is estimated by a dynamic logit model with both accounting and equity market variables.

O-score: Ohlson (1980) O-score yields a similar anomaly to Campbell, Hilscher, and Szilagyi (2008). Ohlson's O-score is measured by the probability of default in a static model using various accounting variables.

Net stock issues: Pontiff and Woodgate (2008) present that there is a negative cross-sectional relation between aggregate share issuance and stock returns. Fama and French (2008) also present that net stock issuers earn negative realized returns.

Earnings quality: Sloan (1996) shows that firms with high accruals earn lower returns than firms with low accruals. Total accruals are calculated as changes in noncash working capital minus depreciation expense scaled by total assets.

Gross profitability: Novy-Marx (2013) finds that more profitable firms have higher returns than less profitable firms. It is calculated by gross profits scaled by assets.

Return-on-assets: Chen, Novy-Marx, and Zhang (2011) show that firms with higher past return on assets earn abnormally higher subsequent returns. Return on assets is measured by earnings before extraordinary items scaled by assets.

Investment-to-assets: Titman, Wei, and Xie (2004) find that higher past investment predicts abnormally lower future returns. Investment-to-assets is measured as the annual change in gross property, plant, and equipment plus the annual change in inventories scaled by the lagged book value of assets.

External financing: Bradshaw, Richardson, and Sloan (2006) find that net overall external financing is negatively related to stock returns. This negative relation suggests that investors may be relatively overoptimistic in forming their earnings expectations for high net external financing firms. External financing is measured by as the net amount of cash a firm raises from equity and debt markets.

Asset turnover: Novy-Marx (2013) find that high asset turnover firms have higher average returns. Asset turnover is often regarded as a proxy of efficiency, which quantify the ability to generate sales. Asset turnover is measured as sales-to-assets.

For each of the 11 anomalies, I examine the strategy that goes long the stocks in the highest-performing decile and short the stocks in the lowest-performing decile. Every portfolio formation on month, I sort stocks into the decile portfolios based on anomaly variables. I then construct a long-short strategy using the extreme decile, 1 and 10, with the long leg being the highest-performing decile and the short leg being the lowest-performing decile.

4.3.2 Anomaly Returns: High vs. Low Inflation

Table 4 presents excess monthly returns on a broad set of anomaly-based strategy following high or low inflation periods. I fist classify returns on each month either a high inflation period or a low inflation period. The high inflation period is one in which the value of money illusion index in the previous month is above the median value for the sample period. The low inflation period is the one below the median value.

The first hypothesis indicates that anomalies are stronger following high inflation periods. This suggests that stocks should earn relatively low (high) returns following high (low) inflation periods. Accordingly, the long-short spread should be larger following high inflation than low inflation. The positive profit on each long-short strategy reflects the unexplained cross-sectional difference in average returns that constitutes an anomaly. Table 4 clearly shows that the average excess returns are lower following high inflation periods. All of the values in 'High-Low' columns are negative and statistically significant. The last three columns in Table 4 present that each of the long-short strategy shows higher average returns following high inflation. All of the values in the last column are positive and statistically significant. The combined long-short spread earns 123 bps per month following high inflation. These results imply that mispricing is stronger following high inflation periods.

The second hypothesis indicates that the stocks in short leg should be more overpriced following high inflation. To the extent that an anomaly reflects mispricing, the profits of the long-short strategy represent relatively greater overpricing of stocks in the short leg. Thus, according to the second hypothesis, the returns on the short leg are lower following high inflation periods. In Table 4, the short leg of all anomaly strategies show a lower excess returns following high inflation periods. All of the values are statistically significant and reject the null hypothesis of no difference between high and low inflation periods. In Table 4, the short leg of the combined strategy earns 177 bps less per month following high inflation periods than low inflation periods. These results indicate that stocks in short leg are relatively overpriced following high inflation. These findings suggest that investors may overestimate the upside potential of stock returns following high inflation periods, inducing the money illusion-driven overpricing.

Overall, the results in Table 4 provide strong support for the first hypothesis and the second hypothesis. This evidence implies the possibility of money illusion-driven overpricing, suggesting that investors excessively extrapolate past performance of stocks and are subsequently experience negative returns.

4.3.3 Predictive Regression

Similar to Stambaugh, Yu, and Yu (2012), I use predictive regressions to examine whether money illusion predicts anomaly returns. The first hypothesis predicts a positive relation between the long-short spread and money illusion. Consistent with this prediction, the estimates for the spreads are positive in both Table 5 and Table 6. In Table 5, ten of 11 anomalies are statistically significant, and one of anomaly, which shows a negative prediction, is not significant. The money illusion index is scaled to have zero mean and unit standard deviation. Therefore, the slope coefficient of 0.0081 for the combination strategy indicates that one standard deviation increase in money illusion is associated with \$0.0081 of additional profit monthly on a long-short strategy with \$1 in each leg. In Table 6, ten of 11 anomalies are statistically significant. The estimate of combination strategy indicates that one standard deviation increase in money illusion is associated with \$0.0061 of an additional monthly profit in each long-short spread.

The second hypothesis predicts a negative relation between the returns on the shot-leg portfolio and the lagged money illusion level. Consistent with this prediction, the slope coefficients for the short-leg returns of all anomalies are negative in both Table 5 and Table 6. In Table 5, all t-statistics are significant. The combination strategy indicates that one standard deviation increase in money illusion is associated with 0.8% decrease in monthly excess return on the short-leg portfolio. In Table 6, ten out of 11 estimates are significant. The combination strategy implies that one standard deviation increase in money illusion is related to 0.6% decrease in monthly excess return on the short-leg portfolio.

In sum, results from predictive regressions reported in Table 5 and Table 6 suggest that money illusion lead to overpricing in the stock market. Overall results are consistent with the findings in Table 2 and Table 3 that investors overestimate the upside potential of stock returns following high inflation periods. The key explanation is that, following high inflation periods, money-illusioned investors are overly optimistic for the past performance of equities and excessively extrapolate into the future when they value firms. These findings indicate money illusion plays an important role in affecting the degree of mispricing in the stock market.

4.3.4 Alternative Money Illusion Index

Overall, the results support the empirical implication that high inflation induces overpricing. This indicates that the money-illusioned investors are overly optimistic following high inflation periods, as a result, produce grater mispricing effects on prices. An alternative explanation for these results is that the money illusion index (i.e. the percentage change of Consumer Price Index) by itself is asymmetric with the period of high inflation. Under this explanation, the mispricing following high inflation periods simply reflect more strong inflation effects during those periods. To address whether the results reflect pricing asymmetry or inflation index asymmetry, I use the alternative measure of money illusion to examine the anomaly returns.

Table 7 presents the results of regressions on the alternative money illusion index. The alternative money illusion index is the inflation expectation, measured by median expected price change next 12 months by Survey of Consumers. The data is obtained from FRED and the source of data is from University of Michigan Inflation Expectation.[14] The sample period is from 1978 to 2010. The alternative money illusion index is scaled to have zero mean and unit standard deviation.

The alternative money illusion index show consistent implications with previous results. In Table 7, ten of 11 anomalies are positive and eight of 11 anomalies are statistically significant.

[14] Web address: http://research.stlouisfed.org/fred2/series/MICH

The estimate of combination strategy indicates that one standard deviation increase in money illusion is associated with $0.0092 of an additional monthly profit in each long-short spread. The results with the alternative money illusion index also support the second hypothesis that money illusion is negatively associated with the returns on the shot-leg. In Table 7, all slope coefficients for the short-leg returns are negative and seven of 11 anomalies are statistically significant. The combination strategy indicates that one standard deviation increase in money illusion is associated with 0.8% decrease in monthly excess return on the short-leg portfolio.

In sum, results from predictive regressions reported in Table 7 show consistent results with Table 5 and Table 6, suggesting that previous results are not driven by asymmetry in inflation index by itself. These results provide a strong support for the possibility of money illusion-driven overpricing that money-illusioned investors overestimate the upside potential of stock returns following high inflation periods.

5. A Source of Money Illusion-Driven Mispricing

In this section, I investigate the source of money illusion-driven mispricing by testing two prominent explanations. The sources of money illusion-driven mispricing are two-fold: One is based on risk and the other one is based on behavioral explanation. The risk-based explanation argues that the stock returns reflect compensation for risk, indicating the risk premium would be correlated with some aspect of macroeconomic conditions. The behavioral-based explanation argues that investors excessively extrapolate on past performance when they value firms and subsequently surprised by the negative returns.

5.1 Risk-Based Explanation

The risk-based explanation argues that the stock returns reflect compensation for risk, indicating the risk premium would be correlated with some aspect of macroeconomic conditions. It is challenging to explain why there is a difference in loadings between long and short legs. To explain this difference, the risk-based explanation suggests the possibility of an omitted risk factor to which each short leg is sensitive but each long leg is not. In this regard, the risk-based explanation argues that the omitted risk factor's premium may explain the required correlation with money illusion.

To access the potential for a risk-based explanation for previous results, I control for an additional set of macro-related variables that seem reasonable to entertain as being correlated with the risk premium. I control for yield premium, term premium, and default premium. The yield premium is the 3-month T-bill rate. The term premium is the difference between yield on 10-year bond and the T-bill. The default premium is the difference between Baa and Aaa-rated corporate bonds. Table 8 reports the results regressing excess returns on money illusion and macro-variables. In Table 8, I find that nine of 11 anomalies are positive and statistically significant. The estimate of combination strategy indicates that one standard deviation increase in money illusion is associated with $0.0050 of an additional monthly profit in each long-short spread. Also, slope coefficients for the short-leg returns are negative in eight out of 11 anomalies. The combination strategy indicates that one standard deviation increase in money illusion is associated with 0.28% decrease in monthly excess return on the short-leg portfolio.

I also control for firm level predictive variables in addition to macro-variables. The firm level predictive variables are earnings-to-price ratio, the dividend-to-price ratio, and the equity variance. Importantly, in Table 9, I find that the predictive power of money illusion for anomaly returns does not weaken after I control for macro-variables and firm level predictive variables. In

Table 9, ten of 11 anomalies are positive and statistically significant. The estimate of combination strategy indicates that one standard deviation increase in money illusion is associated with \$0.0042 of an additional monthly profit in each long-short spread. Also, slope coefficients for the short-leg returns are negative in nine out of 11 anomalies and nine of 11 anomalies are statistically significant. The combination strategy indicates that one standard deviation increase in money illusion is associated with 0.2% decrease in monthly excess return on the short-leg portfolio.

To summarize the findings in Table 8 and Table 9, the results suggest that the effect of money illusion remains largely unchanged after control for additional variables. The coefficient and *t*-statistics are consistent with the main results in Table 5 and Table 6, in which the additional variables are not included.

5.2. Behavioral-Based Explanation

The behavioral-based explanation argues that investors may overestimate the upside potential of stock returns following high inflation periods, inducing the money illusion-driven mispricing. The key explanation of money illusion effects is that, following high inflation periods, money-illusioned investors are overly optimistic for the past performance of equities and excessively extrapolate into the future when they value firms.

To access the potential for a behavioral-based explanation for previous results, I investigate the relation between earnings forecast and money illusion. To examine the relation between forecast errors and money illusion, I first obtain the 12-month-ahead target-price forecasts for all individual analysts from the I/B/E/S database and aggregate the target-prices for each calendar month. Then, I obtain the actual stock prices realized in 1-year from the CRSP database, and define a variable forecast errors as the absolute value of the percentage difference between the realized stock price and the 1-year-ahead target price forecast. In addition, I obtain firms' financial accounting information from the COMPUSTAT database and calculate the log total assets, financial leverage, market-to-book ratio, ROA, and R&D-to-asset ratio. This approach is consistent with the analyst forecast literature.

I begin my analysis to fit regression specifications using forecast errors and money illusion with year and month fixed effects. I control for other factors being documented in prior research that can also influence analyst forecast behavior, such as firm size (log total assets), profitability (ROA), leverage (asset to equity ratio), growth opportunity (market to book ratio), and investment (R&D expense to asset ratio). Table 10 reports results of regressing forecast errors on money illusion index. I break down the sample to two subsamples: high-performance firms and low-performance firms. I find the negative coefficients on money illusion for the high-performance firms. This result indicates that investors' ex-ante expectation of future performance was too optimistic compared with the realized performance. Overall, results suggest that money-illusioned investors tend to overestimate the upside potential of stock returns following high inflation periods.

To clarify the role of dispersion in investors' views, I examine the relation between forecast dispersion and money illusion. The forecast dispersion is defined as the standard deviation of all analyst forecasts of 1-year-ahead target-price scaled by the average target-price for each firm. Table 11 reports results of regressing forecast errors on money illusion index. I find the negative coefficients on money illusion index. These results indicate that investors' views are more dispersed following low inflation. The results are consistent with the prediction of Stambaugh, Yu, and Yu (2012) that investors' views must be sufficiently disperse to include rational valuation when sentiment is low.

In sum, I find that money illusion negatively predicts forecast errors and forecast dispersion. These results suggest that money-illusioned investors are overly optimistic for the past performance of equities and excessively extrapolate into the future when they value firms.

6. Money Illusion, Sentiment, and Cross-Sectional Stock Returns

Overall, the results suggest that money-illisioned investors excessively extrapolate past performance into future and are subsequently experience return reversal. These findings are consistent with previous literatures by Delong, Shleifer, Summers, and Waldman (1990), Baker and Wurgler(2007) and Stambaugh, Yu, and Yu (2012). In this section, I extend the exploration of money illusion effects by examining sentiment and other commonly use measure for predicting stock returns.

Baker and Wugler (2006) provide strong evidence that investor sentiment have significant effects on the stock returns. Moreover, Stambaugh, Yu, and Yu (2012) find evidence that anomaly returns are larger following high levels of sentiment. These previous studies indicate that sentiment captures market-wide impacts in the stock market. Thus, to investigate whether money illusion plays an important and complementary role in cross-sectional stock returns, I control for the effect of sentiment first. The sentiment index is obtained from Baker and Wurgler (2006). Table 12 reports results of regressing benchmark-adjusted anomaly returns on money illusion index and Baker and Wugler sentiment index. The sentiment index is scaled to have zero mean and unit standard deviation. The results in Table 12 are consistent with the findings in Stambaugh, Yu, and Yu (2012). Each anomaly is stronger following high levels of sentiment and is mainly due to the overpricing of short legs.

Importantly, focusing on the coefficient, b_1, where money illusion is used as the explanatory variable, I find that the predictive power of money illusion for anomaly returns does not weaken after I control for the sentiment index. In Table 12, nine of 11 anomalies are positive and statistically significant. The estimate of combination strategy indicates that one standard deviation increase in money illusion is associated with $0.0073 of an additional monthly profit in each long-short spread. Also, slope coefficients for the short-leg returns are negative in ten out of 11 anomalies and nine of 11 anomalies are statistically significant. The combination strategy indicates that one standard deviation increase in money illusion is associated with 0.7% decrease in monthly excess return on the short-leg portfolio. These results suggest that money illusion has the complementary power for predicting anomaly performance, indicating that money illusion provides new information beyond investor sentiment.

In addition to sentiment index, I control for an additional set of macro-related variables that seem reasonable to entertain as being correlated with the risk premium. I control for yield premium, term premium, and default premium. The yield premium is the 3-month T-bill rate. The term premium is the difference between yield on 10-year bond and the T-bill. The default premium is the difference between Baa and Aaa-rated corporate bonds. I also control for firm characteristic variables. They are earnings-to-price ratio, the dividend-to-price ratio, and the equity variance. Table 13 reports the results regressing excess returns on money illusion, sentiment, macrovariables, and other firm characteristic variables. In Table 13, focusing on the coefficient, b_1, I find that nine of 11 anomalies are positive and statistically significant. The estimate of combination strategy indicates that one standard deviation increase in money illusion is associated with \$0.0067 of an additional monthly profit in each long-short spread. Also, slope coefficients for the short-leg returns are negative in nine out of 11 anomalies. The combination strategy indicates that one standard deviation increase in money illusion is associated with 0.49% decrease in monthly excess return on the short-leg portfolio.

In sum, the effect of money illusion remains largely unchanged after controlling for sentiment and additional variables. These results suggest that money illusion plays an important role in affecting the degree of mispricing in the stock market and provides the complementary power to explain the cross-sectional stock returns.

7. Simple Model

In the presence of money illusion and short-sale constraints, the potential disagreement between investors can lead overpricing. To the extent that judgment fallacies may affect some investors but not others, or may differ across investors, heterogeneity of investor beliefs can be sustained as an equilibrium phenomenon, and this in turn can affect asset prices in surprising ways. One characteristic of the asset market is that different investors may interpret the same information in different ways. Much of the public information such as inflation is subjective in nature and open to different interpretations by investors. To better understand the interactions among inflation, beliefs, and asset prices, I suggest a theoretical model that highlights overpricing of stock returns.

7.1 Set up

This model is a simple variation on the Harrison and Kreps (1978) and Morris (1996) model of speculative pricing in asset markets, where the key maintained assumption are risk neutral investors, adequate liquidity, and short-selling constraints. To set up asset market to test the theory of money illusion-driven overpricing, I impose short sales constraints and endow investors with a lot of liquidity so that liquidity constraints do not bind.

7.2 Investors and Heterogeneous Beliefs

Assume that all investors use a common Bayesian updating rule, based on the true stochastic process generating the signals. q is common knowledge and all investors update using Bayes rule.

Let π_t be the common posterior that the state of the world is A after S_t is revealed in period t. [15] Given ρ_t, the common posterior if $s_t = \alpha$ is

$$\pi_t(\rho_t | s_t = a) = \frac{q\rho_t}{q\rho_t + (1-q)(1-\rho_t)}$$

and the common posterior if $s_t = b$ is

$$\pi_t(\rho_t | s_t = b) = \frac{(1-q)\rho_t}{(1-q)\rho_t + q(1-\rho_t)}$$

Given that the asset pays off 1 in state A and 0 in state B, and given that all investors are risk neutral, this common posterior at period t is also the valuation of the asset at period t. In this

[15] There are two possible states of the world, A and B. The probability of A being world is ρ. Nature chooses the state of the world. There is an asset market with $t+1$ trading periods and i risk-neutral investors. There is one type of asset in this market that pays off H per unit if A is the state of the world and L(<H) per unit if B is the state of the world. Investors observe either a sequence of public signals, one at the beginning of each trading period after the first. I assume the signals are generated by a stochastic process that is independent across periods, conditional on the state. If $\omega = A$, then $s_t = a$ with probability $q>0.5$ and $s_t = b$ with probability 1-q. Likewise, when $\omega = B$, $s_t = b$ with probability $q>0.5$ and $s_t = a$ with probability 1-q. In the initial period, investors receive no information about the state of the world. Since the asset pays off only in state A, I refer to a signal $s_t = a$ as high inflation and a signal $s_t = b$ as low inflation.

model, each investor thinks her own belief is correct. Investors have own expectations about the distribution of future prices, and disagree about the fundamental value of asset.

I consider a continuum of investor types characterized by the parameter $\theta \in [0, \infty]$. An investor with type θ_l will treat a public signal (i.e. inflation) as if it had the informational equivalent of θ independent signals, each of informativeness q. Thus, θ_l measures how much investor i under-react ($\theta_l < 1$) or over-react ($\theta_l > 1$) to the public signal, relative to q. Over-reaction to signals is sometimes referred to neglect, and under-reaction is sometimes referred to as conservatism.

Let π_t be investor i's posterior that the state of world is A after st is revealed in period t. This updated posterior after observing $s_t = A$ for an investor of type θ_l is:

$$\pi_{lt}^{\theta l}(\rho_{lt} | s_t = A) = \frac{q^{\theta l}\rho_{lt}}{q^{\theta l}\rho_{lt} + (1-q)^{\theta l}(1-\rho_{lt})}$$

and after observing $s_t = B$ is

$$\pi_{lt}^{\theta l}(\rho_{lt} | s_t = B) = \frac{(1-q)^{\theta l}\rho_{lt}}{(1-q)^{\theta l}\rho_{lt} + q^{\theta l}(1-\rho_{lt})}$$

7.3 Equilibrium Price and Overpricing

I maintain the assumptions of binding short sale constraints and sufficient liquidity among the investors to hold all the assets. Under these assumptions, I can apply the logic of the Morris (1996) model to characterize the equilibrium price dynamics in our model. Given the way I have defined different investors' types, and given that the initial prior belief is 0.5, the private posterior and equilibrium prices will depend only on the investor types, the period number, t, and the number of signals, $h \leq t$. Thus, I can denote the current belief of investor type θ_l by

$$\pi_{it}^{\theta_i}(h) = \frac{q^{\theta_i h}(1-q)^{\theta_i(t-h)}}{q^{\theta_i h}(1-q)^{\theta_i(t-h)} + q^{\theta_i(t-h)}(1-q)^{\theta_i h}}$$

Define $\pi_t^*(h) = \max_{i\in I}\{\pi_{it}^{\theta_i}(h)\}$ to be the most optimistic belief amongst the investors at period *t* about A being the state of the world. The corresponding θ type for the investors with the most optimistic belief is denoted θ^*. The price of the asset period t given the history of public signals must be equal to the highest expect return of holding it to the next period *t+1* in equilibrium.

Let $\varphi_t^*(h)$ be the most optimistic belief about the likelihood of good news being announced in period *t+1*, after h good news signals and *t-h* bad news signals,

$$\varphi_t^*(h) = \pi_t^*(h)\left(\frac{q^{\theta^*}}{q^{\theta^*}+(1-q)^{\theta^*}}\right)+(1-\pi_t^*(h)\left(\frac{(1-q)^{\theta^*}}{q^{\theta^*}+(1-q)^{\theta^*}}\right)$$

Note investors can only update their beliefs and asset valuations based on the sequence of signals revealed so pricing depends upon the signals revealed and expectations about future signals. The θ type with the most optimistic belief about the state of the world being A also has the most optimistic belief about the next guess being A. Now I can specify the equilibrium price

$$P_t(h) = \varphi_t^*(h)P_{t+1}(h+1) + \left(1-\varphi_t^*(h)\right)P_{t+1}(h+1)$$

Therefore, I can define the speculate overpricing, $\alpha_t(h) = P_t(h) - P_t^*(h)$. *h* is the number of guesses about the high pay off state being realized. The speculative overpricing is the amount by which the price exceeds the maximal valuation of all investors. This overpricing is the different between the price and the most optimistic valuation. The price would reflect only the belief of the most optimistic investor or possible exceed the valuations of all of the investors when there is a speculative premium.

Recall that a continuum of investor types is characterized by the parameter $\theta \in [0, \infty]$. Following Morris (1996), I compare the price in each period to the investors' valuations and derive several results. A permanent optimist has the highest probabilistic belief of A being the state of the world out of all investors for every continuation sequence of signals (high inflation) until the end of the market. Accordingly, speculate overpricing, $\alpha_t(h) \equiv P_t(h) - P_t^*(h)$, is the amount by which the price exceeds the maximal valuation of all investors.

This implies that overpricing is more likely during high-inflation. The main prediction of theoretical model is that, following high inflation periods, the most optimistic views about stocks tend to be overly optimistic, as a result, stocks tend to be overpriced. In contrary, during low inflation periods, the most optimistic views about stocks tend to be those of rational investors, and thus overpricing during those periods is less likely. This would be consistent with the money illusion-driven overpricing for the short portfolio stocks.

8. Conclusion

In this study, I investigate whether money illusion deludes investors, as a result, leads to mispricing in the stock market. Numerous researches have examined the existence of money illusion in the capital market and find that the impact of money illusion is crucial on the economy. Motivated by early works and recent renewed interests in money illusion, I examine whether inflation plays an important role in affecting the degree of mispricing in the equity market.

To the extent that anomalies reflect mispricing, I test whether money illusion predicts anomaly returns. I find that anomalies are stronger and the returns on the short-leg portfolio of each anomaly are lower following high inflation periods. These findings indicate that money-illusioned investors overestimate the upside potential of stock returns following high inflation and subsequently experience the return reversal. To the best of my knowledge, this is the first paper to examine the relation between money illusion and anomaly returns.

Furthermore, I explore the source of money illusion-driven mispricing. I find that money illusion negatively predicts forecast errors and dispersion. The findings imply that, following high inflation periods, investors are overly optimistic for the past performance of equities and excessively extrapolate into the future when they value firms. This indicates that the behavioral-based explanation may support the results of this study.

I extend the exploration of money illusion effects by examining sentiment and other commonly use measure for predicting stock returns. I find that the effect of money illusion remains largely unchanged after controlling for many additional variables. The results suggest that money illusion can provide the complementary power for cross-sectional stock returns beyond the commonly used variables. Overall, this study contributes to the literatures on money illusion and mispricing by providing novel evidence that money illusion can lead to mispricing in the stock market.

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Figure1. Money Illusion and CPI (Consumer Price Index)

This figure plots *money illusion* and CPI (Consumer Price Index) from 1965 and 2010. *money illusion* is defined as the percentage change in CPI. The data for CPI is obtained from the Bureau of Labor Statistics.

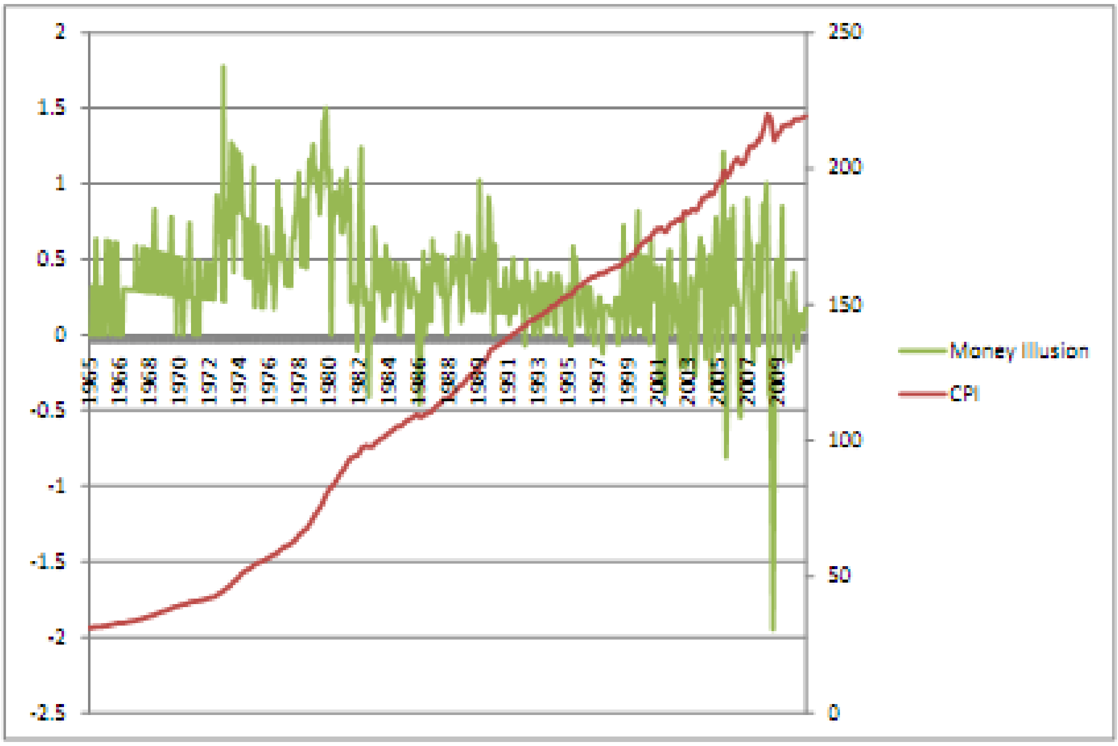

Table 1. Descriptive Statistics for Money Illusion and Stock Market Returns

The table reports the descriptive statistics for money illusion and stock market returns. Four measures of stock market returns are used: the value-weighted raw returns, the value-weighted excess returns, the S&P 500 raw returns, and the S&P excess return. Stock market returns are computed monthly. Money illusion is defined as the percentage change in Consumer Price Index (CPI) from year *t-1* to *t*. The sample period is from 1965 to 2010.

Panel A: Descriptive Statistics			
Variable	Mean	Std.dev	Median
Money Illusion	0.0035	0.0036	0.0030
Value-weighted raw returns	0.0087	0.0458	0.0122
Value-weighted excess returns	0.0043	0.0459	0.0077
S&P 500 raw returns	0.0059	0.0442	0.0087
S&P 500 excess return	0.0014	0.0443	0.0048

Panel B: Correlation				
Variable	Value-weighted raw returns	Value-weighted excess returns	S&P 500 raw returns	S&P excess return
Value-weighted raw returns	1			
Value-weighted excess returns	0.9986	1		
S&P 500 raw returns	0.9858	0.9844	1	
S&P 500 excess return	0.9843	0.9858	0.9985	1
Money Illusion	-0.0930	-0.1157	-0.1033	-0.1268

Table 2. Univariate Regression: Money Illusion and Stock Market Returns

The table reports the predictive regression of one-month-ahead stock market returns on the inflation. Panel A report the results for the full sample period 1965-2010 and Panel B reports results for the subsample period 1970-1990. Four measures of stock market returns are used: the value-weighted raw returns, the value-weighted excess returns, the S&P 500 raw returns, and the S&P excess return. Money illusion is defined as the percentage change in Consumer Price Index (CPI) from year *t-1* to *t*. The inflation variable is standardized to have zero mean and unit variance. *t*-statistics are in parenthesis with ***, ** and * indicating its statistical significant level of 1%, 5% and 10% respectively.

Panel A: 1965-2010				
	Value-weighted raw returns	Value-weighted excess returns	S&P 500 raw returns	S&P 500 excess return
Money Illusion	-0.00426**	-0.00531***	-0.00457**	-0.00562***
	(-2.19)	(-2.73)	(-2.44)	(-3.00)
Intercepts	0.00873***	0.00426**	0.00588***	0.00142
	(4.49)	(2.19)	(3.14)	(0.76)
adj. R^2	0.007	0.012	0.009	0.014

Panel B: 1970-1990				
	Value-weighted raw returns	Value-weighted excess returns	S&P 500 raw returns	S&P 500 excess return
Money Illusion	-0.00969***	-0.0105***	-0.00989***	-0.0107***
	(-3.14)	(-3.39)	(-3.34)	(-3.59)
Intercepts	0.0134***	0.00759**	0.0103***	0.00450
	(4.09)	(2.31)	(3.27)	(1.42)
adj. R^2	0.034	0.040	0.039	0.045

Table 3. Multivariate Regression: Money Illusion and Stock Market Returns

The table reports the predictive regression of one-month-ahead stock market returns on the inflation and other return predictors. Panel A report the results for the full sample period 1965-2010 and Panel B reports results for the subsample period 1970-1990. Four measures of stock market returns are used: the value-weighted raw returns, the value-weighted excess returns, the S&P 500 raw returns, and the S&P excess return. Money Illusion is defined as the percentage change in Consumer Price Index (CPI) from year *t-1* to *t*. The inflation variable is standardized to have zero mean and unit variance. *t*-statistics are in parenthesis with ***, ** and * indicating its statistical significant level of 1%, 5% and 10% respectively.

Panel A: 1965-2010				
	Value-weighted raw returns	Value-weighted excess returns	S&P 500 raw returns	S&P 500 excess return
Money Illusion	-0.00416*	-0.00413*	-0.00463**	-0.00461**
	(-1.88)	(-1.87)	(-2.17)	(-2.16)
T-bill	0.000371	-0.000427	0.000493	-0.000305
	(0.41)	(-0.48)	(0.57)	(-0.35)
Term	0.00137	0.00140	0.00136	0.00139
	(0.72)	(0.74)	(0.74)	(0.76)
Default	0.00467	0.00460	0.00272	0.00265
	(0.98)	(0.96)	(0.59)	(0.58)
Intercept	-0.000354	-0.000425	-0.00177	-0.00184
	(-0.05)	(-0.07)	(-0.28)	(-0.29)
adj. R^2	0.006	0.012	0.007	0.012

Panel B: 1970-1990				
	Value-weighted raw returns	Value-weighted excess returns	S&P 500 raw returns	S&P 500 excess return
Money Illusion	-0.00643*	-0.00642*	-0.00696**	-0.00695**
	(-1.79)	(-1.78)	(-2.00)	(-2.00)
T-bill	-0.00448***	-0.00526***	-0.00425***	-0.00504***
	(-2.70)	(-3.18)	(-2.66)	(-3.15)
Term	-0.00451	-0.00448	-0.00439	-0.00436
	(-1.43)	(-1.42)	(-1.44)	(-1.43)
Default	0.0374***	0.0372***	0.0340***	0.0339***
	(4.28)	(4.27)	(4.04)	(4.02)
Intercept	0.00501	0.00493	0.00440	0.00433
	(0.39)	(0.39)	(0.36)	(0.35)
adj. R^2	0.092	0.101	0.089	0.099

Table 4. Anomaly Returns: High vs. Low Inflation

This table reports excess monthly returns on a broad set of anomaly-based strategies. I classify returns each month as following either a high-inflation or a low-inflation month. A high-inflation month is one in which the value of the money illusion index in the previous month is above the median value of sample period, and a low-inflation month is below the median values. *t*-statistics are in parenthesis.

Anomaly	Long leg			Short leg			Long-Short		
	High	Low	High-Low	High	Low	High-Low	High	Low	High-Low
Size	-0.0028	0.0004	-0.0032 (-3.19)	0.0080	0.0174	-0.0094 (-20.91)	-0.0108 (-16.59)	-0.0170 (-21.73)	0.0062 (6.07)
Book to Market	-0.0181	-0.0145	-0.0036 (-4.56)	-0.0110	0.0089	-0.0199 (-20.51)	-0.0071 (-9.22)	-0.0234 (-23.96)	0.0163 (13.02)
Financial Distress	0.0029	0.0055	-0.0026 (-2.60)	0.0150	0.0409	-0.0259 (-26.85)	-0.0121 (-13.36)	-0.0354 (-33.96)	0.0233 (16.90)
Ohlson's-O (Distress)	0.0048	0.0112	-0.0065 (-19.88)	-0.0213	0.0073	-0.0286 (-13.09)	0.0260 (33.41)	0.0039 (4.27)	0.0221 (17.91)
Net Stock Issues	-0.0015	0.0079	-0.0094 (-32.59)	0.0029	0.0145	-0.0116 (-15.09)	-0.0044 (-8.20)	-0.0065 (-11.30)	0.0021 (2.70)
Accrual	0.0039	0.0098	-0.0059 (-11.11)	0.0044	0.0156	-0.0112 (-15.88)	-0.0005 (-0.83)	-0.0058 (-8.77)	0.0053 (5.91)
Profitability	0.0191	0.0276	-0.0085 (-10.61)	-0.0154	0.0086	-0.0240 (-13.89)	0.0345 (30.47)	0.0190 (15.21)	0.0155 (9.05)
ROA	0.0170	0.0261	-0.0091 (-12.85)	-0.0245	-0.0022	-0.0223 (-14.68)	0.0415 (42.03)	0.0283 (24.66)	0.0131 (8.66)
Investment-to-assets	0.0059	0.0174	-0.0114 (-12.58)	-0.0071	0.0086	-0.0157 (-12.98)	0.0130 (13.63)	0.0088 (7.70)	0.0092 (6.19)
External Finance	0.0069	0.0141	-0.0072 (-5.90)	-0.0188	0.0052	-0.0240 (17.25)	0.0257 (20.88)	0.0089 (5.96)	0.0168 (8.71)
Asset Turnover	0.0041	0.0134	-0.0093 (-11.53)	-0.0049	0.0169	-0.0218 (-10.88)	0.0090 (7.39)	-0.0034 (-2.60)	0.0124 (6.90)
Combination	0.0047	0.0096	-0.0049 (-8.45)	-0.0031	0.0146	-0.0177 (13.21)	0.0078 (8.35)	-0.0050 (-4.53)	0.0128 (8.80)

Table 5. Predictive Regressions: Excess Returns on Long-Short Strategies

The table reports estimates of b in the regression

$$R_{i,t} = a + bM_{t-1} + e_t,$$

where $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference, and M_t is the percentage of the money illusion index $((CPI_t - CPI_{t-1})/CPI_{t-1})$. t-statistics are in parenthesis.

Anomaly	Long leg	Short leg	Long-Short
Size	-0.0006 (1.14)	-0.0036 (-10.68)	0.0031 (5.93)
Book to Market	-0.0032 (-8.33)	-0.0119 (-27.36)	0.0087 (14.11)
Financial Distress	0.0012 (2.39)	-0.0117 (-24.37)	0.0129 (18.85)
Ohlson's O (Distress)	-0.0019 (-11.94)	-0.0146 (-24.34)	0.0127 (20.26)
Net Stock Issues	-0.0049 (-33.15)	-0.0043 (-11.33)	-0.0006 (-1.60)
Accrual	-0.0025 (-9.68)	-0.0051 (-16.65)	0.0026 (5.96)
Profitability	-0.0027 (-6.46)	-0.1204 (-17.05)	0.0094 (10.37)
ROA	-0.0044 (-12.49)	-0.0128 (-21.08)	0.0084 (10.81)
Investment-to-assets	-0.0055 (-12.00)	-0.0083 (-15.41)	0.0028 (3.72)
External Finance	-0.0030 (-5.13)	-0.0125 (-19.77)	0.0095 (10.00)
Asset Turnover	-0.0047 (-11.70)	-0.0140 (-17.26)	0.0094 (10.04)
Combination	-0.0003 (-0.84)	-0.0084 (-15.00)	0.0081 (10.34)

Table 6. Predictive Regressions: Benchmark-adjusted Returns on Long-Short Strategies

The table reports estimates of b in the regression

$$R_{i,t} = a + bM_{t-1} + cMKT_t + dSMB_t + eHML_t + u_t,$$

where $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference, and M_t is the level of the money illusion index (change of Consumer Price Index). t-statistics are in parenthesis.

Anomaly	Long leg	Short leg	Long-Short
Size	0.0041	-0.0004	0.0045
	(8.26)	(-1.18)	(9.04)
Book to Market	0.00003	-0.0078	0.0078
	(0.08)	(-18.61)	(13.24)
Financial Distress	0.0049	-0.0042	0.0091
	(10.48)	(-9.28)	(14.16)
Ohlson's O (Distress)	-0.0005	-0.0049	0.0044
	(-3.22)	(-8.53)	(7.37)
Net Stock Issues	0.0007	0.0010	-0.0003
	(5.16)	(2.86)	(-0.76)
Accrual	-0.0003	-0.0005	0.0002
	(-1.32)	(-1.94)	(0.59)
Profitability	0.0007	-0.0076	0.0084
	(1.71)	(-11.48)	(9.77)
ROA	0.0002	-0.0052	0.0054
	(0.67)	(-8.97)	(7.34)
Investment-to-assets	0.0002	-0.0037	0.0039
	(0.55)	(-7.14)	(5.49)
External Financing	0.0010	-0.0054	0.0064
	(1.830	(-8.92)	(7.06)
Asset Turnover	-0.0010	-0.0055	0.0044
	(-2.75)	(-7.01)	(4.94)
Combination	0.0002	-0.0064	0.0066
	(0.74)	(-11.44)	(8.43)

Table 7. Predictive Regressions: Alternative Money Illusion Index and Benchmark-adjusted Returns on Long-Short Strategie

The table reports estimates of b in the regression

$$R_{i,t} = a + bE_{t-1} + cMKT_t + dSMB_t + eHML_t + u_t,$$

where $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference. E_t is the inflation expectation, measured by median expected price change next 12 months by Survey of Consumers. The data is obtained from FRED and the source of data is from University of Michigan Inflation Expectation. The sample period is from 1978 to 2010. t-statistics are in parenthesis.

Anomaly	Long leg	Short leg	Long-Short
Size	0.0014	-0.0005	0.0019
	(2.43)	(-1.41)	(3.37)
Book to Market	-0.0002	-0.0006	0.0004
	(-0.38)	(-1.17)	(0.61)
Financial Distress	0.0024	-0.0028	0.0053
	(4.43)	(-5.37)	(6.98)
Ohlson's O (Distress)	-0.0010	-0.0022	0.0012
	(-5.76)	(-3.48)	(1.84)
Net Stock Issues	0.0010	-0.0005	0.0015
	(6.28)	(-1.20)	(3.49)
Accrual	-0.0002	-0.0016	0.0014
	(-0.69)	(-5.07)	(3.13)
Profitability	0.0012	-0.0034	0.0046
	(2.96)	(-4.89)	(5.15)
ROA	0.0012	-0.0026	0.0038
	(3.06)	(-4.05)	(4.51)
Investment-to-assets	0.0016	0.0003	0.0013
	(3.47)	(0.51)	(1.64)
External Financing	0.0014	-0.0020	0.0035
	(2.17)	(-2.85)	(3.20)
Asset Turnover	-0.0007	-0.0004	-0.0003
	(-1.47)	(0.44)	(-0.26)
Combination	0.0011	-0.0081	0.0092
	(3.25)	(-13.90)	(11.16)

Table 8. Predictive Regressions: Macro-variables and Benchmark-adjusted Returns on Long-Short Strategies

The table reports estimates of b_1 *and* b_2 in the regression

$$R_{i,t} = a + b_1 M_{t-1} + cMKT_t + dSMB_t + eHML_t + Macro_t + u_t$$

where $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference, and M_t is the level of the money illusion index (change of Consumer Price Index). *Macro is* macrovariables. They are *T-bill* as the 3-month T-bill rate, *Term* as the difference between yield on 10-year bond and the T-bill, and *Default* as the difference between Baa and Aaa-rated corporate bonds. *t*-statistics are in parenthesis.

Anomaly	Long leg	Short leg	Long-Short
Size	0.0009	0.0000	0.0009
	(1.63)	(0.02)	(1.61)
Book to Market	0.0015	-0.0048	0.0063
	(-0.38)	(-10.30)	(9.47)
Financial Distress	0.0027	-0.0041	0.0068
	(5.06)	(-8.12)	(9.40)
Ohlson's O (Distress)	0.0009	-0.0060	0.0069
	(5.65)	(-9.29)	(10.24)
Net Stock Issues	0.0023	0.0021	0.0002
	(14.35)	(5.49)	(0.40)
Accrual	0.0008	0.0004	0.0003
	(2.97)	(1.44)	(0.73)
Profitability	0.0015	-0.0065	0.0080
	(3.59)	(-8.63)	(8.43)
ROA	0.0010	-0.0053	0.0063
	(2.64)	(-8.04)	(7.52)
Investment-to-assets	0.0012	-0.0020	0.0032
	(2.45)	(-3.57)	(4.05)
External Financing	0.0018	-0.0045	0.0063
	(2.90)	(-6.64)	(6.18)
Asset Turnover	0.0002	-0.0048	0.0051
	(0.50)	(-5.63)	(5.10)
Combination	0.0022	-0.0028	0.0050
	(6.41)	(-4.72)	(5.92)

Table 9. Predictive Regressions: Macro-variables, Other Firm Level Predictive Variables and Benchmark-adjusted Returns on Long-Short Strategies

The table reports estimates of b in the regression

$$R_{i,t} = a + b_i M_{t-1} + cMKT_t + dSMB_t + eHML_t + Macro_t + Others_t + u_t$$

where $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference, and M_t is the level of the money illusion index (change of Consumer Price Index). *Macro is* macro-variables. They are *T-bill* as the 3-month T-bill rate, *Term* as the difference between yield on 10-year bond and the T-bill, and *Default* as the difference between Baa and Aaa-rated corporate bonds. *Others* are other firm level predictive variables including the earnings-to-price ratio, the dividend-to-price ratio, and the equity variance. t-statistics are in parenthesis.

Anomaly	Long leg	Short leg	Long-Short
Size	0.0004	0.0003	0.001
	(0.64)	(0.74)	(0.22)
Book to Market	0.0022	-0.0033	0.0055
	(5.04)	(-6.10)	(7.48)
Financial Distress	-0.0006	-0.0013	0.0007
	(-0.96)	(-2.63)	(0.92)
Ohlson's O (Distress)	0.0010	-0.0057	0.0067
	(6.40)	(-7.40)	(8.47)
Net Stock Issues	0.0028	0.0023	0.0005
	(16.77)	(5.90)	(1.26)
Accrual	0.0008	0.0009	-0.0001
	(3.08)	(2.93)	(-0.28)
Profitability	0.0029	-0.0026	0.0055
	(6.63)	(-3.48)	(5.75)
ROA	0.0013	-0.0037	0.0050
	(3.35)	(-5.09)	(5.52)
Investment-to-assets	0.0020	-0.0012	0.0032
	(3.80)	(-2.02)	(3.77)
External Financing	0.0013	-0.0037	0.0050
	(1.99)	(-5.00)	(4.51)
Asset Turnover	0.0007	-0.0043	0.0050
	(1.57)	(-4.54)	(4.64)
Combination	0.0022	-0.0020	0.0042
	(6.38)	(-3.34)	(4.93)

Table 10. Money Illusion and Analyst Forecast Errors

The table reports estimates of b in the regression

$$Forecast\ errors_{i,t} = a + bM_{t-1} + \sum_j^6 c_j\,Controls_{i,t} + u_t$$

where $Forecast\ errors_{i,t}$ are measured by the absolute difference between the realized stock price in one year and the forecasted target price divided by the average target price. M_t is the level of the money illusion index (change of Consumer Price Index). *Controls* are six variables including numbers of forecasts, log of total assets, market-to-book ratio, leverage, return-on-assets, R&D expenditure-to-assets. All specifications use year and month and industry fixed effects and firm-level clustered standard error. The sample period is from 1999-2010. *t*-statistics are in parenthesis with ***, ** and * indicating its statistical significant level of 1%, 5% and 10% respectively.

	Full Sample	High-performing Firm	Low-performing Firm
Money Illusion	-0.0594	-5.229***	4.861***
	(-0.07)	(-2.75)	(28.80)
Year Fixed-effect	Yes	Yes	Yes
Month Fixed-effect	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes
adj. R-sq	0.020	0.027	0.196

Table 11. Money Illusion and Forecast Dispersion

The table reports estimates of b in the regression

$$Forecast\ dispersion_{i,t} = a + bM_{t-1} + \sum_j^6 c_j\, Controls_{i,t} + u_t$$

where $Forecast\ dispersion_{i,t}$ is measured by the standard deviation of all analyst forecasted target prices divided by the average target price. M_t is the level of the money illusion index (change of Consumer Price Index). *Controls* are six variables including numbers of forecasts, log of total assets, market-to-book ratio, leverage, return-on-assets, R&D expenditure-to-assets. All specifications use year and month and industry fixed effects and firm-level clustered standard error. The sample period is from 1999-2010. *t*-statistics are in parenthesis with ***, ** and * indicating its statistical significant level of 1%, 5% and 10% respectively.

	Full Sample	High-performing Firm	Low-performing Firm
Money Illusion	-2.118***	-1.283***	-1.283***
	(-25.00)	(-9.30)	(-9.30)
Year Fixed-effect	Yes	Yes	Yes
Month Fixed-effect	Yes	Yes	Yes
Clustered SE	Yes	Yes	Yes
adj. R-sq	0.125	0.097	0.097

Table 12. Predictive Regressions: Sentiment-adjusted Returns on Long-Short Strategies

The table reports estimates of b_1 *and* b_2 in the regression

$$R_{i,t} = a + b_1M_{t-1} + b_2Sentiment_{t-1} + cMKT_t + dSMB_t + eHML_t + u_t$$

where $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference, and M_t is the level of the money illusion index (change of Consumer Price Index). $Sentiment_t$ is the level of sentiment index of Baker and Wugler (2006). t-statistics are in parenthesis.

Anomaly	Long leg		Short leg		Long-Short	
	b_1	b_2	b_1	b_2	b_1	b_2
Size	0.0028	-0.0069	-0.0001	0.0017	0.0029	-0.0086
	(5.63)	(-13.41)	(-0.19)	(4.91)	(5.76)	(-16.58)
Book to Market	-0.0010	-0.0046	-0.0087	-0.0040	0.0077	-0.0006
	(-2.58)	(-12.11)	(-20.11)	(-9.15)	(12.63)	(-0.99)
Financial Distress	0.0030	-0.0088	-0.0040	0.0011	0.0070	-0.0099
	(6.24)	(-17.89)	(-8.57)	(2.45)	(10.57)	(-14.80)
Ohlson's O (Distress)	-0.0005	-0.0003	-0.0078	-0.0109	0.0073	0.0106
	(-3.42)	(-1.58)	(-13.25)	(-19.15)	(11.88)	(17.53)
Net Stock Issues	-0.0000	-0.0031	0.0005	-0.0045	-0.0005	0.0014
	(-0.01)	(-22.98)	(1.41)	(-10.86)	(-1.31)	(3.17)
Accrual	-0.0007	-0.0019	-0.0006	-0.0002	-0.0001	-0.0017
	(-2.84)	(-7.43)	(-2.01)	(-0.52)	(-0.25)	(-3.98)
Profitability	0.0007	0.0003	-0.0097	-0.0114	0.0104	0.0119
	(1.78)	(0.59)	(-14.17)	(-15.40)	(11.92)	(12.13)
ROA	0.0001	-0.0004	-0.0070	-0.0092	0.0072	0.0088
	(0.38)	(-1.26)	(-11.84)	(-15.92)	(9.46)	(11.68)
Investment-to-assets	-0.0006	-0.0038	-0.0054	-0.0081	0.0047	0.0043
	(-1.45)	(-8.51)	(-10.21)	(-15.10)	(6.47)	(5.84)
External Financing	-0.0004	-0.0065	-0.0070	-0.0094	0.0065	0.0029
	(-0.75)	(-11.10)	(-11.26)	(-14.22)	(6.99)	(3.01)
Asset Turnover	-0.0014	-0.0016	-0.0065	-0.0076	0.0051	0.0060
	(-3.52)	(-3.93)	(-8.24)	(-9.20)	(5.65)	(6.34)
Combination	-0.0001	-0.0023	-0.0074	-0.0072	0.0073	0.0049
	(-0.31)	(-6.58)	(-13.14)	(-11.54)	(9.23)	(5.55)

Table 13. Predictive Regressions: Sentiment, Macro-variables, and Other Variables

The table reports estimates of b in the regression

$$R_{i,t} = a + b_1 M_{t-1} + b_2 Sentiment_{t-1} + cMKT_t + dSMB_t + eHML_t + Macro_t + Others_t + u_t$$

where $R_{i,t}$ is the excess return in month t on either the long leg, the short leg, or the difference, and M_t is the level of the money illusion index (change of Consumer Price Index). $Sentiment_t$ is the level of sentiment index of Baker and Wugler (2006). *Macro is* macrovariables. They are *T-bill* as the 3-month T-bill rate, *Term* as the difference between yield on 10-year bond and the T-bill, and *Default* as the difference between Baa and Aaa-rated corporate bonds. *Others* are other firm level predictive variables including the earnings-to-price ratio, the dividend-to-price ratio, and the equity variance. t-statistics are in parenthesis.

Anomaly	Long leg		Short leg		Long-Short	
	b_1	b_2	b_1	b_2	b_1	b_2
Size	0.0001	-0.0026	-0.0062	-0.0124	0.0063	0.0098
	(0.06)	(-5.34)	(-6.48)	(-11.93)	(5.66)	(8.34)
Book to Market	0.0004	-0.0051	-0.0043	-0.0053	0.0047	0.0002
	(0.84)	(-11.97)	(-7.75)	(-8.67)	(6.15)	(0.29)
Financial Distress	-0.0030	-0.0139	-0.0029	-0.0048	-0.0001	-0.0091
	(-4.58)	(-19.59)	(-5.36)	(-9.37)	(-0.11)	(-10.75)
Ohlson's O (Distress)	0.0009	-0.0006	-0.0093	-0.0160	0.0102	0.0154
	(5.38)	(-3.22)	(-11.80)	(-20.21)	(12.54)	(18.76)
Net Stock Issues	0.0017	-0.0036	0.0013	-0.0054	0.0004	0.0018
	(9.77)	(-22.09)	(3.19)	(-11.51)	(1.04)	(3.64)
Accrual	0.0003	-0.0015	0.0004	-0.0017	-0.0001	0.0002
	(1.17)	(-5.54)	(1.23)	(-4.94)	(-0.19)	(0.37)
Profitability	0.0024	-0.0020	-0.0089	-0.0205	0.0113	0.0185
	(5.27)	(-4.03)	(-11.32)	(-25.19)	(11.34)	(17.76)
ROA	0.0012	-0.0004	-0.0079	-0.0169	0.0091	0.0165
	(2.99)	(-1.11)	(-10.55)	(-22.90)	(9.71)	(17.59)
Investment-to-assets	0.0004	-0.0053	-0.0037	-0.0090	0.0041	0.0037
	(0.79)	(-9.82)	(-5.76)	(-14.23)	(4.56)	(4.18)
External Financing	-0.0004	-0.0066	-0.0068	-0.0164	0.0065	0.098
	(-0.53)	(-9.18)	(-9.05)	(-19.41)	(5.58)	(8.04)
Asset Turnover	0.0000	-0.0026	-0.0062	-0.0124	0.0062	0.0098
	(0.06)	(-5.34)	(-6.48)	(-11.93)	(5.66)	(8.340
Combination	0.0018	-0.0016	-0.0049	-0.0113	0.0067	0.0098
	(4.98)	(-4.17)	(-7.86)	(-16.83)	(7.57)	(10.17)

□ □ □ □ □ □ Governance of Private Universities: A Socio-Economic Cost and Benefit Analysis

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This paper reviews and applies the general theories developed in the extensive nonprofit organization literature to private nonprofit universities. The primary objective is to identify significant socio-economic roles that may help explaining the long and growing existence of this type of universities in many countries in the world. Given the characteristics of higher education, it is found that nonprofit universities fill the demand gaps neglected by the public and for-profit private universities, provide the needed (although not perfect) protection for the students and their sponsors from potential exploitative behavior by the people in control of privately owned universities, create new opportunities to mobilize additional developmental resources to supplement the public funds and private capitals, improve productivity and quality in both private and public universities through increased competition and spillover, and establish attractive environment for academic and other socially minded professionals to pursuit social missions in higher education. The paper also explores some inherent weaknesses of the nonprofit status of universities that include possible increase of agency cost and decrease of operational efficiency. The analysis provides and also rationalizes a conceptual framework for policy implications at both government and university levels to maximize potential benefits while limiting the costs of this increasingly important sector in higher education.

Keywords: Higher education; university governance; nonprofit; non-distribution constraint; private universities; cost and benefit analysis.

1. Introduction

Despite the vast research literature accumulated over past few decades on nonprofit organizations, the governance issues of private universities, especially regarding the distinction between for-profit and nonprofit universities have attracted little interest in academia. Although nonprofit universities could be considered as a subsector in the larger sector of general nonprofit organizations, one may wonder if the specific characteristics of higher education have any bearing on the governance choice and behavior of private nonprofit universities. The large variation in the proportions of private universities, both nonprofit and for-profit, in different parts of the world also raise the question whether what may explain the existence and development of different governance status of private universities.

This conceptual paper aims at exploring the possible social and economic roles of nonprofit universities as well as the implications of this governance choice on their behavior. The key research questions are as follows:

- What are the benefits nonprofit universities can bring to society? (Do such benefits explain the existence of nonprofit universities in parallel with public and for-profit universities?)
- What are the inherent weaknesses of this choice of governance and how are they expressed in the differences in the behavior of nonprofit universities relative to for-profit universities?
- What are the policy implications (at government level as well as the university level) of such characteristics of the nonprofit status in higher education?

The answers to these questions rely on salient characteristics of higher education and applications of general theories developed in the nonprofit organization literature. For social entrepreneurs – and to a certain extent, for managers, professoriate and staff – working in higher education, this essay will provide rational justification for their choice toward nonprofit status. For policy makers, especially those in developing countries, where the emerging private and nonprofit university sector is relatively fragile, a balanced analysis on the benefits and possible weaknesses of the nonprofit governance status of private universities can help formulating effective policy to support and regulate this important subsector of the higher education market. In addition testable hypotheses can be drawn from this conceptual study for future empirical researches.

The next section describes the various theories developed in the literature to explain the needs and benefits of nonprofit organizations, and explains how they can be applied in higher education market to the case of nonprofit universities. In the following section I discuss the inherent weaknesses of the nonprofit status, again by applying the general theories developed for nonprofit organizations to private universities. Finally the policy implications, both at government and university levels, will be explored to develop a healthy nonprofit higher education sector.

2. Benefits of nonprofit governance form of private universities

Higher education (also called tertiary or postsecondary education) is commonly understood as a large and diverse area of services that includes continuing education, vocational and professional diploma programs, associate-degree programs, regular and professional undergraduate education, liberal art education, post-graduate and doctoral education. This diversity itself is probably the most salient characteristic of the higher education, with the implication that the institutions providing such services may vary greatly from training centers focused in short-term non-degree programs to local community colleges to large national research universities offering large variety of programs to a huge and diverse student body. For simplicity, we will call all such institutions "universities".

It is well accepted that a private university, or any private provider of social services, is called nonprofit if it "is barred from distributing its net earnings, if any, to individuals who exercise control over it" (Hansmann 1980, p.838), a condition commonly called "non-distribution constraint". Several authors have developed various theories to explain the role of non-distribution constraint, and consequently of the existence of nonprofit organizations (see for example, Salamon and Anheier 1998, Weisbrod 1977, 1989, Hansmann 1980, 1987, Rose-Ackerman 1996, Hirth 1997). These theories will be briefly reviewed below and then applied to explain the potential benefits of nonprofit governance status of private universities, taking into account specific characteristics of higher education services. The explanations can be divided into three groups: the demand-side, the supply-side and the competition theories.

2.1. *Demand-side theories*

As in many sectors of economy, it is commonly accepted that private universities, for-profit or not, provide higher education services to meet the demand not fulfilled by public universities. The reason for this unmet demand is not necessarily lack of resources from government for higher education since one may observe the existence of private universities even in wealthy industrialized countries, with increasing role despite economic growth. Instead, Weisbrod (1977, 1989) argued that when the demand for a service is heterogeneous, which is typically the case of demand for higher education in most countries, the public sector is designed to serve the need of the majority of the population only, and thus leaving certain needs of different (political, cultural, religious and historical) minority groups to be served by the private sector.

The key question here is that why do we need the services of private nonprofit universities. In other words, why we cannot simply rely on the higher education services of for-profit private universities to fill the gap left over by the public universities, just like many other service sectors in the economy (transportation, utilities, telecommunication, etc.)? The answer to this question could be two-fold. First, even with advanced technology in education, there are many traditional areas in higher education (e.g. liberal art education, basic research education, humanity and social science education, etc.) where the operating expenses are high and the benefits to the students are intangible and only observable in long terms. As consequence, most for-profit universities will simply avoid to provide services in these areas as it is difficult to charge tuition high enough to recover the cost, let alone to earn the needed profit required. This implies that, in these areas of higher education, the gaps left over by public universities are also abandoned by for-profit universities, and could only be filled by nonprofit ones (Hansmann 2012). Second and more importantly, Hansmann (1980, 1987) proposed a general "contract failure theory" that could explain the need for nonprofit organizations even in markets where for-profit firms already provide their services. According to Hansmann, for a private firm to provide goods and services with maximum efficiency, certain market conditions should be met: (a) customers can evaluate the product and prices before making decision; (b) customers can reach clear agreement with the chosen firm on quantity, quality and price; (c) customers can determine if the firm complies with agreement or not; and (d) customers can penalize the firm if it did not. When some of these conditions are not met, either due to the circumstance where the services of the organization are purchased or consumed, or to the nature of the services themselves, the firm has both the incentive and the opportunity to take advantage of customers by providing less service to them than was promised and paid for. In such situations, called "contract failure" by Hansmann or more generally "market failure" (Vlassopoulos 2009, Valentinov 2011, Young 2013) a nonprofit firm providing the same goods and services offers consumers the advantage that, owing to the non-distribution constraint, those who control the organization are constrained in their ability to benefit personally from providing low-quality services and thus have less incentive to take advantage of their customers than do the managers of a for-profit firm.

One can argue that, higher education and especially its major and most traditional elements (that is, under- and post-graduate education), exhibit typical "contract failure" characteristics. In fact, the complexity of higher education services makes it extremely difficult for the "customers" (students or parents) to accurately evaluate the quality and potential benefits of the education they receive, and if its values are worth the price (tuition) they pay. Given the nature of higher education, a student may only realize the full value of the education he or she receive years or even decades after graduation. By that time, if the student is dissatisfied with the education he or she received, the chance of penalize the university is practically nil. Moreover, as the students are in the early stage of their career, their tuition is most likely covered by someone else (parents, scholarship donors, student loan providers, etc.) who is in even less position to assess the quality and value of the education received by the students. The situation is aggravated with the information asymmetry commonly found in higher education: the service providers have significantly more information than all other stakeholders about the quality and cost of the education provided (Hansmann 1996, Valentinov 2011, James 2011, Titova & Shutov 2014). Thus, the nonprofit governance form defined by the "non-distribution constraint" presents a (limited) protection for the students (and those who pay for their study) from potential exploitative behavior of those in the control of the universities by at least reducing their incentive to do so.

Exceptions to this "contract failure theory" can be found in certain areas of higher education like vocational and professional programs, corporate training programs, etc. where a healthy for-profit sector has emerged and grown in the past few decades. On the other hand, in traditional undergraduate education over the past few years, together with the rise of for-profit universities, there are ample reported empirical evidences of malpractices by these universities in US, especially in recruitment approach, poor quality and financing with public funds (see for example the Harkin Report, US Senate Committee on Health, Labor & Pensions 2012). These "predatory education" practices include: 1. providing an educational experience that results in net harm to students; 2. harmful rent-seeking behavior; 3. securing student enrollment through fraud or deception; 4. securing student enrollment through misrepresentation, nondisclosure, and questionable business practices that do not amount to outright fraud; and 5. capitalizing on the absence of legal remedies (James 2011). These findings support the merits of the "contract failure theory" as well as the benefits of the nonprofit status in higher education.

2.2. *Supply-side theories*

From the supply side, Rose-Ackerman (1996) argued that in most societies there are groups of people who are motivated by ideology (generalized beliefs in certain social values) or simple altruism to contribute money and time to help other people. She also cited a study by Hodgkinson & Weitzman (1994) that contribution to education makes the second largest percentage of total household contributions to charity in US, after only donations to religious organizations. Thus, in higher education the nonprofit universities may respond to the need of these altruists and "social entrepreneurs" by reducing their fear that their gift could be converted to private gain, or by avoiding the bureaucratic barriers commonly found in public sector. In this sense nonprofit universities provide opportunities to supplement public funds and private capitals with additional resources in society to develop higher education to serve the overall need of the population. Valentinov (2008) extended Rose-Ackerman's theory to imply that the relevant stakeholders of nonprofit organizations need the non-distribution constraint because they can then better enhance their utility of being involved in pursuing the non- profit mission. This way, the preferences to non-profit mission and the freedom to pursue relevant ideologies and beliefs complement the restriction imposed by non-distribution constraint.

The general "social entrepreneur" theory of Rose-Ackerman and the neo-classical arguments by Valentinov for nonprofit sector could have a direct implication on nonprofit universities that goes beyond mobilizing additional financial resources in the society to serve the higher education needs unmet by the public universities and for-profit universities. In fact, the majority of the academic faculty in universities may arguably be considered as altruistic professionals who pride themselves in their services of the society through creating and disseminating knowledge. For this faculty, the monetary motivations may be secondary to the academic freedom and the professional recognition, by the society and public in general, and by their peers in particulars. As consequence, they cannot generally accept the work environment of for-profit universities where faculty self-governance is absent and professors are merely employees contracted to teach in most cost-effective way standardized courses designed to maximize profits for some shareholders. This way, nonprofit universities provide this faculty better environment to pursue a career of pushing the boundary of knowledge and disseminating it to generations of students (Hansmann 2012). In fact, Valentinov (2008) and Handy & Katz (1998) even argued that, for academic professionals, these environmental factors may substitute monetary incentive and allow for self-selecting those committed to the nonprofit mission of the university.

2.3. *Competition theories*

Without profit motive, the nonprofit universities operate with similar objectives with public universities in higher education market. Thus, they provide the diversity needed to foster a healthy competition with public universities for the best students and the best faculty. This competition in turn promotes high quality in education and research in both sectors (Levin, 2008).

In the relationship with for-profit universities, it is commonly observed that quality of education provided by nonprofit universities is better than that provided by for-profit universities at equivalent tuition range. However, the benefits of nonprofit universities on a mixed higher education market where both nonprofit and for-profit universities operate are often higher than these observable quality differences between the two sectors. Indeed, the formal competition theory developed by Hirth (1997) for mixed market with quality competition and information asymmetry can be applied to higher education market to imply a spillover impact of nonprofit universities. According to this theory, with adequate enforcement of non-distribution constraint, when the presence of nonprofit universities increases, the poorly informed customers (as most students are) will be disproportionately attracted by the assurance of protection provided by the non-distribution constraint to the for-profit sector, leaving the for-profit university market with a higher ratio of better-informed customers, forcing the for-profit universities to increasingly deliver the quality promised to their customers. Eventually, when nonprofit universities dominate the market, the quality of both sectors will converge *because* of the presence of nonprofit universities. As consequence, the quality differences between the two subsectors *understate* the real benefits of nonprofit universities that have originally created this convergence.

In fact, according to Hirth, the response of for-profit universities to the competition from nonprofit universities is more complex and could happen in two ways. First, they may be forced to increase the quality to stay in the business and deliver what they promise to the students. Second, they may also move out from the area where quality education provision is not profitable. In the first case, we have the spillover effect explained above. In the second case, the for-profit universities will leave a larger part of the market demand for nonprofit universities to fill up.

The analysis above gives rise to several hypotheses that may be tested empirically across nations the way Salamon and Anheier (1996) did for general nonprofit organizations. Some of these hypotheses are summarized below.

- The greater the public spending by government on higher education, the smaller presence of private universities (nonprofit and for-profit included).
- There is a segmentation among the private universities: for-profit universities are concentrated more on vocational education and corporate training, while liberal art education and fundamental research are provided mostly by nonprofit universities.

- Academic faculty in nonprofit universities practice higher degree of self-governance and academic freedom than those in for-profit universities.
- Nonprofit universities have larger percentage of their income from donation and endowment compared with for-profit ones.

3. Costs of nonprofit governance form of private universities

The benefits of nonprofit universities in providing higher education services do not come without costs although these costs are usually intangible and non-cash. Two types of costs have been identified in relevant literature: agency costs to ensure the compliance with the non-distribution constraint and the nonprofit mission, and costs of decreased efficiency.

3.1. *Agency costs*

Applying the well-known principal-agent model of Jensen & Meckling (1976) to nonprofit universities, one may readily accept that the role of agent will be played by the university administrators. However, the role of the principals is less clear as, in place of owners, there could be many key stakeholders with different interests: students, academic staff, donors, community and government. Although these stakeholders are usually represented in governing boards, these boards are ultimately not accountable to these stakeholders and they are generally self-perpetuating instead of elected (Glaeser, 2003). Thus, comparing with for-profit firms, the agency problems as defined by Jensen & Meckling (1976) may include not only the gaps between these stakeholders as principals and the administrators as agents, but also the gaps of interests among these stakeholders themselves, and the gaps between these stakeholders and their representatives. As consequence, the agency cost, defined as the sum of the costs to the principals to monitor the agents, the bonding costs to the agents, and the residual loss, will be higher than that in equivalent for-profit universities.

In more practical terms, several authors (e.g. Brekke 2011, Glaeser & Shleifer 2001, Herbst & Prufer 2011, Valentinov 2006) argue that the "non-distribution constraint" cannot completely prevent those in control of nonprofit universities from shirking the net earnings for their own pocket in the forms of unusually high salaries, perquisites[1], contracts with firms controlled by family members, etc. The board, not being elected by stakeholders and not facing competition, could also be manipulated by the administration. The resulting need for increased regulatory control both in policy and enforcements in turn leads to increased costs of auditing and ensuring the transparency (in particular, financial transparency)[2].

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[1] "Perquisites" is defined as non-pecuniary compensation "involving different types of improvement in the working environment, such as lower effort levels, free meals, shorter workdays, longer vacations, better office facilities, etc." (Brekke et al. 2011, p.3)

[2] Fishman (2006) observed, however, that it was a misconception that there has been an increase of contemporary wrong doing and scandal in the nonprofit sector. For example reported that between 1995-2002 there were only 152 reported incidents of misconducts out of over 50,000 nonprofits in NY state, US.

3.2. *Inefficiency*

One implication of the agency problem in nonprofit universities is the lack of clear and unique measurement of performance to guide the university administrators. In fact, while the for-profit universities' administrators are motivated by a single profit motive, management of nonprofit universities faces multiple goals that reflect the conflicting interests of different key stakeholders: quality and value-to-money for students, community and public services for the public and government, academic reputation and freedom for faculty, mission-effectiveness and sustainable growth for donors, etc. It is often argued that this lack of strict and clear performance criteria, combined with less incentive to minimize cost due to the "non-distribution constraint", will render nonprofit universities less efficient than for-profit universities (see for example Hansmann 1996). However, empirical evidences indicated that this concern about operational efficiency "while not entirely misplaced, are easily exaggerated" (Hansmann 1996, p.249).

Hansmann (1996) identified another type of inefficiency in general nonprofit organizations: their sluggishness in responding to changes in demand. Applying Hansmann's arguments to higher education, one can observe that when demand increases or new demand emerges, nonprofit universities may not be able to set up or grow quickly enough to match, either due to the lack of access to equity capital or the lack of incentives from university administrators, or both. Similarly, when demand declines, nonprofit universities may also be slow in reducing their outputs correspondingly or to withdraw entirely. The reasons in this case may include legal constraints for nonprofit universities to withdraw or transfer its capitals dedicated to its original missions, and, again, the lack of incentive from management to downscale their university. The problem is compounded by the fact that, while for-profit universities have to maintain return on capital equal or above the market rate in order to survive, nonprofit universities can continue operating indefinitely just with zero net rate of return.

4. Policy implications

The policy implications of the analysis above will be discussed first at the level of the government, and then at the university level. From macro perspective, we can safely say that the primary goals of the government intervention toward the nonprofit sector of the higher education market are to create conditions for establishment and operation of nonprofit universities and to allow them to fulfill the socially beneficial roles expected as well as to minimize the weaknesses inherent in this governance status. At the university level, the primary goal will be to maximize the potential benefits usually established in the mission statement of the university, and also to minimize the inefficiency and agency cost inherent in the nonprofit governance status.

4.1. *Government's roles*

Given the significant public benefits nonprofit universities can bring to society, the government should create enabling environment for setting up and operating nonprofit universities. At the same time, since most of the benefits from nonprofit universities stem from non-distribution constraint, the government should also play the role of public guarantor to enforce the non-distribution constraint at these universities.

The first environment factor in the support to nonprofit universities starts with the recognition of the needs and potential benefits of this government form, which should happen at the highest level of the government to guide the policy formulation efforts, and then be promoted to the public through open scientific and public debates and forums. Such recognition, together with the assurance by the non- distribution constraint that is enforceable by law, would provide the necessary inputs to solicit donations and voluntary works to set up and sustain nonprofit universities. In countries where the sector is just emerging, a more important enabling factor, however, is an appropriate legal framework that should at least include a legal definition of the nonprofit status for private universities that is consistent with non-distribution constraint; and a provision for the governance of such a university through a board of trustee that is responsible to protect the nonprofit status by enforcing the non-distribution constraint, and the public-benefit mission of the university. In addition, such legal framework should facilitate the creation of new nonprofit universities, at least relatively to creating for- profit universities. The conversion from for-profit status to nonprofit status should also be treated by law favorably to enhance achieving social goals. At the same time, it should be made difficult, even practically impossible, to change back from the nonprofit status to for-profit status, to prevent maneuvering to avoid non-distribution constraint for personal gains. Similarly, when an nonprofit university is dissolved, its asset should be prohibited from being distributed to individuals or for-profit firms.

In countries with more mature nonprofit sector, financial supports to nonprofit universities are provided either in direct subsidies or through differential treatments of nonprofit universities, especially with tax privileges. Direct supports to nonprofit universities could be either financial grants or provision of subsidized land or infrastructure. Given the fact that the nonprofit university sector is expected to supplement the limited resources of the state to serve the public needs in higher education, such direct subsidies could be limited in size, of ad hoc nature and probably difficult to guarantee in law. Tax exemptions are usually considered as more popular ways to support nonprofit universities or nonprofit organizations in general for two reasons:

- Provision of tax breaks or tax reductions for nonprofit universities will not impose direct financial burden on state;
- The implementation power of such policies is vested in the tax authority which is best positioned to check and enforce the non-distribution constraint and the nonprofit status of the these universities (Hines et al. 2010).

Among the tax treatments applicable to support nonprofit universities, income tax exemption on donations plays an especially important role in allowing the nonprofit universities to mobilize further resources untapped in society for meeting the higher education needs. Hirth (1997) argued that the tax exemption on donations could be even more useful as normally the donors may have good understanding of, and some control on, how the nonprofit universities serves the community and public interests according to its missions, and thus adding another mechanism to enforce the non-distribution constraint and protect the nonprofit status of the university.

In addition to financial supports, the government may provide the academic staff of nonprofit universities with non-monetary incentives such as international collaboration opportunities and professional or public recognition, especially for their research and community services. Academic freedom and self-governance are also environmental factors conducive to mobilize socially minded academics to join nonprofit universities and fulfill its social missions.

Compared with supporting roles to nonprofit universities, the need for interventions by the government in regulating the nonprofit universities is less clear. The main reason for this apparent contradiction is that too much intervention from government may impair the autonomy of university and therefore be counter-productive. The primary regulating role (which at the same time is also a supporting one) of the government to nonprofit universities is to ensure that non-distribution constraint is properly enforced. Without much interference with the university's operations and autonomy, this can be achieved by having a clear internal governance structure in the university and have the governing board liable under law to protect the nonprofit mission and the non-distribution constraint. The government can also enhance the effect of non-distribution constraint in protecting the customers (students, parents and donors) by reducing the information asymmetry through two major sets of instruments: 1. Transparency and accountability requirements with mandatory reporting from the boards and administrations of nonprofit universities and regular or occasional auditing by government agencies; 2. Setting up public or independent agency to collect, compile the information from the universities and disseminate to the public in useful and consumable format.

Contrary to the enforcement of non-distribution constraint, the role of government in controlling the quality of the nonprofit universities is more controversial. While in many developing countries, the governments exercise a great power in directly auditing and controlling the quality of education provided by private universities, nonprofit or for-profit alike, the experiences from US and developed countries show that better results in guaranteeing and improving higher education quality could be achieved by

- Accreditation system implemented by associations of universities without intervention of the state;
- Competition among the universities, especially for the best faculty and students (Hansmann 2012, Levin 2008).

Thus, the role of the government in this area may better be indirect and limited to facilitate setting up – and, if necessary, to monitor – such independent accreditation system as well as to create conditions to allow for high mobility by student and academic staff among all universities and thus foster competition in the higher education market.

4.2. *Internal governance structure*

As discussed above, the best – and least expensively – way to enforce the non-distribution constraint critical in creating the benefits of nonprofit universities is with an appropriate internal governance structure of the universities. With the absence of owners represented by boards of directors in for-profit universities, the common and tested governance structure observed in most nonprofit universities is the dual system consisting of a board of trustees and a professional management team hired by the board. The non-distribution constraint is then protected by giving the board, as the highest authority of the university, the power of appointing and controlling the management and of setting policies for the university, but no executive power which is vested in the professional management. In the same spirit, the board members are normally uncompensated (or at the very least, the compensation should only nominal, and cannot be related to the university's performance). The Board is perpetuated and has fiduciary duty to ensure that the management will perform in line with the original mission and for the best interest of the organization. To overcome the efficiency problems caused by lack of management incentive discussed above, the board may establish policy to link compensation of management and employees to the performance as long as such policy serves the interest of organization. Such duality of the system implies that the Board and the Management should be separated, with the Rector or President of the university is only ex officio member of the Board, and Board members should not be employed by the university (or enrolled as student of the university).

The governance board of nonprofit universities should be made liable under law to protect the non- distribution constraint conditions and the nonprofit mission of the university. The board should be responsible in monitoring the performance of the university, especially cost control measures by administration. The administration of the nonprofit universities should also report and be accountable to the board, the tax authorities and the concerned government agencies with regular reports on compliance with the non-distribution constraint and the nonprofit charter of the university. Stakeholders should be encouraged to report deviations from the non-distribution constraint, and incompliance should be appropriately penalized.

In addition to performance-based compensation system, nonprofit universities may set up fringe benefit systems that promote the self-selecting mechanism to ensure that the right types of socially-minded people will join and work for the university. For example, Handy and Katz (1998, p. 258) suggested that "offering an academic wage package consisting of less cash but more research funding and facilities, increases the likelihood that research-minded professors will self-select. This strategy can work even if a devoted manager values a dollar of fringe benefit at less than a dollar in cash."

5. Conclusion

This paper reviews the theories developed in the nonprofit organizations literature and applies them to the private nonprofit university sector with view of specific characteristics of higher education. The conceptual analysis highlights many significant roles of nonprofit universities that may help explaining the long and growing existence of the sector in many countries in the world. In fact, nonprofit universities fill the gap of higher education demand in society that is neglected by the public and for- profit private sector. Given the information asymmetry evident in higher education sector, the status- defining non-distribution constraint provides the needed (although not perfect) protection for the students and their sponsors from potential exploitative behavior of for-profit private universities by reducing the incentives of the people in control of these universities. The nonprofit universities also create new opportunities to mobilize additional resources to supplement the public funds and private capitals by ensuring private donors that their contributions will be used to the intended purpose. In particular, the nonprofit status is attractive to academic professionals as it provides the foundation for the cherished autonomy and academic freedom often absent in public universities and for-profit universities. The presence of nonprofit universities in the higher education market also promotes the improvements of productivity and quality in both private and public universities by increasing the competition for students and faculty. Moreover, nonprofit universities are proven to have spillover impact in mixed higher education market, increasing the quality of the services of the for-profit universities to converge to that of nonprofit universities.

These positive impacts of nonprofit universities, on the society in general and on the higher education market in particular, depend on the level of enforcement of non-distribution constraint. In fact, if non- distribution constraint is easily circumvented, many for-profit universities may adopt the strategy to disguise as nonprofit ones to gain access to both the students and the support of the government and public and thus driving out honest nonprofit universities. To a lesser extent, the non-distribution constraint might be bypassed with exceptional perquisites, substantially weakening possible positive impacts. Thus, it is critical to have a clear legal framework and appropriate internal check-and-balance mechanism to ensure that the non-distribution constraint is reinforced without interference by government in the universities' operations. Tax privileges for donations to nonprofit universities, transparency requirements, independent accreditation and conditions for students and faculty mobility are found to be constructive ways government can encourage development of this critical sector. In addition to government's roles, separating the control role of the board of trustees from the executive power of the administration of the nonprofit universities, with appropriate compensation policy for the latter are means to ensure both the non-distribution constraint and needed incentive for performance. The conceptual analysis in this paper also provides empirically testable hypotheses for future research.

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□ □ □ □ □ □ Information Technology for Financial Service Applications

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Securities trading is one of the few business activities where a few seconds processing delay can cost a company big fortune. The growing competition in the market exacerbates the situation and pushes further towards instantaneous trading even in split second. The key lies on the performance of the underlying information system. Following the computing evolution in financial services, it was a centralized process to begin with and gradually decentralized into a distribution of actual application logic across service networks. Financial services have tradition of doing most of its heavy lifting financial analysis in overnight batch cycles. However, in securities trading it cannot satisfy the need due to its ad hoc nature and requirement of fast response. New computing paradigms, such Grid and Cloud computing, aiming at scalable and virtually standardized distributed computing resources, are well suited to the challenge posed by the capital markets practices. It is also no doubt that both have been gaining popularity to serve as a production environment for finance services in recent years. In this study the core computing competence for financial services is examined. Grid and Cloud computing will be briefly described. How the underlying algorithm for financial analysis can take advantage of Grid environment is chosen and presented. One of the most popular practiced algorithms Monte Carlo Simulation is used in our cases study for option pricing and risk management. The various distributed computational platforms are carefully chosen to demonstrate the performance issue for financial services.

Keywords: Financial Service, Grid and Cloud Computing, Monte Carlo Simulation, Option Pricing, Risk Management

Abstract: Securities trading is one of the few business activities where a few seconds processing delay can cost a company big fortune. The growing competition in the market exacerbates the situation and pushes further towards instantaneous trading even in split second. The key lies on the performance of the underlying information system. Following the computing evolution in financial services, it was a centralized process to begin with and gradually decentralized into a distribution of actual application logic across service networks. Financial services have tradition of doing most of its heavy lifting financial analysis in overnight batch cycles. However, in securities trading it cannot satisfy the need due to its ad hoc nature and requirement of fast response. New computing paradigms, such Grid and Cloud computing, aiming at scalable and virtually standardized distributed computing resources, are well suited to the challenge posed by the capital markets practices. It is also no doubt that both have been gaining popularity to serve as a production environment for finance services in recent years. In this study the core computing competence for financial services is examined. Grid and Cloud computing will be briefly described. How the underlying algorithm for financial analysis can take advantage of Grid environment is chosen and presented. One of the most popular practiced algorithms Monte Carlo Simulation is used in our cases study for option pricing and risk management. The various distributed computational platforms are carefully chosen to demonstrate the performance issue for financial services.

Keywords Financial Service • Grid and Cloud Computing • Monte Carlo Simulation • Option Pricing • Risk Management

1. Introduction

1.1 Information Technology (IT) for Financial Services

The finance services industry involves a broad range of organizations such as banks, credit card companies, insurance companies, consumer finance companies, stock brokerages, investment funds and some government sponsored enterprises. The industry represents a significant share of the global market. Information technology (IT) in the financial service industry is considered as an indispensable tool for productivity as well as competitiveness in the market. The IT spending in financial service industry grows constantly across different industry verticals (banking, insurance, and securities and investments). The impact directly from the use of advanced IT brings on financial services industry is on the rise.

The structure of the industry has changed significantly in the last two decades as companies, which are not traditionally viewed as financial service providers, have taken advantage of opportunities created by technology to enter the market. New technology-based services keep emerging. These changes are direct result of the interaction of technology with the industrial environment, such as economic atmosphere, societal pressures, and the legal/regulatory environment in which the financial service industry operates. The effects of IT on the internal operations, the structure and the types of services offered by the financial service industry have been particularly profound (Phillips et al, 1984;Hauswald and Marquez, 2003; Griffiths and Remenyi, 2003). IT technology has been and continues to be both a motivator and facilitator of change in the financial service industry, which ultimately leads to competitiveness of the industry. The change is in particular radical after 1991 when World Wide Web was invented by Tim Berners-Lee and his group for information sharing in the community of high energy physics. It was later introduced to the rest of the world, which subsequently changed the face of how people doing business today.

Informational considerations have long been recognized to determine not only the degree of competition but also the pricing and profitability of financial services and instruments. Recent technological progress has dramatically affected the production and availability of information, thereby changing the nature of competition in such informationally sensitive markets. Hauswald and Marquez (2003) investigate how advances in information technology (IT) affect competition in the financial services industry, particularly credit, insurance, and securities markets. Two aspects of improvement in IT are focused: better processing and easier dissemination of information. In other words, two dimensions of technology progress that affects competition in financial services can be defined as advances in the ability to process and evaluate information, and in the ease of obtaining information generated by competitors. While better technology may result in improved information processing, it might also lead to low-cost or even free access to information through, for example, informational spillovers. They show that in the context of credit screening better access to information

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decreases interest rates and the returns from screening. On the other hand, an improved ability to process information increases interest rates and bank profits. Hence predictions regarding financial claims' pricing hinge on the overall effect ascribed to technological progress. Their results conclude that in general financial markets informational asymmetries drive profitability.

The viewpoint of Hauswald and Marquez is adopted in this work. Assuming competitors in the dynamics of financial market possess similar capacity, the informational asymmetries can be created sometimes only between seconds and now are possible to be achieved through the outperformance of underlying IT platforms.

1.2 Competitiveness through IT Performance

Following the computing evolution in financial services, it was a centralized process to begin with and gradually decentralized into a distribution of practical trading application logic across service networks. Financial services have tradition of doing most of its heavy lifting financial analysis in overnight batch cycles. However, in securities trading it cannot satisfy the need due to its ad hoc nature and requirement of fast response.

New computing paradigms, Grid computing and Cloud computing were subsequently emerged in the last decade. The Grid computing was initially incorporated into the core context of a well referenced Atkins' report of National Science Board of US, namely"Revolutionizing Science and Engineering Through Cyberinfrastructure" (Atkins et al, 2003), which lays down a visionary path for future IT platform development of the world. One may observe this trend from statistics from Google Trend regarding the global Search Volume and global News Reference Volume of key phrases of "Cluster Computing", "Grid Computing", "Cloud Computing" and "Big Data" (Fig. 1), which represents four main stream computing paradigms in high end quantitative analysis.

Cluster Computing is a group of coupled computers that work closely together so that in many respects they can be viewed as though they are a single computer. They are connected with high speed local area networks and the purpose is usually to gain more compute cycles with better cost performance and higher availability. The Grid Computing aims at virtualizing scalable geographically distributed computing and observatory resources to maximize compute cycles and data transaction rates with minimum cost. Cloud Computing is more of recent development owing to the similar technology used in global information services providers, such as Google, Amazon … etc. The Cloud is referred to as a subset of internet if to be explained in a simplest fashion. Within the cloud the computers also talk with servers instead of communicating with each other similarly to that of Peer to Peer Computing (Milojicic et al, 2002). There are no definitive definitions for the above terminology. However, people tend to view Clusters as one of foundational components of Grids, or Grids as a meta-cluster on wide area networks. This is also known as horizontal integration. The Cloud virtualizes further the compute, store and network in an utility sense and provides an interface between users and Grids. We refer to Foster et al (2008) and Yelick (2011) for a comparison. This perspective considers Grids as a backbone of Cyberinfrastructure to support the Clouds. Similarly, in early days of development of Grids there is a so called "@HOME" style PC Grids (Korpela et al, 2001), which are exactly working on at least ten of thousands of PCs, in which owners of PCs donate their CPU times when their machines are in idle. The PC Grids can be specifically categorized as Clouds.

Fig. 1 shows that there is a gradually drop in the curve of search volume for Grid Computing and Cluster Computing, and many surges, grows but a recent quick drop on Cloud Computing since its introduction in mid-2007. The new rising technology is Big Data (Bughin et al, 2010), which implies a paradigm shift from compute centric, network centric gradually to data centric computing. However, the size of the search volume strongly relates to the degree of maturity of each computing paradigm. This is obvious in cluster computing. Clusters are the major market products, either in supercomputers from big vendors, such as IBM, HP, SGI and NEC…etc, or from aggregation of PCs in university research laboratories. Fig. 1 also implies constant market need for high end computing. The performance and security issues are fundamental to general distributed and parallel computing, which also remain as a challenge to Cluster, Grid, Cloud and Big Data (Lauret et al, 2010, Ghoshal et al 2011, Ramakrishnan et al 2011). Performance models in compute based grid, which is also cloud-like, environment are adopted in this work. The general definitions of Grid and Cloud Computing will be introduced and briefly compared. To tackle the core performance issue Grids are chosen to demonstrate how fundamental financial calculations can be improved, hence leverage the financial service.

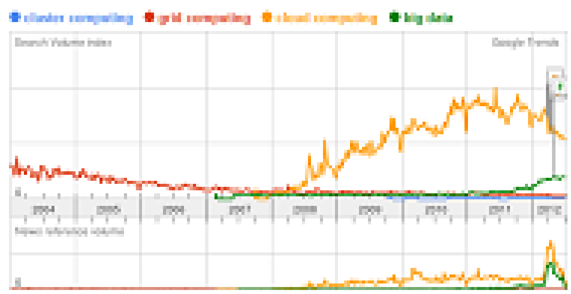

Fig. 1 The trend history from Google Trend according to global Search Volume and global News Reference Volume, in which the alphabetic letters represent the specific events that relate to each curve.

Grid computing, following by cloud computing as shown in Fig 1, has been matured to serve as a production environment for finance services in recent years. Grid computing is well suited to the challenge posed by the capital markets practices. In this study the core computing competence for financial services will examined and how underlying algorithms for financial analysis can take advantage of Grid environment scrutinized. One of the most popular practiced algorithms is Monte Carlo Simulation (MCS) and it will be specifically used in our cases study for calculations of option pricing and for value at risk (VaR) in risk management.

Three grid platforms are carefully chosen to exploit the performance issue for financial services. The first one is traditional grid platform with heterogeneous and distributed resources. Usually digital packets are connected via optical fibers. For long distance, depending on network traffics, it will produce approximately 150~300 microseconds (mm) latency across Pacific Ocean. This is the physical constrain of light speed when traveling through the fiber channels. Therefore, even in split second packets can still travel to anywhere in the world. The Pacific Rim Applications and Grid Middleware Assembly (PRAGMA) grid is a typical example, which linked with 14 countries and 36 sites. The system is highly heterogeneous. The computer nodes mounted to PRAGMA grid range from usual PC clusters to high-end supercomputers. The second one is a special Linux, or DRBL, PC cluster. It converts system into a homogenous Linux system and exploits the compute cycles of the cluster. The intention is to provide dynamic and flexible resources to cope better with uncertainty of the traders' cycle demand. Finally, PC grid is chosen to demonstrate finance services that can be effectively conducted through a Cloud-based computing. The usefulness of PC Grid is based on the fact that 90% of CPUs time of PCs were in idled status.

2 Performance Enhancement

In this section two types of Grid systems, compute intensive and data intensive respectively, are introduced. The classification of the types is based on various grid applications. Traditionally, the grid systems provides a general platform to harvest, or to scavenge if used only in idle status, compute cycles for a collection of resources across boundaries of institutional administration. In real world most applications are in fact data-centric. For example in a trading center, it collects tick-by-tick volume data from all related financial markets and is driven by informational flows, hence typical data-centric. However, as noted in Section 3.2.1 the core competence still lies on the performance enhancement of the IT system. The following two subsections are will gives more details of compute intensive as well as data intensive grid systems by a survey of current development of Grids specifically for financial services. In some cases, e.g. high frequency data with real time analysis, two systems have to work together to get better performance. Our emphasis will be more on compute intensive grid system.

2.1 High End Computing Technology

2.1.1 Definitions of High End Computing

Grid was coined by Ian Foster (Foster and Kesselman, 2004) who gave the essence of the definitions as below

> "The sharing that we are concerned with is not primarily file exchange but rather direct access to computers, software, data, and other resources, as is required by a range of collaborative problem solving and resource-brokering strategies emerging in industry, science, and engineering. This sharing is, necessarily, highly controlled, with resource providers and consumers defining clearly and carefully just what is shared, who is allowed to share, and the conditions under which sharing occurs. A set of individuals and/or institutions defined by such sharing rules form what we call a *virtual organization*."

The definition is centered on the concept of virtual organization, but it is not explicit enough to explain what the grid is. Foster then provide additional checklist as below to safeguard the possible logic pitfalls of the definition. Hereby, Grid is a system that:

1) *coordinates resources that are not subject to centralized control*

A Grid integrates and coordinates resources and users that live within different control domains—for example, the user's desktop vs. central computing; different administrative units of the same company; or different companies; and addresses the issues of security, policy, payment, membership, and so forth that arise in these settings. Otherwise, we are dealing with a local management system.

2) *using standard, open, general-purpose protocols and interfaces*

A. Grid is built from multi-purpose protocols and interfaces that address such fundamental issues as authentication, authorization, resource discovery, and resource access. As I discuss further below, it is important that these protocols and interfaces be *standard* and *open*. Otherwise, we are dealing with an application specific system.

3) *to deliver nontrivial qualities of service.*

A Grid allows its constituent resources to be used in a coordinated fashion to deliver various qualities of service, relating for example to response time, throughput, availability, and security, and/or co-allocation of multiple resource types to meet complex user demands, so that the utility of the combined system is significantly greater than that of the sum of its parts.

The definition of Grid thus far is well accepted and has been stably used up to now. The virtual organization (VO) has strong implication of community driven and collaborative sharing of distributed resources. The advance of development of optical fiber network in recent years plays a critical role of why Grids can be a reality. It is also the reason why now the computing paradigm shift to distributed/Grid computing.

Additionally, perhaps the most generally useful definition is that *a grid consists of shared heterogeneous computing and data resources networked across administrative boundaries.* Given such a definition, a grid can be thought of as both an access method and a platform, with grid middleware being the critical software that enables grid operation and ease-of-use.

The term "cloud computing" has been used to refer to different concepts, models, and services over the last few years. The definition for cloud computing provided by the National Institute of Standards and Technology (NIST) is well received in the IT community, which defines cloud computing as *a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort service provider interaction* (Peter Mell and Tim Grance, 2011). The model gains popularity in the industry for its emphasis on pay-as-you-go and elasticity, the ability to quickly expand and collapse the utilized service as demand requires. Thus new approaches to distributed computing and data analysis have also emerged in conjunction with the growth of cloud computing. These include models like MapReduce and scalable key-value stores like Big Table (Chang et al 2006).

From the high end computing perspective, Cloud computing technology allows users to have the ability to get on-demand access to resources to replace or supplement existing systems, as well as the ability to control the software environment. Yet the core competence still lies on the performance of financial calculation and further of the transactions of financial processes. This work will focus on the core competence in financial calculation based on Grid environment. Grid computing technology will be used to explain how the core financial calculations can be significantly accelerated in various distributed and parallel computing environments. The calculation models in this work can be easily migrated to pure cloud environments.

2.1.2 Essence of IT Technology

To realize the above goal, it needs to handle technically inter-operability of middleware that is capable of communicating between heterogeneous computer systems across institutional boundaries. The movement of Grid began in 1996 by Ian Foster and Kesseleman(2004). Before their development, another branch of high performance computing that focuses on connecting geographically distributed supercomputers to achieve one single grand task had been developed by Smarr and Catlett (1992). They coined such a methodology as metacomputing and their query has been how can we have infinite computing power under the physical limit, such as Moore's Law. However, it remains to be less useful because its limit goal on pursuing top performance without noticing practical use in real world. The idea lives on and generates many tools dedicated to high performance/throughput computing, such as Condor (Litzkow, Livny and Mutka, 1988), Legion(Grimshaw and Wulf, 1997) and UNICORE (Almond and Snelling,1999). Condor, as suggested by the name of the project, is devised to scavenge a large clusters of idle workstations. Legion is closer to the development of world-wide virtual computer. The goal of UNICORE is even much simpler and practical. It was developed due to Germany government decided to consolidate their 5 national supercomputer centers into a virtual one to reduce the management cost, and need a software tool to integrate them, hence the UNICORE. These tools were successful under their development scope. However they fail to meet the first and the second items in Foster's checklist in the previous section.

The emergency of Grids follows the similar path as that of Condor and Legion at the first place, which development aims at resources sharing in high performance computing. However, its vision in open standards and the concept of virtual organization allows its development go far beyond merely cluster supercomputers together. It gives a broader view of resources sharing, in which it is not only limited to the sizable computing cycles and storage space to be shared, but also extended virtually to calculable machines that are able to hook up to the internet, such as sensors and sensor loggers, storage servers, computers etc. Since 1996, Foster and his team have been developing software tools to achieve the purpose. Their software Globus Toolkit (Foster and Kesselman, 2004) is now a de facto middleware for Grids. However, the ambitious development is still considered insufficient to meet the ever growing complexity of grid systems.

As mentioned earlier that grid based on open specifications and standards, they allow all stakeholders within the virtual organization/grid to communicate with each other with ease and enable ones more to focus on integrated value creation activities. The open specifications and standards are made by the community of Open Grid Forum (OGF), which plays as a standard body and made, discussed and announced new standards during regular OGF meetings. Grid Specifications and Standards include Architecture, Scheduling, Resource Management, System Configuration, Data, Data movement, Security, Grid Security infrastructure. In 2004, OGF announced Globus Toolkit version, which adopt both the open standard of grid, Open Grid Services Architecture (OGSA), and the more widely adopted World Wide Web standard, Web services resrouce framework (WSRF), which ultimately enable grids to tackle issues of both scalability and complexity of very large grid systems.

2.2 Compute Intensive IT Systems

The recent development of computational finance based on grids is hereby scrutinized and remarks given. Our major interest is to see if the split second performance is well justified under the grid architecture. Also, real time issue with real market parametric data should be used as input for practical simulation. In addition, issues of inter-system, inter-disciplinary, geographically distribution of resources and the degree of virtualization are crucial to the success of such a grid. The chosen projects are reviewed and discussed as follow:

1.) PicsouGrid:
This is a French Grid Project for Financial Service. It provides a general framework for computation Finance and targets on applications of options trading, options pricing, Monte Carlo simulation, aggregation of statistics etc (Stokes-Rees et al, 2007). The key for this development is the implementation of the middleware ProActive. ProActive is an in-house Java library for distributed computing developed by INRIA Sophia Antipolis, France. It provides transparent asynchronous distributed method calls and is implemented on top of Java RMI. It is also used in commercial applications. It also provides fault tolerance mechanism. The architecture is shown in Fig. 2, which is very similar to most of grid applications apart from the software stack used. The option pricing was tested in an approximately 894 CPUs. The underlying computer systems are heterogeneous. The system is used for metacomputing. As a result, the system has to specifically design to orchestrate and to synchronize and re-synchronize the whole distributed processes for one calculation. Once the grid system require synchronization between processes, which imply stronger coupling of algorithm of interest, the performance will be seriously affected. There is no software treatment to solve such problems and should be tackled by physical infrastructure, e.g. optical fiber network with Layer 2 light path.

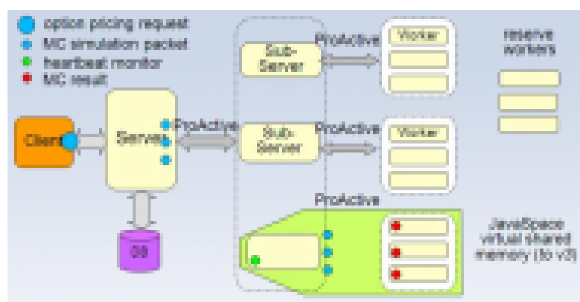

Fig. 2 Architecture of PicsouGrid for option pricing based on Monte Carlo simulation (Stokes-Rees, 2007).

2.) FinGrid:
FinGrid stands for Financial Information Grid. Its study includes components of bootstrapping, sentimental analysis and multi-scale analysis, which focusing on information integration and analysis, e.g. data mining. It takes advantage of the huge collection of numerical and textual data simultaneously to emphasize the study of societal issues (Amad et al, 2004, Ahmad et al, 2005, Gillam et al, 2005). The architecture of FinGrid is shown in Fig. 3. It is a typical 3 tiers system, in which the first tier facilitates the client in sending a request to one of the services: Text Processing Service or Time Series Service; the second tier facilitates the execution of parallel tasks in the main cluster and is distributed to a set of slave machines (nodes) and the third tier comprises the connection of the slave machines to the data providers. This work focuses on small scale and dedicated grid system. It pumps in real and live numerical and textual data from say Reuters and performs real

time sophisticated data mining analysis. This is a good prototype for Finanical grid. However, it will encountered similar problem as that of PicsouGrid if it is to scale up. The model is more successful in automatically combining real data and the analysis.

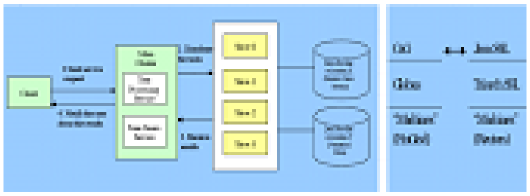

Fig. 3 The architecture of Financial Information Grid (FinGrid).

3.) IBM Japan collaborates with life insurance company and adopt PC grids concept to scavenge more compute cycles (Tanaka, 2003):

In this work an integrated risk management system (see Fig. 4) is modified, in which the future scenarios of red circle of Fig. 4 are send via Grid middleware to a cluster of PCs. According to the size of the given PCs, the number scenarios are then divided in a work balanced manner for each PC. This is the most typical use of compute intensive grid systems and a good practice for production system. However, the key issues that discussed in the above two cases cannot be answered in this study. Similar architecture can also be found in EGrid (Leto et al, 2005).

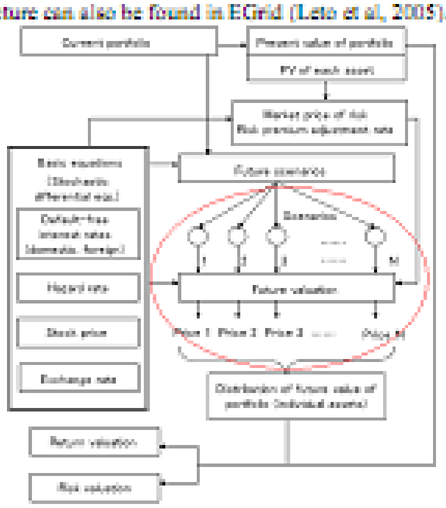

Fig. 4 Architecture of Integrated Risk Management System (Tanaka, S. 2003).

4.) UK e-Science developed a grid service discovery in the financial markets sector focusing on integration of different knowledge flows (Bell and Ludwig, 2005).

From application's viewpoint, business and technical architecture of financial service applications may be segmented by product, process or geographic concerns. Segmented inventories make inter silo re-use difficult. The service integration model is adopted and a loosely coupled inventory – containing differing explicit capability knowledge. Three use cases were specifically chosen in this work to explore the use of semantic searching:

Use-case 1 – Searching for trades executed with a particular counterparty

Use-case 2 – Valuing a portfolio of interest rate derivative products

Use-case 3 – Valuing an option based productThe use-cases were chosen to provide examples of three distinct patterns of use – aggregation, standard selection and multiple selection. The architecture (see Fig. 5) is bound specifically with the user-cases. The advantage for grid in this case is that it can be easily tailored into specific user need to integrate different applications, which is a crucial strength of using grid.

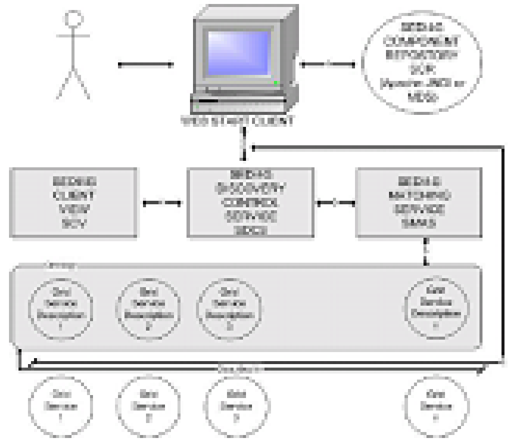

Fig. 5 The Semantic Discovery for Grid Services architecture (SEDI4G) (Bell and Ludwig 2005).

2.3 Data Intensive IT Systems

Grid in Financial Services from the perspective of web Services towards Financial Services Industry. The perspective is more on transactional side. Once the bottleneck of compute cycle is solved, the data-centric nature will play the key role again. The knowledge flows back to the customized business logic should provide the best path for users to access the live data of interest. There is no strong focus of development on this data intensive grid system. Even in FinGrid, which claims in streaming live data for real time analysis, the data issue remains part of compute grids. However, the need for dynamic data management is obvious as mentioned in (Amad et al, 2004). Hereby, we like to introduce and implement a dynamic data management software Ring Buffer Network Bus (RBNB) Dataturbine to serve such a purpose.

RBNB Dataturbine was used recently to support global environmental observatory network, which involves linking with ten of thousand of sensors and is able to obtain the observed data online. It meets grid/cyberinfrastructure (CI) requirements with regard to data acquisition, instrument management, and state-of-health monitoring including reliable data capture and transport, persistent monitoring of numerous data channels, automated processing, event detection and analysis, integration across heterogeneous resources and systems, real-time tasking and remote operations and secure access to system resources. To that end, streaming data middleware provides the framework for application development and integration.

Use cases of RBNB Dataturbine include adaptive sampling rates, failure detection and correction, quality assurance and simple observation (see Tilak et al, 2007). Real-time data access can be used to generate interest and buy-in from various stakeholders. Real-time streaming data is a natural model for many applications in observing systems, in particular event detection and pattern recognition. Many of these applications involve filters over data values, or more generally, functions over sliding temporal windows. The RBNB DataTurbine middleware provides a modular, scalable, robust environment while providing security, configuration management, routing, and data archival services. The RBNB DataTurbine system acts as an intermediary between dissimilar data monitoring and analysis devices and applications. As shown in Fig. 6 a modular architecture are used, in which a source or "feeder" program is a Java application that acquires data from an external live data sources and feeds it into the RBNB server. Additional modules display and manipulate data fetched from the RBNB server. This allows flexible configuration where RBNB serves as a coupling between relatively simple and "single purpose" suppliers of data and consumers of data, both of which are presented a logical grouping of physical data sources. RBNB supports the modular addition of new sources and sinks with a clear separation of design, coding, and testing (ref. Fig. 6). From the perspective of distributed systems, the RBNB DataTurbine is a "black box" from which applications and devices send data and receive data. RBNB DataTurbine handles all data management operations between data sources and sinks, including reliable transport, routing, scheduling, and security. RBNB accomplishes this through the innovative use of memory and file-based ring buffers combined with flexible network objects. Ring buffers are a programmer-configurable mixture of memory and disk, allowing system tuning to meet application-dependent data management requirements. Network bus elements perform data stream multiplexing and routing. These elements combine to support seamless real-time data archiving and distribution over existing local and wide area networks. Ring buffers also connect directly to client applications to provide streaming-related services including data stream subscription, capture, rewind, and replay. This presents clients with a simple, uniform interface to real-time and historical (playback) data.

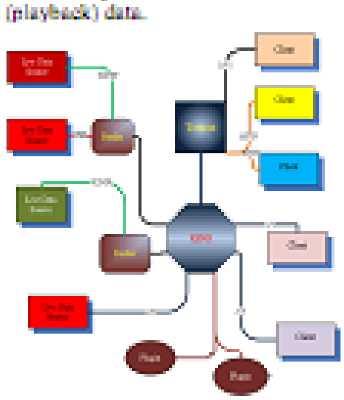

Fig. 6 RBNB DataTurbine use-scenario for collaborative applications.

3 Distributed and Parallel Financial Simulation

In the previous sections, we address issues of incorporating IT technology for financial competitiveness and derive that the core lies on the performance of IT platform, providing the competitors in the market have similar capacity and equally informed. Grid technology, as the leading IT development in high performance computing, is introduced as the cutting edge IT platform to meet our goal. Many companies have adopted similar technology of Grids with success as mentioned in Section 1. There are also increasing research interests, which result in the work discussed in Section 2.3. Better performance, however, cannot be achieved by merely using a single architecture as observed in the cases of Section 2.3. The architecture obviously has to be specifically chosen for the analysis of interest. Simultaneously, the analysis procedures have to be tailored into the chosen architecture for performance fine tune.

In this section, we will introduce and discuss analysis procedures of financial simulation and how to tailor the analysis procedures into grid architectures by distribution and parallelism. The popular calculations for option pricing and for value at risk (VaR) in trading practice are used to serve the purpose. The calculation is based on Monte Carlo simulation, which is chosen not only because it is a well received approach due to the absence of straightforward closed form solutions for many financial models, but also a numerical method intrinsically suited to mass distribution and mass parallelism. The success of Monte Carlo simulation lies on the quality of random number generator, which will be discussed in details at the end of the section.

3.1 Financial Simulation

There are wide variety of sophisticated financial models developed, to name a few, ranging from analysis in time series, fractals, nonlinear dynamics and agent-based modeling to applications in optional pricing, portfolio management and market risk measure etc (Schmidt, 2005), in which option pricing and VaR calculations of market risk measure can be considered crucial and one of the most practiced activities in market trading.

3.1.1 Option Pricing

An option is an agreement between two parties to buy or sell an asset at a certain time in the future for a certain price. There are two types of options:

Call Option: A call option is a contract that gives the right to its holder (i.e. buyer) without creating an obligation, to buy a pre-specified underlying asset at a predetermined price. Usually this right is created for a specific time period, e.g., six months, or more. If the option can be exercised only at its expiration (i.e. the underlying asset can be purchased only at the end of the life of the option) the option is referred to as an European style Call Option (Or European Call). If it can be exercised any date before its maturity, the option is referred to as an American style Call Option (or American Call).

Put Option: A put option is a contract that gives its holder the right without creating the obligation, to sell a pre-specified underlying asset at a predetermined price. If the option can be exercised only at its expiration (i.e. the underlying asset can be sold only at the end of the life of the option) the option is referred to as a European style Put Option (Or European Put). If it can be exercised any date before its maturity, the option is referred to as an American style Put option (or American Put).

To price options in computational finance, we use the following notation: K is the strike price; T is the time to maturity of the option; S_t is the stock price at time t; r is the risk-free interest rate; μ is the drift rate of the underlying asset (a measure of the average rate of growth of the asset price); σ is the volatility of the stock; V denotes the option value. Here is an example to illustrate the concept of option pricing. Suppose an investor enters into a call option contract to buy a stock at price K after three months. After three months, the stock price is S_t. If $S_t > K$ then one can exercise one's option by buying the stock at price K and by immediately selling in the market to make a profit of $S_T - K$. On the other hand, If he $S_T - K$ to be buy the stock. Hence, we see a call option to buy the stock at time T at price K will get payoff $(S_T - K)^+$,where $(S_T - K)^+ \equiv \max(S_T - K, 0)$ (Schmidt, 2005; Hull, 2003).

3.1.2 Market Risk Measurement based on VaR

Market risks are the prospect of financial losses , or gains, due to unexpected changes in market prices and rates. Evaluating the exposure to such risks is nowadays of primary concern to risk managers in financial institutions. Until late 1980s market risk were estimated through gap and duration analysis (interest rates), portfolio theory (securities), sensitivity analysis (derivatives) or scenarios analysis. However, all these methods either could be applied only to very specific assets or relied on subjective reasoning.

Since the early 1990s a commonly used market risk estimation methodology has been the Value at Risk (VaR). A VaR measure is the highest possible loss L incurred from holding the current portfolio over a certain period of time at a given confidence level (Dowd, 2002)

$$P(L > VaR) \leq 1 - c \qquad (1)$$

where c is the confidence level, typically 95%, 97.5% or 99% and P is cumulative distribution function. By convention, $L = -\Delta X(\tau)$, where $\Delta X(\tau)$ is the relative change (return) in portfolio value over the time horizon τ. Hence, large values of L correspond to large losses (or large negative returns).

The VaR figure has two important characteristics: 1) it provides a common consistent measure of risk across different positions and risk factors and 2) it takes into account the correlations or dependencies between different risk factors. Because of its intuitive appeal and simplicity, it is no surprise that in a few years Value at Risk has become the standard risk measure used around the world. However, VaR has a few deficiencies, among them the non-subadditivity – a sum of VaR's two portfolios can be smaller than the VaR of the combined portfolio. To cope with these shortcomings, Artzner et al proposed an alternative measure that satisfies the assumptions of a coherent risk measure. The Expected Shortfall (ES), also called Expected Tail Loss (ETL) or Conditional VaR, is the expected value of the losses in excess of VaR:

$$ES = E(L|L > VaR) \qquad (2)$$

It is interesting to note, that although new to the finance industry – Expected Shortfall has been familiar to insurance practitioners for a long time. It is very similar to the mean excess function which is used to characterize claim size distribution, see (Cizek et al, 2004)

The essence of the VaR and ES computations is estimation of low quantiles in the portfolio return distributions. Hence, the performance of market risk measurement methods depends on the quality of distribution assumptions on the underlying risk factors. Many of the concepts in theoretical and empirical finance developed over the past decades, including the classical portfolio theory, the Black-Scholes-Merton option pricing model and even the RiskMetrics variance-covariance approach to VaR rest upon the assumption that asset returns follow a normal distribution. The assumption is not justified by real market data. Our interest is more on the calculation side. For interested readers we refer further to (Weron, 2004).

3.2 Monte Carlo Simulations

3.2.1 Monte Carlo and Quasi-Monte Carlo Methods

In general, Monte Carlo (MC) and Quasi-Monte Carlo (QMC) methods are applied to estimate the integral of function $f(x)$ over $[0,1]^d$ unit hypercube where d is the dimension of the hypercube.

$$I = \int_{[0,1]^d} f(x)dx \qquad (3)$$

In MC methods, I is estimated by evaluating $f(x)$ at N independent points randomly chosen from a uniform random distribution over $[0,1]^d$ and then evaluating average

$$\hat{I} = \frac{1}{N}\sum_{i=1}^{N} f(x_i) \qquad (4)$$

From the law of large numbers, $\hat{I} \to I$ as $N \to \infty$. The standard deviation is

$$\sqrt{\frac{1}{N-1}\sum_{i=1}^{N}(f(x_i) - I)^2} \qquad (5)$$

Therefore, the error of MC methods is proportional to $N^{-1/2}$.

QMC methods compute the above integral based on low-discrepancy (LD) sequences. The elements in a LD sequence are "uniformly" chosen from $[0,1]^d$ rather than "randomly". The discrepancy is a measure to evaluate the uniformity of points over $[0,1]^d$. Let $\{q_n\}$ be a sequence in $[0,1]^d$, the discrepancy D_N^* of q_n is defined as follows, using Niederreiter's notation (Niederreiter, 1992).

$$D_N^*(q_n) = \sup_{B \in [0,1]^d} \left|\frac{A(B, q_n)}{N} - v_d(B)\right| \qquad (6)$$

Where B is a subcube of $[0,1]^d$ containing the origin, $A(B, q_n)$ is the number of points in q_n that fall into B, and $v_d(B)$ is the d -dimensional Lebesgue measure of B. The elements of q_n is said uniformly distributed if its discrepancy $D_N^* \to 0$ as $N \to \infty$. From the theory of uniform distribution sequences (Kuipers and Niederreiter, 1974), the estimate of the integral using a uniformly distributed sequence $\{q_n\}$ is $\hat{I} = \frac{1}{N}\sum_{n=1}^{N} f(q_n)$, as $N \to \infty$ then $\hat{I} \to I$. The integration error bound is given by the Koksma-Hlawka inequality:

$$\left|I - \frac{1}{N}\sum_{n=1}^{N} f(q_n)\right| \leq V(f)\, D_N^*(q_n) \qquad (7)$$

where $V(f)$ is the variation of the function in the sense of Hardy and Krause (see Kuipers and Niederreiter, 1974), which is assumed to be finite.

The inequality suggests a smaller error can be obtained by using sequences with smaller discrepancy. The discrepancy of many uniformly distributed sequences satisfies $O((\log N)^d/N)$. These sequences are called lowdiscrepancy (LD) sequences (Chen et al, 1006). Inequality (7) shows that the estimates using a LD sequence satisfy the deterministic error bound $O((\log N)^d/N)$.

3.2.2 Monte Carlo Simulations for Option Pricing

Under the risk-neutral measure, the price of a fairly valued European call option is the expectation of the payoff

$E[e^{-rT}(S_T - K)^+]$. In order to compute the expectation, Black and Scholes (1973) modeled the stochastic process generating the price of a non-dividend-paying stock as geometric Brownian motion:

$$dS_t = \mu S_t dt + \sigma S_t dW_t \qquad (8)$$

where W is a standard Wiener Process, also known as Brownian motion. Under the risk-neutral measure, the drift μ is set to $\mu = r$.

To simulate the path followed by S, suppose the life of the option has been divided into n short intervals of length $\Delta t (\Delta t = T/n)$, the updating of the stock price at $t + \Delta t$ from t is (Hull, 2003):

$$S_{t+\Delta t} - S_t = r S_t \Delta t + \sigma S_t Z \sqrt{\Delta t} \qquad (9)$$

Where Z is a standard random variable, i.e. $Z \sim (0,1)$. This enables the value of $S_{\Delta t}$ to be calculated from initial Value S_t at time Δt, the value at time $2\Delta t$ to be calculated from $S_{\Delta t}$, and so on. Hence, a completed path for S has been constructed.

In practice, in order to avoid discretization errors, it is usual to simulate $\ln S$ rather than S. From Itô's lemma, the process followed by of (9) is (Bratley and Fox, 1988):

$$d\ln S = \left(r - \frac{\sigma^2}{2}\right)dt + \sigma dz \qquad (10)$$

so that

$$\ln S_{t+\Delta t} - \ln S_t = \left(r - \frac{\sigma^2}{2}\right)dt + \sigma Z\sqrt{\Delta t} \qquad (11)$$

or equivalently:

$$S_{t+\Delta t} = S_t \exp\left[\left(r - \frac{\sigma^2}{2}\right)dt + \sigma Z\sqrt{\Delta t}\right] \qquad (12)$$

Substituting independent samples $Z_1, \cdots, Z_n$ from the normal distribution into (12) yields independent samples $S_T{}^{(i)}$, $i = 1, \cdots, n$, of the stock price at expiry time T. Hence, the option value is given by

$$V = \frac{1}{n}\sum_{i=1}^{n} V_i = \frac{1}{n}\sum_{i=1}^{n} e^{-rT}\max\left[S_T{}^{(i)} - K, 0\right] \qquad (13)$$

The QMC simulations follow the same steps as the MC simulations, except that the pseudo-random numbers are replaced by LD sequences. The basic LD sequences known in literature are Halton (1960), Sobol (1967) and Faure (1982). Niederreiter (1992) proposed a general principles of generating LD sequences. In finance, several examples have shown that the Sobol sequence is superior to others. For example, Galanti and Jung (1997) observed that "the Sobol sequence outperforms the Faure sequence, and the Faure marginally outperforms the Halton sequence. In this research, we use Sobol sequence in our experiments. The generator used for generating the Sobol sequence comes from the modified algorithm 659 of Joe and Kuo (2003).

3.2.3 Monte Carlo Bootstrap for VaR

Monte Carlo simulation is applicable with virtually any model of changes in risk factors and any mechanism for determining a portfolio's value in each market scenario. But revaluing a portfolio in each scenario can present a substantial computational burden, and this motivates research into ways of improving the efficiency of Monte Carlo methods for VaR.

The bootstrap (Efron, 1981; Efron and Tibshirani, 1986) is a simple and straightforward method for calculating approximated biases, standard deviations, confidence intervals, and so forth, in almost any nonparametric estimation problem. Method is a key word here, since little is known about the bootstrap's theoretical basis, except that (a) it is closely related to the jackknife in statistic inferring; (b) under reasonable condition it gives asymptotically correct results; and (c) for some simple problems which can be analyzed completely, for example, ordinary linear regression, the bootstrap automatically produces standard solutions.

The bootstrap method is straightforward. Suppose we observe returns $X_i = x_i$, $i = 1, 2, \cdots, n$, where the X_i are independent and identically distributed (iid) according to some unknown probability distribution F. The X_i may be real valued, two-dimensional, or take values in a more complicated space. A given parameter $\theta(F)$, perhaps the mean, median, correlation, and so forth, is to be estimated, and we agree to use the estimate $\hat{\theta} = \theta(\hat{F})$, where $\hat{F}$ is the empirical distribution function putting mass $1/n$ at each observed value x_i. We wish to assign some measure of accuracy to $\hat{\theta}$.

Let $\sigma(F)$ be some measure of accuracy that we would use if F were known, for example $\sigma(F) = SD_F(\hat{\theta})$, the standard deviation of $\hat{\theta}$ when $X_1, X_2, \cdots, X_n \sim F^{(iid)}$. The bootstrap estimate of accuracy is $\hat{\sigma} = \sigma(\hat{F})$ is the nonparametric maximum likelihood estimate of $\sigma(F)$. In order to calculate $\hat{\sigma}$ it is usually necessary to employ numerical methods. (a) A bootstrap sample $X_1^*, X_2^*, \cdots, X_n^*$ is drawn from $\hat{F}$, in which each X_i^* independently takes value x_j with probability $1/n$, $j = 1, 2, \cdots, n$. In other words, $X_1^*, X_2^*, \cdots, X_n^*$ is an independent sample of size n drawn with replacement from the set of observations $\{x_1, x_2, \cdots, x_n\}$. (b) This gives a bootstrap empirical distribution function $\hat{F}^*$, the empirical distribution of the n values $X_1^*, X_2^*, \cdots, X_n^*$, and a corresponding bootstrap value $\hat{\theta}^* = \theta(\hat{F}^*)$. (c) Steps (a) and (b) are repeated, independently, a large number of times, say N, giving bootstrap values $\hat{\theta}^{*1}, \hat{\theta}^{*2}, \cdots, \hat{\theta}^{*N}$. (d) The value of $\hat{\sigma}$ is approximated, in the case where $\sigma(F)$ is the standard deviation by the sample standard deviation of the $\hat{\theta}^*$ values, where

$$\hat{\mu} = \frac{\sum_{j=1}^{N} \hat{\theta}^{*j}}{N} \qquad (14)$$

And

$$\hat{\sigma}^2 = \frac{\sum_{j=1}^{N}\left(\hat{\theta}^{*j} - \hat{\mu}\right)^2}{N - 1} \qquad (15)$$

3.3 Distribution and Parallelism based on Random Number Generation

Financial variables, such as prices and returns, are random time dependent variables. Wiener process plays the central role in modeling. As shown in (8) and (9) for approximating the underlying prices $S_{t+\Delta t}$, or the bootstrap samples of return X_i^*, The solution methods involve basic market parameters, drift μ, volatility σ and risk-free interest rate r, current underlying price S or return X, strike price K, and Wiener process, which is related to time to maturity Δt and standard random variable Z, i.e. $\Delta W = Z\sqrt{\Delta t}$. Monte Carlo methods simulate this nature of the Brownian motion directly. It follows Wiener process and approximates the standard random variable Z by introducing pseudo iid random number into each Wiener process. When the simulation number is large enough, e.g. if n in (13) is large enough, the mean value will approach the exact solution. The large number for n also implies the performance problems are the key problems for Monte Carlo methods. One the other hand, the *iid* property of the random number Z shows possible solution to tackle the performance problem through mass distribution and/or parallelism. The solution method centers on the random number generation.

The techniques of random number generation can be developed in a simple form through the approximation of a d-dimensional integral, e.g. (3). Mass distribution and parallelism required solutions of for large dimension. However, most modern techniques in random number generation have limitations. In this study, both tradition pseudo random number generation and high dimensional low discrepancy random number generator are considered.

Following Section 3.2.1 better solution can be achieved by making use of Sobol sequences, which were proposed by Sobol (1967). A computer implementation in Fortran 77 was subsequently given by Bratley and Fox (1988) as Algorithm 659. Other implementations are available as C, Fortran 77, or Fortran 90 routines in the popular Numerical Recipes collection of software. However, as given, all these implementations have a fairly heavy restriction on the maximum value of d allowed. For Algorithm 659, Sobol sequences may be generated to approximate integrals in up to 40 dimensions, while the Numerical Recipes routines allow the generation of Sobol sequences to approximate integrals in up to six dimensions only. The FinDer software of Paskov and Traub (1995) provides an implementation of Sobol sequences up to 370 dimensions, but it is licensed software. As computers become more powerful, there is an expectation that it should be possible to approximate integrals in higher and higher dimensions. Integrals in hundreds of variables arise in applications such as mathematical finance (e.g., see Paskov and Traub(1995)). Also, as new methods become available for these integrals, one might wish to compare these new methods with Sobol sequences. Thus, it would be desirable to extend these existing implementations such as Algorithm 659 so they may be used for higher-dimensional integrals.We remark that Sobol sequences are now considered to be examples of (t, d)-sequences in base 2. The general theory of these low discrepancy (t, d)-sequences in base b is discussed in detail in Niederreiter (1992). The generation of Sobol sequences is clearly explained in Bratley and Fox (1988). We review the main points so as to show what extra data would be required to allow Algorithm 659 to generate Sobol sequences to approximate integrals in more than 40 dimensions. To generate the j th component of the points in a Sobol sequence, we need to choose a primitive polynomial of some degree s_j in the field $\mathbb{Z}_2$ that is, a polynomial of the form

$$x^{s_j} + a_{1,j}x^{s_j-1} + \cdots + a_{s_j-1,j}x + 1, \qquad (16)$$

where the coefficients $a_{1,j}, \cdots, a_{s_j-1,j}$ are either 0 or 1.

We use these coefficients to define a sequence $\{m_{1,j}, m_{2,j}, \cdots\}$ of positive integers by the recurrence relation

$$\begin{aligned} m_{k,j} &= a_{1,j}m_{k-1,j} \oplus 2^2 a_{2,j}m_{k-2,j} \oplus \cdots \\ &\oplus 2^{s_j-1}a_{s_j-1,j}m_{k-s_j+1,j} \oplus 2^{s_j}a_{s_j,j}m_{k-s_j,j} \\ &\oplus m_{k-s_j,j} \end{aligned} \qquad (17)$$

for $k \geq s_j + 1$, where $\oplus$ is the bit-by-bit exclusive-OR operator. The initial values $m_{1,j}, m_{2,j}, \cdots, m_{s_j,j}$ can be chosen freely provided that each $m_{k,j}$, $1 \leq k \leq s_j$ is odd and less than 2^k. The "direction numbers" $\{v_{1,j}, v_{2,j}, \cdots\}$ are defined by

$$v_{k,j} \equiv \frac{m_{k,j}}{2^k} \qquad (18)$$

Then $x_{i,j}$, the j th component of the ith point in a Sobol sequence, is given by

$$x_{i,j} = b_1 v_{1,j} \oplus b_2 v_{2,j} \oplus \cdots \qquad (19)$$

where b_l is the lth bit from the right when i is written in binary, that is, $(\cdots b_2 b_1)_2$ is the binary representation of i. In practice, a more efficient Gray code implementation proposed by Antonov and Saleev (1979) is used; see Bratley and Fox (1988) for details. We then see that the implementation in Bratley and Fox (1988) may be used to generate Sobol sequences to approximate integrals in more than 40 dimensions by providing more data in the form of primitive polynomials and direction numbers (or equivalently, values of $m_{1,j}, m_{2,j}, \cdots, m_{s_j,j}$). When generating such Sobol sequences, we need to ensure that the primitive polynomials used to generate each component are different and that the initial values of the $m_{k,j}$'s are chosen differently for any two primitive polynomials of the same degree. The error bounds for Sobol sequences given in Sobol (1967) indicate we should use primitive polynomials of as low a degree as possible. We discuss how additional primitive polynomials may be obtained in the next section. After these primitive polynomials have been found, we need to decide upon the initial values of the $m_{k,j}$ for $1 \leq k \leq s_j$. As explained above, all we require is that they be odd and that $m_{k,j} < 2^k$. Thus, we could just choose them randomly, subject to these two constraints. However, Sobol (1988) introduced an extra uniformity condition known as Property A. Geometrically, if the cube $[0,1]^d$ is divided up by the planes $x_j = 1/2$ into 2^d equally sized subcubes, then a sequence of points belonging to $[0,1]^d$ possesses Property A if, after dividing the sequence into consecutive blocks of 2^d points, each one of the points in any block belongs to a different subcube. Property A is not that useful to have for large d because of the computational time required to approximate an integral using 2^d points. Also, PropertyA is not enough to ensure that there are no bad correlations between pairs of dimensions. Nevertheless, Property A would seem a reasonable criterion to use in deciding upon a choice of the initial $m_{k,j}$. The numerical results for Sobol sequences given in Section 4 suggest that the direction numbers obtained here are indeed reasonable. Otherways of obtaining the direction numbers are also possible. For example, in Cheng and Druzdzel (2000), the initial direction numbers are obtained by an interesting technique of minimizing a measure of uniformity in two dimensions. This technique may alleviate the problem of bad correlations between pairs of dimensions that was mentioned above. Sobol (1967) showed that a Sobol sequence used to approximate a d dimensional integral possesses Property A if and only if

$$\det(V_d) = 1 \pmod 2, \qquad (20)$$

where V_d is the $d \times d$ binary matrix defined by

$$V_d = \begin{bmatrix} v_{1,1,1} & v_{2,1,1} & \cdots & v_{d,1,1} \\ v_{1,2,1} & v_{2,2,1} & \cdots & v_{d,2,1} \\ \vdots & & \ddots & \vdots \\ v_{1,d,1} & v_{2,d,1} & \cdots & v_{d,d,1} \end{bmatrix} \qquad (21)$$

with $v_{k,j,1}$ denoting the first bit after the binary point of $v_{k,j}$. The primitive polynomials and direction numbers used in Algorithm 659 are taken from Sobol and Levitan (1976) and a subset of this data may be found in Sobol (1967). Though it is mentioned in Sobol (1967) that Property A is satisfied for $d \leq 16$, that is, $\det(V_d) = 1 \pmod 2$ for all $d \leq 16$, our calculations showed that Property A is actually satisfied for $d \leq 16$. As a result, we change the values of the $m_{k,j}$ for $21 \leq j \leq 40$, but keep the primitive polynomials. For $j \geq 41$, we obtain additional primitive polynomials. The number of primitive polynomials of degree s is $\phi(2^s - 1)/s$, where ϕ is Euler's totient function. Including the special case for $j = 1$ when all the $m_{k,j}$ are 1, this allows us to approximate integrals in up to dimension $d = 1111$ if we use all the primitive polynomials of degree 13 or less. We then choose values of the $m_{k,j}$ so that we can generate Sobol sequences satisfying Property A in dimensions d up to 1111. This is done by generating some values randomly, but these are subsequently modified so that the condition $\det(V_d) = 1 \pmod 2$ is satisfied for all d up to 1111. This process involves evaluating values of the $v_{k,j,i}$'s to obtain the matrix V_d and then evaluating the determinant of V_d. A more detailed discussion of this strategy is given in the next section. It is not difficult to produce values to generate Sobol's points for approximating integrals in even higher dimensions.

The following figures is the two dimensional plots of high dimension Sobol sequences of Joe and Kuo with $d = 1000$. It is compared with pseudo random number generation. The number of sampling points is 3000. In Fig. 7 pseudo random number is plotted in comparison with that of quasi-random number of Sobol. The leading dimensions 1 and 2 of Sobol sequences are used. The improvement is immense. In order to understand more of the nature of Sobol sequences, we chose prime dimensional numbers 499, 503, 991 and 997 respectively as suggested by Joe and Kuo. The results are plotted in Fig. 8 and Fig. 9. It is found that there are stronger correlations between Sobol sequences of non-adjacent dimensions in the fashion of the dimensional comparison of their randomness. Larger numbers of sampling points, e.g. 10,000, are also tested and the patterns persist. It implied the violation of *iid* assumption and may incur problems in mass distribution and parallelism, in which each process the random number is generated independently without knowing what other processes are doing. The dependency may deteriorate the quality of randomness. Nevertheless, in our numerical experiments there are no significant differences found thus far.

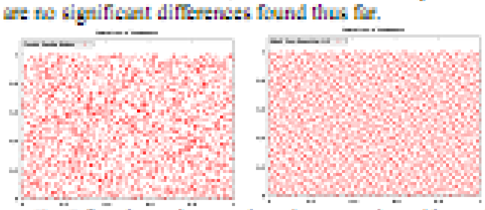

Fig. 7 Pseudo random number plot comparing with quasi-random number of Sobol for dimensions 1 and 2.

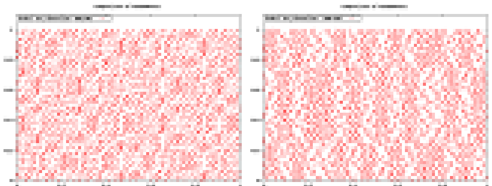

Fig. 8 Comparison of adjacent dimensions in Quasi-random number Sobol sequence. The dimensions are chosen according to prime numbers. There are high discrepancy found in higher dimensions of Sobol sequence modified by Joe and Kuo (2003).

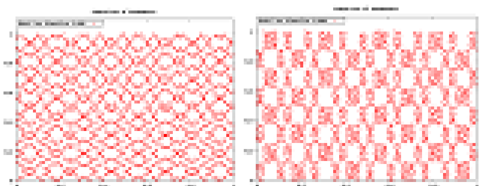

Fig. 9 Comparison of non adjacent dimensions. High discrepancy is found in their correlations and forms clusters of islands in the distribution.

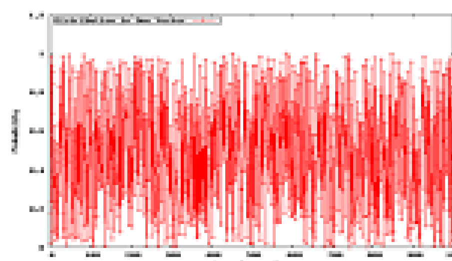

Fig. 10 The distribution of probability in directional vector $v_{i,j}$ of Sobol sequences at i=3000 with $j \in \{1, \cdots, 1000\}$. The mean of the distribution is 0.491357, which approaches the mean of the normal distribution 0.5.

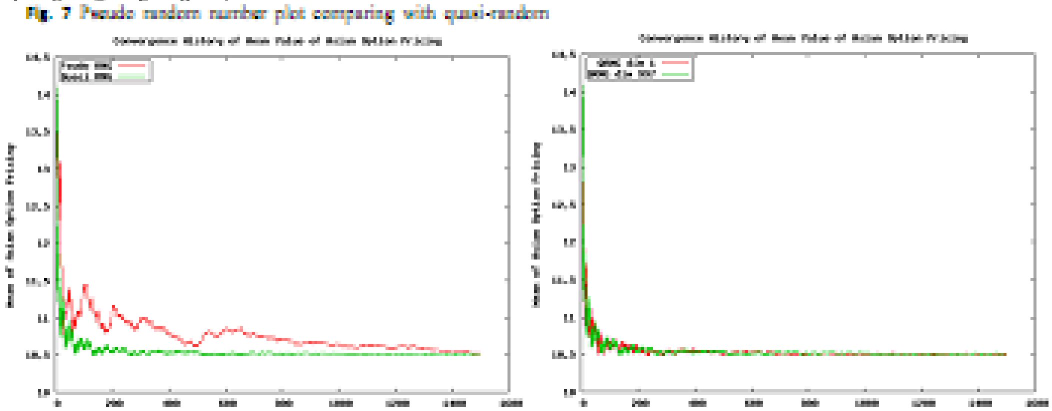

Fig. 11 The convergence history of the mean value of Asian option pricing with risk-free interest rate r=0.1, underlying asset spot price S=100, strike price X=100, duration to maturity T=1 and volatility σ =0.3: The comparison is based

on a single dimension of the extended high-dimensional Sobol sequences. The quasi random number generator (QRNG) outperforms pseudo random number generator. The test also is conducted to compare the convergence history between different dimensions in Sobol sequences and found all perform consistently as shown in the right figure, in which the low dimension and high dimension are chosen for the comparison.

4 Cases Study and Discussions

4.1 Cases Study

Asian Options and Rainbow Options

To demonstrate what the grid computing can contribute to the financial service in a significant manner, two kinds of popular options, Asian options and rainbow options, are chosen for Monte Carlo pricing model. Asian options have payoffs that depend on the average price of the underlying asset such as stocks, commodities, or financial indices. However, there is no exact closed-form formula existed for these popular options. Rainbow options, also known as basket options, is referred to an entire class of options which consist of more than one underlying asset. Rainbow options are usually calls or puts on the best or worst of the underlying assets, or options which pay the best or worst of the assets. They are excellent tools for hedging risk of multiple assets. The rainbow options are therefore used for our bootstrap calculations of VaR.

Parallelization, Distribution and Message Passing Interface (MPI)

MPI is a library specification for message passing, proposed and developed as a standard by a broadly based committee of vendors, developers and users (Snir et al, 1996). MPI was designed for high performance on both massively parallel machines and on distributed clusters. The MPI standard is nowadays widely accepted and used in the community of high performance computing.

The basic MPI functions are point-to-point pair-wise message passing for send and for receive. Collective communications are also provided for ease of use as well as better performance. These communication methods, when used in supercomputers, do facilitate the parallelization of numerical methods that require both heavy compute cycles and stronger dependency between parallel processes.

Recent development of supercomputer, affected by the popularity of cluster computing in PCs, tends to be designed hierarchically scalable. Further extension of clusters of supercomputers can be regarded as initial concept of grids (see Section 2). The use of MPI is straightforward in this kind of hardware architecture and interlink of networks. There is always an obvious physical limitation in this architecture, which is also proportional to the limitation of the investment of governmental research funding. People tend to use mass distribution of computers, mostly PCs, which linked loosely in internet cloud. The terminology cloud is often used in networking community to show that in internet there is no specific network path from one computer to another. MPI working in such an environment is expected to be inefficient and unstable, e.g. high network latency induced packet lost in long distance real time communication. In the following sections three specific platforms, including local clusters, geographically distributed large clusters, and PC grids with ten of thousand PCs connected in the cloud, will be used for the financial calculations to demonstrate benefits in using grids.

Empirical Study for Data Grid System

In order to demonstrate the usefulness of grid system, in particular in data-intensive application, the real market data are used, including daily from iShares (Morgan Stanley Capital International) MSCI Taiwan Index (ETF) and Taiwan Stock Exchange Center (TSEC) weighted index, extracted specifically from May 31, 2005 to May 31, 2008, and 30 days tick-by-tick trading data from Taiwan Futures Exchange Center (TAIFEX).

4.2 Grid Platforms Tests

The various grid platforms are carefully chosen to demonstrate the performance issue in finance services, which include a small diskless remote boot Linux (DBRL) PC clusters, large scale and geographically widely distributed test-bed the Pacific Rim Applications and Grid Middleware Assembly (PRAGMA) compute grid, and a densely distributed at-home style PC grid, which resembles the clouding computing.

4.2.1 Diskless Remote Boot Linux (DRBL) Cluster

DRBL is an in-house program of National Center for High-Performance Computing (NCHC) and was an original software product developed by Steven Shiau and his group under the auspice of National Knowledge Innovation Grid (KING) of Taiwan. It was developed initially as a centralized system management tool aiming at small and median size of PC clusters. It is nowadays recognized internationally as one of the most advanced mass backup solutions. Here DRBL is used as an alternative scavenger for compute cycles of spare clusters. When needed, it converts systems of PC clusters into an aggregated and homogenous Linux system, simultaneously with a mass backup of the original systems, and recovery back the original systems once the need satisfied. The most popular use is to convert a PC classroom into a compute linux cluster. In such a case, compute cycles of the clusters can be fully exploited. In a grid environment, this is a perfect case to resources scale-up when in contingent need and once the situation relieved resources will be released correspondingly. Such a dynamic feature can be beneficial for the financial services.

The schematic of DRBL system can be shown in Fig. 12, where DRBL duplicates image files of an operational system, e.g. Linux kernel, via network to the clients. The clients' original operational systems are not used. The clients are therefore temporarily turned into dedicated compute resources, which also provide additional security to financial data.

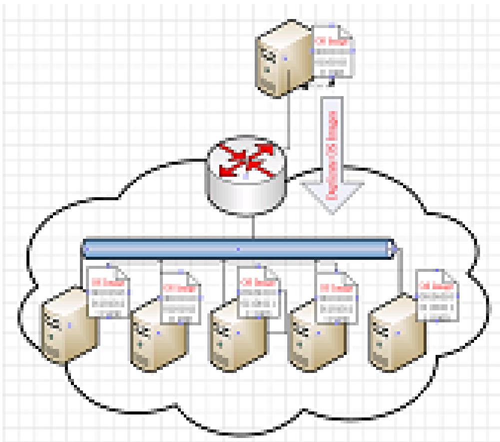

Fig. 12 The schematic of DRBL system: DRBL duplicates image files of operational system via network to the clients, in which the clients' original operational systems are untouched. Therefore, the clients are temporarily turned into dedicated compute resources, which also provide additional security to financial data.

The test case here involves Monte Carlo simulations on Asian option pricing, on rainbow option pricing and on a bootstrap VaR calculation respectively (see Section 3.2). The market parameters are given as risk-free interest rate r=0.1, underlying asset spot price S =100, strike price X=100, duration to maturity T=125 and volatility σ =0.3. For the rainbow options a linear weighted combination of 4 underlying assets is assumed with underlying prices of S_i=100, 110, 120, 130 and the corresponding weightings of volatility σ_i = 0.3, 0.4, 0.5, 0.6. The correlation matrix is taken to be

$$\rho_{ij} = \begin{pmatrix} 0.5 & 0.4 & 0.5 \\ 0.4 & 0.3 & 0.4 \\ 0.5 & 0.4 & 0.6 \end{pmatrix}.$$

The calculation of the VaR uses the same 4 dimensional rainbow options with additional expectation of return 0.07, 0.08, 0.09 and 0.10 respectively. They are calculated in DRBL cluster as well as benchmarked with two cluster-based supercomputers in NCHC. The results are shown in Table 1 and Table 2.

Table 1 Comparison of performance between DRBL-based PC platform with 32 nodes, FORMOSA II of NCHC with a batch job of 32 nodes and IBM Cluster 1350 with a batch job of 32 nodes. The PCs are 20 XEON 2.6 GHz and 4GB RAM.

	DRBL Cluster	FORMOSA II	IBM Cluster 1350
Asian Option Pricing (AOP)	81	49	24
Rainbow Option Pricing (ROP)	329	197	98
VaR Calculation (based on ROP w/ Bootstrap)	322	194	97

Unit: micro-secs per Monte Carlo path. Averaged from 1000,000 Monte Carlo paths.

Table 2 Comparison of Speedup ratios based on the calculations in Table 1.

	DRBL Cluster	FORMOSA II	IBM Cluster 13 50
Asian Option Pricing (AOP)	28.68	29.46	30.16
Rainbow Option Pricing (ROP)	27.31	28.59	29.34
VaR Calculation (based on ROP w/ Bootstrap)	27.20	28.10	29.10

Unit: Speedup Ratio:CPU(non-parallel single node)/CPU(parallel single node)

In Table 1, instead of giving a total wall clock time of the calculation with some given numbers of Monte Carlo simulations or paths, a more useful averaged single Monte Carlo simulation based on 1,000,000 simulations is used to demonstrate the performance when different system architectures are used. The results show that the traditional big irons, i.e. supercomputers, still outperform the cluster. Yet, considering there are no extra cost invested in the computing resources and still obtain compute cycle in a sizable manner, the approach is appealing to be further developed in to a fully operational production system.

4.2.2 Pacific Rim Applications and Grid Middleware Assembly (PRAGMA) Grid

The Pacific Rim Applications and Grid Middleware Assembly (PRAGMA), founded in 2002, is an open international organisation that focuses on a variety of practical issues of building international scientific collaborations in a number of application areas. PRAGMA Grid is established by the resources and data computing working group of Group as a global grid testbed for benchmarking the interoperability of grid middleware and the usability and productivity of grids. The PRAGMA Grid consists of physical resources as well as system administration supports from 29 institutions across 5 continents and 14 countries. It is an instantiation of a useful, interoperable, and consistently available grid system that is neither dictated by the needs of a single science domain, nor funded by a single national agency. It does not have uniform infrastructure management, yet robust and supports a wide range of scientific applications. The software stack of the system is shown in Fig. 12.

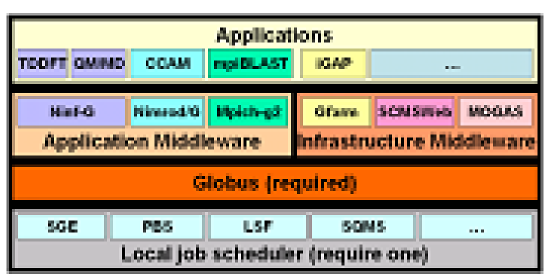

Fig. 13 Software stack developed in the PRAGMA grid.

The PRAGMA grid successfully tackle the issues of distance and time zone differences among sites, lack of infrastructure tools for heterogeneous global grid, non-uniform system and network environments, and diverse application requirements. For more technical details both in theory and practice we refer to (Abramson et al, 2006).

Table 3 Comparison of performance between Group A, which consists of 13 nodes from NCHC and 15 from UCSD, and Group B, which consists of 122 nodes collectively from UCSD, AIST, NCHC and Osaka University. The details of resources are referred to (http://pragma-goc.rocksclusters.org/pragma-doc/resources.html).

	Group A.	Group B
Asian Option Pricing (AOP)	68	56
Rainbow Option Pricing (ROP)	278	234
VaR Calculation (based on ROP w/ Bootstrap)	271	229

Unit: secs/per Monte Carlo path. Averaging from 1000,000 Monte Carlo paths

Table 4 Comparison of Speedup ratios based on the calculations in Table 3.

	Group A.	Group B
Asian Option Pricing (AOP)	25.24	107.98
Rainbow Option Pricing (ROP)	25.81	110.34
VaR Calculation (based on ROP w/ Bootstrap)	25.63	110.09

Unit: secs/per Monte Carlo path. CPU(non-parallel single node)/CPU(parallel single node)

Following the similar test case in Section 4.2.2, but extended the platform with a collection of clusters across institute boundaries. The common job submission is executed via a homogeneous middleware Globus Toolkit. We demonstrate the usefulness of the platform by grouping compute resources across national boundaries and still achieve good performance. The results are shown in Table 3 and Table 4.

4.2.3 At-Home Style PC Grid

While the continued penetration of personal computers and the remarkable improvement of CPU processing speed, 80 to 90 percent of most PCs' processing power is untapped, according to a study. This does not mean that many PCs remain turned off, but that the capacity of the CPU, the brain of the PC, is not fully utilized. In case the CPU is more extensively used when a task requiring an enormous number of operations, such as three-dimensional graphical processing, is assigned, it sits idle most of the time during word processing and Internet browsing because CPU processing speeds are much faster than the speeds of input from the keyboard or the communication line.

This fact led to the idea of virtually gathering the power of idle CPUs to use as a computer resource. In other words, this means networking numerous computers to make them work like a single high performance computer, and assigning complex processing tasks to it. The assigned task will be divided into a myriad of small tasks and allocated to individual computers on the grid-like network. Even when increasingly faster CPUs, the power of PCs are not comparable to those of supercomputers, but in a networked environment where individual PCs simply process complex task in parallel, PCs can deliver surprisingly high performance. This is the core concept of CP grid computing, and it came into a reality several years ago.

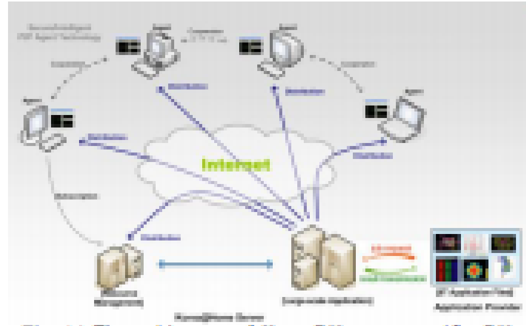

Fig. 14 The architecture of Korea@Home, a specific @Home style PC Grid used in our case study (Jun-Weon Yoon, 2008).

Table 5 Summary of the case for the PC Grid calculations.

Asian Option Pricing	Statistics
Number of Monte Carlo Path	1,000,000 x 10,000
The running period (1) (Wall clock time)	28h 51m (104911s)
Number of jobs	10,000
CPU time per job	28"30s
Total running time (2) (Wall clock time)	4 days 14h 31m (397919 s)
Speedup ratio $\frac{(2)}{(1)}$	3.79

The commoditization and the increased processing speed of PCs leads the growth of idle CPU power. This will facilitate the construction of PC grid computing system along with improvement of communication environment by broadband connectivity (Chen et al, 2006). In practice, a PC Grid platform Korea@Home (or K@H) is used in our study. Its architecture is shown in Fig. 14. The is based on MS Windows. Asian option pricing is used to demonstrate the performance of the system, in which the number of iterations is taken to be 1,000,000. The duration to maturity is further divided by 10,000 periods, which push the system to run on the mass parallel system of K@H. To tackle this scale, or even larger scale for all kinds of possible scenarios in real trading practice, an off line distributed and parallel approach is adopted. The total number of Monte Carlo simulation is 1,000,000 x 10,000. It was divided into 10,000 jobs and each job consists of 1,000,000 Monte Carlo simulations. The market parameters are given as above.

The results demonstrated here are not as good as expected (see Table 1). It shows that the speedup ratio is only 3.79. In this test, K@H further divides the jobs into 10 groups. Each group was send and run in a sequential fashion, which causes the low speedup ratio. However, if one looks into the executed CPU time for each job, our assumption is still valid. We simulated the result in a small cluster with the same scenario and Monte Carlo paths. The result shows 90% speedup can be easily achieved.

4.2.4 RBNB Data Grid

RBNB DataTurbine in market data streaming is implemented here (See Fig. 11), in which the real data from iShares MSCI Taiwan Index (ETF) and TSEC weighted index from May 31, 2005 to May 31, 2008 and 30 days tick-by-tick trading data from Taiwan Futures Exchange Center (TAIFEX) are used and open in different file-based online channels from the RBNB DataTurbine. The purpose is to dynamically manage the high frequency market data and connect the data with analysis applications on the fly. The system implemented up to date is for large scale dynamic and static data management.

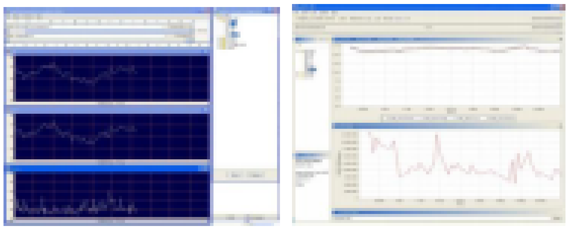

Fig. 15 RBNB DataTurbine streaming open for data channels of iShares MSCI Taiwan Index (ETF) and TSEC weighted index from May 31, 2005 to May 31, 2008, and 30 days tick-by-tick trading data from Taiwan Futures Exchange Center (TAIFEX). (real data plot in collaboration with Ebbe et al, 2007).

5 Conclusions

Securities trading is one of the few business activities where a few seconds processing delay can cost a company big fortune. The growing competitive in the market exacerbates the situation and pushes further towards instantaneous trading even in split second. The key lies on the performance of the underlying information system. Following the computing evolution in financial services, it was a centralized process to begin with and gradually decentralized into a distribution of actual application logic across service networks. Financial services have tradition of doing most of its heavy lifting financial analysis in overnight batch cycles. However, in securities trading it cannot satisfy the need due to its ad hoc nature and requirement of immediate response. A new computing paradigm, Grid computing, aiming at virtualizing scale-up distributed computing resources, is well suited to the challenge posed by the capital markets practices.

In this study we revisit the theoretical background of how performance will affect the market competition. The core concept lies on information asymmetry. Due to the advance of IT, even in split second it will be a matter of win or lose in real market practice. After establish the motivation we review recent grid development specifically used for finance service. Monte Carlo simulations are chosen not only because of its popularity in real world, but also its nature of so call "fine grain" or mass parallelism approach. The success of Monte Carlo simulations lies on better random number generators. The well recognized Sobol sequences as a quasi random number generator are carefully studies to ensure the quality of Monte Carlo simulations when employed for mass parallelism. Then some popular basic option pricing models, collectively Asian option pricing, rainbow option pricing and VaR calculation with constant market parameters, are introduced as drivers to introduce more details of grids for better finance service. Finally, we test various grid platforms, based on the methodology of mass parallelism and mass distribution, with the drivers. The real market data are also used, but at this stage they are only used to demonstrate the dynamic data management, in which grids can offer better.

During this study, we encountered system architect Koschnick from Zürcher Kantonalbank of Switzerland (Koschnick, 2008). Coincidentally, the system they plan to migrate from big irons is the similar system to that of DRBL with additional virtual local area networks (VLAN) for security. The system is used for overnight batch job as well as real time trading practice. It is confirmed that for the years to come, financial services providers will adopt more grid or grid-based technology to enhance their competitiveness.

Our future work will be following the current work: continuously using the current grid platforms and extending them to the use high-frequency real market data. Along the track of this development, we will also develop sophisticated Monte Carlo based option pricing and risk management based on tick-by-tick daily market information.

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□ □ □ □ □ □ The Impact of Free Trade Agreement on Trade Flow of Goods in Vietnam

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This study analyzes the effect of free trade agreement on Vietnam’s trade flow of goods by establishing gravity model for 185 countries between 1990 and 2012. Basing on the theoretical foundation and previous empirical papers, the FTA is expected to have positive relationship with trade flow of member countries. In details, two countries being in a same FTA will trade much more than those without in a same FTA. The results from the current study also find out that FTA’s estimated coefficients are consistently positive. The empirical results from all estimation models are consistent with each other in term of sign of FTA’s coefficient. For policy implication, the study proposes that FTA is a good trade policy for Vietnam because it can help to improve the export value among FTA members. However, FTA does not impact on trade outflow only, but it also has effect on other aspects of Vietnam economy such as wage structural, investment. Those issues are beyond the objective of this study.

Keywords: Free Trade Agreement, gravity model, total bilateral trade, export.

1 Introduction

According to World Trade Organization, Vietnam is now official member of eight free trade agreements which are signed and into force; and, Vietnam is also launching negotiation with a number of countries and economic groups to establish other free trade agreements such as TPP, ASEAN-EU FTA. On the one hand, free trade is espoused in improving the trade and welfare of signing countries. This belief is developed from the absolute advantage by Adam Smith, comparative advantage by David Ricardo, Heckscher-Ohlin model by Eli Heckscher and Bertil Ohlin to Paul Krugman with economies of scale and product differentiation. On the other hand, Viner (1950) not only accepted the gain from free trade but he also pointed out the loss if countries build trading blocs. The "trade diversion" is the terminology for the diverting trade from countries to countries. Therefore, question should be asked is how trade flow of Vietnam is affected by her free trade agreements.

Empirically, there are a vast number of papers investigating the relationship between free trade agreement and bilateral trade. Hur, Alba &Park (2009) conducted a research to evaluate the Hub-and-Spoke problem in free trade agreements by using panel data analysis of 96 countries from 1960 to 2000; and concluded that in spite of the existing of overlapping free trade agreement, export also increased. Other relevant paper by Baier & Berstrand (2009), that gives comprehensive contribution to the empirical model to investigate the effect of free trade agreement on international trade flow, also found the positive linkage. However, Aitken (1972) did an empirical research on trade creating and trade diverting after the establishment of EEC and EFTA. He found that EEC increased trading value of member countries significantly by trade creating and trade diverting, whereas the effect of EFTA is not considerably because of trade diverting. Besides, Bhavish, Jugurnath, Stewart & Brooks (2007), conducted a research on ASEAN FTA, APEC, CER, MERCOSUR and NFTA. The authors asserted that ASEAN FTA, CER increase its members' trade significantly, while MERCOSUR, NFTA and APEC created the trade diversion. As a result, the demand for study for international trade effect on specific context needs a critical exploration. Relating to Vietnam context, papers analyze the linkage between free trade agreement and trade flow in Vietnam is limited. For instance, Thai (2006) used gravity model to calculate the trade between Vietnam and twenty-three European countries. The paper found the determinants in trading such as economic characteristics, exchange rate volatility and the demand of destination. However, free trade agreement is not mentioned in the paper because Vietnam and those countries have not signed Free trade Agreement yet. Other paper investigates the impact of ASEAN Free Trade Agreement (AFTA) on Vietnam's economy is by Fukase & Martin (2001). The authors concluded that impact of AFTA is not significant. Agricultural sector gets benefit from that free trade because of exporting opportunity to ASEAN market, while some other industries is hurt and need to be protected due to ASEAN competitors. Therefore, this study will analyze the role of free trade agreement on trade flow of goods in Vietnam by applying gravity model for panel of 184 countries over the period 1990-2012. The study is carried out by using Fixed Effect model proposed by Baier & Bergstrand (2007), Sample Selection model by Helpman et al (2008), and Poisson Pseudo Maximum Likelihood model by Tenreyro & Silva (2008).

2 Free trade agreement

After establishing trading bloc, member countries can shift import from higher-taxed suppliers to lower-no taxed suppliers; and, domestic goods are substituted by member's low-cost goods. Johnson (1974) stated these above movements will balance the increasing-welfare. Lipsey (1957) and Bhagwati (1971) defined the trade diversion as the change in the locus of production from initial lower supplier to higher member suppliers. Trade creation is defined as the increase in trade between member countries. Johnson (1974) argued that trade diversion can give a transfer from locus of production which negatively impact on welfare, and create a substitution effect which positively impact on welfare. Furthermore, Michaely (1976) asserted that trade liberalization impacts on the trade pattern of signing countries in three ways. First effect is the increase in new trade flow between bloc's members. Secondly, reducing trade barrier can divert the import from non-member suppliers to member suppliers. Finally, the change in term of trade is an attributable to a rise in demand of substitute commodity.

Chaney (2008) stated that the change in trade flow due to trade barrier shock can be explained through two mechanisms. The first mechanism is the intensive margin which is the increase in exporting volume of incumbent firms. The second one is the extensive margin which is the change in the number of exporter in different sectors. In general, trade barrier reduction such as free trade agreement between two countries leads to the change in the number of good each firm exports, and new exporters can enter the market. Crozet and Koenig (2010) confirmed the theory in heterogeneous firms established in Chaney (2008). The paper disintegrated effect of trade cost on trade flow in to intensive margin and extensive margin as follow:

$$\varepsilon_{\tau_j}^{M} = \varepsilon_{\tau_j}^{EXT} + \varepsilon_{\tau_j}^{INT} \qquad (2.1)$$

Where $\varepsilon_{\tau_j}^{M}$ is the total trade cost elasticity of trading value

$\varepsilon_{\tau_j}^{EXT}$ is the trade cost elasticity of external margins

$\varepsilon_{\tau_j}^{INT}$ is the trade cost elasticity of internal margins

Crozet and Koenig (2010) concluded that the change in trade flow due to fluctuation in trade cost varied across the industries. In details, the reducing in trade barrier impacts on trade level greater in homogenous industries than more heterogeneous industries. Extensive margin effect can dominate the intensive margin effect in industry with high differentiated product. Moreover, Helpman, Melitz, and Rubinstein (2008) stated that the profitability of firm export is higher if the importing countries' demand is higher, and lower trade costs. On the other hand, firm will not export if the profit of firm is negative. That can explain the zero value in export between two countries. He showed the primary bias in estimating impact of trade barrier on trade flow is attributed to ignoring extensive margin effect. The reducing in trade friction may not only lead to the expansion of trade between existent country pairs, but also to create new trading partners.

3 Gravity model for free trade agreement

Aitken (1973) is the first author which applied the theory of gravity model in order to estimate the effect of European Economic Community (EEC) and European Free Trade Association (EFTA) on the import and export of member countries. In his model, he proposed a number of indicators for conceptions in the theoretical model. The dependent variable was export value. The independent variables were Free trade agreement, Income of exporting countries, Income of Importing countries, Distance between trading partners. Those indicators have been used by latter researches on observing the impact of FTA on trade flow of countries.

Trade flow

In empirical papers, there are three indicators for trade flow between countries. Firstly, McCallum (1995) used the shipment value from one country to other country as the representative for trade flow. In his paper, he analyzed the impact of trade border effect in the trade between The United States of America (USA) and Canada. The idea of research is that within-provincial trade of Canada is greater than the trade with USA's states, or foreign trade. By applying the gravity model as follow:

$$x_{ij} = a + by_i + cy_j + ddist_{ij} + eDUMMY_{ij} + u_{ij} \tag{2.2}$$

Where x_{ij} is the total export from region i to region j

Anderson and Wincoop (2003) examined the results obtaining from McCallum (1995). The authors argued that the result is overestimated because it omitted trade resistance variables which are called multilateral resistance terms (MRTs). Anderson and Wincoop (2003) proposed a new estimated model as follow:

$$x_{ij} = \frac{y_i y_j}{y^w}\left(\frac{t_{ij}}{\prod_i P_j}\right)^{1-\sigma} \tag{2.3}$$

The model also used the export from countries i to j as the dependent variable for trade flow. The differences with McCallum (1995) are the variables $\prod_i$, and P_j, the multilateral resistance terms. The meaning of MRTs is that it indicated the average price of export country to the rest of the world's price. The definitions of MRTs are as follow:

$$\prod_i = \left(\sum_j \left(\frac{t_{ij}}{P_j}\right)^{1-\sigma} \theta_j\right)^{1/_{1-\sigma}} \tag{2.4}$$

$$P_j = \left(\sum_i \left(\frac{t_{ij}}{\prod_i}\right)^{1-\sigma} \theta_i\right)^{1/_{1-\sigma}} \tag{2.5}$$

Baier and Bergstrand (2007) conducted a research to estimate the impact of FTA on trade flow. The paper used data of 96 countries around the world from 1960 to 2000. In his estimation model, the trade flow between i and j is the export value from i to j divided by the GDP deflator to obtain real trade flow. Hur, Alba, and Park (2010) applied the gravity model proposed by Baier and Bergstrand (2007) to find out the hub-spoke effect of FTA using data on 96 countries around the world throughout 40 years from 1960. In the model, dependent variable is real exporting value, the nominal exporting value divided by GDP deflator. However, Yang and Martinez-Zarzoso (2014) estimated whether ASEAN-China Free Trade agreement is trade creation or trade diversion. In the paper, current export level in US dollar represent for trade flow concept in international trade.

On the other hand, Jugurnath, Stewart, and Brook (2007) did not exploit the export value as an indicator for trade flow. Instead of that, current import value is use as a dependent variable in the model. The reason is that country often strictly reports its import value for the tax purpose, so the import value is more correct than export value.

Free Trade Agreement

The primary effect of FTA on trade flow is through the elimination of trade tariffs, so many research papers has analyzed trade cost as a tool for evaluation the impact of FTA. Anderson and Wincoop (2003) use the following measurement:

$$t_{ij} = b_{ij} d_{ij}^{p} \tag{2.6}$$

b_{ij} indicates the border effect in his analysis. The variable will take the value of 1 if two regions is in same country, otherwise, it is equal to one add trading tax. Although the paper did not mention about FTA, the paper has been applied by later researcher. Baier and Bergstrand (2007) estimated the impact of FTA on trade flow of countries by using variable FTA as a dummy variable. The variable FTA took value of 1 of exporter and importer are in the same free trade area, unless FTA was equal to 0. The paper use panel data and fixed effect estimation to find the FTA's coefficient, and the result showed that there is positive relationship between FTA and trade flow. Basing on Baier and Bergstrand (2007), Jugurnath, Stewart, and Brooks (2007) also used FTA as dummy variable in their paper. However, the paper not only estimated the impact of FTA on trade flow, but also intent to find the trade diversion and trade creation effect of FTA. Therefore, they set up more dummies variable to separate the diversion and creation effect in trade. The model is as follow:

$$\log IMPORT_{ij} = aX + \sum_{k=1} \alpha RTA_{ik} RTA_{kj} + \sum_{k=1} \alpha RTA_{ki} + \sum_{k=1} \alpha RTA_{kj} \tag{2.7}$$

In the model, i is the importing country, j is exporter, and k indicates the Regional Trade Agreement (RTA) k. Unlike in Baier and Bergstrand (2007), there are separate RTAs for two countries to analyze the trade creation and trade diversion of RTAs. The paper concluded that regional trade agreement of ASEAN, CER are trade creation while APEC, MERCOSUR, and NAFTA have a tendency to increase trade within regional member or may be trade diversion. Furthermore, Yang and Martinez-Zarzoro (2014) estimated the relationship between ASEAN-China (ACFTA) on trade flow of member countries. The model of paper set up three types of FTA dummy variables. The first FTA variable is equal one if both export and import countries are in same FTA. This variable showed the trade increase between member countries as the effect of ACFTA. The second dummy FTA is equal 1 if exporter is in the ACFTA, and importer is not in ACFTA. The final dummy FTA is equal 1 if only importer is in ACFTA. FTA dummy variable is applied to measure free trade agreement effect in Hur, Alba, and Park (2010). Objectives of the paper are to answer two questions. The first question is the effect of FTA on trade by using dummy variable FTA as in Baier and Bergstrand (2007). The second question is the hub and spoke nature of FTA. Data covered 96 countries in the world in 40 years from 1960. By applying fixed effect panel data in estimation, the paper pointed out that the increase in export of countries which are in same free trade agreement.

In conclusion, indicator for Free Trade Agreement is the dummy variable taking value of 1 if two countries is in same FTA, otherwise, FTA equal to 0. The coefficient of FTA variable is expected to be positive

Income of exporting and importing countries

Aitken (1973) took the nominal GDP of exporting and importing countries as measurement of income concept in international trade. This indicator for income has been accepted by other empirical papers. Anderson and Wincoop (2003) chose the gross domestic production as a proxy for income of trading countries. The nominal gross domestic production also used in paper of Jugurnath, Stewart, and Brooks (2007). However, Baier and Bergstrand (2007) divided nominal GDP by the GDP deflator in order to obtain real GDP. There was no clear argument between choosing nominal GDP or real GDP as an indicator for income. In all mentioned papers, both income of exporting country and importing countries have been found to impact positively on the trade flow.

Distance

The development of information technology and transportation infrastructure has leaded to a decrease in transport cost between countries, yet the question arose is whether the distance effects on trade flow is important or not. Disdier and Head (2008) analyzed the distance effect on trading between two countries. The paper collected 1467 coefficients of distance on trade flow from the estimation of 103 papers, and then found out that the change in the value of distance elasticity of trade flow. The authors stated that the mean effect of distance is approximate 0.9 meaning that 10 percent increase in the distance of two countries; the trade value will decrease 9 percent.

Carrère and Schiff (2005) conducted a paper to answer for puzzle in distance of trade. In the paper, the authors decomposed the components of transport cost into non-distance trade cost whose costs do not related to distance of goods export, and distance cost. By analyzing the transport cost of data from 150 countries between 1962 and 2000, Carrere and Schiff (2005) stated that the decision on how much to trade to foreign countries locating at varied distance depends on the combination of non-distance cost and distance cost. Although the paper did not solve which costs can be dominance factors, the measurement showed that the distance's role in trade is rose throughout the period.)

Relating to measure distance variable in empirical study, Baier and Bergstrand (2007) measured the distance variable by the distance between economic center of countries, while Yang and Martinez-Zarzoso (2014) estimate the distance variable by calculating the great circle distance from capital of exporting countries to capital of importing countries. In both papers, the expected impact of distance on trade flow is negative.

Exchange rate

The role of exchange rate in international trade is an ongoing argument within empirical studies. Rose and Wincoop (2001) did a research on the effect of currency union on European countries on the trade flow. The paper used Economic and Monetary Union (EMU) as an indicator for no exchange rate volatility in international trade. In the paper, if the EMU impacts positively on the trade flow of member countries, the exchange rate volatility has negative relationship on export and import value. By using data on trade of 200 countries from 1970 to 1995, the paper applied gravity model adding EMU dummies variable for estimation. The result indicated that the trade between EMU countries is higher than those without in EMU. In detail, EMU increased trade within European countries approximately 250% to 400%. Rose and Wincoop (2001) posed the importance of currency barrier in trade flow. McKenzie (2002) conducted a paper reviewing previous researches on the risk of exchange rate's effect to trade. The papers also found out the conclusion supporting Rose and Wincoop (2001); the result is that exchange rate volatility impact negatively on international trade, yet the degree of impact varying among the paper. The explanation for this problem came from the issue in measuring exchange rate volatility. There are many techniques to calculate the value of the fluctuation in exchange rate between countries; however, the author suggested that the application of Autoregressive Conditional Heterogeneity (ARCH) can produce the efficient and consistent result of exchange rate volatility. Recently, Al-Rashidi and Lahiri (2013) used heterogeneous firm-selection model to estimate that relationship. The argument of this model is that it can solve the problem selection bias and asymmetric trade occurring in other models. The impact of exchange rate change seems to be lower in model without correcting the selection bias and asymmetric trade than in model with those problems. Finally, the result of paper pointed out that exchange rate volatility coefficient in model is statistically significant

4 Analytical specifications

The study will apply the gravity model considered the powerful one in analyzing trade policies in order to estimate the coefficients between trade flow and FTA (Anderson & vanWincoop, 2003; Baier & Bergstrand, 2007; Silva & Tenreyro, 2006; Baier & Bergstrand, 2009; Zarzoso, 2013; Head & Mayer. 2013). The functional form is as follow:

$$\log(X_{vjt}) = \beta_0 + \beta_1 \log(GDP_{vjt}) + \beta_2 \log(DIST_{vt}) + \beta_3 FTA_{vjt} + \beta_4 \log(REER_{vjt}) + \beta_5 ERV_{jt} + \beta_6 REV_{vt} + u_{vjt}$$

Where LnX_{vjt} is natural logarithm of trade flow between Vietnam and country j in year t; $Log(GDP_{vjt})$ is natural logarithm of product of Vietnam and partner GDP share to world GDP in year t; $Log(DIST_{vt})$ is the natural logarithm of distance between Vietnam and country j; FTA_{vjt} is the dummy variable take value of 1 if Vietnam and country j is in the same FTA in year t; $REER_{vjt}$ is the real effective exchange rate in year t of Vietnam and country j; ERV_{vt}, ERV_{jt} is the real effective exchange rate volatility of Vietnam and country j in year t, respectively.

However, there are nearly 50 percent values of total trade in data equal to zero, so they will be ignored from the model. However, the omitted variable may create sample selection bias, thus the study will apply PPML model, Sample Selection Model and Fixed-Effect model with adding one in trade value as following table:

Table 1

Estimation models

Model	Model Specification	Estimation Method
Log linear Functional form		
4.9	$\log(X^*_{vjt} + t) = \beta_0 + \beta_1 \log(GDP_{vjt}) + \beta_2 \log\left(DIST_{vt}\right) + \beta_3 FTA_{vjt} + \beta_4 \log(REER_{vjt}) + \beta_5 ERV_{jt} + \beta_6 REV_{vt} + u_{vjt}$	Fixed Effect Model;
4.11	$\log(X_{vjt}) = \beta_0 + \beta_1 \log(GDP_{vjt}) + \beta_2 \log(DIST_{vt}) + \beta_3 FTA_{vjt} + \beta_4 \log(REER_{vjt}) + \beta_5 ERV_{jt} + \beta_6 REV_{vt} + u_{vjt}$	Sample selection model.
Multiplicative Functional Form		
4.5	$X_{ijt} = e^{(\beta_0 + \beta_1 \log(GDP_{vjt}) + \beta_2 \log(DIST_{vt}) + \beta_3 FTA_{vjt} + \beta_4 \log(REER_{vjt}) + \beta_5 ERVVN_{vt} +}$	Poisson Pseudo Maximum Likelihood

Source: Constructed by Author

5 Data

The study uses panel data set of 185 countries including Vietnam from 1990 to 2012 at the country level. The export value is collected from database of International Direction of Trade Statistics. GDP data is in real values, based year in 2005, and provided by World Bank Indicator. The data on distance come from CEPII database. Real effective exchange rate is compiled from Bruegel database. The volatility of real effective exchange rate is calculated by the author. (See Appendix A1, A2 for details)

6 Empirical results and discussion

6.1 Fixed Effect Model

Table 6-1 shows the results of log-form gravity model using fixed effect in panel data. The heteroscedasticity is claimed to be a problem in the model, so regressions use white heteroscedasticity consistent covariance matrix by the robust option in STATA after all regressions to cope with the problem; hence, the standard error is now robust standard error. All models in the table use time fixed effect and country-paired fixed effect, so log of distance is omitted from model due to time-invariant value. However, it is expected that the fixed-effect techniques will control the time-invariant unobserved factors, country-pair unobserved factors; yet, the time-varying unobserved factors cannot be controlled completely from the model.

In Table 6-1, column (1A) is the estimation results from model (4.9) whose explanatory variables do not include Vietnam REER and Partner REER. As can be seen from the result, three independent variables' coefficients are statistical significance at 1% (FTA, Dummy variable for Asian Crisis, and Global Crisis) and FTA's coefficient is statistically significant at 10%; log of world share GDP's coefficient does not have statistical meaning while log of distance is omitted in FEM due to time-invariant value. For controlling factors, dummy variable for Asian Financial crisis 1997's coefficient is significantly positive; so, it seems unreasonable because Asian Financial Crisis 1997 affect South East Asian countries seriously. This problem put the question on the reliability of FEM in model (1A), so this will be compared with the results from Poisson Pseudo Maximum Likelihood model and sample selection model. While the coefficient for Global Crisis in 2008 is statistical significance, namely -1.040, this means the Global Crisis 2008 affected the export between Vietnam and other countries. The result is consistent with Levchenko, Lewis and Tesar (2010). The variable of interest FTA's coefficient is 1.367 which is consistent with the expectation that FTA will increase the export between Vietnam and its trading members. In details, on average, if Vietnam and trading partner is in the FTA, the total export will be merely 3.9 times ($e^{1.367}$) higher than the trade value between Vietnam and non-FTA trading partner, other factors are the same.

Relating to column (2A), after adding exchange rate volatility variables, the results do not change in term of coefficient's sign; the differences are the variable Log of World Share GDP is statistically-significant negative at 10%. FTA's coefficient is statistical significance at 1% in this column, and value is 3.517 which is higher than the one in column (1A), *ceteris paribus*. This indicates that if two countries are in FTA, the export value is average 33.68 times higher export value between Vietnam and non-FTA countries, *ceteris paribus.*

In conclusion, the results from FEM regressions with dependent variable are export plus one in Table 6-1 accepts the hypothesis that FTA will increase the trade flow between Vietnam and FTA-member trading countries. The coefficient in model (2A) is considerably higher than FTA's coefficient in model (1A); the results will be compared with estimation result of sample selection model and PPML model.

Table 2

Regression Result for Fixed-Effect Model with dependent variable: Log (X_{vjt}+1)

Explanatory Variable	**(1A)[a]**	**(2A)[b]**
	FEM[c]	FEM
FTA	**1.367***	**3.517*****
	(1.96)	(3.79)
Log of Distance	-	-
	(.)	(.)
Log of World Share GDP	-1.345	-2.795*
	(-1.53)	(-1.91)
Asian Crisis Dummy 1997	5.305***	3.451***
	(6.78)	(2.92)
Global Crisis Dummy 2008	-1.040***	-1.096**
	(-2.93)	(-2.61)
Both Countries in WTO	0.954	-1.331
	(1.19)	(-1.23)
Only Vietnam in WTO	-0.929	-0.704
	(-1.25)	(-0.87)
Only Partner in WTO	0.349	-1.287
	(0.53)	(-1.37)
Vietnam REER	1.354	6.913*
	(0.69)	(1.93)
Partner REER	-0.162	0.690
	(-0.42)	(0.56)
Vietnam ERV		37.52
		(1.56)
Partner ERV		-7.777
		(-1.40)
Constant	30.51**	58.52**
	(2.00)	(2.28)
Adjusted R-squared	0.765	0.786
Observations	3456	2522

*Note: *, **, *** denotes statistical significance at 10%, 5%, and 1% respectively. Numbers in brackets are robust standard error. [a] presents regression models without Real Effective Exchange Rate Volatility variables; [b] presents regression models with Real Effective Exchange Rate Volatility variables; [c] present Fixed-Effect Model*

6.2 Sample Selection Model

Table 6-2 presents the regression results of Heckman sample selection model adjusted by Semykina and Wooldridge (2010) in panel data (column 1B, 2B, 3B and 4B). Column (1B) and (2B) are the models excluding the Real Effective Exchange Rate volatility (ERV), yet model in (2B) includes the interaction variables between inverse Mill ratio and time dummy variables. While column (3B) and (4B) are the models including Real Effective Exchange Rate volatility (ERV), yet model in (4B) accounts for the interaction variables between Inverse Mill Ratio and time dummy variables. The Wald test after each regression rejects the hypothesis that estimated coefficients of Mill ratio and interaction variables equal to zero in four models. Therefore, sample selection bias is a problem in model, and sample selection model is required to be applied (see Appendix 3 for details)

In general, four regressions are consistent in term of the sign of independent variable's impact on total export, yet the sample selection models with ERV provide higher-value results than those without ERV. As can be seen from the table, FTA impacts positively on the trade outflow of Vietnam. The level of improvement in trade between Vietnam and FTA members are about 3.55 times in column (1B), 3.84 times in column (2B), 6.16 times in column (3B), and 6.57 times in column (4B), *ceteris paribus*; all estimated coefficients are statistical significance at 1%. As a result, sample selection model does not reject the study' hypothesis. Relating to controlling variables, distance appears to have negative relationship with total bilateral trade. This is reasonable because the distance implies the variable trade cost. GDP of two countries effects positively on the trade outflow of Vietnam. Furthermore, estimated coefficients of Asian financial crisis 1997-1998 are negative and statistically significant in all four models. For the Crisis 2008, the sign of estimated coefficient in four models are negative, although it is only statistically significant for (1B) and (2B). In general, the crisis provoked unexpected consequences on the export between Vietnam and trading partners, in average and other conditions unchanged.

Table 3

Regression Result for Sample Selection Model with Dependent Variable: log (Xvjt)

Explanatory Variable	(1B) SSM_NERV_NIR	(2B) SSM_NERV_IR	(3B) SSM_ERV_NIR	(4B) SSM_ERV_IR
FTA	1.266**	1.348***	1.819***	1.883***
	(2.50)	(2.62)	(3.69)	(3.81)
Log of Distance	-1.139***	-1.171***	-0.891***	-0.904***
	(-4.36)	(-4.49)	(-3.65)	(-3.79)
Log of World Share GDP	1.075***	1.093***	1.052***	1.060***
	(8.26)	(8.62)	(4.87)	(4.90)
Crisis Dummy 1997	-0.762	-0.929*	-0.630	-0.811*
	(-1.57)	(-1.88)	(-1.37)	(-1.69)
Crisis Dummy 2008	-0.368***	-0.549***	-0.386***	-0.569***
	(-3.27)	(-3.74)	(-3.39)	(-3.82)
Both Countries in WTO	0.472	0.491	0.429	0.448
	(1.11)	(1.16)	(1.12)	(1.19)
Only Vietnam in WTO	0	0	0	0
	(.)	(.)	(.)	(.)
Only Partner in WTO	0.456*	0.483*	0.287	0.259
	(1.83)	(1.91)	(1.09)	(0.97)
Vietnam REER	0	0	0	0
	(.)	(.)	(.)	(.)
Partner REER	-0.254	-0.175	0.0271	0.0743
	(-1.44)	(-0.97)	(0.13)	(0.37)
Vietnam ERV			0	0
			(.)	(.)
Partner ERV			0.944	1.239
			(0.76)	(0.98)
Inverse Mill ratio	1.110***	0	1.340***	0
	(4.31)	(.)	(4.08)	(.)
Constant	8.033***	7.576***	4.495*	4.258*
	(3.01)	(2.81)	(1.81)	(1.73)
Observations	1698	1698	1383	1383
Wald test for				
H_0: p=0	Rejected	Rejected	Rejected	Rejected
H_0: p_s=0, with all s= 1,23	Rejected	Rejected	Rejected	Rejected

*Note: Number in bracket is robust standard error. *, **, and *** are statistical significance at 10%, 5%, and 1% respectively. SSM_NERV_NIR: Sample Selection Model without ERV and Interaction variables; SSM_NERV_IR: Sample Selection Model without ERV, yet including Interaction variables; SSM_ERV_NIR: Sample Selection Model with ERV and without Interaction variables; SSM_ERV_IR: Sample Selection Model with ERV and Interaction variables*

6.3 Multiplicative-Form Gravity Model

Table 6-3 provides the regression results for model with Possion Pseudo Maximum Likelihood estimation method. The dependent variable is export between Vietnam and trading partner (X_{vjt}). The column (1C) and (2C) contain the explanatory variables without real effective exchange rate volatility (ERV), and with ERV, respectively. In column (1C), FTA is not statistical significance, yet its sign is positive which is consistent with the hypothesis. FTA's coefficient value in column (2C) is 0.660, yet it is not statistically significant. Therefore, the PPML model may not accept the hypothesis of the study that FTA impact positively on the export of Vietnam. Relating to controlling variables, log of distance can be obtained from model (4.9) to interpret the effect of distance on trade flow. Its coefficient is negative and statistically significance at 1 percent in both regression (1C) and (2C). The results in model (1C) and (2C) are -0.77 and -0.69, respectively; the coefficients do not vary greatly after adding the ERV into model (2C). For interpreting, if the distance between Vietnam and trading partner increase 1 percent, the total trade value may decrease around 0.77 percent in column (1C) and 0.69 percent in column (2C). The World share GDP of two countries provide consistent result with Anderson & van Wincoop (2003) and Baier & Bergstrand (2007); the GDP of two countries relative to the world is greater, the more total trade value of country pair. The model can prove the statistically significant effect of crisis on trade outflow of Vietnam. In details, the sign is negative for Asian Financial Crisis 1997 and Global Crisis 2008 in both column (1C) and (2C). The impact of ERV on trade flow is ambiguous. Trading agents can be risk-averse so they will try to avoid doing business in countries with high fluctuation in exchange rate while others can be risk-loving agents to ready to trade with such countries (McKenzie, 2002). Therefore, the study does not analysis the results of real effective exchange rate and exchange rate volatility variables; and, they are used only for controlling the impact of FTA on trade value.

Table 4

Regression Results for PPML model with Dependent variable Xvjt

Explanatory Variable	(1C)	(2C)
	PPML	PPML
FTA	0.407	0.506
	(1.28)	(1.49)
Log of Distance	-0.770***	-0.692***
	(-5.17)	(-4.41)
Log of World Share GDP	0.875***	0.868***
	(10.89)	(10.26)
Crisis Dummy 1997	-0.413**	-0.498**
	(-2.01)	(-2.24)
Crisis Dummy 2008	-0.270***	-0.221***
	(-3.72)	(-2.91)
Both Countries in WTO	0.171	-0.120
	(0.65)	(-0.48)
Only Vietnam in WTO	-0.577	-0.792**
	(-1.59)	(-2.16)
Only Partner in WTO	0.165	0.227
	(0.59)	(0.89)
Vietnam REER	0.203	1.700**
	(0.62)	(2.39)
Partner REER	-0.0747	-0.0333
	(-0.26)	(-0.09)
Vietnam ERV		13.31**
		(2.57)
Partner ERV		0.173
		(0.03)
Constant	8.655***	7.929***
	(4.07)	(3.50)
Observations	3456	2522

Note: Number in bracket is robust standard error;

, **, and * are statistical significance at 10%, 5%, and 1% respectively.*

In PPML estimators, the FTA has positive relationship with the export of Vietnam, and is consistent with those in FEM and sample selection model. However, the value of FTA's coefficient is lower than coefficients and statistically insignificant in other two methods. PPML can perform efficiently in the case of heteroscedasticity in data, yet it is claimed to be poorly estimating in the case of frequent zero-value in trade (Martin & Pham, 2008). This can be applied to the study' data where the zero value is account for nearly 50% in total observations. One indicator used to evaluate the bias in model is GDP's coefficient. Theoretically, the coefficient of GDP converge to unity (Anderson & van Wincoop, 2003); and Martin and Pham (2008) stated that if GDP's coefficient is lower greatly than one, model may be underestimated or downward biased. Looking at the coefficient of log World Share GDP in PPML model, it is significant lower than one, so it may indicate that FTA coefficient in model is downward bias. Applying to FEM models, the log World Share GDP's coefficient is considerably greater than one, so the FTA is upward biased. That may be one reason for the high value of FTA coefficients in FEM in compare to those in sample selection model and PPML model. Turning to the sample selection model, the value of log of World Share GDP's coefficient is nearly equal to one. This may subjectively assert that sample selection model is better than other model (Linder & Groots, 2006; Helpman, Melitz, and Rubinstein, 2008). Furthermore, sample selection models solve the problem of zero value trade in data. The model judges zero-trade value as non-random value and come from the decision of other factor such exporter and importer while PPML and FEM do not judge zero-trade in such way.

7 Conclusion

Empirical results from three above estimation models prove the positive relationship between FTA and Vietnam's export consistently. After joining the FTA, the trade between Vietnam and its FTA-member partner from 3.9 times to 33 times in FEM, 3.5 times to 6.5 times in sample selection model. In the descriptive statistics in Chapter 4, the impact of FTA is clearly observed in case of AFTA and ACFTA. Because the FTA is signed in 1995 and 2002, respectively, FTA impact can be seen obviously. Other FTAs is signed from 2009, so FTA's results cannot be observed in reported period. However, the results from descriptive statistics are consistent with empirical results because they do not reject the hypothesis that FTA impact positively on trade flow of goods. The reason for why FTA improves the trade flow between member countries can be attribute to the elimination in the tariffs and other trade-facilitate conditions. In details, FTA members have to follow the schedule in reducing import and export tariff which is accord by all members which is discussed in chapter 3. The tax reduction will help to reduce the trade cost substantially. The other condition is the integration in transit infrastructure and other custom obligation. One more reason for the positive impact on trade of FTA can be attributed to the "natural FTA" (Krugman, 1995). Natural FTA is terminology for the FTA between countries have advantage on geography (neighboring country, short distance), culture. The author stated that if natural FTA is established, it will impact positively on trade flow and welfare of members. Turning to Vietnam FTAs, most of them are with ASEAN countries, which can become the "natural FTA".

Study results prove the important role of free trade agreement on the trade outflow of Vietnam. Although the level of improvement in trade flow does not strongly confirm in the study due to its limitations, the positive effect of free trade agreement is clearly shown from the regression results based on previous empirical papers. The government may consider the free trade agreement as a policy for trade openness and export development. However, the study does not applied to sub sectors in the economy, so it should be a noticeable to deep analysis in the impact of FTA in specific sector which the policy aims for. The other implication come from the study results is the impact of the controlling variable. The distance variable indicates that Vietnam is less likely to trade with countries are in greater distance than the shorter ones. The trade will increase when the GDP of two countries are higher in relative to world GDP. The controlling variables help the government to decide in choosing trading partners.

8 Limitation and Further Research

Firstly, gravity model is "work horse" tool in estimating ex-post relationship between trade policy and trade flow, yet in order to estimate the ex-ante effect of FTA on trade flow of goods, the Computable General Equilibrium (CGE) is a recommended model (Hertel et al, 2007). CGE can help to anticipate the effect of FTA on Vietnam trade flow when the tax elimination fully in force in 2020-2027. Other limitation of gravity model is its functional form. The log- linear form and multiplicative form take account for non-negative observation. Thus, in the model, dependent variables are total bilateral trade, export value, or import value. Trade balance which is also important trade indicator cannot be included in the model due to its negative value. The time period in data does not capture the full impact of FTA on trade flow because the available of data is constrained at the time this study is done.

The study analyzes the aggregate data on trade flow, yet the disaggregate data also need to be taken account for because the effect of FTA will be difference depend on sectors in the industries. Trade flow is one of the points of view in judging the foreign trade policy. Other aspects are the welfare change (McCaig, 2011), the investment (Lakatos & Walmsley, 2012; Anderson, 2010) the labor wage (Fukase, 2013). Those aspects are beyond the copes of this study, and they can be a topic for future evaluation.

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Appendix 1. List of countries

Afghanistan, Islamic Republic of	Bosnia and Herzegovina	China, P.R.: Mainland	Guatemala	Kuwait	Morocco	Russian Federation	Tajikistan
Albania	Botswana	Denmark	Guinea	Kyrgyz Republic	Mozambique	Rwanda	Tanzania
Algeria	Brazil	Dominica	Guinea-Bissau	Lao People's Democratic Republic	Myanmar	Samoa	Timor-Leste, Dem. Rep. of
American Samoa	Brunei Darussalam	Dominican Republic	Guyana	Latvia	Namibia	Saudi Arabia	Togo
Antigua and Barbuda	Bulgaria	Ecuador	Haiti	Lebanon	Nepal	Senegal	Tonga
Angola	Burkina Faso	Egypt	Honduras	Lesotho	Netherlands	Seychelles	Tunisia
Argentina	Burundi	El Salvador	Hungary	Liberia	New Zealand	Sierra Leone	Turkey
Armenia, Republic of	Cabo Verde	Equatorial Guinea	Iceland	Libya	Nicaragua	Singapore	Turkmenistan
Aruba	Cambodia	Eritrea	India	Lithuania	Niger	Slovak Republic	Tuvalu
Australia	Cameroon	Estonia	Indonesia	Luxembourg	Nigeria	Slovenia	Thailand
Austria	Canada	Ethiopia	Iran, Islamic Republic of	Macedonia, FYR	Norway	Solomon Islands	Trinidad and Tobago
Azerbaijan, Republic of	Colombia	European Union	Iraq	Madagascar	Oman	South Africa	Uganda
Bahamas, The	Comoros	Fiji	Ireland	Malawi	Pakistan	Spain	Ukraine
Bahrain, Kingdom of	Congo, Democratic Republic of	Finland	Israel	Malaysia	Palau	Sri Lanka	United Arab Emirates
Bangladesh	Congo, Republic of	France	Italy	Maldives	Panama	St. Kitts and Nevis	United Kingdom
Barbados	Costa Rica	Gabon	Jamaica	Mali	Papua New Guinea	St. Lucia	United States
Belarus	Cote d'Ivoire	Gambia, The	Japan	Malta	Paraguay	St. Vincent and the Grenadines	Uruguay
Belgium	Croatia	Georgia	Jordan	Mauritania	Peru	Sudan	Uzbekistan
Belize	Cuba	Germany	Jordan	Mauritius	Poland	Suriname	Vanuatu
Benin	Cyprus	Ghana	Kazakhstan	Mexico	Portugal	Swaziland	Venezuela, Republica Bolivariana de
Bermuda	Czech Republic	Greece	Kenya	Moldova	Philippines	Sweden	Yemen, Republic of
Bhutan	Chad	Greenland	Kiribati	Montenegro	Qatar	Switzerland	Zambia
Bolivia	Chile	Grenada	Korea, Republic of	Mongolia	Romania	Syrian Arab Republic	Zimbabwe

Appendix 2. Data collection summary

Number	Variable	Variable Definition	Expected sign	Unit	Source
Dependent Variable					
1 Total Export Value		Total export value at 2005 US$		US$	DOTS
Independent Variable					
2	FTA	Dummy variable, equal 1 if Vietnam and trading country is in FTA in year t	+	Binary number (0,1)	WTO database
3	GDP	Ratio of Product of RGDP of Vietnam and trading partner to world GDP in year t, based year 2005	+	US$	World Bank Indicator
5	DIST	Distance between two capital of Vietnam and trading partner	-	Km	CEPII
6	REER	Real Effective Exchange Rate of Vietnam, Trading Partner	-	Index, based year 2007	Bruegel
7	ERV	Real Effective Exchange Rate Volatility of Vietnam, Trading Partner	-	Percentage	Author's calculation
8	DUM97 DUM08	Dummy variables for Financial Crisis	-	Binary number (0,1)	Author's establishment
9	WTO2 WTOV WTOP	Dummy variables for WTO member ship	+/-	Binary number (0,1)	WTO

Note: + indicates the expected positive effect; - indicates the expected negative effect

Source: Constructed by the Author

Appendix 3. Endogenous testing for FTA

FTA is argued to suffer the problem of endogeneity in the gravity model, yet the study does not agree with that belief for the case of Vietnam. It is the reason that FTA is tested whether it is endogenous variable or not by using the command ivreg2 and ivendog in STATA 13.0. The result is as follow

Table 5

Testing results for Interaction Terms in Sample Selection Model

H_0: Restricted model nested in non-restricted model	**Model: 1B and 2B**	**Model: 3B and 4B**
Chi-square	2.16	1.22
P-value	0.021	0.24
Accepted or Not Accepted H_0	**Not Accepted**	**Accepted**

Source: Constructed by the Author

The test accepts the null Hypothesis that FTA is exogenous.

Appendix 4. Testings in Sample Selection Model

1. Testing Results for Collinearity Problem in sample selection model

The study applies the command collin in STATA 13.0 to detect multi-collinearity problem in data. The testing will report the VIF (Variance Inflation Factor) and Condition Number. After testing, the mean VIF is 1.86 which is lower 10 and the condition number 4.5918, so the multi-collinearity is not a problem in the study. Relating to the reliability of four models, all models in the table do not contain excluded restriction variable in selection equation, so the models are argued to be vulnerable if there are the collinearity between inverse Mill's ratio and other regressors. As mentioned in Chapter 3, the collinearity is checked by calculating formula proposed by Madden (2008). The result is illustrated by following table.

Table 6

Testing Results for Collinearity Problem in sample selection model

Mean VIF	**Condition number**
2.03	4.80

Source: Constructed by the Author

The condition number is less than 20 which is the threshold for concerning collinearity problem in Sample selection (Leung &Yu, 2000), so the inverse Mill's ratio does not encounter the collinearity problem with other regressors.

2. Testing results for Interaction Terms in Sample Selection Model

Turning to test for choosing between model with interaction terms and without interaction terms, the study considers the model without interaction terms as restricted models, and model with interaction terms as non-restricted models. Thus, there are two pair of model for judgment (1B and 2B; 3B and 4B). The Wald-test will be applied for testing. The results are indicated in following table

Table 8

Testing results for Interaction Terms in Sample Selection Model

H_0: Restricted model nested in non-restricted model	**Model: 1B and 2B**	**Model: 3B and 4B**
Chi-square	2.16	1.22
P-value	0.021	0.24
Accepted or Not Accepted H_0	**Not Accepted**	**Accepted**

Source: Constructed by the Author

Between model in 1B and 2B, Wald test rejected the Null Hypothesis, so adding interaction terms in model 2B is worthy, and more preferable than in restricted model 1B. Between model in 3B and 4B, Wald test accepted the Null Hypothesis, so it does not required to add interaction term in model 4B, or restricted model is still reliable.

Appendix 5: Exchange Rate Calculation

There are two type of exchange rate applied in the study for analyzing the relationship between exchange rate and trade: real effective exchange rate (REER) and exchange rate volatility (ERV)

Real Effective Exchange Rate index (REERvjt, REERjt)

The study will use real effective exchange rate index (REER) as a proxy for controlling the impact of exchange rate on trade flow between Vietnam and her partner. REER is obtained from Nominal Effective Exchange Rate (NEER) deflated by the relative price between calculating country and its trading partners. It is consider as the measurement of the change of domestic currency in response to bundle of trading partners.

Based on Darva (2012), REER calculated as following formula

$$REER_t^d = NEER_t^d \frac{CPI_t^d}{CPI_t^f} \tag{3.9}$$

Where $REER_t^d$ is the real effective exchange rate of domestic country in year t

$NEER_t^d$ is the nominal real effective exchange rate of domestic country in year t, calculated as $NEER_t^d = \prod_{i=1}^{n} S(i)_t^{w(i)}$, $S(i)_t$ is the nominal bilateral exchange rate between domestic country and its trading partner i with the weighted w^i, n is the total trading partners.

CPI_t^d is the consumer price index of domestic country in year t

CPI_t^f is the consumer price index of trading partners weighted geometrically, calculated as $CPI_t^f = \prod_{i=1}^{n} CPI(i)_t^{w(i)}$, $CPI(i)_t$ is the consumer price index of partner i in year t

Exchange Rate Volatility

Besides of REER index, the exchange rate volatility (ERV) also impacts on the trade of country (Bahmani-Oskooee & Hegerty, 2009; McKenzie, 2002). The reason is that the uncertainty in exchange rate will distort the behavior of risk-aversion exporters. Exporters may not enter the market whose exchange rate is not stable because of the risk in future payments.

The study will use the ERV as a proxy for controlling the effect of currency-related risk on export and import value. From McKenzie (2002), and Tenreyro (2007), the ERV will be calculated by the standard deviation of percentage change in monthly real effective exchange rate, formulated as

$$ERV_{it} = \sqrt{Var(\ln REER_{i,tm} - \ln REER_{i,t(m-1)})_{\{m=1\to 12\}}} \quad (4.9)$$

where ERV_{it} is the exchange rate volatility of country i in year t

$REER_{i,tm}$ is the real effective exchange rate of month m in year t of country i.

Relating to use nominal effective exchange rate or real effective exchange rate, McKenzie (2002) pointed out that there is no different in estimation results in applying REER or NEER. Therefore, the study can use the real effective exchange rate because there is available and consistent with the REER index variable used in study

There are arguments in the effect of ERV on trade flow. Bahmani-Oskooee & Hegerty (2009) find out the negative relationship between ERV and trade flow of Mexico and United States of America; Bahmani-Oskooee and Xu (2013) analyzed the short run and long run impact of ERV on trade between Hong Kong and United States of America, the results are negative. However, Tenreyro (2007) applied instrument variable in observation the ERV and trade flow changes from 1970 to 1997. The authors did not found significant result in the relationship. McKenzie (2002) mentioned that the relationship of ERV and international trade is in arguments, and may depend on specific data and measurement of ERV.

Determinants of Accessibility to Microcredit in Terms of the Formal and Informal Sectors

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Microcredit is an emerging concept helping the poor out of poverty situation. This paper attempts to investigate the determinants affecting the probability of participation in different types of credit sectors in terms of formal sector and informal sector. Using a sample size of 1,522 households participate in credit market from The Vietnam Access to Resources Household Survey (VARHS) 2012; bivariate probit model is employed to explore the determinants of household credit demand due to the binary nature of the dependent variables. Various explanatory variables include age, gender, marital_stt, edu, hhsize, income, savingamount, landsize, agriculture_act, network and location that influence probability of accessibility to different sectors of credit. Furthermore, relationship between dependent variables is accounted in this research. Results reveal that factors affecting formal credit participation are different from factors affecting informal credit participation. Additionally, the result indicates that there is negative correlation across two sectors of credit.

INTRODUCTION

There are about 1.22 billion people (21 percent of population) in the world living on less than $1.25 a day in 2010 (World Bank). Focusing towards poverty reduction and finding ways to improve living condition have taken a lot of attention of public policies in the world. The rate of poverty in Vietnam decreases remarkably in recent years. According to annual report shown by GSO, the poverty rate declined from 15.5 percent in 2006, to 13.4 percent in 2008, to 10.7 percent in 2010. In a report of GSO in 2010, it also revealed that poverty level in rural area (13.2 percent) is much higher compared to that in urban area (5.1 percent). How to distribute the benefits of economics growth, especially to rural area is one of the challenges remained. Therefore, rural economy deserves more attention and support to reduce inequality between rural and urban area. Providing a channel to ease the credit constraints for the poor rural household is the primary object in poverty alleviation strategy of developing countries, including Vietnam.

Despite the importance of credit to the poor, the poor family that lacks ability to access to adequate financial service leads to the fact that they do not have prospects for increasing their productivity and living standard. Robinson (2001) and Gonzalez Vega (2003) indicated that most of microfinance institutions have been not sustainable in developing countries. Credit subsidized interest rate provided by "Agricultural development banks" which established by commercial banks to extend credit to rural household not considered creditworthy. However, majority of these credit programs have failed to reach their targets both to be sustainable credit providers and serve the poor (Adams, Graham, and von Pischke 1984; Adams and Vogel 1986; Braverman and Guasch 1986).

Risk management and transaction costs associated with Asymmetric information are the most problematic features facing by lenders and borrowers (Pham & Lensinnk, 2007). It is also well know that different forms of credit market serve different group of borrowers, it is difficult for large number of poor households to access to credit sources. Households often face limited access to credit because of rationing of credit demand that leads to the poor and low income households are generally excluded from the formal credit sector (Stiglitz & Weiss, 1981). In fact that formal provider, semi-formal provider and informal provider exist side by side in Vietnamese financial market. To deal the level of information asymmetry between borrowers and different lenders; many government microcredit programs are accompanied by the local Peoples Committees in terms of lending process to assist microcredit market operation.

In respect of this, narrowing gaps in term of whom it serves and the service it provides, improving the efficiency and effectiveness of microfinance system is the main challenge of policy makers as well as program organizers.

With data collected from The Vietnam Access to Resources Household Survey 2012 (VARHS), econometrics techniques are employed in this research to explore the factors that affect access to credit in terms of formal credit and informal credit.

LITERATURE REVIEW

This section presents the overview of theory and discusses previous studies relate to the research topic.

Concept of credit

There are several and various definitions regarding the word credit as follows:

Credits are referred as loans that permit consuming in the present, in exchange for an agreement to make repayment at sometimes in the future (Pischie et al., 1983).

Obtaining credit was considered as the process of controlling over the use of money, goods and services based upon a promise to repay at a future day (Adegeye & Dittoh, 1985).

Ololade & Ologunju (2013) defined credit as a mean for temporary transfer of assets to individuals or organizations that has not them from individuals or organizations that has. This process requires evidences of debt obligation in return for a loan, in the case of transaction between friends or relative that based on good relationship excluded.

Microcredit that is a component of microfinance provides small loan to the poor for self –employment. That generates income, helping them care for themselves and their family (The Microcredit Summit, 1997).

To raise income level and improve living standard of semi-urban and urban areas are considered as targets of microcredit by providing of thrift, credit, other financial services and products of every small amount to the rural household (Reserve Bank of India- Master Circular, 2011).

Theory of demand for credit

According to life circle model (Franco Modigliani, 1966), individuals cannot maintain consumption at an acceptable level when the size of family changed withuncertainties of future. To maximize time life utility, income should be reallocated inter-temporally (Morduch, 1995a). Consumers can afford their purchases by using saving from past or present income or by accessing to credit funds which help borrowers to make inter-temporal choice. By borrowing money, borrowers have additional spending power in the present and duty to pay loan and interest rate in the future in exchange (Soman & cheema, 2002).

The inter-temporal model of life circle hypothesis and permanent hypothesis that explain the consumption behavior of individuals were also discussed by Modigliani in1986. It is assumed that borrower have opportunity to borrow in perfect market in Modigliani's model.

In model of Chen and Chiivakul (2008), current household‘s consumption level not only depends on the current income but also depends on household's life time characteristics (behaviors of household on participation in credit market). Additionally, it is argued that current consumption depends on expected consumption in the future period (consumers firstly estimate their ability to afford consumption in long run) which depends on their saving or demand for loan (Hall, 1978).

Moreover, in Cobb Douglas function: $Y = AL^{\alpha}K^{\beta}$, capital is viewed as a production input factor, accessible and affordable inputs; profit from production depends on labor (L) and capital (K) with given technology (Zellne at al., 1966). Cobb Douglas showed how two factors (Capital and Labor) effect on production function and how income distribution is effected by production output (Felipe and Adams, 2005). This capital can be provided by a variety of credit sources at different interest rates (cost of capital).

Determinants of participation in microcredit programs

When income and wealth to increase purchase are insufficient, households borrow money as a way to finance their consumption (Kirchler et al., 2008). There are two stages in process of getting loan. First, the households who demand credit apply for a certain amount of loan for a type of credit sector which they want to borrow from. Second, the providers choose which applicants are met requirements for loan based on household's information and availabilities of the lenders.

However, in this analysis, I focus on demand side's characteristics to consider the probability of access to credit. The determinants of microcredit participation include age, gender, marital_stt, edu, hhsize, income, savingamount, landsize, agriculture_act, network and location.

Age

According to the life circle hypothesis, the age is negative relationship with the decision to get loan. It is also confirmed in research of M. Ajugam and C. Ramasamy (2007). Similarly, Okurut (2006) and Mohamed (2003) pointed out that the possibility to access to credit resources decrease when they get older. Younger persons more likely to borrow than the elderly because of elements of personal risk level (Fabbri and Padula, 2004; Zeller, 1994; Magri, 2002; Abdul- Muhmin, 2008; Del- Rio and

Young, 2005); additionally, the young tend to spend more on a variety of activities while the old maybe less (Mpuga, 2008).

In contrast, some studies showed accessibility to credit positively related to age. For example, Tinh (2010) demonstrated that age of household head has a significant positive relationship with getting a loan. It was also proven in research in 2010 of Tang et al.

Gender of household's head

Banerjee et al. (2010) Bruno and Cre1pon et al. (2011) prove that there are a majority proportion of male borrowers from the microcredit programmes. Moreover, Nwaru (2011) and Bendig et al (2009) also proven that demanding in loan negatively related with being female.

However, contrary to mentioned studies, Owuor George (2009) stated that being a female headed household increases probability of joining financial activities.

Marital status

A vast of previous studies showed that married individuals are likely to get loans than unmarried individuals because of the level of needs (Kamleitneir and Kirchler, 2007; Bridges et al., 2004; Chen and Jensen, 1985; Duca and Rosenthal, 1994; Magri, 2002). Similarly, in a research by Kenya National Fin Access (2009) indicated that the probability of credit program participation is the highest with married persons. It is explained that there is difficult to access to credit for single household due to lack of social network (Ferede, 2012).

Level of household head's education

Education was an important factor that influences the probability of accessibility of microcredit programmes (Tang et al., 2010). Quach (2005) demonstrated that education level had a positive relationship with demanding in loan. Moreover, education level was founded as a determinant that fosters the accessibility to microcredit programme thanks to their awareness of financial market system (Yehuala, 2008; Okunade; 2007; Vaessen, 2001; and Okunade, 2007).

On the other hand, Khandker (2001) and Khandker (2005) demonstrated that higher education level of household head would less likely to borrow from microcredit program. Similar to Khandker's finding, Cuong H. Nguyen's research (2007) also proves that household head with higher education has lower chance of accessibility to credit sector in Vietnam which composed of high proportion of borrowers with education level at primary and lower secondary school.

It is interesting that the impact of this variable on various source of credits are different. Bendig et al. (2009) stated that better educated individuala tend to access to formal financial sector. Moreover, there was an inverse relationship between education and informal loan.

Household size

The ideas of relationship between household size and accessibility of credit are different from studies to studies.

Schreiner & Nagarajan (1998), Vaessen (2001), Ho (2004) and Quach (2005) indicates that the number of members in a family were significantly positive relationship with household borrowing. It is explained that more loans are demanded by large-size household or that more credits are allocated to household with more members. That idea was the same in research in the case of Nguyen (2007) and Tinh Doan (2010).

In contrast, Bendig at al. (2009) argued that household size has negative impact on probability to credit in a research of demand for financial service. This is due to the assumption that there are more dependent members including children and elderly people who would consume a large share of income in their family and had higher risk of default (Tang et al., 2010).

However, household size did not effect on getting loan in Greece (Mitrakos and Simiyiannis, 2009).

Household's income

Income is the most common measurement used to define the poor (The World Bank); hence, household with high income is not considered as the poor whereas the primary target of microcredit is to provide credit to the poor who will provided credit to increase income (World Bank, 2010). Therefore, applicants with higher income have lower chance to get loan. This idea was proven in the research by Pham & Lensink (2007) and Li et al. (2011) that household's income negative correlation with probability of participation in credit program including microcredit. It is also explained that marginal utility of consumption of poor household is high, leading to more demand for credit of the poor (Ferede, 2012).

In contrast, many researches argued that high-income household more likely access to loan than low-income household (Crrok, 2001; Lin and Yang, 2005; Jappelli and Pistaferri, 2007). The reason for that is due to assumption that high-income households hold mortgage (Ambrose et al., 2004).

Saving amount

Saving amount is identified as collateral to reduce adverse selection and moral hazard arising from lending process between lenders and borrowers. Compared to others, saving amount is more liquidity. Therefore, applicants with bigger saving amount have more opportunities for accessing credit sector. It means that relationship between household saving and possibility to lend credit is positive.

However, total saving is considered as a determinant of household's demand for credit; hence, saving amount is negatively related to probability to approach credit sector (Tang et al., 2010). It is explained that households with larger saving amount tend to borrow less because they have money for affording their spending at acceptant level, they are non-poor.

Land size

For household's characteristics, Phan (2012) found that land ownership had negatively significant relationship with demand for credit. It was similar to finding by Phan (2012). Quach (2005) also pointed that household which own more land tended to borrow less than those with smaller land size. The reason is that household with more land is considered as non-poor household who less demand for loan; therefore, there is a little of credit is allocated to them. Moreover, Khandker (2001) and Khandker (2005) proved that there was an inverse relationship between land own and probability of accessibility to microcredit sectors. It is also appropriate in the case of Vietnam (Cuong H. Nguyen, 2007 and Duong Pham, 2002).

In contrast, finding by Okurut (2006) revealed that land endowment has a positive correlation with household's probability to borrow credit. Land title may be considered as collateral for household's borrowing, so it is easier for household with bigger land size to get loan from formal sector (Sai et al, 2010). This result is in the line with the finding by Vu (2002) and Zeller (2001) that Land is the most important variable to measure the household's ability to get credit, especially credit from formal sector. Additionally, some empirical research states that households with large own land scale which is the basic source of livelihood of the farmer demands for more credit in order to run production activities (Mohamed, 2003; Ravi, 2003 and Davis et al., 1998; Svay et al, 2006).

Social network

Relationship between probability of accessibility to credit and social capital has been a controversial issue. A vast of literature has revealed that social capital play a crucial role in credit accessibility, particularly in developing countries (Okten and Osili, 2004; Fafchamps, 2000). Social network is considered as social collateral in order to obtain credit and there is a strong positive relationship between social collateral and credit borrowing shown (Karlan et al, 2009). Bui (2010) also indicated that social capital also play an important factor on credit ration. This result is consistent with the finding by Grootaert (1999) that social capital has positively influence for accessing to credit. Additionally, borrowers rely on social network to lower uncertain information lead to a better flow of information between lenders and borrowers, so demand for credit increase (Thierry, 2000). Considering the role of social network on credit obtaining, it is expected that social capital is a determinant of credit transaction.

Different from previous result, some indicates that social network does not guarantee poor households participate in rural credit (World Bank, 2000).

The objective of this research is to find out the effect of social network not only on overall credit but also on types of credit, informal sector and formal sector.

Location

The main objective of rural credit is to help the rural poor household out of poverty situation, so it is assumed that households in rural area have higher probability to get credit compared to that located in urban area.

However, Consultative Grove to Assist the Poor (CGAP) demonstrated that the probability of accessibility to credit source in rural area is probably significant lower than in urban area. Microfinance for rural areas is not sustainably provide financial services for rural populations; only densely populated areas benefit from a widespread microfinance services. Therefore, households in remote area have less chance to access to credit services. This might be due to opportunity costs of time spending, transaction costs to travel to financial institutions and deficiencies in communication with lenders because of long distance (Zeller & Sharma, 2000). This negative relationship between location and demand for credit supported the result of research by Balogun and Yusuf (2011).

In this research, I examine how location variable does affect the possibility to approach credit source of household.

Rural activities

One target of microcredit is to help the poor on rural farming activities. Therefore, it is assumed that households have more probability of accessibility to rural credit if the households take part in rural activities.

OVERVIEW OF MICROFINANCE SYSTEM

Like other countries, credit system of Vietnam comes from three main sectors including formal, semi-formal and informal sector (Meyer and Nagarajan, 1992). The coexistence of formal sector, informal sector and semi-formal financial sector not only provide greater credit source for the poor but also create greater competition among different credit suppliers in rural credit market. There are different in term of interest rate and lending practices between formal sector, semi-formal sector and informal sector (Pham and Lensink, 2007) .

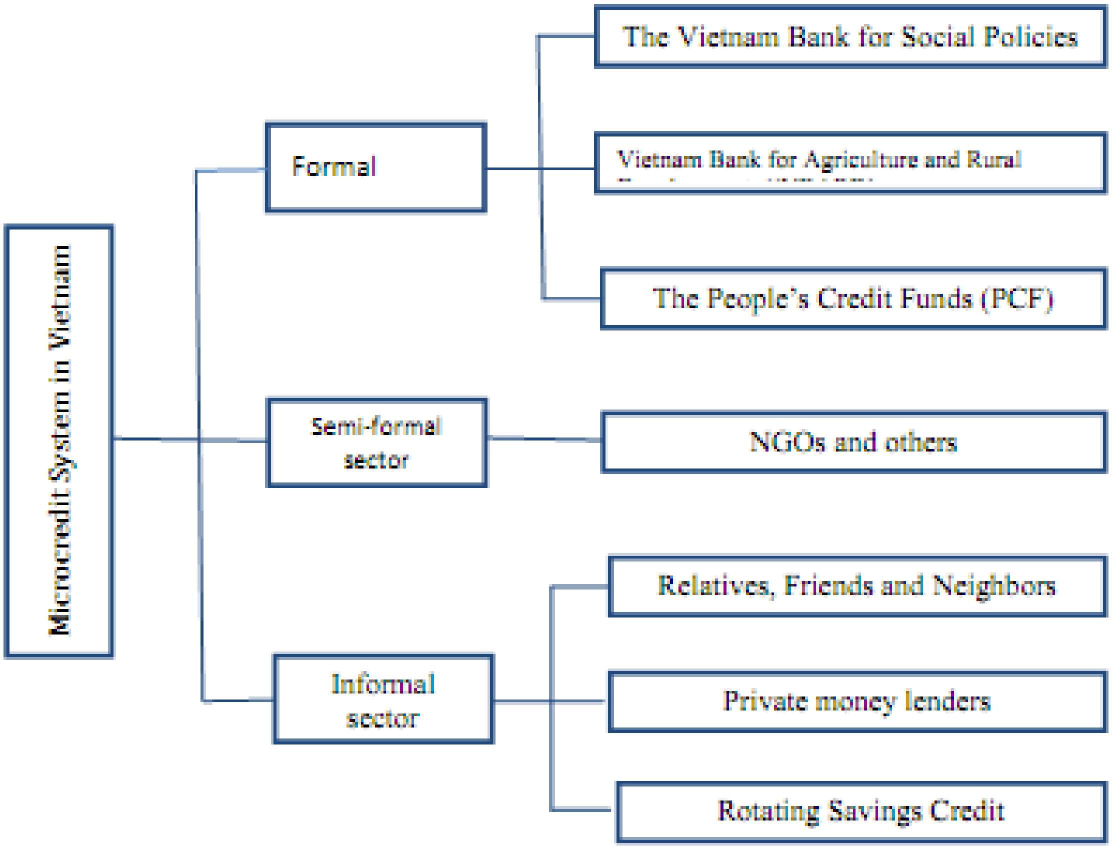

Figure 3.1 Microfinance Systems in Vietnam

The formal credit market

According to World Bank (2002), the formal sector is composed of Vietnam Bank for Social Policy (VBSP), Vietnam Bank for Agriculture and Rural Development (VBARD) that are state owned organizations, and the People Credit Funds (PCF). It was also reported by World Bank (2002) that lending by formal sector is accounted for 73.5% of total lending. Formal sector aims at covering the overall rural credit market. The main strength of this form is that it has a wide network with good connection to Local People Committee which plays an important role in financial system of Vietnam. However, its operation falls in short of achieving the defined objectives (Phan, 2012).

The Vietnam Bank for Social Policies (VBSP)

The Vietnam Bank for the Poor (VBP) was organized in 1995, and it was official renamed to The Vietnam Bank for Social Policies (VBSP) under Premier's Decision No.131/2002QD-TTg date October 4th, 2002 and the government's Decree No. 78/NP-CP dated October 4^{th}, 2002 for the poor. VBSP in the second largest state-owned Vietnam bank established is for the poor and other policy beneficiaries. It operates as an efficient tool helping Vietnam government to fight against poverty by providing low interest rate with formal collateral and accessible financial services to the poor households to reduce the gap that has emerged and to alleviate poverty (Izumida, 2003). VBSP functions under State Bank of Vietnam's supervision and granted by Vietnamese Government. In theory, serving the low income households to obtain credit is the target of VBSP; but in practice, it failed to provide service to the poor. In 2001, only half of VBSP clients served was listed as poor households.

The most quickly method is applied to delivery loans to the poor via four mass organizations namely: War veteran Union of Vietnam, Framer Union of Vietnam, Youth Union of Vietnam and Women of Vietnam. Their responsibilities are establishing saving and credit group; certifying poor households and supervising

The semi-formal credit market

Semi-formal credit sector contains Women's Union, Farmer's Association, Youth Union….or non-governmental organizations (NGOs) financial program are funded by international and national donor (Phan, 2012). Although semi-formal credit funds do not have nationwide network, they have a variety advantages as compared with formal lenders that serve the poor as targeted customers by providing subsidized credit. Additionally, semi-formal such as NGOs are recognized as the best channel providing credit, especially in group lending and social intermediation to help the poor thanks to experiences taken from abroad (Dao,2002; McCarty,2001). Moreover, semi-formal sector is considered as an important channel of many international programs for combat poverty (World Bank, 2000, p.110).

The informal credit market

Informal financial system consists of relatives, friends, neighbor, unregistered private money lenders, traders and rotating savings and credit associations (ROSCAs) (Quach, 2005).

Table 1 below summarizes the main differences between informal credit sector and formal credit sector.

Table 1 Comparison between formal and informal lenders

	Formal sector	**Informal sector**
Clients Targets	Poor household	Poor households
Administrative procedure	Complex procedure	Simple procedure
Collateral	Collaterals such as land use certificate, saving account and so on are required	Basing on trust and personal relationship between borrowers and lenders
Interest rate	Low	High
Loan size	Large	Small
Repayment rate	Low	High

Source: report of VBARD and VBSP, 2012

RESEARCH METHODOLOGY

Table 2 shows joint summary information on household's participation across all three credit sector.

Table 2 Summary of Participation in different credit sectors

(Formal, Semi-formal, Informal)	Frequency	Joint probability
(1,0,0)	724	47.57
(0,1,0)	68	4.47
(0,0,1)	413	27.14
(1,1,0)	24	1.58
(0,1,1)	12	0.79
(1,0,1)	255	16.75
(1,1,1)	26	1.71
Total	1522	100.00

Source: Author's calculation

The estimations of unconditional and conditional for rural credit resources are calculated from Table 2 are presented in Table 3.

Table 3 Conditional and Unconditional Credit Participation Probabilities

	Formal	Semi-formal	Informal
Prob(*)	67.61	8.55	46.39
Prob(*|F=1)	100.00	4.87	27.30
Prob(*|SF=1)	38.48	100.00	29.24
Prob(*|IF=1)	39.79	5.39	100.00
Prob(*|F=1,SF=1)	100.00	100.00	51.98
Prob(*|SF=1,IF=1)	68.40	100.00	100.00
Prob(*|F=1,IF=1)	100.00	9.26	100.00

Source: Author's calculation

The marginal probability of semi-formal sector is the lowest among three sectors with 8.55 percent of the sample. On the other hand, the marginal probability of formal sector is the highest among all type of combinaton with 67.61percent and that of observing informal sector is 46.39 percent. The probability of combination which contains three sectors at one is at the rate of 1.17 percent only.

Additionally, the likely correlations across the threes sector are also shown. For example, whereas 67.61 percent of sample takes part in formal credit, the probability of a household will be a lender from formal resource within the semi-formal participation and informal participation are lower at 38.48 percent and 39.79 percent respectively. Similarly, the percentage of a household participating in semi-formal credit sector or informal credit sector will be lower if they are a participant of any other credit sector. This mean that the probability of any sector participation decreased if there an existence of others. In other words, there is a relationship between different choices for credit participation.

All variables in this are defined in the Table 4.

Table 4 Definition of Variables

Variables	Type	Explanation
Age	Continuous	Age measures the age of household' head and it is performed over 18 years old
Gender	Binary	Gender is sex of household head. This is dummy variable which takes a value one if the household head is female and zero if the household head is male
marital_stt	Binary	Marital status is divided into two categories including married if the household head is married and single otherwise. Marital status would be coded as 1 for married, and 0 for single.
Edu	Continuous	Edu is education level of household head. It is measured by number of schooling year of household head attending.
Hhsize	Continuous	Household size is considered as the number of member in family.
Income	Continuous	Income is the total income of household (1,000,000 VND).
Savingamount	Continuous	It is measured in 1,000,000 VND.
Landsize	Continuous	Landsize is is the size of land owning by household. It is measured in 1,000 m^2.
agriculture_act	Binary	1- Household takes part in agricultural activities 0- Otherwise
Network	Binary	Network variable is zero-one dummy variable; with the value of 1 if the household is member of any Association/ Union/Cooperative/Group/Political Party, 0 otherwise.
Location	Binary	1- household is located in rural area 0- other wise

Summary statistics for all explanatory variables are given in the Table 5.

Table 5 Summary statistics

Variables	Mean	Std. Dev.	Min	Max
Age	47.13	12.38	18	93
Gender	0.84	0.37	0	1
Marital_stt	0.86	0.35	0	1
Edu	8.34	3.23	1	13
Hhsize	5.75	3.42	1	25
Income	88.23	157.53	2.01	4,500.00
Savingamount	22.42	58.27	0	820
Landsize	10.99	16.3	0.04	181.2
Agriculture_act	0.67	0.47	0	1
Network	0.56	0.5	0	1
Location	0.79	0.4	0	1

Source: Author's calculation

Data Analysis Method

It is easy to see that household participating in semi-formal credit sector accounting for only about 10 percent of the total number of household in sample; so the effect of lending from semi-formal credit sector on lending from other sectors is small. Therefore, this research investigates the determinants of accessibility to formal and informal sector as well as the relationship between two types of credit sectors namely formal sector and informal sector only.

There may be a relationship between household's choices for different credit sectors and use of any credit form is not exclusive; hence, there are possible that households use more than one credit sectors. Therefore, equations of probit for sectors participation estimated separately that seems an inefficient approach since that method ignores the relationship between error terms.

Both multivariate probit regression model and multinominal logit regression model can estimate the influence of independent observations on different categories of dependent observations with unordered multiple choices (Gbetibouo,2009). However, it seems that the former is preferred to the latter because it stimulates the effect of a set of explanatory variables on different choices as well as the relationship between these decisions at the same time.

In this case, there are two dependent variables including formal sector participation and informal sector participation; it is assumed that two dependent observations are correlated in bivariate probit model. I develop two binary variables denoting two types of credit provider including formal lender (F), and informal lender (IF) to test which factors impact on decision of access to each of credit sector.

There are two equations for this estimation and each equation is a binary choice model; for simplicity, same explanatory variables are employed in estimation which is given as below:

$$F^{*} = \beta_F X' + \varepsilon_F$$

$$IF^{*} = \beta_{IF} X' + \varepsilon_{IF}$$

In which:

X' presents for explanatory variables including age, gender, marital_stt, edu, hhsize, income, savingamount, landsize, agriculture_act, network and location.

F^{*}, IF^{*} are latent variables for the participation in formal credit sector and informal credit sector

F and IF which received value of 1 if these respective latent variable are greater than 0 and zero otherwise

$F = 1$ if $F^* > 0$ and 0 otherwise

$IF = 1$ if $IF^* > 0$ and 0 otherwise

$\varepsilon_{F,}\ \varepsilon_{IF}$ are error terms which follow multivariate normal distribution with a mean of zero and covariance equal to 1 because magnitude of the variance for the error term can't be identified for each probit estimation (Greene, 2003).

In which:

$$E(\varepsilon_F) = E(\varepsilon_{IF}) = 0$$

$$Var(\varepsilon_F) = Var(\varepsilon_{IF}) = 1$$

$$Cov(\varepsilon_{F,}\ \varepsilon_{IF}) = \rho = \rho_{F,IF} = \rho_{IF,F}$$

$$\begin{pmatrix} \varepsilon_F \\ \varepsilon_{IF} \end{pmatrix} \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix} \quad \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right]$$

There are four possible outcomes in bivariate probit model:

$$P_{11} = \Pr[F=1, IF=1] = \int_{-\infty}^{\beta_F X'} \int_{-\infty}^{\beta_{IF} X'} \phi_2\ (\beta_F X', \beta_{IF} X', \rho) d(\beta_F X') d(\beta_{IF} X')$$

$$P_{10} = \Pr[F=1, IF=1] = \int_{-\infty}^{\beta_F X'} \int_{\beta_{IF} X'}^{\infty} \phi_2\ (\beta_F X', \beta_{IF} X', \rho) d(\beta_F X') d(\beta_{IF} X')$$

$$P_{01} = \Pr[F=1, IF=1] = \int_{\beta_F X'}^{\infty} \int_{-\infty}^{\beta_{IF} X'} \phi_2\ (\beta_F X', \beta_{IF} X', \rho) d(\beta_F X') d(\beta_{IF} X')$$

$$P_{00} = \Pr[F=1, IF=1] = \int_{\beta_F X'}^{\infty} \int_{\beta_{IF} X'}^{\infty} \phi_2\ (\beta_F X', \beta_{IF} X', \rho) d(\beta_F X') d(\beta_{IF} X')$$

$$(\beta_F X', \beta_{IF} X', \rho) = \frac{\exp[-0.5[(\beta FX')2 + ((\beta IFX')2 + \rho(\beta FX')(\beta IFX')]]/(1-\rho 2)}{2\pi\sqrt{(1-\rho 2)}}$$

RESULTS AND DISCUSSION

In this section, bivariate probit model is used to examine which observables affect credit sector in terms of formal sector and informal sector.

Additionally, cross-sector correlatios between formal credit participation and informal credit participation in the sample is examined also.

Estimation of determinants of microcredit participation

The model is estimated by carring out in Stata presented in Table 6.

Table 6 Determinants of accessibility to formal and informal credit sector

Variables	formal credit		informal credit	
	Coefficient	Std Error	Coefficient	Std Error
Age	0.008**	0.003	(0.013)***	0.003
Gender	0.152	0.128	(0.240)*	0.129
Marital_stt	0.068	0.139	0.470***	0.138
Edu	0.029***	0.011	0.006	0.011
Hhsize	0.019*	0.011	(0.054)***	0.010
Income	(0.001)***	0.000	0.001**	0.000
Savingamount	0.003***	0.001	(0.002)***	0.001
Landsize	0.008***	0.003	-0.002	0.002
Agriculture_act	0.055	0.078	-0.005	0.075
Network	-0.045	0.075	0.154**	0.071
Location	0.858***	0.083	(0.332)***	0.082
Rho	-0.81			
Number of observation	1522			
Wald $\chi2(22)$ = 244.13				
Log Likelihood = 480.84				

****significant at 1 percent, **significant at 5 percent, * significant at 10 percent*

The result shows that among eleven explanatory variables including age, gender, marital_stt, edu, hhsize, income, savingamount, landsize, agriculture_act, network and location are considered for research model, the probability of household's participation in formal credit is affected by seven variables namely age, edu, hhsize, income, savingamount, landsize and location. However, the determinants of accessibility to informal credit sector are different from that of formal credit sector. Estimation result indicates seven variables (age, gender, marital_stt, hhsize, income, savingamount, network and location) are statistically significant determinants of participation in informal credit source.

The relationship between age and the probability of formal credit source obtaining is statistically significant at 5% significant level. The probability is higher for the older and that rate declines with age decrease. Different from formal lenders, informal lenders prefer offering loan for the younger to the elderly, is consistent with some studies that assert that accessibility to rural credit negatively related to age (M. Ajugam and C. Ramasamy, 2007; Okurut, 2006; Mohamed, 2003 Zeller, 1994; Magri; 2002). It is explained that young person does not have accumulated asset, which is required by formal sector for their credit borrowing so they tend to borrow money from informal source such as from their friends, from their relatives and so on while the elderly have asset accumulation for collateral requirement from formal lenders. It is possible that the younger have stable income that leads to reduce risk to the informal lenders. Additionally, informal lenders refer to give opportunity for young family member who is the most productive generation in a family in their carrier.

It is possible that gender is not seen as a good proxy that influence on the probability of formal credit borrowing. Because implement of government policy that will reduce gender inequality in rural credit market, so there is no difference in the right of applicant in terms of gender for the purpose of economic empowerment and economic development. However, there is gender discrimination existence in the lending credit from informal lender with estimated coefficient for household head gender is negative and statistically significant at 10% level. In the line with literature review, more male-headed household is served by informal sector compared to female-headed household. This phenomenon is consistent with the finding by Wabei (2012) that female usually lack of collateral relative to their male counterpart.

The result from estimation shows that there is a positive relation between marital status and the chance for credit rationing from informal sector. It demonstrates that single household head have lower probability to access to informal credit sector, it is explained by Ferede (2012) that single persons are lack of social network. This phenomenon was also indicated by many researchers such as Kirchler Kamleitneir and Kirchler (2007); Bridges et al. (2004); Magri (2002).

According to this estimation, education has no effect on the probability of informal credit obtaining. In contrast to the result from the informal sector, educational level plays a critical role in determining demand for formal credit sector at 1% significant level. Positive sign of estimated education coefficient means the higher educational qualification, the higher probability of accessibility to formal sector for applicants. That is in line with the literature, demand for credit will be low if borrowers have fewer years of schooling (Khandker, 2001; Cuong H. Nguyen, 2007). Additionally, high education correlates high income with productive jobs; so the formal lenders prefer to higher educated borrowers because of their lower default risk of lending.

Besides, this research shows that the larger family has positive effect on the probability of accessibility to formal credit borrowing while that has significantly negative influence on informal credit sector participation at 1% significant level. It is explained that formal sector is partially control by government with the policy that concerns on large families with more children and elderly people because family with more dependents will be more vulnerable to economic shock. On the other hand, informal lenders do not require any document as collateral, lenders and borrowers in this sector treat each other by informal law. So the informal lenders have to consider if borrowers have repayment ability at the maturity date; if a family has many dependent family members the risk default will be high for informal lenders, so they are more willing to lend to families which do not have many children and the elderly who their age is out of labor force.

There is a strong relationship between household's income and credit allocation in both formal and informal sector. However, the sign of household's income coefficient of formal credit source is different from that of informal credit source. According to this research estimation, it points that income is an important factor that has a positive impact on household's demand for informal credit at 5% significant level. It implies that more income household get, more opportunity to borrow money from informal credit sector; this result is consistent with researches by Crrok (2001), Lin and Yang (2005), Jappelli and Pistaferri (2007), Ambrose et (2004) which states that high-income households more likely access to loan than low-income household. Different from the result from informal credit sector, it reveals that there is a negative relationship between income and credit constrain for formal sector. The result show that household would like to borrow more when their income is low because more low income, more marginal utility of consumption. As literature involved in rural credit, primary target of microfinance is that provides capital for the poor to help them in living improvement (World Bank, 2010), so the chance for credit obtaining is lower with high income applicant. This research result is in line with the finding by Pham & Lensink (2007); Li et al. (2011) and Ferede (2012).

The estimation results that saving amount plays an important factors of credit participation in both formal and informal sector at 1 percent of significance. The negative coefficient of savingamount variable in informal sector implying that household with large saving amount is not considered as a poor house. Different from that, there is a positive relationship between savingamount variable and formal credit participation. As mentioned by many researches, formal credit requires collateral for credit lending, so borrowers have bigger saving amount will have higher chance for borrow money from formal credit source. The sign of coefficient of savingamount variable in this research is consistent with literature review.

Result shown in Table 6 indicates that relationship between rural credit participation and land size is statistically significant at 1 percent level. It is explained that land size is consider as collateral for credit borrowing, so it is easy for households with bigger land size to access to credit market, especially formal market which ask household to submit collateral to reduce risk; this result is consistent with finding by Vu (2002) and Zeller (2001). According to Mohamed (2003), Ravi (2003) and others, households own large land scale need more credit for agricultural production. However, household borrowing from informal sector is significantly negative related to land size at the 1% level of significance. There is an assumption that household with large land size is not consider as the poor (Quach, 2005).

Network does not effect on formal credit sector. However, social capital plays as an important factor of participation in informal credit sector at the 5% level of significance. The positive coefficient of social network proves that household which is a member of any organization will have more probability to borrow money from informal sector. This possibly demonstrates that household's network is considered as social collateral that plays crucial role in lending from informal sector because this transaction bases more on trust and personal relationship. This result is consistent with findings of Okten and Osili (2004); Fafchamps (2000); Karlan (2009); Bui (2010) and Grootaert (1999).

Consistently with primary target of rural credit that is to help rural households, this estimation shows that probability of households located in rural areas is higher than that of households located in urban area. It demonstrates that the sign of coefficient of location variable is statically positive at 1 percent of significance in estimation of determinants of accessibility to formal credit. However, estimated result shows that more households in urban areas participate in informal credit sector. As known, standard of living in urban areas in higher than that is rural areas; so urban families have more free money for lending to help the poor.

The Likelihood-ratio (χ^2= 490.84) test suggests that two error terms are significant correlation (reject null hypothesis of zero correlation). Additionally, rho (ρ) is presented for estimated correlation receive the value of -0.81 is far away from zero and estimation shows that Prob > chi2 = 0.0000 implying that there is a relationship between two dependent variables. That leads to conclusion that bivariate probit model estimation is superior to those of unvariate probit model. Specifically, negative value of rho in estimated result indicates that the choice of rural credit sources is negatively correlation and it is also affected by unobserved variables.

There are many marginal effects can be evaluated for bivariate probit model. For example, marginal effects are calculated for different outcomes such as Pr(formal=1, informal=1), Pr(formal = 1, informal = 0), Pr(formal = 0, informal = 1) or Pr(formal=0,informal=0), or or for the unconditional probabilities such as Pr(formal = 1) and Pr(informal = 1), or for the conditional probabilities such as Pr(formal=1|informal=1) and Pr(informal=1|formal=1).

Marginal effects for continuous variable are computed differently from that for binary variables. For dummy variables, marginal effect relates to discrete change in the probability of participation in a particular sector in response to an increase of explanatory variable from zero to one; holding all other variables at their means. Whereas, for continuous variables, marginal effect relates to instantaneous rate of chance measuring the absolute change of probability of participation in a particular sector in response to one unit increase of dependent variables.

Since there is a correlation of error terms of two functions, so conditional marginal effects and marginal effects are different even at the same referent points. Because this research accounts for the relationship between two types of credit sector, conditional marginal effects make more sense than others. Therefore, in this section, I present results of conditional marginal effects only.

Estimation of conditional marginal effects

Marginal effects for conditional probability of formal participation sector with given informal sector participation, Pr(formal=1|informal=1) are as Table 7.

Table 7 Marginal effects for conditional probability of formal sector participation

Variables	dy/dx	Std. Err.	P>|z|	X
Age	0.00016	0.001	0.905	47.133
Gender	0.009	0.056	0.87	0.839
Marital_stt	0.182	0.055	0.001	0.855
Edu	0.017	0.005	0	8.34
Hhsize	-0.007	0.005	0.161	5.755
Income	-0.0002	0	0.052	88.226
Savingamount	0.001	0	0.099	22.418
Landsize	0.003	0.001	0.006	10.992
Agriculture_act	0.003	0.035	0.42	0.671
Network	0.003	0.033	0.486	0.561
Location	0.316	0.027	0	0.794

Source: Author's calculation

The predicted probability that a household participates in formal sector is 40.18 percent at the reference points, given that household participates in informal sector already: Pr(formal=1|informal=1) = 0.40, as calculated in Table 3.

Command predict(pcond1) is employed to compute conditional marginal effects for each independent variable on formal sector participation with given informal participation sector.

The estimation result presents when combining direct and indirect effects, for an additional year of education level of household head, the probability of accessibility to formal credit sector will increase by 1.7 percent; all other variables are hold constant at their reference points.

In term of marital_stt, the opportunity to get credit from formal source for married household head is 18.2 percent higher compared to that for unmarried household head.

Similarly, the location of household, which participates in informal credit sector, plays an important role in credit lending from formal sector. The result shown suggests that the predicted probability of lending credit from formal sector is expected to increase by 31.6 percent for household located in rural area, ceteris paribus.

Besides, dy/dx for income variable is -0.0002. This means that after controlling for other variables at their means, the probability of accessibility to formal credit will be reduced 0.02 percent when household's income increases by 1.000.000 VND, given that household participates in informal sector already.

Saving amount is considered as formal collateral for credit borrowing. Therefore, it has positively correlated to formal credit obtaining. Particularly, given household participates in informal credit sector, the probability of accessibility to formal credit sector increases in 0.1 percent if saving amount of household increasing 1.000.000 VND.

Additionally, the predicted probability of accessibility to formal sector of a household which participates in informal sector already will be increased by 0.3 percent when the land owned by that household increase by 1000m^2, holding other variables at their reference points.

Similarly, marginal effects for conditional probability of informal participation sector with given formal participation sector, Pr(informal=1|formal=1) are shown as Table 8.

Table 8 Marginal effects for conditional probability of informal sector Participation

Variables	dy/dx	Std. Err.	P>|z|	X
Age	-0.004	0.001	0	47.133
Gender	-0.074	0.051	0.142	0.839
Marital_stt	0.187	0.034	0	0.855
Edu	0.009	0.004	0.019	8.34
Hhsize	-0.02	0.004	0	5.755
Income	0	0	0.265	88.226
Savingamount	0	0	0.155	22.418
Landsize	0.001	0.001	0.497	10.992
Agriculture_act	0.01	0.027	0.713	0.671
Network	0.057	0.026	0.027	0.561
Location	0.061	0.029	0.038	0.794

Source: Author's calculation

The predicted probability that a household participates in informal sector is 27 percent at the reference points, given that household participates in formal sector already: Pr(informal=1|formal=1) = 0.27 as calculated in Table 3.

Command predict(pcond2) is employed to compute conditional marginal effects for each independent variable on informal sector participation with given formal participation sector.

Accordingly, household head's age has negative effect on informal credit participation, given that household participates in formal sector already; in particular, holding others variables constant, one age addition leads a decrease of 0.4 percent in probability of informal credit accessibility.

Similarly to Pr(formal=1|informal=1), Pr(informal=1|formal=1) has been affected by marital status of household head. Given household participates in formal credit sector, the possibility for that household approaches informal providers is 18.7 percent higher for married household, ceteris paribus.

Consistently with finding by Yehuala (2008); Okunade (2007); Vaessen (2001) and Okunade (2007), estimation result shows that one year increase in education level will produce a 0.9 percent increase in the probability of participation in informal credit source, holding other variables at constant.

Besides, the value of dy/dx for household size variable is -0.02 explaining that, controlling other variable at their reference, the percentage of probability for informal participation goes down by 0.2 for every additional the number of member in household which participates in formal credit sector already.

Additionally, social network and location is positively related to household borrowing from informal credit sector. According estimated result, the percentage of accessibility to informal credit sector for household participating in formal credit sector will increase by 5.7 percent and 6.1 percent respectively if the value of independent variable changes from zero to one.

CONCLUSION

This section presents findings of this research, policy recommendations as well as limitations of the research.

Research Findings

This research employs bivariate probit model to exam the factors influencing household accessibility to formal credit sector and informal credit sector as well as relationship between two of them is investigated. The results show that the determinants of the use of formal credit sector are different from the determinants of the use of informal credit sector. Furthermore, the probability of formal sector participation will be decreased if there is an existence of informal credit sector participation and vice versa.

Bases on estimated results, seven determinants namely age, edu, hhsize, income, savingamount, landsize and location affect the formal credit participation. The estimation indicates that formal lender tend to provide credit to household who are better off with collateral requirement such as land size or saving amount.

Policy implications

Based on the research results, in order to improve the smooth of microfinance system operation; some policies are suggested

As research result indicated, education level is statistically significant factor of formal credit sector; complicated process leads to imperfects in choosing credit source of poor household that has low level of education. Therefore, administrative process for lending should be more simplifier.

Secondly, criteria for lending assessment process should reflect the primary target of microfinance system, do not depend on the confidence the lender has.

Thirdly, developing an appropriate management system to manage informal credi source is to promote the positive role of this sector in poverty reduction in rura areas.

Limitations

The number of households that participate in semi-formal credit in sample collecte is small, so this research cannot examine the relationship between the choice o semi-formal credit sector and that of formal credit sector as well as that of informa credit sector.

Moreover, determinants of credit participation come from demand sid characteristics and supply side characteristic (Vaessen, 2002; Duong Pham, 2002) However, in this research, I focus on demand side presented by characteristics o household only.

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The Product and Timing Effects of eWOM in Viral Marketing

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To be effective in viral marketing campaigns, firms must first select proper disseminators, and use them as opinion leaders to communicate the information with followers via mass media in the online space. In this paper, we study major characteristics of opinion leaders and find that their online word-of-mouth (eWOM) increase product sales. Our findings provide firms managerial insights about product aspects of eWOM, and how firms should arrange the timing of eWOM for successful viral marketing campaign.

It has been noted that consumers have shown a tendency of using online word of mouth (eWOM) in finalizing their buying decisions (Guernsey 2000). Studies have revealed that consumers tend to consult with eWOM more than advertising because they trust their peers more than firms that sell products (Piller 1999). Thus, firms that receive favorable eWOM will likely enjoy a better chance for sales increase (Chevalier and Mayzlin 2006, Chung 2011). eWOM is an important source of information for consumers to make purchase decisions. Given the user-generated nature of eWOM, how can firms better utilize such eWOM to their advantage? As a hybrid between traditional advertising and consumer word of mouth, eWOM can be initiated by firms as a campaign and implemented by consumers for marketing communications (Godes and Mayzlin 2009). For an eWOM marketing campaign to be successful, it is critical to consider the behavioral characteristics of target consumers and the seeding strategy for selecting opinion leaders (Hinz et al. 2011). The purpose of this study is to identify eWOM opinion leaders and to examine the impacts of such opinion leaders' eWOM on a firm's product sales.

Literature Review

Word of mouth (WOM) has long been used to promote products or to criticize a competitor (Jacobson 1948, Katz and Lazarsfeld 1955). Its impact on sales and diffusion of new products was first reported to be positive in Arndt's study (1967). In recent years, the development of social network, and social media has further helped the spread of WOM via internet. eWOM has thus been suggested as "free sales assistant" of online sellers (Chen and Xie 2008). However, it is critical for firms to identify proper opinion leaders for seeding eWOM in order to generate favorable buzz effectively towards their products. Based on the nature of eWOM, we review the literature of opinion leader and WOM related to viral marketing and propose hypotheses for studying the relationships between opinion leaders' eWOM and sales.

Viral Marketing via Opinion Leaders

In a viral marketing campaign, firms select a small number of consumers as opinion leaders to disseminate information (Hinz et al. 2011). To be effective in such campaign, firms must first identify key opinion leaders, and then let key opinion leaders to communicate the information as disseminators with followers via mass media (Iyengar et al. 2011). Key opinion leaders are consumers who provide information and leadership to others in making their consumption decisions (Childers 1986). Given the opinion leaders' behavioral tendency and ability to influence purchase decisions of followers, a firm can benefit from effective use of such opinion leaders in order to assist potential customers for shaping their buying decisions in favor of the firm's products. A theoretical basis for viral marketing is to follow a two-step process that involves target opinion leaders (Lazarsfield et al. 1944). For example, by using the fashion-related magazines as a mass media, firms can benefit from the use of target opinion leaders in women's clothing fashion who tend to read such magazines (Summers 1970). However, how could firms identify proper opinion leaders for effective viral marketing?

Rogers and Cartano (1962) summarizes three methods of identifying opinion leaders: (1) self-designation, i.e. asking consumers to identify whether and to which extent they are opinion leaders; (2) sociometric method, i.e., using social network to compute network centrality and other network structure related measures; (3) key informant method, i.e., asking consumers whom they listen to. The self-designation method seems to be the most popular method in marketing literature due to the survey proposed by King and Summers (1970), while the key informant method is also used in recent studies (e.g., Nair et al. 2010). The main findings are that, self-designated and peer-nominated opinion leaders influence the choices of their followers. The sociometric method has been widely used by network analysis researchers, and has obtained increasing recognition among marketeers (Iyengar et al. 2011, Hinz et al. 2011). Previous studies reveal that both hub which is connected with many people and bridge which connects two clusters are influential (Hinz et al. 2011). However, large cascade of influences may not be driven by opinion leaders but by a large number of easily influenced people (Watts and Dodds 2007). In addition to the above-mentioned methods, other methods are also used to identify opinion leaders. For example, Aral and Walker (2012) use demographics to identify opinion leaders, and Godes and Mayzlin (2009) examine whether loyalty can be a moderating factor for self-designated opinion leaders. (2012).

In this study, we empirically study the appropriateness of opinion leaders identified from a dataset of Amazon reviews for the benefit of using its product sales rank and user rating information. The dataset is described in the following section. In order to classify key eWOM opinion leaders, we consider three attributes of Amazon website reviewers in the dataset. The first attribute is how many reviews a consumer posts on the website. By counting the number of reviews a consumer writes, we identify communicative reviewers as opinion leaders. According to an early study (Lazarsfeld et al. 1944), communicative opinion leaders tend to be someone who is most concerned and most articulate about the products. Consumers write their opinions for a number of reasons. Based on their expertise and/or usage experience, opinion leaders have a tendency of helping other consumers or the firm (Sundaram, Mitra, & Webste 1998). Posting reviews give them a chance to articulate their opinions and thus reduce the emotional tension if they feel strongly about a product (Dichter 1966).

The second attribute of opinion leaders is how much buzz a consumer’s review generates from peers. We identify buzz-generating consumers as opinion leaders. Previous study demonstrates that opinion leaders are progressive attention-seekers (Summers 1970). Opinion leaders fulfill their self-enhancement motivation via buzz creation (Engel, Blackwell, and Miniard 1993). The reviews written by buzz-generating opinion leaders can generate buzz among followers for them to increase product/brand awareness. And such awareness was found to be good for sales, whether the buzz is positive or negative (Berger et al. 2010). As such, buzz-generating opinion leaders could help firms to increase sales through the buzz they created.

The third attribute of opinion leaders is how trustworthy product reviews are considered by the other consumers. In the offline world, WOM is spread through consumers who know each other, that is, “whom he knows” for an opinion leader (Katz 1957). But this is not the case in an online setting where eWOM is disseminated freely among strangers. It remains a question why consumers trust eWOM from strangers? Obtaining target consumers' trust is a major challenge for firms operating on the Internet (Resnick et al. 2000). Consumers tend to rely on information sources with good reputation. Structural, lexical, sementical aspects of eWOM have been found to be related to trustworthiness of eWOM (Chen et al. 2008, Cao et al. 2011). We identify the most trustworthy buzz-creating opinion leaders as the consumers who generate the most helpful reviews.

Having identified communicative, buzz-generating, and trustworthy opinion leaders, we study the relationships between sales and eWOM of these opinion leaders. We discuss two streams of research on eWOM that have been found in the literature, namely, product effects and timing effects.

Product Effect of eWOM on Sales

There are three product aspects of eWOM, namely, product awareness/popularity, customer satisfaction and horizontal product differentiation. We first examine the product awareness/popularity of eWOM. Product awareness is the first phase in consumer's buying decision. Without product awareness, consumers will not have the interest and desire to consider a particular product that leads to a buying decision. The amount of eWOM influences consumers in two ways. It has been noted that the amount of eWOM increases exposure to a product and therefore increases consumer's awareness of the existence of a product (Liu 2006). In addition, large amount of eWOM suggests popularity of a product (Chen et al. 2004, Zhu and Zhang 2010). Previous studies reveal that volume of eWOM drives sales (Chevalier and Mayzline 2006, Liu 2006, Dellarocas et al. 2007 and Duan et al. 2008). We thus propose:

H1a: *Product Popularity and Awareness* is positively associated with Sales.

Consumers communicate their satisfaction using online user rating, (Chen and Xie 2008, Sun 2012). The persuasiveness of user review depends on consumption goal of a consumer. Positive review is more persuasive than negative review for products used for promotional consumption goal, while the opposite holds for products used for prevention consumption goal (Zhang et al. 2010). It has been found that consumer satisfaction can influence future sales (Kopalle and Lehmann 2006, Yi 1989). In his study, Liu (2006) indicates that positive rating can enhance consumer's attitude while negative rating reduces attitude. Although most existing literature finds that product satisfaction drives sales (Chevalier and Mayzline 2006, Dellarocas et al. 2007, Moe 2009, Chintagunta et al. 2010), negative review can also drive sales due to its ability to increase consumer awareness (Berger 2011). Therefore, we propose:

H1b: *Product Satisfaction* is positively associated with Sales.

Consumers perceive vertical differentiation in the same way. In contrast, consumers have different rankings of a group of products which are horizontally differentiated (Hotelling 1929). For example, fuel efficiency in mile per gallon (mpg) is vertical differentiation. But features of comfort vs. sportiness are examples of horizontal product differentiation. The same product can satisfy some consumers and receive high ratings while disappoint other consumers and receive low ratings at the same time. And a high variance indicates that a product is well differentiated horizontally, satisfying more consumers in different target segments, and therefore drives sales (Godes and Mayzlin 2004, Clemons et al. 2006, Sun 2012). We thus propose:

H1c: *Horizontal Product Differentiation* is positively associated with Sales.

Timing Effect of eWOM on Sales

It has been noted that eWOM marketing campaign tends to last a short period of time (Godes and Mayzlin 2009). The timing of launching eWOM is thus critical for generating desired effect of a firm's marketing campaign. Researchers have found that eWOM at the early stage of product luanch increases product sales (Liu 2006, Li and Hitt 2008). However, eWOM has diminishing effects over time (Cao et al. 2011). It is then a challenge for firms to decide how to arrange the timing of eWOM marketing campaign. Two hypotheses (H3a and H3b) are developed accordingly to test the relationships between the first arrival and time span of eWOM and sales. Finally, similar to advertising intensity, we hypothesize (H3c) that the intensity of eWOM also has an impact on sales (Strong 1977, Naik et al. 1998, Appleton-Knapp et al. 2005). We use standard deviation of opinion leaders' eWOM as a proxy for eWOM intensity.

H2a: Early arrival of top eWOM is positively associated with sales.

H2b: Time span of top eWOM is positively associated with sales.

H2c: Standard deviation of top eWOM is negatively associated with sales.

Data and Model

Data and Opinion Leaders

Online user review has been used as a proxy for overall eWOM (Zhu and Zhang 2009). In this paper, we use an Amazon user review dataset to identify opinion leaders and study eWOM dissemination. The dataset contains a sample of 350122 book, music, video and DVD titles which, as experience goods, have qualities difficult to ascertain before consumption, and therefore user reviews are helpful for consumers (Nelson 1970, Park and Lee 2009). A user review on Amazon has both a star rating and a text review. For each title, we collect three statistics of star rating, i.e., average rating, number of reviews, and variance of all star ratings for the title. On average, a title receives 13.98 reviews with an average rating of 4.33 and variance of 0.68. Amazon puts a title into relevant product categories. Amazon product category has a tree structure. For example, Jane Austen's Sense and Sensibility belongs to the category: /Books/Literature & Fiction/World Literature/ British/19th Century. The category at the top level of the tree is book, and the deeper the tree is, the finer the category is. The category count for a title ranges from 1 to 116 with an average of 4.88. Our approach to identify opinion leaders is based on the fact that Amazon allows consumers to display their names for their user reviews. We identify 1479053 unique consumers who write 86% of the user reviews in the dataset. The remaining 14% of the user reviews have no unique identifications. On average, a unique consumer writes 4.37 reviews. The most prolific consumer writes 8659 reviews. Amazon provides a mechanism for consumers to respond to a user review, that is, consumers can vote whether a user review is helpful or not. The number of vote (either helpful or not) that a user review receives is a proxy for buzz. And the number of helpful votes is a proxy for how trustworthy a user review is. On average, a consumer receives 26.43 votes, and 12.83 helpful votes.

Some researchers treat all reviewers as opinion leaders (Cui et al. 2010). But we are interested in examining a much smaller set of reviewers because it is costly for a firm to recruit all available reviewers. The theoretical basis for considering a subset of reviewers is that opinion leadership is not a dichotomy: consumers are not clearly divided into two groups of opinion leader and followers. Instead, opinion leaders also listen to followers, and opinion leadership varies in a continuous fashion (Rogers 1962). As discussed in Introduction, we identify communicative opinion leaders as the top 21458 reviewers in terms of the number of user reviews written (1.5% of the total unique consumers in the dataset). We identify buzz-generating opinion leaders as the top 21458 reviewers in terms of number of votes, and identify trustworthy opinion leaders as the top 21458 reviewers in terms of the number of helpful votes. It is worth noting that the three types of opinion leaders are not mutually exclusively. The total size of the three sets is 21458×3=64371, but the total distinct number of the opinion leaders in the three sets is 34340. 12109 consumers are both communicative and buzz-generating opinion leaders. 11819 consumers are both communicative and trustworthy opinion leaders. And, 16989 consumers are both buzz-generating and trustworthy opinion leaders. 10886 consumers belong to all three sets. The overlapping of different types of opinion leaders is consistent with extant literature (Iyengar et al. 2011).

Opinion Leader's eWOM

We discuss how to operationalize the hypothesis for communicative opinion leaders (the same operationalization applies to buzz-generating and trustworthy opinion leaders). Since we are interested in the impact of opinion leaders on sales, the unit of analysis is a title. Following extant literature, we use log transformation of sales rank as a proxy to sales (Chevalier and Mayzlin 2006). To test product effects of eWOM (H1a-c), we collect star ratings from communicative opinion leaders for each title. Then we compute the three statistics for each title, i.e., number of ratings (volume), average rating (valence), and standard deviation (SD). We operationalize product popularity/awareness, product satisfaction, and horizontal differentiation by volume, valence, SD (summary statistics of the variables for communicative opinion leaders are reported in Table 1). A title receives between 1 and 1000 reviews from communicative opinion leaders, and the average rating is 4.24, and the standard deviation is 0.40.

Table 1: Summary Statistics

Variable	Mean	Std. Dev.
Log sales rank (*Sales*)	11.57	1.60
Category count ($Count_{cat}$)	5.34	4.95
Volume of reviews (*Volumn*)	6.02	17.57
Average rating (*Valence*)	4.24	0.86
Std. dev. of rating (*SD*)	0.40	0.50
Arrival time of first review ($Time_1$)	454.70	562.48
Average arrival time of reviews ($Time_{ave}$)	758.80	634.58
Std. dev. of arrival time of reviews ($Time_{SD}$)	239.20	264.82
Average knowledge of opinion leader (*Know*)	3710.00	4793.44
Average distinct knowledge of opinion leader ($Know_d$)	2874.00	4453.40

To study timing effects of eWOM, we need a measure of when user reviews arrive. Since we do not have information on when a title is launched on Amazon, we use the date of the first user review as a proxy for the launch date. The *arrival time* of a user review is the days elapsed from the launch date. We collect arrival time of the first review written by a communicative opinion leader. We also collect the arrival time of all reviews by communicative opinion leaders, and use them to find the average and standard deviation of arrival time.

We add two control variables for each title. The first is the number of categories a title belongs to as *category count*. As shown in Table 1, a title belongs to 5.34 categories. The highest number is 116. As described in Data section, Amazon's category has a tree structure. We use the top level of category as a control variable and refer to it as *group*. A group can be book, music, video, and DVD (Table 2).

Table 2: Summary Statistics for Product Group

	Book	Music	Video	DVD
Number	129615	46913	10725	12000

We specify the following model to empirically test our hypothesis.

$$sales = \beta_0 + \beta_1 group + \beta_2 count_{cat} + \beta_3 valence^j + \beta_4 volume^j + \beta_5 SD^j + \beta_6 time_1^j + \beta_7 time_{ave}^j + \beta_8 time_{SD}^j + \varepsilon.$$

$Sales$ = logarithm of sales rank

J = types of opinion leaders, i.e., communicative, buzz-generating, and trustworthy

$Group$ = top level of category tree, i.e. book, music, DVD, and video

$Count_{cat}$ = number of categories to which a title belongs

$Valence^j$ = average review by type j opinion leader

$Volume^j$ = number of reviews by type j opinion leader

SD^j = standard deviation of reviews by type j opinion leader

$Time_1^j$ = arrival time of first review by type j opinion leader

$Time_{ave}^j$ = average arrival time of reviews by type j opinion leader

$Time_{SD}^j$ = standard deviation of arrival time of reviews by type j opinion leader

Results and Discussions

We first test our model specifications with two alternative models where timing effects and knowledge effects are omitted. We conduct regression analysis on 90% of the total sample, and then use the estimated parameters to conduct a prediction exercise on the remaining 10% hold-out sample. Comparison of in-sample fit and prediction error on hold-out sample suggests that our model fit the sample the best (Table 3). Next we report estimation results on communicative opinion leaders. Similar results hold for buzz-generating and trustworthy opinion leaders (we omit detailed reporting due to space limit).

Table 3: Model Validation

	In sample (AIC**)	Hold-out sample (RMSE***)
Model 1*	580977.700	3.086
Model 2	570920.200	3.054

*Model 1: product effects only; model 2: product and timing effects.
**Akaike's Information Criterion (AIC) is defined as $AIC = -2 \times \log(l) + 2 \times p$
where l is likelihood and p is number of parameters.
***RMSE = Root Mean Square Error.

The intercept estimates in Table 4 is interpreted as the intercept for book group since group is a factor variable. The music group has a significant estimate of -1.304 where the minus sign implies that, as a group, music titles have higher sales than book titles because a lower sales rank means higher sales. Comparing estimates on music, video, and DVD, we find that video has the highest sales, DVD the second highest, music the third highest, and book the lowest. The estimate on category count is -0.011 and significant. It implies that sales increase in category count. An explanation is that category count is a proxy for content diversity of a title. The more diversified a content is, the more market segments a title appeals to, and thus the more consumers it is able to attract.

Table 4: Estimates of eWOM

	Model 1 (product effects)	Model 2 (product and timing effects
Intercept	13.472*	13.460*
	(0.017)	(0.017)
DVD (*Group*)	-2.207*	-2.262*
	(0.014)	(0.014)
Music (*Group*)	-1.269*	-1.291*
	(0.007)	(0.007)
Video (*Group*)	-2.532*	-2.510*
	(0.014)	(0.013)
Category count ($Count_{cat}$)	-0.018*	-0.013*
	(0.0007)	(0.0007)
Average rating ($Valence$)	-0.220*	-0.168*
	(0.004)	(0.004)
Volume of reviews ($Volumn$)	-0.016*	-0.013*
	(0.0002)	(0.0002)
Std. dev. of rating (SD)	-0.520*	-0.255*
	(0.006)	(0.007)
Std. dev. of arrival time of reviews ($Time_{SD}$)		2.900e-04*
		(2.956e-05)
Average arrival time of reviews ($Time_{ave}$)		-1.007e-03*
		(2.094e-05)
Arrival time of first review ($Time_1$)		7.471e-04*
		(2.177e-05)

Product Effects

The estimate for volume is -0.011 and significant. It implies that high product popularity/awareness increases sales (H1a). The estimate for average rating is -0.163 and significant. It implies that high product satisfaction increases sales (H1b). The estimate for standard deviation is -0.216 and significant. It implies that high horizontal differentiation increases sales (H1c). Although the extant literature has demonstrated the three product effects, researchers have not found evidence that all three product effects are significant in one empirical setting. Explanations for the inconsistency are: (1) empirical issues including collinearity and functional form (Godes and Mayzline 2004), market aggregation and time series (Chintagunta et al. 2010), (2) specific roles of a measure including volume increasing awareness (Liu 2006) and variance signaling hyper-differentiation (Clemons et al. 2006), and (3) variance and volume both depends on quality (Moe 2009). Consumer satisfaction, consumer awareness/popularity, and horizontal differentiation are all costly to accomplish. The extent literature seems to suggest that marketers only need to focus on two of three product effects. But our result is the first evidence to support the importance of improving all three product effects at the same time. We also compare the three types of opinion leaders in terms of eWOM. We find that communicative opinion leader's eWOM is the strongest on the dimension of consumer satisfaction. Buzz-generating opinion leader's eWOM is the strongest on the dimension of horizontal differentiation. Trustworthy opinion leader's eWOM is the strongest on the dimension of product awareness/popularity.

Timing effects of eWOM from Opinion leaders

The estimate of arrival time of the first review by communicative opinion leader is 6.363e-04 and significant. It implies that a short arrival time of the first communicative opinion leader's eWOM increases sales (H2a). But the estimate of average arrival time of all communicative opinion leaders is -9.032e-04 and significant. It implies that a long average arrival time of all communicative opinion leaders' eWOM increases sales (H2b). In addition, the estimate of standard deviation of all communicative opinion leaders is 2.335e-04 and significant. It implies that a small standard deviation of all communicative opinion leaders' eWOM increases sales (H2c).

Although early researchers have found evidence that opinion leaders and early purchasers can overlap, opinion leaders are not necessarily early purchasers (Arndt 1967, Baumgarten 1975). Recent studies in eWOM context have found that eWOM has more impact at the early stage of the product life cycle (Liu 2006, Li and Hitt 2008). So an implication is that firms should have eWOM marketing at the early stage of product launch. Our finding implies that opinion leader's eWOM has effects on sales at both early and later stage of product life cycle. In addition a given eWOM has diminishing effects over time (Cao et al. 2011). So to arrange the timing of eWOM, firms should start eWOM of opinion leader as early as possible. But firms should also spread eWOM from opinion leaders over time. As a consequence, the average time will increase. The finding that small standard deviation of arrival time increases sales suggests that eWOM of opinion leaders should be close to one another. Such implication is consistent with the findings that advertising messages need to be grouped together to increase intensity in advertisement scheduling literature (Naik et al. 1998, Appleton-Knapp et al. 2005). Among the three types of opinion leaders, communicative opinion leaders has the largest marginal effects in first eWOM arrival time, average arrival time, and standard deviation of arrival time.

Conclusion

In summary, our findings provide the following insights to help firms create communication campaigns in the US. Despite being a small fraction of target consumers, communicative, buzz-generating, and trustworthy opinion leaders drive sales through disseminating eWOM. Firms should start the eWOM campaign as early as possible in order to obtain early mover advantage. But firms should not arrange all opinion leaders to write reviews at the early stage of the product adoption process. Instead, firms should have eWOM from opinion leaders over a long period of time. And eWOM intensity needs to be strong. This paper has the following limitations that we hope to address in the future research. First, we do not consider mediation factors such as willingness to buy and online-store image/product image. Second, the extant literature has identified opinion leaders based on network structure (Hinz et al. 2012). Our dataset does not have information to study the network-related properties of opinion leaders identified in our paper.

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Estimating the Equity Beta for the Listed Vietnamese Utilities: A Quantile Regression Approach

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This study was conducted to estimate the equity beta, a key input of the Sharpe-Lintner capital asset pricing model, which then can be used to determine an expected return on equity. The motivation of this study is to provide the Vietnamese Government with an additional piece of evidence in relation to the determination of the sale prices of the government owned assets during the process of privatization and equalization.

Using a sample of 19 listed companies operating in the Utilities Industry in the Ho Chi Minh City Stock Exchange for the period of more than 7 years (from 2007 to 2013 inclusive), a new approach (a Quantile Regression approach); together with the other two traditional approaches (the OLS and the LAD), have been used to estimate the equity beta for these listed firms in this study. Estimates of beta were conducted at the individual firms' level and at the portfolios' level. At the portfolios' level, two different types of portfolios are formed: (i) the equally-weighted portfolio; and (ii) the value-weighted portfolio.

Under all approaches, estimates of beta indicate that the appropriate value of the equity beta for companies operating in the Utilities Industry in Vietnam is 0.8 – which is still below the market beta of the entire market. This finding provides an evidence to confirm that a level of risk faced by a company in the Utilities Industry is below the average of the level of risk for the entire market.

Keywords: Equity beta; Sharpe Lintner CAPM; Quantile regression; Ho Chi Minh City Stock Exchange.

1. Introduction

Vietnam is going to be the next young Tiger in the Asian region for the next decade or so. In achieving this dream, privatization and/or equitization of the government-owned businesses, particular in the capital intensive Utilities Industry including energy, water, electricity, and public transport, is considered unavoidable to ensure that scarce resources are best utilized. The presence of the government ownership in these state-owned companies is very significant. This presence will limit the government's ability to meet its other socio-economical objectives and/or to under-invest in these public utilities companies. However, selling these assets to the private sector requires an appropriate pricing to ensure that these assets will raise fair amount of money for the public. In a financial term, the government is required to determine its appropriate expected return on equity for being present in these public utilities businesses in any offer of selling their assets. This expected return on equity can be used to confirm whether or not current government owned businesses in the same or similar industry are efficient in running their businesses and/or to determine a fair price of the assets (the companies) should the Government decide to privatize and/or equitize these assets.

Estimating a return on equity is an extremely complicated task and there is no consensus so far among academics and practitioners. One of the important elements to evaluate the efficiency of enterprises and to provide evidence whether or not the government should privatize a particular enterprise within the public utilities industry is the expected return which is generated by the company in the future.

Among all approaches, the first ever capital asset pricing model (CAPM), Sharpe-Lintner CAPM, introduced by Sharpe (1964) and Lintner (1965), has still been widely used by policymakers including regulators from countries around the world. In particular, according to Mckenzie and Partington (2014), regulators in Australia, Germany, New Zealand, USA, Canada and UK are currently using this CAPM to estimate an expected return adopted in their regulatory decisions (see Appendix 1 for details).

A key component of this CAPM is the equity beta. In order to estimate the equity beta, most of the previous empirical studies have adopted the standard Ordinary Least Square (OLS) and Least Absolute Deviation (LAD) to estimate the beta coefficient in the CAPM model. It has been argued for a long time that estimating beta suffers instability of the estimates. In addition, extreme outliers in the sample have been considered as a key issue for any empirical estimate of beta. In this context, this paper argues that Quantile Regression approach may be useful in minimizing the effects of outliers in the sample. This paper aims to provide the estimation of betas for individual company as well as the portfolio in the Utilities Industry in Vietnam using a new approach, the Quantile Regression approach.

The structure of the paper is as follows. Following this Introduction, Section 2 presents a brief summary of literature relating to the CAPM and empirical studies on beta estimation. Data description is presented in Section 3. Section 4 presents results and discussions. This paper is concluded by some main conclusions and policy implications in Section 5.

2. Literature review

2.1. The Capital Asset Pricing Model

The Capital Asset Pricing Model (CAPM), introduced by Sharpe (1964) and Lintner (1965) describes the relationship between the expected return and risk. In this model, the expected return of a security (an asset) is given by the following equation:

$$E(r_i) = r_f + \beta_i\left[E(r_m - r_f)\right]$$

Where $E(r_i)$ is the expected return of security i, r_f is the risk free rate, r_m is the expected return of the market portfolio, $\beta_i = \frac{Cov[r_i, r_m]}{Var[r_m]}$ is the beta coefficient of security i. Moreover, β_i is defined as the profitability volatility measurement, and therefore it is considered as security's risk measurement.

The CAPM indicates that the expected return of security is positively correlated with its Beta coefficient. Assuming that the capital market is efficient and unsystematic risk can be reduced completely through diversification, the return of a security is only affected by its systematic risk. The higher the Beta coefficient is, the riskier the security is. Therefore, investors tend to require a higher return to compensate the higher risk (or high Beta).

2.2. Current approaches to estimate equity beta

The systematic risk, which cannot be managed through portfolio diversification, can be obtained from the following regression:

$$r_{i,t} = \alpha_i + \beta_i r_{mt} + \varepsilon_{i,t} \qquad (1)$$

In which, the residual is $\varepsilon_{i,t} = r_{i,t} - \alpha_i - \beta_i r_{mt}$

In 2009, Associate Professor Henry from the University of Melbourne, Australia established his work in estimating equity beta for the Australian Utilities regulation as an advice to the Australian Competition and Consumer Commission (Henry, 2009). Five years later, Henry and Street (2014) updated the estimates. In these two studies, the OLS and LAD approaches were utilized.

Vo, Mero, and Gellard (2014) re-examined the estimates of beta in the Australian regulatory context. In their study, a data set is updated in comparison with Henry's study in 2009. In addition, another key contribution from Vo et al. (2014) study is that two new approaches were added in their study: (i) the Maximum Likelihood robust theory (MM) and (ii) the Theil Sen methodology. For each of these new approaches, the authors argued that among the robust regression estimators currently available, the MM regression has the highest breakdown point (50 percent) and high statistical efficiency (95 percent) while the Theil Sen estimator is proposed by Fabozzi (2013) in response to the OLS estimator being acutely sensitive to outliers.

We acknowledge that the two new approaches adopted inVo et al. (2014) study were a choice of different, arguably more advanced, econometric techniques. However, for the purpose of this paper, these two new approaches are not considered. Instead, we consider that it is even more appropriate to introduce a new approach, a Quantile Regression, which is best known for its capacity to limit the effects of outliers on the estimates. In addition, other two traditional approaches, the OLS and the LAD, are also in use in this study.

2.2.1. Ordinary Least Squares

The OLS method estimates the α_i and β_i in the equation (1) by minimizing the sum of squared residuals:

$$\sum_{t=1}^{T} \varepsilon_{i,t}^2 = \sum_{t=1}^{T} (r_{i,t} - \hat{r}_{i,t})^2 = \sum_{t=1}^{T} (r_{i,t} - \hat{\alpha}_i - \hat{\beta} r_{m,t})^2$$

The β coefficient from OLS indicates the average relationship between the regressor and the outcome variable based on the conditional mean function.

2.2.2. Least Absolute Deviations

In the LAD approach, the absolute value of residuals is minimized to achieve the estimates from equation (1) as follows:

$$\sum_{t=1}^{T}|\varepsilon_{i,t}| = \sum_{t=1}^{T}|r_{i,t} - \hat{r}_{i,t}| = \sum_{t=1}^{T}|r_{i,t} - \hat{\alpha}_i - \hat{\beta} r_{m,t}|$$

Since the sum of the absolute value of residuals is minimized rather than minimizing the sum of squares, the estimators obtained from the LAD method may alleviate the effect of outliers.

3. Methodology and data

3.1. Data

The listed companies belonging to the Utilities Industry in Vietnam are examined in this paper. There are currently 19 companies listed in the Utilities Industry in Ho Chi Minh Stock Exchange. Daily closing stock price of an individual company is collected from its starting day until 31/12/2013. The sample of companies (see Appendix 2 for more details) and time period are presented in Table 1 below:

Table 1. Listed utilities companies in the sample

Name of company	Code	From	To
An Pha Petrol Joint Stock Company	ASP	15/02/2008	31/12/2013
BaRia Thermal Power Joint Stock Company	BTP	25/11/2009	31/12/2013
Cholon Water Supply Joint Stock Company	CLW	11/01/2011	31/12/2013
CNG Viet Nam Joint Stock Company	CNG	23/11/2011	31/12/2013
Hydro Power Joint Stock Company – Power No.3	DRL	23/11/2011	31/12/2013
PetroVietnam Gas Corporation	GAS	11/04/2012	31/12/2013
Khanh Hoa Power Joint Stock Company	KHP	02/01/2008	31/12/2013
MTGas Joint Stock Company	MTG	15/01/2009	31/12/2013
Petrolimex Gas Corporation - JSC	PGC	02/01/2007	31/12/2013
PetroVietNam Low Pressure Gas Distribution JSC	PGD	26/11/2009	31/12/2013
Pha Lai Thermal Power Joint Stock Company	PPC	26/01/2007	31/12/2013
Song Ba Joint Stock Company	SBA	01/06/2010	31/12/2013
SaiGon Fuel Joint Stock Company	SFC	02/01/2007	31/12/2013
Can Don Hydro Power Joint Stock Company	SJD	02/01/2007	31/12/2013
Thac Ba Hydropower Joint Stock Company	TBC	25/09/2009	31/12/2013
Thu Duc Water Supply Joint Stock Company	TDW	11/11/2010	31/12/2013
Tay Nguyen Electricity Investment JSC	TIC	12/10/2009	31/12/2013
Thac Mo Hydro Power Joint Stock Company	TMP	18/06/2009	31/12/2013

Vinh Son - Song Hinh Hydropower JSC	VSH	02/01/2007	31/12/2013

The market return volatility is measured by the Vietnam Stock Index, the VN Index, in the relevant period.

3.2. *Methodology*

3.2.1. *Return and return period*

Equation 1 can be run using the raw return of stocks or the excess return which is the difference between the raw return of stock and the risk free rate of return. It is argued that the raw return of stock is applied widely in the empirical studies. On the other hand, the excess return is also considered. Suppose the risk free rate does not fluctuate significantly, the excess return may be obtained by transforming the data $R_{i,t} = r_{i,t} - r_{f,t}, R_{m,t} = r_{m,t} - r_{f,t}$ and equity beta is estimated from:

$$R_{i,t} = \beta_i R_{m,t} + \varepsilon_{i,t} \tag{2a}$$

Or

$$r_{i,t} - r_{f,t} = \beta_i (r_{m,t} - r_{f,t}) + \varepsilon_{i,t} \tag{2b}$$

Subtracting $r_{f,t}$ from both sides of (2b) and rearranging yields (3):

$$r_{i,t} = (1 - \beta_i) r_{f,t} + \beta_i r_{m,t} + \varepsilon_{i,t} \tag{3}$$

In the circumstances when the variance of risk free rate is low as the intercept term, $(1 - \beta_i) E(r_{f,t}) = \mu$, the Beta yielded from equation (3) should be consistent with those estimated from equation (1) (Henry & Street, 2014). Furthermore, no assumptions about possible variations in chosen risk free rate is required when the raw returns instead of the excess returns are used. For these reasons, this paper employs the raw returns for its simplicity.

The return period of stock or market is calculated at different frequency such as daily, weekly, monthly, etc. Henry and Street (2014) argued that weekly frequency of return should be used to avoid both the noisy nature in daily data and unreliable estimators from monthly data due to too few observations. Therefore, data on the weekly return of stocks are used in this paper.

There are two different ways in which a weekly return of a stock can be calculated. *First*, the weekly stock return is measured by the difference between *a closing price* on Fridays and *an opening price* on Monday from a same week. Since stock trading does not happen on Saturdays and Sundays, the closing price of Friday of the week before is used instead of an opening price on Monday. This weekly return represents the change in stock price during a particular week.

Second, alternatively, the weekly return can be estimated using the average daily return within a week. This means that the weekly return indicates the average change of the five trading days of a stock during a week. This paper adopts the former weekly return and uses the latter weekly return as an alternative to check the robustness of the estimates. In general, the stock return in period t can be calculated as follows:

$$r_{i,t} = \frac{Stockprice_{i,t} - Stockprice_{i,t-1}}{Stockprice_{i,t-1}}$$

Similarly, the weekly market return is computed using the VNI Index.

3.2.2. A new approach – Quantile Regression

In relation to a validity of a Quantile Regression approach, it has been argued that:

> *"On the average" has never been a satisfactory statement with which to conclude a study on heterogeneous populations. Characterization of the conditional mean constitutes only a limited aspect of possibly more extensive changes involving the entire distribution".*

Buchinsky (1994)

When all of the OLS assumptions are satisfied, the β coefficient estimated from (1) is the best linear unbiased estimator. It indicates the average relationship between the regressor and the outcome variable based on the conditional mean function. Indeed, using OLS method leads to some attractive statistical properties of estimators which are straightforward to interpret and easy to calculate (Hao & Naiman, 2007).

However, OLS estimator has some limitations as follows:

(1) The strict assumptions cannot always be met in reality. In particular, the homoscedasticity assumption is likely to fail in estimating the return on equity. Also, the heavy-tailed distributions commonly occur in reality.

(2) The conditional mean attracts the researchers' attention into the central location and steers them away the whole distribution' properties as well as the noncentral locations. Koenker and Bassett Jr (1978) indicated that when the exogenous variables affect the dependent variable at different parameters in the distribution from the mean, the analysis would be seriously weakened.

(3) The effect of existing outliers tends to be magnified due to square effect in the optimization function. Therefore, the validity of OLS estimators is concerned in the outlying conditions.

There are some possible approaches to deal with above problems. This paper applies the most common method, the Quantile Regression. With the Quantile Regression (QR) proposed by Koenker and Bassett Jr (1978), the estimator can be found with following minimization function:

$$\beta_{QR} = \arg\min \left[\sum_{Y_i \geq \beta X_i} \tau(Y_i - \beta X_i) + \sum_{Y_i < \beta X_i} (1-\tau)(Y_i - \beta X_i) \right] \forall \tau \in (0,1)$$

The QR method, considered as an ordered statistics-based estimation, might estimate coefficient vector which is not sensitive to the influences of outliers since the minimization function is a weighted sum of absolute deviations. Moreover, it loosens some of OLS assumptions such as normality, homoscedasticity, etc. (Johnston & DiNardo, 1997). Estimating simultaneously many different percentiles could provide a complete view of the relationship and extend the analysis to noncentral locations, which are the main interests of recent social science researches. For instance, studies in gender inequality and income gaps pay attentions in the poor (lower tail) and the rich (upper tail). Researchers in education may have intrinsic interests and need to fully understand in pre-established achievement levels.

The interpretations for the OLS and QR coefficients have different meanings. While the OLS estimators suggest the **average** marginal effect of regressor on dependent variable, the QR estimators examine the **marginal** effect under each conditional percentile. By using the QR, it is possible to investigate the relationship between returns and Beta at the lower and upper tail observations relative to the mean. Indeed, the LAD is a special case of QR at 0.5 percentile. In this paper, equity Beta is estimated at 0.05, 0.2, 0.4, 0.6, 0.8 and 0.95 percentile to investigate the consistency of the relationship. We agree that this choice is arbitrary but believe that a full coverage of percentiles will provide a more comprehensive result of the estimates.

With the above mentioned advantages compared with the OLS estimations, the QR method is applied widely recently in various areas of research after the approach was first introduced by Koenker and Bassett Jr (1978). Buchinsky (1998a) and Buchinsky (2002) applied this QR approach to analyze the female wage distribution in the US in relation to demographic characteristics. Then, Buchinsky (1998b) developed guidelines for empirical research using QR.

Taylor (1999) found some good achievement by practicing QR in estimating the distribution of daily Value at Risk. Yu, Lu, and Stander (2003) concluded that researchers in survival analysis, pharmaceutical and many other scientific areas of research have also applied QR in their studies. Recently, various papers used QR as a new approach to their empirical studies (Atella, Pace, & Vuri, 2008; Hung, Shang, & Wang, 2010; Ramdani & Witteloostuijn, 2010)

3.2.3. *Portfolio construction*

After estimating Beta for individual companies, some portfolios are constructed in order to provide a general view for those who are interested in more than 1 stock in the Utilities Industry. There are 2 set of portfolios used in this paper: (i) an equally-weighted portfolio and (ii) a value-weighted portfolio with the company's market capitalization being used as a weight. Furthermore, because companies in the sample were listed at different points in time, portfolios are updated every 6 months. For example, starting in January 2007, all companies listed within a period from January 2007 and June 2007 were used to form a portfolio. As a result, 14 portfolios are formed in this paper including 7 equally-weighted and 7 value-weighted portfolios (see Appendix 3 for the details of the companies in each portfolio).

The first portfolio, P1, includes PGC, PPC, SFC, SJD and VSH with the available data from 26th Jan 2007. The second portfolio adding ASP and KHP into P1 starts on the 15th Feb 2008. P3 adds MTG and TMP to P2. It is estimated from the 18th June 2009. Adding TBC, TIC, BTP and PGD to the current P3 yields P4 with the sample period starting from 26th Nov 2009. The fifth portfolio is considered from 11th Nov 2010 by including SBA and TDW to P4 and so on for the sixth and seventh portfolios.

3.2.4. *De-levered/Re-levered estimates of β*

Estimating beta for a particular company will implicitly assume the gearing level of a company in the estimation. As such, the estimates of equity beta for a particular company may not reflect an overall level of risk faced by the utilities industry in the context of the Vietnamese economy. The Vietnamese Government (as a seller) and investors may need to know the overall level of risk faced by the entire industry for their investment decisions. Following the practice adopted in Henry and Street (2014) and Vo et al. (2014) studies, all equity betas are de-levered using the relevant company's gearing ratio (for a particular company) or a portfolio's average gearing ratio (for a portfolio's estimates) over the examined period and re-levered using the average leverage ratio for the whole industry. Supposing that the debt β equals to zero, the de-levering/re-levering equation is:

$$\beta_A = \beta_E \frac{E}{V}$$

In which β_A and β_E are the asset β and equity β; E/V is the ratio between the market value of equity and the company's total asset. The gearing ratio is usually defined as the proportion of the book value of debt in the value of the company which is measured by its total asset. Considering $\bar{G}$ as the gearing ratio, $\overline{D}$ as the book value of debt and E is the market value of equity, then:

$$\bar{G} = \frac{\overline{D}}{\overline{D} + E}$$

Currently, for 19 companies in the Utilities industry in Vietnam, the average leverage ratio is approximately 42 percent. For the raw beta estimation, the following re-levering factor should be applied:

$$\omega = \frac{1 - \bar{G}}{1 - 0.42}$$

Assume that $\bar{G}$ is independent of $\hat{\beta}$ and ω is constant, the re-levered β, $\hat{\beta}_r$ has a mean of $\omega\hat{\beta}$.

4. Result and discussion

4.1. Individual companies' Beta estimates

The stock return used in the CAPM regression in this paper is the raw returns of the stocks. The weekly frequency is chosen to take advantage of avoiding the noisy in daily data and obtaining the statistical accuracy from many observations. VNI Index is considered as market index. The weekly return is measured by the change of return within a week, from last week Friday (closing price) and this week Friday (closing price). Table 2 reports the equity Beta estimated from OLS, LAD, and different quantiles for individual companies.

Table 2. Estimates of equity beta for individual companies, using the weekly return from Friday-to-Friday week closing prices

	OLS	LAD	τ = 0.05	τ = 0.20	τ = 0.40	τ = 0.60	τ = 0.80	τ = 0.95
ASP	0.900***	0.850***	0.887***	0.852***	0.828***	0.793***	0.895***	1.084***
BTP	0.774***	0.688***	0.855***	0.775***	0.802***	0.609***	0.990***	0.497
CLW	0.464***	0.349**	0.556	0.340*	0.305**	0.263	0.411*	1.307
CNG	0.668***	0.745***	0.531	0.460*	0.701***	0.826***	0.838**	0.119
DRL	0.764***	0.422**	1.337**	0.732*	0.514**	0.421*	0.616	2.202
GAS	0.890***	0.839***	0.913***	0.715***	0.756***	0.800***	0.937**	0.854*
KHP	0.821***	0.739***	0.837***	0.806***	0.741***	0.727***	0.856***	1.078***
MTG	0.935***	0.889***	0.768**	0.878***	0.918***	0.842***	0.965***	1.496***
PGC	1.183***	1.051***	1.036***	1.091***	1.010***	1.103***	1.298***	1.570***
PGD	0.869***	0.833***	1.005***	0.857***	0.873***	0.833***	0.855***	0.828**
PPC	1.022***	0.999***	0.752***	0.869***	1.023***	1.052***	1.051***	1.351***
SBA	0.693***	0.546***	0.859	0.756***	0.677***	0.563***	0.601***	0.889
SFC	0.691***	0.710***	0.448*	0.596***	0.715***	0.756***	0.835***	0.906*
SJD	0.657***	0.644***	0.521**	0.639***	0.636***	0.641***	0.691***	0.937***
TBC	0.609***	0.576***	0.436	0.571***	0.551***	0.504***	0.651***	0.914***
TDW	0.174	0.0932	-0.716	0.192	0.267	0.202	-0.114	0.16
TIC	0.437***	0.393***	0.406	0.515**	0.392***	0.316***	0.282*	0.317
TMP	0.671***	0.522***	0.692**	0.735***	0.607***	0.553***	0.564***	0.667
VSH	0.932***	0.944***	0.766***	0.853***	0.944***	0.922***	0.991***	1.183***
Average	**0.745**	**0.675**	**0.679**	**0.696**	**0.698**	**0.670**	**0.748**	**0.966**
Median	**0.764**	**0.710**	**0.766**	**0.735**	**0.715**	**0.727**	**0.838**	**0.914**

Source: Authors' analysis

Most Beta OLS estimates are statistically significant and lower than 1 – the market beta. When the market return changes by 1 percent, these stock returns would change in the same direction with a magnitude of less than 1 percent. However, the Quantile Regression results are mixed for some companies in the sample. Some key conclusions have been achieved as below.

- *First*, at various percentiles, the beta estimates are lower than 1 (the market beta)and these estimates are relatively stable in relation to the OLS method for the following companies BTP, CNG, GAS, PGD, SBA, SFC, SJD, TBC, TIC, and TMP. Although some estimates are not significant at τ = 0.95 (e.g. BTP, CNG, SBA, TIC and TMP). These outcomes point out that there is no biased tendency due to the heavy-tailed distribution in these companies.

- *Second*, for ASP, CLW, DRL, KHP, MTG and VSH, the beta estimates are interesting to note. While the OLS method and most percentiles under the QR method show that the equity betas are lower than 1, the 0.95 percentile regression indicates the estimates of greater than 1. This suggests at 95% percentile, these stock returns tend to fluctuate more than the fluctuation of the market returns. In other words, it presents evidence to confirm the existence of the upper tail observations and these presences make the OLS estimates biased. Especially, there is not only the upper tail but also the lower tail observations in the case of DRL. In particular, at τ = 0.05, Beta is 1.337, higher than the OLS Beta (0.764); at τ = 0.95, the Beta is even much higher (2.202).
- *Third*, there are two companies with Beta estimates higher than 1 at most estimations (i.e. PGC and PPC). While the Betas of PGC are stable and consistently higher than 1 with the average is 1.168, the PPC's Betas seem to be affected by the lower tail outliers. At 0.05 and 0.20 percentile, PPC's Betas are lower than 1 (0.752 and 0.869, respectively).
- *Last*, beta estimates for TDW are not statistically significant by all methods.

Table 2 presents beta estimates of individual companies in the sample when the alternative measurement of weekly return is used. The estimates are relatively similar and unchanged in comparison with outcomes presented in Table 3 when weekly return is measured as change in closing prices from last Friday to this Friday.

Table 3. Estimates of equity beta for individual companies, using the average of the daily returns within a week as weekly return

	OLS	LAD	τ = 0.05	τ = 0.20	τ = 0.40	τ = 0.60	τ = 0.80	τ = 0.95
ASP	0.918***	0.874***	0.930***	0.901***	0.891***	0.824***	0.903***	1.004***
BTP	0.850***	0.771***	0.917***	0.900***	0.831***	0.675***	0.879***	0.515
CLW	0.401**	0.132	0.507	0.302	0.259*	0.213	0.384*	1.251
CNG	0.649***	0.653***	0.529	0.440*	0.664***	0.776***	0.830**	0.110
DRL	0.820**	0.396**	1.349***	0.741*	0.532***	0.420**	0.602*	1.728
GAS	0.924***	0.869***	0.921***	0.720***	0.870***	0.876***	0.939**	0.778*
KHP	0.817***	0.692***	0.929***	0.773***	0.725***	0.691***	0.826***	1.017***
MTG	1.011***	0.914***	0.849***	0.908***	0.917***	0.954***	1.176***	1.236**
PGC	1.212***	1.077***	1.108***	1.130***	1.049***	1.118***	1.265***	1.541***
PGD	0.941***	0.907***	1.052***	0.883***	0.846***	0.839***	0.955***	1.116***
PPC	1.017***	0.997***	0.709***	0.906***	1.043***	1.011***	1.082***	1.337***
SBA	0.756***	0.559***	0.780*	0.751***	0.687***	0.570***	0.624***	1.008
SFC	0.647***	0.673***	0.503**	0.571***	0.704***	0.714***	0.758***	0.796*
SJD	0.638***	0.645***	0.592**	0.633***	0.636***	0.644***	0.638***	0.721**
TBC	0.600***	0.489***	0.367	0.596***	0.541***	0.470***	0.625***	0.878***
TDW	0.165	0.200	0.620	0.222	0.238	0.197	-0.115	0.212
TIC	0.453***	0.333***	0.429	0.528***	0.384***	0.383***	0.398**	0.355
TMP	0.663***	0.508***	0.774**	0.767***	0.593***	0.578***	0.554***	0.606
VSH	0.907***	0.942***	0.803***	0.847***	0.951***	0.904***	0.948***	1.111***
Average	**0.757**	**0.665**	**0.772**	**0.712**	**0.703**	**0.677**	**0.751**	**0.912**
Median	**0.817**	**0.673**	**0.780**	**0.751**	**0.704**	**0.691**	**0.826**	**1.004**

Source: *Authors' analysis*

4.2. Beta estimates of various portfolios

Two set of portfolios including (i) an equally-weighted portfolio and a value-weighted portfolio are formed in order to provide a deeper analysis for more than 1 stock and to test the robustness of beta estimates for individual companies. Given the choice of the approach in which the weekly returns are measured does not affect beta estimates for individual companies, the Friday-to-Friday approach is used to construct the portfolios. Then the OLS, LAD and QR at different percentile approaches are all adopted. Table 3reports the equity Beta estimates for each portfolio:

Table 4. Estimates of portfolios equity beta

Equally-weight portfolios

	OLS	LAD	τ = 0.05	τ = 0.20	τ = 0.40	τ = 0.60	τ = 0.80	τ = 0.95
P1	0.910***	0.926***	0.756***	0.875***	0.959***	0.953***	0.976***	0.904***
P2	0.875***	0.891***	0.834***	0.882***	0.951***	0.857***	0.860***	0.955***
P3	0.846***	0.806***	0.772***	0.871***	0.848***	0.783***	0.855***	1.040***
P4	0.750***	0.716***	0.770***	0.763***	0.742***	0.685***	0.686***	0.874***
P5	0.603***	0.547***	0.606**	0.620***	0.570***	0.546***	0.607***	0.855**
P6	0.563***	0.511***	0.528*	0.593***	0.526***	0.537***	0.482***	0.871***
P7	0.612***	0.616***	0.698***	0.604***	0.564***	0.609***	0.617***	0.694*
Average	**0.737**	**0.716**	**0.709**	**0.744**	**0.737**	**0.710**	**0.726**	**0.885**
Median	**0.750**	**0.716**	**0.756**	**0.763**	**0.742**	**0.685**	**0.686**	**0.874**

Value-weighted portfolios

	OLS	LAD	τ = 0.05	τ = 0.20	τ = 0.40	τ = 0.60	τ = 0.80	τ = 0.95
P1	0.966***	0.953***	0.802***	0.883***	0.953***	1.017***	0.973***	1.203***
P2	0.992***	1.045***	0.753***	0.942***	1.022***	1.049***	0.998***	1.156***
P3	0.871***	0.906***	0.719***	0.865***	0.890***	0.888***	0.878***	1.044**
P4	0.838***	0.825***	0.787***	0.818***	0.866***	0.887***	0.853***	0.891**
P5	0.724***	0.692***	0.694***	0.714***	0.682***	0.650***	0.713***	0.947**
P6	0.697***	0.680***	0.675***	0.638***	0.644***	0.609***	0.684***	0.934**
P7	0.895***	0.843***	0.898***	0.788***	0.719***	0.799***	0.928***	0.854**
Average	**0.855**	**0.849**	**0.761**	**0.807**	**0.825**	**0.843**	**0.861**	**1.004**
Median	**0.871**	**0.843**	**0.753**	**0.818**	**0.866**	**0.887**	**0.878**	**0.947**

Source: Authors' analysis

For the equally-weight portfolio, the estimates of Beta using the OLS, LAD and QR at all percentile except 95%fall within a range of 0.482 to 0.976. Moving from P1 to P6 by adding more companies to the portfolios will decrease the estimates of beta. However, Beta estimates of P7 increases compared to the decreasing trend from P1 to P6. This change may be due to a limited data available for P7 On the other hand, at 95% percentile regression, the estimates of

Beta fluctuate significantly across different portfolios. The estimates of Beta for P3 are 1.040, which is higher than the beta for the entire market. This higher-than-expected coefficient, in particular, and the fluctuation, in general, may be explained by the existence of heavy tail observations or outliers in the additional companies being added into P7.

For the value-weighted portfolio, the results are mixed. At 95% percentile regression, the estimates of Beta of P1, P2 and P3 are higher than 1. Moreover, Beta estimations of P1 and P2 are higher than 1 at some percentiles. Other estimates of Beta face a declining trend from P2 to P6 and increase in P7. Again, these changes could be a result of less and less available data in the sample under P7.

4.3. De-levered/Re-levered estimates of β

The weekly returns measured by the change of stock prices from closing price of last Friday and this Friday are also adopted in this analysis. The results of de-levered and re-levered Beta estimates of individual companies and portfolios are shown in Table 5 and Table 6.

Table 5. De-levered/Re-levered estimates of β for weekly frequency: Individual companies

	Gearing (%)	ω	OLS	LAD	τ=0.05	τ=0.20	τ=0.80	τ=0.95
ASP	68.17	0.549	0.494	0.466	0.487	0.468	0.491	0.595
BTP	55.78	0.762	0.590	0.525	0.652	0.591	0.755	0.379
CLW	39.57	1.042	0.483	0.364	0.579	0.354	0.428	1.362
CNG	37.80	1.072	0.716	0.799	0.569	0.493	0.899	0.128
DRL	8.32	1.581	1.208	0.667	2.113	1.157	0.974	3.481
GAS	33.30	1.150	1.024	0.965	1.050	0.822	1.078	0.982
KHP	57.15	0.739	0.607	0.546	0.618	0.595	0.632	0.796
MTG	48.77	0.883	0.826	0.785	0.678	0.775	0.852	1.321
PGC	48.52	0.888	1.050	0.933	0.920	0.968	1.152	1.394
PGD	43.54	0.973	0.846	0.811	0.978	0.834	0.832	0.806
PPC	64.91	0.605	0.618	0.604	0.455	0.526	0.636	0.817
SBA	62.71	0.643	0.446	0.351	0.552	0.486	0.386	0.572
SFC	41.06	1.016	0.702	0.722	0.455	0.606	0.849	0.921
SJD	50.65	0.851	0.559	0.548	0.443	0.544	0.588	0.797
TBC	6.39	1.614	0.983	0.930	0.704	0.922	1.051	1.475
TDW	61.96	0.656	0.114	0.061	-0.466	0.126	-0.072	0.105
TIC	9.03	1.568	0.685	0.616	0.637	0.808	0.442	0.497
TMP	38.43	1.062	0.712	0.554	0.735	0.780	0.599	0.708
VSH	21.41	1.355	1.263	1.279	1.038	1.156	1.343	1.603
Average	**41.97**	**1.000**	**0.733**	**0.659**	**0.695**	**0.685**	**0.732**	**0.986**
Median	**43.54**	**0.973**	**0.702**	**0.616**	**0.637**	**0.606**	**0.755**	**0.806**

Source: Authors' analysis

The de-levered/re-levered estimates of individual companies' equity β for the OLS estimates are from 0.446 to 1.263 while the corresponding de-levered LAD β estimates range from 0.351 to 1.279. The existence of outliers still affect seriously on the outcomes. For instance, at 95% percentile, the equity β of CLW, DRL, MTG, PGC, TBC and VSH are much higher than those obtained from OLS and LAD. Besides, the effect of lower tail observations can be seen at the 5% percentile regression for DRL.

Similarly, the de-levered estimates are applied for portfolio betas. Both the equally-weighted portfolios and the value-weighted portfolios results are quite stable with a magnitude of lower than 1 for all estimates except at the 95% percentile regression for P1.

Table 6. De-levered/Re-levered estimates of β for weekly frequency: Portfolios

	Gearing (%)	ω	OLS	LAD	τ = 0.05	τ = 0.20	τ = 0.80	τ = 0.95
Equally-weighted portfolios								
P1	45.31	0.943	0.858	0.873	0.713	0.825	0.920	0.852
P2	50.27	0.857	0.750	0.764	0.715	0.756	0.737	0.819
P3	48.79	0.883	0.747	0.712	0.682	0.769	0.755	0.918
P4	42.60	0.990	0.742	0.709	0.762	0.755	0.679	0.865
P5	45.23	0.944	0.569	0.517	0.572	0.585	0.573	0.807
P6	44.46	0.958	0.539	0.489	0.506	0.568	0.462	0.834
P7	41.97	1.000	0.612	0.616	0.698	0.604	0.617	0.694
Average	**45.52**	**0.939**	**0.688**	**0.669**	**0.664**	**0.695**	**0.678**	**0.827**
Median	**45.23**	**0.944**	**0.742**	**0.709**	**0.698**	**0.755**	**0.679**	**0.834**
Value-weighted portfolios								
P1	45.31	0.943	0.911	0.899	0.756	0.833	0.917	1.134
P2	50.27	0.857	0.851	0.896	0.646	0.808	0.856	0.991
P3	48.79	0.883	0.769	0.800	0.635	0.764	0.775	0.922
P4	42.60	0.990	0.829	0.816	0.779	0.810	0.844	0.882
P5	45.23	0.944	0.684	0.653	0.655	0.674	0.673	0.894
P6	44.46	0.958	0.667	0.651	0.646	0.611	0.655	0.894
P7	41.97	1.000	0.895	0.843	0.898	0.788	0.928	0.854
Average	**45.52**	**0.939**	**0.801**	**0.794**	**0.717**	**0.755**	**0.807**	**0.939**
Median	**45.23**	**0.944**	**0.829**	**0.816**	**0.655**	**0.788**	**0.844**	**0.894**

5. Conclusion

The Vietnamese Government's effort to a process of privatization and equitization of key government owned assets has attracted attention from both Vietnamese and international investors. This process is considered unavoidable to pave a way for the national economy to fully integrate with the world economy. Privatization and/or equitization require a sale of government owned assets to the private investors. A question is how the government can determine a reasonable price for these assets to ensure that the Vietnamese people will get the fair share.

In response to this complicated question, this study is conducted to estimate a key input, the equity beta, adopted in the Sharpe Lintner CAPM, which then can be used to determine a rate of return on equity for the owner of the assets (the Government). This expected return on equity can be used to confirm whether or not current government owned businesses in the same or similar industry are efficient in running their businesses and/or to determine a fair price of the assets (the companies) should the Government decide to privatize and/or equitize these assets.

Using a sample of 19 listed companies operating in the Utilities Industry in the Ho Chi Minh City Stock Exchange for the period of more than 7 years (from 2007 to 2013 inclusive), a new approach (a Quantile Regression approach); together with the other two traditional approaches (the OLS and the LAD), have been used to estimate the equity beta for these listed firms in this study. Estimates of beta were conducted at the individual firms' level and at the portfolios' level. At the portfolios' level, two different types of portfolios are formed: (i) the equally-weighted portfolio; and (ii) the value-weighted portfolio.

Under all approaches, estimates of beta indicate that the appropriate value of the equity beta for companies operating in the Utilities Industry in Vietnam is 0.8 – which is still below the market beta of the entire market. This finding provides an evidence to conform that a level of risk faced by a company in the Utilities Industry is below the average of the level of risk for the entire market.

While it is well beyond the scope of this paper, an indicative quick estimate of an expected return on equity for utilities in Vietnam is approximately 12.4 per cent – an estimate using the Sharpe Lintner CAPM with equity beta of 0.8, the risk free rate of 6 per cent and the market risk premium of 8 per cent. It is obvious to note that these estimates require an update to reflect the prevailing market conditions for funds at different point in time. An estimate of 12.4 per cent in this paper can be used to set a benchmark and to compare with the realized return on equity of the Government owned businesses to confirm whether these companies are operating efficiently and/or to determine a fair price for the government owned assets to be sold to the private sector.

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Appendix1. Fundamental models adopted by Australian and international regulators in estimating a return on equity

	Australia	Germany	New Zealand	USA	Canada	UK
Regulator	**Australian Energy Regulator (AER)**	**The Federal Network Agency (FNA)**	**The Commerce Commission (CC)**	**New York State Public Utilities Commission (NYSPUC)**	**The Ontario Energy Board (OEB)**	**The Office of Gas and Electricity Markets (Ofgem)**
Primary model	CAPM	CAPM/RPM	CAPM	DDM	RPM	CAPM
Secondary model				CAPM		
Other use of DDM	*Cross-check on MRP*		*Cross-check on MRP*		*Cross-check on MRP*	*Cross check on the overall cost of equity but not for individual firms*

Source: *Sudarsanam, Kaltenbronn, and Park (2011)*

Notes: CAPM: *Sharpe-Lintner Capital Asset Pricing Model*

RPM: *Risk Premium Model*

DDM: *Dividend Discount Model*

Appendix 2. Detail of companies used in the sample

Code	Full company name	Main business	Current Government Ownership (%)*	Current market capitalization (bil. VND)**	Current total liabilities (bil. VND)**	Current Equity (bil. VND)**
ASP	An Pha Petrol Joint Stock Company	Natural Gas Distribution	48.90	227.8	533.8	391.0
BTP	BaRia Thermal Power Joint Stock Company	Electric Power Generation, Transmission and Distribution	7.10	949.6	939.9	1.052.4
CLW	Cholon Water Supply Joint Stock Company	Water, Sewage and Other Systems	5.40	240.5	159.8	196.0
CNG	CNG Viet Nam Joint Stock Company	Natural Gas Distribution	24.80	864.0	207.3	432.5
DRL	Hydro Power Joint Stock Company – Power No.3	Electric Power Generation, Transmission and Distribution	0.30	361.0	28.4	109.5
GAS	PetroVietnam Gas Corporation	Natural Gas Distribution	2.50	148,757.5	16,079.1	35,985.6
KHP	Khanh Hoa Power Joint Stock Company	Electric Power Generation, Transmission and Distribution	15.90	560.7	754.9	553.9
MTG	MTGas Joint Stock Company	Natural Gas Distribution	1.00	44.4	151.8	122.9
PGC	Petrolimex Gas Corporation - JSC	Natural Gas Distribution	5.20	663.8	1,412.3	616.2
PGD	PetroVietNam Low Pressure Gas Distribution JSC	Natural Gas Distribution	6.00	1,734.0	2,297.3	1,162.5
PPC	Pha Lai Thermal Power Joint Stock Company	Electric Power Generation, Transmission and Distribution	16.90	8,112.9	5,608.1	5,674.4
SBA	Song Ba Joint Stock	Electric Power Generation,	0.30	657.1	762.2	685.8

	Company	Transmission and Distribution				
SFC	SaiGon Fuel Joint Stock Company	Natural Gas Distribution	2.10	296.6	258.0	184.3
SJD	Can Don Hydro Power Joint Stock Company	Electric Power Generation, Transmission and Distribution	34.60	1,403.0	287.5	995.3
TBC	Thac Ba Hydropower Joint Stock Company	Electric Power Generation, Transmission and Distribution	0.40	1.625.6	51.4	928.8
TDW	Thu Duc Water Supply Joint Stock Company	Water, Sewage and Other Systems	2.30	255.0	226.3	140.5
TIC	Tay Nguyen Electricity Investment JSC	Electric Power Generation, Transmission and Distribution	0.50	294.1	33.9	225.1
TMP	Thac Mo Hydro Power Joint Stock Company	Electric Power Generation, Transmission and Distribution	0.10	1,883.0	532.2	1,025.8
VSH	Vinh Son - Song Hinh Hydropower JSC	Electric Power Generation, Transmission and Distribution	25.10	2,804.9	678.5	2,982.6

Appendix 3. Portfolios construction

Portfolio	Companies	From	To
P1	PGC, PPC, SFC, SJD, VSH	26/01/2007	31/12/2013
P2	PGC, PPC, SFC, SJD, VSH, ASP, KHP	15/02/2008	31/12/2013
P3	PGC, PPC, SFC, SJD, VSH, ASP, KHP, MTG, TMP	18/06/2009	31/12/2013
P4	PGC, PPC, SFC, SJD, VSH, ASP, KHP, MTG, TMP, TBC, TIC, BTP, PGD	26/11/2009	31/12/2013
P5	PGC, PPC, SFC, SJD, VSH, ASP, KHP, MTG, TMP, TBC, TIC, BTP, PGD, SBA, TDW	11/11/2010	31/12/2013
P6	PGC, PPC, SFC, SJD, VSH, ASP, KHP, MTG, TMP, TBC, TIC, BTP, PGD, SBA, TDW, CLW	11/1/2011	31/12/2013
P7	PGC, PPC, SFC, SJD, VSH, ASP, KHP, MTG, TMP, TBC, TIC, BTP, PGD, SBA, TDW, CLW, CNG, DRL, GAS	21/05/2012	31/12/2013

Profitability of Momentum Strategies: The Role of Consistent Winners and Losers

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Momentum profits, resulting from buying winners and selling losers, are robust and persistent in the stock market; however, less than 60% of winner and loser stocks remain in winner and loser groups in the subsequent formation month. This study applies duration analysis to test the consistency of momentum effect and demonstrates that consistent winners and losers experience higher subsequent momentum profits than inconsistent winners and losers. Consistent with the information asymmetry hypothesis and the heterogeneous beliefs hypothesis, the momentum consistency is associated to size, idiosyncratic risk, institutional ownership, and trading volume. In addition, an asymmetric effect is observed that the post-formation return contributes to the winner consistency more, while the formation period return can explain the loser consistency more. The duration analysis also shows that the trading volume reflects effects of both heterogeneous beliefs among investors and the momentum lifecycle. The consistent momentum strategy may offer an enhanced performance despite controlling for factors associated to market risk, size, book-to-market ratio, momentum effect, and liquidity risk.

Keywords: Consistent winners; Consistent losers; Duration; Censored life regression; Trading volume; Heterogeneous beliefs; Momentum lifecycle; Consistent momentum strategy.

JEL Classifications: G11, G14

1. Introduction

Return continuations of individual stocks and equity indices in the intermediate term have been documented in the literature (e.g., see Jegadeesh and Titman, 1993; Chan, Jegadeesh, and Lakonishok, 1996, Rouwenhorst, 1998; Moskowitz and Granblatt, 1999; and Griffin, Ji, and Martin, 2003). The momentum strategy proposed by Jegadeesh and Titman (1993), taking a long position in the top decile and a short position in the bottom decile of companies raked by prior stock returns, becomes a benchmark for academics analyzing return continuation of equity and also a suggestive strategy for practitioners. Grinblatt, Titman, and Wermers (1995), Chen, Jegadeesh, and Wemers (2000), Chan, Chen, and Lakonishok (2002), and Jin and Scherbina (2011) show that mutual fund managers tend to utilize momentum strategies to enhance performances of their portfolios. However, we find a large variation in post-formation performance for momentum stocks, indicating momentum profits may be just average numbers and only contributed by certain winner and loser stocks. Given the limited number of stocks an investor or a fund manager can trade (see Sapp and Yan, 2008), buying a portion of winner stocks and selling a portion of loser stocks may not yield a positive return, and even face a potential lose.[1]

Studies demonstrate that a further sample-grouping can reduce number of securities in winners and losers portfolios, and yield more promising momentum profits. For example, Jegadeesh and Titman (1993) and Zhang (2006) find momentum strategy is more profitable in small stocks. Hong, Lim, and Stein (2000), Zhang (2006), Avramov, Chordia, Jostova, and Philipov (2007), Arena, Haggard, and Yan (2008), and Stambaugh, Yu, and Yuan (2012) show that momentum effect exists in stocks with lower analyst forecast coverage and credit rating, and higher analyst forecast dispersion, idiosyncratic volatility, and investor sentiment. Chen, Chen, Hsin, and Lee (2014) show that momentum profits can be enhanced by incorporating earnings and revenue information. However, back to the observation of large variation in post-formation performance for momentum stocks, the turnover of winner and loser stocks and the distribution of their post-formation returns are less well understood. Only a few studies conduct examinations on the return predictability of winners and losers in terms of the persistency of previous stock returns. For example, Watkins (2003) and Grinblatt and Moskowitz (2004) show that stocks with consecutive positive returns during the formation period will strongly outperform stocks with consecutive negative returns in the same horizon. Watkins (2006) finds short-term reversals for stocks with consistent positive or consistent negative previous weekly returns. However, the definition for winner and loser stocks by Watkins (2003), Grinblatt and Moskowitz (2004), and Watkins (2006) are quite different from Jegadeesh and Titman's (1993) winners and losers, and they only examine how the return components during the formation period can affect post-formation returns of stocks rather than investigate post-formation turnover rates and the distribution of post-formation returns for winner and loser stocks.

We therefore begin this study by investigating the distribution of post-formation returns and the turnover rates for stocks in winner and loser portfolios. A duration analysis provides us an avenue to tackle such tasks. We here define the duration of a winner (loser) stock as the

[1] Sapp and Yan (2008) show that an equity mutual fund holds only 90.85 stocks in average and 228.83 stocks in the top quintile.

number of month for which a winner (loser) stock can stay in the top (bottom) decile portfolio. Consistent winners (losers) are, therefore, winner (loser) stocks with duration greater than one, and inconsistent winners (losers) are winner (loser) stocks with zero duration. We find that at least one-quarter winner (loser) stocks experience negative (positive) post-formation returns and may make the momentum strategy face a potential lose if an investor coincidently longs for such winner stocks and shorts for such loser stocks. We also find that, in terms of 6-month formation period, more than 40% of winner and loser stocks are inconsistent winners and losers. The large dispersion of post-formation performance and high turnover rates for winner and loser stocks inspire us to further explore the difference of post-formation performance for consistent winners (losers) and inconsistent winners (losers). We subsequently separate winner (loser) stocks into two subsamples, consistent winners (losers) and inconsistent winners (losers), and examine their post-formation returns. Empirical results show that, in terms of post-formation performance, consistent winners experience a larger price appreciation than inconsistent winners, while consistent losers may lose more than inconsistent losers. Such different post-formation performance can last for more than six months.

Given the fact that consistent winners (losers) and inconsistent winners (losers) have significantly different post-formation performance. We are interested in finding determinants of consistent winners and losers. O'Hara (2003), Sadka (2006), and Chen and Zhao (2012) show that the greater information asymmetry will make investors react a firm's good news or bad news in a more conservative way, leading a delayed price adjustment. Allen, Morris, and Shin (2006), Hong and Stein (2007), Banerjee, Kaniel, and Dremer (2009), Verardo (2009) and Makarov and Rytchkov (2012) argue that higher heterogeneity among investors implies a stronger momentum effect. Instead of examining the magnitude of the delayed reaction by the literature, this study investigates the persistency of price adjustment induced by information asymmetry. Consistent with information asymmetry hypothesis and heterogeneous beliefs hypothesis, we find that winner and loser stocks with higher level of information asymmetry and higher degree of heterogeneous beliefs tend to be winners and losers in the next formation period. Moreover, in addition to the formation period returns, the post-formation returns also significantly contribute to the consistency for winner and loser stocks, indicating that consistent winners and losers do not only depend on their extreme returns during the formation period.

We further investigate how long the consistent winners and losers can sustain in winner and loser portfolios and try to find characteristics affecting winner and loser durations. Among consistent winners (losers) based on prior 6-month stock returns, 18.6% (19.0%) of those stocks have only a 1-month duration, 10.8% (10.9%) of those stocks have a 2-month duration, and around 97% of consistent winners and losers have a duration of less than 6 months. Consistent winners and losers with relative small size, low book-to-market ratio, high idiosyncratic volatility, and small institutional ownership will have longer duration as winners (losers). That is, investors tend to underreact stocks with greater information asymmetry, leading a momentum effect. In addition, the positive association between the duration and the trading volume indicates that the duration of momentum stocks will be longer if momentum stocks have higher degree of heterogeneous beliefs among investors. We also find that, in terms of duration of consistency, the formation period return plays a relatively important role for consistent losers, while the post-formation return is more important for consistent winners.

Besides exploring the consistency and future returns for winner and loser stocks, the duration analysis for the consistency also provides us an opportunity to reconcile the role of trading volume under heterogeneous beliefs hypothesis and momentum lifecycle hypothesis. Hong and Stein (2007) and Verardo (2009) argue that investors with different opinions on the liquidation value for a stock will trade in opposite directions and lead a higher trading volume, and therefore the trading volume can be a measure of the disagreement among investors. Verardo (2009) empirically show that higher heterogeneity among investors (higher trading volume) will lead a stronger momentum effect. In contrast, Lee and Swaminathan (2000) propose a momentum lifecycle hypothesis and demonstrate that low-volume winners and high volume losers do not attract investors' notice and have more persistent momentum effect, while high-volume winners and low-volume losers have caught the eye of investors and have relatively short-lived momentum effect. However, Lee and Swaminathan (2000) do not test the momentum lifecycle hypothesis at the individual firm level nor directly examine the persistency for winners and losers in different periods of favoritism. We therefore apply a censored life regression to test the persistency for winner and loser stocks and to decompose the effect on trading volume into the effect of heterogeneous beliefs and the effect of momentum lifecycle. Results show that the trading volume reflects effects of both heterogeneous beliefs and momentum lifecycle, while the effect of momentum lifecycle cannot dominate the effect of heterogeneous beliefs.

Finally, given the fact that consistent winners and losers have stronger and more persistent momentum effect, we conduct a consistent momentum strategy by buying consistent winners and selling consistent losers. A consistent momentum strategy is found to yield monthly returns as high as 1.25%, which amounts to an annual return of 15%. Such a consistent momentum strategy outperforms original momentum strategy by almost 20 basis points in monthly return (more than 20% improvement). The superior profits for consistent momentum strategy remain robust after adjusting for capital asset pricing model, the Fama-French three-factor model, Carhart's (1997) momentum factor, and Pastor and Stambaugh's (2003) liquidity factor.

Overall, this study contributes to finance literature in several ways. First, this study provides an evidence of implementation cost for the momentum strategy. Knez and Ready (1996), Shleifer and Vishny (1997), Grundy and Martin (2001), Korajczyk and Sadka (2004) argue that the trading cost may deterring investors from applying momentum strategy, while the effect of trading costs cannot fully explain momentum profits. This study demonstrates a large dispersion of post-formation returns and a high turnover rate for winner and loser portfolios, indicating that not all of winner and loser stocks follow the mid-term return continuation. The momentum strategy contains an implementation risk that investors would face a potential loss if they cannot long for all of winner stocks and short for all of loser stocks. Such implementation risk, one of indirect implementation cost for the momentum strategy, is new to literature and may present a venue to track the sources of the momentum effect. Second, this study confirms the role of information asymmetry and heterogeneous beliefs in the momentum consistency. Literature demonstrate that, in terms of momentum profits, the momentum effect is stronger among stocks with more serious information asymmetry and larger difference of opinions among investors. However, those studies either keep silent or indirectly show that information asymmetry and heterogeneous beliefs can enhance the consistency of momentum effect. This study fills in the gap providing a direct test on the consistency of momentum effect, and shows that information asymmetry and heterogeneous beliefs do enhance the persistency of momentum effect. Third, this study reconciles the role of trading volume under heterogeneous beliefs hypothesis proposed and momentum lifecycle hypothesis by decomposing the effect of trading volume. To the best of our knowledge, this study is the first to offer evidence that the trading volume reflects effects of both heterogeneous beliefs and momentum life cycle, while the effect of momentum life cycle cannot dominate the effect of heterogeneous beliefs. Last, this study finds a consistent momentum strategy may offer monthly return as high as 1.25%, which outperforms Jegadeesh and Titman's (1993) momentum strategy by 19 basis points. Aside from academic interest, we believe that our findings can serve as a useful guide for asset managers seeking profitable investment strategies.

The paper is organized as follows. In Section 2, we describe the methodologies and the data used in this study. In Section 3, we discuss how consistent winners and losers affect momentum profits and the determinants of consistent winners and losers. In Section 4, we discuss the role of trading volume under the information asymmetry hypothesis and the heterogeneous beliefs hypothesis. In Section 5, we test the profitability of consistent momentum strategies. Section 5 concludes.

2. Methodology and data description

2.1. *Durations for winners and losers*

We first construct winner and loser portfolio according to the approach suggested by Jegadeesh and Titman (1993). At the end of each month, we identify our sample as those stocks which have complete data available for their past *J*-month returns (J = 3, 6, 9, and 12) and subsequent 24-month returns. We rank those sample stocks into deciles based on their prior *J*-month returns, and group the stocks into 10 equally weighted portfolios. Sample stocks in the top decile portfolio are called "winners," and those in the bottom decile are called "losers." A duration for a winner (loser) stock is defined as the number of month which a winner (loser) stock is continuously ranked in the top (bottom) decile portfolio in the following months. The durations for winner stocks and for loser stocks can, therefore, be expressed as

$$Duration_{i,t}^{W} = \sum_{k=t+1}^{t+24} I_{i,k} \ , \tag{1}$$

where $I_{i,k}$ is one if stock *i* is in the winner portfolio from *t* to *k*, and zero otherwise; and

$$Duration_{i,t}^{L} = \sum_{k=t+1}^{t+24} I'_{i,k} \ , \tag{2}$$

where $I'_{i,k}$ is one if stock *i* is in the loser portfolio from *t* to *k*, and zero otherwise.

We further identify consistent winners as the winner stocks with duration greater than one, and consistent losers as loser stocks with duration greater than one. For example, a winner stock in month *t* has the highest ranked returns from month *t-J+1* to month *t*, while a consistent loser in month *t* are defined as a stock has the lowest ranked returns for at least two consecutive periods, from *t-J+1* to *t* and from *t-J+2* to *t+1*.

Only few studies investigate the role of return consistency. Watkins (2003) and Grinblatt and Moskowitz (2004) find stocks with consistent positive returns over a period yields higher future returns, and demonstrate that return consistency can predict future stock returns. In contrast, this study focuses on stocks in winner and loser portfolios based on their previous returns and treats a winner (loser) stock as a consistent winner (loser) if it stays in winner (loser) portfolio in the following formation months. The measure of consistency, durations for winners and losers, used in this study has two advantages. First, consistent winners (losers) defined in this study should be stocks stay in winner (loser) group for at least two consecutive months, while consistent winning (losing) stocks defined by Watkins (2003) and Grinblatt and Moskowitz (2004) are not necessary to be winners (losers) during the formation period. This study is to investigate post-formation performance of winner (loser) stocks with different consistency, and hence the consistency measure used in this study is more appropriate. Second, Watkins (2003) and Grinblatt and Moskowitz's (2004) consistency is so restrictive that, on average, only 1.32% (1.12%) of observations are consistent winning (losing) stocks, whereas this study has 60.71% (59.59%) consistent winners (losers). Hence, this study can be free from small sample size problem and provide trustworthy implications for the analyses of consistent winners and losers.

2.2. *Data*

We collect the basic firm information and the firm accounting data from COMPUSTAT, and obtain stock price, stock returns, trading volume, market capitalization, share codes, and exchange codes from Center for Research in Security Prices (CRSP). Institutional holdings are compiled quarterly from SEC 13-F filing. The sample period is from 1980 through 2011. Only common stocks (SHRCD = 10, 11) and firms traded on the NYSE, AMEX, or NASDAQ are included in our sample. We exclude closed-end funds, Real Estate Investment Trusts (REITs), American Depository Receipts (ADR), utility services, and financial institutions. We also exclude firms with stock prices below $5 on the formation date, considering that investors generally pay only limited attention to such stocks. To investigate durations for winner and loser stocks and their price performance, firms in our sample should have at least six consecutive monthly returns prior to the formation month and at least 24 consecutive monthly returns after the formation month. In addition, firms in our sample should have their corresponding size, book-to-market ratio, turnover, idiosyncratic volatility, and institutional ownership in each formation month.

To ensure that the firm accounting information is available to the public investors at the time the stock returns are recorded, we follow the approach of Fama and French (1992) and match the accounting data for all fiscal year ending in calendar year *t*-1 with the returns for July of year *t* to June of *t*+1. The market capitalization is calculated by the closing price of the last trading day of June of that year times the number of outstanding shares at the end of June of that year. Book-to-market ratio is calculated as a firm's book value of common equity for the fiscal year ending in year *t*-1 divided by its market equity at the end of December in year *t*-1. We adopt Lee and Swaminathan's (2000) method to obtain a firm's monthly turnover as the average daily ratio of the number of share traded to the number of shares outstanding.[2] Similar to Ali, Hwang, and Trombley (2003), the idosyncratic volatility is defined as the residual variance from regressing of a firm's daily excess returns on market daily excess returns over the past 12 months. Institutional ownership is the percentage of outstanding shares held by institutional investors.

2.3. *Distribution of momentum profits and turnover rates of winner and loser portfolios*

Table 1 presents the distribution of post-formation performance for winner and loser stocks. In terms of 6-month post-formation performance for winner and loser stocks on the basis of their prior 6-month returns, winner stocks experience an average 0.5% price appreciation with a standard deviation as high as 3.2%, and loser stocks suffer 1% loss with a standard deviation of 4.2%. In addition, the first quartile performance for winner stocks is -0.13%, and the bottom quartile performance for loser stock is 1.4%. Consistent with Lesmond, Schill, and Zhou (2004), the finding of large variation of post-formation performance for winner and loser indicates that not all of winner and loser stocks follow the finding of mid-term return continuity. On the contrary, at least one quarter of winner and loser stocks appear a contrarian pattern in the intermediate future after the formation month. Therefore, although a momentum strategy can statistically generate a significantly positive return, high standard deviations of the post-formation performance for winner and loser stocks may lead a potential loss if investors randomly long and short for a small portion of winner and loser stocks.

[Insert Table 1 about here]

Table 2 summarizes the average turnover rates for winners and losers portfolio based on different formation periods. In terms of six-month formation period, 60.71% of winner stocks and 59.59% loser stocks will stay in winner and loser group in the following one month. There are 0.83% (0.95%) of winner (loser) stocks will turn to be losers (winners) just one month after they are ranked as winners and losers.[3] We understand that a turnover happens when a winner (loser) stock is not ranked as the top (bottom) decile if we retire its most previous monthly return and include its most recent monthly return one month after formation date. The observation that only a change of $1/J$ formation period return will make near 40% of winner and loser stocks out of winners and losers groups confirms the

[2] Gould and Kleidon (1994) show that trading volume for NASDAQ securities may be inflated due to the double counting of dealer trades. We therefore follow Anderson and Dyl (2005) to scale down the trading volume for NASDAQ securities by 50% before 1997 and by 38% after 1997.

[3] One may argue that inconsistent winner stocks are those winner stocks with lower formation period returns, and hence are easily dropped from the winner portfolio next month. We therefore further divide sample firms into 20 groups in each formation month and investigate turnover rates for extreme winner and loser portfolios. Appendix A shows that only 56.08% of top 5% winners and 54.29% of bottom 5% losers stay in extreme portfolios, indicating that the consistency of momentum portfolios is not driven by extreme previous formation period performance.

importance of the role of the subsequent monthly returns for winner and loser stocks. It also indicates an existence of a large difference of post-formation performance between consistent winners (losers) and inconsistent winners (losers). The fact that large variation of post-formation performance and high turnovers for winner and loser stocks therefore inspires us to further explore price behaviors for consistent and inconsistent momentum portfolios.

[Insert Table 2 about here]

3. Momentum profits for consistent and inconsistent momentum portfolios

3.1. *Post-formation performance of consistent and inconsistent momentum portfolios*

We here divide winner (loser) stocks into consistent winner (loser) group and inconsistent winner (loser) group, and examine their post-formation performance. Panel A of Table 3 presents the averages of subsequent 13 monthly returns after the formation month *t* for consistent winners and inconsistent winners. The 6-month formation period winner stocks experience an average of 2.7% monthly return (R_{t+1}) one month after the formation month, while consistent winners have as high as 7.3% monthly return and inconsistent losers have a loss of 4.9%. By definition, consistent winners are those winner stocks stay in winners group in the next formation month, so it is reasonable that consistent winners have higher monthly returns one month subsequent to the formation date.[4] However, in terms of raw return and risk-adjusted return, we can find significant different post-formation performance between consistent winners and inconsistent winners up to seven months after the formation month. A strong post-formation performance for consistent winners relative to inconsistent winners can also be observed for winner portfolios with different formation periods. Similar results for loser portfolios as shown in Panel B of Table 3 that, relative to inconsistent losers, consistent losers experience large losses one month after the formation month, while the relatively bad price performance for consistent losers can last for eight months after the formation month. Figures 1 and 2 depict the average buy and hold return for consistent and inconsistent momentum portfolios in various formation periods. In addition, a large spread of holding returns between consistent and inconsistent momentum portfolios provide us an opportunity to utilize a zero-investment strategy to generate a positive return. We will discuss consistent momentum strategies in Section 5.

[Insert Table 3 about here]

[Insert Figure 1 about here]

[Insert Figure 2 about here]

Besides the finding of significantly different post-formation performance between consistent and inconsistent momentum portfolios, results from Table 3 also provide some interesting implications on the implementation of momentum strategy. As suggested by Jegadeesh and Titman (1993), momentum strategies usually skip a week between formation period and

[4] Our results are still held when we skip one week in calculating post-formation returns to avoid bid-ask bounce.

holding period to avoid short-term reversal induced by bid-ask bounce, price pressure, and lagged reaction effects documented in Jegadeesh (1990) and Lehmann (1990). However, stocks with strong short-term reversal are typically treated as inconsistent winners or losers, and may experience a weak momentum effect in the future as Table 3 shows. That is, even though skipping one week in momentum strategy can avoid a short-term reversal due to bid-ask bounce, price pressure, or lagged reaction, an investor or a fund manager may get relatively weak momentum profits if they coincidently include inconsistent winners or losers into their momentum portfolios.

3.2. *Determinants of consistent and inconsistent momentum portfolios*

Given the different post-formation performance between consistent and inconsistent momentum portfolios, we subsequently try to find determinants of the consistency. Specifically, we use a cross-sectional Probit regression to examine what factors can make a winner (loser) stock to be a consistent winner (loser) or not. The model specification is denoted as

$$\begin{aligned} P\left(Duration_{i,t}^{W} > 0\right) = a_t + b_{1,t}\ln(Size)_{i,t} + b_{2,t}BM_{i,t} + b_{3,t}Ivol_{i,t} + b_{4,t}IO_{i,t} \\ + b_{5,t}Turnover_{i,t} + b_{6,t}R_{i,t-J+1,t} + b_{7,t}R_{i,t,t+1} + \varepsilon_{i,t} \end{aligned}, \text{ and} \tag{3}$$

$$\begin{aligned} P\left(Duration_{i,t}^{L} > 0\right) = a_t + b_{1,t}\ln(Size)_{i,t} + b_{2,t}BM_{i,t} + b_{3,t}Ivol_{i,t} + b_{4,t}IO_{i,t} \\ + b_{5,t}Turnover_{i,t} + b_{6,t}R_{i,t-J+1,t} + b_{7,t}R_{i,t,t+1} + \varepsilon_{i,t} \end{aligned}, \tag{4}$$

where $Duration_{i,t}^{W}$ and $Duration_{i,t}^{L}$ are durations for a winner stock and a loser stock, and the dependent variable is one if a winner (loser) stock has a non-zero duration, and zero otherwise. Independent variables are the natural logarithm of firm size, book-to-market ratio, the monthly turnover, idiosyncratic volatility, institutional ownership, previous *j*-month return (j = 3, 6, 9, and 12), and one-month post-formation return.

Table 4 presents the time-series averages of estimates from Probit regressions. We find that both the formation-period return and the one-month return subsequent to the formation month are important in determining consistent winners and losers. The significance of post-formation performance implies that to be a consistent winner or lower stock does not solely depend on its previous higher or lower returns, but also depend on its most recent price performance. Controlling for returns before and after formation month, we also find that, among winner and loser stocks, stocks with smaller size, higher turnover, higher indiosyncratic volatility, and lower institutional ownership yield a higher probability to be consistent winners or losers. As shown in Table 3 that consistent winners and losers will have relatively pronounced momentum effect during the post-formation period. Therefore, our findings support the argument that investors will underreact new information for firms with more degree of information asymmetry and larger divergence of investors' opinions, resulting a stronger and more persistent momentum effect.

[Insert Table 4 about here]

3.3. *Durations for momentum portfolios*

We further investigate how long the consistent winners and losers can sustain in winner and loser portfolios and try to find characteristics affecting winner and loser durations. To avoid double count on firm-months in the same duration period, we restrict our sample firms to those winner and loser stocks which do not belong to winner and loser portfolio in the previous formation month. Table 5 presents distributions of duration for winner stocks and loser stocks in different formation periods. For the six-month formation period, 46.69% of winners and 47.00% of losers have zero duration, and the rest of 53.31% of winners and 53.00% of losers are consistent winners and consistent losers. Around 19% of winners and losers can only stay in momentum portfolios for consecutive two months (duration is equal to one month), around 11% of winners and losers can stay in momentum portfolios for consecutive three months (duration is equal to two month), and around 95% of winners and losers cannot sustain in momentum portfolios longer than seven months (duration is equal to six month). The average durations are 0.889 months for all winners and 1.914 months for consistent winners; while the average durations are 0.836 months for all losers and 1.855 months for consistent losers. The observation of short durations for winner and loser stocks indicate that, when an investor implements momentum strategies, including short-duration momentum stocks may result higher frequency of stock turnovers and higher transaction cost. That is, if a momentum strategy investor coincidently chooses inconsistent winners and losers into his momentum portfolio, not only the relatively poor post-formation performance, but also a higher transaction cost he will face. We are, therefore, interested in finding characteristics which affect winner and loser durations.

[Insert Table 5 about here]

3.4. *Determinants of the duration for momentum portfolios*

In this section, we attempt to examine whether information asymmetry hypothesis, heterogeneous beliefs hypothesis, or other factors can determine the duration of momentum portfolios. Atiase (1985) and Huddart and Ke (2007)suggest that a firm with small size, lower book-to-market ratio, and lower institutional ownership may suffer more serious information asymmetry problem, and lead investors react the new information of such firm more conservatively. A stronger momentum effect can therefore be found in firms with higher degree of information asymmetry (e.g. Zhang, 2006; and Chen and Zhao, 2012). In addition, Harris and Ravid (1993), Shalen (1993), Gebhardt, Lee, and Swaminathan (2001), Boehme, Danielsen, and Sorescu (2006), Hong and Stein (2007), and Verardo (2009) show that the idiosyncratic volatility and/or the trading volume can represent the degree of heterogeneous beliefs of investors on a firm. If a firms has higher trading volume or higher idiosyncratic volatility, the large divergence of investors' opinions will also lead a stronger momentum effect on the stock return of the firm (e.g. Hong and Stein, 2007; and Verardo, 2009). However, those studies only investigate the relative strength of momentum effect in terms of the magnitude of post-formation returns rather than the consistency of momentum effect. The duration analysis provides us an opportunity to examine whether factors associate to information asymmetry and heterogeneous beliefs can affect the consistency of momentum effect, more specifically, the duration for consistent winners and losers. We apply a life regression model with censored data used by Ongen and Smith (2001) and Deville and Riva (2007)to deal with the dependent variable, the duration of consistent winners and losers, censored between zero and twenty four.[5] The model specification is denoted as

$$\begin{aligned} Duration_{i,t} = {} & a_t + b_{1,t}\ln(Size)_{i,t} + b_{2,t}\ln(Size)_{i,t} * D_{i,t} + b_{3,t}BM_{i,t} + b_{4,t}BM_{i,t} * D_{i,t} + b_{5,t}Ivol_{i,t} + b_{6,t}Ivol_{i,t} * D_{i,t} \\ & + b_{7,t}IO_{i,t} + b_{8,t}IO_{i,t} * D_{i,t} + b_{9,t}Turnover_{i,t} + b_{10,t}Turnover_{i,t} * D_{i,t} \\ & + b_{11,t}\left|R_{i,t-J+1,t}\right| + b_{12,t}\left|R_{i,t-J+1,t}\right| * D_{i,t} + b_{13,t}\left|R_{i,t,t+1}\right| + b_{14,t}\left|R_{i,t,t+1}\right| * D_{i,t} + \varepsilon_{i,t} \end{aligned} \quad , (5)$$

where the dependent variable is the duration for consistent momentum stocks, and independent variables are the natural logarithm of firm size, book-to-market ratio, the monthly turnover, idiosyncratic volatility, institutional ownership, absolute value of previous J-month return (j = 3, 6, 9, and 12), absolute value of previous j-month return times winner dummy, absolute value of one-month post-formation return, and absolute value of one-month post-formation return times winner dummy. Besides investigating the effect of information asymmetry and heterogeneous beliefs on momentum consistency, we also examine the role of formation period performance and post-formation performance in determining the duration for consistent momentum stocks. Table 6 shows results of the censored life regressions. Consistent with information asymmetry hypothesis and heterogeneous beliefs hypothesis, the momentum duration is positively associated to idiosyncratic volatility and monthly trading volume, and negatively associated to size, book-to-market ratio, and institutional ownership. Specifically, if consistent winner and loser stocks have relatively higher idiosyncratic volatilities, higher trading volume, smaller size, lower book-to-market ratio, and lower institutional ownership, those stock prices are underreacted to new information due to investors' conservatism and different opinions. Hence, those consistent winner and loser stocks can sustain in winner and loser portfolios for a longer period.

[Insert Table 6 about here]

Table 6 also shows that both formation period performance and one-month post-formation return can determine the duration of consistent winners and losers. The significantly positive coefficients indicate the higher formation period returns and higher monthly return after the formation date can extend the duration of consistent winner and loser stocks. Moreover, we find a slightly negative on the interaction between winners dummy and formation period performance and a significantly positive coefficient on the interaction between winners dummy and one-month post-formation return. The asymmetry effect on the duration between consistent winners and losers indicates that, in terms of the duration of consistency, the post-formation performance plays a more important role for consistent winners than consistent losers, while the formation period performance is relatively less important for consistent winners than consistent losers.

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[5] Estimations of ordinary least square would be biased if the dependent variable violates normality assumption. It is obvious that the dependent variable in Eq. (5), the duration of momentum portfolios, is between zero and twenty-four. We therefore adopt a censored life regression model to investigate the influence of explanatory variables on the right-censored dependent variable.

4. Heterogeneous beliefs and momentum life cycle

Besides examine the consistency of momentum effect, the duration analysis for the consistency also provide a venue to examine effects of the trading volume under heterogeneous beliefs hypothesis proposed by Hong and Stein (2007) and Verardo (2009) and under the momentum lifecycle hypothesis proposed by Lee and Swaminathan (2000). Hong and Stein (2007) demonstrate that even investors receive same information signals, their different analysis models may result in different opinions on the liquidation value for a stock. The existence of disagreement among investors for a stock may induce investors to trade with one another, leading a higher trading volume on the stock. Hong and Stein's (2007) disagreement model also shows that the momentum effect should be more pronounced in those stocks with higher trading volume. Verardo (2009) provides an empirical evidence that momentum effect is stronger for stocks with higher trading volume. In contrast, Lee and Swaminathan (2000) propose a momentum lifecycle hypothesis, in which stocks experience periods of investor neglect will have stronger and more persistent momentum effect, while stock under periods of favoritism will have relatively less momentum effect in terms of magnitude and persistency. They suggest that trading volume may provide information useful in locating the degree of favoritism for a stock. Specifically, low-volume winners and high volume losers are during the periods of neglect and have more persistent momentum effect, while high-volume winners and low volume losers are during the periods of favoritism and have relatively short-lived momentum effect. However, Lee and Swaminathan (2000) do no directly examine the persistency for winners and losers in different periods of favoritism.

The trading volume therefore may be positively associated to momentum consistency if the trading volume stand for the degree of heterogeneous beliefs among investors, while the trading volume may be positively associated to winner consistency and negatively associated to loser consistency if the trading volume represents the degree of favoritism for a stock. We here take advantage of the censored life regression to decompose the effect of trading volume into the effect of heterogeneous beliefs and the effect of momentum life cycle.

$$\begin{aligned} Duration_{i,t} &= a_t + b_{1,t}\ln(Size)_{i,t} + b_{2,t}BM_{i,t} + b_{3,t}Ivol_{i,t} + b_{4,t}IO_{i,t} + b_{5,t}Turnover_{i,t} \\ &+ b_{6,t}Turnover_{i,t} * D_{i,t} + b_{7,t}\left|R_{i,t-J+1,t}\right| + b_{8,t}\left|R_{i,t-J+1,t}\right| * D_{i,t} + b_{9,t}\left|R_{i,t,t+1}\right| + b_{10,t}\left|R_{i,t,t+1}\right| * D_{i,t} + \varepsilon_{i,t} \end{aligned}, \quad (6)$$

where the dependent variable is the duration for consistent momentum stocks, and independent variables are the natural logarithm of firm size, book-to-market ratio, the monthly turnover, the monthly turnover times winner dummy, idiosyncratic volatility, institutional ownership, absolute value of previous *j*-month return (*j* = 3, 6, 9, and 12), absolute value of previous *j*-month return times winner dummy, absolute value of one-month post-formation return, and absolute value of one-month post-formation return times winner dummy. If the trading volume represents heterogeneous beliefs among investors, higher trading volume may lead longer momentum consistency and a positive estimated coefficient on turnover can be observed. If the trading volume stands for favoritism for a stock under the momentum lifecycle hypothesis, higher trading volume will contribute a shorter momentum consistency for winner stocks than that for loser stocks. Therefore, the estimated coefficient on the interaction of turnover and winner dummy will be negative.

Table 7 shows estimation results of censored life regressions. The significantly positive coefficients for the turnover support the prediction of heterogeneous beliefs hypothesis and the loser part of momentum lifecycle hypothesis. The significantly negative coefficients for the interaction between the turnover and winner dummy confirm the effect of the winner part of momentum lifecycle hypothesis. Our results show that the trading volume reflects effects of both heterogeneous beliefs hypothesis and momentum lifecycle hypothesis. However, the magnitudes of the negative coefficients for the interaction term is smaller than those of the positive coefficients for the turnover, implying that, at least for winners, the effect of momentum lifecycle cannot dominate the effect of heterogeneous beliefs.

[Insert Table 7 about here]

5. Consistent momentum strategies

Table 3 presents a large spread of post-formation returns between consistent and inconsistent momentum portfolios. In addition, the higher degree of information asymmetry and heterogeneous beliefs among investors for consistent winner and loser stocks may make the momentum effect last longer. Our findings then suggest that a consistent momentum strategy using one more monthly return information should offer improved momentum profits. Specifically, the enhanced performance of a consistent momentum strategy can be observed by taking a long positions for consistent winners and a short position for consistent losers and holding the portfolio for subsequent six months.[6] Panel A of Table 8 provides raw and adjusted returns to consistent momentum strategy, inconsistent momentum strategy, and traditional momentum strategy suggested by Jegadeesh and Titman (1993). In terms of six-month formation period and six-month holding period, a consistent momentum strategy yields a monthly raw return as high as 1.25%, which is significantly higher than those returns earned by inconsistent momentum strategy (0.47%) and by traditional momentum strategy (1.06%). That is, investors can earn an average monthly return 1.25% by buying consistent winner stocks and selling consistent loser stocks, which outperforms the traditional momentum strategy by almost 19 basis points.

[Insert Table 8 about here]

The superior performance for consistent momentum strategy is still held after adjusting for capital asset pricing model, the Fama-French three-factor model, Carhart's (1997) momentum factor, and Pastor and Stambaugh's (2003) liquidity factor. Note that, profits from traditional momentum strategies and inconsistent momentum strategies can be explained away by Fama-French 3-factors and Carhart's momentum factor, whereas 3-month formation period and 6-month formation period consistent momentum strategies can sustain significantly positive profits after adjusting by Fama-French 3-factors and Carhart's momentum factor.

One may argue that the superior performance of consistent momentum strategies is because consistent momentum strategies include one more month information than traditional

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6 Because we need one more monthly return to define winners (losers) as consistent winners (losers) and inconsistent winners (losers), the implementation date of the consistent momentum strategy is one month after the formation date of the traditional momentum strategy.

momentum strategies. To tackle such possible explanation, as shown in Panel B of Table 8, we further conduct a traditional momentum strategy with a 7-month formation period and obtain a monthly raw return of 1.09%. Comparing to the consistent momentum strategy, which yields 1.28%, the 7-month formation period momentum strategy still cannot perform as well as the consistent momentum strategy. We therefore conclude that the higher profitability of consistent momentum strategies is not due to the more information generated, but due to investors' conservatism toward consistent momentum stocks.

6. Conclusion

This paper conducts a comprehensive analysis on the consistency of momentum effect. We show that only 60% of winner and loser stocks can be consistent winners and losers and at least 25% of winner and loser stocks experience a contrarian effect rather than momentum effect. Such high turnover rates and large return dispersions in the post-formation period for momentum stocks not indicate that momentum strategy not only involves a higher direct implementation cost, transaction cost, but also contains an indirect implementation cost that momentum investors may face a potential loss if they cannot include all of winner stocks and loser stocks in their portfolio.

We find, in the post-formation period, consistent winner stocks outperform inconsistent winner stocks, while consistent loser stock will continuously underperform inconsistent loser stocks. The finding of a large spread of post-formation returns between consistent and inconsistent momentum portfolios confirms the importance of consistency for momentum portfolios in determining the strength of the momentum effect. In addition, this pattern also indicates a zero-investment strategy by buying consistent winners and selling inconsistent winners. An enhanced trading strategy, consistent momentum strategy, is therefore found, yielding an average monthly return of 1.25% and remaining significant after adjusting for various asset pricing factors.

Behavioral explanations to the momentum effect, including the information asymmetry hypothesis and heterogeneous beliefs hypothesis, show that investors' conservatism and divergence of their opinions to the liquidation value of a company may lead a delayed reaction to the stock price of such company. Results of the duration analysis provide a new evidence that both information asymmetry hypothesis and heterogeneous beliefs hypothesis can explain not only the magnitude of momentum profits but also the persistency of the momentum effect. We also find an asymmetric effect that the post-formation return contributes to the winner consistency more, while the formation period return can explain the loser consistency more. Moreover, the duration analysis provides us an opportunity to directly examine the momentum lifecycle hypothesis, which lower favoritism winner stocks and neglected loser stocks have more persistent momentum effect. Using the trading volume to proxy for investors' favoritism, the duration analysis supports the argument of momentum lifecycle hypothesis, while the effect of momentum lifecycle hypothesis cannot dominate the effect of information asymmetry.

As mentioned earlier, the momentum effect is robust and persistent in the stock market for more than four decades, while the consistency of winner and loser stocks is less well understood. This paper contributes to the extant finance literature in presenting new evidence on the market efficiency with respect to the momentum consistency. The further research is necessary in tracing the distribution and the consistency of post-formation performance for momentum portfolios.

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Table 1. The distribution of momentum profits

This table presents distributions of various holding period returns for winner and loser stocks. At the end of each month from January 1960 to December 2011, all stocks are ranked by their prior *J*-month return (*J* = 3, 6, 9, and 12) and assigned to one of deciles. Stocks in the highest prior return decile are winners, and stocks in the lowest prior return decile are losers. *K*-month (*K* = 3, 6, 9 and 12) holding period return are equally-weighed *K*-month returns holding winner or loser group. Mean, standard deviation, minimum value, the first quartile, median, the bottom quartile, are maximum value for various holding period returns are presented.

		Winners				Losers			
		K=3	*K*=6	*K*=9	*K*=12	*K*=3	*K*=6	*K*=9	*K*=12
J=3	Mean	0.009	0.004	0.001	0.000	0.001	-0.009	-0.010	-0.011
	Std Dev	0.046	0.032	0.027	0.024	0.053	0.039	0.033	0.027
	Min	-0.214	-0.121	-0.123	-0.106	-0.206	-0.167	-0.126	-0.097
	Q1	-0.015	-0.015	-0.013	-0.012	-0.029	-0.028	-0.028	-0.026
	Median	0.011	0.006	0.005	0.002	0.003	-0.006	-0.006	-0.007
	Q3	0.036	0.022	0.018	0.015	0.033	0.015	0.007	0.004
	Max	0.197	0.105	0.076	0.068	0.197	0.108	0.079	0.070
J=6	Mean	0.010	0.005	0.002	0.000	0.000	-0.010	-0.012	-0.012
	Std Dev	0.045	0.032	0.027	0.023	0.057	0.042	0.034	0.029
	Min	-0.216	-0.123	-0.127	-0.112	-0.241	-0.159	-0.120	-0.110
	Q1	-0.014	-0.013	-0.013	-0.012	-0.029	-0.029	-0.030	-0.028
	Median	0.013	0.007	0.005	0.004	-0.001	-0.007	-0.007	-0.007
	Q3	0.036	0.024	0.020	0.015	0.032	0.014	0.005	0.003
	Max	0.208	0.092	0.080	0.067	0.318	0.191	0.133	0.107
J=9	Mean	0.010	0.005	0.002	0.000	0.001	-0.009	-0.011	-0.010
	Std Dev	0.045	0.033	0.027	0.023	0.059	0.041	0.033	0.029
	Min	-0.200	-0.130	-0.118	-0.105	-0.211	-0.149	-0.116	-0.100
	Q1	-0.014	-0.015	-0.013	-0.013	-0.028	-0.029	-0.030	-0.026
	Median	0.014	0.007	0.004	0.002	-0.001	-0.007	-0.006	-0.006
	Q3	0.036	0.024	0.019	0.015	0.032	0.014	0.005	0.004
	Max	0.180	0.104	0.079	0.065	0.360	0.195	0.132	0.103
J=12									
	Std Dev	0.046	0.033	0.027	0.023	0.058	0.041	0.033	0.028
	Min	-0.195	-0.131	-0.117	-0.101	-0.183	-0.162	-0.122	-0.101
	Q1	-0.016	-0.016	-0.014	-0.013	-0.027	-0.025	-0.028	-0.025
	Median	0.012	0.006	0.004	0.003	0.001	-0.006	-0.005	-0.005
	Q3	0.037	0.024	0.019	0.015	0.034	0.014	0.005	0.004
	Max	0.187	0.106	0.076	0.057	0.333	0.217	0.138	0.114

Table 2. Turnover rates of momentum portfolios

This table reports the average turnover rates for winner and loser stocks in the next formation month. At the end of each month, winner stocks are those stocks with top decile previous *J*-month (*J*= 3, 6, 9, and 12) returns, while loser stocks are those stocks with bottom decile previous *J*-month returns. Panel A presents average percentages of winner stocks which will be ranked and assigned to a certain decile in the next formation month. Panel B presents average percentages of loser stocks which will be ranked and assigned to a certain decile in the next formation month.

Panel A: Winner stocks										
J	P1(Losers)	P2	P3	P4	P5	P6	P7	P8	P9	P10(Winners)
3	1.784%	1.982%	2.204%	2.600%	3.154%	4.189%	6.037%	9.746%	19.257%	47.242%
6	0.832%	0.842%	0.890%	1.109%	1.432%	2.110%	3.584%	7.194%	19.697%	60.713%
9	0.743%	0.729%	0.736%	0.832%	1.033%	1.468%	2.413%	5.500%	19.115%	66.408%
12	0.773%	0.670%	0.665%	0.758%	0.919%	1.253%	2.034%	4.560%	18.230%	69.319%

Panel B: Loser stocks										
J	P1(Losers)	P2	P3	P4	P5	P6	P7	P8	P9	P10(Winners)
3	46.614%	19.215%	9.824%	6.045%	4.306%	3.323%	2.788%	2.434%	2.235%	2.053%
6	59.590%	20.370%	7.426%	3.655%	2.281%	1.536%	1.248%	1.076%	0.923%	0.945%
9	65.162%	19.819%	5.817%	2.608%	1.544%	1.069%	0.854%	0.736%	0.736%	0.786%
12	67.968%	18.977%	4.933%	2.084%	1.291%	0.954%	0.799%	0.739%	0.711%	0.839%

Table 3. Average post-formation returns for consistent and inconsistent momentum portfolios

This table reports average monthly post-formation returns for consistent and inconsistent momentum stocks. At the end of each month, winner stocks are those stocks with top decile previous *J*-month (*J*= 3, 6, 9, and 12) returns, while loser stocks are those stocks with bottom decile previous *J*-month returns. Consistent winners (losers) are those winner (loser) stocks stay in winner (loser) group both in the formation month *t* and in the next formation month *t*+1, while inconsistent winners (losers) are those winner (loser) stocks do not stay in winner (loser) group in the next formation month *t*+1. Panel A presents the subsequent 13 monthly equally-weighted returns for winners, consistent winners, and inconsistent winners. Panel B presents the subsequent 13 monthly equally-weighted returns for losers, consistent losers, and inconsistent losers.

Panel A: Winner portfolios

J	Portfolio	R_{t+1}	R_{t+2}	R_{t+3}	R_{t+4}	R_{t+5}	R_{t+6}	R_{t+7}	R_{t+8}	R_{t+9}	R_{t+10}	R_{t+11}	R_{t+12}	R_{t+13}
3	Winners	0.028	0.002	0.013	0.013	0.013	0.013	0.012	0.011	0.01	0.011	0.009	0.008	0.006
	Consist. winners	0.105	0.003	0.015	0.014	0.015	0.015	0.013	0.011	0.012	0.011	0.010	0.007	0.007
	Inconsist. winners	-0.043	0.002	0.011	0.012	0.011	0.011	0.010	0.011	0.009	0.011	0.009	0.010	0.006
	Consist.-Inconsist.	0.147***	0.001**	0.004***	0.002*	0.003**	0.004***	0.003**	0.001	0.003*	-0.001	0.001	-0.003**	0.000
		(31.97)	(2.42)	(3.28)	(1.76)	(2.10)	(3.21)	(2.17)	(0.60)	(1.87)	(-0.50)	(0.89)	(-2.02)	(0.36)
	FF-3 adjusted	0.145***	0.001***	0.004***	0.002	0.002	0.004***	0.002*	0.001	0.002*	-0.000	0.001	-0.003*	0.000
		(34.04)	(2.88)	(3.14)	(1.23)	(1.57)	(2.83)	(1.69)	(0.57)	(1.67)	(-0.25)	(0.54)	(-1.89)	(0.29)
6	Winners	0.027	0.002	0.015	0.014	0.014	0.014	0.013	0.011	0.009	0.009	0.009	0.007	0.005
	Consist. winners	0.073	0.003	0.017	0.015	0.015	0.015	0.014	0.012	0.010	0.009	0.008	0.007	0.005
	Inconsist. winners	-0.049	0.002	0.011	0.012	0.012	0.011	0.012	0.008	0.009	0.010	0.009	0.006	0.005
	Consist.-Inconsist.	0.122***	0.000	0.006***	0.003***	0.003**	0.003***	0.002	0.004***	0.001	-0.001	-0.000	0.001	0.001
		(33.20)	(0.84)	(4.07)	(2.85)	(2.54)	(2.92)	(1.23)	(2.79)	(0.58)	(-0.54)	(-0.20)	(0.59)	(0.56)
	FF-3 adjusted	0.121***	0.000	0.006***	0.003**	0.003**	0.003**	0.001	0.003**	0.001	-0.001	0.000	0.001	0.001
		(34.47)	(0.47)	(3.84)	(2.51)	(2.31)	(2.22)	(0.71)	(2.41)	(0.55)	(-0.42)	(0.01)	(0.78)	(0.45)
9	Winners	0.026	0.002	0.015	0.015	0.013	0.012	0.011	0.009	0.008	0.008	0.007	0.007	0.007
	Consist. winners	0.062	0.002	0.016	0.016	0.015	0.013	0.011	0.010	0.009	0.008	0.007	0.007	0.006
	Inconsist. winners	-0.050	0.003	0.012	0.013	0.010	0.010	0.009	0.008	0.008	0.008	0.008	0.007	0.008
	Consist.-Inconsist.	0.112***	-0.000	0.003**	0.003**	0.005***	0.003**	0.002	0.002	0.001	-0.000	-0.001	-0.000	-0.001
		(29.92)	(-0.63)	(2.43)	(2.18)	(3.16)	(2.17)	(1.46)	(1.62)	(0.46)	(-0.19)	(-0.59)	(-0.18)	(-0.86)
	FF-3 adjusted	0.111***	-0.000	0.004**	0.003**	0.004***	0.003**	0.001	0.002	0.000	0.000	-0.001	0.000	-0.001
		(31.18)	(-0.99)	(2.58)	(1.97)	(2.69)	(2.26)	(0.88)	(1.61)	(0.33)	(0.01)	(-0.66)	(0.06)	(-0.69)
12	Winner	0.024	0.002	0.014	0.013	0.013	0.011	0.01	0.009	0.008	0.009	0.008	0.008	0.008
	Consist. winners	0.054	0.002	0.015	0.014	0.013	0.012	0.010	0.009	0.009	0.008	0.008	0.008	0.008
	Inconsist. winners	-0.051	0.002	0.012	0.011	0.011	0.008	0.010	0.007	0.008	0.009	0.008	0.008	0.010
	Consist.-Inconsist.	0.105***	-0.001	0.003**	0.003**	0.003*	0.003**	0.000	0.002	0.000	-0.001	-0.000	-0.000	-0.002**
		(29.92)	(-1.14)	(2.30)	(2.42)	(1.85)	(2.16)	(0.10)	(1.16)	(0.20)	(-0.54)	(-0.33)	(-0.24)	(-2.06)
	FF-3 adjusted	0.104***	-0.001	0.003**	0.004**	0.002	0.003**	-0.001	0.001	0.000	-0.001	-0.000	0.000	-0.002**
		(30.82)	(-1.27)	(2.15)	(2.31)	(1.34)	(1.96)	(-0.50)	(0.86)	(0.00)	(-0.53)	(-0.23)	(0.14)	(-1.96)

Panel B. Loser portfolios

J	Portfolio	R_{t+1}	R_{t+2}	R_{t+3}	R_{t+4}	R_{t+5}	R_{t+6}	R_{t+7}	R_{t+8}	R_{t+9}	R_{t+10}	R_{t+11}	R_{t+12}	R_{t+13}
3	Losers	0.045	-0.003	0.000	0.000	-0.001	0.000	0.002	0.003	0.002	0.000	0.002	0.005	0.009
	Consist. losers	-0.055	-0.006	-0.003	-0.004	-0.005	0.000	0.001	0.000	-0.002	0.000	0.001	0.008	0.009
	Inconsist. losers	0.113	-0.001	0.001	0.001	0.001	-0.001	0.002	0.005	0.004	0.001	0.002	0.004	0.008
	Consist.-Inconsist.	-0.168***	-0.005***	-0.004**	-0.006***	-0.006***	0.001	-0.001	-0.005***	-0.006***	-0.002	-0.001	0.004*	0.001
		(-38.56)	(-2.78)	(-2.10)	(-3.05)	(-2.75)	(0.62)	(-0.51)	(-2.66)	(-3.04)	(-0.93)	(-0.55)	(1.79)	(0.36)
	FF-3 adjusted	-0.169***	-0.005**	-0.003*	-0.005**	-0.006***	0.002	-0.001	-0.004**	-0.005***	-0.002	-0.001	0.002	0.001
		(-37.69)	(-2.56)	(-1.74)	(-2.45)	(-2.60)	(1.07)	(-0.57)	(-1.98)	(-2.69)	(-1.16)	(-0.31)	(1.17)	(0.22)
6	Losers	0.047	-0.004	-0.003	-0.001	0.000	0.001	0.000	0.000	0.003	0.003	0.005	0.007	0.010
	Consist. losers	-0.023	-0.009	-0.005	-0.002	-0.002	-0.002	-0.002	-0.002	0.001	0.003	0.006	0.010	0.013
	Inconsist. losers	0.125	0.001	-0.001	-0.001	0.001	0.003	0.001	0.002	0.004	0.004	0.005	0.004	0.008
	Consist.-Inconsist.	-0.148***	-0.010***	-0.004**	-0.001	-0.003	-0.005**	-0.003	-0.004**	-0.003	-0.001	0.001	0.006**	0.005**
		(-30.71)	(-5.12)	(-2.07)	(-0.69)	(-1.20)	(-2.56)	(-1.47)	(-2.56)	(-1.50)	(-0.30)	(0.22)	(2.39)	(2.19)
	FF-3 adjusted	-0.148***	-0.010***	-0.003	-0.001	-0.004	-0.005**	-0.005**	-0.004**	-0.003	-0.001	0.002	0.005**	0.004**
		(-30.10)	(-5.41)	(-1.42)	(-0.25)	(-1.24)	(-2.42)	(-2.15)	(-2.34)	(-1.42)	(-0.20)	(0.77)	(2.19)	(2.07)
9	Losers	0.049	-0.005	-0.002	0.000	-0.001	0.002	0.001	0.004	0.005	0.005	0.006	0.010	0.011
	Consist. losers	-0.011	-0.005	-0.004	-0.002	-0.003	0.000	0.001	0.003	0.005	0.006	0.007	0.013	0.012
	Inconsist. losers	0.126	0.002	0.001	0.001	-0.001	0.003	0.002	0.004	0.005	0.005	0.005	0.005	0.009
	Consist.-Inconsist.	-0.137***	-0.007***	-0.005**	-0.004	-0.002	-0.003	-0.001	-0.000	-0.001	0.001	0.002	0.007**	0.003
		(-23.39)	(-3.21)	(-2.39)	(-1.58)	(-0.92)	(-1.33)	(-0.40)	(-0.13)	(-0.42)	(0.26)	(1.14)	(2.55)	(1.02)
	FF-3 adjusted	-0.136***	-0.007***	-0.004**	-0.003	-0.002	-0.002	0.000	0.001	-0.001	0.001	0.003	0.007**	0.002
		(-24.53)	(-3.06)	(-1.97)	(-1.02)	(-1.10)	(-0.82)	(0.09)	(0.29)	(-0.30)	(0.41)	(1.34)	(2.40)	(0.68)
12	Losers	0.051	-0.005	0.000	0.001	0.001	0.003	0.003	0.004	0.006	0.007	0.007	0.009	0.010
	Consist. losers	-0.001	-0.006	-0.003	-0.001	-0.001	0.003	0.003	0.004	0.006	0.007	0.009	0.010	0.011
	Inconsist. losers	0.122	0.001	0.002	0.002	0.003	0.002	0.003	0.004	0.006	0.006	0.006	0.006	0.010
	Consist.-Inconsist.	-0.123***	-0.007***	-0.005**	-0.003	-0.003	0.001	0.000	0.001	0.000	0.001	0.003	0.004	0.001
		(-22.18)	(-2.69)	(-2.13)	(-1.16)	(-1.39)	(0.31)	(0.13)	(0.33)	(0.15)	(0.46)	(1.19)	(1.58)	(0.21)
	FF-3 adjusted	-0.123***	-0.008***	-0.006**	-0.001	-0.004	0.002	0.001	0.002	0.000	0.000	0.003	0.003	0.000
		(-22.11)	(-2.66)	(-2.10)	(-0.34)	(-1.49)	(0.84)	(0.33)	(0.49)	(0.02)	(0.20)	(1.29)	(1.16)	(0.10)

Table 4. Characteristics of consistent momentum portfolios

This table presents the time-series averages of estimates from Probit regression models. The cross-sectional regression is estimated for each month during the period of 1981 to 2011, with all of winner and loser stocks listed on NYSE, AMEX, or NASDAQ. Coefficients estimated from the cross-sectional regressions are then averaged over the months. The models are as follows:

$$P\left(Duration_{i,t}^{W} > 0\right) = a_t + b_{1,t}\ln(Size)_{i,t} + b_{2,t}BM_{i,t} + b_{3,t}Ivol_{i,t} + b_{4,t}IO_{i,t} + b_{5,t}Turnover_{i,t} + b_{6,t}R_{i,t-J+1,t} + b_{7,t}R_{i,t,t+1} + \varepsilon_{i,t}$$

$$P\left(Duration_{i,t}^{L} > 0\right) = a_t + b_{1,t}\ln(Size)_{i,t} + b_{2,t}BM_{i,t} + b_{3,t}Ivol_{i,t} + b_{4,t}IO_{i,t} + b_{5,t}Turnover_{i,t} + b_{6,t}R_{i,t-J+1,t} + b_{7,t}R_{i,t,t+1} + \varepsilon_{i,t}$$

The dependent variable is one if a winner (loser) stock has a non-zero duration, and zero otherwise. A duration for a winner (loser) stock is defined as the number of month which a winner (loser) stock is continuously ranked in the top (bottom) decile portfolio in the following months after the formation date. The independent variables are the natural logarithm of firm size, book-to-market ratio, the idiosyncratic volatility, institutional ownership, monthly turnover, previous J-month return (J = 3, 6, 9, and 12), and one-month post-formation return. The idiosyncratic volatility is the residual variance from regressing of a firm's daily excess returns on market daily excess returns over the past 12 months. Institutional ownership is the percentage of outstanding shares held by institutional investors. The monthly turnover is the average daily ratio of the number of share traded to the number of shares outstanding within one month. Newey-West t-statistics are shown in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% respectively.

	Winners (J = 6)					Losers (J = 6)				
Intercept	-0.3500***	-0.3426***	-0.4676***	-1.9049***	-0.5649***	-1.1801***	-1.3401***	-1.5509***	-1.2178***	-2.5105***
	(-8.75)	(-6.83)	(-9.10)	(-3.57)	(-11.17)	(-12.95)	(-10.81)	(-12.78)	(-12.72)	(-3.29)
ln(Size)	-0.0193***	-0.0410***	-0.0183***	0.0412	-0.0238***	0.0243*	0.0227	0.0391***	0.0297**	0.1447
	(-2.64)	(-6.01)	(-2.61)	(0.48)	(-3.21)	(1.92)	(1.59)	(2.78)	(2.15)	(1.46)
BM	-0.0126	0.0099	-0.0036	0.1792*	0.0132	-0.0952***	-0.0913***	-0.0852***	-0.0987***	-0.1092***
	(-1.18)	(0.84)	(-0.31)	(1.83)	(1.28)	(-7.92)	(-6.32)	(-6.66)	(-7.18)	(-4.51)
Ivol			3.6922***		2.8751***			5.5283***		6.7968***
			(5.35)		(5.13)			(5.11)		(5.34)
IO				-5.8036*	-0.0773*				-0.1301*	-0.4368
				(-1.73)	(-1.73)				(-1.82)	(-0.85)
Trunover		0.0905***			0.1049***		0.0583**			0.0062
		(6.66)			(7.43)		(2.33)			(0.13)
$R_{t-J+1,t}$	10.2085***	9.5025***	9.3671***	27.0883***	0.1439***	-12.400***	-13.672***	-13.350***	-12.940***	-0.5951***
	(18.89)	(20.38)	(21.08)	(3.85)	(2.63)	(-19.11)	(-16.47)	(-17.26)	(-18.57)	(-5.30)
$R_{t,t+1}$	0.1627**	0.1019**	0.1123**	1.5048**	10.2652***	-0.3672***	-0.3885***	-0.4412***	-0.3977***	-19.506***
	(1.97)	(2.05)	(2.15)	(2.09)	(26.34)	(-5.16)	(-3.84)	(-5.71)	(-5.14)	(-4.79)
LogLikehood	-158.05***	-162.24***	-159.32***	-44.254***	-134.11***	-66.096***	-61.497***	-63.809***	-64.803***	-58.923***
	(-38.20)	(-31.78)	(-40.59)	(-18.48)	(-52.38)	(-20.34)	(-18.76)	(-19.39)	(-20.14)	(-18.00)
# months	384	384	384	384	384	384	384	384	384	384
N>0	323	323	323	323	323	227	227	227	227	227
(%)	[60.71%]	[60.71%]	[60.71%]	[60.71%]	[60.71%]	[58.80%]	[58.80%]	[58.80%]	[58.80%]	[58.80%]
N=0	209	209	209	209	209	159	159	159	159	159
(%)	[39.29%]	[39.29%]	[39.29%]	[39.29%]	[39.29%]	[41.20%]	[41.20%]	[41.20%]	[41.20%]	[41.20%]

Table 5. Distribution of winner/loser durations

We report the percentage and the number of observation for each duration length. Duration is the maximum length of time that a winner (loser) being winner (loser) in the subsequent month(s). To avoid the overlapping problem when computing durations, we also report the non-overlapping durations of the whole sample for each duration length. Panel A and Panel B show winners' overlapping and non-overlapping duration distributions, and Panel C and Panel D show losers' overlapping and non-overlapping duration distributions.

Panel A: Winner portfolios

	J=3		*J*=6		*J*=9		*J*=12	
Duration	Obs.	%	Obs.	%	Obs.	%	Obs.	%
0	32,406	52.87	20,739	46.69	17,685	46.59	17,054	48.60
1	12,798	20.88	8,248	18.57	6,315	16.64	5,125	14.61
2	10,750	17.54	4,811	10.83	3,693	9.73	3,287	9.37
3	2,841	4.64	3,070	6.91	2,408	6.34	2,016	5.75
4	1,289	2.10	2,103	4.74	1,791	4.72	1,476	4.21
5	620	1.01	2,526	5.69	1,255	3.31	1,072	3.06
6	303	0.49	1,086	2.45	986	2.60	886	2.53
7	139	0.23	633	1.43	776	2.04	678	1.93
8	73	0.12	407	0.92	1,086	2.86	582	1.66
9	35	0.06	271	0.61	596	1.57	478	1.36
10	24	0.04	171	0.39	389	1.03	432	1.23
11	8	0.01	116	0.26	265	0.70	640	1.82
12	2	<0.01	88	0.20	180	0.47	381	1.09
13	2	<0.01	46	0.10	136	0.36	241	0.69
14	0	0.00	32	0.07	110	0.29	178	0.51
15	0	0.00	25	0.06	68	0.18	117	0.33
16	0	0.00	15	0.03	52	0.14	95	0.27
17	1	<0.01	11	0.03	53	0.14	58	0.17
18	0	0.00	7	0.02	30	0.08	79	0.23
19	0	0.00	3	0.01	25	0.07	48	0.14
20	0	0.00	6	0.01	13	0.03	31	0.09
21	0	0.00	1	<0.01	19	0.05	25	0.07
22	0	0.00	0	0.00	9	0.02	21	0.06
23	0	0.00	2	0.01	7	0.02	24	0.07
24	0	0.00	0	0.00	15	0.04	65	0.19

Including D=0	*J*=3	*J*=6	*J*=9	*J*=12
Mean	0.889	1.514	1.910	2.152
Std.	1.260	2.101	2.820	3.402
Excluding D=0	*J*=3	*J*=6	*J*=9	*J*=12
Mean	1.914	3.016	3.839	4.495
Std.	1.201	2.398	3.429	4.273

Panel B: Loser portfolios								
	J=3		*J*=6		*J*=9		*J*=12	
Duration	Obs.	%	Obs.	%	Obs.	%	Obs.	%
0	33,543	53.69	21,648	47.00	18,452	46.15	17,949	48.11
1	13,069	20.92	8,748	18.99	6,784	16.97	5,639	15.12
2	10,569	16.92	5,021	10.90	4,136	10.34	3,562	9.55
3	3,007	4.81	3,137	6.81	2,631	6.58	2,254	6.04
4	1,300	2.08	2,178	4.73	1,855	4.64	1,555	4.17
5	600	0.96	2,767	6.01	1,383	3.46	1,204	3.23
6	217	0.35	1,124	2.44	1,045	2.61	998	2.68
7	82	0.13	548	1.19	842	2.11	795	2.13
8	52	0.08	371	0.81	1,271	3.18	622	1.67
9	19	0.03	199	0.43	573	1.43	536	1.44
10	8	0.01	128	0.28	336	0.84	433	1.16
11	3	0.01	76	0.17	237	0.59	703	1.88
12	2	<0.01	54	0.12	130	0.33	325	0.87
13	1	<0.01	24	0.05	94	0.24	222	0.60
14	0	0.000	15	0.03	77	0.19	162	0.43
15	0	0.000	11	0.02	46	0.12	87	0.23
16	0	0.000	4	0.01	35	0.09	61	0.16
17	0	0.000	2	<0.01	19	0.05	52	0.14
18	0	0.000	1	<0.01	19	0.05	59	0.16
19	0	0.000	0	0.00	9	0.02	28	0.08
20	0	0.000	0	0.00	7	0.02	18	0.05
21	0	0.000	0	0.00	2	0.01	14	0.04
22	0	0.000	1	<0.01	1	<0.01	9	0.02
23	0	0.000	0	0.00	1	<0.01	4	0.01
24	0	0.000	0	0.00	0	0.00	16	0.04
Including D=0	*J*=3		*J*=6		*J*=9		*J*=12	
Mean	0.836		1.426		1.805		2.053	
Std.	1.200		2.101		2.820		3.402	
Excluding D=0	*J*=3		*J*=6		*J*=9		*J*=12	
Mean	1.855		2.834		3.565		4.167	
Std.	1.111		2.152		3.045		3.817	

Table 6. Determinants for momentum consistency

This table presents the time-series averages of estimates from censored life regression model. The cross-sectional censored life regressions are estimated for each month during the period of 1981 to 2011, with all of non-overlapped consistent winners and losers listed on NYSE, AMEX, or NASDAQ. Coefficients estimated from the cross-sectional censored life regressions are then averaged over the months. The models are as follows:

$$\begin{aligned} Duration_{i,t} = {} & a_t + b_{1,t}\ln(Size)_{i,t} + b_{2,t}\ln(Size)_{i,t} * D_{i,t} + b_{3,t}BM_{i,t} + b_{4,t}BM_{i,t} * D_{i,t} + b_{5,t}Ivol_{i,t} + b_{6,t}Ivol_{i,t} * D_{i,t} \\ & + b_{7,t}IO_{i,t} + b_{8,t}IO_{i,t} * D_{i,t} + b_{9,t}Turnover_{i,t} + b_{10,t}Turnover_{i,t} * D_{i,t} \\ & + b_{11,t}\left|R_{i,t-J+1,t}\right| + b_{12,t}\left|R_{i,t-J+1,t}\right| * D_{i,t} + b_{13,t}\left|R_{i,t,t+1}\right| + b_{14,t}\left|R_{i,t,t+1}\right| * D_{i,t} + \varepsilon_{i,t} \end{aligned}$$

The dependent variable is the duration of consistent winners or losers. A duration for a winner (loser) stock is defined as the number of month which a winner (loser) stock is continuously ranked in the top (bottom) decile portfolio in the following months after the formation date. The independent variables are the natural logarithm of firm size, book-to-market ratio, idiosyncratic volatility, institutional ownership, the monthly turnover, absolute value of previous *J*-month return (J = 3, 6, 9, and 12), absolute value of previous *J*-month return times winner dummy, absolute value of one-month post-formation return, and absolute value of one-month post-formation return times winner dummy. The idiosyncratic volatility is the residual variance from regressing of a firm's daily excess returns on market daily excess returns over the past 12 months. Institutional ownership is the percentage of outstanding shares held by institutional investors. The monthly turnover is the average daily ratio of the number of share traded to the number of shares outstanding within one month. Winner dummy is equal to one if the observation belongs to consistent winner, and zero otherwise. Newey-West t-statistics are shown in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% respectively.

	J=3	*J*=6	*J*=9	*J*=12
Intercept	0.4785***	0.7332***	0.8386***	0.8622***
	(20.03)	(21.92)	(22.63)	(19.18)
ln(Size)	-0.0121***	-0.0184***	-0.0180***	-0.0129*
	(-3.47)	(-4.00)	(-3.32)	(-1.94)
BM	-0.0296***	-0.0145*	-0.0185**	-0.0057
	(-4.91)	(-1.90)	(-2.05)	(-0.53)
IVol	1.8380***	1.7008***	1.8613***	2.3351***
	(6.11)	(4.35)	(3.95)	(4.58)
IO	-0.0477**	-0.0576**	0.0090	0.0155
	(-2.29)	(-2.10)	(0.27)	(0.39)
Turnover	0.0550***	0.0986***	0.1544***	0.1307***
	(7.43)	(6.32)	(6.36)	(5.76)
TR*Dw	-0.0456***	-0.0774***	-0.1309***	-0.1283***
	(-4.46)	(-4.04)	(-5.63)	(-4.33)
|Past_J|	0.9553***	3.7667***	6.5056***	9.9351***
	(6.47)	(10.30)	(10.95)	(10.69)
|Past_J|*Dw	-0.0282	0.3482	-0.1405	-1.7544**
	(-0.21)	(1.10)	(-0.25)	(-2.08)
|Post_0|	1.0991***	1.0150***	0.7616***	0.7957***
	(12.03)	(9.02)	(6.64)	(6.00)
|Post_0|*Dw	0.2671***	0.2646*	0.5836***	0.7849***
	(2.70)	(1.92)	(3.79)	(4.65)
Log-Likelihood	-103.56***	-119.78***	-117.46***	-111.23***
	(-33.20)	(-37.24)	(-38.50)	(-38.41)

Table 7. Heterogeneous beliefs versus momentum lifecycle

This table presents the effects of heterogeneous beliefs hypothesis and momentum lifecycle hypothesis on the momentum consistency. Time-series averages of estimates from censored life regression model are presented. The cross-sectional censored life regressions are estimated for each month during the period of 1981 to 2011, with all of non-overlapped consistent winners and losers listed on NYSE, AMEX, or NASDAQ. Coefficients estimated from the cross-sectional censored life regressions are then averaged over the months. The models are as follows:

$$Duration_{i,t} = a_t + b_{1,t}\ln(Size)_{i,t} + b_{2,t}BM_{i,t} + b_{3,t}Ivol_{i,t} + b_{4,t}IO_{i,t} + b_{5,t}Turnover_{i,t} + b_{6,t}Turnover_{i,t} * D_{i,t}$$
$$+ b_{7,t}\left|R_{i,t-J+1,t}\right| + b_{8,t}\left|R_{i,t-J+1,t}\right| * D_{i,t} + b_{9,t}\left|R_{i,t,t+1}\right| + b_{10,t}\left|R_{i,t,t+1}\right| * D_{i,t} + \varepsilon_{i,t}$$

The dependent variable is the duration of consistent winners or losers. A duration for a winner (loser) stock is defined as the number of month which a winner (loser) stock is continuously ranked in the top (bottom) decile portfolio in the following months after the formation date. The independent variables are the natural logarithm of firm size, book-to-market ratio, idiosyncratic volatility, institutional ownership, the monthly turnover, the monthly turnover time winner dummy, absolute value of previous *J*-month return (J = 3, 6, 9, and 12), absolute value of previous *J*-month return times winner dummy, absolute value of one-month post-formation return, and absolute value of one-month post-formation return times winner dummy. The idiosyncratic volatility is the residual variance from regressing of a firm's daily excess returns on market daily excess returns over the past 12 months. Institutional ownership is the percentage of outstanding shares held by institutional investors. The monthly turnover is the average daily ratio of the number of share traded to the number of shares outstanding within one month. Winner dummy is equal to one if the observation belongs to consistent winner, and zero otherwise. Newey-West t-statistics are shown in parentheses. *, **, and *** denote statistical significance at the 10%, 5%, and 1% respectively.

	J=3	*J*=6	*J*=9	*J*=12
Intercept	0.4785***	0.7332***	0.8386***	0.8622***
	(20.03)	(21.92)	(22.63)	(19.18)
ln(Size)	-0.0121***	-0.0184***	-0.0180***	-0.0129*
	(-3.47)	(-4.00)	(-3.32)	(-1.94)
BM	-0.0296***	-0.0145*	-0.0185**	-0.0057
	(-4.91)	(-1.90)	(-2.05)	(-0.53)
IVol	1.8380***	1.7008***	1.8613***	2.3351***
	(6.11)	(4.35)	(3.95)	(4.58)
IO	-0.0477**	-0.0576**	0.0090	0.0155
	(-2.29)	(-2.10)	(0.27)	(0.39)
Turnover	0.0550***	0.0986***	0.1544***	0.1307***
	(7.43)	(6.32)	(6.36)	(5.76)
TR*Dw	-0.0456***	-0.0774***	-0.1309***	-0.1283***
	(-4.46)	(-4.04)	(-5.63)	(-4.33)
|Past_J|	0.9553***	3.7667***	6.5056***	9.9351***
	(6.47)	(10.30)	(10.95)	(10.69)
|Past_J|*Dw	-0.0282	0.3482	-0.1405	-1.7544**
	(-0.21)	(1.10)	(-0.25)	(-2.08)
|Post_0|	1.0991***	1.0150***	0.7616***	0.7957***
	(12.03)	(9.02)	(6.64)	(6.00)
|Post_0|*Dw	0.2671***	0.2646*	0.5836***	0.7849***
	(2.70)	(1.92)	(3.79)	(4.65)
Log-Likelihood	-103.56***	-119.78***	-117.46***	-111.23***
	(-33.20)	(-37.24)	(-38.50)	(-38.41)

Table 8. Returns to consistent momentum strategies

This table presents returns and the associated *t*-statistics from consistent momentum strategies, inconsistent momentum strategies and Jegadeesh and Titman's (1993) momentum strategies executed during the period from 1980 to 2011. At the end of each month, winner stocks are those stocks with top decile previous *J*-month (*J*= 3, 6, 9, and 12) returns, while loser stocks are those stocks with bottom decile previous *J*-month returns. Consistent winners (losers) are those winner (loser) stocks stay in winner (loser) group both in the formation month *t* and in the next formation month *t*+1, while inconsistent winners (losers) are those winner (loser) stocks do not stay in winner (loser) group in the next formation month *t*+1. For the consistent momentum strategy, the zero-investment portfolios which long for consistent winner stocks and short for consistent loser stocks are held for six subsequent months and are not rebalanced during the holding period. For the inconsistent momentum strategy, portfolios of buying inconsistent winner stocks and selling inconsistent loser stocks are held for six subsequent months and not rebalanced during the holding period. For the Jegadeesh and Titman's (1993) momentum strategy are developed by buying winner stocks and selling loser stocks and held for six subsequent months and not rebalanced during the holding period. Panel A shows the average monthly returns for consistent and inconsistent momentum strategies based on *J*-month formation period return. Panel B presents the average monthly returns between consistent (inconsistent) momentum strategies based on 6-month formation period return and Jegadeesh and Titman's (1993) momentum strategies based on 7-month formation period return. Panel C reports the average monthly return differences between consistent (inconsistent) momentum strategies and Jegadeesh and Titman's (1993) momentum strategies. Raw returns and risk-adjusted returns for various momentum strategies and the differences between momentum strategies are presented in this table. Risk-adjusted returns are intercepts of regressions of the capital asset price model (CAPM), Fama-French 3-factor model (FF-3), Fama-French three factors plus Charhart's momentum factor (FF-4), and Fama-French three factors plus Stambaugh's liquidity factor (FF-3+LIQ). The associated *t*-statistics are in parenthesis. *, **, and *** denote statistical significance at the 10%, 5%, and 1% respectively.

Panel A: Returns to consistent, inconsistent, and JT momentum strategies (*J*-month formation period)

		Consistent momentum (*J*-month formation period)					Inconsistent momentum (*J*-month formation period)					Momentum (*J*-month formation period)				
J	Portfolio	Raw	CAPM	FF-3	FF4-	FF-3+LIQ	Raw	CAPM	FF-3	FF-4	FF-3+LIQ	Raw	CAPM	FF-3	FF-4	FF-3+LIQ
3	Loser	0.0059	-0.0026	-0.0021	0.0035*	-0.0020	0.0093**	-0.0001	0.0001	0.0043***	0.0003	0.0070	-0.0012	-0.0008	0.0040**	-0.0007
		(1.27)	(-0.90)	(-0.83)	(1.82)	(-0.78)	(2.06)	(-0.05)	(0.07)	(2.90)	(0.14)	1.62	(-0.48)	(-0.38)	(2.44)	(-0.32)
	Winner	0.0175***	0.0103***	0.0106***	0.0072***	0.0107***	0.0120***	0.0074***	0.0073***	0.0050***	0.0073***	0.0157***	0.0088***	0.0088***	0.0060***	0.0089***
		(4.64)	(4.74)	(5.69)	(4.46)	(5.72)	(3.46)	(4.11)	(4.73)	(3.53)	(4.78)	4.41	(4.45)	(5.27)	(4.03)	(5.31)
	W-L	0.0116***	0.0129***	0.0127***	0.0037**	0.0126***	0.0027	0.0076***	0.0071***	0.0006	0.0071***	0.0086***	0.0100***	0.0096***	0.0020	0.0095***
		(3.74)	(4.18)	(4.06)	(2.05)	(4.03)	(1.10)	(3.31)	(3.10)	(0.46)	(3.07)	3.27	(3.84)	(3.66)	(1.34)	(3.63)
6	Loser	0.0058	-0.0020	-0.0034*	0.0040***	-0.0021	0.0094**	0.0001	0.0000	0.0060***	0.0002	0.0070	-0.0016	-0.0016	0.0050***	-0.0015
		(1.17)	(-0.92)	(-1.85)	(2.92)	(-0.94)	(1.96)	(0.03)	(0.02)	(3.39)	(0.08)	1.46	(-0.54)	(-0.60)	(2.61)	(-0.55)
	Winner	0.0183***	0.0119***	0.0117***	0.0068***	0.0121***	0.0141***	0.0098***	0.0097***	0.0064***	0.0097***	0.0175***	0.0105***	0.0109***	0.0071***	0.0110***
		(4.78)	(7.86)	(9.30)	(7.00)	(7.96)	(4.09)	(5.08)	(5.74)	(4.50)	(5.76)	4.79	(5.04)	(6.06)	(4.88)	(6.08)
	W-L	0.0125***	0.0139***	0.0150***	0.0028**	0.0142***	0.0047	0.0097***	0.0096***	0.0005	0.0096***	0.0106***	0.0121***	0.0125***	0.0020	0.0124***
		(3.35)	(5.77)	(6.21)	(2.17)	(4.80)	(1.48)	(3.17)	(3.13)	(0.28)	(3.09)	3.08	(3.57)	(3.63)	(1.18)	(3.60)
9	Loser	0.0073	-0.0015	-0.0021	0.0057***	-0.0020	0.0087*	-0.0005	-0.0009	0.0059***	-0.0008	0.0075	-0.0011	-0.0017	0.0058***	-0.0016
		(1.44)	(-0.44)	(-0.70)	(2.63)	(-0.66)	(1.81)	(-0.18)	(-0.36)	(3.22)	(-0.30)	1.54	(-0.36)	(-0.59)	(2.95)	(-0.54)
	Winner	0.0171***	0.0096***	0.0106***	0.0065***	0.0107***	0.0160***	0.0112***	0.0113***	0.0076***	0.0113***	0.0173***	0.0101***	0.0108***	0.0068***	0.0109***
		(4.42)	(4.42)	(5.63)	(4.34)	(5.66)	(4.61)	(5.69)	(6.45)	(5.36)	(6.47)	4.64	(4.80)	(5.93)	(4.72)	(5.96)
	W-L	0.0098**	0.0111***	0.0127***	0.0008	0.0127***	0.0073**	0.0118***	0.0122***	0.0017	0.0121***	0.0098***	0.0112***	0.0125***	0.0010	0.0124***
		(2.52)	(2.87)	(3.27)	(0.44)	(3.26)	(2.22)	(3.51)	(3.62)	(1.11)	(3.59)	2.67	(3.08)	(3.40)	(0.62)	(3.38)
12	Loser	0.0096*	0.0008	-0.0004	0.0077***	-0.0003	0.0092*	0.0037	0.0030	0.0090***	0.0031	0.0095*	0.0009	-0.0002	0.0076***	-0.0001
		(1.83)	(0.22)	(-0.12)	(3.17)	(-0.10)	(1.92)	(1.05)	(0.91)	(3.25)	(0.95)	1.90	(0.27)	(-0.07)	(3.59)	(-0.03)
	Winner	0.0155***	0.0080***	0.0092***	0.0055***	0.0093***	0.0153***	0.0083***	0.0085***	0.0051***	0.0085***	0.0158***	0.0085***	0.0096***	0.0059***	0.0097***
		(4.00)	(3.71)	(4.99)	(3.59)	(5.03)	(4.35)	(3.96)	(4.63)	(3.24)	(4.67)	4.22	(4.09)	(5.32)	(3.97)	(5.36)
	W-L	0.0059	0.0071*	0.0097**	-0.0022	0.0097**	0.0061*	0.0045	0.0055*	-0.0039*	0.0055	0.0063*	0.0076**	0.0098**	-0.0017	0.0098**
		(1.43)	(1.74)	(2.37)	(-0.95)	(2.36)	(1.85)	(1.36)	(1.66)	(-1.94)	(1.64)	1.64	(1.99)	(2.57)	(-0.90)	(2.56)

Panel B: Returns to consistent, inconsistent, and JT momentum strategies (7-month formation period)

	Consistent momentum (6-month formation period)					Inconsistent momentum (6-month formation period)					Momentum (7-month formation period)				
Portfolio	Raw	CAPM	FF3	FF4	FF3+LIQ	Raw	CAPM	FF3	FF4	FF3+LIQ	Raw	CAPM	FF3	FF4	FF3+LIQ
Loser	0.0053	-0.0020	-0.0034*	0.0040***	-0.0021	0.0087***	0.0001	0.0000	0.0060***	0.0002	0.0069	-0.0017	-0.0018	0.0051***	-0.0016
	(1.57)	(-0.92)	(-1.85)	(2.92)	(-0.94)	(2.78)	(0.03)	(0.02)	(3.39)	(0.08)	(1.44)	(-0.56)	(-0.64)	(2.62)	(-0.59)
Winner	0.0181***	0.0119***	0.0117***	0.0068***	0.0121***	0.0152***	0.0098***	0.0097***	0.0064***	0.0097***	0.0178***	0.0108***	0.0113***	0.0073***	0.0113***
	(6.74)	(7.86)	(9.30)	(7.00)	(7.96)	(6.31)	(5.08)	(5.74)	(4.50)	(5.76)	(4.86)	(5.17)	(6.28)	(5.17)	(6.31)
W-L	0.0128***	0.0139***	0.0150***	0.0028**	0.0142***	0.0065***	0.0097***	0.0096***	0.0005	0.0096***	0.0109***	0.0125***	0.0130***	0.0022	0.0130***
	(5.28)	(5.77)	(6.21)	(2.17)	(4.80)	(3.18)	(3.17)	(3.13)	(0.28)	(3.09)	(3.11)	(3.59)	(3.70)	(1.30)	(3.68)

Panel C: Average monthly return differences between consistent (inconsistent) momentum strategies and Jegadeesh and Titman's (1993) momentum strategies

		Consistent momentum versus Jegadeesh and Titman's Momentum					Inconsistent momentum versus Jegadeesh and Titman's Momentum				
J	Portfolio	raw	CAPM	FF3	FF4	FF3+LIQ	raw	CAPM	FF3	FF4	FF3+LIQ
3	Loser	-0.0011**	-0.0014**	-0.0013**	-0.0005	-0.0013***	0.0023	0.0027*	0.0022	0.0020	0.0022
		(-1.99)	(-2.43)	(-2.23)	(-0.89)	(-2.24)	(1.59)	(1.93)	(1.53)	(1.37)	(1.54)
	Winner	0.0019***	0.0015***	0.0018***	0.0012***	0.0018***	-0.0037***	-0.0033***	-0.0040***	-0.0028***	-0.0040***
		(4.83)	(4.26)	(5.10)	(3.89)	(5.09)	(-4.83)	(-4.39)	(-5.34)	(-4.18)	(-5.31)
	W-L	0.003***	0.0029***	0.0031***	0.0017***	0.0031***	-0.0060***	-0.0060***	-0.0061***	-0.0048***	-0.0061***
		(4.14)	(4.02)	(4.16)	(2.70)	(4.16)	(-5.26)	(-5.30)	(-5.32)	(-4.34)	(-5.31)
6	Loser	-0.0012**	-0.0034**	-0.0030**	-0.0016	-0.0030**	0.0024	0.0030*	0.0026	0.0017	0.0026
		(-2.45)	(-2.25)	(-1.96)	(-1.04)	(-1.97)	(1.49)	(1.90)	(1.61)	(1.02)	(1.61)
	Winner	0.0008***	0.0030***	0.0040***	0.0028***	0.0040***	-0.0035***	-0.0029***	-0.0037***	-0.0027***	-0.0037***
		(2.70)	(3.24)	(4.55)	(3.39)	(4.56)	(-4.39)	(-3.82)	(-5.04)	(-3.94)	(-5.04)
	W-L	0.0019***	0.0063***	0.0070***	0.0043***	0.0070***	-0.0059***	-0.0059***	-0.0063***	-0.0044***	-0.0063***
		(3.28)	(3.71)	(4.03)	(2.74)	(4.05)	(-3.87)	(-3.87)	(-4.06)	(-2.96)	(-4.07)
9	Loser	-0.0002	-0.0003	-0.0005	-0.0001	-0.0005	0.0013	0.0020	0.0020	0.0006	0.0020
		(-0.47)	(-0.82)	(-1.09)	(-0.28)	(-1.12)	(0.70)	(1.12)	(1.09)	(0.33)	(1.09)
	Winner	-0.0002	-0.0004**	-0.0002	-0.0003	-0.0002	-0.0013	-0.0005	-0.0015**	-0.0008	-0.0015**
		(-0.73)	(-2.05)	(-0.96)	(-1.50)	(-0.93)	(-1..49)	(-0.66)	(-1.99)	(-1.02)	(-2.00)
	W-L	>0.0001	-0.0001	0.0003	-0.0002	0.0003	-0.0025	-0.0025	-0.0035*	-0.0013	-0.0035*
		(0.04)	(-0.19)	(0.53)	(-0.38)	(0.56)	(-1.43)	(-1.42)	(-1.95)	(-0.79)	(-1.95)
12	Loser	0.0001	-0.0001	-0.0002	0.0001	-0.0002	-0.0004	0.0005	0.0008	-0.0009	0.0008
		(0.13)	(-0.16)	(-0.39)	(0.16)	(-0.42)	(-0.18)	(0.27)	(0.42)	(-0.47)	(0.43)
	Winner	-0.0004	-0.0006***	-0.0004**	-0.0003**	-0.0004**	-0.0006	0.0001	-0.0008	-0.0004	-0.0008
		(-1.86)	(-3.27)	(-2.27)	(-2.00)	(-2.26)	(-0.74)	(0.17)	(-1.10)	(-0.57)	(-1.10)
	W-L	-0.0004	-0.0005	-0.0002	-0.0004	-0.0002	-0.0002	-0.0004	-0.0016	0.0005	-0.0016
		(-0.80)	(-0.90)	(-0.32)	(-0.77)	(-0.29)	(-0.12)	(-0.21)	(-0.82)	(0.27)	(-0.83)

Figure 1. Average buy-and-hold returns to consistent and inconsistent momentum portfolios

These figures show the average buy-and-hold returns to winner (loser), consistent winner (loser), and inconsistent winner (loser) portfolios. *Winner* (*loser*) means the winner (loser) in a standard momentum strategy. At the end of each month, winner stocks are those stocks with top decile previous *J*-month (*J*= 3, 6, 9, and 12) returns, while loser stocks are those stocks with bottom decile previous *J*-month returns. Consistent winners (losers) are those winner (loser) stocks stay in winner (loser) group both in the formation month *t* and in the next formation month *t*+1, while inconsistent winners (losers) are those winner (loser) stocks do not stay in winner (loser) group in the next formation month *t*+1. The holding period is calculated from one month after defining consistent and inconsistent momentum portfolios (*t*+2) up to 12 months after defining consistent and inconsistent momentum portfolios (*t*+13).

Figure 1.a 3-month formation period

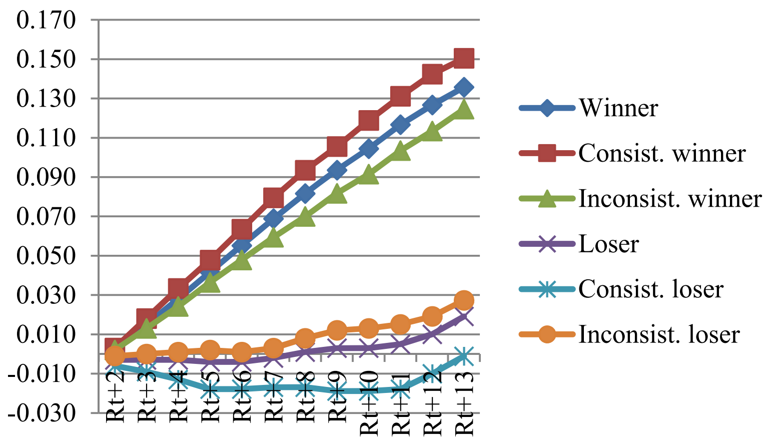

Figure 1.b 6-month formation period

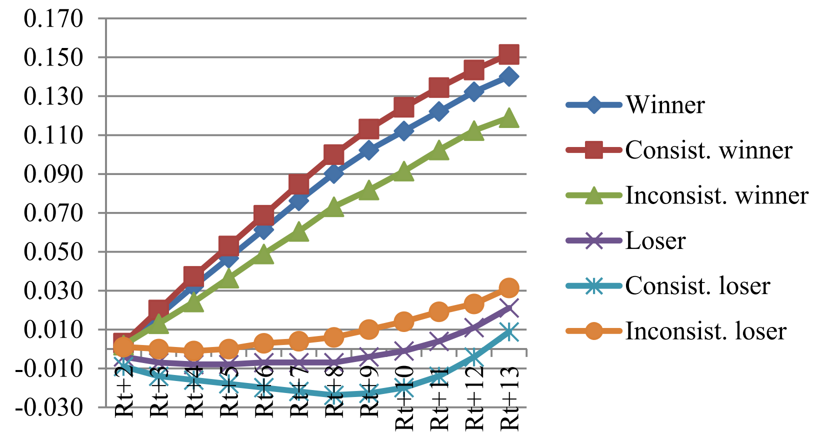

Figure 1.c 9-month formation period

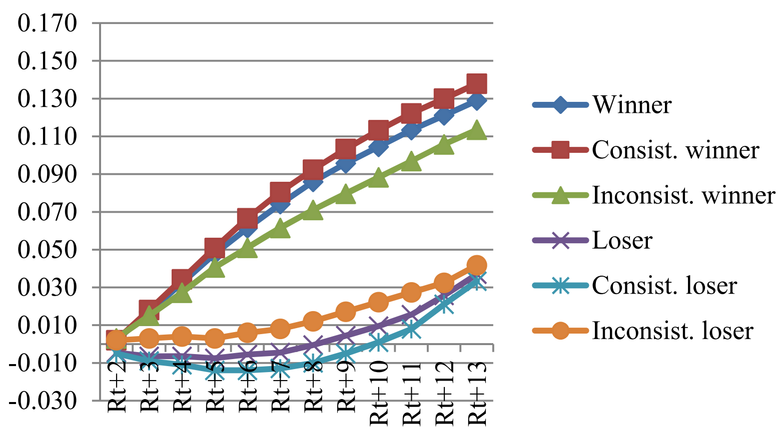

Figure 1.d 12-month formation period

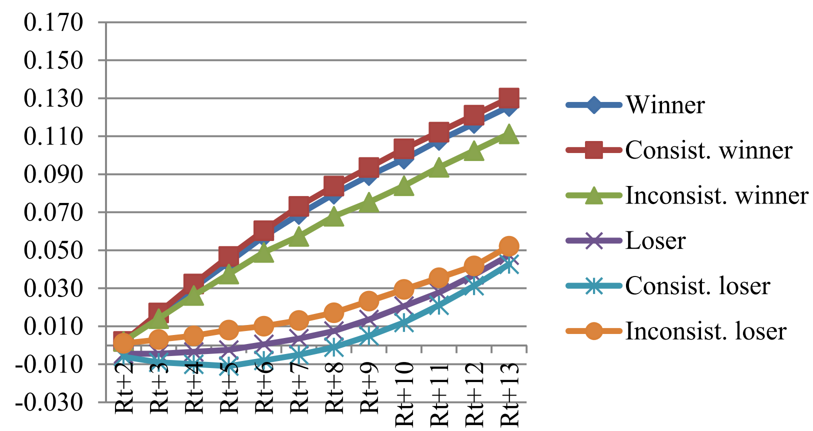

Table A1. Turnover rates of momentum portfolios: 20 groups

This table presents the average turnover rates for winner and loser stocks in the next formation month. At the end of each month, winner stocks are those stocks with top 5% previous *J*-month (*J*= 3, 6, 9, and 12) returns, while loser stocks are those stocks with bottom 5% previous *J*-month returns. Panel A presents average percentages of winner stocks which will be ranked and assigned to one of twenty groups in the next formation month. Panel B presents average percentages of loser stocks which will be ranked and assigned to one of twenty groups in the next formation month.

Panel A: Winner																				
J	P1(Loser)	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20 (Winner)
3	1.184%	1.150%	1.073%	1.164%	1.125%	1.158%	1.147%	1.299%	1.259%	1.372%	1.525%	1.673%	1.999%	2.256%	2.967%	3.949%	5.704%	9.103%	16.782%	42.238%
6	0.793%	0.765%	0.724%	0.781%	0.828%	0.725%	0.774%	0.835%	0.783%	0.864%	0.911%	1.031%	1.218%	1.417%	1.685%	2.409%	3.824%	7.467%	18.749%	56.084%
9	0.864%	0.757%	0.741%	0.756%	0.735%	0.730%	0.708%	0.747%	0.776%	0.772%	0.805%	0.913%	0.983%	1.135%	1.396%	1.806%	2.828%	6.138%	19.040%	61.786%
12	0.877%	0.744%	0.735%	0.770%	0.704%	0.747%	0.739%	0.799%	0.740%	0.771%	0.826%	0.839%	0.931%	0.984%	1.178%	1.465%	2.432%	5.351%	18.540%	64.958%
Panel B: Loser																				
J	P1(Loser)	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20 (Winner)
3	41.148%	17.010%	8.984%	5.954%	3.955%	3.048%	2.476%	1.998%	1.803%	1.545%	1.583%	1.475%	1.373%	1.317%	1.226%	1.257%	1.321%	1.255%	1.303%	1.360%
6	54.292%	19.083%	8.319%	4.178%	2.648%	1.772%	1.423%	1.226%	1.080%	1.024%	0.899%	0.910%	0.858%	0.857%	0.812%	0.813%	0.764%	0.809%	0.794%	0.935%
9	60.111%	19.279%	6.781%	3.155%	1.929%	1.409%	1.171%	0.990%	0.927%	0.846%	0.750%	0.736%	0.724%	0.750%	0.698%	0.701%	0.764%	0.725%	0.694%	0.898%
12	62.781%	18.978%	5.887%	2.702%	1.735%	1.242%	0.999%	0.907%	0.915%	0.813%	0.863%	0.753%	0.723%	0.690%	0.726%	0.712%	0.718%	0.719%	0.809%	0.943%

Sustainability of Vietnam's Current Account Deficit in the Period of 1990-2013

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This paper uses stationarity and cointegration tests and potential sustainability indicators to evaluate the sustainability of the Vietnamese current account between 1990 to 2013. The results of the stationarity test performed on Vietnam's current account balance over the period 1990–2013, reveal sustainability. Cointegration test also performed on exports and imports reflect that the two are cointegrated with the cointegrating coefficient of 0.900195 which is significantly below one, implying that the current account was not on the sustainable path indicating a weak form of sustainability. A number of leading sustainability indicators examined in the study point to weak sustainability of the Vietnam's current account deficit due to a number of factors, including sizable fiscal deficits, growing external debt, inefficient investment, growing errors and omissions, the risk of the exchange rate becoming overvalued, and inadquate foreign exchange reserves. These weaknesses have presented serious developmental challenges for Vietnam and have negatively affected the attainment of accelerated economic growth which is necessary to avoid the so-called middle income trap.

Keywords: current account; sustainability; stationarity test; Johansen cointegration test.

1. Introduction

Current account balance (CAB) is an important macroeconomic indicator in any open economy, since it is closely related to other important components of national savings and investment - the budget balance and private savings - and has important implications for overall economic growth, exchange rate movements, and competitiveness (Roubini and Wachtel, 1997).

In principle, an economy will be able to sustain deficits as long as it can raise the necessary funds by borrowing. Although such behaviour may be feasible in the short-run, the ability of the economy to service its debt by resorting to further borrowing is likely to be questioned once the deficits become persistent. Persistent deficits may have serious effects. First, they might increase domestic interest rates to attract foreign capital, and, secondly, the accumulation of external debt owing to persistent deficits will imply increasing interest payments which imposes an excess burden on future generations. Episodes of currency crisis in the 1990s have been associated with large, growing and eventually unsustainable current account imbalances. The Mexican peso crisis of 1994 and the 1997 currency turmoil in a number of Asian countries (in particular Thailand, Malaysia and the Philippines) appear to have been partly triggered by unsustainable current account imbalances.

Figure 1 shows that the current account in Vietnam has been worsened (up to 1998), improved (from 1999-2001) and again deteriorated (from 2002-2010) and once again improved. While the current account does not appear to be a source of policy concern, especially in recent four years, a sudden negative terms of trade shocks could easily produce an external crisis as the financing of future current account deficit (CAD) become constrained by the existing stock of external debt obligations.

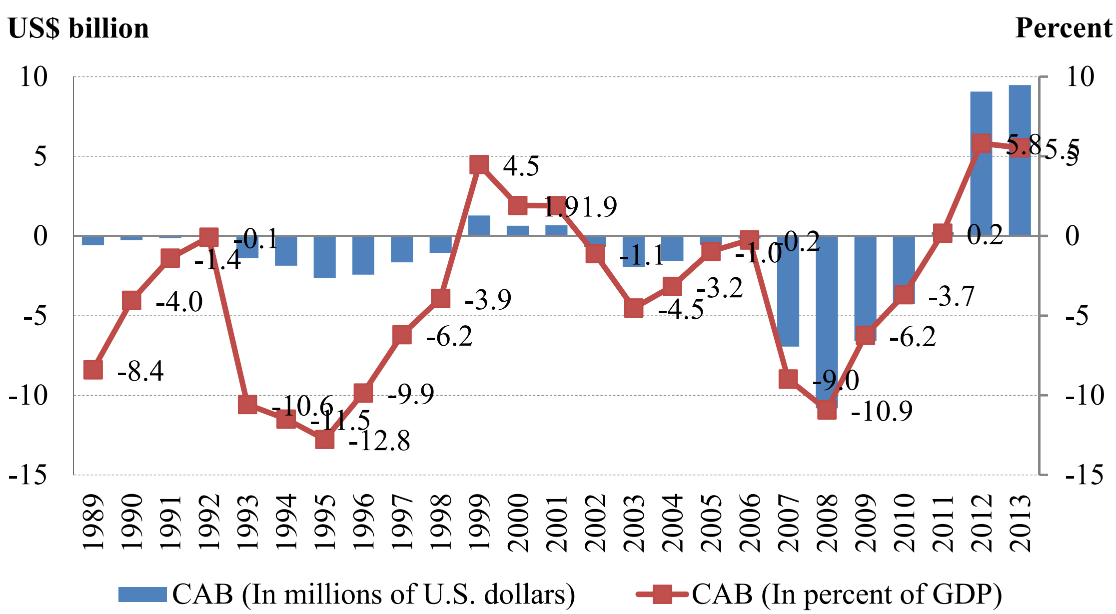

Figure 1. Current account balance in Viet Nam, 1989-2013

This paper attempts to add some insight towards understanding the current account sustainability of Vietnam. The paper is organized as follows: Section 2 presents the theoretical framework. Section 3 provides methodology and data. Section 4 presents the empirical results of examining current account sustainability. Finally, the last section summarizes the paper's main conclusions.

2. Theoretical framework

2.1 *Basics of the current account*

According to the IMF Balance of Payments Manual (1993 and 2008), the current account balance is a component of the balance of payment accounts, which systematically summarizes, transactions in goods, services, income and transfers between residents of an economy and the rest of the world in a given time period, usually a year.

(1) On one side, the current account balance is the sum of three components: the balance on goods and services, the balance on primary income (previously called factor services), and the balance on secondary income (formerly referred to as current transfers). Expressed in equation form:

$$CAB = X - M + BPI + BSI \qquad (1)$$

where

X = exports of goods and services

M = imports of goods and services

BPI = balance on primary income

BSI = balance on secondary income

(2) On the other side, the current account balance is also equal to the difference between the economy’s total savings and its total investment

$$CAB = S - I \qquad (2a)$$

$$= (S_p - I_p) + (S_g - I_g) \qquad (2b)$$

where

S = gross saving

I = gross capital formation (capital formation includes fixed capital, inventories, and valuables)

S_p and I_p = private saving and investment

S_g and I_g = government saving and investment

As equation (2b) show, the current account represents the outcome of forward-looking investment and savings decisions of economic agents. Economic theory suggests that intertemporal borrowing and lending are natural vehicles for achieving faster capital accumulation, a more efficient allocation of investment, and the smoothing of consumption.

Equation (2b) also shows that the budgetary position of the government ($S_g - I_g$) may be an important factor influencing the current account balance. In particular, a sustained current account deficit may reflect persistent government spending in excess of receipts, and such excess spending suggests that fiscal tightening is the appropriate policy action.

(3) It could be said that the current account balance is the change in the net foreign liabilities of a country and equals the sum of balances on the capital and financial accounts (with signs reversed, if necessary, depending on the presentation used) including reserve assets.

$$CAB_t = F_t - F_{t\text{-}1} \qquad (3a)$$

$$= NKF_t + RT_t \qquad (3b)$$

where

F = the stock of net foreign assets

NKF = net capital and financial account transactions excluding reserve assets

RT = net reserve asset transactions

Equation (3b) demonstrate that all economies face an *intertemporal budget constraint* (IBC) that relates current account imbalances over time. As such, a current account deficit today must be matched in present value terms by current account surpluses in the future. An incurrence of current account deficit today implies that a country becomes a net debtor, thereby tying up future foreign exchange earnings to meet its debt service and repayment obligations. Hence, a perpetual current account deficit will clearly not satisfy the IBC. Clearly, if lenders believe that a current account deficit today will continue in perpetuity, they have no prospect of repayment and will not voluntarily finance today's deficit. Therefore, persistent current account deficits are often viewed as a sign of weakness that implies a need for policy action.

2.2 *"Sustainable" current account deficit*

As current account deficits represents an increase in the net foreign liabilities of a country (see equation 3(a)), one approach to current account sustainability focuses on an economy's solvency. An economy is accepted as solvent if the present discounted value of future trade surpluses equals current external indebtedness. Ultimately, such a definition is difficult to apply since it relies on future events/policy decisions without imposing any restriction on them. A country can remain technically solvent even while running large external deficits as long as policies are adjusted as needed in the future to bring about the required surpluses that enable debt to be repaid.

Milesi-Ferretti and Razin (1996) developed another, more complete, approach to current account sustainability. In their view, CAD sustainability refers to whether the resulting path of an economy's trade balance is consistent with intertemporal solvency (i.e. an economy is capable of meeting its IBC) in the long run without a drastic change in the current government policy stance and/or in the present private sector behaviour. The sustainablity adds on to the notion of solvency the idea that policies remain constant for the indefinite future. Thus, an external position is sustainable if, under the assumption that policies do not change, the country does not violate its intertemporal solvency constraint. The problem with the sustainability concept is that what matters for the current account are people's expectations of future policies rather than the policies themselves. These expectations are notoriously difficult to observe and measure, which makes the sustainability concept difficult to apply operationally (Ostry, 1997).

2.3 *Operational criteria of current account sustainability*

While large and persistent current account deficits begin to raise doubts about long-term sustainability, there is no agreement of what constitutes a high or persistent current account deficit. Lawrence Summers, the U.S. deputy Treasury secretary, wrote in The Economist on the anniversary of the Mexican financial crisis (Dec. 23, 1995-Jan. 5, 1996, pp. 46-48) *"that close attention should be paid to any currentaccount deficit in excess of 5% of GDP, particularly if it is financed in a way that could lead to rapid reversals."* Calvo (1998, p. 27) put deficit little lower *"Prominent people and institutions regard a CAD in excess of 4 percent of GDP as "large"."* Although 1994 Mexican peso crisis and the 1997 Asian currency crisis appear to support this view, some countries with larger deficits have not experienced crises (Fry, 1997). Moreover, a clear definition of persistence is also not available. While some countries have faced a high current account deficit for over a decade without a crisis, as in the case of Australia (Milesi-Ferretti and Razin 1996a, b), other countries have suffered a crisis following only a few years of high current account deficits. Therefore, large and persistent current account imbalances do not necessarily imply unsustainability regardless of other factors. Following non-structural case study, Milesi-Ferreti and Razin (1996a, b) and Roubini and Wachtel (1997) suggest that, when performing an assessment of the current account deficit sustainability one should take into account the following factors/indicators: the cause of the current account deficit; current account structure; the structure and volume of foreign capital inflow; the level of economic growth; real exchange rate appreciation; the structure and level of external debt, the level of foreign reserves; financial system stability; openness of the economy; political and macroeconomic stability; global factors. However, the main obstacle to to assess current ccount sustainability based on indicators is *"how to "rank" these different indicators and how to translate them into an overall measure of external sustainability"* (IMF, 1998, p. 87), thereby lacking the ability to provide a quantitative analysis of sustainability.

2.4 *Intertemporal approach: Empirical studies*

A large number of empirical studies on CAD sustainability focus on the tests of the intertemporal long-run budget (solvency) constraint. This lends credence to the assertion by Baharumshah et al (2005) that *"The claims that the current account is sustainable if exports and imports are cointegrated with the cointegrating vector being (1, -1), is, by now, a widely accepted theory"*. The intertemporal solvency constraint holds if the initial foreign debt of the economy is paid off by future trade balance surpluses. This solvency constraint requires that the current account balance be stationary and, thus, the exports and imports cointegrated.

Therefore, in evaluating the sustainability of the external deficits in open economy settings, one may apply the methodology developed by Trehan and Walsh (1991). These two authors states that the sustainability refers to stationarity of the current account balance over time, whereas nonstationarity implies that the country violates its IBC.

Alternatively, Hakkio and Rush (1991) and Husted (1992) propose a model in which cointegrating (long-run equilibrium) properties of the exports and imports variables are tested. In this framework, cointegration of the exports and imports variables is a necessary condition for the country to have sustainable external deficits (ie. intertemporal external solvency). The model starts with the budget constraint of an individual who is able to borrow and lend freely to the rest of the world. Clearly, this model can be extended from an individual to a household or to a country. The current-period budget constraint of this representative household is:

$$C_0 = Y_0 + B_0 - I_0 - (1+r)B_{-1}$$

where C_0, I_0, Y_0, B_0 and r are the current consumption, investment, output, international borrowing and one-period interest rate, respectively. $(1+r)B_{-1}$ is the initial debt size. After making several assumptions, Husted (1992) derives the following testable model:

$$X_t = \alpha + \beta M_t + \varepsilon_t \qquad (4)$$

Where X is exports of goods and services, and M is imports of goods and services plus net transfer payments and net interest payments.

Under the null hypothesis, in the economy that satisfies its IBC (i.e. for a sustainable current account deficit), it is expected that $\beta = 1$ and ε_t is a stationary process.

The empirical results may allow establishing several conclusions concerning the sustainability of the intertemporal budget constraint:

- when there is no co-integration the current account is not sustainable and do not move towards external-account equilibrium.;
- when there is co-integration with $\beta = 1$, the current account is sustainable,
- when there is co-integration, with $\beta < 1$, economy's imports growing faster than economies exports, and the current account may not be sustainable.

As Hakkio and Rush (1991) demonstrate in the context of government finance also if X and M are non stationary variables in level, the condition $0 < \beta < 1$ is a sufficient condition for the budget constraint to be obeyed. However, when imports and exports are expressed as a percentage of gross domestic product or in per capita terms, it is necessary to have $\beta = 1$ in order for the trajectory of the debt-to-GDP not to diverge in an infinite horizon.

3. Methodology and data

Based on the synthesis of the literature reviewed in the foregoing, this study employs a unit root analysis of Vietnam's current account deficits over the period 1990-2013. In addition, the study seeks to reenforce the findings of the unit root tests on the current account balance with a cointegration analysis of the country's export and imports to ascertain their long-run relationship and implications for current account sustainability. As such, the model suggested in Hakkio and Rush (1991) and Husted (1992) will be used in this study. The long-run relationship between exports and imports will be determined by using the Johansen procedure.

A necessary condition for testing for a long-run relationship between two variables is that these variables are I(1), i.e., stationary in first differences. We, therefore, use the classical unit root tests, namely, the Augmented Dickey-Fuller (ADF) test (see Dickey and Fuller, 1981; Said and Dickey, 1984) and KPSS test from Kwiatkowski et al. (1992). ADF test is based on the null hypothesis that a unit root exists in the time series. The KPSS semi-parametric procedure tests for level (η_μ) or trend stationary (η_τ) against the alternative of a unit root. Further evidence regarding the nature of time series data is provided by the DF-GLS unit root test, which is more powerful than the ADF and PP tests.[1] Like in other unit root tests the null hypothesis in the DF-GLS test is that the variable under consideration is non-stationary against the alternative that it is stationary.

Once it is established that two series representing measures of exports and imports are I(1), we can proceed to test for a long-run relationship between the series. If such a relationship exists, the two series are cointegrated and the intertemporal budget constraint is satisfied. We tested cointegration using the two cointegration techniques devised by Johansen and Juselius (1990). In the Johansen and Juselius (JJ) method, two tests are used to determine the number of cointegrating vectors (r): the trace test and the maximum eigenvalue test. In the trace test, the null hypothesis is that the number of cointegrating vectors is less than or equal to r, where r is 0, 1, or 2. In each case, the null hypothesis is tested against a general alternative. In the maximum eigenvalue test, the null hypothesis $r = 0$ is tested against the alternative that $r = 1$, $r = 1$ against the alternative $r = 2$, etc.

The study also comprehensively analyse a number of factors based on the aforesaid three perspectives on the current account balance (see section on "Basics of the current account"):

(1) a domestic perspective based on national income and product accounts;
(2) an international perspective based on trade flows in goods and services; and
(3) an international perspective based on flows and holdings of financial assets.

These three perspectives are different lenses through which to analyze the current account balance. Each perspective involves a decision to focus on certain variables or economic relationships and to ignore other variables and relationships. Each perspective may be particularly useful in certain situations or time frames. All together, the three perspectives give views that are consistent and mutually reinforcing.

At the same time, the following several complementary criteria that are helpful in assessing the sustainability a path of current account imbalances (Milesi-Ferreti and Razin,

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[1] Maddala and Kim advocate that the traditional ADF and PP tests should be discarded and KPSS should be avoided. Instead, it is better to use one of the following: DF-GLS test (Elliott, Rothenberg, Stock, 1996), Ng-Perron test (Perron and Ng, 1996), …. But the commonly used ADF, PP, and KPSS tests should be added that as yet there is no uniformly powerful test of the unit root hypothesis.

op. cit.; and Roubini and Wachtel, op. cit.) are also included in the analysis:

- the level of economic growth;
- the level of foreign reserves;
- openness of the economy;
- real exchange rate appreciation; and
- investment efficiency.

Sources and data

Almost the data are available on the IMF web site (elibrary-data.imf.org). The data on balance of payment over the period 2005-2013 were obtained from IMF Data homepage while the data for the period 1990-2004 from IMF country reports. Other data will be indicated in this paper. Exports (X), imports (I), and current account balances (CA) used in unit root/stationary tests and Johansen cointegrating test are measured in nominal terms as a percentage of nominal GDP[2], where exports include exports of goods and services, while imports includes imports of goods and services plus net transfer payments and net interest payments[3].

4. Research findings

As shown in Figure 1, Vietnam's CABs have mostly remained in negative territory for the analysis period, indicating that the deficits is a persistent feature of Vietnamese economy. It also indicates that CAB has exceeded ten times some threshold value 5 percent, this result would make one to say that the current account deficit is unsustainable.

However, in some sense, focusing on the current account balance is misguided. After all, the current account is not a fundamental economic force in itself, but only one manifestation of the general equilibrium interaction between many factors. Therefore, it is useful and common to take all three perspectives on the current account deficit (Mann, 2002).

4.1.1 *A perspective based on international trade in goods and services*

The first viewpoint on the current account is an international perspective based on the factors that underpin the flows of exports and imports of goods and services. Evidently, Vietnam's current account balance largely emanates from the merchandise trade balance. As illustrated

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[2] Studies of several authors measure variables in real rather than nominal terms. If done so, it is more appropriate to use the merchandise export price index and merchandise import price index to derive the real exports and the real imports, respectively, instead of using the consumer price index (CPI). However, the author can't find the data of Vietnam over the analysis period. The United Nations Conference on Trade and Development (UNCTAD) has the data only from 2000. Similarly, the World Trade Organization (WTO) has the data (annual percentage changes) only from 2002. The World Economic Outlook (WEO) database contains data series on annual percentage changes of volume of exports and imports of goods and volume of exports and Imports of goods and services. The CPI can't be used as deflator for both import and export series instead since the available data for the 2000-2013 period show that the values of the export price index, import price index (from UNCTAD), and CPI are different.

[3] This is the convention in the literature. See Husted (1992).

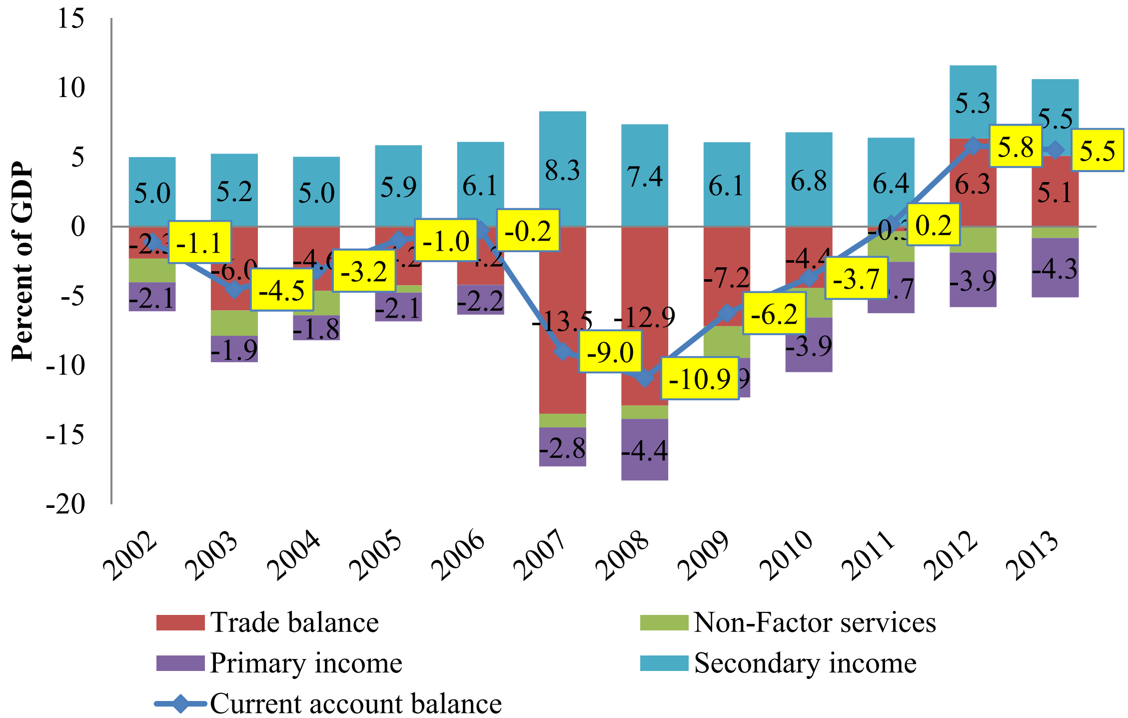


Figure 2. Vietnam: Level and composition of current account balance, 2002–2013

in Figure 2, in the period of 2002-2010, the trade account recurred to deficit levels, thereby pulling the current account deficit with it. In 2011, both the trade and the current accounts nearly balanced. In the next two years 2012 and 2013, Vietnam earmarked current account surpluses, including trade surpluses for the first time since 2002. Exports rose rapidly thanks largely to production from a large foreign-financed investment project coming on stream while imports, in line with slower demand, remained subdued.

The two components of Vietnam's current account balance, the balance on service trade and net primary income, have been consistently negative, or in deficit. Trade in services has remained a minor component of Vietnam's foreign trade: in 2013, exports (receipts) of commercial services, mainly from travel services, accounted for 7.4 percent of total exports of goods and services; and imports (payments) of commercial services, primarily from transportation and shipping of imported goods, represented about 8.8 percent of total imports of goods and services. Increased payment on investment income has led to increased net primary income payments to the rest of the world. With a growing stock of FDI, one would expect higher level of investment payments in future years.

At the same time, the country has received significant amounts of current transfers, mainly private remittances sent by "Việt kiều" and migrant workers. The surlus on current transfers has offsetted the dificits on net service and net primary income, except the year 2012.

Openness, and direction and composition of trade

A more open economy (with a higher share of exports or trade in GDP) can service it's external debt more easily, because debt service absorbs a lower fraction of total exports. Thus, the effect of a shock on imports or domestic production is lower, ceteris paribus, than for low-export countries. The cost of default is also higher for a more open economy – it has more to lose – and the domestic constituency to avoid trade disruptions will be stronger (Ostry, 1997). Nonetheless, a high degree of openness could make the country more vulnerable to external shocks, especially when the export base is thin.

The Vietnamses economy has become increasingly open since 1990. The ratio of exports to GDP increased from 30% in 1990 to 70% in 2008, slowed down somewhat in 2009 due to the global recession, and increased again to 83% in 2013.

In terms of geographical destinations, overall, Vietnam's merchandise exports have been fairly diversified. The United States domestic market was truly opened up for exports from Vietnam by the Vietnam- U.S. bilateral trade agreement, which came into effect in November 2001. Immediately in 2002, exports to the US doubled and the the U.S. became the largest single-country export market, overtaking Japan. In 2013, exports to the US accounted for about 19% of Vietnam's total exports. Other key export markets include the European Union (EU), Japan, China, ASEAN-4 (Indonesia, Malaysia, Philippines, and Thailand), and Korea. In recent years, new markets are being developed, especially in United Arab Emirates, India and other countries in the Western Hemisphere, raising expectations for potential future growth. Unlike many countries in the East Asia and Pacific (EAP) region that have been sending an increasingly larger share of their exports to China, Vietnam continues to rely on industrial countries for the majority of its exports. Overall, industrial countries account for nearly two-thirds of Vietnamese exports.

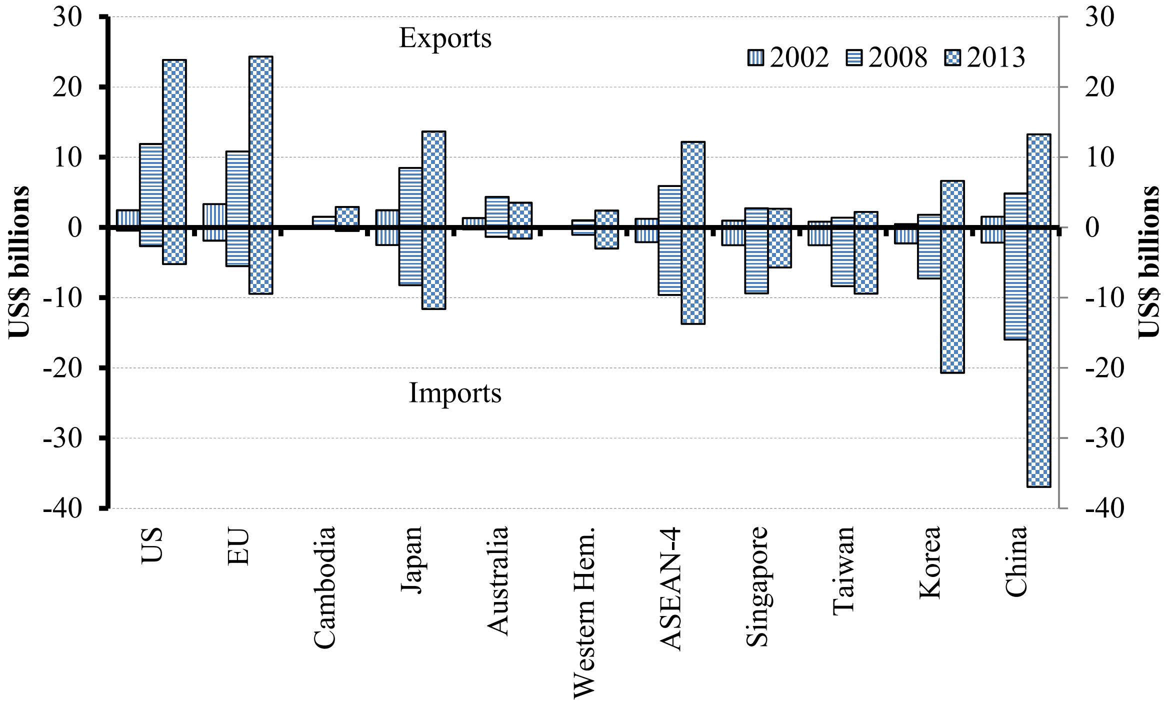
However, Vietnam's merchandise imports are quite concentrated. The top 10 partners account for above 80 percent of imports in 2013.[4] China is the largest supplier of imports to Vietnam, overtaking Japan from 2003. In 2013, imports from China accounted for nearly 29% of Vietnam's total imports value. It is followed by Korea, ASEAN-4, Japan (9%), the EU, Taiwan, Singapore, United States. So Vietnam's import sources are China and other East Asian countries.

This explains, as can be seen from Figure 3, why Vietnam continues to register trade surplus with industrial countries, while at the same time runs large trade deficit with trading partners in the region (The bilateral trade balance with China has turned from a surplus of US$135 million in 2000 to a deficit of near US$23,7 billion in 2013 - ten times Vietnam's overall trade deficit of US$2,4 billions. Vietnam has also run large and growing trade deficit with Korea, amounting to $14.07 billion in 2013.) World Bank (December 2010) comments: *"This could imply either of the two things. One, Vietnam is yet to be linked to the global production networks that end in the EAP/ASEAN region. Second, there are some global production networks, especially those involving low-cost, labor intensive products like garments and footwear, whose final stage is in Vietnam. This provides an important opportunity for Vietnam to strengthen the global supply chains ending up in its own territory as well as to use*

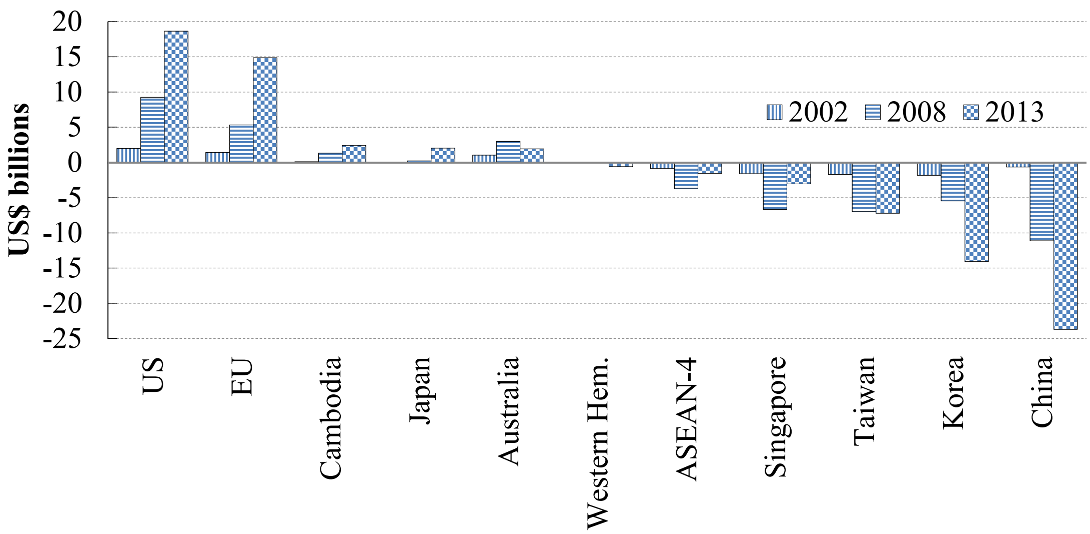
[4] Countries are ranked by descending order, including: China, Korea, Japan, Taiwan, Thailand, Singapore, United States, Malaysia, Germany, and India.

regional trade agreements such as ASEAN to become part of global production network passing through the region, including China."

Vietnam's exports are becoming more diverse, as it moves from primary products (oil, rice, coffee, rubber and coal) into labor-intensive light manufactures (garments, footwear, and furniture) and more sophisticated industrial goods (electronics, computers, and cell phones).

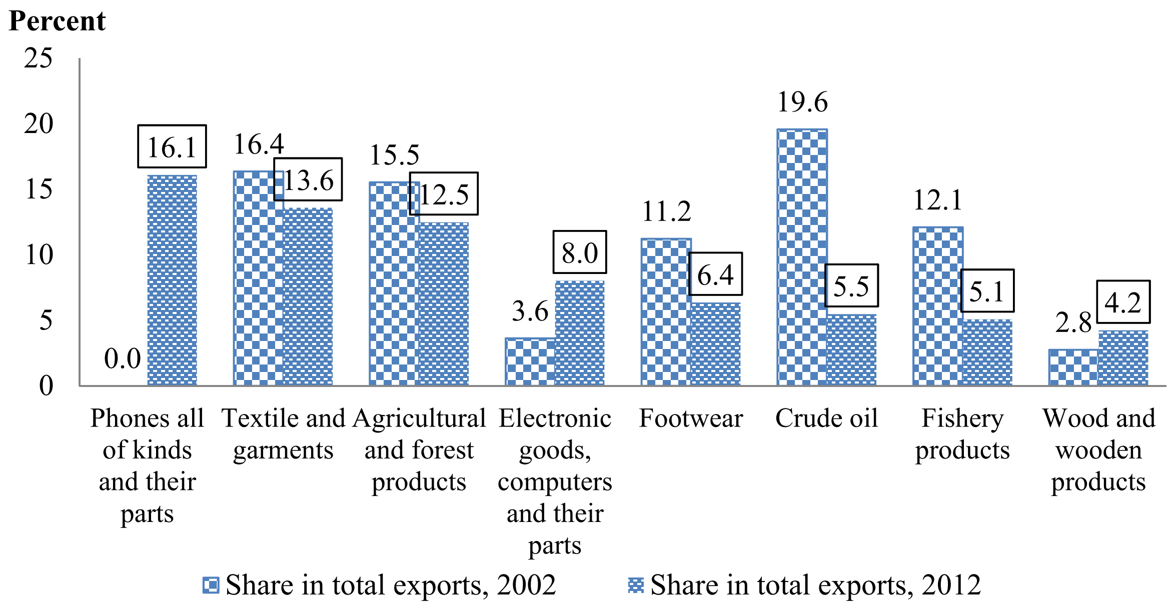


(a) Vietnam: Merchandise trade with selected partners



(b) Vietnam: Trade balance with selected partners

Figure 3. Merchandise trade and trade balance with selected partners



Source: GSO, Statistical yearbook of Vietnam (various issues) and author's calculations.

Figure 4. Vietnam: Selected export products

Vietnam's traditional exports items such as garments, footwear, and furniture continue to sustain rapid growth. More recently, exports of hi-tech and higher value-added products (e.g., cell phones and parts, computers, electronics and accessories, automobile parts) have emerged as Vietnam's largest exports. These new sectors could become the next driver for exports. In summary, the aforesaid diversification of exports increases the resilience of the Vietnamese economy to external shocks.[5]

Efforts to open up more overseas markets for Vietnamese exports. Vietnam has embarked on a process of internationalization and integration that has resulted in membership in the ASEAN Free Trade Area, AFTA, since 1996, membership in the World Trade Organization, WTO, since 2007 and a very significant diversification of external economic relations. Vietnam is now exerting efforts in Trans-Pacific Partnership (TPP)[6] negotiations and concluding Free-Trade Agreements (FTAs) with the European Union and South Korea. These agreements are expected to secure access to main export markets and spur market-based reforms.

Some schools of thought believe that TPP membership may be able to help Vietnam to expand its export market and compensate for its trade deficit with China through a surplus in trade with TPP members, especially the U.S. In a study by Peter A. Petri and Michael G. Plummer (2012), Vietnam is projected to gain the most from the TPP. Vietnam's Exports on the TPP track by 2025 would increase by $89 billion (of 2007 dollars) (37 percent over the

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[5] Trade diversification can be achieved through either products (introduction of new product lines, a more balanced mix of existing exports or product-quality upgrading) or trading partners (Papageorgiou and Spatafora, 2012).

[6] The countries involved in the TPP talks include 12 countries in the Pacific rim: USA, Australia, Malaysia, Mexico, Brunei, Canada, Chile, Japan, New Zealand, Peru, Singapore and Vietnam.

baseline). Three factors explain this result: strong trade with the United States; high protection abroad against apparel and footware, which are Vietnam's principal exports; strong competitive positions in these and other manufacturing industries where China's competitive advantage is fading. These tree factors boost Vietnamese exports and terms of trade under the TPP.

However, the benefits would be far from certain. Take the textiles, garment and footwear industries, for example. Vietnam's competitiveness in large markets such as the U.S. should give it comparative advantages over China. Yet the TPP's rules of origin, namely the "yarn forward" rule, put the benefits in question. Vietnam's supply chain is heavily dependent on Chinese inputs, which could disqualify Vietnamese garments makers from access to zero tariffs under the TPP. Vietnam could turn to other suppliers within the TPP, but none can match China on price. Moreover, Chinese companies have recently rushed to invest in Vietnam's textile market in order to reap the benefits that the TPP is projected to provide. For the short term, at least, it will be unrealistic for Vietnam to expect an immediate decline in its trade imbalances with China.

Real exchange rate

A country's large current account deficit is likely to be less sustainable when its real exchange rate is overvalued beyond a certain threshold value, or above an historical average. A significant real appreciation of the currency (from large capital inflows or any other reasons) may lead to a loss of external competitiveness and a worsening of the trade balance, thus jeopardizing the sustainability of the current account.

According to World Bank staff estimates (Table 1), Vietnam's real effective exchange rate (REER) has exhibited appreciating trends for many years. Nevertheless, Vietnam's external competitiveness is likely to remain adequate. In its latest assessment, the IMF (2014) says that the results of CGER-type analysis[7] and broader trends in the balance of payments suggest there is no convincing evidence of misalignment. The external balance of the FDI-intensive export-oriented sector remains in significant surplus, with the recent overall current account improvement. Wages remain competitive, and foreign direct investment inflows remain robust. However, there is the risk of the exchange rate becoming overvalued if large public contingent liabilities are realized during bank restructuring.

Table 1. Vietnam: Real effective exchange rate, 2003-2013

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
REER (2000=100)	91.1	89.8	93.7	96.8	106.0	125.7	115.7	117.4	122.7	127.5	136.1
(% change yoy)	-7.7	-1.4	4.3	3.3	9.5	18.6	-8.0	1.5	4.5	3.9	6.7

Source: World Bank, East Asia and Pacific Economic Update, Various issues from April 2009 – October 2014.

[7] the Consultative Group on Exchange Rate Issues (CGER)

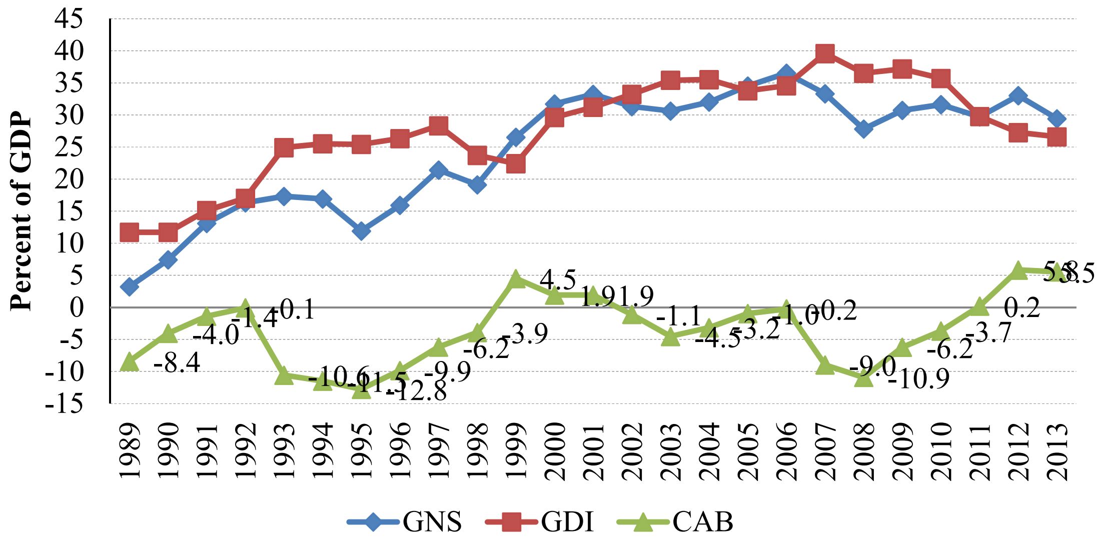


Figure 5. Vietnam's current account balance, total investment and gross national saving as percentage of GDP, 1989–2013

4.1.2 *A domestic perspective based on the national income and product accounts*

The second perspective to gain further insights into the CAB is to consider national savings and domestic investment. Milesi-Ferretti and Razin (1996a, b) argue that both the theoretical and empirical evidence suggests that, *ceteris paribus*, a current account imbalance is likely to be less sustainable if: (a) the imbalance is due to a reduction in national saving rates rather than an increase in national investment rates; (b) national savings rates are low.

Viewing from saving-investment gap, in pursuit of economic growth by relying on investment, Vietnam has maintained high investment rate. However, domestic saving is not sufficient to support the investment demand. As a result, Vietnam's economy depends on external sources to finance the saving-investment imbalnce, raising concerns about the country's external deficits and foreign currency reserves. Figure 5 shows that the gross domestic investment (GDI)/GDP ratio generally exceeds the gross national saving (GNS)/GDP ratio from 2002. As long as the saving-investment gap exists, Vietnam will continue suffering from current account deficit.

If we devide the analysis period into two sub-periods: 1990-2001 and 2002-2013, then CAB in the latter was less serious than CAB in the former (Table 2). However, a striking difference is CAB in the former turning into surpluses owing to GNS increases while GDI

Table 2. Comparison of Vietnam's current account balances in two sub-periods

Sub-period	n	average	median	max	min
1990-2001	12	-4.3	-4.0	4.5	-12.8
2002-2013	12	-2.4	-2.1	5.8	-10.9

almost constant. In the latter period, CAB turning into surpluses owing to GDI decreases while GNS almost constant. Total investment in 2013 was 26.6 percent of GDP, significantly lower than the investment rate of 35,7% in 2010.

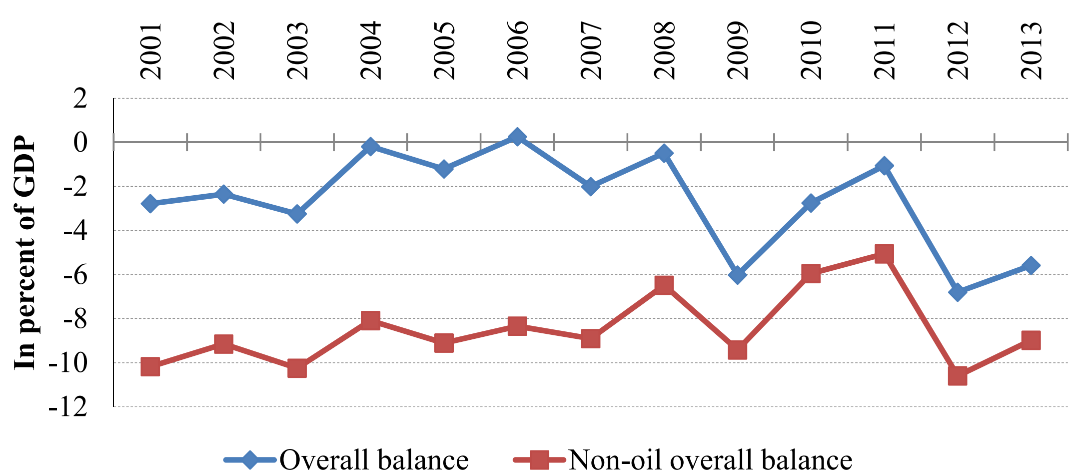
Budget deficits

The current account balance is closely related to the fiscal balance and private savings. Hence, judgement about sustainability will also be affected by the fiscal policies underlying external deficits. In this regard, Vietnam's budget deficits have been sizable recently – 5.6 per cent of GDP in 2013 (Figure 6). The government has received substantial tax and royalty revenue from the oil and gas sector – the share of revenue from crude oil exports in total revenue and grants declined from 17,1% in 2012, to 14,6% in 2013. Hence, that may make the state budget unsustainable in case a fall in global oil prices will reduce the amount of tax collected. In addition, as shown in Figure 7, budget expenditure of Vietnam in the period 2006-2013, on average, is higher 1.2 times than those of China and Thailand; 1.5 times than those of Philippines and Indonesia and equals that of Malaysia. Therefore, it seems that large and persistent budget deficits have largely driven by high budget expenditure, but not by low budget revenue.

Efficiency of the economy

In addition to the level of savings and investment, the *allocation* and *efficiency* of investment is also clearly important for assessing current account sustainability.

Total factor productivity (TFP), which is GDP per unit of combined inputs, is a crucial



Source: General Statistics Office (GSO), various issues

Figure 6. Vietnam's overall budget balance and non-oil budget balance as percentage of GDP, 2001–2013

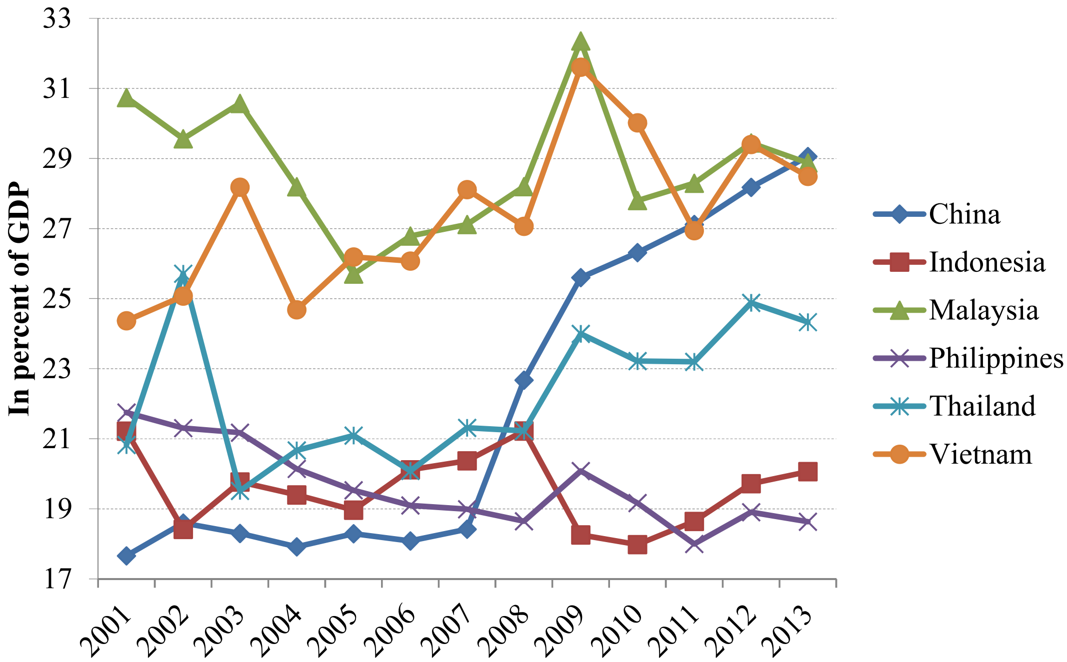
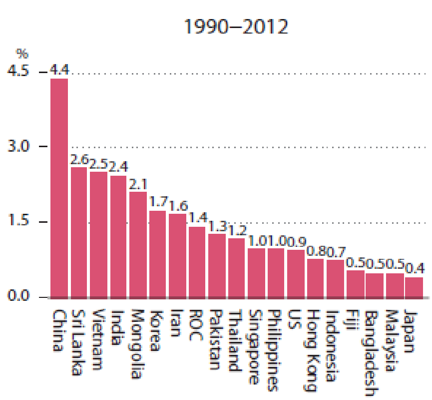
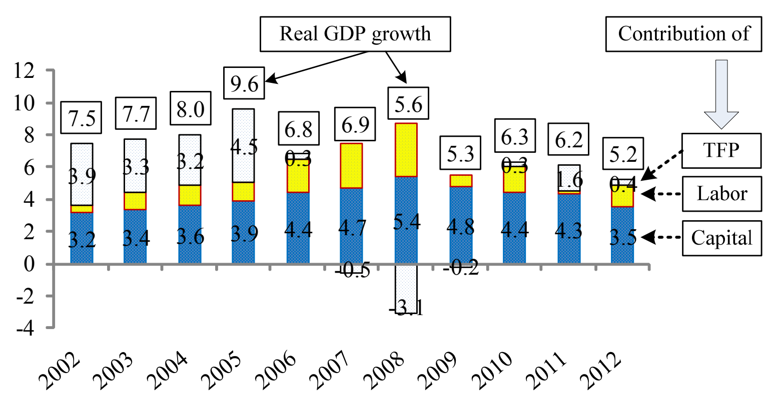


Figure 7. Vietnam's budget expenditure as percentage of GDP in comparison with those of some Asian countries, 2001–2013

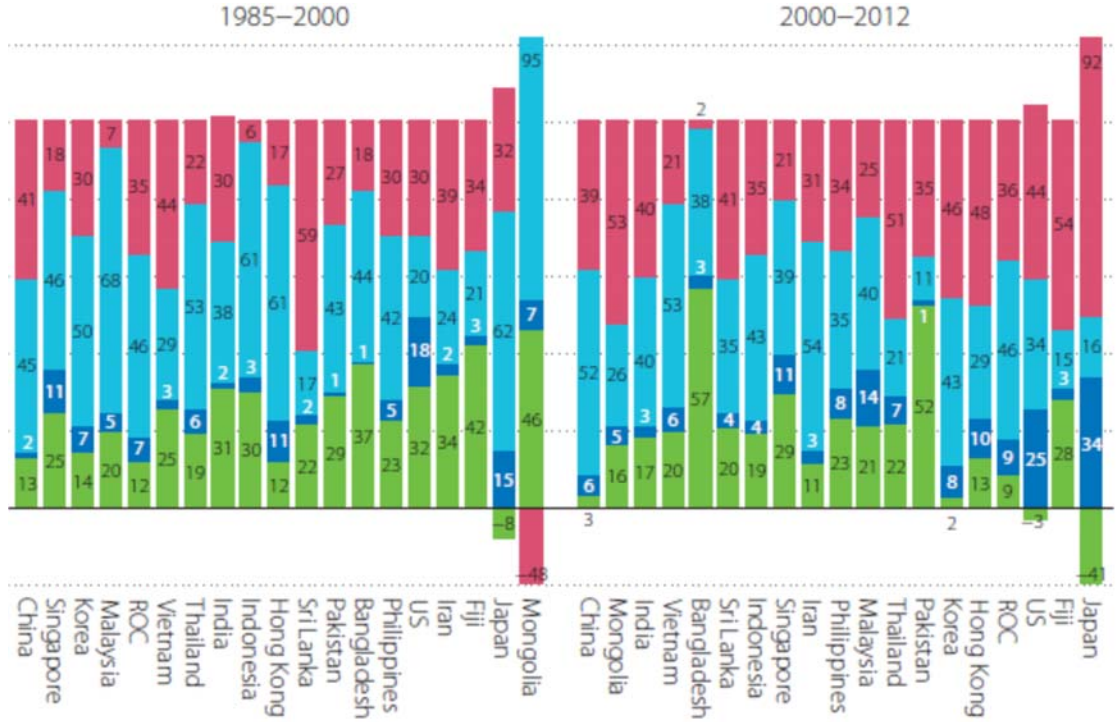
measure of a country's production efficiency and thus an important indicator for policymakers. According to figures compiled by Asian Productivity Organization (APO), over the period 1990–2012, Vietnam's TFP growth was at 2.5% on average per year, in third place of the 18 Asian countries compared (Figure 8(a)) but the trend had declined. In terms of its contribution to vietnam's economic growth, TFP accounted for 44% in 1985-2000 and down to 21% in 2000-2012 – tied with singapore for second place in reverse order [Figure 9(b)]. As shown in Figure 8(c), in the last seven year (2006-12), almost entire growth came from factor accumulation and not productivity.



(a) TFP Growth, 1990–2012



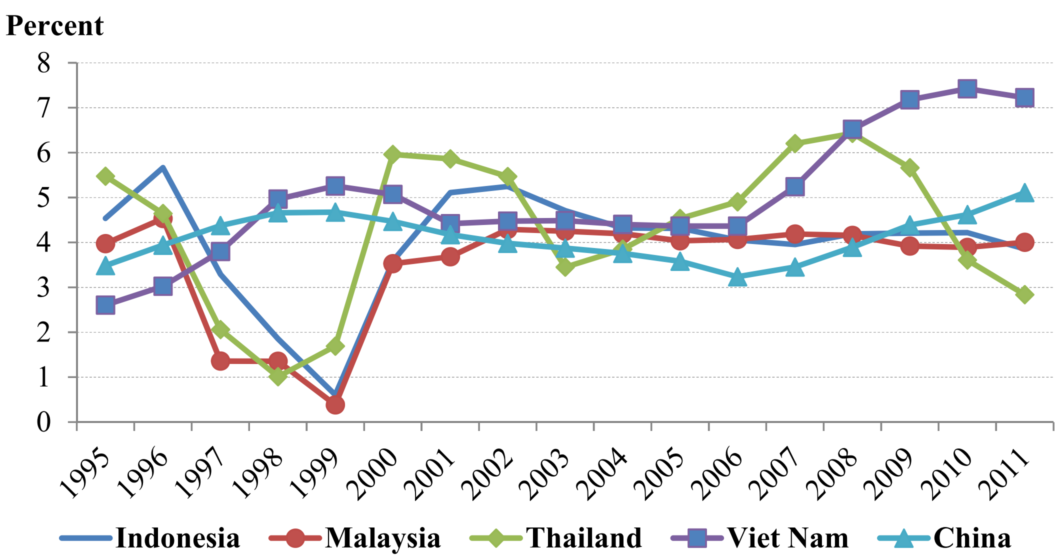
(c) Vietnam: Sources of economic growth, 2002–2012



(b) Contribution shares of economic growth, 1985–2000, and 2000–2012

Source: APO Productivity Database 2014.

Figure 8. Efficiency of the Vietnamese economy



Source: OECD Development Centre`s calculation

Figure 9. ICOR in emerging Asia, 1995-2011

Incremental capital-output ratios (ICORs) provide another indication of comparative productivity among the countries and their trends over time.[8] The higher the ICOR, the more additional capital it takes to produce a unit of GDP. Generally, ICOR tends to be comparatively low in early stages of develoment, when the aggregate capital stock is low and higher at later stages, when the capital stock is higher and additional investment produces less of an increase in output.

The OECD (2013), based on World Bank, reported the relatively high and rising ICOR for Vietnam (Figure 9). However, based on IMF, figures were somewhat lower and declined since 2010 – the ICOR of Vietnam climbed to 6.88 in 2009 and then down to 4.91 in 2013.

Moreover, the efficiency of foreign invested enterprises (FIEs) is constrained by insufficient infrastructure and the shortage of skilled labor. Relatively low levels of labor skills limit FDI within low value-added industries and make technology transfer via labor movement difficult. As a result, the technology spillovers from FIEs to domestic firms are limited.

Public investment, channeled largely through weak state-owned enterprises (SOEs), has led to inefficient public investments and a high level of indebtedness in the state sector. SOEs themselves are not only inefficient but also distort the allocation of resources. Therefore, local firms in the private sector are placed at a disadvantage in terms of access to capital and land for investment.

GDP growth

The historical experience suggests that a large CAD is likely to be sustainable when current and expected economic growth is high. For a given ratio of CAD to GDP, higher growth rates will lead to a smaller increase in the foreign debt to GDP ratio, and enhance the country's ability to service its external debt. Higher GDP growth tends to lead to higher investment rates driven by expectations of increased profitability. At the same time, high growth might lead to temporary lower private savings rates resulted from higher expected future income. If this is the case, CADs driven by a temporary fall in private savings and an increase in domestic investment should not be a concern.

The Vietnamese economy has experienced a downturn in growth since 2008. In the past five years, the annual growth averaged about 5.86 per cent and remains below potential (IMF, 2014a[9]; World Bank, 2014a, b). Moreover, the quality, and hence sustainability, of growth remain a source of concern, given the resource-intensive pattern of growth, high levels of pollution, low domestic value-added in exports, and the declining contribution of productivity to growth. In the longer-term, World Bank assesses: *"growth potential remains hampered by a web of structural problems in state-owned enterprises and the banking sector, policy weaknesses that continue to thwart domestic private investment and competition in key*

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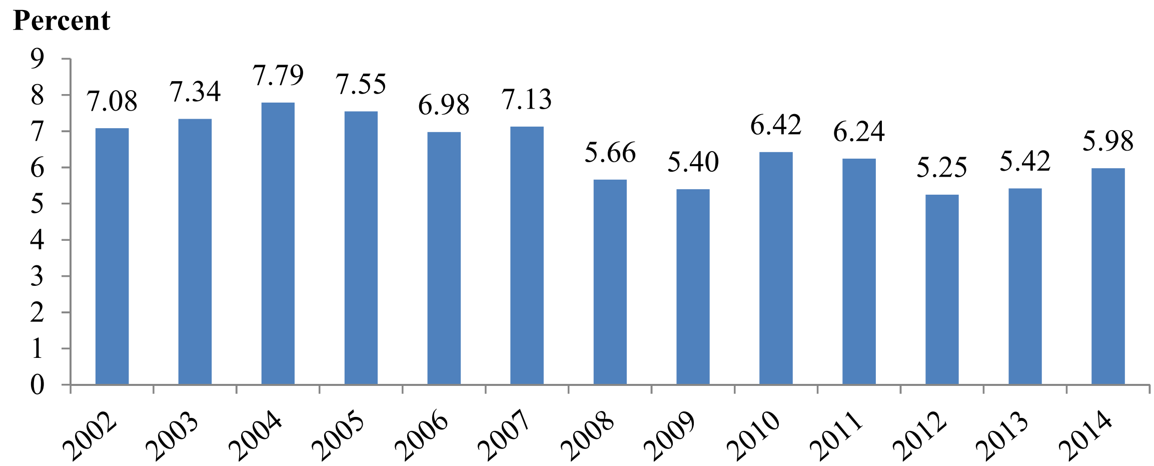
[8] The ICOR is the ratio of the value of new investment to the change in output in a given year. It can be computed by dividing the investment-GDP ratio by the annual GDP growth rate. This measure has to be treated with care, since it does not provide for necessary lags between investment and subsequent changes in output. However, as a measure of overall investment efficiency, its level and changes over time provide a broad estimate of the quality of investment.

[9] The IMF staff report for the 2014 Article IV Consultation estimates that a negative output gap opened after the global financial crisis, and widened to around 1½ percent of potential GDP in 2013.



Nguồn: IMF, and the figure for 2014 from GSO, available at http://www.gso.gov.vn/default.aspx?tabid=507&ItemID=16155

Figure 10. Vietnam: Growth rates of GDP, 2002-2014

sectors, a widening skills gap, constrained access to finance, and relatively high trade logistics costs."

Regarding to TPP, Vietnam is estimated to gain the largest percentage increase in GDP (14 percent, equivalent to 46.1 billions of 2007 dollars) by 2025 due to TPP, compared to 2025 without the TPP. The main reasons for the gain is Vietnam would become a much-expanded manufacturing hub in textile, garment, and other industries (Peter A. Petri and Michael G. Plummer, op. cit.).

4.1.3 *A global perspective from international capital markets*

The third viewpoint on the current account deficit focuses on international flows of financial assets or composition of the capital and financial accounts inflows. Capital and financial account flows have been dominated by foreign direct investment and relatively smaller portfolio flows into the country's two stock markets. Short-term capital outflows (including part of the errors and omissions from 2010) were moderately significant.

Vietnam has access to large foreign direct investment (FDI) inflows, providing significant nondebt-creating financing. Thanks to the large flows of FDI, Vietnam has been increasingly intertwined in the machinery supply chains developed by multinational corporations in East Asia. Machinery is becoming increasingly important in Vietnam's trade structure: it accounted for more than 30 per cent of Vietnam's exports in 2013, compared to only 10 per cent in 2000. Given the expansion of FDI in this field in recent years, this share can be expected to rise further. However, large FDI inflow influenced the growth in imports since foreign investors imported equipment, raw material, furnishings, construction material and the like in order to initiate the production process. In the case of Vietnam, vertical linkages between FDI and local firms are very weak. FDI firms in machinery assembly heavily rely on imports of parts, components and other intermediate goods. They do partially procure

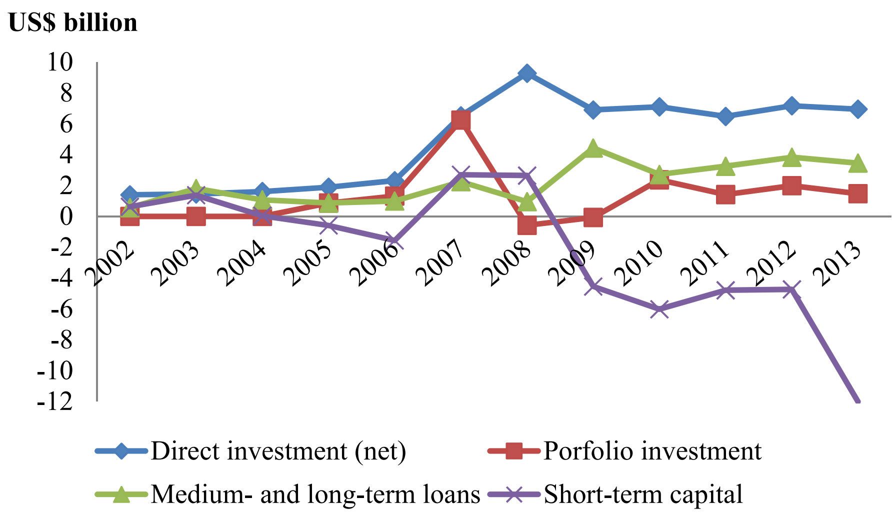


Figure 11. Vietnam's components of capital and financial account balance, 2002–2013

intermediate goods in domestic resources but mainly from the supply of other foreign firms rather than local firms.

On the other hand, portfolio investments have been negligible. After reaching $6.2 billion in 2007, they became slightly negative in the two years 2008 and 2009 (-$0.6 and -$0.1 billion, respectively) and only recovered marginally since then.

Growing errors and omissions

Although the balance of payments accounts are, in principle, balanced, imbalances result in practice from imperfections in source data and compilation. This imbalance is labeled net errors and omissions. In the case of Vietnam, net errors and omissions can be computed by taking reserve assets minus the sum of the current account balance and capital and financial account balances. Negative errors and omissions in the balance of payments have increased sharply since 2009.[10] The cumulative errors and omissions (a proxy for capital flight) in the period 2009-2013 were estimated at $32.4 billions, equivalent to nearly 19 percent of GDP in 2013. According to the common explanation, this may reflect large volumes of gold being held by private individuals in the country and a large amount of hard currency (almost U.S. dollar assets) being held either off-shore or outside the banking system. However, Vũ (2014) has put forward the following possible reasons for Vietnam's large and growing errors and omissions:

(1) The Vietnamese rich has send money abroad. Illegal business of people with the right in Vietnam is likely increasing, and this may be proved through transfering money back into Vietnam increasingly in order to money laundering in the form of remittances.

(2) Money transfers overseas to pay for illegal imports from China.

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[10] The figures must be bigger because "Data up to 2009 reflect an old presentation; from 2010, part of errors and omissions began to be reflected in net foreign assets." (IMF Country Reports No. 10/281, 12/165, 14/311).

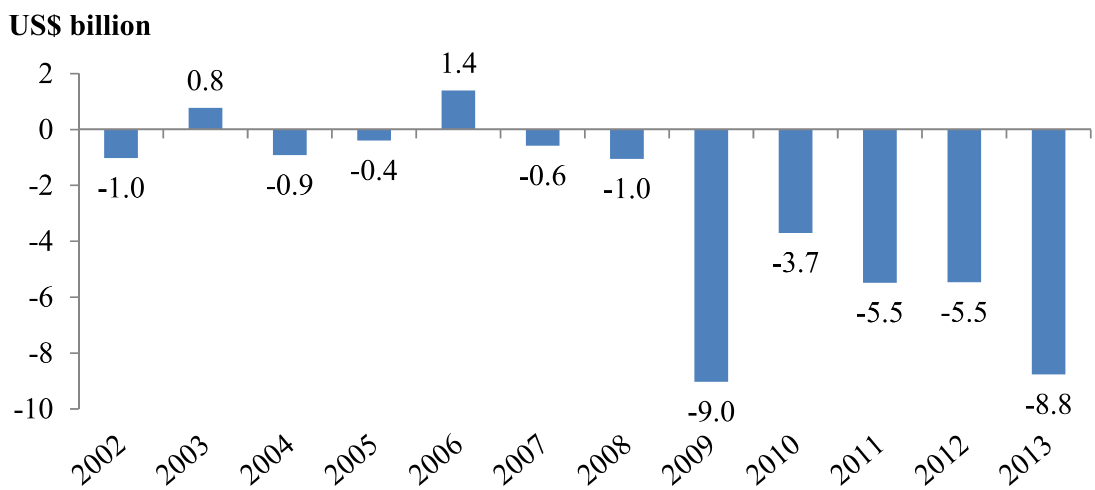


Figure 12. Vietnam, errors and omissions, 2002-2013

According to the IMF Balance of Payments Manual 5 and 6, a large, persistent errors and omission relative to the size of the economy are a cause for concern as they undermine the credibility of the balance of payments statistics.

Gross international reserves

Large international reserves (and a small external debt burden) reduce the risk of current account unsustainability and enable a country to finance a CAD at lower cost.

Vietnam's gross international reserves remain low on account of large, despite declining, domestic shift from Vietnamese dong into U.S. dollars and gold. At the end of 2013, gross international reserves stood at $26.0 billions, providing prospective GNFS import cover for just 2 months (Table 3). This remains well below the 8 months average of regional emerging market countries, and below the minimum level desirable for countries with a fixed exchange rate, according to the Fund's reserve adequacy metric (IMF, 2014). So the balance of payments will receive little support from the country's international reserves.

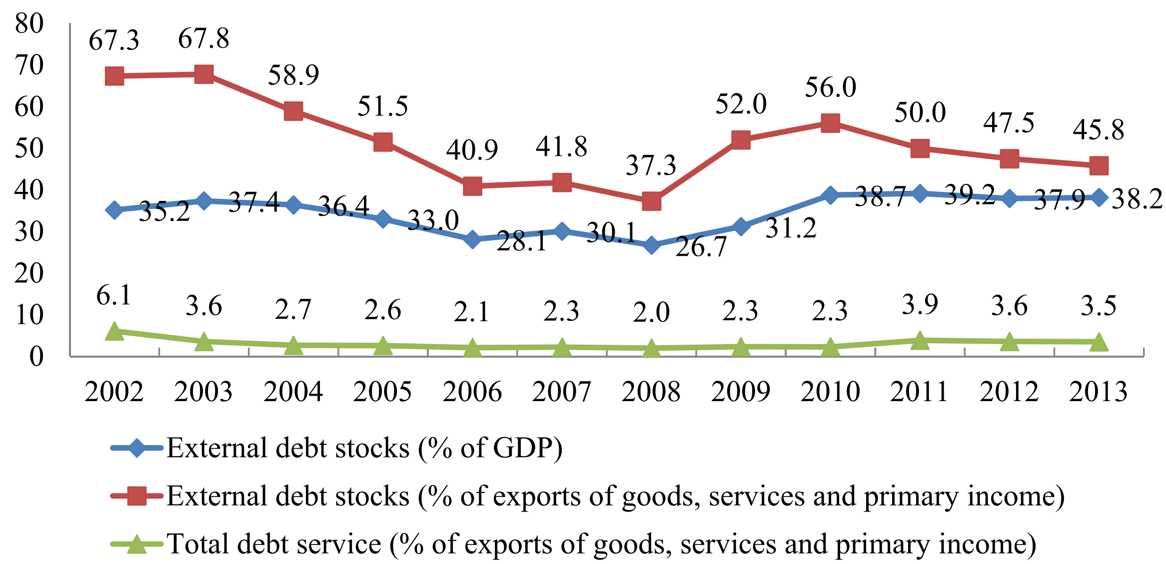
The stock of external debt

An existing large burden of international debt will make it more difficult to finance a current account imbalance. Moreover, a large debt-servicing burden can easily exhaust export

Table 3. Vietnam: Gross international reserves

(US$ billion)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Gross international reserves	3.7	6.0	6.3	8.6	11.5	21.0	23.0	14.1	12.4	13.5	25.4	26.0
In months of prospective GNFS imports	1.7	2.0	1.9	2.2	2.1	3.0	3.8	1.9	1.4	1.4	2.3	2.0



Source: World Bank, http://data.worldbank.org/country/vietnam

Figure 13. Vietnam: Some measures of external debt, 2002-13

revenues and prevent imports of investment goods that are needed for growth. In such a case, investors' behaviour may be altered by uncertainty about the country's *ability* or *willingness* to meet its debt obligations, or by a shift in expectations following an external shock. However, foreign debt may also be the counterpart of productive domestic investment that may later generate the foreign exchange needed to repay the loans. The debt position of a country may be proxied by relating the outstanding debt and debt servicing obligations to some macroeconomic variables, such as GDP and exports. Roubini and Wachtel (1997) suggest that a current account deficit is sustainable if the country maintains *a non-increasing foreign debt to GDP ratio*.

Figure 13 showed Vietnam's all three measures of external debt had fallen to lowest levels at the end of 2008, but risen again somewhat since 2009. In recent years, Vietnam's ratio of external debt to GDP has been relatively stable while the ratio to exports of goods, services and primary income has declined. At the end of 2013, the external debt stocks amounted to 38.2% of GDP and 45.8% exports of goods, services and primary income. The debt-service ratio reduced slightly from 3.9% in 2011 to 3.5% in 2013. Based on the LIC Debt Sustainability Analysis (DSA), Vietnam is at low risk of external debt distress (IMF, 2014).

4.1.4 *Stationarity of Vietnam's current account balance*

Now we perform a number of different unit root tests to determine the univariate properties of the Vietnam's CAB/GDP. We use 4 traditional unit root tests that include Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), Kwiatkowski-Phillips-Schmidt-Shin (KPSS) and Dickey-Fuller Generalized Least Squares (DF-GLS). The test equations are chosen based on the visual inspection of the graph of the Vietnam's CAB/GDP in levels (Figure 1). The unit

Table 4. Unit Root/Stationarity Test

	ADF test		PP test		KPSS test	DF-GLS Test
	No constant included	Constant included	No constant included	Constant included	Constant included	Constant included
CAB	-1.9362*	-2.3834	-1.7586*	-1.8503	0.1902	-2.4406**

Asterisks * and ** indicate rejection of the null hypothesis (H0) for the ADF, PP, KPSS, and DF-GLS tests at 10% and 5% level of significance respectively. The null of the ADF, PP, and DF-GLS tests is non stationary series (unit root) while the null of the KPSS is stationary series.

Notes: Test statistics and critical values are computed by the statistical software EViews 6. Lag lengths or bandwidths were automatically selected by the program. Selection of lag lengths for ADF and DF-GLS tests was based on Schwarz Information Criterion (SIC). In the PP and KPSS tests, Newey-West Bandwidth was selected using Bartlett kernel spectral estimation method. The Critical values in the ADF, PP, and DF-GLS tests refer to critical values computed by Mac Kinnon (1996) while those in the KPSS test refer to Kwiatkowski-Phillips-Schmidt-Shin (1992, Table 1).

root test results are presented in Table 4.

Both the ADF and PP tests reject the null hypothesis of a unit root in favor of the alternative stationary at the 10% level only in the case no constant included. That is CAB/GDP is stationary with zero mean. Based on the KPSS test, the null hypothesis of stationary cannot be rejected at usual critical values. Further evidence is provided by the DF-GLS unit root test, which is more powerful than the ADF unit root test (Elliot et al. 1996). Hence, we conclude that Vietnam's current account deficit is stationary and, therefore, sustainable.

4.1.5 *Cointegration analysis of Vietnam's exports and imports*

The choice of the cointegration method is based on the unit root test results. Most of the evidence shown in Table 5 indicates that both X_t and M_t are I(1). So, we could check for cointegration between these two variables by using Johansen technique of cointegration. Johansen cointegration analysis requires the determination of appropriate lag length with an unrestricted VAR model. In Table 6, we see the statistical results regarding estimations of simple VARs for 6 different lag structures (from lags 5 to 0). Criteria suggest the use of a lag of 5 in the analysis. Hence, for the cointegration, the lag length is 4 (since we are running the model in first difference now, unlike in level when we used VAR to decide the lag length).

Thus, the results of Johansen cointegration test indicate that there is a long-run relationship between exports and imports for Vietnam in the sample period. The coefficients of the cointegrating vector are given in Table 8.

The results of the Johansen cointegration method of maximum likelihood method are reported in Table 7. Both trace statistic and maximum eigenvalue statistic suggest one cointegrating vector between X_t and M_t at 95 percent confidence level.

Table 5. Unit Root/Stationarity Test

	ADF test		PP test		KPSS test		DF-GLS Test	
	Constant included	Constant & trend included	Constant included	Constant & trend included	Constant included	Constant & trend included	Constant included	Constant & trend included
Level								
X	-0.0974	-4.1257**	0.9420	-3.6181*	0.7068**	0.0408	0.2207	-3,5586**
M	-1.5034	-4.0733**	-1.7090	-1.9347	0.6578**	0.0982	-0.8193	-2.1494
First difference								
ΔX	-4.9894***	-4.7564***	-9.0616***	-8.5944***	0.2803	0.1901**	-5.1602***	-5.6558***
ΔM	-4.2445***	-4.4961***	-4.3022***	-6.4624***	0.2166	0.3204***	-4.0479***	-4.5024***

Asterisks *, **, and *** indicate rejection of the null hypothesis (H0) for the ADF, PP, KPSS, and DF-GLS tests at 10%, 5%, and 1% level of significance respectively. The null of the ADF, PP, and DF-GLS tests is non stationary series (unit root) while the null of the KPSS is stationary series.

Notes: In the DF-GLS test with a constant and a trend included, the Critical values refer to Elliott-Rothenberg-Stock (1996, Table 1). Eviews 6 warns: "Test critical values calculated for 50 observations and may not be accurate for a sample size of 22". The rest is the same as above.

Table 6. Statistical values of the VAR lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-137.5456	NA	8212.784	14.68901	14.78842	14.70583
1	-109.2088	47.72503	637.0318	12.12725	12.42549	12.17772
2	-107.8307	2.030927	856.4868	12.40323	12.90030	12.48736
3	-100.8024	8.877842	652.8879	12.08446	12.78037	12.20224
4	-96.25342	4.788413	675.4797	12.02668	12.92141	12.17810
5	-77.88418	15.46883*	175.2287*	10.51412*	11.60768*	10.69920*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Table 7: Unrestricted Cointegration Rank Test (Maximum Eigenvalue and Trace Test)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.662701	21.80752	15.49471	0.0049	20.64893	14.26460	0.0043
At most 1	0.059157	1.158596	3.841466	0.2818	1.158596	3.841466	0.2818

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

While the existence of a cointegration relationship between imports and exports is a necessary condition to sustain the foreign deficit, it is not an enough condition. Along with the existence of a cointegration relationship between imports and exports the slope coefficients obtained from the equations derived from these series should also be equal to 1 to put forth clearly that the current account deficit is sustainable. Failure to fulfill the second condition (sufficient condition) in Vietnam case requires that the sustainability of foreign deficit must be considered with doubt.

Since we found a cointegration relation between exports and imports with the estimated value of β coefficient, 0.900195, which is significantly not equal to one (Table 9); we can conclude the CAD of Vietnam may not be sustainable in the long-run because of faster rise in the Vietnam imports relative to the exports. In other words, based on the results of Johansen cointegration analysis, we can argue that the sustainability of the Vietnam's CAD is weak.

Table 8. Normalized cointegrating coefficients and adjustment coefficients

Normalized cointegrating coefficients (standard error in parentheses)	
X	M
1.000000	-0.900195
	(0.03150)
Adjustment coefficients (standard error in parentheses)	
D(X)	0.959542
	(0.34158)
D(M)	2.540876
	(0.61039)

Table 9. Tests of cointegration restrictions: B(1,1)=1, B(1,2)=-1

Hypothesized No. of CE(s)	Restricted Log-likehood	LR Statistic	Degrees of Freedom	Probability
1	-82.09169	7.256433	1	0.007065

5. Conclusion

The results from the unit root/stationarity tests and the Johansen cointegration test attest to the fact that the country's current account deficit is sustainable. However, the results of the Johansen cointegration analysis on intertemporal balance model indicate that there is a weak evidence for sustainability of CAD in Vietnam for the 1990-2013 period.

The use of various relevant indicator to assess the sustainability of the Vietnamese current account deficits reveals a key insight. Current account deficits associated with sizable fiscal deficits, low efficiency of the economy, medium GDP growth, and the risk of the exchange rate becoming overvalued. When associated with growing external debt, inadquate foreign exchange reserves, and large errors and omissions, current account deficits may lead the vulnerability of the economy to spillovers from external shocks.

Even though findings of the study indicates a weak evidence for the sustainability of CAD in Vietnam, the lack of action to to reinforce the sustainability of CAD might give scope for misinterpretation on the part of markets, and to possible destabilizing capital flows. The annual economic growth rate is expected to be 5-6 percent over the period 2015-19 (IMF, 2014a, b). For a country of per capita income of about US$2000, that rate of growth is not high enough to escape from the so-called middle income trap.[11] Therefore, there is an urgent need to implement some economic policies, such as allowing greater exchange rate flexibility, enhancing the efficiency of public investment activities, developing human capacity, improving infrastructure and business environment, and promoting supporting industries.

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[11] Increasing the rate of growth to somewhere in the vicinity of 8 per cent a year is imperative if Vietnam is to avoid middle income trap (Tran Van Tho).

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China Macroeconomic Fundamentals and Hong Kong Stock Market Volatility – A GARCH-MIDAS Analysis

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This paper investigates the dynamic movements between the China macroeconomic fundamentals and the stock market volatility of the China enterprises in Hong Kong. By using the Generalized Autoregressive Conditional Heteroskedasticity with Mixed Data Sampling (GARCH-MIDAS) model, our empirical evidence from monthly data on both stock market indexes and 36 cross listed China enterprises in Shanghai and Hong Kong stock markets shows that industrial production growth, short term interest rate, industrial product price index and consumer price index, all contribute significantly to the stock volatility in Hong Kong with different magnitudes. These findings have implications to investors and policy makers on portfolio management and policy formulation respectively.

Keywords: Information Transmission, Mixed Data Sampling, GARCH, Macroeconomic fundamentals, volatility.

JEL Classifications: C22, C58, G10

1. Introduction

The study on relationship between the volatility of stock returns and macroeconomic fundamentals has been a major topic in financial literature. Contemporary financial theory suggests that stock return volatility is closely related to the movements of macroeconomic variables and many empirical researchers have examined the pattern in stock return movements with factors determining such movements. Chen et al (1986) examined the macroeconomic variables, such as industrial production, inflation and spread between long and short term interest rates and indicated that such macro variables affected stock returns. Schwert (1989) performed testing to examine the causes of stock market volatility in the United States (U.S.) for period 1859 to 1987 and found that the volatilities of money supply growth and real economic activity were helpful in forecasting the volatility of stock returns. These studies unfolded extensive research areas on using various sophisticated econometric methods for analyzing stock returns and macroeconomic varies.

Dhaka et al (1993) investigated the relationship between the money supply, industrial production (IP), short term three-month Treasury bill rate, consumer price index (CPI) and share prices in U.S. by employing the vector autoregressive (VAR) model. They found that money supply has a significant effect on share prices through the changes in interest rate and inflation rate. Chiang and Chiang (1996) examined the dynamic behavior of stock return volatility for Canada, Japan, Germany and the United Kingdom (U.K.) and found that the international stock return volatility was mainly influenced by the U.S. stock return volatility which supported the market information transmission hypothesis. Their findings evidenced that correlation existed between stock return volatility and volatility in macroeconomic variables although the effects were not substantial at that moment. Apergis (1998) applied the generalized autoregressive conditional heteroskedatic (GARCH) and GARCH-X models to study the effects of short-run deviations between S&P500 index and money supply, CPI, IP and the exchange rate. He found that forecasting U.S. stock prices were harder as they move apart from the pattern for volatility was more persistent.

Chaudhuri and Koo (2001) investigated the volatility of stocks in Asian emerging markets from both the volatility of domestic and external factors. They evidenced that both domestic macroeconomic fundamentals and international variables have positive influence stock return volatility and there were strong contagion effect in the region. Beltratti and Morana (2006) studied the relationship between macroeconomic and stock market volatility using S&P500 data for period 1970-2001 by using a multi-component econometric model which acknowledged structural breaks and estimates dynamics with different persistence characteristics. They found a bidirectional links between volatilities in stock market and in macroeconomic variables and there was a stronger evidence of causality running from macroeconomic to stock market volatility than the other way round. Ratanapakorn and Sharma (2007) investigated the long term and short term relationship S&P500 and six macroeconomic variables over the period 1984 to 1999 and observed a negative relationship between stock prices and long term interest rates and a positive relation between stock prices and money supply, IP, inflation, the exchange rate and the short term interest rate. In the Granger causality sense, every macroeconomic variable caused the stock prices in the long run. Abugri (2008) examined the dynamics in key macroeconomic indicators such as interest rates, and IP in four Latin American countries by using a six-variable vector autoregressive (VAR) model, the study found that those factors significantly explained market returns in all the markets. The country variables were found to impact the markets at varying significance and magnitudes. The study also implied that the increasing integration of these markets with the global economy may increase the exposure to external shocks such as capital reversals and performance of the international capital markets.

By investigating a broad international cross section of stock markets covering about 40 countries and focused on the cross section obtained by averaging over time, Diebold and Yilmaz (2008) used time series data on real GDP, real consumption expenditures, stock market returns and consumer price inflation for each country. They found a clear link between macroeconomic fundamentals and stock market volatilities, with volatile fundamentals translating into volatile stock markets. In an international study relating to volatility to macroeconomic variables, Engle and Rangel (2008) used the spline-GARCH model found that high frequency aggregate stock volatility has both a short run and long run component. They suggested that the long run component was related to the business cycle. Engle et al. (2009) further examined the relation between U.S. series of aggregate stock market volatility and macroeconomic variables by using a new mixed data sampling, the GARCH-MIDAS model, which used a mean-reverting unit daily GARCH process, similar to Engle and Rangel (2008), and found that the long term component of return volatility was driven by inflation and industrial production growth.

Chen (2009) extended the study to investigate whether macro-variables, such as interest rate spread, inflation rate, money stocks and aggregate output, were useful in predicting recession in stock market. The empirical evidence from monthly data on the S&P500 price index revealed that yield curve spreads and inflation rates were the most useful predictors of recessions in the U.S. stock market. Macro-variables performed better in predicting bear markets than predicating returns in the stock market. The forecasting on bear market was useful for market participants to conduct a market timing strategy. This was also benefit to monetary authorities when deciding the monetary policy which would affect the stock market finally.

Corradi, Distaso and Mele (2013) studied the relationship between stock market volatility and business cycle. They developed and estimated a no-arbitrage model which stock market volatility was related to a number of macroeconomic and unobservable factors. They also used the model to assess how market volatility and volatility related risk premiums change in response to business cycle conditions. Their model found that macroeconomic factors substantially helped explaining the variability of stock volatility and volatility risk premiums was strongly countercyclical, which even greater than the stock volatility. The key aspect was that the relations among market, stock volatility, volatility risk premiums and the macroeconomic factors were consistent with no arbitrage.

Girardin and Joyeux (2013) followed the methodology proposed by Engle et al. (2009) and Engle and Rangel (2008) to explain the effects of macro fundamentals and the relationship with speculative factors. By applying the MIDAS to analyze the Chinese A- and B-shares markets' long run volatility, they found that the Chinese A-share market has speculative characteristics before entering into the WTO. However, afterwards, macroeconomic fundamentals contributed substantially to the volatility of the A-share market, in particular the CPI information.

Engle, Ghysels and Sohn (2013) reviewed the linkage between stock market volatility and macroeconomic fundamentals by employing the GARCH-MIDAS model. The model combines the insights of spline-GARCH and MIDAS filtered and distinguished short and long sources of volatility and linked them directly to economic variables. Followed the series constructed by Schwert (1989), they used monthly Producer Index Index (PPI), IP and IP growth rate to see the relation between stock market volatility and macroeconomic volatility. The results found that for the full sample period, the long run component typically accounted for about half of predicted volatility. As for the most recent period, the results contributed about one-third of the explanation.

Regarding the China related stock markets, mainly there are three different kinds of stock, in terms of ownership structure, the A-share, B-share and H-share markets. The study of the relationship between the A-share and H-share is also an extensive research area in financial literature. Wang and Iorio (2007) investigated the integration of the three stock markets and found that a high level integration between the A-share and Hong Kong H-share market after 2004. Qiao, Chiang and Wong (2008) applied the FIVECM-BEKK GARCH model to examine the relationships among A-share and B-share stock markets in China and the Hong Kong H-share market. They found a unidirectional volatility spillover effects from the A-share stock market to the Hong Kong stock market. The evidence indicated that A-share market had an influential effect in both mean and volatility spillover effects to the H-share market in Hong Kong. Ke, Wang and Murray (2010) by employing the GARCH and EGARCH model to examine the volatility spillovers between the A-share market and both main and merging stock markets, including H-share in Hong Kong. They found that the mainland China A-share market had shown a unidirectional influence on the Hong Kong market.

Cai, McGuinness and Zhang (2011) examined the co-integration relation between the A-share and H-share prices of cross listed Chinese stock for period for period January 1999 to March 2009. They found that the movement of A- and H-shares highly co-related during the period owing to the congruence with the two economies' growing interdependence. It was suggested that the mainland China macroeconomic policy initiatives had contributed to the above phenomena. Li, Yi and Su (2011) used the VAR modeling to exam the spillover of same day return effect of cross listed equities which were traded in Shanghai (A-share) and Hong Kong (H-share), they found it occurred from A-share to H-share. Yip, Cheng and So (2014) by employing the DDC-MGARCH model to examine the information transmission and spillover processes among U.S., China and Hong Kong stock market and found that the volatility of China market had shown greater spillover effect on to Hong Kong since the 2007 financial crisis and the interaction between the China and Hong Kong stock markets was more prominent than those between the U.S. and China.

This paper aims to provide systematic evidence of the role of China macroeconomic fundamentals to the Hong Kong stock market volatility by employing the Engle's GARCH-MIDAS model to link macroeconomic variables to the component of stock market volatility on 36 cross listed equities in both A-share and H-share for period August 2010 to September 2014. The broad sets of macroeconomic variables include Industrial Production Growth, Industrial Product Price Index, Consumer Price Index and 3-month short term SHIBOR. The selection of the state variables is the key macroeconomic indicators which can reflect the economy activities and monetary movements in mainland China. They serve as the thermometer in measuring the growth or slowdown of the China economy. Both the industrial production growth and industrial price index belong to the producer's goods market. The 3-month short term SHIBOR represents the money market. Tradition economic literature indicates that interest rate contribute to the movement of stock price through affecting cost of capital and firm's profitability. Whereas the consumer price index provides a mean to measure the effect of consumer's goods market and inflation to the China economy. Furthermore, in line with the findings in Schwert (1989), the GARCH-MIDAS model provides strong evidence on the behaviour of stock market volatility. We, therefore, make reference to the approach of using the Engle et. al. (2013) model by estimating both monthly and quarterly frequency in our study.

The principal contribution of our study lies in the application of a model which enables us to evident the dimensions of dynamic movement between the China macroeconomic variables and the volatility of the Hong Kong stock market. The regression results with significant positive correlation among various estimators strongly support that a high degree of congruence towards the two important economies in Asia. These bring implications to investors and policy makers for the study of financial contagion effect.

This paper is structured as follows. Section 2 presents the research methodology. Section 3 describes the sample data. Section 4 reports the empirical results, analysis and robustness tests. Finally, concluding remark is made in Section 5.

2. Methodology

Different news events may have different impacts on financial markets, depending on whether they have consequences over short or long horizons. Our study relates some recent studies in econometrics modeling. In order to explore the role of China macroeconomic fundamentals on the China and Hong Kong stock markets, we perform our analysis with reference to the methodology introduced by Engle and Randel (2008) and Engle et. al (2013), which states that the unexpected returns can be written as

$$r_{i,t} - E_{i-1,t}\left(r_{i,t} \right) = \sqrt{\tau_t \, h_{i,t}} \, \varepsilon_{i,t}, \tag{1}$$

where $r_{i,t}$ is the log return on day i during month t, $E_{i-1,t}(\cdot)$ is the conditional expectation given information up to time $t-1$. Volatility has two components: $h_{i,t}$ is the short-run component which accounts for daily fluctuations and τ_t is the long-run component assumed initially to be fixed for month t. This specification allows the same news to have a different impact depending on the condition of the economy. Macroeconomic variables are expected to influence the long-run component of volatility but not the short-run component.

As there is little predictability in returns for daily data, the conditional expectation is assumed to be μ, that is $E_{i-1,t}\left(r_{i,t} \right) = \mu$. Thus, Eq. (1) can be rewritten as

$$r_{i,t} = \mu + \sqrt{\tau_t \, h_{i,t}} \, \varepsilon_{i,t}, \quad \forall i = 1, \dots, N_t, \tag{2}$$

where $\varepsilon_{i,t} \mid \Phi_{i-1,t} \sim N(0,1)$ and $\Phi_{i-1,t}$ is the information set up to day $(i-1)$ of period t, in which the period may be a month, quarter, or longer. The volatility dynamics of the component $h_{i,t}$ is assumed to follow a GARCH(1,1) process:

$$h_{i,t} = \alpha_0 + \alpha_1 \frac{(r_{i-1,t}-\mu)^2}{\tau_t} + \beta_1 h_{i-1,t}. \tag{3}$$

For the volatility models that directly incorporate macroeconomic time series, Engle et al (2013) proposed fixed span and rolling window specification in the MIDAS filter. Their empirical results show that both specifications have similar results. Thus, we assume τ is fixed for month t. Such a MIDAS filter is defined as

$$\log \tau_t = m + \theta \sum_{k=1}^{K} \varphi_k\,(\,\omega_1\,,\omega_2\,) X_{t-k} \tag{4}$$

where X_{t-k} is the level of a macroeconomic fundamentals, m and θ are the intercept and slope, respectively, of the MIDAS filter. The macroeconomic variables of interest are growth rate of IP, SHIBOR, IPP and CPI. For the weighting function $\varphi_k\,(\,\omega_1\,,\omega_2\,)$ in Eq. (4), we use the Beta lag structure:

$$\varphi_k\,(\,\omega_1\,,\omega_2\,) = \frac{(\,k\,/\,K\,)^{\,\omega_1-1}(\,1-k\,/\,K\,)^{\,\omega_2-1}}{\sum_{j=1}^{K}(\,j\,/\,K\,)^{\,\omega_1-1}(\,1-j\,/\,K\,)^{\,\omega_2-1}} \tag{5}$$

where the weights in Eq. (5) sum up to 1. The beta lag, based on the beta function, is very flexible to accommodate various lag structures. It can represent a monotonically increasing or decreasing weighting scheme and also a hump-shaped weighting scheme. See Ghysel et. al. (2007) for further details regarding the various patterns one can obtain with beta lags. As Engle et. al. (2013) and Girardin and Joyeux (2013) stated that the lag structure in Eq. (5) using beta weights and exponential weights produce almost identical results. Thus, we apply the more flexible Beta lag structure in our model setting.

Eqs. (2) – (5) form a GARCH-MIDAS model for time-varying conditional variance with fixed span macroeconomic time series volatility and parameter space $\Theta = \{\,\mu,\ \alpha_0,\ \alpha_1,\ \beta,\ m,\ \theta,\ \omega_1,\ \omega_2\,\}$. The number of parameters is fixed for different choices of the period t (month or quarter) and the number of lags K.

To estimate GARCH-MIDAS model, we develop a Bayesian approach to generate samples from the joint posterior distribution of all parameters via Markov chain Monte Carlo (MCMC) methods instead of QMLE. One advantage of this approach is that it allows all parameters to be estimated simultaneously and thus incorporates their variations in the statistical inference. In addition, this Bayesian approach allows us to perform the estimation easily even increasing the number of parameters for different model settings. For instance, one extension of the return series in Eq. (2) can be governed by an autoregressive function or the volatility dynamics can be governed by a GARCH(p,q) process. To estimate the GARCH-MIDAS model, we divide the set of parameters into four blocks by the Eqs (2) – (5). The first block of parameters represents the conditional mean in Eq. (1). The second and the third blocks are the parameters associated with the GARCH equation (Eq. (3)) and intercept and slope of Eq. (4), respectively. The fourth block is the weighting function in Eq. (5). See So and Yip (2011) for details of prior settings and sampling scheme. We carry out 20,000 iterations, discarding the first 8,000 MCMC iterations and obtain the final posterior estimates with posterior standard deviations. In each MCMC iteration, we sample the estimates from the prior and maximize the log-likelihood function, which can be written as

$$L(\Theta) = -\frac{1}{2}\sum_{i=1}^{T}\left[\log(2\pi) + \log h_t(\Phi)\tau_t(\Phi) + \frac{(r_t-\mu)^2}{h_t(\Phi)\,\tau_t(\Phi)}\right]. \quad (6)$$

3. Data

Dependent variables

Chinese stock market is a hot topic in recent studies. Lee and Rui (2000) studied the relation between trading volume, stock returns and return volatility in and across China stock exchanges. Yeh et al. (2002) studied stock returns and volatility of China A- and B-shares. Girardin and Joyeux (2013) study China A- and B-shares markets' long run volatility. However, the literature on relationship of stock market volatility and macroeconomic fundamentals in and across China and Hong Kong market context is still limited.

As at September 2014, there were 54 cross listed equities in both A-share and H-share for China and Hong Kong stock market. Out of the 54 cross listed equities, 16 companies were listed after 2010 with less than 4 years data and 2 enterprises were suspended for trading for more than two months during the sample data period. In order to maintain data integrity, they are taken out from the sample data. Accordingly, daily data of 36 cross listed equities from the August 2nd 2010 through September 30th 2014 are selected for analysis. Data sample starting from 2010 is used so as to include one of the biggest Hong Kong IPO listing of the Agricultural Bank of China Limited in the same year. Details of the 36 companies, including their names, corresponding sectors are provided in Table 1. The selected equities are grouped under four sector sub-indexes by making reference to the Hang Seng Indexes Company Limited's industry classification. Regarding market-wide indexes, Shanghai Stock Exchange Composite Index (SSCI), Shanghai A-share Index (SSHA) and Hang Seng China Enterprises Index (HSCE) are of interest so as to represent the dynamic relations between China and Hong Kong stock markets. Daily closing data of the stock equities and indexes are obtained from Bloomberg. Return of equity and indexes i at time t is calculated as:

$$r_{i,t} = \ln P_{i,t} - \ln P_{i,t-1}$$

where P_t is the closing price or index level at time t. Descriptive statistics of the returns of the 36 cross listed equities and 3 indexes are given in Table 2. Most of the mean of these stocks and market indexes are around 0 and have high volatility. In comparing the market indexes in China (SSCI and SSHA) and Hong Kong (HSCE), both average returns are negative, while HSCE is more volatile than SSCI and SSHA. In addition, SSCI and SSHA have a negative skewness while HSCE has a positive skewness. Among these 36 H-shares listed in Hong Kong stock exchange, all 36 stock average returns have a larger volatility than the HSCE. The composition of HSCE consists of 40 China enterprises, in which 21 of them are included in our 36 selected stocks. Regarding 36 A-shares listed in Shanghai stock exchange, three equities, namely Petro China Company Limited, Agricultural Bank of China Limited and Bank of China Limited, are less volatile than its market indexes. Figure 1 show the time series plot of SSCI, SSHA and HSCE indexes, the right panel on this figure demonstrate the daily returns of these indexes. The indexes and returns of SSCI and SSHA are quite similar. There is a substantial drop since the first quarter in 2011. However, the significant drop in HSCE can only be observed until the third quarter in 2011. The volatility of HSCE is increased substantially since August 2011 after the announcement of a series of measures to reinforce the Central Authorities' support for the development of Hong Kong as an offshore Renminbi (RMB) business centre by the Vice-Premier of the State Council. This announcement has a positive impact to Hong Kong market and rebound the market indexes from its lowest point which leads to the high volatility during the period August 2011 to December 2011.

Independent variables

Regarding the selection of macroeconomic variables, they are also obtained from the Bloomberg. According to the Central Intelligence Agency, industrial production growth rate can provide the comparison on the percentage increase in industrial production which includes manufacturing, mining and construction. The producer price index measures the average changes in price received by domestic producers for their output. Both indicators provide valid measure on the producers' goods market. Monetary authority can, through the adjustment on interest rate, affect the money supply. The use of 3-month SHIBOR provides a good measure regarding short term liquidity which in term affecting the money supply in the economy. Abdullah and Hayworth (1993) found that money supply was related to stock prices through portfolio substitution or inflationary expectation. On the other hand, through the change in consumer price index, it shows the economic activities in the consumer's goods market. Their studies also indicated that stock returns were related to inflation. Table 3 gives the descriptive statistics of the four selected China macroeconomic fundamentals. Industrial production has a negative growth rate and negative skewness while others fundamentals have a positive growth rate and positive skewness. Figure 2 shows the growth rates of these macroeconomic factors. The industrial production has a sudden decrease in second quarter of 2012 due to the increasingly violent environmental protests in 2011, which forced the suspension or cancellation of chemical plants, coal-fired power plants and a giant copper smelter. The industrial production index maintained its growth after the announcement by the environment minister that all major industrial projects must pass a "social risk assessment" before they began. The growth rate of industrial producer price index and consumer price index are similar and declines since the third quarter of 2011 due to the government policy on loosen fiscal policy in controlling the high inflation and maintaining the monetary policy stable. Hence, the 3-month short-term interest rate has maintained stable since the third quarter of 2011.

4. Empirical Results and Analysis

Parameter estimates

In this paper, we use the GARCH-MIDAS model described in Section 2 to fit daily returns of three market indices, namely Shanghai Stock Exchange Composite Index (SSCI), Shanghai

A-share Index (SSHA) and Hang Seng China Enterprises Index (HSCE), and 36 cross listed equities in A- and H-share indexes. We choose one year MIDAS lag years ($K = 12$ for monthly data and $K = 4$ for quarterly data).

The estimates of the GARCH-MIDAS parameters with IP, SHIBOR, IPP and CPI are presented in Tables 4 to 7 respectively. The estimates are the posterior means of 12,000 MCMC iterates and posterior standard deviations of these estimates are omitted for clearer presentations. All posterior standard deviations are available upon request. Although the beta lag structure weighting in Eq. (5) includes two parameters ω_1 and ω_2, the optimal ω_1 is always 1 such that the weights are monotonically decreasing over the lags. Therefore, we report a single ω parameter. The larger value of ω indicates a faster decay for the macroeconomic fundamentals. From Tables 4 to 7, all parameters are significance excepts for some conditional expectations μ. This is supported by the evidence from Table 2 in which most of the sample means are close to zero and insignificance. Most of the results show that sum of GARCH coefficients, $\alpha_1 + \beta$, are very close to 1 except for SSCI and SSHA, which indicate high persistence of volatility. All slope coefficients in Eq. (4), θ, of these China macroeconomic variables are statistically significance, which indicate that these China macroeconomic fundamentals are significant in estimating the market volatilities. Positive θ means an increase in the macroeconomic variable would lead to high stock or equity market volatility. The larger the magnitude of θ, the higher the impact of this macroeconomic variable to the equity or market volatility.

From Table 4, IP is used as the macroeconomic fundamentals. The positive θ in Eq.(4) implies an increase in industrial production index would increase the market volatility. In Table 4a, SSCI series with IP macroeconomic fundamental, the value of θ is 0.071, which implies an increase in IP, the conditional volatility would increase. Since the weighting function with with ω = 15.815 puts 0.766 on the first lag and 0.187 on the second lag of SHIBOR (in total of 95.3% of the weights), we find that a 1% increase of IP during the current month would increase the next month market volatility by $e^{0.071 \cdot 0.766} - 1 \approx 0.0559$ or 5.59%. For example, if the IP increases by 1 percentage point (say, from 4% to 5%), the next month market volatility would rise by 5.59% (say, from 15% to 15.84%). Similarly, if the IP of previous month increases by 1 percentage point, we would see $e^{0.071 \cdot 0.187} - 1 \approx 0.0134\%$ or 1.34% increase in market volatility next month. For SSHA, the conditional market volatility of next month would be increased by 15.16% and 4.56% of 1 percentage point increase of current month IP and previous month IP, respectively. In HSCE, the value of θ is -0.487, which implies an increase in IP, the conditional volatility of HSCE would decrease. The magnitude of the value governs the degree of impact on the conditional volatility. The next month market volatility of HSCE would drop 33.68% by 1 percentage point increase of current month IP and drop 6.42% of previous month IP. Figure 3 shows the time-varying conditional volatility of three market indexes with IP and SHIBOR macroeconomic fundamentals. The left panels of time-varying conditional volatility with IP as MIDAS filters demonstrate the impact of IP is significant. The increase in IP would increase the market volatility of SSCI and SSHA but decrease the market volatility of HSCE. And hence, the time-varying conditional volatilities are more volatile in HSCE than SSCI and SSHA.

Similar results can be estimated based on the weights ω and slope coefficients θ. Regarding the 3-month short term SHIBOR, a 1 percentage point increase of current month interest rate and previous month interest rate would decrease the market volatility of SSCI by 0.41% and 0.07% respectively. However, it would increase the market volatility of SSHA by 1.67% and 0.22%, respectively. It is appealing that the degree of impact of SHIBOR is higher in HSCE than SSCI and SSHA. The HSCE market volatility would increase by 10.48% and 3.83% of 1 percentage point increase in SHIBOR. In Figure 3, the right panels show the time-varying conditional volatility with SHIBOR as MIDAS filter. As the volatilities of HSCE and SSHA are positively related with SHIBOR, they are evidenced by the time-varying conditional volatility plots.

In view of the industrial product price index, a 1 percentage point increase of current IPP and previous IPP would increase the market volatility of SSCI by 2.28% and 0.64%, respectively. IPP affects SSHA index similarly by 2.48% and 0.23%, respectively. It is worth noting that the volatility of HSCE has a greater impact of an increase of 1percentage point of current IPP and previous IPP by 5.34% and 0.71%. Figure 4 provides the time-varying conditional volatility of three market indexes with IPP and CPI macroeconomic fundamentals. All three market volatilities have a similar movement as IPP. However, the market volatility of SSCI and SSHA are less volatile than that of HSCE.

With a view to consumer price index, the impact of CPI to HSCE market volatility has the greatest impact among three market indexes. The volatility of HSCE increases by more than 40 times of 1 percentage point increases in current month CPI and previous month CPI, while it increases about 4.5 times of previous month CPI by a 1 percentage point increment. CPI affects negatively in local markets instead of positively related. SSCI will decrease by 31.35% and 13.09% by an increase of 1 percentage point of current month CPI and previous month CPI, respectively. SSHA will decrease by 82.05% and 38.27% of a 1 percentage point increment in current month CPI and previous month CPI, respectively. The right panels of time-varying conditional volatility plots in Figure 4 demonstrate the impact of CPI on three market indexes.

By employing the GARCH-MIDAS model, we find that all examined macroeconomic fundamentals, IP, SHIBOR, IPP and CPI, have an explanatory power for the stock return volatility of the cross listed China enterprise in Shanghai (A-shares) and Hong Kong (H-shares). In addition, the explanatory power is more significant for the H-shares. The empirical result is supported by analyzing both the movements of two market indexes in Shanghai stock exchange (SSCI and SSHA) and one market index in Hong Kong stock exchange (HSCE).

Analysis on macroeconomic fundamentals

From the parameter estimates, the larger the magnitude of θ imply the larger degree of response to the change of the macroeconomic fundamentals. Based on the estimation in Section 4.1, we find that China macroeconomic fundamentals not only useful in explaining the market and stock volatility in China, but also exists a significant contagion effect on the movement of the stock return in Hong Kong, especially for CPI. It increases the HSCE market volatility by more than 40 times of an increase of 1 percentage point of current CPI. Similar results can be drawn for other economic factors. This empirical result which CPI inflation volatility plays an important role with high explanatory power is supported by the findings of Ratanapakorn and Sharma (2007) and Girardin and Joyeux (2013). The volatility on CPI inflation affects the monetary authority's decision on money supply policy which has an indirect impact on stock returns volatility.

To investigate the relationship between the cross listed China enterprises on A-share and H-share markets, we perform *t*-test on the slope coefficient, θ, in Eq. (4) among 4 selected China macroeconomic fundamentals, IP, SHIBOR, IPP and CPI to each of these 36 individuals China enterprises in both Shanghai (A-shares) and Hong Kong markets (H-shares). Table 8 shows the test statistics and the *p*-value of these tests. We apply one-tailed *t*-test to investigate whether positive impact or negative impact exists. In Panel A of Table 8, we perform the test with A-shares. SHIBOR, IPP and CPI show significant negative values on the slope coefficient, while IP has insignificant value different from zero. These results show that significant contagion effect on the movement of the equities return in A-shares by the SHIBOR, IPP and CPI. Similarly, IP, SHIBOR and IPP have shown significant contagion effect on the movement of the equities return in H-shares.

To eliminate the movement due to individual company news or events, a further analysis on paired difference tests are performed. All paired *t*-tests with different economic factors are statistically significance, which indicate the same China fundamentals impact on A-shares and H-shares are statistically significance. The difference of the 36 cross listed China enterprises in Shanghai and Hong Kong markets are all negative with SHIBOR, IPP and CPI macroeconomic fundamentals, while it is positive with IP macroeconomic factor. This implies that the degree of response to their changes is in general larger for Hong Kong market than that for the China market. The expectation of macro-controls on interest rate, production price and CPI on policy makers from international investors in Hong Kong seems to be the best justification for this.

These findings have important implications for investors who would like to adopt a cross market approach to capture the investment opportunities created by exposure to a comprehensive Chinese investment universe, especially on their portfolio diversification and trading strategies. As China macroeconomic variables have shown various degrees of impact and significance on the return of the China enterprise stock market in Hong Kong, investors could view the China and Hong Kong stock markets are heading toward an integrated one. In view of the increasing integration of the two stock markets, in particular under the Shanghai-Hong Kong Stock Connect and the proposed the Shenzhen-Hong Kong Stock Connect arrangements, the stock market volatility of Hong Kong may increase its exposure to the mainland China economy in addition to the other external shocks. The Hong Kong policy makers also benefit from the study since at the time when they formulate the policy, consideration on China macroeconomic fundamentals and sequence of implementation may help to minimize economy risk factors and maintain Hong Kong's financial market stability.

Impact of data frequency

Furthermore, we also apply the GARCH-MIDAS model with these four quarterly macroeconomic variables. Parameter estimates are available upon request. On parameter estimation, we observe similar results as monthly macroeconomic variables. All parameters are significant except for some expected market returns μ. It is worth noting that the values of slope coefficient θ are significant but closer to zero than that in monthly macroeconomic variables. We also perform the t-tests and paired difference tests. It is appealing that all the four quarterly macroeconomic fundamentals also have significant impacts on three market indexes and all 36 cross listed China enterprise in Shanghai and Hong Kong. However, in the paired difference tests, only SHIBOR and IPP show significant larger contagion effect on the movement of the stock return in H-shares than that in A-shares. On the IP and CPI factors, the contagion effect on the movement of the stock return in H-shares and A-shares are insignificantly different from each other. This evidence shows that short term impact running from macroeconomic variables to stock return volatility is found in comparing the monthly and quarterly estimations.

Robustness test

Firstly, in order to provide reliable estimates, we perform simulation study of the Bayesian MCMC approach with 100 simulated time series data under the various parameter settings. Summary statistics and parameter estimates of these 100 simulated time series can be provided upon request. Secondly, in the estimation process with market returns and macroeconomic variables, we start with various initial values and result with similar parameter estimates. Thirdly, in order to provide consistent and efficient estimates, we perform with different MCMC iterations. Sufficiently large MCMC iterations are required to generate reliable estimates. However, it may take a longer time for the estimation. The current selection of 20,000 iterations with first 8,000 iterations discarded can provide consistent and time efficient estimates.

Finally, we perform an ANOVA test to diagnosis the robustness on different sectors of these 36 cross listed China enterprises. In general, there are significant contagion effect on the movement of the individual stock return in H-shares and A-shares among four sectors, namely Commerce and Industry, Finance, Properties and Utilities. Table 1 provides the corresponding sector of each stock into four sectors by making reference to the Hang Seng Indexes Company Limited's industry classification. In general, these analyses show that similar contagion effects are observed among various sectors under the same macroeconomic variables.

5. Conclusion

This paper examines the dynamic relations between various China domestic macroeconomic variables and the causal behaviour of stock market volatility of the China enterprises in Hong Kong. By employing the GARCH-MIDAS model, we find that all the examined variables, Industrial Production Growth (IP), 3-month short term interest rate (SHIBOR), Industrial

Product Price Index (PPI) and Consumer Price Index (CPI) have explanatory power for the stock return volatility of the China enterprise in Hong Kong. The empirical result is supported by analyzing both the movements of the Shanghai Stock Exchange Composite Index and Shanghai A-Share Index against the Hang Seng China Enterprises Index in Hong Kong.

The empirical finding strongly shows that China macroeconomic fundamentals not only useful in explaining the market and stock volatility in China, but also exists a significant contagion effect on the movement of the stock return in Hong Kong, especially for CPI. Further estimation is made by applying the Paired-Difference Test to each of the 36 individual cross listed China enterprises in both Shanghai and Hong Kong markets, the result also evidenced our findings. It is noticeable that among the macroeconomic variables that we considered, the degree of response to their changes is in general larger for Hong Kong market than that for the China market, except for the IP. Our study contributes to the growing body of evidence on the transmission of the influences of macroeconomic variables of cross listed securities under the case of Chinese A- and H- shares. Further research can be studied with longer time horizon to perform the analysis on impact of these four macroeconomic fundamentals for different sub-period with structural breaks analysis.

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TABLE 1:

Market and Company Information.

Code	Name	Category	Sector
Panel A: Market Indices of China and Hong Kong Stock Market			
SSCI	Shanghai Stock Exchange Composite Index (SSCI)		
SSHA	SHASHR Index (SSHA)		
HSCE	Hang Seng China Enterprise (HSCE)		
Panel B: 36 China Enterprises equities cross listed on China and Hong Kong Stock Market			
1	Air China Ltd	Consumer Services	C
2	Aluminum Corporation of China Ltd.	Materials	C
3	China Coal Energy Co. Ltd.	Energy	C
4	China Eastern Airlines Corporation Ltd.	Consumer Services	C
5	China Oilfield Services Ltd.	Energy	C
6	China Shenhua Energy Co. Ltd.	Energy	C
7	China Southern Airlines Co. Ltd.	Consumer Services	C
8	China Shipping Container Lines Co. Ltd.	Industrials	C
9	CSR Corporation Ltd.	Industrials	C
10	Dongfang Electric Corporation Ltd.	Industrials	C
11	Guangshen Railway Co. Ltd.	Consumer Services	C
12	Jiangxi Copper Co. Ltd.	Materials	C
13	PetroChina Co. Ltd.	Energy	C
14	China Petroleum & Chemical Corporation	Energy	C
15	Tsingtao Brewery Co. Ltd.	Consumer Goods	C
16	Weichai Power Co. Ltd.	Industrials	C
17	Yanzhou Coal Mining Co. Ltd.	Energy	C
18	Zijin Mining Group Co., Ltd.	Materials	C
19	ZTE Corporation	Information Technology	C
20	Agricultural Bank of China Ltd.	Financials	F
21	Bank of China Ltd.	Financials	F
22	Bank of Communications Co., Ltd.	Financials	F
23	China Construction Bank Corporation	Financials	F
24	China Life Insurance Co. Ltd.	Financials	F
25	China CITIC Bank Corporation Ltd.	Financials	F
26	China Merchants Bank Co., Ltd.	Financials	F
27	China Pacific Insurance (Group) Co., Ltd.	Financials	F
28	Industrial and Commercial Bank of China Ltd.	Financials	F
29	China Minsheng Banking Corp., Ltd.	Financials	F
30	Anhui Conch Cement Co. Ltd.	Properties and Construction	P
31	China Railway Construction Corporation Ltd.	Properties and Construction	P
32	China Railway Group Ltd.	Properties and Construction	P
33	Metallurgical Corporation of China Ltd.	Properties and Construction	P
34	Datang International Power Generation Co., Ltd.	Utilities	U
35	Huadian Power International Corporation Ltd.	Utilities	U
36	Huaneng Power International, Inc.	Utilities	U

Note: In sector Column, “C” represents the Commerce and Industry sector, “F” represents Finance sector, “P” represents Properties sector and “U” represents Utilities sector.

TABLE 2:

Summary statistics for three market indices and 36 cross listed equities daily stock returns.

	China stock market				Hong Kong stock market			
Code	Mean	Std Dev	Skewness	Kurtosis	Mean	Std Dev	Skewness	Kurtosis
SSCI	-0.012	1.116	-0.162	1.845				
SSHA	-0.012	1.123	-0.158	1.782				
HSCE					-0.017	1.503	0.088	2.491
1	-0.115	1.931	0.198	2.256	-0.062	2.372	0.037	1.351
2	-0.104	2.123	0.865	4.327	-0.076	2.371	0.206	2.263
3	-0.076	1.724	0.406	3.146	-0.089	2.308	-0.317	5.579
4	-0.102	2.055	0.430	3.578	-0.056	2.528	0.090	1.537
5	0.037	2.430	0.105	2.043	0.065	2.427	0.459	2.922
6	-0.044	1.663	0.229	4.089	-0.034	1.965	-0.105	1.422
7	-0.092	1.992	0.181	2.841	-0.039	2.605	0.392	3.559
8	-0.023	2.207	0.842	4.527	-0.033	3.044	0.469	3.159
9	-0.003	2.066	0.739	2.906	0.006	2.924	0.270	4.376
10	-0.051	2.188	0.061	1.940	-0.066	2.850	-0.106	2.633
11	-0.025	1.628	0.476	4.894	0.007	1.912	0.351	2.616
12	-0.078	2.292	0.316	2.576	-0.030	2.539	0.388	5.520
13	-0.032	1.042	0.382	6.127	0.009	1.602	-0.081	1.203
14	-0.025	1.439	0.359	3.828	0.031	1.703	0.075	2.701
15	0.011	1.607	0.197	1.319	0.038	1.792	-0.017	0.989
16	-0.037	2.205	0.174	1.857	0.002	2.556	0.162	1.158
17	-0.072	2.563	0.486	2.394	-0.097	2.587	-0.058	3.368
18	-0.053	1.890	0.859	5.138	-0.058	2.663	0.580	4.640
19	-0.024	2.477	0.024	2.001	-0.021	2.644	-0.289	6.482
20	-0.012	1.091	0.567	9.031	-0.002	1.927	0.143	4.237
21	-0.027	0.984	-0.827	11.519	-0.014	1.581	-0.120	4.042
22	-0.035	1.342	0.751	7.378	-0.038	1.777	-0.024	3.089
23	-0.018	1.153	-1.095	11.638	-0.018	1.592	-0.218	2.458
24	-0.044	1.773	0.257	2.558	-0.048	1.963	-0.070	3.215
25	-0.024	1.883	0.640	5.682	-0.011	1.942	0.073	2.277
26	-0.033	1.627	0.527	3.740	-0.044	2.068	0.232	5.545
27	-0.020	1.962	0.279	1.485	-0.013	2.082	0.288	3.189
28	-0.020	1.118	-0.703	13.838	-0.020	1.752	0.201	4.690
29	0.028	1.779	0.348	5.323	0.014	2.088	-0.052	2.640
30	0.025	2.396	-0.009	1.575	0.027	2.713	0.140	2.054
31	-0.040	1.688	0.463	3.024	-0.043	2.671	0.273	3.627
32	-0.040	1.600	0.615	3.437	-0.036	2.595	0.524	4.533
33	-0.049	1.516	0.724	6.094	-0.053	2.161	0.338	4.292
34	-0.057	1.701	0.474	3.222	0.017	2.164	1.504	12.614
35	0.002	1.905	0.400	2.795	0.103	2.378	-0.146	2.299
36	-0.004	1.788	0.131	2.123	0.060	2.002	-0.149	2.618

TABLE 3:

Summary statistics for monthly macroeconomic mean variables.

Name	Code	Mean	Std Dev	Skewness	Kurtosis
Industrial Production	IP	-0.516	6.818	-1.702	6.545
Three-month short term interest rate	SHIBOR	1.234	10.890	1.601	3.405
Industrial Product Price Index	IPP	0.806	3.803	0.747	-1.160
Consumer Price Index	CPI	3.380	1.431	0.749	-0.662

TABLE 4a:

Parameter estimates for GARCH-MIDAS with IP in China market indices and A-shares

Code	μ	α_0	α_1	β	m	θ	ω
SSCI	0.509	0.164	0.185	0.378	6.021	0.071	15.815
SSHA	0.918	0.197	0.087	0.640	6.328	0.202	13.080
1	0.047	0.600	0.079	0.884	-0.565	-0.151	15.906
2	0.168	0.311	0.265	0.679	2.901	0.020	10.078
3	-0.019*	0.471	0.086	0.484	2.980	-0.122	8.703
4	-0.127	0.388	0.178	0.787	2.201	-0.075	13.933
5	0.093	0.123	0.084	0.901	2.616	0.055	20.563
6	-0.049*	0.754	0.042	0.870	-1.427	-0.134	15.883
7	0.082	0.617	0.094	0.879	-0.794	-0.195	15.598
8	-0.024*	0.417	0.183	0.741	3.093	0.118	15.852
9	0.148	0.247	0.096	0.624	3.362	0.001	16.660
10	0.118	0.422	0.098	0.474	3.258	0.022	14.059
11	0.024*	0.386	0.172	0.789	1.731	0.238	15.056
12	-0.082	0.367	0.207	0.390	3.350	-0.124	13.503
13	0.027*	0.428	0.210	0.429	1.763	-0.014	10.051
14	-0.016*	0.422	0.386	0.423	2.607	0.076	10.518
15	0.066	0.344	0.088	0.545	2.334	0.024	16.325
16	0.120	0.441	0.090	0.852	0.965	0.003	14.090
17	0.089	0.388	0.270	0.255	4.059	-0.013	20.126
18	-0.222	0.402	0.275	0.613	2.207	-0.154	11.102
19	0.227	0.221	0.161	0.553	3.459	0.061	15.984
20	0.037	0.376	0.127	0.486	2.453	0.209	13.254
21	-0.027	0.341	0.138	0.355	2.531	0.199	11.427
22	0.094	0.400	0.364	0.497	2.634	0.138	13.313
23	0.072	0.397	0.173	0.380	2.609	0.150	9.117
24	0.065	0.423	0.111	0.303	3.459	-0.141	11.749
25	0.192	0.192	0.221	0.753	3.393	0.331	20.220
26	0.035*	0.120	0.167	0.810	3.114	0.217	11.898
27	0.299	0.413	0.041	0.543	3.408	-0.022	14.026
28	0.080	0.444	0.336	0.494	1.410	0.060	12.944
29	0.275	0.236	0.089	0.900	0.637	0.240	12.871
30	0.261	0.701	0.036	0.950	-2.507	-0.060	15.988
31	0.114	0.376	0.112	0.497	3.355	0.030	16.407
32	0.107	0.445	0.149	0.447	3.499	0.021	14.195
33	0.155	0.487	0.479	0.353	3.235	0.040	19.783
34	0.070	0.260	0.062	0.406	3.521	-0.032	15.670
35	0.297	0.398	0.092	0.847	1.924	0.026	11.361
36	0.092	0.411	0.081	0.864	0.624	-0.055	14.160

TABLE 4b:

Parameter estimates for GARCH-MIDAS with IP in Hang Seng China Enterprices indices and H-shares

Code	μ	α_0	α_1	β	m	θ	ω
HSCE	0.709	0.485	0.045	0.949	-6.486	-0.487	20.120
1	1.215	0.222	0.121	0.579	6.185	-0.095	20.342
2	1.301	0.087	0.140	0.573	6.053	-0.122	18.848
3	0.681	0.713	0.031	0.965	-2.317	-0.018	22.913
4	0.301	0.187	0.404	0.458	6.178	-0.066	15.287
5	1.541	0.098	0.219	0.725	6.644	0.111	16.494
6	0.436	0.109	0.109	0.825	5.448	0.003	11.367
7	0.508	0.130	0.428	0.402	6.178	-0.138	21.012
8	0.111	0.196	0.158	0.745	6.254	-0.218	13.429
9	0.590	0.226	0.219	0.599	6.649	-0.189	12.678
10	0.801	0.212	0.096	0.722	5.562	-0.165	27.846
11	0.845	0.226	0.160	0.721	6.467	0.295	27.874
12	0.381	0.091	0.248	0.621	6.214	-0.237	9.299
13	0.762	0.681	0.028	0.967	-2.883	-0.053	12.396
14	0.773	0.086	0.086	0.791	4.838	-0.015	18.557
15	0.806	0.139	0.138	0.476	6.356	0.021	12.725
16	0.434	0.171	0.183	0.538	5.718	-0.093	28.653
17	0.079	0.068	0.104	0.858	7.433	0.043	18.317
18	0.873	0.151	0.356	0.532	6.673	-0.150	13.999
19	0.854	0.181	0.335	0.613	6.023	0.017	21.145
20	0.648	0.138	0.229	0.692	5.521	-0.103	14.916
21	0.574	0.100	0.097	0.820	2.815	-0.121	11.502
22	1.059	0.204	0.046	0.509	6.268	-0.148	18.218
23	0.164	0.610	0.058	0.934	-1.457	0.020	16.287
24	0.855	0.074	0.080	0.893	3.258	-0.041	11.801
25	0.956	0.091	0.174	0.797	5.093	0.052	17.779
26	0.550	0.129	0.152	0.795	5.258	-0.058	9.691
27	0.420	0.216	0.149	0.617	6.235	-0.093	19.490
28	0.693	0.042	0.134	0.755	6.251	-0.101	20.362
29	0.737	0.169	0.235	0.709	6.289	0.090	14.428
30	1.113	0.074	0.232	0.683	7.171	-0.077	11.605
31	0.782	0.131	0.115	0.338	6.249	-0.282	10.171
32	0.797	0.086	0.179	0.403	6.184	-0.301	19.780
33	0.837	0.181	0.209	0.625	6.345	-0.036	15.357
34	1.188	0.131	0.106	0.421	5.963	-0.044	13.685
35	0.727	0.192	0.231	0.585	6.219	0.040	16.165
36	0.738	0.159	0.307	0.401	6.367	-0.034	22.025

TABLE 5a:

Parameter estimates for GARCH-MIDAS with SHIBOR in China market indices and A-shares

Code	μ	α_0	α_1	β	m	θ	ω
SSCI	0.585	0.031	0.108	0.482	6.669	-0.005	19.052
SSHA	0.020	0.721	0.020	0.952	-5.405	0.019	22.103
1	-0.044	0.766	0.026	0.968	-4.459	-0.035	17.427
2	0.447	0.213	0.507	0.383	6.634	0.012	20.557
3	0.482	0.120	0.079	0.512	5.622	0.036	14.065
4	0.759	0.169	0.187	0.781	5.008	-0.014	14.252
5	0.467	0.090	0.085	0.724	6.237	0.055	8.709
6	0.726	0.187	0.161	0.528	5.774	0.028	17.409
7	0.509	0.671	0.062	0.936	-8.390	0.184	21.019
8	-0.024*	0.230	0.174	0.682	6.281	-0.056	13.015
9	0.750	0.095	0.107	0.465	6.180	0.013	16.320
10	0.889	0.248	0.154	0.307	6.352	-0.046	17.288
11	0.449	0.159	0.171	0.723	5.496	-0.019	23.080
12	-0.364	0.251	0.272	0.456	4.752	-0.011	12.203
13	-0.079	0.222	0.132	0.395	5.741	-0.007	11.321
14	0.842	0.196	0.444	0.314	6.422	-0.017	18.625
15	0.140	0.219	0.085	0.347	6.477	0.022	13.011
16	0.488	0.220	0.078	0.465	6.306	-0.063	23.719
17	1.112	0.209	0.139	0.523	6.097	0.013	10.854
18	-0.001*	0.164	0.473	0.365	6.651	0.026	16.957
19	0.677	0.252	0.114	0.777	4.598	-0.046	12.713
20	0.475	0.746	0.046	0.864	-1.931	-0.021	13.467
21	0.466	0.207	0.179	0.329	6.107	-0.058	18.414
22	0.043	0.263	0.556	0.283	6.031	-0.056	18.436
23	0.378	0.202	0.204	0.225	5.488	-0.051	8.079
24	0.246	0.111	0.101	0.797	3.899	-0.032	13.384
25	1.002	0.110	0.117	0.810	5.504	0.010	14.053
26	0.879	0.198	0.160	0.740	2.876	-0.021	13.722
27	0.791	0.216	0.132	0.338	6.099	-0.032	17.161
28	0.262	0.228	0.269	0.515	3.124	-0.054	11.964
29	1.091	0.061	0.198	0.704	6.933	-0.037	9.209
30	0.702	0.131	0.121	0.583	6.166	0.005	8.369
31	0.663	0.240	0.243	0.441	6.492	-0.040	20.090
32	0.800	0.229	0.206	0.344	7.395	-0.027	21.644
33	1.015	0.206	0.542	0.323	6.780	-0.013	8.647
34	0.773	0.195	0.183	0.451	6.503	-0.017	13.919
35	0.700	0.791	0.037	0.947	-1.701	-0.062	16.857
36	0.315	0.716	0.038	0.949	-2.729	-0.047	15.448

TABLE 5b:

Parameter estimates for GARCH-MIDAS with SHIBOR in Hang Seng China Enterprices indices and H-shares

Code	μ	α_0	α_1	β	m	θ	ω
HSCE	0.637	0.218	0.029	0.969	-5.810	0.155	11.241
1	1.161	0.560	0.029	0.967	-2.760	0.027	15.991
2	0.386	0.122	0.138	0.777	5.535	0.035	10.150
3	0.504	0.026	0.109	0.822	6.605	0.030	11.155
4	0.575	0.182	0.310	0.629	6.336	0.008	17.628
5	1.128	0.188	0.194	0.645	6.563	0.066	14.114
6	0.149	0.813	0.074	0.921	-9.584	0.283	12.879
7	0.198	0.212	0.332	0.511	6.995	0.029	15.160
8	0.737	0.043	0.148	0.808	8.272	-0.126	12.242
9	0.798	0.161	0.198	0.633	6.869	0.054	12.128
10	0.918	0.581	0.024	0.974	-3.327	0.013	20.644
11	0.428	0.249	0.153	0.784	3.243	0.022	20.028
12	0.365	0.047	0.083	0.874	6.528	-0.007	12.696
13	0.380	0.079	0.188	0.772	4.783	0.045	12.872
14	1.582	0.268	0.036	0.622	5.333	0.046	13.061
15	0.627	0.561	0.018	0.965	-3.263	0.053	15.879
16	1.449	0.074	0.119	0.861	6.569	-0.093	16.989
17	0.875	0.031	0.095	0.813	6.654	0.037	11.291
18	0.243	0.179	0.131	0.849	6.559	0.015	19.406
19	0.708	0.663	0.030	0.966	-2.538	-0.010	11.539
20	0.593	0.741	0.051	0.943	-4.170	0.043	12.662
21	0.856	0.778	0.027	0.971	-5.667	0.049	16.240
22	0.857	0.064	0.042	0.947	1.789	-0.014	20.629
23	0.527	0.648	0.026	0.971	-4.114	0.043	18.479
24	0.412	0.051	0.270	0.682	6.684	0.031	16.961
25	1.084	0.116	0.121	0.826	4.986	0.023	19.072
26	0.795	0.678	0.030	0.967	-4.331	0.086	13.326
27	1.350	0.231	0.284	0.490	6.904	0.013	8.567
28	0.544	0.036	0.098	0.826	7.638	-0.034	24.973
29	0.443	0.231	0.194	0.788	4.733	-0.037	28.331
30	0.663	0.057	0.083	0.909	6.511	-0.007	17.222
31	0.601	0.668	0.038	0.958	-2.871	0.061	12.887
32	1.417	0.057	0.109	0.830	6.998	0.003	16.755
33	-0.077	0.154	0.346	0.603	6.998	-0.003	9.186
34	0.827	0.264	0.336	0.401	6.781	0.073	16.957
35	0.858	0.219	0.156	0.590	4.937	-0.021	21.047
36	0.886	0.242	0.302	0.293	6.287	0.063	22.078

TABLE 6a:

Parameter estimates for GARCH-MIDAS with IPP in China market indices and A-shares

Code	μ	α_0	α_1	β	m	θ	ω
SSCI	0.644	0.216	0.111	0.520	3.938	0.031	14.203
SSHA	0.343	0.174	0.061	0.562	5.631	0.027	25.898
1	0.385	0.041	0.152	0.459	5.962	0.052	10.411
2	0.591	0.232	0.350	0.464	6.984	-0.020	16.148
3	0.220	0.247	0.199	0.453	5.840	0.055	10.056
4	0.626	0.200	0.344	0.397	6.833	0.028	12.044
5	0.877	0.741	0.022	0.973	-2.930	0.017	13.630
6	-0.005^	0.185	0.085	0.529	5.978	0.043	19.223
7	0.107^	0.635	0.053	0.935	-2.289	-0.009	17.338
8	0.432	0.260	0.247	0.713	6.341	-0.051	16.582
9	0.663	0.273	0.096	0.628	3.363	0.011	8.548
10	0.432	0.202	0.163	0.444	6.398	-0.006	15.957
11	0.205^	0.725	0.059	0.931	-3.536	-0.136	14.399
12	1.124	0.201	0.426	0.333	6.798	0.035	9.676
13	0.466	0.177	0.193	0.415	5.591	-0.003	32.109
14	0.521	0.228	0.441	0.292	5.927	-0.034	16.978
15	0.380	0.110	0.121	0.629	5.717	-0.023	19.376
16	0.522	0.111	0.081	0.817	5.976	-0.029	9.659
17	0.355	0.192	0.315	0.262	6.258	0.000	10.094
18	0.121^	0.147	0.275	0.349	6.355	0.056	9.110
19	0.722	0.230	0.229	0.617	6.343	-0.045	14.085
20	0.328	0.180	0.103	0.362	4.974	-0.072	9.952
21	0.063^	0.195	0.068	0.227	5.396	-0.080	24.934
22	-0.238	0.248	0.291	0.584	4.510	-0.058	22.679
23	-0.088^	0.216	0.433	0.192	5.336	-0.059	10.414
24	0.764	0.201	0.067	0.414	6.073	0.053	19.912
25	0.347	0.147	0.177	0.750	5.570	-0.111	13.052
26	0.899	0.115	0.322	0.605	6.380	-0.057	15.989
27	0.953	0.785	0.017	0.952	-1.930	-0.014	7.939
28	0.207	0.173	0.489	0.319	4.995	-0.009	16.776
29	0.851	0.487	0.040	0.957	-2.265	-0.200	12.406
30	1.066	0.155	0.052	0.662	5.527	0.035	14.404
31	0.488	0.191	0.108	0.486	6.007	-0.011	17.032
32	0.804	0.164	0.090	0.308	6.043	0.005	14.893
33	0.370	0.254	0.322	0.558	6.248	-0.015	21.906
34	0.441	0.517	0.057	0.557	1.564	0.027	16.311
35	1.126	0.128	0.104	0.777	6.634	-0.028	11.497
36	0.581	0.157	0.059	0.816	4.244	0.011	12.537

Note: ^ represents insignificant at 5%.

TABLE 6b:

Parameter estimates for GARCH-MIDAS with IPP in Hang Seng China Enterprices indices and H-shares

Code	μ	α_0	α_1	β	m	θ	ω
HSCE	0.699	0.286	0.019	0.976	-3.354	0.060	21.935
1	0.519	0.212	0.470	0.337	6.761	0.080	19.793
2	0.169	0.228	0.105	0.703	5.211	0.106	10.809
3	0.156	0.102	0.073	0.888	5.035	0.075	12.557
4	0.493	0.128	0.461	0.456	7.405	0.080	13.683
5	1.116	0.112	0.164	0.677	6.199	0.060	19.389
6	0.449	0.066	0.251	0.698	7.022	0.029	18.524
7	1.035	0.152	0.257	0.514	6.118	0.089	16.574
8	0.571	0.247	0.319	0.380	7.062	0.143	18.159
9	0.660	0.215	0.262	0.631	6.675	0.117	6.841
10	1.180	0.814	0.038	0.951	-0.923	0.041	13.611
11	0.497	0.206	0.100	0.843	5.921	-0.114	13.405
12	0.647	0.031	0.193	0.748	6.560	0.133	12.572
13	0.855	0.411	0.088	0.852	0.198	0.046	29.454
14	0.302	0.754	0.035	0.955	-2.453	-0.087	13.410
15	0.789	0.215	0.134	0.494	6.179	0.038	19.798
16	1.166	0.144	0.077	0.372	6.460	0.060	9.971
17	0.222	0.054	0.103	0.835	6.861	0.032	6.854
18	0.555	0.142	0.240	0.707	6.477	0.100	27.982
19	1.183	0.219	0.305	0.596	6.360	0.022	21.267
20	0.453	0.202	0.160	0.753	6.223	0.088	17.745
21	0.985	0.198	0.127	0.641	2.743	0.084	10.766
22	0.642	0.183	0.111	0.540	5.641	0.127	12.572
23	0.885	0.840	0.077	0.916	-11.564	0.944	27.964
24	0.816	0.128	0.065	0.308	5.738	0.126	18.409
25	0.770	0.095	0.281	0.577	6.181	0.050	8.711
26	0.906	0.132	0.137	0.751	6.056	0.080	11.166
27	0.541	0.249	0.167	0.543	6.310	0.085	20.622
28	0.204	0.769	0.032	0.959	-4.381	0.093	16.507
29	0.964	0.191	0.318	0.624	5.998	-0.003	8.706
30	0.639	0.216	0.089	0.827	3.988	0.112	14.067
31	1.119	0.218	0.443	0.462	7.074	0.124	10.480
32	0.641	0.221	0.284	0.605	6.906	0.133	13.771
33	0.654	0.126	0.196	0.709	6.581	0.051	16.580
34	0.603	0.210	0.114	0.376	6.150	0.048	14.883
35	0.663	0.106	0.116	0.677	6.054	0.004	20.131
36	1.156	0.241	0.489	0.193	6.825	0.042	13.869

TABLE 7a:

Parameter estimates for GARCH-MIDAS with CPI in China market indices and A-shares

Code	μ	α_0	α_1	β	m	θ	ω
SSCI	0.359	0.163	0.121	0.595	5.624	-0.583	11.388
SSHA	0.659	0.209	0.120	0.766	8.214	-2.348	14.327
1	0.016*	0.588	0.081	0.906	-15.568	2.437	17.892
2	0.027*	0.190	0.210	0.775	9.504	-2.025	14.766
3	0.808	0.245	0.084	0.787	4.306	-0.653	17.803
4	0.196	0.079	0.150	0.841	10.498	-2.509	20.577
5	0.395	0.091	0.057	0.936	4.346	-0.826	16.075
6	0.104	0.790	0.064	0.902	-27.441	4.312	18.988
7	-0.112	0.803	0.160	0.829	-39.260	6.040	14.861
8	1.100	0.156	0.252	0.705	13.255	-2.572	20.027
9	0.531	0.844	0.084	0.900	-25.635	3.897	8.883
10	0.085	0.256	0.189	0.611	8.225	-0.751	17.890
11	0.225	0.195	0.124	0.864	12.772	-3.674	13.034
12	0.159	0.250	0.216	0.715	9.314	-2.485	18.020
13	0.109	0.765	0.128	0.776	-13.390	2.149	19.755
14	0.611	0.258	0.330	0.541	13.145	-2.563	12.630
15	0.642	0.188	0.130	0.754	11.678	-2.925	14.101
16	0.677	0.184	0.120	0.858	12.095	-3.030	11.928
17	0.386	0.233	0.226	0.260	7.237	-0.239	13.284
18	0.206	0.788	0.188	0.765	-1.024	0.237	20.586
19	0.487	0.243	0.169	0.813	13.391	-2.862	10.390
20	0.471	0.145	0.170	0.646	10.064	-2.440	12.901
21	0.433	0.209	0.096	0.441	7.443	-0.603	20.229
22	0.125	0.230	0.239	0.693	9.659	-1.819	12.290
23	0.095	0.223	0.233	0.224	6.737	-0.438	8.541
24	0.355	0.183	0.091	0.329	6.332	-0.107	22.131
25	0.782	0.236	0.160	0.833	9.890	-2.865	25.029
26	0.626	0.147	0.160	0.829	11.732	-3.293	20.660
27	0.770	0.222	0.091	0.631	10.649	-1.966	15.494
28	0.359	0.189	0.414	0.418	6.533	-0.487	18.237
29	0.709	0.074	0.133	0.863	11.533	-3.220	14.313
30	0.906	0.251	0.123	0.792	9.428	-2.773	15.905
31	0.601	0.231	0.141	0.652	10.955	-2.101	7.720
32	0.341	0.198	0.197	0.626	11.150	-3.018	11.237
33	0.545	0.210	0.419	0.513	10.425	-1.744	11.860
34	0.930	0.256	0.145	0.480	6.169	-0.212	12.487
35	0.656	0.354	0.079	0.736	1.872	-0.039	12.971
36	0.754	0.739	0.033	0.947	-2.640	0.181	14.871

TABLE 7b:

Parameter estimates for GARCH-MIDAS with CPI in Hang Seng China Enterprices indices and H-shares

Code	μ	α_0	α_1	β	m	θ	ω
HSCE	0.526	0.268	0.083	0.912	-40.184	6.616	9.591
1	0.843	0.225	0.130	0.832	6.561	-1.016	10.775
2	0.772	0.150	0.070	0.916	4.144	-0.599	9.012
3	0.617	0.072	0.070	0.926	9.656	-2.839	19.010
4	1.174	0.091	0.176	0.801	10.894	-2.199	16.755
5	1.223	0.780	0.040	0.949	-2.540	0.308	18.985
6	0.446	0.759	0.111	0.883	-21.156	3.574	9.391
7	0.903	0.238	0.296	0.664	10.216	-1.959	12.594
8	0.590	0.231	0.175	0.742	3.542	0.261	13.182
9	1.136	0.198	0.150	0.825	6.663	-1.205	14.960
10	0.692	0.808	0.098	0.893	-32.478	5.234	11.380
11	0.362	0.213	0.153	0.826	13.100	-3.430	17.904
12	0.611	0.678	0.112	0.882	-36.775	5.963	12.219
13	0.460	0.093	0.064	0.920	3.750	-0.759	7.430
14	0.317	0.225	0.109	0.881	11.385	-3.837	11.393
15	1.272	0.102	0.042	0.928	2.956	-0.372	17.896
16	0.941	0.724	0.036	0.946	-1.280	0.163	10.348
17	0.360	0.129	0.080	0.917	9.124	-2.722	13.243
18	0.819	0.144	0.212	0.763	9.587	-1.975	12.492
19	0.812	0.804	0.054	0.936	-0.909	0.070	17.113
20	0.461	0.748	0.064	0.912	-3.947	0.487	15.276
21	0.637	0.610	0.113	0.879	-33.425	5.553	10.342
22	0.448	0.674	0.120	0.861	-36.238	6.186	8.998
23	0.410	0.774	0.107	0.887	-43.369	7.136	14.762
24	1.100	0.600	0.028	0.960	-2.555	0.332	10.410
25	0.114	0.714	0.049	0.933	-1.736	0.177	12.835
26	0.357	0.604	0.064	0.927	-1.348	0.154	13.322
27	0.588	0.869	0.093	0.872	-2.738	0.465	10.674
28	0.796	0.071	0.084	0.908	6.770	-1.764	18.252
29	1.075	0.859	0.068	0.922	-1.677	0.162	17.224
30	0.436	0.705	0.097	0.898	-33.239	5.402	16.806
31	0.647	0.119	0.106	0.876	6.489	-1.434	10.632
32	0.449	0.721	0.125	0.859	-29.086	4.800	20.983
33	0.227	0.219	0.185	0.790	12.326	-3.324	10.218
34	1.150	0.231	0.103	0.706	9.964	-1.798	8.746
35	1.582	0.154	0.178	0.790	12.989	-3.097	8.231
36	1.256	0.125	0.288	0.570	10.837	-1.773	14.970

TABLE 8:

Test statistics and corresponding p-values for the parameter θ in GARCH-MIDAS

Variable	Test statistics	p-value
Panel A: Test on A-shares		
IP	1.288	0.103
SHIBOR	-1.739*	0.045
IPP	-1.925*	0.031
CPI	-2.533*	0.008
Panel B: Test on H-shares shares		
IP	-3.328*	0.001
SHIBOR	2.420*	0.010
IPP	3.394*	0.001
CPI	0.555	0.291
Panel C: Test on paired difference with A-shares minus H-shares		
IP	3.866*	0.000
SHIBOR	-3.599*	0.000
IPP	-3.928*	0.000
CPI	-1.871*	0.035

Note: * significance at 5%

FIGURE 1:

Time series plot of Shanghai Stock Exchange Composite Index (SSCI), Shanghai A-share Index (SSHA) and Hang Seng China Enterprises Index (HSCE). The returns of these series are shown in the right panel.

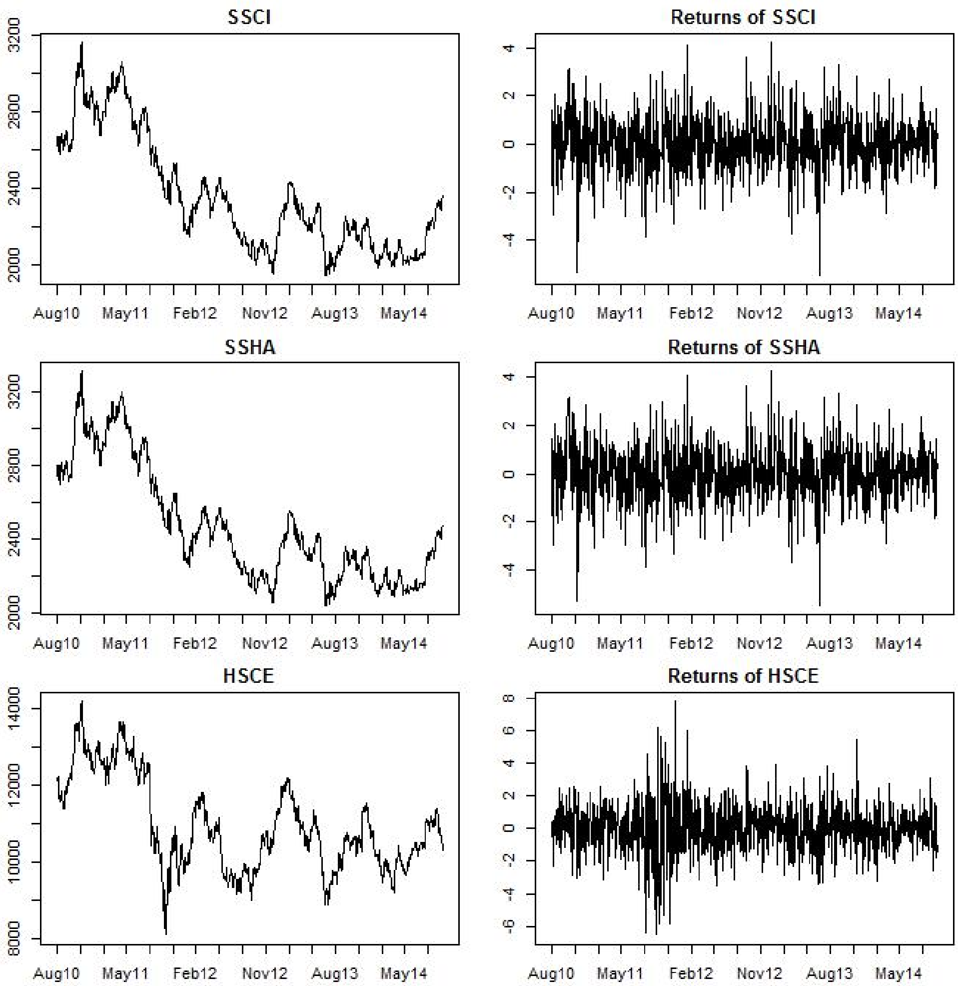


FIGURE 2:

Time series plot of the four macroeconomic variables, industrial production (IP), three-month short-term SHIBOR (SHIBOR), industrial product price index (IPP) and Consumer Price Index (CPI)

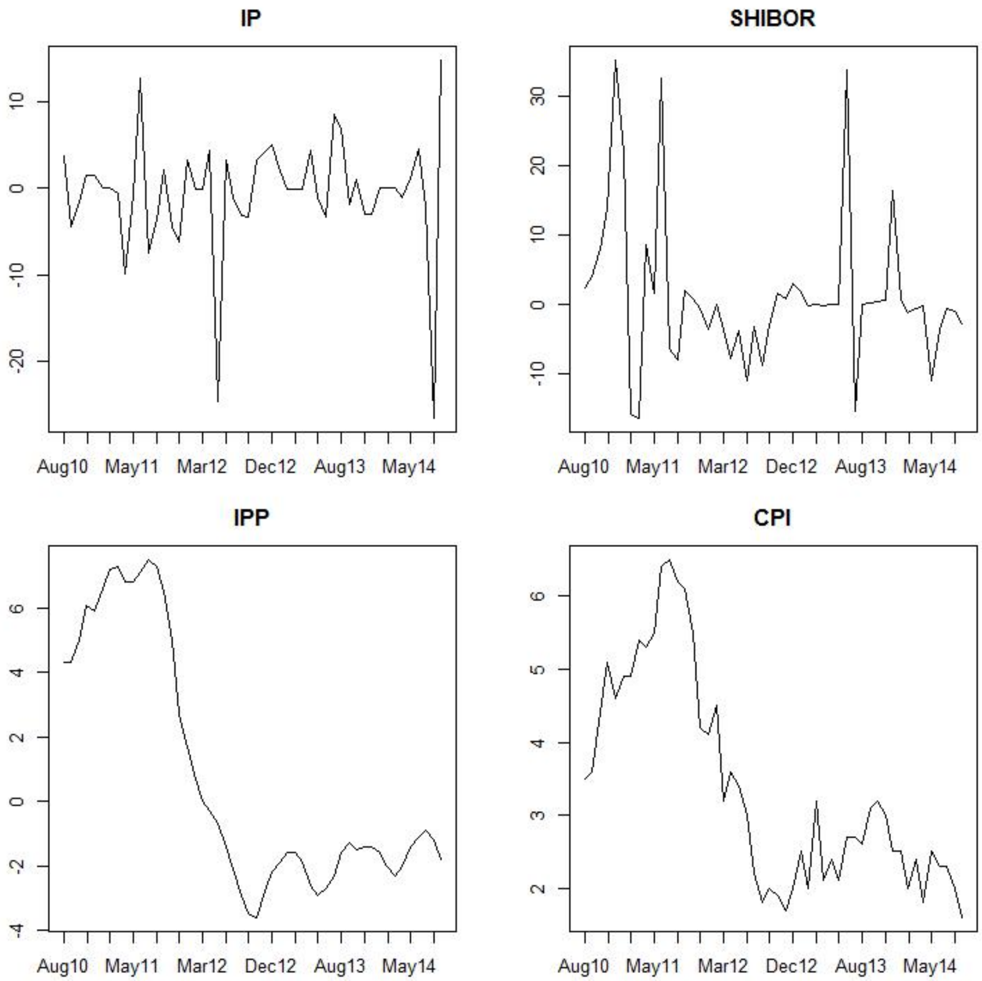


FIGURE 3:

Time-varying conditional volatility of stock market returns estimated by GARCH-MIDAS model with industrial production and 3-month short term SHIBOR macroeconomic fundamentals

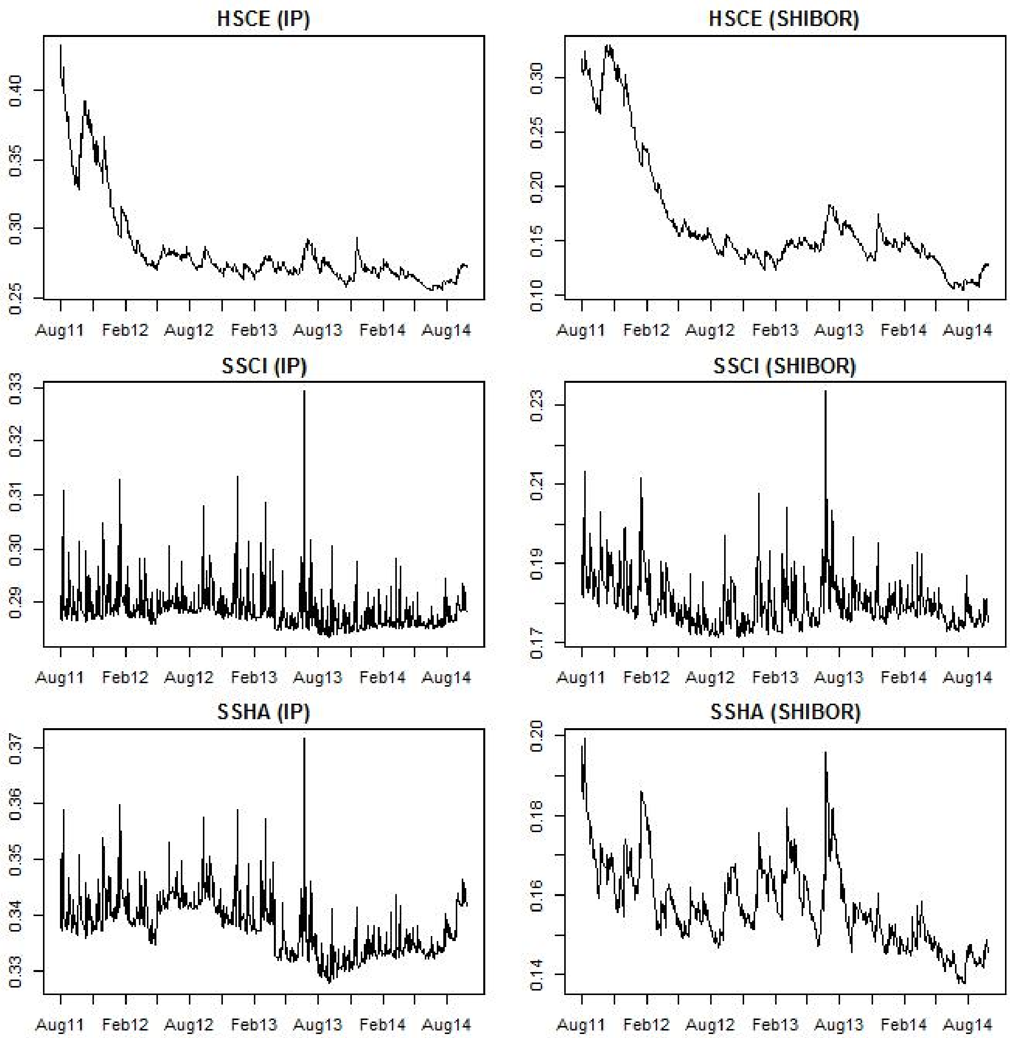
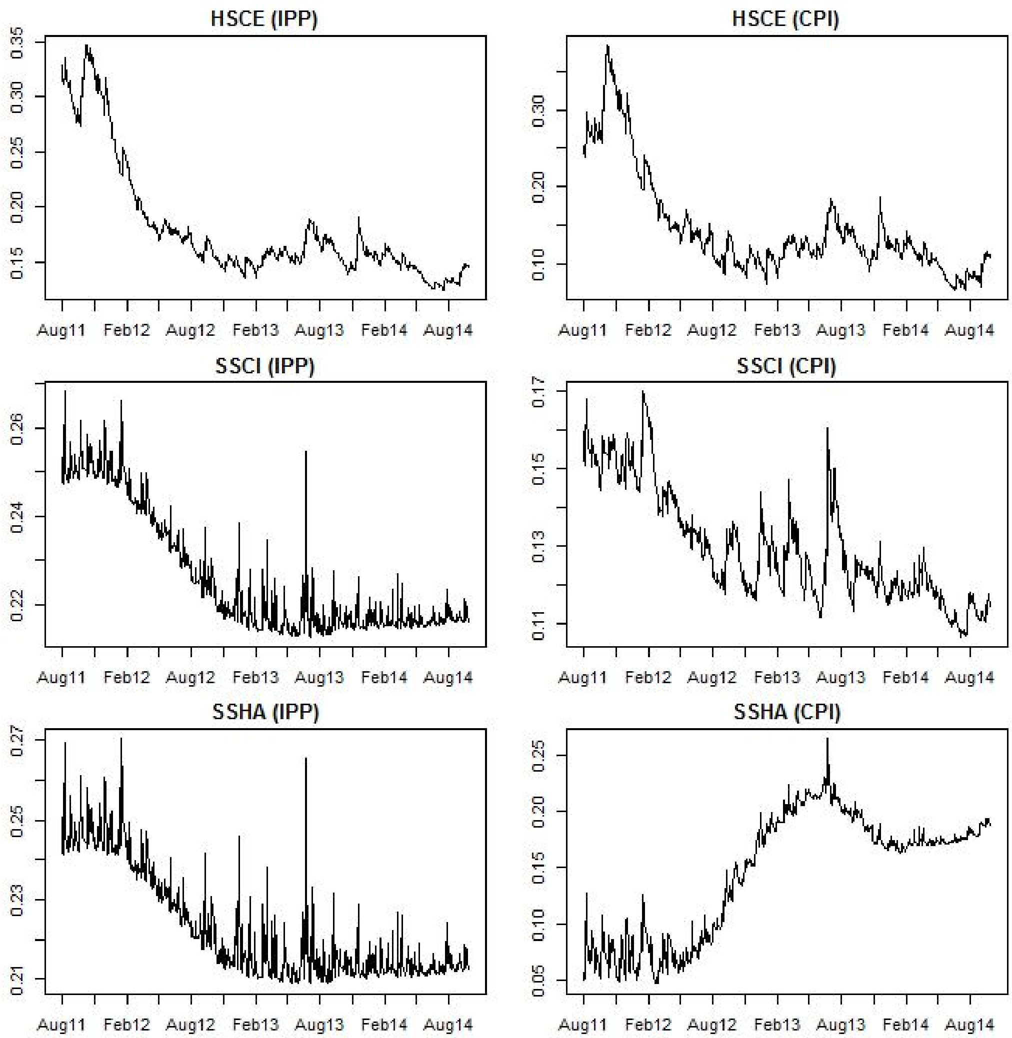


FIGURE 4:

Time-varying conditional volatility of stock market returns estimated by GARCH-MIDAS model with industrial product price index and consumer price index macroeconomic fundamentals



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A Simple Model on Hong Kong's Price Level

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Based on the theory of law of one price and Quantity Theory of money, a simple regression model on the price level of Hong Kong has been created. It is found, during the period 1998Q2-2014Q4, the price level of mainland China, the exchange rate between Hong Kong dollar and Chinese yuan, the amount of Hong Kong money supply per real output, and the unemployment rate of Hong Kong are significant factors in determining the price level of Hong Kong.

1. Introduction

Inflation is always a concern of both residents and government in whatever countries, because of its welfare implications, like redistribution of wealth under anticipated and unanticipated inflation. (Alchian, pp.363-411). However, the problem of inflation becomes less serious after the 2008 financial crisis because many industrialized countries had recorded a fall, rather than a rise, in their price levels. To deal with the stagnant economies, many countries, led by the US, had been expanding their money supply (quantitative easing). However, the rise in money supply seemed ineffective to boost their weak economies much during the initial years. But those increased money stock had been flowing to Asian countries and emerging markets, and had led to rises in the general price and asset prices in latter economies. Hong Kong is one of those Asian economies affected by these capital inflows. In fact, over US$640 billion of foreign capital had come to Hong Kong during 2008 to 2010. (The 2010-11 Budget, pp.8-9)

Through out the five years after 2009, Hong Kong's inflation (measured by consumer price index) has been rising from -0.1% in the second quarter of 2009 to nearly 5% in the last quarter of 2014 (year on year growth rate), see Figure 1.

But unlike many other countries / economies that fiscal and monetary tools can be used to deal with inflation, under the current "currency board system" (also called "linked exchange rate system") adopted since 1983, Hong Kong is deprived of the use of independent monetary policy to tackle inflation. The currency board arrangement requires HK dollar to be pegged to US dollar at a rate around HK$7.8 to US$1 (with fluctuations allowed within the range of HK$7.85 to HK$7.75 per US$1, after refinements in recent years). And the money supply change of Hong Kong is determined by Hong Kong's external balances. When more hot money flows to Hong Kong, Hong Kong's money supply would increase according, and would lead to a rise in price level according to the Quantity Theory of Money.

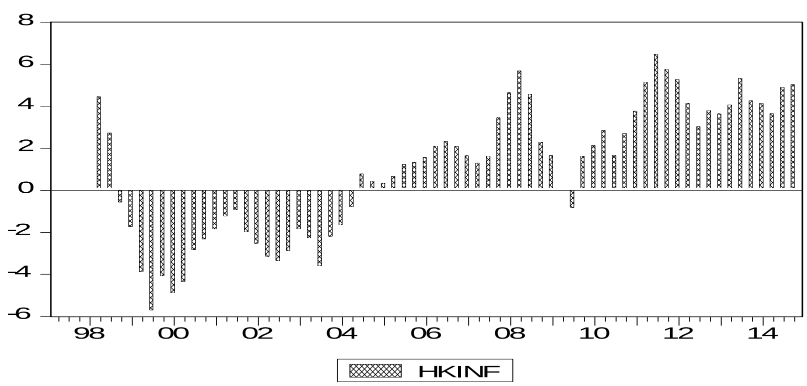

Figure 1: Hong Kong inflation (1998Q2-2014Q4)

Table 1 Correlation coefficients between Hong Kong and mainland China, 1979-2002

	1979-2002	1991-2002
Output growth correlation		
(a) in local currency	0.18	0.42
(b) PPP-based	0.42	0.53
Real per capita Consumption growth rate	0.10	0.37

Apart from the monetary aspect that affects Hong Kong's price level, the price level of Hong Kong is also related to the price level of its trading partners (e.g. mainland China). The higher the price differential between Hong Kong and its trading partners, the greater the volume of arbitrage activities. Due to the geographical proximity between Hong Kong and mainland China, the two places are highly connected. For instance, Cheung, Chinn and Fujii (2007) indicated that a high degree of integration existed between the two economies was reflected by the rise in correlation coefficients of output growth rate and real per capita consumption growth rate, during 1979-2002, between the two economies, see Table 1.

Besides, the close linkage between Hong Kong and mainland can be reflected by trading activities between the two places. Mainland China has long been been the largest single trading partner of Hong Kong (e.g. Table 2).

Table 2 Merchandise trade of Hong Kong with Mainland China (HK$ million)

Type of trade	2003	2008	2009	2010	2011	2012	2013
Imports (supplier) from Mainland China	785625 (43.5%)	1410735 (46.6%)	1249374 (46.4%)	1529751 (45.5%)	1696807 (45.1%)	1840862 (47.1%)	1942131 (47.8%)
Domestic exports to Mainland China	36757 (30.2%)	34758 (38.3%)	26672 (39.3%)	31223 (44.9%)	30699 (46.8%)	26026 (44.2%)	24784 (45.6%)
Re-exports to Mainland China	705787 (43.5%)	1335687 (48.9%)	1236577 (51.3%)	1566999 (52.9%)	1716656 (52.5%)	1831732 (54.3%)	1924463 (54.9%)
Re-exports from Mainland China	967104 (59.7%)	1707696 (62.3%)	1503319 (62.3%)	1820964 (61.5%)	2015046 (61.6%)	2104417 (62.3%)	2159878 (61.6%)

Source: Hong Kong Annual Digest of Statistics 2014. Figures inside parenthesis are percentage to Total Imports, Total Domestic exports, Total Re-exports to, and Total Re-exports from Mainland China respectively.

2. Previous Literature on Hong Kong's price level and inflation

Far before the 2008 financial crisis, researches had been done on the price level and inflation of Hong Kong. For example, Ha and Leung (2001) explained the inflation of Hong Kong, during 1977-2000, by analyzing the output gap and import price changes. Their results showed that a positive output gap of 1 percentage point would raise inflation by ½ percentage point in the short run, and 2½ percentage point in the long run. However, a rise in the domestic price of imports by 1 percent would push inflation up by ¼ percentage points in the short run, and will have full pass-through effect in the long run.

On the other hand, Ha and Fan (2002) investigated the inflation of Hong Kong by looking at the degree of price convergence between Hong Kong and mainland China. They found statistical evidence of price convergence between HK and mainland cities. The average half-life of the price differentials was estimated to be 6½ years. But they had indicated also that the convergence pace may differ significantly across the spectrum of products. The study of Hans, Liu and Jin (2006) focused on HK's integration and business cycle synchronization with mainland and also the US. They constructed a structural vector auto-regression model and found that shocks from US could explain about 45% of the variation in prices in HK, but mainland shocks could explain about 1/3 of HK's price movement.

As Hong Kong imported large amount of goods from other countries, Liu and Tsang (2008) estimated the effect of exchange rate pass-through to Hong Kong's inflation. Empirically, they found that a 10% depreciation of the US dollar against all currencies except for the Hong Kong dollar would raise HK domestic prices by 0.82 and 1.61 percent in the short run and medium run. Thus, the impact of exchange rate change should not be ignored.

Although price convergence between Hong Kong and the US is implied theoretically under the currency board system, Manopimoke (2012), analyzed with a New Keynesian Phillips Curve, found little evidences on the price convergence between Hong Kong and US in the long-run. However, the output gaps of US and of China have opposite effects on the cycle component of HK inflation, with the coefficient of the China output gap twice as large as that of the US. Hence, the proximity of Hong Kong with mainland China may be a relevant factor to consider.

In sum, output gap, price convergence, exchange rate pass-through, economic shocks and business cycle synchronization have been studied separately in the determination of Hong Kong's price level and inflation rate in previous studies.

In this study, we are going to construct a simple model with the consideration of monetary changes as well as price convergence between Hong Kong and mainland China.

3. Model

Inflation is normally described as a monetary phenomenon where a continuous rise is found in the general price level. The two common measurements for general price level are CPI and GDP deflator. In this study, we measure inflation by the change in CPI. A rise in CPI means a rise in the price of a consumer basket of goods and services, thus inflation.

Since those goods in the consumer basket include goods produced domestically and goods imported from other places. The rise in CPI may be the result of rise in either type of goods.

As mentioned above, HK relies heavily on imports (e.g. water, food and basic necessities) from mainland China, so the price level of mainland will affect the price of goods imported to Hong Kong.

Let the price of Chinese products be Pc. If Pc is measured in US$, it is

$$Pc * US\$/CHN$$

where US$ is US dollar; and CHN is Chinese yuan.

The price of Hong Kong products (and services), Phk, if expressed in US$ is:

$$Phk * US\$/HK\$$$

If the law of one price holds and if a non-arbitrage equilibrium on tradable goods between Hong Kong and mainland China exists, then

$$Pc*(US\$/CHN) - Phk*(US\$/HK\$) = \text{transportation cost}$$

However, if transportation cost is considered to be small due to the close proximity between the two economies, the above relationship can be simplified to:

$$Pc* (US\$/CHN) = Phk*(US\$/HK\$)$$

Rearrange the terms gives

$$Phk = Pc* (US\$/CHN) * (HK\$/US\$) \qquad (1)$$

or

$$Phk = Pc* (HK\$/CHN) \qquad (2)$$

Therefore, the price level (of tradable goods) of Hong Kong is related to the price level of mainland, given the existence of good arbitrage.

On the other hand, as mentioned above, CPI can rise when the price of domestic products increases. According to a simple production function, the potential domestic output of an economy is determined by the factor endowment as well as technological level. But if unemployment exists in an economy, and if that unemployment is not of the frictional and structural types, unemployment would acts as a constraint on inflation. In the traditional Phillips Curve analysis, a rise in inflation is normally accompanied by a fall in unemployment rate. The negative relationship between HK inflation (HKINF) and unemployment rate (HKUR), seems existed in Hong Kong during 1998-2014, is shown in Figures 2 and 3.

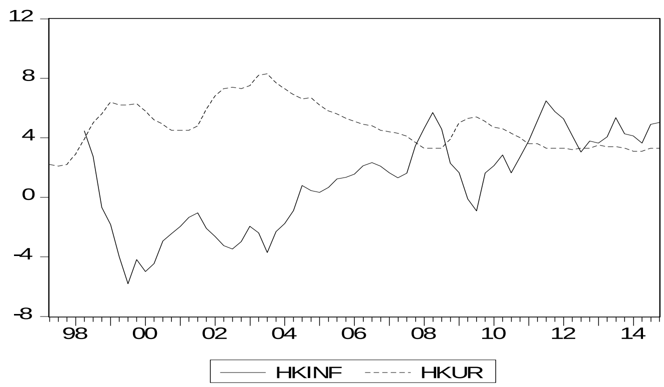

Figure 2 Line-graph of Inflation and Unemployment rates of Hong Kong (1998Q2-2014Q4)

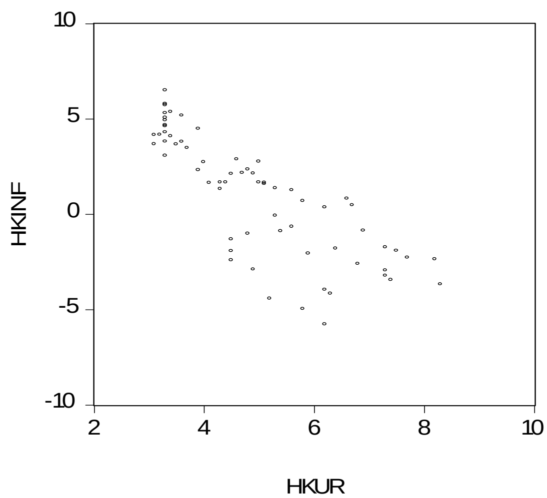

Figure 3 Scatters of Inflation and Unemployment rates of Hong Kong (1998Q2-2014Q4)

Equation (1) above tells us that Hong Kong's price level (of tradable goods) is related to that of mainland China. But according to Milton Friedman (1994, p.193), long-term price movements should be related to changes in the money stock. Base on Quantity theory of money, we have

$$MV = Py$$

where M is money supply; V is the velocity of money in circulation; P is general price level; and y is real output.

Rearranging the terms gives

$$P = (M/y)V \qquad (3)$$

where M/y is money per unit of real output and sometimes it described as "excess liquidity". (Chung, p.57) If V remains unchanged, a change in M/y will lead to a proportionate change in P.

Regression Equation

Combining the ideas that Hong Kong's price level is related to mainland's price level and also affected by excess liquidity, a regression model on Hong Kong price level is established as follow:

$$Phk = \beta 0 + \beta 1\ Pc + \beta 2\ EXHKCHN + \beta 3\ EXLIQM2 + \beta 4\ HKUR + \mu \qquad (4)$$

where Phk is the price level of HK; Pc price level of mainland; EXHKCHN is HK$/CHN exchange rate; EXLIQM2 is excess liquidity (calculated as M/y, and we use M2 to represent M); HKUR is unemployment rate of Hong Kong that acts as a constraint on the rise in price level; and μ is the error term. The values of β1, β2 and β3 are expected to be positive, but that of β4 is negative.

Data

Data on mainland China and Hong Kong is obtained from Datastream, Hong Kong Census and Statistics Department, and Hong Kong Monetary Authority. For comparison sake, CPIs

Table 3 Results of Unit Root Test (Sample: 1998Q2-2014Q4)

Variable	ADF statistics	1% critical value	5% critical value
China CPI (1997Q2=100)	0.217896 (0, 0, 5)	-2.5983	-1.9454
ΔChina CPI	-6.446872 (0, 0, 3)**	-2.5978	-1.9453
HK CPI (1997Q2=100)	-1.326116 (C, T, 5)	-4.1035	-3.4790
Δ HK CPI	-4.116711 (C, 0, 1)**	-3.5281	-2.9042
HK$ /CHN	-1.779572 (C, T, 1)	-4.0928	-3.4739
Δ HK$ /CHN	-2.929498 (0, 0, 1)**	-2.5968	-1.9452
HKM2	0.356799 (C, T, 3)	-4.0990	-3.4769
Δ HKM2	-3.575467 (C, T, 4)*	-4.1035	-3.4790
HK real GDP (s.a.)	-0.004345 (C, 0, 2)	-3.5281	-2.9042
Δ HK real GDP (s.a.)	-9.357585 (0, 0, 1)**	-2.5973	-1.9452
ExliqM2	1.498584 (C, 0, 4)	-3.5312	-2.9055
Δ ExliqM2	-9.259731(0, 0, 1)**	-2.5973	-1.9452
HKUR	-0.881460 (0, 0, 5)	-2.5983	-1.9454
Δ HKUR	-4.229264 (0, 0, 3)**	-2.5978	-1.9453

Note: **(*) indicates rejection of unit root at 1% (5%) critical value. Terms inside parenthesis represents the existence of an intercept (C), a trend (T) and lag differences. 0 indicates neither intercept nor trend.

of mainland China and of Hong Kong have been adjusted to 100 at 1997Q2. Since the Hong Kong GDP estimates exhibit seasonal patterns, they have been adjusted with X11 (additive) method. All variables in Equation (4), except HKUR, have taken logarithmic values.

Stationarity and Unit root test

To avoid spurious regression, the several series of variables have been tested for unit roots. The Augmented Dickey Fuller (ADF) test has been employed and the series of mainland CPI, Hong Kong CPI, US$/CHN exchange rate, HK$/US$ exchange rate, Hong Kong money supply M2, Hong Kong real GDP (seasonally adjusted), excess liquidity (M2 / real GDP), and Hong Kong unemployment rate are all found non-stationary. However, the first-differences of these series are stationary, and they are all I(1). For details, see Table 3.

Cointegration Test

Johansen cointegration test has been applied to series of Hong Kong CPI, mainland CPI, HK$/CHN exchange rate, excess liquidity M2, and HK unemployment rate, to see if they can be cointegrated. The result (Table 4) shows that are cointegrated and thus there are long-run relationship among them.

4. Regression Results

Since the variables are cointegrated, OLS can be been applied to estimate equation (4) and results are shown in the second column of Table 5.

Table 4 Result of Johansen Cointegration Test

Sample: 1997:2 2014:4

Series: LPHK LPC LEXHKCHN LEXLIQM2 HKUR

Lags interval: 1 to 4

Eigenvalue	Likehood Ratio	5% Critical Value	1% Critical Value	Hypothesized No. of CE(s)
0.526441	120.1202	68.52	76.07	None**
0.401678	70.78653	47.21	54.46	At most 1**
0.360265	36.88716	29.68	35.65	At most 2**
0.094765	7.404879	15.41	20.04	At most 3
0.012555	0.833875	3.76	6.65	At most 4

*(**) denotes rejection of the hypothesis at 5% (1%) significance level

L. R. test indicates 3 cointegrating equation(s) at 5% significance level.

Table 5 Regression Results

	Equation (4)	Equation (5)
C	10.33997	9.103443
	(8.986423)	(10.78687)
LPC	-1.354158	-1.061955
	(-5.789660)	(-6.153028)
LEXHKCHN	-0.011663	0.314156
	(-0.065371)	(2.326074)
LEXLIQM2	0.245147	0.220125
	(2.809740)	(2.396386)
HKUR	-0.031062	-0.032524
	(-7.761396)	(-11.25347)
Dummy		-0.090626
		(-7.878995)
R-squared	0.819423	0.907636
Adjusted R-squared	0.808479	0.900531
Durbin-Watson stat	0.228143	0.496489
F-statistic	74.87366	127.7471
	Prob (F-stat) 0.0000	Prob (F-stat) 0.0000

Note: numbers inside parenthesis are t-statistics.

The regression model basically fits the data well and the Adjusted R-squared is 0.8. It means around 80% of the variation in Hong Kong CPI can be explanatory variables. However, the sign of mainland CPI is different from what we have expected. Besides, the variable HK$/CHN is insignificant.

After checking with the data again, as China had undergone a reformation in its exchange rate system, CHN was no longer pegged to US$ at a fixed rate in 2005Q3. Therefore, a dummy variable is added to the regression equation to separate the stage before and after the reformation. The equation is modified to:

$$Phk = \beta 0 + \beta 1\ Pc + \beta 2\ EXHKCHN + \beta 3\ EXLIQM2 + \beta 4\ HKUR + \beta 5 DUMMY + \mu \qquad (5)$$

The regression results of Equation (5) are shown in the last column of Table 5. The Adjusted R-squared has increased to 0.9. The exchange rate HK$/CHN becomes significant. But the variable LPC is still of an unexpected sign. Further research has to be done to investigate this problem. The coefficient of LEXHKCHN indicates that a depreciation of HK$ by 1%, Hong Kong's price level will increase by 0.3%. The rise in excess liquidity by 1% will lead to a rise in Hong Kong CPI by 0.22%. If the unemployment rate falls, Hong Kong CPI will rise.

5. Conclusion

Based on the above regression model, we found that the exchange rate between HK$ and Chinese yuan, excess liquidity and the change in unemployment do affect the price level of Hong Kong. The results are basically consistent with the implications of Quantity theory of money. Although the price level of mainland China is a significant factor in determining the price level of Hong Kong, the price convergence may not be so apparent and further studies have to be done in that area.

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□ □ □ □ □ □ Service Quality and User Satisfaction of HK Government Services in Digital Economy

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This article discusses the determinants of service quality and user satisfaction of electronic government (e-government) services. Adopting the Technology Acceptance Model as the core component in the model development, this study introduces perceived security as a construct that may affect service quality and e-government services user satisfaction. Our data was collected from an online survey of 229 users of the e-government services in Hong Kong. The results showed relationships among perceived usefulness, perceived ease of use, perceived security, service quality and e-government services user satisfaction. Perceived security was the most significant antecedent of service quality which in turn heavily affected e-government services user satisfaction. In addition, assurance and reliability were found to be the most important aspects of service quality that affected the satisfaction level of users. We present implications for research and practice to e-government services.

Keywords: e-government, satisfaction, security, service, TAM (Technology Acceptance Model).

JEL Classifications: F31, F37, F47

1. Introduction

Research on the management of information in public sector has aroused much attention in recent years. Many governments have disseminated information and provided electronic services (e-services) through the government Web sites (Musso et al., 2000; Welch et al., 2005). These governments are commonly known as the electronic governments (e-governments) which are defined as "the use of information technologies to improve the efficiency, effectiveness, transparency, and responsibility of public governments". (Titah & Barki, 2008, p. 43). The e-government is also named as "digital government", "internetworked government" and "government online" (Tapscott, 1995; Yong & Lim, 2003). Layne and Lee (2001) found that governments realized the value of Internet as a channel to provide government services to citizens who could comply with the government requirements online and enjoy a saving of travelling time. Since 1998, the e-government system in Hong Kong has been launched as a part of the Digital 21 Strategy which provides Hong Kong people with e-services. It has undergone three major enhancements in 2001, 2004 and 2008. A new government portal known as GovHK has been in operation since August 2007 (HKSAR Government, 2008).

Developed by Davis (1986), the Technology Acceptance Model has been widely applied in the context of information systems (Davis, 1989; Davis et al., 1989; Venkatesh et al., 2003). In particular, it has been used in the examination of the acceptance rate of information systems (Al-Khaldi & Wallace, 1999; Gefen et al., 2003). Using the Technology Acceptance Model as the core component in the model development of this study, we examine the effects of different constructs on service quality and e-government services user satisfaction in Hong Kong. Although research has been carried out to study satisfaction in online systems (e.g., Oliver, 1980, 2000; Szymanski & Hise, 2000), the determinants of user satisfaction with e-government services have not been studied. To fill the research gap, this study investigates the direct and indirect effects of different variables on the user satisfaction with e-government services. A better understanding of user satisfaction is important to improve the effectiveness of an e-government system.

This study contributes to the literature by investigating the impacts of the construct of security, which has not been studied in the Technology Acceptance Model. The objectives of this study are as follows: firstly identifying the determinants of service quality and user satisfaction of e-government services; secondly examining the relationship between these determinants; and finally exploring the relative importance of each determinant for service quality and user satisfaction of e-government services.

2. Theoretical Foundation

The most salient constructs of the Technology Acceptance Model, namely perceived usefulness and perceived ease of use, are used in this study to examine their effects on service quality and user satisfaction of the e-government services.

The Technology Acceptance Model, which is firstly proposed by Davis (1986), is a prominent model that explains and predicts the phenomenon of technology acceptance (Venkatesh et al., 2003). It aims to explore the determinants of computer acceptance, which in turn affect the behavior of different computing technology end-users, and is parsimonious and theoretically justified (Davis et al., 1989). The Technology Acceptance Model is developed from Fishbein and Ajzen (1975)'s Theory of Reasoned Action which is used in the social psychology field and is typically represented by the following equation:

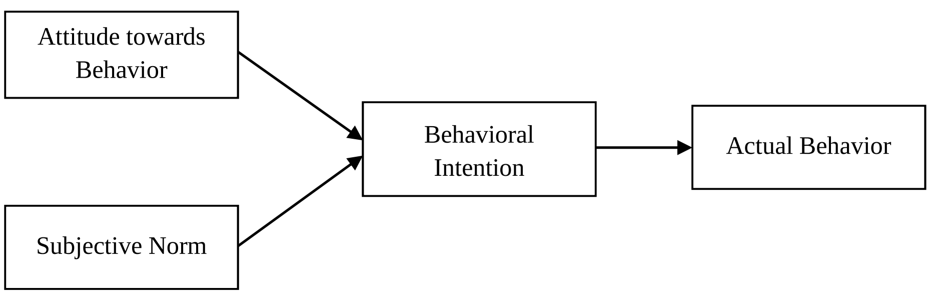
$$BI = A + SN$$

where

BI = behavioral intention,
A = person's attitude, and
SN = subjective norm

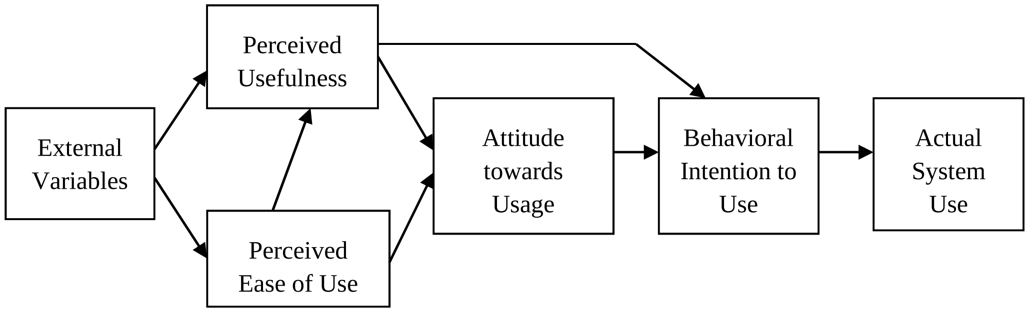
While a person's attitude is defined as his or her positive or negative feelings (i.e., evaluating effect) about performing the target behavior, subjective norm means a person's perception in which most people who are important to him or her think whether he or she should perform the behavior (Davis et al., 1989; Fishbein & Ajzen, 1975). Behavioral intention is defined as a measure of the strength of a person's intention to perform a specified behavior. Figure 1 highlights the key components underlying the Theory of Reasoned Action.

Figure 1: Theory of Reasoned Action



Built on the Theory of Reasoned Action, perceived ease of use and perceived usefulness are the two most salient constructs developed in the Technology Acceptance Model which examines their effects on computer system usage. Figure 2 depicts a typical Technology Acceptance Model. Behavioral intention to use is determined by attitude towards usage as well as by both the direct and indirect effects of perceived usefulness and the indirect effect of perceived ease of use. In addition, perceived ease of use is a predictor of perceived usefulness and actual system usage is determined by behavioral intention to use (Davis, 1989; Taylor & Todd, 2001). Subjective norm is omitted from the Technology Acceptance Model because of its uncertain theoretical and psychometric status (Davis et al., 1989). It is noted that the construct of attitude towards usage is often disregarded in recent studies as the constructs of perceived usefulness and perceived ease of use have already explained a large portion of variance of behavioral intention to use, with perceived usefulness serves as a stronger predictor (Gefen et al., 2003; Venkatesh et al., 2003).

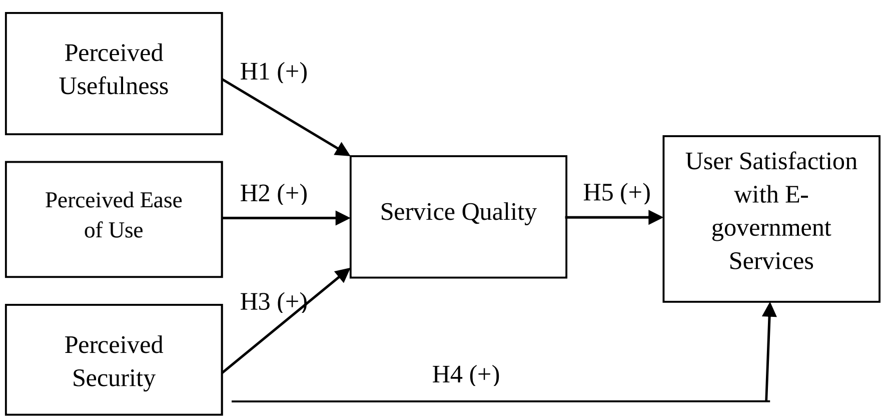
Figure 2: Technology Acceptance Model



3. Model Development

The overall research model and hypotheses of this study are shown in Figure 3. Similar to other studies (e.g., Chau, 1996; Hong et al., 2001; Lu & Gustafson, 1994; Wang, 2002), the construct of attitude towards usage is excluded in order to simplify the model. The proposed research model includes three variables (i.e., perceived usefulness, perceived ease of use, and perceived security) in the service quality and user satisfaction context. Oliver (1980) refers satisfaction as a summary of affective reactions to a service incident. User satisfaction is crucial to the success of information systems (Szajna & Scamell, 1993) and is a fundamental determinant of long-term consumer behavior (Oliver, 1980). The level of satisfaction of citizens who have used online government services is used as one of the indicators to evaluate the e-government system in Hong Kong (HKSAR Government, 2008).

Figure 3: Research Model and Hypotheses



Perceived Usefulness

Perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320) and is widely adopted as an antecedent toward other constructs in technology context (Tan & Chou, 2008).

The relationship between perceived usefulness and service quality has not been empirically tested until recently. Hu et al. (2009) used the Technology Acceptance Model as their model framework and conducted a two-stage longitudinal research with 518 respondents by comparing their perception before and after using the eTax service in Hong Kong. They found that perceived usefulness serves as a significant and positive determinant of eTax service quality. The perceived usefulness will positively affect the e-government service quality because e-government is a system which provides citizens with various online services (e.g., applying for a government job online, making an online appointment booking, using library services online, and using eTax). Therefore, we hypothesize that:

H1: Perceived usefulness of the e-government services will positively influence the perception of service quality of the e-government.

Perceived Ease of Use

Similar to perceived usefulness, perceived ease of use is a popular construct in studying new technology system. Perceived ease of use refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320) and is sometimes denoted as "usability" (Venkatesh & Davis, 1996; Zeithaml et al., 2002). The perceived ease of use is suggested to be a positive antecedent of service quality in several research works (e.g., Shin, 2003; Hu et al., 2009). In this regard, a different but related construct of "complexity" was explored in earlier research (Roger & Shoemaker, 1971; Tornatzky & Klein, 1982), and is defined as "the degree to which an innovation is perceived as relatively difficult to understand and use" (Roger & Shoemaker, 1971, p. 154). If complexity is a strong and negative antecedent of the rate of adoption of an innovation (Thompson et al., 1991; Tornatzky & Klein, 1982), perceived ease of use will positively affect the service quality of a new technology system. Accordingly, we hypothesize that:

H2: Perceived ease of use of the e-government services will positively influence the perception of service quality of the e-government.

Perceived Security

Salisbury et al. (2001, p. 166) defined security as "the extent to which one believes that the Web is secure for transmitting sensitive information". Recently, Flavián and Guinalíu (2006, p. 604) provided a comprehensive interpretation of perceived security as "the subjective probability with which consumers believe that their personal information will not be viewed, stored, and manipulated during transit and storage by inappropriate parties in a manner consistent with their confident expectations". Flavián and Guinalíu (2006) further pointed out that perceived security refers to the technical aspects that ensure the integrity, confidentiality, authentication and non-recognition of transactions. Whilst integrity provides that unauthorized third parties cannot modify the transmitted or stored data, confidentiality ensures that the data can only been viewed by authorized individuals. In addition, authentication, which is often adopted in a Web site, means that a party can carry out certain operations only after his identity is confirmed or guaranteed. Furthermore, non-recognition of transactions involves an information system which avoids a party from denying his action (e.g., a purchasing order on a Web site).

Many scholars agreed that the lack of security in an online platform is one of the major obstacles to the development of information systems (Chou et al., 1999; Dong-Her et al., 2004; Flavián & Guinalíu, 2006; Furnell & Karweni, 1999). In this regard, the user perception of a more secured service is found to be the most important feature of an online banking system (Aladwani, 2001).

Janda et al. (2002) suggested that there are two forms of security from the user perspective of information systems, namely financial security and non-financial security. Non-financial security primarily refers to the security of disclosing personal information online. Prior studies showed that financial security and personal security are antecedents of perceived service quality (Liljander et al., 2002; Yoo & Donthu, 2001; Zeithaml et al., 2000). Since an e-government system will collect both financial and non-financial data about the users, the perceived security will positively influence the service quality of the system. Therefore, we hypothesize that:

H3: Perceived security of the e-government services will positively influence the perception of service quality of the e-government.

It has been shown that financial security will directly affect the user satisfaction of e-commerce (Szymanski & Hise, 2000). In addition, Bailey and Pearson (1983) found that perceived security is an antecedent of user satisfaction in technology context. As e-government services will capture a considerable amount of user information, the perceived security will positively affect the satisfaction level of the users. Hence, we hypothesize that:

H4: Perceived security of the e-government services will positively influence the perception of user satisfaction with the e-government services.

Service Quality

Service quality refers to a form of attitude, related but not equivalent to satisfaction, which represents a long-term overall evaluation toward a service (Cronin & Taylor, 1992; Bolton & Drew, 1991; Parasuraman et al., 1988; Teas, 1993, 1994). Recently, researchers (e.g., Brady et al., 2002; Cronin & Taylor, 1992; Parasuraman et al., 1985) tend to adopt a more performance-based perspective rather than the gap view (i.e., the difference between user's expectation and a firm's actual performance) to measure service quality.

Since service quality is important in measuring the effectiveness of information systems (e.g., Kettinger & Lee, 1995; Li, 1997; Pitt et al., 1995; Wilkin & Hewitt, 1999), the service quality of the e-government system will play an important role in measuring the user satisfaction of the e-government services. Prior studies indicated that online service quality is a strong antecedent construct of customer satisfaction (Anderson & Sullivan, 1993; Carlson & O'Cass, 2010; Carrillat et al., 2009; Cronin & Taylor, 1992; DeLone & McLean, 1992, 2003; Shemwell et al., 1998; Oliver, 2000). Hence, we hypothesize that:

H5: Service quality of the e-government system will positively influence the user satisfaction with e-government services.

4. Research Methodology

Measurement

We used previously validated scales to measure all the constructs in the model (see Appendix A). Both perceived usefulness and perceived ease of use were measured with four items from Davis (1989). Perceived security was measured with 3 items from Flavián and Guinalíu (2006) and 1 item from Ranganathan and Ganapathy (2002). The 22-item SERVQUAL developed by Parasuraman et al. (1988) was used to measure service quality because it has been widely applied in various studies, in particular, for measurement of the online service quality (e.g. Devaraj et al., 2002; Gefen, 2002; Hu et al., 2009; Kuo et al., 2005; Li et al., 2002). In order to better fit for the context in our study, the 22-item SERVQUAL was revised as follows: four items are removed and some wordings were adjusted slightly. Also, a single-item measure was added to measure the overall service quality. User satisfaction with e-government services was measured with 3 items from Oliver (1980) and 1 item from Janda et al. (2002). In addition, a new single-item measure was added to measure the overall user satisfaction. All items were evaluated using a 7-point Likert scale anchored from “1 = strongly disagree” to “7 = strongly agree”.

Participants

Adults who have used the e-government services in Hong Kong are identified as the target respondents of this study. Data was collected through a Web survey instrument in Chinese and English. The survey was posted on a popular Web site in Hong Kong. Screening questions were included in the system to check if the respondents had used the e-government services and their ages were 18 or above.

A total of 340 responses were received, but only 229 questionnaires were fully completed. Table 1 indicates that 61% of the respondents were female and 39% were male. Over 80% of the respondents fell into the range of 18-27 years old, 14% of the respondents were within 28-37 years old, 3.1% of them were within 38-47 years old and 1.3% of them were within 48-57 years old.

Table 1: Demographic Data of the Respondents

	Number	Percentage (%)
1. Gender		
Male	89	38.9
Female	140	61.1
Total	**229**	**100.0**
2. Age Group		
Under 18	0	0

	Number	Percentage (%)
18-27	187	81.7
28-37	32	14.0
38-47	7	3.1
48-57	3	1.3
58 or above	0	0
Total	**229**	**100.0**

5. Results

Instrument Validation

We conducted reliability and validity tests of the measurement items using Cronbach's alpha and factor analysis. Table 2 presents the reliabilities, descriptive statistics and correlations. The reliability of the single-item measures of service quality and user satisfaction with e-government services were not reported because they cannot be estimated by traditional reliability estimation techniques (see Wanous & Hudy, 2001, pp. 361-375, for further discussions). Cronbach's alpha values of other multi-item variables were greater than or equal to 0.92 (which were above the threshold level of 0.8 as suggested by Nunnally (1978)), indicating the variables had high reliability. A factor analysis using principal component factor analysis with oblimin rotation was also conducted on the multi-item independent variables to examine the convergent and discriminatory validity. Table 3 shows that all the items loaded highly on their corresponding latent variables, with little cross-loadings on other variables. These results suggest that the scales exhibit adequate convergent and discriminatory validity.

Table 2: Reliabilities, Descriptive Statistics and Correlations

	Mean	Std.	PU	PEOU	PS	SQ1	SQ2	EGO	EGO
PU	5.08	1.07	**0.92**						
PEOU	5.08	1.12	0.67	**0.92**					
PS	4.66	1.22	0.37	0.38	**0.95**				
SQ1	4.64	1.02	0.63	0.60	0.59	**0.97**			
SQ2	4.67	1.23	0.62	0.58	0.55	0.86	**N/A**		
EGOV_S1	4.95	1.16	0.69	0.67	0.54	0.85	0.84	**0.96**	
EGOV_S2	5.00	1.19	0.68	0.65	0.55	0.83	0.84	0.91	**N/A**

Note 1 PU: perceived usefulness; PEOU: perceived ease of use; PS: perceived security; SQ: service quality; EGOV: user satisfaction with e-government services; SQ1 is the index measure of service quality; SQ2 is the single-item measure of service quality; EGOV_S1 is the index measure of the satisfaction with e-government services; EGOV_S2 is the single-item measure of the satisfaction with e-government services.

Note 2 Cronbach alpha values of variables are presented at their corresponding diagonal positions. All correlations are significant at least at $p<0.01$ (2-tailed).

Note 3 As traditional reliability estimation techniques cannot be used for testing the reliability of a single-item measure, SQ2 and EGOV_S2 were not included when measuring reliabilities. See Wanous & Hudy (2001, pp. 361-375) for further discussions.

Table 3: Principal Component Analysis with Oblimin Rotation

Items	PU	PEOU	PS
PU1	**0.80**	0.17	-0.03
PU2	**0.91**	-0.08	0.04
PU3	**0.94**	-0.06	0.02
PU4	**0.77**	0.20	0.01
PEOU1	-0.09	**0.96**	-0.03
PEOU2	0.20	**0.78**	-0.05
PEOU3	0.11	**0.79**	0.05
PEOU4	-0.03	**0.90**	0.11
PS1	0.02	-0.05	**0.92**
PS2	0.01	0.01	**0.94**
PS3	0.03	0.01	**0.91**
PS4	-0.05	0.06	**0.93**

Note PU: perceived usefulness; PEOU: perceived ease of use; PS: perceived security

Hypotheses Testing

Regression analysis was conducted in order to test our hypotheses. The results of the regression analysis were shown in Table 4. Perceived usefulness, perceived ease of use and perceived security were significant and positive determinants of service quality, hence supporting H1, H2 and H3. User satisfaction with e-government services was significantly determined by perceived security and service quality, as predicted by H4 and H5. In examining the mediation effect of the variables on user satisfaction with e-government services, we found that only perceived security had an effect on user satisfaction over and above its effect through service quality. The variance explained in service quality and user satisfaction was 57% and 78% respectively.

Given that we used an index measure for service quality and user satisfaction with e-government services in our analyses, we benchmarked the results using the single-item overall service quality and user satisfaction with e-government services measures. Table 4 indicates that the regression results with single-item of service quality and e-government services user satisfaction were highly consistent with that of their index measure. Also, the correlations between the index measure and the single-item measure of service quality (0.86) and user satisfaction with e-government services (0.91) were extremely high (see Table 2).

Table 4: Service Quality and Satisfaction with E-government Services

	SQ1	SQ2	EGOV_S1		EGOV_S2	
Adjusted R^2	0.57	(0.52)	0.78	(0.77)	0.74	(0.76)
PU	0.33***	(0.34***)	0.07	(0.08)	0.09	(0.08)
PEOU	0.24***	(0.22***)	0.07	(0.08)	0.05	(0.06)
PS	0.39***	(0.35***)	0.14***	(0.10*)	0.18***	(0.12*)
SQ1			0.62***		0.57***	
SQ2				(0.57***)		(0.58***)

Note 1 PU: perceived usefulness; PEOU: perceived ease of use; PS: perceived security; SQ: service quality; EGOV: user satisfaction with e-government services; SQ1 is the index measure of service quality; SQ2 is the single-item measure of service quality; EGOV_S1 is the index measure of the satisfaction with e-government services; EGOV_S2 is the single-item measure of the satisfaction with e-government services.

Note 2 The results of regression with the single-item measure of service quality are shown in parentheses.

*p<0.05, **p<0.01, ***p<0.001.

Post-hoc Analysis

Further analysis was carried out in order to explore the relationship between the three variables (namely perceived usefulness, perceived ease of use and perceived security) and the five dimensions of service quality (namely tangibles, reliability, responsiveness, assurance and empathy) as well as between these factors and the user satisfaction with e-government services. Whilst tangibles means the physical evidence of the services (i.e., the Web technologies and Web layout in the e-government context), reliability ensures that e-government system provides consistent and accurate services. In addition, responsiveness measures the willingness of performing real time services as per user request. Furthermore, assurance involves the ability to inspire the trust and confidence of users politely while empathy means the offering of individualized attention and caring (Parasuraman et al., 1988).

Table 5 presents the result of the post-hoc analysis. Perceived security had the strongest influence on all dimensions of service quality except tangibles. On the other hand, only reliability, assurance and empathy of service quality were significant and positive determinants of user satisfaction with e-government services in index measure. These results were highly consistent with that of the user satisfaction e-government services in single-item measure except that empathy was not a significant determinant in the single-item measure. In order to avoid the problem of multicollinearity, the variance inflation factors (VIF) were checked. The VIF for all independent variables were all smaller than the cutoff value of 10.0 as suggested by Chatterjee and Price (1977), thus minimizing concerns about multicollinearity.

Table 5: Individual Dimensions of Service Quality and User Satisfaction with E-government Services

	Tangibles	Reliability	Responsiveness	Assurance	Empathy	EGOV_	EGOV_
Adjusted R^2	0.43	0.54	0.44	0.58	0.32	0.79	0.75
PU	0.35***	0.27***	0.30***	0.28***	0.26***	0.18***	0.20***
PEOU	0.17*	0.27***	0.18**	0.27***	0.19*	0.14**	0.13**
PS	0.31***	0.40***	0.35***	0.40***	0.27***	0.01	0.06
Tangibles						-0.01	0.01
Reliability						0.23***	0.22**
Responsiveness						0.09	0.11
Assurance						0.29***	0.24**
Empathy						0.11*	0.08

Note PU: perceived usefulness; PEOU: perceived ease of use; PS: perceived security; EGOV_S1 is the index measure of the satisfaction with e-government services; EGOV_S2 is the single-item measure of the satisfaction with e-government services.

*p<0.05, **p<0.01, ***p<0.001.

6. Discussion

Theoretical Implication

User satisfaction of information system is a perceptual measure of system effectiveness and system success (Ives et al., 1983). Built on the Technology Acceptance Model, a new construct of perceived security was examined in this study for its effects on service quality and satisfaction with e-government services. This study imposes several implications for e-government services in Hong Kong and is expected to be applied to government in other nations.

In this study, we argue that the security of an online platform is important in the e-government services. Every day, there is abundant personal and financial data transferred via the e-government system. The security level of the service should be high enough to protect the information. In line with our expectation, perceived security contributes most to service quality. The perceived high security of the e-government system will lead to perceived high service quality, which in turn will improve the development of e-government system.

Prior research has examined the relationship between service quality and user satisfaction (e.g., Anderson & Sullivan, 1993; Cronin & Taylor, 1992; DeLone & McLean, 1992, 2003; Shemwell et al., 1998). However, few have applied the well-founded Technology Acceptance Model in model formulation. This present study applies the Technology Acceptance Model, which is added with the perceived security and service quality constructs, in examining user satisfaction of e-government services. We found that service quality was a significant determinant of user satisfaction. This present study stimulates other possibilities in adopting these constructs in investigating other aspects of behavioral intention.

Practical Implication

This study offers several important implications for developing and promoting e-government services. More resources should be allocated to improve the security measures of e-government system. The practices adopted by the eTax system, which is a part of the e-government services in Hong Kong, serve as a good example. In order to ensure the security level of the service, eTax service implemented the following measures (HKSAR Government, 2008):

- followed the latest best practice for information security management; and
- adopted the latest encryption technology.

These security measures should be widely applied to other e-government services. In addition to the advanced technology measures like firewalls, digital certificates and anti-virus programmes, more enhanced legislative measures can be introduced to improve the effectiveness of various security measures.

Research and development is needed to upgrade the e-government system with more functions and services. Attention will also be given to the ease of use of the portal. Free training courses, publicity events and exhibitions shall also organized to develop people's beliefs of usefulness, ease of use and security of the service, which in turn will increase the perceived service quality, and ultimately the user satisfaction with e-government services.

Furthermore, the assurance and reliability aspects of service quality can be enhanced through adopting better monitoring system, maintaining a more stable online server with proper pilot testing before the launch of new functions, and ensuring the services are tailor-made for their specific user groups.

Limitation and Further Research

There are several limitations in this study. First, user satisfaction of e-government services is a relatively new area of research. Comparisons of results with other studies are difficult. Second, the respondents of this study are from Hong Kong and majority of them are quite young. Last, this study is cross-sectional in nature. Further longitudinal work might advance the understanding of various variables of e-government services user satisfaction.

There are other variables which may be worth exploring in future research. System characteristics like screen design, terminology and result demonstrability can be added to the existing model. Social characteristics like subjective norm can also be tested for the relationship with service quality and e-government services user satisfaction. Individual characteristics like age and gender are other possible dimensions to examine. In addition, the trust in government (which is found to be strongly associated with e-government services user satisfaction (Welch et al., 2005)), can be investigated.

7. Conclusion

This study examined the impact of the two constructs adopted from the Technology Acceptance Model, namely perceived ease of use and perceived usefulness, and a new construct of perceived security on service quality and user satisfaction of the e-government services in Hong Kong. There are three major findings. First, perceived usefulness, perceived ease of use and perceived security of the e-government services contribute significantly to the service quality, with perceived security having the strongest influence. Second, service quality is a significant contributor to the e-government services user satisfaction. Third, assurance and reliability empathy are the most important aspects of service quality. Results of the study highlight the escalating importance of security of an online service which ultimately leads to a higher level of service quality and user satisfaction.

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Appendix

Perceived Usefulness (PU; 7-point Likert scale, ranging from “1=strongly disagree” to “7=strongly agree”)

PU1. Using e-government services would enable me to accomplish tasks more quickly.

PU2. Using e-government services would improve my task performance.

PU3. Using e-government services would enhance my effectiveness on accomplishing tasks.

PU4. Using e-government services would make it easier to accomplish tasks.

Perceived Ease of Use (PEOU; 7-point Likert scale, ranging from “1=strongly disagree” to “7=strongly agree”)

PEOU1. Learning to operate e-government services would be easy for me.

PEOU2. I would find it easy to get e-government services to accomplish tasks.

PEOU3. My interaction with e-government services would be clear and understandable.

PEOU4. It would be easy for me to become skillful at using e-government services.

Perceived Security (PS; 7-point Likert scale, ranging from “1=strongly disagree” to “7=strongly agree”)

PS1. I think e-government services have sufficient technical capacity to ensure that the data I send cannot be modified by a third party.

PS2. When I send data to e-government services, I am sure that they will not be intercepted by unauthorized third parties.

PS3. I think e-government services have sufficient technical capacity to ensure that the data I send will not be intercepted by hackers.

PS4. I think e-government services have adequate mechanisms to ensure the safe transmission of my personal information.

Service quality (SQ; 7-point Likert scale, ranging from “1=strongly disagree” to “7=strongly agree”)

1. E-government services have up-to-date Web technologies.
2. The portal of e-government services, GovHK, is visually appealing.
3. The portal of e-government services, GovHK, looks professional and neat.

4. The portal of e-government services, GovHK, has an appropriate style of design for site type.
5. When e-government services promise to do something by a certain time, e-government services can do so.
6. E-government services are dependable.
7. E-government provides services at the time it promises to do so.
8. E-government provides error-free services.
9. E-government keeps me informed about when services will be performed.
10. E-government provides prompt service.
11. E-government services are always willing to help me.
12. E-government services can respond to user requests promptly.
13. I can trust e-government services.
14. The portal of e-government services, GovHK, provides polite feedbacks and content.
15. E-government services have ability to do the job well.
16. E-government services give users individual attention.
17. The portal of e-government services, GovHK, gives users personal attention.
18. E-government services know my need.

Overall Service quality (7-point Likert scale, ranging from "1=strongly disagree" to "7=strongly agree")

Overall, I think the service quality of e-government is excellent

User Satisfaction with E-Government Services (EGOV; 7-point Likert scale, ranging from "1=strongly disagree" to "7=strongly agree")

1. I think I did a right thing when I decided to use e-government services for accomplishing tasks.
2. My choice to use e-government services was a wise one.
3. I feel good about my decision concerning the e-government services.
4. Based on my all my experience with e-government services, I feel satisfied.

Overall User Satisfaction with E-Government Services (7-point Likert scale, ranging from "1=strongly disagree" to "7=strongly agree")

Overall, I am satisfied with e-government.

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□ □ □ □ □ □ Gatekeeper and Whistle Blower in Transition Economy: Examples of Auditors in China’s Financial Market

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This paper discusses the roles of auditors in China’s financial market, in particular the banking sector, from a legal perspective. After the outbreak of the financial crisis, there was comment that auditor was a significant contributory factor to the financial crisis for his inability to be aware of and alert the failure of the companies. The role of auditor in providing sufficient and relevant information is in the top agenda for discussion in various western countries and international orgainzations. In China, with repeated accounting scandals, there is a more fundamental problem rasied to the roles of auditors in enhancing the accuracy and timeliness of information disclosed, in addition to the sufficiency and relevancy of information disclosed. Weak legal and regulatory system in regulating the auditors may be one of the key factors for the above accounting issues. There are ambiguous provisions on external audit requirement, insufficient regulations relating to audit independence, legal constraint during the audit process, insufficient guidance on communication with regulators and limited liability risks to auditors. Auditors in China’s financial market could be more proactive and act as a whistle blower, a more vigilant gatekeeper, to protect the public interest as well as a conduit between companies and regulators to enhance the accuracy and reliability of accounting information in building a healthy and substainable financial system in China.

Keywords: auditor, bank, gatekeeper, law and financial reporting.

Introduction

A well-functioned disclosure system in a financial market is important as it can help reduce information asymmetry and enhance transparency of companies. Auditors, one of the gatekeepers of the financial market, can help to enhance credibility and reliability of information disclosed, in particular financial information. After the outbreak of the financial crisis in 2008, auditors were blamed for their inability to be aware of and alert the failure of the companies. There are studies initiated by various supervisors and international bodies as discussed below on improving auditors' roles in providing quality services. Despite the adverse economic impact of the financial crisis on China is comparatively less prominent, a lesson from the financial crisis is a caveat to China.

In China, information disclosed, in particular audited financial information disclosed, is always questionable. Accounting scandals of Chinese companies for false business performance, not up-to-date information and manipulating profits have repeatedly occurred in China and overseas. There were also cases triggering lawsuits and regulatory probes against the Chinese listed companies and their auditors. Despite the concerns of regulators of western countries and international bodies after the financial crisis are more on the sufficiency and relevancy of information disclosed, it appears that the concern for information disclosed in China should be more on the fundamental problem, i.e. accuracy and timeliness of information disclosed. Auditors in China appear not be able to function effectively in their roles to enhance the credibility and reliability of information provided, at least in light of previous accounting scandals in China. The weak legal and regulatory framework in regulating auditors may be one of the key factors that failing to uphold auditors' independent role in practice and may lead auditors to trade off the quality of their services for profitability possibly leading to the inaccuracy of information disclosed. Auditor who possesses professional knowledge and knowledge of his client's business and operation may be able to smell the fishy acts of the company. After the financial crisis, auditor's duty of care and skills excercised to the engagement is beyond the traditional expectation. In compliance with relevant regulations, auditor could act more proactively as a whistle blower to initiate timely communication with regulator on suspicious worngdoings to protect the public interest in the financial market instead of last minute resignation from his engagement like the recent accounting scandals overseas leaving the monies of investors and creditors probably in vain. Auditor could also act as a conduit between company and regulator to communicate, clarify and ascertain some significant accounting information to enhance a healthy and transparent financial market.

This paper focuses on the discussion of the roles of the auditors to the disclosure system relating to disclosure of financial information in China's financial market, in particular the banking sector, after the financial crisis from a legal perspective. The following sections will first briefly discuss the the roles of auditors in the financial market after the financial crisis. Then, this paper will discuss the issues facing the auditors in China's financial market, in particular banks, from a legal perspective and the related possible sugestions, followed by a concluding remark.

Roles of auditors in the financial market after the financial crisis

After the financial crisis, transparency and disclosure have been at the top agenda for discussion and improvement. Transparency is an essential element of a well-functioning system of corporate governance and disclosure to stakeholders is the principal means by which companies can become transparent.[1] Among various information disclosed, periodic reports, like financial reports, are important for a well-functioning disclosure system.[2] Financial report is also considered as one of the most important and comprehensive sources of corporate information.[3] Auditors who provide certification services to investors are gatekeepers to the financial markets.[4] For financial reports, under International Standards on Auditing (ISAs), auditors are required to consider the overall presentation of the financial statements and whether the financial statements, including the related disclosures, represent the underlying transactions and events in manner that achieve fair presentation.[5] As an independent watchdog, auditors' services provided can help screen out flaws and verifies compliance with standards or procedures.[6] With these functions, auditors could help improve the reliability of information,[7] facilitate the function of market discipline[8] and promote good corporate governance of companies.[9] Nevertheless, disclosure alone may not be sufficient. The quality of information disclosed is important. Information disclosed must be accurate, sufficient, relelvant and timely to enhance transparency of companies.[10]

Auditors were blamed not doing their jobs well in the recent financial crisis. There was comment that bank auditor was a significant contributory factor to the financial crisis for auditors' failure to be aware of the mounting dangers.[11] There are recently many studies regarding the improvement of auditors' work and their respective regulatory framework.[12] In

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[1] JILL SOLOMON, CORPORATE GOVERNANCE AND ACCOUNTABILITY 143 (John Wiley & Sons, Ltd. 2007).

[2] Technical Committee (TC) of the International Organization of Securities Commissions (IOSCO), Principles for Periodic Disclosure by Listed Entities 5 (TC of the IOSCO 2010).

[3] See id.

[4] See John C. Coffee, Jr., *Gatekeeper Failure and Reform: The Challenge of Fashioning Relevant Reforms*, 84 Boston University Law Review 301 (2003), at 309.

[5] International Auditing and Assurance Standards Board (IAASB), Discussion Paper - The Evolving Nature of Financial Reporting: Disclosure and Its Audit Implications 6 (International Federation of Accountants (IFAC) 2011) [hereinafter IAASB Discussion Paper].

[6] JOHN C. COFFEE JR., GATEKEEPER: THE PROFESSIONS AND CORPORATE GOVERNANCE 2 (Oxford University Press 2006).

[7] Basel Committee on Banking Supervision (BCBS), Enhancing Bank Transparency: Public Disclosure and Supervisory Information that Promote Safety and Soundness in Banking Systems 13 & 16 (Bank for International Settlements (BIS) 1998); IAASB, Feedback Statement - The Evolving Nature of Financial Report: Disclosure and its Audit Implications 5 (IAASB 2012) [hereinafter IAASB's Feedback Statement].

[8] See Constantinos Stephanou, Rethinking Market Discipline in Banking - Lessons from the Financial Crisis 6-7 (The World Bank (WB) - Financial and Private Sector Development Vice Presidency, Financial Policy Development Unit 2010).

[9] See BCBS, Principles for Enhancing Corporate Governance 33 (BIS 2010).

[10] See Organization for Economic Co-operation and Development (OECD), OECD Principles of Corporate Governance 2004 47 (OECD 2004).

[11] Select Committee on Economic Affairs (SCEA), 2nd Report of Session 2010-11 - Auditors: Market Concentration and their Role Volume I: Report 46 (House of Lords SCEA 2011) [hereinafter SCEA Report].

[12] E.g., European Commission (EC) - Internal Market and Services Dg, Summary Report of the Responses

addition, the G20 during the Summit in Seoul in 2010 pinpointed that there should be actions to be taken to improve the convergence of financial instrument accounting standards,[13] which are relied on by auditors in providing their services.

For disclosure in the financial reporting, after the financial crisis, it was found that information disclosed was not sufficient in the financial market, like information of structured products and the work process of auditors, and there is a cry for more information disclosed on the financial reports and on the auditor's report. Various accounting standards which are related to information disclosure are revised after the financial crisis.[14] The new standards will promote better disclosures about valuations, methodologies and the uncertainty associated with valuations.[15] Moreover, for audits of financial statement for periods ending on or after December 15, 2016, in accordance with ISAs, format of auditor's report, which is attached together with the financial reports, is revised, with one of the focuses to provide more professional and material information for the users.[16] In line with the above revised format of auditor's report as stipulated in the ISAs, the EU also requires more information to be included in the auditor's report to provide more useful and relevant information to the users.[17] This revised format of auditor's report will help fill out the gap for information expected by the users.

In additional to the sufficiency of information provided, internationally, there is also a call for disclosing of more relevant information on financial reports. In view of the broad variety of information disclosed, the content and length of the financial reports are of concern lately. It is found that the length of financial reports has increased significantly,[18] in particular narrative disclosures.[19] It is also found that information is disclosed mainly for compliance-based purpose, using a checklist requirement approach and overall result is disclosure of immaterial information that leads to clutter.[20] A recent reportd commented that the length of

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Received to the Commission's Consultation on Country-by-country Reporting By Multinational Companies (EC 2011); EC, Green Paper - Audit Policy: Lessons from the Crisis (Text with EEA Relevance) (EC 2010); TC of the IOSCO, Auditor Communications: Consultation Report - Comment Letters (IOSCO 2010); IAASB's Feedback Statement, supra note 7, at 2; IAASB, International Standards on Auditing - Reporting on Audited Financial Statements – New and Revised Auditor Reporting Standards and Relating Confirming Amendments (IAASB January 2015 [hereinafter Reporting on Audited Financial Statements].

[13] Financial Stability Board (FSB) website, FSB Meets in Seoul, October 20, 2010, at 3, available at: http://www.financialstabilityboard.org/list/fsb_meetings/index.htm.

[14] E.g. IFRS 7 – Financial Instruments: Disclosures, IFRS 12 – Disclosure of Interest in Other Entities, etc.

[15] Financial Stability Forum (FSF), Report of the FSF on Enhancing Market and Institutional Resilience 27 (FSF 2008).

[16] Reporting on Audited Financial Statements, supra note 12, at 7-16; International Standard on Auditing 701 – Communicating the Key Audit Matters in the Independent Auditor's Report, Paragraph 2.

[17] Directive 2014/56/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2006/43/EC on statutory audits of annual accounts and consolidated accounts [hereinafter Directive 2014/56/EU], Article 28.

[18] IAASB Discussion Paper, supra note 5, at 10. See also Joint Oversight Group of The Institute of Chartered Accountants of Scotland and the New Zealand Institute of Chartered Accountants (The Joint Oversight Group), Losing the Excess Baggage – Reducing Disclosures in Financial Statements to What's Important 2 (The Joint Oversight Group 2011) [hereinafter Joint Oversight Group Report].

[19] Deloitte, Swimming in Words: Surveying Narrative Reporting in Annual Reports 1 & 13-14 (Deloitte 2010); Deloitte, Gems & Jetsam: Surveying Annual Reports 14 (Deloitte 2011).

[20] See Financial Reporting Council (FRC), Thinking about Disclosures in a Broader Context: A Road Map for a Disclosure Framework 32 (FRC 2012); European Financial Reporting Advisory Group (EFRAG), Autorite des

financial reports could be reduced by 30% to better serve the needs of users of the financial statements which contain meaningful information and less irrelevant details.[21] The revised format of auditor's report as mentioned above is also amied at providing more relevant information to the users.[22] It is important to achieve the right balance of the quantity of information disclosed on the financial reports that can provide relevant and quality information.

One of the focuses of the western countries after the financial crisis is more on the sufficiency and relevancy of information provided by auditors to the users. However, in addition to sufficiency and relevancy of information disclosed, information disclosed being inaccurate and not in a timely manner has long been posed a bigger challenge to auditors in China.

Audit failures of Chinese companies in the financial market

In China, inaccurate and not up-to-date accounting information have always been found in companies in the financial market. For accounting information of banks, the financial statements are always found to underestimate their loan losses and overestimated their assets, etc.[23] For listed companies, a study by Shanghai Stock Exchange (SHSE) found that most of the violation cases for listed companies were related to violation of disclosure, representing 78% of total cases for the period from 1996 to 2007.[24] Besides, most of violation cases during the period of the survey were related to the non-disclosure of major events in timely manner, representing more than 50% of total violation cases relating to disclosure issues.[25] In addition to the above non-compliance cases, financial data of listed companies are also inaccurate, with quite a number of companies required to provide supplementary data or restatements after the issuance of the periodic reports.[26] Worse still, it is quite common to find companies in China to maintain multiples sets of financial books – for management, the tax authorities and the auditors.[27] It is no doubt that investors are sceptical of the truthfulness of the audited

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norms Comptables (ANC) & FRC, Discussion Paper: Towards a Disclosure Framework for the Notes 6 (EFRAG, ANC & FRC 2012).

[21] Joint Oversight Group Report, supra note 18, at 11-12.

[22] Reporting on Audited Financial Statements, supra note 12, at 5.

[23] Luo Shuixiang, *Wo guo shang ye yin hang xin xi pi lu cun zai de wen ti ji jie jue dui ce [Problems and Solutions on Information Disclosure of the Commercial Banks in China]*, 8 Bei fang jing ji [Northern Economy] 81 (2011), at 81; Zhang Huaiwen, *Jian lun shang ye ying hang xin xi pi lu cun zai de wen ti ji dui ce [Brief Discussion on the Existing Problems and Countermeasures of Information Disclosure for Commercial Banks]*, 3 Cai jing jie [Money China] 25 (2010), at 25.

[24] SHSE website, Zhong guo gong si zhi li bao gao (2008): Shang shi gong si tou ming du yu zi xun pi lu [Corporate Governance Report in China (2008): Transparency and Information Disclosure of Listed Companies], July 2008, at 1 (Forward) & 30 [hereinafter SHSE Report 2008], available at: http://www.sse.com.cn/researchpublications/special/. See also SHSE website, Zheng quan wei fa wei gui cheng jie shi xiao yu zhi du cheng ben yan jiu [Studies on the Effectiveness of Disciplinary System on Securities Illegal Acts and the Cost of Disciplinary System], Issue 15, at 17, available at: http://www.sse.com.cn/researchpublications/jointresearch/.

[25] SHSE Report 2008, supra note 24, at 109.

[26] Id., at 25.

[27] Christine Gonsalves, *Do Ask, Do Tell: A New Code of Ethics for Accountants Comes into Effect this Month to Help Professionals Navigate Ethical Minefields*, A Plus, January 2011, 32, at 36. See also Ministry of Finance

financial reports of even listed companies which are already considered comparatively more regulated in China.

Other than in China, Chinese companies listed overseas are also afflicted with accounting problems relating to inaccurate information. Chinese companies have increased their presence in overseas Exchanges in the recent decade. However, questionable accounting issues are kept surfacing and draw concerns to investors and oversea regulators. There were various accounting scandals for Chinese listed companies in the US, Canada and Hong Kong. More remarkable cases are relating to Chinese listed companies in the US where there has been a proliferation of Chinese-listed companies engaged in accounting fraud after their listing. US regulator probes against the Chinese companies and their auditors and there have been increasing numbers of claims against them in US courts every year since 2004, like securities class action filings with majority of the cases being accounting-related allegations.[28] The common accounting issues for Chinese listed companies are related to the accuracy of accounting information, like financial results reported to Chinese authorities differ significantly from the filings in the US, cash balances cannot be verified, etc.[29] The above cases shed light as to the imminent accounting and audit problems in China.

Low audit quality may be one of the reasons for the widespread fraudulent financial reporting of companies in China. Examinations on the quality of audit services conducted by various organs, i.e. National Audit Office of the PRC (NAO), MOF, the regulator of the accounting profession in China, Chinese Institute of Certified Public Accountants (CICPA) and WB, find that there is some room for improvement in audit services performed by auditors in China, including areas like lack of professional skepticism, incomplete disclosure, insufficient audit procedures, insufficient audit evidence, etc., especially for those which are usually relatively smaller in size.[30] Nevertheless, large or even global accounting firms may also show issues relating to audit quality. For overseas accounting scandals, though most of the Chinese companies in trouble were audited by small accounting firms, there were some cases which also involved the large global accounting firms, which relied on the work of their Chinese arms and signed off on the financial statements of overseas listed Chinese companies that were later accused of fraud and misrepresentation.[31] In addition to the above, a study

(MOF) website, Zhong hua ren min gong he guo cai zheng bu kuai ji zi xun pin zhi jian cha gong gao (Di 22 hao) [Bulletin of the MOF on Accounting Information Quality Examination (Number 22)] [hereinafter MOF Bulletin No 22], available at: http://jdjc.mof.gov.cn/zhengwuxinxi/jianchagonggao/.

[28] Caixin Wang [Caixin Online], Shen Hu and Zhang Tao, Watchdogs Growl over Concept-stock Probes, June 11, 2012, available at: http://english.caixin.com/2012-06-11/100399298.html; Renzo Comolli, Ron Miller, John Montgomery & Svetlana Starykh, Recent Trends in Securities Class Action Litigation: 2012 Mid-Year Review – Settlement Bigger, but Fewer 9 (NERA Economic Consulting 2012); PricewaterhouseCoopers (PWC), The Ever-changing Landscape of Litigation Comes Full Circle: 2011 Securities Litigation Study 11 & 43-44 (PWC 2012) [hereinafter PWC Securities Litigation Study].

[29] PWC Securities Litigation Study, supra note 28, at 11-12 & 36.

[30] MOF Bulletin No 22, supra note 27; MOF website, Zhong hua ren min gong he guo cai zheng bu kuai ji zi xun pin zhi jian cha gong gao (Di 21 hao) [Bulletin of the MOF on Accounting Information Quality Examination (Number 21)], available at: http://jdjc.mof.gov.cn/zhengwuxinxi/jianchagonggao/. See also Financial Management - Central Operational Services Unit: East Asia and Pacific Region, WB, Report on the Observance of Standards and Codes (ROSC) - Accounting and Auditing, PRC 20-21 (WB 2009) .

[31] The Wall Street Journal, Dinny McMahon & Shen Hong, China Wants Local Control of Foreign Auditing Firms, May 10, 2012, available at:

http://online.wsj.com/article/SB10001424052702304203604577395423545473012.html. See The Economist, conducted by Canadian Public Accountability Board (CPAB), audit regulator in Canada, on China-based listed companies found that their auditors very often did not properly apply procedures that would be considered fundamental in Canada, such as maintaining control over the confirmation process.[32]

Problems with audits are not only specific to auditors in China. According to inspections performed by Public Company Accounting Oversight Board (PCAOB), supervisor to oversee the audits of public companies, in the US, CPAB in Canada and audit supervisors in the UK, inspectors continue to find deficiencies in important audit areas.[33] These deficiencies of audit are not country-specific but related to the profession at large, like concerns about a lack of professional skepticism, inadequate supervision and review, ineffective substantive analytical procedures, and the poor quality of evidence in the audit files.[34] In the UK, the quality review conducted by professional bodies in 2011 also reviewed a high number of unsatisfactory operations of audit firms, with a situation that 28% of visits conducted by a professional body were regarded as unsatisfactory on successive monitoring visits.[35]

Despite the above audit issues, accuracy and reliability of the accounting information in these countries at large is not in doubt. Nevertheless, this is not the case in China. The deficiency of audit work shows a more profound and adverse impact on the quality of information disclosed in China. The weak legal and regulatory framework regulating the audit profession may be one of the key factors of the low audit quality in China.

1. Ambiguous provisions on external audit requirement

In the past, in China, the external audit requirement for companies in the financial market in particular banks has been "neglected" by the Chinese government as only limited numbers of the companies, i.e. foreign companies, certain state-owmed enterprises (SOEs) and listed companies, were required to prepare audited reports prepared by external auditors. Lack of clear provisions in regulations stipulating the requirement of external audit may hinder the healthy development of the audit profession in China.

In the banking sector, the first regulation regarding the preparation of audited reported by external Chinese auditors was promulgated as early as in 1985 but the requirement only applied to foreign banks and joint Chinese-foreign banks which operated business in the Special Economic Zones in China.[36] There were some other regulations and rules issued later

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Accounting in China Internal Controls: Foreign Auditors in China are being Squeezed on All Sides, May 19, 2012, available at: http://www.economist.com/node/21555574.

[32] CPAB, Auditing in Foreign Jurisdictions: CPAB Special Report 1 (CPAB 2012).

[33] PCAOB website, Report on the PCAOB's 2004, 2005, 2006 and 2007 Inspections of Domestically Annually Inspected Firms, December 5, 2008, at 2, available at: http://pcaobus.org/Inspections/Pages/PublicReports.aspx. See also CPAB, Meeting the Challenge "A Call to Action": 2011 Public Report 4 & 10 (CPAB 2012) [hereinafter CPAB Report]; Professional Oversight Board (POB) of FRC, Report to the Secretary of State for Business, Innovation and Skills 17 & 66-70 (POB of FRC 2012) [hereinafter POB Report to Secretary of State].

[34] CPAB Report, supra note 33, at 4 & 10.

[35] POB Report to Secretary of State, supra note 33.

[36] Regulations Governing Foreign Banks and Joint Chinese-Foreign Banks in Special Economic Zones of the PRC (issued by the State Council (SC) on April 2, 1985) (PRC) Article 12.

but still only elaborated the external audit for foreign banks only.[37] Local banks were always exempted from audit requirement in the past. It appears that clearer and stricter control on external audit requirement was applied to foreign banks but not local banks.

Moreover, state-owned commercial banks (SOCBs) in the past were also exempted from external audit requirement which applied to SOEs. Though MOF issued the Interim Measures of SOEs' Annual Accounting Reports Audited by Registered CPAs which stipulated that SOEs were required to issue annual financial reports audited by the Chinese auditors,[38] SOCBs were excluded from the requirement to prepare audited reports performed by the audit firms.[39] Even being state-owned, banks are treated differently for external audit requirement from other SOEs, at least they are selected to be applied the requirement at a later stage.

Comparatively, the more enforceable rules for external audit requirement are found for listed companies. As early as in 1993, according to the Interim Provisions on the Management of the Issuing and Trading of Stocks issue by the SC, for listed companies, the annual financial reports should be audited by registered auditors.[40] Subsequently, China Securities Regulatory Commission (CSRC), the regulator of the exchange markets in China, also issue a measure requires listed companies to furnish audited financial statements.[41] Despite there is a clearer requirement for external audit in the stock markets, in the past, only a very limited number of banks were listed in the Exchanges. Moreover, according to Securities Law, listed companies are only required the preparation and submission of annual financial reports to CSRC and the Stock Exchanges, without specifying the external audit requirement.[42] Though audit requirement is stipulated in both SC Interim Provisions and CSRC Administrative Measure, the above Interim Provision is a regulation issued by the SC and the CSRC Administrative Measure is a departmental rule while the Securities Law is a

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[37] E.g., Regulations of the PRC on the Management of Foreign-Funded Financial Institutions (issued by the SC on February 25, 1994 and was effective from April 1, 1994) (PRC) Article 34; Notice Regarding Appointment of Registered Certified Public Accountants (CPAs) for Foreign Financial Institutions on Auditing (issued by the People's Bank of China (PBOC) on April 30, 1996) (PRC); Notice Regarding Reinforcement of External Audit for Foreign Banks (issued by the PBOC on November 28, 1998) (PRC); Guideline Opinions Regarding External Audit of Foreign Banks (issued by the PBOC on May 6, 1999) (PRC).

[38] Cai zheng bu guan yu yin fa <guo you qi ye nian du kuai ji bao biao zhu ce kuai ji shi shen ji zan xing ban fa> de tong zhi [Notice of MOF Regarding Issuing the Interim Measures of SOEs' Annual Accounting Reports Audited by Registered CPAs] (issued by the MOF on October 22, 1998) (PRC), Preamble and Articles 3 & 5. These Interim Measures were repealed by Cai zheng bu guan yu gai jin he jia qiang qi ye nian du kuai ji bao biao shen ji gong zuo guan li de ruo gan gui ding [Certain Measures of the MOF Regarding Improving and Reinforcing Enterprises' Annual Accounting Reports Audited by Registered CPAs] (issued by the MOF on January 17, 2004 and was effective from February 1, 2004) (PRC) Article 1.

[39] Interim Measures of SOEs' Annual Accounting Reports Audited by Registered CPAs, supra note 38, Preamble; Certain Measures of the MOF Regarding Improving and Reinforcing Enterprises' Annual Accounting Reports Audited by Registered CPAs, supra note 38, Article 2.

[40] Interim Provisions on the Management of the Issuing and Trading of Stocks (issued by the SC on April 22, 1993) (PRC) Articles 57 and 59 [hereinafter SC Interim Provisions].

[41] Sheng ci gong xi xin xi pi lu kuan li ban fa [Administrative Measures for the Disclosure of Information of Listed Companies] (issued by the CSRC on January 30, 2007) (PRC) [hereinafter CSRC Administrative Measure] Article 19.

[42] Zhong hua ren min gong he guo zheng quan fa [Securities Law of the PRC] (promulgated by the Standing Committee of the National People's Congress (NPC) on October 27, 2005 and was effective from January 1, 2006) (PRC) [hereinafter Securities Law] Article 66.

law issued by the Standing Committee of the NPC, which has a higher level of legal effect than regulation and rule.[43] It appears that the Chinese government is not willing to place external audit requirement at the highest level of laws.

For unlisted or local Chinese banks, though there are requirements in various laws, regulations and rules regarding the "audit" of financial reports,[44] in the past, the word "audit" had been interpreted broadly as internal audit or audit by one of the ministries of the SC, NAO, instead of performing by external accounting firms, and the audit results were not disclosed to the public.[45] Moreover, NAO mainly focused on auditing the losses of state-owned assets,[46] unlike the scope of work of external auditors. Furthermore, during implementation of laws or rules regarding audit requirement, the authorities are allowed to grant exemption to certain banks. Currently, CBRC, the regulator of the banking sector, only requires banks with total assets exceeding RMB1 billion to have their financial statements audited by qualified external accounting firms.[47] It appears that the Chinese government

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[43] Zhong hua ren min gong he guo li fa fa [The Law on Legislation of the PRC] (promulgated by the NPC on March 15, 2000 and was effective from July 1, 2000) (PRC) Article 79.

[44] E.g., Zhong hua ren min gong he guo shang ye yin hang fa [Law of the PRC on Commercial Bank] [hereinafter CB Law] 1995, Article 56; CB Law 2003, Article 56. In the past, Company Law only required companies to prepare annual financial reports which were subject to examination and verification. See Zhong hua ren min gong he guo gong si fa [Company Law of the PRC] (promulgated by the NPC on December 29, 1993 and was effective from July 1, 1994) (PRC) Article 175 and Zhong hua ren min gong he guo gong si fa (2005 xiu ding) [Company Law of the PRC (2005 revised)] (promulgated by the Standing Committee of the NPC on October 27, 2005 and was effective from January 1, 2006) (PRC) [hereinafter Company Law 2005] Article 165. Company Law 2005 requires companies to prepare the annual financial report and the reports are required to be audited according to laws, regulations and rules. The newly revised Company law 2014 requires company to be audited by an accounting firm according to the law, Article 164. Interim Measures for the Information Disclosure of Commercial Banks (promulgated by the PBOC on May 15, 2002) (PRC) Article 6; Measures for the Information Disclosure of Commercial Banks (promulgated by the China Banking Regulatory Commission (CBRC) on July 3, 2007) (PRC) Article 6; CSRC Administrative Measure, supra note 41, Article 19; Financial Rules for Financial Enterprises (issued by the MOF on December 7, 2006 and was effective from January 1, 2007) (PRC) Article 58.

[45] Zhong hua ren min gong he guo xian fa [Constitution of the PRC (2004)] (revised by the NPC on March 14, 2004) (PRC) Article 91 which stipulates that revenues and expenditures of financial organizations are supervised by NAO; Zhong hua ren min gong he guo shen ji fa (2006 xiu zheng) [Audit Law of the PRC (Revision 2006) (promulgated and revised by the Standing Committee of the NPC on February 28, 2006) (PRC) Articles 2, 18 & 21 which stipulates that NAO performs audit supervision to the revenues and expenditures of SOCBs. Also see Wang Jingfang, *Lun wo guo shang ye yin hang wai bu shen ji zhi du he mo shi de chuang xin [On External Auditing System and Model Innovation by Our Commercial Banks]*, 7 Jin rong lun tan [Finance Forum] 57 (2004), at 58-59; Nong Hang Hu Bei Sheng Fen Hang Shen Ji Chu & Hu Bei Sheng Nei Bu Shen Ji Shi Xie Hui Ke Ti Zu, *Lun guo you shang ye yin hang gong shi zhi li guan li zhong de shen ji yue shu wen ti yu dui ce [Discussion on Audit Constraints in Corporate Governance and the Countermeasures for the State-owned Commercial Banks], in* Zhong guo nei bu shen ji xie hui 2006 nian du quan guo "gong si zhi li yu nei bu shen ji" li lun yan tao ji jing yan jiao liu hui yi er deng jiang lun wen hui bien (2005-2007) [China Institute of Internal Audit: 2006 National Conference on "Corporate Governance and Internal Audit" Best Papers on Internal Auditing (2005-2007)] (China Institute of Internal Audit 2006), at 242; Jiang Jianhua, *Lun ru shi hou jin rong shen ji dui shang ye yin hang de jian du [Discuss about the Supervision of the Financial Audit of Commercial Banks]*, 11 Jin yong zong heng [Financial Perspectives Journal] 40 (2003), at 40; Qin Huizhong, *Yin ru she hui zhong jie ji gou yu yin hang jian guan [The Introduction of Social Intermediary Organizations Involved in Banking Supervision]*, 19 Zhong guo jin rong [China Finance] 29 (2003), at 30.

[46] Jiang Jianhua, supra note 45, at 41.

[47] International Monetary Fund (IMF) Monetary and Capital Markets Department & The World Bank Financial and Private Sector Development Vice Presidency East Asia and Pacific Region Vice Presidency, Financial Sector Assessment Program PRC: Basel Core Principles for Effective Banking Supervision – Detailed Assessment of Observance 90 (IMF & WB 2012).

prefers to use lower level of regulations or rules to gradually implement the audit requirement and preferably to larger banks first.

With insufficient attention by the Chinese government to external audit requirement, the development of the audit profession in China is still in its nascent stage. Most of the audit firms in China are still very small with insfficient resources in terms of qualified auditors,[48] which will have impact on the quality of audit. Even though the Chinese government is currently encouraging the development of local firms especially in the securities market and the banking sector,[49] the global big four accounting firms i.e. PWC, Deloitte Touche Tohmatsu, KPMG and Ernst & Young (E&Y), occupy the audit market in China in terms of revenue earned[50] and total capitalization of the listed companies audited.[51] Probably, the local firms are still lack of the experience and capacity to deal with complicated and complex companies.

2. Insufficient regulations relating to audit independence

Audit independence can help maintain the quality of audit services. Auditor should be free of any influence, interest or relationship that might impair professional judgment or objectivity or, in the view of the reasonable investor, might impair professional judgment or objectivity.[52] Auditors must be independent of the entities they audit, in both fact and appearance.[53] However, audit firms which rely on the fees of clients for their services could inherently lead to conflict of interest issue.[54]

Audit independence is always a challenging issue not only in China but also in other countries, like the US and the EU. There are various measures to help improve the audit independence as implemented by the above countries. In the US, one of the key issues addressed by the audit profession and by regulators involves auditor independence after a series of serious accounting scandals in early 2000s.[55] In response to the accounting scandals, Sarbanes-Oxley Act (SO Act) was enacted in 2002 to protect investors by improving the

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[48] See Directorate General for Internal market and Services (DGIMS), Consultation on Control Structures in Audit Firms and Their Consequences on the Audit Market – Summary Report 7 (DGIMS 2010) [hereinafter DGIMS Report].

[49] See A Plus, Mainland Emerges as Rotation Laboratory, A Plus, Augus 2013, at 19.

[50] CICPA website, Zhong guo zhu ce kuai ji shi xie hui guan yu fa bu <2012 nian kuai ji shi shi wu suo zong he ping jia qian bai jia zi xun> de tong gao [CICPA released Notice of <the 2012 Comprehensive Evaluation Information of Top 100 Accounting Firms>], available at: http://www.71cpa.org.cn/tztg/201207/t20120730_34855.html.

[51] PBOC website, Wo guo shang shi gong si 2010 nian zhi xing qi ye kuai ji zhun ze qing kuang fen xe bao guo [Implementation of Accounting Standards Analysis Report for China's Listed Companies in 2010], at 2, available at: http://kjs.mof.gov.cn/zhengwuxinxi/diaochayanjiu/.

[52] IOSCO, Objectives and Principles of Securities Regulation 9 (IOSCO 2010); IOSCO, Methodology for Assessing Implementation of the IOSCO Objectives and Principles of Securities Regulation 120 (IOSCO 2011) [hereinafter IOSCO Methodology].

[53] IOSCO Methodology, supra note 52.

[54] See JOHN C. COFFEE JR., supra note 6, at 286.

[55] Certified General Accountants website, Recovery of the Accounting Profession Post-Enron, at 2, available at: http://www.cga-pdnet.org/Non_VerifiableProducts/ArticlePublication/RecoveryAccountingProfession/RecoveryAccountingProfession_p2.pdf.

accuracy and reliability of corporate disclosures, including some sections on the enhancement of auditor independence.[56] For instance, SO Act specifies that certain non-audit services, including bookkeeping or other services related to the audit client's accounting records or financial statements; financial information systems design and implementation; appraisal or valuation services; internal audits outsourcing services; management functions or human resources; legal services and expert services unrelated to the audit; etc., are prohibited.[57] Also, the Act requires a five-year lead (or coordinating) audit partner mandatory rotation on public company engagements.[58] There has been also discussion on mandatory rotation of audit firm as a way to enhance auditor independence, objectivity and skepticism.[59]

In the EU, lately, there is a concern regarding the low switching rates of audit firms which may pose the risk of over familiarity between auditor and auditee and may in turn impair professional skepticism and audit independence.[60] Joint audit, i.e. two firms appointed for one audit engagement, is currently a mandatory requirement in France, the only Member State in the EU implementing this measure.[61] Moreover, the EU will implement the rotation of audit firms, despite their existing requirement for rotation of audit partner.[62] Currently, the rotation of audit firm is a mandatory requirement in Italy.[63] In the UK, according to the revised UK Corporate Governance Code, FTSE 350 companies are required to put the external audit contract out to tender at least every ten years,[64] though this Code adopts a "comply or explain" approach.[65] To enhance independence of auditors, a new statutory audit framework will be implemented for mandatory rotation of audit firms for public-interest entities in the EU, including banks, listed companies, etc., applicable on June 17, 2016.[66]

In addition, like the US, in the EU, there is also a concern regarding the relatively high

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[56] Public Law 107-204 of July 30, 2002, Preamble and Sections 201-209.

[57] Id., Section 201.

[58] Id., Section 203.

[59] See PCAOB website, James R. Doty, Statement on Public Meeting On Auditor Independence and Audit Firm Rotation, October 18, 2012, available at: http://pcaobus.org/News/Speech/Pages/10182012_DotyOpeningStatement.aspx; PCAOB website, Concept Release on Auditor Independence and Audit Firm Rotation, Notice of Roundtable, PCAOB Release No. 2011-006, August 16, 2011, at 2, available at: http://pcaobus.org/rules/rulemaking/docket037/release_2011-006.pdf.

[60] EC, Commission Staff Working Paper Impact Assessment: Accompanying the Document Proposal for a Directive of the European Parliament and of the Council amending Directive 2006/43/EC on Statutory Audits of Annual Accounts and Consolidated Accounts and a Proposal for a Regulation of the European Parliament and of the Council on Specific Requirements Regarding Statutory Audit of Public-interest Entities 123 (EC November 2011) [hereinafter Commission Staff Working Paper]. See also Joelle Le Vourc'h & Pascal Morand, Final Report: Study on the Effect of the Implementation of the Acquis on Statutory Audits of Annual and Consolidated Accounts Including the Consequences on the Audit Market 7 (ESCP Europe 2011).

[61] DGIMS Report, supra note 48, at 19.

[62] For rotation of audit partner, in the EU, see Directive 2006/43/EC of the European Parliament and of the Council of 17 May 2006 on Statutory Audits of Annual Accounts and Consolidated Accounts, amending Council Directives 78/660/EC and 83/349/EEC and repealing Council Directive 84/253/EEC, Article 42; Regulation (EU) No 537/2014 of The European Parliament and of The Council of 16 April 2014 on specific requirements regarding statutory audit of public-interest entities and repealing Commission Decision 2005/909/EC [hereinafter Regulation No 537/2014], Article 17.

[63] Commission Staff Working Paper, supra note 60, at 122-123 & 171.

[64] FRC, The UK Corporate Governance Code 19 (FRC 2012).

[65] Id., at 4.

[66] Regulation No 537/2014, supra note 62.

level of audit firms' revenues deriving from non-audit services as it is also considered as one of the factors that affects the independence of audit firms. There may be a risk of cross-subsidization using audit as a loss leader to sell higher margin consulting services, especially big four accounting firms have targeted non-audit services.[67] Currently, in France, there is a strict restriction of the provision of non-audit services to statutory audit clients within the EU.[68] In the UK, FRC provides Ethical Standards on how to deal with non-audit services.[69] The new statutory audit framework to be implemented in the EU in 2016 also covers the non-audit services provided by auditors.[70] To enhance independence of auditors, regulators in the US and the EU are in the process of working and implementing tougher measures to ensure the provision of quality audit services.

In addition to all of the above, to maintain independent, as auditors, they are also required to comply with ethical standards issued by their professional bodies, which issue ethical standards usually in line with those issued by IFAC. IFAC, which is a global organization for accountancy profession, issues code of ethics to deal with independence of auditors.[71] However, these standards are relied on auditors' compliance, though auditors may be subject to disciplinary actions for violation by their professional bodies. The revised format of auditor's report in accordance with ISAs requiring auditors to include a statement of their independence in the auditor's report may place more accountability to auditors during their audits.[72]

In China, independence of auditor may be particularly required of attention. The accounting market in China is in keen competition. To secure business, audit firms must maintain good "guanxi", i.e. good relationship, with their clients for business. To maintain a good relationship for business, there is a concern that clients may become too close to their auditors and clients may also be able to exert certain influence on the audit. It may result in a situation where auditors trade off quality standards for profitability. Moreover, the competition could result in cases of predatory pricing by audit firms as they try to maintain or increase their market share.[73] An audit work in China can be as low as RMB50.[74] From a longer term perspective, reduced audit fees could result in audit firms scaling back investments in people, training and methodology improvements which may put the long term sustainability of a quality audit in jeopardy.[75] To further complicate the issue, other than clients' influence, political interference may also affect the independence of auditors, e.g. local government requests for a favorable audit report for companies to be listed to benefit

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[67] Joelle Le Vourc'h & Pascal Morand, supra note 60, at 8.

[68] Id., at 65.

[69] See FRC website, APB Ethical Standards 5 (Revised) – Non-audit Services Provided to Audit Entities, December 2011, available at: http://www.frc.org.uk/Our-Work/Codes-Standards/Audit-and-assurance/Standards-and-guidance/Standards-and-guidance-for-auditors/Ethical-standards-for-auditors.aspx.

[70] Regulation No 537/2014, supra note 62, Article 5.

[71] International Ethics Standards Board for Accountants, Handbook of Code of Ethics for Profession Accountant: 2012 Edition (IFAC 2012).

[72] See Reporting on Audited Financial Statements, supra note 12, at 9.

[73] CPAB Report, supra note 33, at 9.

[74] MOF website, Zhu ce kuai ji shi hang ye xing zheng guan li diao yan bao gao [Administrative Management Research Report on the CPA Profession] available at: http://kjs.mof.gov.cn/zhengwuxinxi/diaochayanjiu/.

[75] CPAB Report, supra note 33, at 9.

the local economy.[76]

There are more measures implemented in China lately to ensure the independence of auditors but their results remain to be seen. Similar to the measure in the US and the EU, in China, change of the signatory auditors after five years is required.[77] In addition, since 2011, for hiring auditors, financial institutions require to follow the stipulated bidding process and re-start the bidding process again for the continuous of employment of the audit firms after five years.[78] Though China took an early lead in audit rotation, the rotation resulted in a downward of audit fees due to competition in the first round of the rotation, leading to the concern of long-term audit quality.[79]

Moreover, in China, some of the measures to enhance audit independence seem lack of clarity. According to the Law on the CPAs, auditors can provide accounting consultancy and accounting services to clients and there is currently no other law, regulation or rule on how to deal with non-audit services,[80] except normative documents, which are strictly speaking not legal documents, stipulating that an accounting firm which provides internal control consultancy services for an enterprise cannot concurrently provide internal control auditing services for the enterprise.[81] In addition, according to CBRC's normative document, accounting firms in China are only advised not to provide consultation service to its audited clients.[82] It is not a mandatory requirement, meaning accounting firms could provide various types of consultation services to their clients.

It appears that in theory auditors in China are independent in their provision of services. However, it may be difficult for them to carry out their jobs independently in practice. Although there are some measures implemented in line with those of western countries to deal with independent issues, the measures are not comprehensive and not specific to the situations for China. In particular the issue of political pressure, it relies solely on auditor to uphold the accounting and auditing standards, which apparently is not an effective way of resolution. MOF and CICPA could provide more guidance on a mechanism for audit independence and establish a mechanism that performs regular reviews of audit firms and auditors in the area of independence.

3. Legal constraint during the audit process

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[76] Administrative Management Research Report on the CPA Profession, supra note 74.

[77] Notice of the MOF on Issuing the Measures for Financial Enterprises to Select and Employ Accounting Firms by Bidding (for Trial Implementation) (issued by the MOF on December 3, 2010 and was effective from January 1, 2011) (PRC) [hereinafter MOF Notice on Accounting Firms], Article 30; Yin hang ye jin rong ji gou wai bu shen ji jian guan zhi yin [Guidelines on External Audit for Financial Institutions] (issued by the CBRC on August 11, 2010) (PRC) [hereinafter CBRC Guidelines on External Audit] Article 11.

[78] MOF Notice on Accounting Firms, supra note 77, Articles 5, 28 & 29.

[79] A Plus, supra note 49.

[80] Law of the PRC on CPAs (promulgated by the Standing Committee of the NPC on October 31, 1993 and was effective from January 1, 1994) (PRC) Article 15.

[81] Notice of the MOF, CSRC, NAO, CBRC and China Insurance Regulatory Commission (CIRC) on Issuing the Basic Internal Control Norms for Enterprises (promulgated by the MOF, CSRC, NAO, CBRC and CIRC on May 22, 2008 and was effective from July 1, 2009) (PRC) Article 10.

[82] CBRC Guidelines on External Audit, supra note 77, Article 12.

In China, further complicating the above issues, certain legal provisions may constraint the audit process and auditors leave no choice but may passively choose to comply with these laws and regulations. According to the Law of the PRC on Guarding State Secrets (Secrecy Law), matters which relate to the national security and interests and the leakage of which may damage the national security and interests in the field of politics, economy, national defence, foreign affairs, etc. should be regarded as state secrets.[83] State secrets are broadly determined in Article 9 of Secrecy Law with one of the state secrets including other matters as determined by the state secrecy administrative department.[84] In addition to the above, in accordance with Measures on the Strengthening of the Works of Confidentiality and File Management for Overseas Securities Issued and Listing, accounting records, including audit working papers, may be subject to claims of state secrecy and also they should be stored in China.[85] Without the approval of relevant authorities, the above materials cannot be taken, sent or transmitted outside China.[86] Further, everyone, including accounting firm, should have the obligation of guarding state secrets and any violation will be subject to legal liability, or even criminal liability.[87]

In light of the above law and rule, auditors encounter a difficult situation to balance their obligations to provide professional services and their obligations to comply with regulator's oversight while at the same time their compliance with PRC law and rule. Based on the claim of state secret, currently, auditors may encounter two types of issues. Firstly, state secret may be used as a ground for companies to refuse to disclose information to auditors, like the China High Precision Automation Group Limited (High Precision) case in Hong Kong. High Precision used state secret as the reason for not giving information to its auditor, KPMG. Secondly, Chinese auditors are restricted to disclose information to overseas regulators due to state secret. For the recent accounting failures of Chinese listed companies, overseas regulators were unable to obtain or review the relevant materials of the audit which were performed by auditors in China, claiming the violation of the state secrecy,[88] like the Longtop Financial Technologies (Longtop) case in the US and the Standard Water Limited (SWL) case in Hong Kong. Without audit information from Chinese auditors, it is difficult for regulators to pursue legal action and usually regulators just suspend trading or delist a stock after a company refuses to provide information, like Longtop.[89]

The above cases show some deficencies of the regulatory systems in these jurisdictions where China's secrecy law and regulation may be used to prevent disclosure of information to auditors and regulators. There is no stipulated procedure to handle this kind of issue.

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[83] Zhong hua ren min gong he guo bao shou guo jia mi mi fa [Law of the PRC on Guarding State Secrets] (Standing Committee of the NPC revised on April 29, 2010 and was effective from October 1, 2010) (PRC) Articles 2 & 9.

[84] Id., Article 9(7).

[85] Guan yu jia qiang zai jing wai fa xing zheng quan yu shang shi xiang guan bao mi he dang an guan li gong zuo de gui ding [Measures on the Strengthening of the Works of Confidentiality and File Management for Overseas Securities Issued and Listing] (issued by the CSRC, National Administration for the Protection of State Secrets and the State Archives Administration of the PRC) (PRC) [hereinafter Secrecy Measure] Article 6.

[86] Id., Article 6.

[87] Secrecy Law, supra note 83, Articles 3, 48 & 49; Secrecy Measure, supra note 85, Article 9.

[88] Shen Hu and Zhang Tao, supra note 28.

[89] Id.

Moreover, there is no international auditing standard provided to auditors on how to handle state secrets. There should be some institutional changes to prevent any potential systemic risk and for the healthy development of the economy. For the first issue, regulators and the Exchanges may consider measures to tackle companies' refusal of information disclosure for securities issued when companies use state secrets as basis. For auditors, there should be more audit procedures to obtain evidence for their audits of Chinese companies, if certain information is refused to be disclosed by client. Even for SOEs or SOCBs, which may probably be bailed out by the government in difficulties, auditor should not at any time take this as a decisive consideration in making the going concern judgment.[90] Besides, not only SOEs but also privately-owned enterprises could use state secrets as reasons for non-disclosure. Professional skepticism should be exercised to ensure the reliability of information. Auditor may resign from the job engagement and/or communicate with regulators, if deemed necessary or required. For the second issue, legal proceedings or reforms could be proceeded. In the US, on May 9, 2012, Securities and Exchange Commission (SEC), the regulator of the securities market in the US, brought a public administrative proceedings against Deloitte Shanghai pursuant to Rule 102(e)(1)(iii) of the Commission's Rules of Practice for Deloitte Shanghai's willful failure to provide audit work papers of a client which was in violation of Section 106 of SO Act of 2002.[91] In violation, the court will determine if the auditor in China be censured or denied the privilege of appearance and practice.[92] In 2015, a settlement of US$2 million for failing to provide audit papers for investigation was finally made between the SEC and the big four accounting fims, with each of the firm paying US$500,000.[93] In addition to the involvement of judicial proceedings, in the US, the PCAOB issued a policy in October, 2010 making the inability to inspect auditors in nations such as China a factor when considering whether to approve for registration of CPA firm in the US.[94] The accounting board rejected an application by Hong Kong-based Zhonglei CPA Co. to become a registered US auditor in 2011, citing an inability to inspect its work for companies based in China.[95] It was the first time the PCAOB had rejected an application since tightening rules in October 2010.[96] PCAOB also sought to resolve the obstacles to PCAOB inspections with the relevant authorities in 16 jurisdictions, including

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[90] See SCEA Report, supra note 11, at 40.

[91] SEC website, Deloitte Touche Tohmatsu Certified Public Accountants Ltd., Release No. 66948, May 9, 2012, at 1-3 [hereinafter Deloitte-Release No.66948], available at: http://www.sec.gov/litigation/admin/2012/34-66948.pdf.

[92] Deloitte-Release No.66948, supra note 91.

[93] Wall Street Journal, Michael Rapoport, SEC, Big Four Accounting Firms in China Settle Dispute: Deal Over Refusal to Turn Over Audit Documents Lifts Threat of Suspension, February 6, 2015, available at: http://www.wsj.com/articles/sec-big-four-accounting-firms-in-china-settle-dispute-1423237083.

[94] PCAOB website, Consideration of Registration Applications From Public Accounting Firms in Non-U.S. Jurisdictions Where There Are Unresolved Obstacles to PCAOB Inspections, October 7, 2010, at 3, available at: http://pcaobus.org/International/Inspections/Documents/Registration_of_Non-US_Firms.pdf; Bloomberg, China Said to Discuss Allowing SEC Probes of Mainland Firms for First Time, July 5,2011 [hereinafter Bloomberg's Article on July 5, 2011], available at: http://www.bloomberg.com/news/2011-07-05/china-said-to-discuss-allowing-sec-probes-of-mainland-firms-for-first-time.html.

[95] Bloomberg's Article on July 5, 2011, supra note 94.

[96] Id.

China.[97] Meanwhile, in Hong Kong, in August 2012, pursuant to Section 185 of the Securities and Futures Ordinance, the Securities and Futures Commission (SFC), regulator of the exchange market in Hong Kong, has commenced legal proceedings against E&Y, the auditor of SWL, for failing to produce to the SFC specified accounting records.[98] The court could order E&Y to comply with SFC's requirement within a specified period if the court is satisfied that there is no reasonable excurse for E&Y not to comply with the requirement.[99] Moreover, the court could punish E&Y and any other person knowingly involved in the failure in the same manner as if he had been guilty of contempt of court.[100]

The above court cases in the US and Hong Kong vindicated, though in a long process, that auditors' refusal to provide audit papers based on state secret is not able to challenge the supremacy of the laws in respective jurisdictions.

4. Insufficient guidance on communication and coordination with regulators

The audit failure cases overseas showed that, in cases if there were any irrevocable conflicts with clients, auditors usually chose to resign from their engagements. Nevertheless, depending on the type and the level of seriousness of the issues in conflicts, auditors in accordance with laws may have legal obligation to report to regulators. In the US, in certain situations, like detecting illegal acts that would have a direct and material effect on the determination of financial statement amounts, auditors are required to report to management, the audit committee, the board of directors or lastly to the SEC, unless the illegal act is clearly inconsequential.[101] In the UK, auditors are also required by law to provide information to the FSA who also has powers to make rules imposing duties on auditors to make reports to the regulator about aspects of firms' business.[102] Nevertheless, it is found that auditors seldom report cases in violation of laws to regulators. After the financial crisis, it is found that, in the UK, if any events exist that may trigger the legal obligation to report, the auditor, instead directly reporting the potential breach, persuades bank itself to notify the regulator of the potential breach.[103] It appears that auditors may emphasis on maintaining the auditor-client-relationship and keeping client confidentiality in preference to disclosing information to a regulator in the public interests, regardless the reporting duties of auditors to regulator as stipulated in regulations and auditing standards.[104]

To protect public interest, the EU recently requires the duty of report by auditor to the

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[97] PCAOB website, Updated Information on PCAOB International Inspections, June 30, 2012, at 2-3, available at: http://pcaobus.org/International/Inspections/Pages/default.aspx.

[98] SFC website, SFC Commences Legal Proceedings against E&Y over Access to Accounting Records, August 27, 2012, available at: http://www.sfc.hk/edistributionWeb/gateway/EN/news-and-announcements/news/?year=2012&month=8.

[99] Securities and Futures Ordinance, Section 185(1).

[100] Id.

[101] Securities Exchange Act of 1934, Section 10A.

[102] HM Treasury, A New Approach to Financial Regulation: Securing Stability, Protecting Consumers 39 (HM Treasury 2012) [hereinafter Treasury Report].

[103] FSA & FRC, Enhancing the Auditor's Contribution to Prudential Regulation 30 (FSA & FRC, Discussion Paper 10/3, 2010).

[104] Id., at 29-30.

regulator / supervisor information concerning the public-interest entity in case of some irregularities.[105] The role of auditor is expected beyond only exercising reasonable care and skills in his engagement. Rather, in case of suspicion, auditor should be more vigilant, exercise professional skeptism and investigate more. In compliance with relevant regulations, auditor is also expected to be a whistle blower and intitiate timely communication with regulator on cases in violation of laws or regulations to protect investors and public interest.

In addition to the reporting obligation by auditors to regulators, after the financial crisis, the requirement for regular communication (1) between supervisors and auditors; and (2) between the auditor and the audit committee of the audited companies are reinforced. In the UK, Financial Services Authority (FSA), the then regulator of the financial market in the UK, issued a guidance for the relationship between the external auditor and the supervisor in 2011 which encourages bilateral and trilateral formal meetings as well as informal communications between auditors and supervisors.[106] Meanwhile, information provided by auditor to supervisor will not contravene the duty of auditor if he is acting in good faith and he reasonably believes that the information or opinion is relevant to any functions of the supervisor.[107] In addition to the above, Financial Services Bill extends the power of regulator to impose various sanctions for violation by auditors, like censure, financial penalties.[108] Further, communication between auditor and audit committee of audited company is important as it facilitates audit committees' financial reporting oversight, fostering improved financial reporting and result in benefitting investors.[109] In the US, PCAOB completed a new audit standard on communication between auditor and audit committee which provides list of matters, like information related to significant unusual transaction, etc. for auditor to be discussed with audit committee before the issuance of the audit report.[110] In the UK, the FRC also revised the Guidance on Audit Committees in 2012 which provides guidance on the roles and responsibilities of audit committee, including the detailed works of overseeing external auditor.[111] In the EU, the new statutory audit framework also stipulates the communication between auditors and audit committees.[112] The duties of auditors are expected to be more onerous requiring more communication and coordination with various related parties.

In China, similar to its counterparts, there is not sufficient communication between auditors and regulators and report by auditors to regulators is also uncommon in China. Usually, the accounting scandals in China have been committed by the senior level of management for a long period of time without exposure to the public and their exposures are usually discovered like by media, not the regulators nor the auditors.[113]

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[105] Regulation No 537/2014, supra note 62, Article 12.

[106] FSA, Finalised Guidance: Code of Practice for the Relationship between the External Auditor and the Supervisor 2 (FSA. May 2011) [hereinafter FSA Code of Practice].

[107] Financial Services and Markets Act 2000, Sections 342 and 343; FSA Code of Practice, supra note 106, at 4.

[108] Treasury Report, supra note 102.

[109] PCAOB website, PCAOB Release No. 2012-004, August 15, 2012, at 2-3, available at: http://pcaobus.org/Rules/Rulemaking/Docket030/Release_2012-004.pdf.

[110] Id., at 10-11.

[111] FRC, Guidance on Audit Committees 10-16 (FRC 2012).

[112] Directive 2014/56/EU, supra note 17, Article 39.

[113] Ma Qiaozhen, *Zhong guo jin rong gao guan fu bai wen ti yan jiu ji dui ce qian xi [Brief Analysis Regarding*

Communication among audited companies, auditor and regulator is not sufficient possibly partly due to the unclear legal provisions or standards. For instance, in the banking sector, there is in lack of clear and unambiguous guidance regarding reporting obligation by auditor to regulator. Pursuant to CAS No.1613, it provides guidance on issues to be discussed or reported to regulator.[114] However, according to the above standard, communication with regulator still largely relies on the discretion of auditors and generally auditors are required to inform the management of banks or request their presence.[115] Though CBRC issued a guideline stipulated that banks cannot intervene the report by auditors to regulators on five situations, i.e. (1) serious violation of law, regulation or industry rules; (2) matters seriously affecting the on-going operations; (3) issuance of non-standard audit report; (4) fraudulent behaviors by management; and (5) serious conflict in decision making unit and key functional person resigns suddenly,[116] these Guidelines only state that banks cannot intervene the report of matters relating to the above five situations and there is no requirement for a mandatory report. The report to regulators is subject to the discretion of the auditors. Moreover, the above Guidelines also stipulate the holding of meetings between auditors and the CBRC.[117] However, there is no details regarding when the meeting to be held, how the meeting is held and what to be discussed in the meeting.

There is also a lack of clear guidance regarding the communication between audit committee and auditor, except as stipulated in the Codes on Corporate Governance for Listed Companies which state the responsibilities of audit committee, including (1) proposing the appointment or replacement of external auditors; (2) overseeing the company's internal audit system and its implementation; (3) communicating between the internal and external auditors; (4) inspecting company’s financial information and its disclosure; and (5) reviewing company's internal control system.[118] To enhance the independence of the audit committee, the Codes also stipulate that the majority members in the audit committee should be independent directors who should also be the convener and at least one should be accounting professional.[119] However, the above communication between audit committee and auditor is general in nature and does not specify the details of communications, e.g. the discussion of problems encountered during the audit process.

In accordance with regulations, if auditor could take a more proactive role in reporting cases, like illegal acts as stipulated in regulations, in advance to the attention of regulators instead of the comparatively more passive role of resignation at the very late stage of the scandals, regulators may be able to take more appropriate action earlier to protect the public interests. Regulators in China may also consider to revise their regulations in stipulating clear

the Study and Solution on the Scandals of the Senior Management of China's Finance], 6 Jing rong jin ji [Finance & Economy] 129 (2006), at 129.

[114] CAS No. 1613 – Relationship with Bank Regulator (issued by MOF on February 15, 2006 and was effective from January 1, 2007) (PRC) Article 22 & Chapters IV - V.

[115] Id.

[116] CBRC Guidelines on External Audit, supra note 77, Article 17.

[117] Id., Article 16.

[118] Shang shi gong si zhi li zhun ze [Codes on Corporate Governance for Listed Companies] (promulgated by the CSRC and the State Economic and Trade Commission on January 7, 2002) (PRC) Article 54.

[119] Id., Article 52.

and practical guidelines for bilateral and trilateral formal meetings among audited companies, auditors and regulators.

5. Limited liability risks to audit firms / auditors

Liability regime could be one of the factors which drive audit efforts.[120] Under joint and several liability, the auditor may deliver a higher audit effort as auditor has to compensate plaintiffs by damage payments if the company and/or the manager (as the co-defendant) be insolvent.[121] However, if the liability of auditor is limited, an auditor may have a reduced incentive to deliver high audit efforts given a relatively small threat of expected liability losses.[122]

Currently, in China, the possible legal liabilities on auditors and/or audit firms are mainly administrative punishment, which are rather lenient and lack of deterrent effect. MOF can only impose rather mild sanctions like warning.[123] Both criminal liabilities and civil liabilities are available for false reports or serious omission cases. Nevertheless, for civil claims, the compensation is limited to the untrue amounts, except in civil cases relating to false reports for listed companies in the securities market pursuance to the Securities Law. However, civil cases under Securities Law require a numbers of hurdles to be overcome before the cases to be lodged. Moreover, the courts prefer mediation over court proceedings. More importantly, civil liabilities mainly apply to audit firms not auditors. With most of the audit firms in China being limited liability companies, which bear legal liabilities with only their total assets, shareholders are shielded from any claims for compensation from companies, leading to the losses of creditors or investors in vain. Without proper deterrent measures from regulators and courts, compliance with relevant laws or rules may not be effective. Nevertheless, in China, audit firm in the form of limited liability company is now excluded from auditing of banks and listed companies. In recent years, there is a new requirement for the change of the form of audit firms to special general partnership in which a partner or several partners may bear unlimited liabilities or unlimited joint and several liabilities for his (their) intentional or serious wrongful act(s), and that this also the form of establishment for audit firms to be qualified to audit listed companies and banks,[124] that may help drive audit efforts.

The way forward and concluding remarks

A well-functioned disclosure system in financial reporting is important to protect the interests of stakeholders and for the stability of the financial system. Auditor plays an important role in

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[120] London Economics in association with Professor Ralf Ewert, Study on the Economic Impact of Auditors' Liability Regimes (MARK/2005/24/F): Final Report To EC-DG Internal Market and Services xli (London Economics in association with Professor Ralf Ewert, Goethe University, Frankfurt am Main, Germany 2006).

[121] See id., at 143.

[122] See id., at 143-144.

[123] MOF Bulletin No 22, supra note 27.

[124] Notice of the MOF and the CSRC on Adjusting the Application Conditions of Accounting Firms for Securities Qualifications (issued by the MOF and the CSRC on January 21, 2012) (PRC); MOF Notice on Accounting Firms, supra note 77, Chapter II.

the disclosure system in enhancing the credibility and reliability of information disclosed. After the financial crisis, the duties of auditor are expected to be more onerous. With professional knowledge and knowledge of client's business and operation, for public interest, auditor is expected to communicate more with regulator and act as a whistle blower beyond just exercising reasonable care and skills as expected in the past. Auditor could also perform as a conduit for information exchange between audit committee of audited company and regulator, especially in communicating, clarifying and ascertaining some significant accounting information, like accounting estimates and valuation of financial products. Moreover, auditors in China need to focus more on the accuracy and the timeliness of information disclosed in the financial reports, in addtion to the sufficiency and relevance of information disclosed in line with international trend.

To synchronize the revised roles of auditors and for the substainable and healthy development of the financial system, the Chinese government should take a firm and determined step forward to improve the legal and regulatory regime regulating auditors. In particular, there should be clear provisions to ensure the independence of auditors to enhance the quality of audit work. Legal liabilities of auditors and audit firms could be reviewed again to provide effective, proportionate and deterrent sanctions. To foster effective and efficient communication, from the legal perspective, there should be specific rules or guidance providing details regarding situations how, what and when auditors should report to the regulators without violating confidentiality between auditors and audited companies. There should also be guidelines regarding areas for communication among audit committees, auditors and regulators. In particular, it is important to provide guidelines on communication between audit committees and auditors and the report of the above communication to regulators and the users of financial reports.

A Premier on the Shanghai-Hong Kong Stock Connect

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In this paper, some premier findings on the Shanghai-Hong Kong Stock Connect are presented. The Shanghai-Hong Kong Stock Connect is a major step in the liberalization of China's capital markets. The Shanghai-Hong Kong Stock Connect is considered as a pioneer and a testing ground for the relaxation over the control of China's capital accounts. Findings in this paper provide some early evidence on the liberalization of China's capital markets. Some issues are suggested for further research.

Keywords: Shanghai-Hong Kong Stock Connect, Capital Market Liberalization, China.

JEL Classifications: F21, G15, O16

1. Introduction

Liberalization of capital market is an important policy decision. To emerging markets, the major advantage of a liberalized capital market is that it can attract more foreign investment and this will lead to greater potential for economic development. From a theoretical point of view, it depicts that liberalization of emerging capital markets can also enhance the efficiency of financial market by allowing its cost of equity capital to decrease (e.g., Stapleton and Subrahmanyan, 1977; Eun and Janakiramanan, 1986; and Stulz, 1999, etc.). Empirically, Henry (2000) provides international evidence to support this view. It is extensively documented in the literature that liberalization of capital market can bring a lower cost of equity capital which can lead to greater investment, hence higher growth potential of the economy.

Though it is well established that capital market liberalization is beneficial to emerging markets, the opening up of capital markets is not a simple consideration. For emerging markets, their infant capital markets are fragile to attacks by overseas speculative capital and financial security is always a major concern. Many emerging markets still recall the painful experience of the 1997 financial crises in which many emerging Asian capital markets were badly hit during the processes of liberalization of their capital markets. Therefore, it is not surprising to observe the opening of capital markets, in particular those of Asia, is occurring in a slow pace.

The issue of opening up capital markets is particularly crucial to China. China is the second largest economy in the world. In 2014, China's GDP reached US$9,240 billion, and is ranked second after the US, which has a GDP of US$16,800 billion. Despite of China's contribution to worldwide GDP, the Chinese capital markets remain underdeveloped. For example, China's capital account is not open and the Chinese currency, the Reminbi (RMB), is not freely convertible. As a result of this underdevelopment, China's capital account only accounts for less than three percent of global holdings of cross-border assets and liabilities. As mentioned in China's 12th Five-Year Plan, ambitious attempts will be made to liberalize its capital markets. Therefore, liberalization of the Chinese capital markets is an important topic, both in terms of policy and in terms of market impact. Academically, the opening of capital markets in China also provides a new testing ground on the benefits of capital market liberalization. The opening of capital markets in China is therefore an important area that deserves closer examination.

Nevertheless, a lot of controversial issues still remain in the debate of liberalization of China’s capital markets. The cause for financial security is often cited by government officials, think tanks and academics in the Mainland as the major source for taking a prudent step in the liberalization of China’s capital markets. The pace of liberalization of China’s capital accounts is not rapid.

The Shanghai-Hong Kong Stock Connect (SHSC) is the latest attempt of China’s efforts in the liberalization of its capital accounts. Through the SHSC, investors in Mainland China can invest directly in selected stocks in Hong Kong, and vice versa. Effectively, this can be considered as opening up China’s capital accounts in a small and well controlled scale. Needless to say, the launch of the SHSC was a major milestone of the liberalization of China’s capital markets.

To ascertain the successful launch of the SHSC, numerous seminars are organized in Shanghai and Hong Kong. For example, more than 100 conferences and workshops were organized in Mainland China to promote the SHSC. As the initial stage of the SHSC targets for the high net worth investors, more than 12,500 institutional and high new worth investors participated in these conferences and workshops. Similar approach was also adopted in Hong Kong. More than 140 seminars were organized in Hong Kong and more than 14,000 investors, including retail, institutional and sales executives participated in these seminars. Apart from Mainland China and Hong Kong, international roadshow activities were also organized. The Hong Kong Stock Exchange has organized roadshows in cities in the US, the UK, Canada, Europe, Middle East, Japan, Taiwan, Korea, Singapore and Australia. These international efforts have reached over 1,500 institutional investors. All these activities demonstrate that the Chinese Government and the Stock Exchange of Hong Kong are serious in making the SHSC a success.

The major implication of the SHSC is that it marked a major breakthrough of capital inflow and outflow of China. Before the SHSC, Chinese investors can only invest in the highly restricted Qualified Domestic Institutional Investors (QDII) scheme. The QDII can hardly be considered as a successful scheme in terms of opening up China’s capital accounts. QDII’s many constraints have, in practice, discouraged Chinese capital investment overseas. The SHSC can be considered as a major breakthrough in the process of opening up China’s capital accounts.

In this paper, some premier findings of the SHSC are contained. The objective of this paper is to document some preliminary findings of this important step of opening up China’s capital markets. The SHSC has in place since November 2014, but the trading was not active in the initial months. The short trading period, together with the problems of non-synchronous trading and availability of data, make it not feasible to draw meaningful conclusions from performing statistical analysis on the trading data. Hence, this paper is mainly descriptive in nature so as to document the development of the SHSC and to report some initial statistics of the SHSC.

Remainder of the paper is organized as follows. Section 2 describes the stock markets in China and Hong Kong, which aims to give readers a background on the development of the SHSC and the institutional issues faced by the SHSC. Section 3 explains the operation of the SHSC, the trading mechanism, as well as some technical details. Section 4 contains the preliminary statistics of the SHSC and offers some discussion of the findings. The final section concludes the paper.Methodology

2. Capital Markets in China and Hong Kong

The Chinese stock markets were established in 1990 in Shanghai and Shenzhen. Initially only domestic investors were allowed, which is known as the "A-share" market. Like any other typical emerging markets, the Chinese stock markets were characterized by strong government influence, insufficient protection to investors, low market transparency, and speculative in nature.

Later development of the Chinese stock markets called for more involvement from overseas capital. To attract overseas capital, a "B-share" market was created in 1992, which only overseas investors could participate. Since overseas investors were allowed, the establishment of the "B-share" market can be viewed as the first step to liberalize China's stock markets. Hence, there exist two segments in China's stock markets: the "A-share" market for domestic investors and the "B-share" market for overseas investors. The "A-share" market is traded in the Reminbi (RMB), while "B-share" market in Shanghai is traded in US dollar and that in Shenzhen is traded in Hong Kong dollar. Despite the establishment of the "B-share" market, this segment was inactive relative to the "A-share" market. The capitalization of the "B-share" market is small. Stocks that issued "A-shares" and "B-shares" typically exhibit discounts in the "B-share" markets. The average discount in the "B-share" market reached a record high of 86% in 2001 (He et. al., 2014).

Apart from the “B-share” market, Chinese firms are also listed in overseas stock markets. Hong Kong and New York are the most common stock markets for the Chinese firms to get listed overseas. The Chinese firms listed in Hong Kong are also known as the “H-shares.” For some big Chinese firms, they have strong links with the Chinese Government and these companies are known as “Red Chips.”

The Stock Exchange of Hong Kong (SEHK) is the only organised stock exchange in Hong Kong. At the end of 2014, more than 1,500 firms were listed on the SEHK. According to the International Finance Corporation (IFC), the Hong Kong stock market is classified into the upper income group, and Hong Kong has been considered a developed market by the IFC since 1993. The importance of the Hong Kong market can be revealed from the fact that Hong Kong is a major international financial centre in channelling investment funds to China. A lot of Chinese firms, the “red chips” and the “H-shares,” are listed on the SEHK (Neoh, 1998). Red chips are companies incorporated and listed in Hong Kong but whose controlling shareholders are China entities. Examples include CITIC Pacific, Guangdong Investment, China Travel and China Telecom. Large red chips are diversified conglomerates which have grown rapidly by injecting assets from their parent companies and raising funds from the public. Indeed, CITIC Pacific and Guangdong Investment were added to the Hang Seng Index, the most known and representative stock index of the Hong Kong market, in 1992 and 1994 respectively.

In 1993, Chinese state-owned enterprises (SOEs) started to issue shares in Hong Kong. These are called H-shares as the “H” denotes Hong Kong, the place in which the companies raise funds. Similarly, shares issued in London are called “L-shares,” and shares issued in Tokyo are called “T-shares.” Examples of H-shares include Tsingtao Brewery Company and Shanghai Petrochemical. Unlike the red chips, H-share companies tend to specialize in a single activity, usually heavy industry or a major infrastructure project. Not every Chinese SOE can issue H-shares on the SEHK. The SOEs are selected by the Chinese Government for their economic importance, management quality, technology, profitability and international significance. At the time of writing, there are around forty H-shares listed on the SEHK.

The listing of red chips and H-shares on the SEHK has been one of the most important events in the development of the Hong Kong stock market in recent years. By signalling to the international financial community that the SEHK is a gateway to China, Hong Kong has established itself as China’s primary source of external capital. Red chips and H-shares have become a small but stable component of the portfolios of many large institutional funds.

Table 1 shows the turnover of China-related stocks on the Hong Kong stock. As evinced by the figures in Table 1, turnover of China-related stocks constitute more than 50% of total turnover on the Stock Exchange of Hong Kong in recent years. This also demonstrates the importance of China related stocks in the investment community.

One particular thing to note is that there are many stocks which are dually listed in China and in Hong Kong. Many “A-shares” stocks also have Hong Kong listings, and it is not uncommon to observe price discrepancies among the “A-shares” and the “H-shares.” Simple finance theory posits that such price differences should lead to arbitrage activities. Limitations to arbitrage opportunities arise because China’s capital accounts are not open. Investors simply cannot buy and sell the same stock in China and Hong Kong to benefit from the price difference. The lack of effective capital flows effectively prohibits arbitrage actions.

The market is well aware of this issue. Indeed, there is a Hang Seng China AH Premium Index which tracks the average price difference of A-shares over H-shares for Chinese companies with both A-share and H-share listings. If the index is below (above) 100, that means the A-shares are traded at a discount (premium) relative to that of H-shares. When the index hits 100, the A-shares and H-shares are trading at par.

3. The Shanghai-Hong Kong Stock Connect

The SHSC was launched on November 17, 2014, which allows cross market investment between Shanghai and Hong Kong stock markets, subject to restrictions in the number of stocks and daily limit. For funds originating from Hong Kong and to be invested in the Shanghai Stock Exchange, the trading is known as the Northbound trading. For funds originating from China and to be invested in the Hong Kong Stock Exchange, this is known as the Southbound trading. The terms “Northbound” and “Southbound” vividly describe the geographical locations of the Shanghai and the Hong Kong stock exchanges.

There are separate daily trading limits for both the Northbound and the Southbound trading. The current daily limit for Northbound trading is set at RMB 13 billion, while that of the Southbound trading is set at RMB 10.5 billion. The trading limits are on a “net buy” basis. This means that the actual trading volumes can be larger than those of the trading limits, as long as the “net buy” positions are still within the prescribed daily limits. In addition to the daily trading limits, there are aggregate quotas for both Northbound and Southbound trading. The current aggregate quota for Northbound trading is RMB300 billion, while the aggregate quota of Southbound trading is RMB 250 billion. Utilization of the daily quota will be disseminated by the Hong Kong Stock Exchange on a 1-minute interval.

Not every stock listed on the Shanghai and Hong Kong stock markets can be included in the SHSC. For the Northbound trading, only 56 stocks are covered in the SHSC. Out of the 56 eligible stocks, 29 of them are qualified for buy and sell activities, while 27 stocks are for sold only. When compared with the Northbound trading, the number of stocks available for Southbound trading is 284, and all of them are eligible for both buy and sell. There are reasons for this difference. For the stocks covered in the Northbound trading, they are to be in the Shanghai Stock Exchange 180 Index or Shanghai Stock Exchange 300 Index, and they are to have both A and H shares. In addition, certain restrictions also apply. For the stocks that are covered in the Southbound trading, apart from certain restrictions, they are not necessary to be index constituent stocks. Hence, the number of stocks available for the Southbound trading exceeds that of Northbound trading by a large margin. In fact, many of the stocks available for the Southbound trading are relatively small and illiquid. The list of stocks available in the SHSC is contained in Table 2.

Trading is done via respective subsidiaries of the Shanghai and Hong Kong Stock Exchanges. Eligible investors are able to place their orders through conventional channels. The trading, however, needs to go through both Shanghai and Hong Kong stock exchanges instead of having one stock exchange to handle the logistics. Details of the trading mechanism are depicted in Figure 1. As seen from Figure 1, Mainland and Hong Kong investors can place their orders through their respective brokers. The orders, however, will go through the respective stock exchange first. Take the Northbound trading as an example. A Hong Kong investor will place his / her order through the broker. The broker will then direct the order to the Stock Exchange of Hong Kong, which will route the order to subsidiary of the Stock Exchange of Hong Kong, and the final order execution is done by the Shanghai Stock Exchange. The settlement of the trading is done by the ChinaClear. Similarly, a Mainland investor can place his / her order through his / her broker. The actual processing is done through the Shanghai Stock Exchange and then directed to the Stock Exchange of Hong Kong. The Hong Kong Securities Clearing will handle the clearing process in Hong Kong. Both the China Securities Regulation Commission in China and the Securities and Future Commission in Hong Kong will perform the roles of macro regulations of the securities, as well as that for the SHSC trading.

Some important points are to be noted. Hong Kong is an international financial market in which dividends and capital gains are exempted from taxes. On contrary, there are taxes on capital gain and dividend in China. Through the SHSC, investors can trade Chinese securities listed on the Shanghai Stock Exchange, hence they are subject to Chinese taxes. For cash and stock dividends, a standard tax rate of 10% will be withheld and paid to Chinese authorities by the respective listed companies. For capital gain taxes, it was resolved to be exempted from paying taxes. This represent a substantial difference between Chinese and overseas investors.

Also, short selling is regulated under the SHSC. Naked short selling is prohibited for both the Northbound and Southbound trading. Stock Borrowing and short selling, however, is allowed for the Northbound trading.

It is expected that many of the above mentioned regulations and limitations will be relaxed in the future. As mentioned by the officials of the Hong Kong Exchange, there are negotiations with the Chinese government on the relaxations on the daily trading limits in the future. At the time of writing, there is also a discussion of a similar initiative called “Shenzhen-Hong Kong Stock Connect,” which is to be modelled after the SHSC to allow cross border trading between the Shenzhen and Hong Kong stock exchanges. It is expected that the success of the SHSC will lead to greater flexibility in the design of the Shenzhen-Hong Kong Stock Connect

4. Preliminary Statistics and Discussion

In this section, some preliminary data and statistics on the SHSC are reported. Panels A and B of Table 3 report, respectively, the summary statistics of the Northbound and Southbound trading. From Panel A, the monthly turnover of the Northbound trading reached the highest level of RMB 137.5 billion in March 2015. When we look at the difference in the buy and sell trade, the net buy trade were RMB 40.6 billion, RMB 28 billion, RMB 11.3 billion, RMB 15.7 billion and RMB 9.8 billion, respectively, for the five months starting in November 2014. Given the fact that the daily limit on “net buy” basis for the Northbound trading is RMB 13 billion, the monthly net buy trades for the Northbound trading clearly did not utilize fully the allowable daily limit. Many people conjecture that the Northbound trading is not welcome by the investors. When compared with the trading volume of the Shanghai stock exchange, the trading activity of the Northbound trading can be considered as minimal. Further, the average daily buy trade is usually larger than the average daily sell trade. It can be viewed as the market's willingness to use the SHSC to enter the Shanghai stock market. Given the fact that the Shanghai stock index is on the upward trend during the sample period, it is conceivable to have more buy trades than sell trades originating from the Northbound trading. When one is to examine the impacts of the Southbound trading, a similar picture also exists. There are more buy trades, in terms of total volume, than sell trades.

This point can be further illustrated by the statistics in Table 4. Panel A shows the percentage of buy trades in total turnover for the Northbound trading. As evidenced by the numbers, buy trade constitute more than 50% of the total turnover in the first five months of the operation of the SHSC. There were only ten trading days for the first month of operation of the SHSC, which is not appropriate to use this as a demonstrable example. In the following four months, the buy trades typically occupy around 60% of total trading volume. When the same metric is examined for the Southbound trading, the buy trades even constitute higher percentages in total turnover. This simple statistic shows that the SHSC allows investors in both markets to invest through the SHSC. The initial stage suggests that investors are more inclined to buy stocks from the respective markets.

Also, the number of buy trades over the number of sell trades also suggests a similar conclusion. If we exclude the first month of operation of the SHSC, for the Northbound trading, the times of buy over sell trades range from 1.60 to 1.05, which indicate that there are more buy trades than sell trades. The numbers for Southbound trading range from 2.70 to 1.69, again consistent with that of the Northbound. Nevertheless, the higher times of buy over sell trades for the Southbound trading suggest that investors in the Mainland are more keen to buy Hong Kong stocks than selling their holdings.

The average size of the buy and sell trades also suggest some interesting findings. For the Northbound trading, the average trade size is smaller than that of the Southbound trading. However, the trading volume of Northbound trading is higher than the trading volume of Southbound trading. This means that despite the fact there are more trading activities in Northbound trading than in the Southbound trading, investors from Hong Kong typically conduct smaller trade than the Mainland investors doing the Southbound trading. This can be an indication that the Mainland investors are typically high net worth investors and their trading sizes are larger, while investors doing the Northbound trade are not as big as those in the Mainland.

Table 5 looks at the growth rate of the utilization of the SHSC over the first months of operation of the scheme. The results are mixed. For the Northbound trading, the growth in total turnover is substantial. The arithmetic monthly growth rate is 53.37%, while the geometric monthly growth rate is 35.26%. The overall growth rate during the sample period is 195.20%, which is a very encouraging finding. For the Southbound trading, the growth rate in total turnover is even more spectacular. The arithmetic monthly growth rate is 97.77%, while that of the geometric monthly growth rate is 56.11%. The overall growth rate during the sample period is 368.84%. Though the growth rates are encouraging, one must be cautious in reading these numbers as both the Northbound and Southbound trading are still in the early period of operations. The trading intensities are still yet to be established. The high growth rate figures may well be an indication that the bases for calculation of growth are still small.

Other growth measurements also suggest a very high growth period for the SHSC. Apart from the average size of daily buy trade and the average daily number of buy trades for the Northbound trading, all measurements exhibit remarkable growth rates. When a closer look is made to the Northbound trading, it can be seen that more drastic growth rates exist. The overall growth rate for sell trade turnover is 2,016.85%; but the average daily buy trade turnover has an overall growth rate of -23.16%. The corresponding numbers for the Southbound trading are not as drastic as those of the Northbound trading. It can be inferred from the growth rates that investors in the Northbound trading exhibit different trading behaviors than those of the Southbound trading.

The above discussion illustrates that the operating of the SHSC gives investors in Mainland and Hong Kong a good opportunity to invest in the other markets. The growth is rapid in early months, though the trading volumes do not match those of the respective home markets. In other words, if one is to judge the effectiveness of the SHSC in terms of flow of funds and trading volumes, the SHSC does not seem to be effective. However, as mentioned in Section 3, the SHSC has a bigger goal of providing a testing ground for the opening of China’s capital markets, as well as leading to the internationalization of the Reminbi. The smooth and orderly operation and execution of the SHSC can be considered as a success.

This finding contributes to one important element in the liberalization of China’s capital markets. To policy makers, the worry over interdependence of financial markets may lead to contagion effect of financial crises. However, this worry does not mean that China should not open up its capital markets. Forbes and Rigobon (2002) show that it is market interdependence and not contagion effect that exists in capital markets. When the Chinese capital markets are having greater interdependence with other capital markets (e.g., Johansson and Ljungwall, 2009; Lin et al., 2009; and Glick and Hutchison, 2013, etc.), the concern over contagion effect should not be over-emphasized.

As suggested by Rejeb and Boughrara (2013), liberalization of capital markets not only improves the degree of market efficiency, but it also reduces the chances of financial crises. Given the SHSC is able to achieve its objective, liberalization of capital markets can be carried out at a faster pace. It is recommended that the SHSC can relax some of its restrictions and put the SHSC to a greater scope of the testing ground in opening China's capital markets.

5. Conclusions

In this paper, some preliminary findings on the SHSC are presented. It is suggested that the SHSC has made some early successes in the opening up of China's capital markets. The statistics provided in this paper are mainly descriptive in nature, given the sample period is too short and the trading of the Northbound and Southbound are not active enough at the current moment to make any meaningful analyses. Nevertheless, findings in this paper suggest that the SHSC helps to speed up China's opening of capital markets. From a theoretical point of view, greater market efficiency will occur. A future research direction can be on the price discovery process of the SHSC. A recent paper by Chan and Kwok (2014) has some exploratory findings of the impacts of the SHSC before the launch of the scheme. Future research along the path of Chan and Kwok (2014) can be made by incorporating more updated data. This will also shed light into the questions of market efficiency and the relative roles of the stock exchanges in Shanghai and Hong Kong in the price discovery process. I leave this to future research.

Table 1: Turnover of Chinese Related Stocks on the Mainboard of Hong Kong Stock Market

Year	H-share		Red Chips		Total	
	HK$ (Billion)	% of equity Turnover	HK$ (Billion)	% of equity Turnover	HK$ (Billion)	% of equity Turnover
1993	33.04	3.01%	88.29	8.05%	121.33	11.07%
1994	34.21	3.32%	57.52	5.59%	91.72	8.91%
1995	17.29	2.27%	45.86	6.02%	63.15	8.29%
1996	24.89	1.93%	135.36	10.52%	160.25	12.45%
1997	297.77	8.48%	1043.67	29.71%	1341.44	38.19%
1998	73.54	4.61%	369.39	23.13%	442.93	27.74%
1999	102.79	5.80%	354.82	20.01%	457.61	25.81%
2000	164.31	5.74%	674.86	23.60%	839.17	29.34%
2001	245.20	13.47%	497.25	27.31%	742.45	40.77%
2002	139.71	9.50%	309.35	21.04%	449.07	30.54%
2003	501.50	22.12%	493.95	21.79%	995.44	43.92%
2004	933.86	27.49%	614.73	18.10%	1,548.59	45.58%
2005	949.16	26.46%	603.82	16.83%	1,552.98	43.29%
2006	2,521.76	39.26%	1,100.51	17.13%	3,622.27	56.39%
2007	7,748.90	46.93%	2,725.60	16.51%	10,474.50	63.44%
2008	6,130.59	48.53%	2,283.23	18.08%	8,413.82	66.61%
2009	5,152.81	44.56%	1,936.59	16.75%	7,089.40	61.30%
2010	4,700.84	38.29%	1,928.71	15.71%	6,629.55	54.00%
2011	4,662.79	38.84%	1,699.52	14.16%	6,362.31	52.99%
2012	3,681.42	38.77%	1,459.85	15.37%	5,141.27	54.14%
2013	4,217.37	37.85%	1,704.42	15.30%	5,921.79	53.14%
2014	4,398.54	35.27%	1,897.81	15.22%	6,296.35	50.49%

Source: Stock Exchange of Hong Kong

Table 2: Lists of Stocks Covered in the Shanghai-Hong Kong Stock Connect											
Panel A: Stocks Listed on Shanghai Stock Exchange (SSE)											
No	Stock Code	Stock Name	Buy / Sell	No	Stock Code	Stock Name	Buy / Sell	No	Stock Code	Stock Name	Buy / Sell
1	600860	Beijing Jingcheng Machinery Electric	Both	20	601339	Bros Eastern	Both	39	600246	Beijing Vantone Real Estate	Sell
2	600169	Taiyuan Heavy Industry	Both	21	601798	Lanpec Technologies	Both	40	600262	Inner Mongolia North Hauler	Sell
3	600180	Ccs Supply Chain Management	Both	22	603005	China Wafer Level Csp	Both	41	600287	Jiangsu Sainty	Sell
4	600255	Ahhui Xinke New Materials	Both	23	603006	Shanghai Lianming Machinery	Both	42	600337	Markor International Home Furnishings	Sell
5	600305	Jiangshu Hengshun Vinegar	Both	24	603009	Shanghai Beite Technology	Both	43	600368	Guangxi Wuzhou Communications	Sell
6	600399	Fushun Special Steel	Both	25	603126	Sinoma Energy Conservation	Both	44	600469	Aeolus Tyre	Sell
7	600416	Xiangtan Electric Manufacturing	Both	26	603168	Zhejiang Shapuaisi Pharmaceutical	Both	45	600475	Wuxi Huaguang Boiler	Sell
8	600490	Pengxin International Mining	Both	27	603288	Foshan Haitian Flavouring And Food	Both	46	600508	Shanghai Datun Energy Resourses	Sell
9	600537	Eging Photovoltaic Technology	Both	28	603328	Guangdong Ellington Electronics Technology	Both	47	600560	Beijing Aritime Intelligent Control	Sell
10	600562	Glarun Technology	Both	29	603369	Jiangsu King's Luck Brewery Joint-Stock	Both	48	600575	Wuhu Port Storage&Transportation	Sell
11	600621	Shanghai Chinafortune	Both	30	600082	Tianjin Hi-Tech Development	Sell	49	600589	Guangdong Rongtai Industry	Sell
12	600640	Besttone Holding	Both	31	600094	Greattown Holdings	Sell	50	600622	Shanghai Jiabao Industry & Commerce	Sell
13	600645	Zhongyuan Union Cell & Gene Engineering	Both	32	600097	Shanghai Kaichuang Marine International	Sell	51	600702	Sichuan Tuopai Shede Wine	Sell
14	600711	Chengtun Mining Group	Both	33	600121	Zhengzhou Coal Industry & Electric Power	Sell	52	600723	Beijing Capital Retailing	Sell
15	600716	Jiangsu Phoenix Property Investment	Both	34	600123	Shanxi Lanhua Sci-Tech Venture	Sell	53	600829	Harbin Pharm Group Sanjing Pharmaceutical	Sell
16	600736	Suzhou New District Hi-Tech Industrial	Both	35	600139	Sichuan Western Resources Holding	Sell	54	600975	Hunan New Wellfull	Sell
17	600802	Fujian Cement	Both	36	600193	Shanghai Prosolar Resource	Sell	55	601388	Yechiu Metal Recycling (China)	Sell
18	601199	Jiangsu Jiangnan Water	Both	37	600199	Anhui Golden Seed Winery	Sell	56	603001	Zhejiang Aokang Shoes	Sell
19	601218	Jiangsu Sinojit Wind Energy Technology	Both	38	600227	Guizhou Chitianhua	Sell				

Panel B: Panel A: Stocks Listed on Stock Exchange of Hong Kong (SEHK)								
No.	Stock Code	Stock Name	No.	Stock Code	Stock Name	No.	Stock Code	Stock Name
1	00001	CKH Holdings	96	00588	Beijing N Star	191	01378	Chinahongqiao
2	00002	CLP Holdings	97	00590	Luk Fook Hold	192	01382	Pacifictextiles
3	00003	HK & China Gas	98	00604	Shenzhen Invest	193	01387	Renhe Comm
4	00004	Wharf Holdings	99	00606	China Agri	194	01398	ICBC
5	00005	HSBC Holdings	100	00636	Kerry Log Net	195	01618	Mcc
6	00006	Power Assets	101	00639	Shougang Res	196	01619	Tianhe Chem
7	00008	PCCW	102	00656	Fosun Intl	197	01638	Kaisa Group
8	00011	Hang Seng Bank	103	00659	NWS Holdings	198	01668	Chinasouthcity
9	00012	Henderson Land	104	00669	Techtronic Ind	199	01680	Macau Legend
10	00013	Hutchison	105	00670	China East Air	200	01728	Zhengtongauto
11	00014	Hysan Dev	106	00683	Kerry Ppt	201	01766	CSR
12	00016	SHK Ppt	107	00688	China Overseas	202	01800	China Comm Cons
13	00017	New World Dev	108	00691	Shanshui Cement	203	01813	Kwg Property
14	00019	Swire Pacific A	109	00699	Car Inc	204	01816	Cgn Power
15	00020	Wheelock	110	00700	Tencent	205	01828	DCH Holdings
16	00023	Bank of East Asia	111	00728	China Telecom	206	01833	Intime
17	00027	Galaxy Ent	112	00732	Truly Int'l	207	01880	Belle Int'l
18	00038	First Tractor	113	00737	Hopewell Infr	208	01882	Haitian Int'l
19	00041	Great Eagle H	114	00751	Skyworth Digital	209	01888	Kb Laminates
20	00054	Hopewell Hold	115	00753	Air China	210	01898	China Coal
21	00066	MTR Corporation	116	00754	Hopson Dev Hold	211	01918	Sunac
22	00069	Shangri-La Asia	117	00762	China Unicom	212	01919	China Cosco

23	00081	China Overseas Gas Oceans	118	00787	Global Brands	213	01928	Sands China Ltd
24	00083	Sino Land	119	00813	Shimao Property	214	01929	Chow Tai Fook
25	00086	Sun Hung Kai Co	120	00817	Franshion Ppt	215	01958	Baic Motor
26	00101	Hang Lung Ppt	121	00829	Shenguan Hldgs	216	01972	Swireproperties
27	00107	Sichuan Express	122	00836	China Res Power	217	01988	Minsheng Bank
28	00119	Poly Property	123	00846	Mingfa Group	218	01999	Man Wah Hldgs
29	00123	Yuexiu Property	124	00857	Petrochina	219	02007	Country Garden
30	00135	Kunlun Energy	125	00861	Digital China	220	02008	Phoenix Tv
31	00142	First Pacific	126	00867	Cms	221	02009	Bbmg
32	00144	China Mer Hold	127	00868	Xinyi Glass	222	02018	Aac Tech
33	00148	Kingboard Chem	128	00874	Baiyunshan Ph	223	02020	Anta Sports
34	00151	Want Want China	129	00880	Sjm Holdings	224	02038	FIH
35	00152	Shenzhen Int'l	130	00881	Zhongsheng Hldg	225	02128	China Lesso
36	00165	China Everbright Ltd	131	00883	CNOOC	226	02168	Yingde Gases
37	00168	Tsingtao Brew	132	00902	Huaneng Power	227	02186	Luye Pharma
38	00173	K. Wah Int'l	133	00914	Anhui Conch	228	02196	Fosun Pharma
39	00175	Geely Auto	134	00916	China Longyuan	229	02238	Gac Group
40	00177	Jiangsu Express	135	00933	Bright oil	230	02282	Mgm China
41	00178	Sa Sa Int'l	136	00934	Sinopec Kantons	231	02313	Shenzhou Intl
42	00179	Johnson Elec H	137	00939	CCB	232	02314	Lee & Man Paper
43	00200	Melco Int'l Dev	138	00941	China Mobile	233	02318	Ping An
44	00215	Hutchtel Hk	139	00960	Longfor Ppt	234	02319	Mengniu Dairy
45	00220	U-President China	140	00966	China Taiping	235	02328	PICC P&C
46	00241	Ali Health	141	00967	Sound Global	236	02329	Guorui Ppt
47	00242	Shun Tak Hold	142	00968	Xinyi Solar	237	02333	Greatwall Motor
48	00257	China Everbright Int'l	143	00981	Smic	238	02356	Dahsing Banking

49	00267	CITIC	144	00991	Datang Power	239	02357	Avichina
50	00270	Guangdong Inv	145	00992	Lenovo Group	240	02380	China Power
51	00272	Shui On Land	146	00995	Anhuiexpressway	241	02382	Sunny Optical
52	00283	Goldin Ppt	147	00996	Carnival Group	242	02386	Sinopec Seg
53	00285	BYD Electronic	148	00998	Citic Bank	243	02388	BOC Hong Kong
54	00288	Wh Group	149	01038	CKI Holdings	244	02600	Chalco
55	00291	China Resources	150	01044	Hengan Int'l	245	02601	CPIC
56	00293	Cathay Pac Air	151	01053	Chongqing Iron	246	02607	Sh Pharma
57	00297	Sinofert	152	01055	China South Air	247	02628	China Life
58	00300	Kunming Machine	153	01060	Ali Pictures	248	02688	Enn Energy
59	00303	VTech Holdings	154	01065	Tianjin Capital	249	02689	Nd Paper
60	00308	China Travel Hk	155	01066	Weigao Group	250	02727	Sh Electric
61	00315	Smartone Tele	156	01071	Huadian Power	251	02777	R&F Properties
62	00316	Ooil	157	01072	Dongfang Elec	252	02866	CSCL
63	00317	Guangzhou Ship	158	01083	Towngas China	253	02877	Shineway Pharm
64	00322	Tingyi	159	01088	China Shenhua	254	02880	Dalian Port
65	00323	Maanshan Iron	160	01093	Cspc Pharma	255	02883	China Oilfield
66	00330	Esprit Holdings	161	01099	Sinopharm	256	02899	Zijin Mining
67	00336	Huabao Intl	162	01108	Luoyang Glass	257	03308	Golden Eagle
68	00338	Shanghai Pechem	163	01109	China Res Land	258	03311	China State Con
69	00358	Jiangxi Copper	164	01111	Chong Hing Bank	259	03323	CNBM
70	00363	Shanghai Ind H	165	01112	Biostime	260	03328	Bankcomm
71	00371	BJ Ent Water	166	01114	Brilliance Chi	261	03331	Vinda Int'l
72	00384	China Gas Hold	167	01117	Ch Modern D	262	03333	Evergrande
73	00386	Sinopec Corp	168	01128	Wynn Macau	263	03360	Fe Horizon
74	00388	HKEx	169	01136	Tcc Int'l Hold	264	03377	Sino-Ocean Land

75	00390	China Railway	170	01138	China Ship Dev	265	03380	Logan Ppt
76	00392	Beijing Ent	171	01165	Sfce	266	03383	Agile Property
77	00410	Soho China	172	01169	Haier Elec	267	03618	CQRC Bank
78	00425	Minth Group	173	01171	Yanzhou Coal	268	03699	Wanda Comm
79	00440	Dah Sing	174	01177	Sino Biopharm	269	03800	Gcl-Poly Energy
80	00460	Sihuan Pharm	175	01186	China Rail Cons	270	03808	Sinotruk
81	00489	Dongfeng Group	176	01193	China Res Gas	271	03888	Kingsoft
82	00493	Gome	177	01199	Cosco Pacific	272	03898	Csr Times Elec
83	00494	Li & Fung	178	01205	CITIC Resources	273	03899	Cimc Enric
84	00506	China Foods	179	01208	Mmg	274	03900	Greentown China
85	00511	TVB	180	01212	Lifestyle Int'l	275	03968	CM Bank
86	00522	ASM Pacific	181	01230	Yashili Int'l	276	03988	Bank Of China
87	00525	Guangshen Rail	182	01288	ABC	277	03993	Cmoc
88	00530	Goldin Fin-2k	183	01293	Baoxin Auto	278	03998	Bosideng
89	00548	Shenzhenexpress	184	01299	Aia	279	06030	Citic Sec
90	00551	Yue Yuen Ind	185	01313	Chinares Cement	280	06199	China Cnr
91	00552	Chinacomservice	186	01333	China Zhongwang	281	06808	Sunart Retail
92	00553	Nanjing Panda	187	01336	Nci	282	06818	CEB Bank
93	00564	Zmj	188	01339	Picc Group	283	06837	Haitong Sec
94	00566	Hanergy Tfp	189	01347	Hua Hong Semi	284	06863	Huishan Dairy
95	00586	Conch Venture	190	01359	China Cinda			

Table 3: Descriptive Statistics of the Shanghai-Hong Kong Stock Connect

Panel A: Northbound Trading

	Nov 2014	Dec 2014	Jan 2015	Feb 2015	Mar 2015
Turnover (Buy and Sell) (RMB Mil)	46,589.19	120,922.63	99,886.81	67,492.64	137,529.81
Buy Trade (RMB Mil)	43,571.71	74,469.42	55,604.07	41,620.35	73,654.36
Sell Trade (RMB Mil)	3,017.48	46,453.21	44,282.74	25,872.29	63,875.45
No. of Trades (Buy and Sell)	1,061,448	2,549,367	2,653,326	1,987,275	3,589,341
No. of Buy Trades	976,425	1,568,580	1,525,651	1,190,042	1,838,546
No. of Sell Trades	85,023	980,787	1,127,675	797,233	1,750,795
Average Daily Turnover (Buy + Sell Trades) (RMB Mil)	4,658.92	6,046.13	4,994.34	4,499.51	6,251.36
Average Daily Buy Trade (RMB Mil)	4,357.17	3,723.47	2,780.20	2,774.69	3,347.93
Average Daily Sell Trade (RMB Mil)	301.75	2,322.66	2,214.14	1,724.82	2,903.43
Average Daily No. of Buy + Sell Trades	106,144	127,468	132,665	132,484	163,151
Average Daily No. of Buy Trades	97,642	78,429	76,282	79,336	83,570
Average Daily No. of Sell Trades	8,502	49,039	56,383	53,148	79,581

Panel B: Southbound Trading

Turnover (Buy and Sell) (HKD Million)	7,600.25	18,410.75	30,719.76	10,217.84	35,632.91
Buy Trade (HKD Mil)	6,114.48	13,465.11	23,260.55	6,207.04	23,335.60
Sell Trade (HKD Mil)	1,485.77	4,945.64	7,459.21	4,010.80	12,297.31
No. of Buy + Sell Trades	154,316	314,305	485,814	207,279	599,092
No. of Buy Trades	118,591	229,263	360,103	130,232	402,090
No. of Sell Trades	35,725	85,042	125,711	77,047	197,002
Average Daily Turnover (Buy + Sell Trades) (HKD Mil)	760.03	1,022.82	1,535.99	785.98	1,619.68
Average Daily Buy Trade (HKD Mil)	611.45	748.06	1,163.03	477.46	1,060.71
Average Daily Sell Value (HKD Mil)	148.58	274.76	372.96	308.52	558.97
Average Daily No. of Buy + Sell Trades	15,431	17,460	24,290	15,943	27,230
Average Daily No. of Buy Trades	11,859	12,736	18,005	10,017	18,276
Average Daily No. of Sell Trades	3,572	4,724	6,285	5,926	8,954

Table 4: Comparison of Buy over Sell Trade of Shanghai-Hong Kong Stock Connect

Panel A: Northbound Trading

	2014/11	2014/12	2015/1	2015/2	2015/3
% of Buy in Total Turnover	93.52%	61.58%	55.67%	61.67%	53.56%
% of Sell in Total Turnover	6.48%	38.42%	44.33%	38.33%	46.44%
Times of Buy Over Sell	11.48	1.60	1.35	1.49	1.05
Average Buy Trade Size	44,623.71	47,475.69	36,446.13	34,973.85	40,061.20
Average Sell Trade Size	35,490.16	47,363.20	39,269.06	32,452.61	36,483.68

Panel B: Southbound Trading

	2014/11	2014/12	2015/1	2015/2	2015/3
% of Buy in Total Turnover	80.45%	73.14%	75.72%	60.75%	65.49%
% of Sell in Total Turnover	19.55%	26.86%	24.28%	39.25%	34.51%
Times of Buy Over Sell	3.32	2.70	2.86	1.69	2.04
Average Buy Trade Size	51,559.39	58,732.15	64,594.16	47,661.40	58,035.76
Average Sell Trade Size	41,589.08	58,155.26	59,336.18	52,056.54	62,422.26

Table 5: Growth Rate of Shanghai-Hong Kong Stock Connect

Panel A: Growth Rate of Northbound Trading (in Percentages)

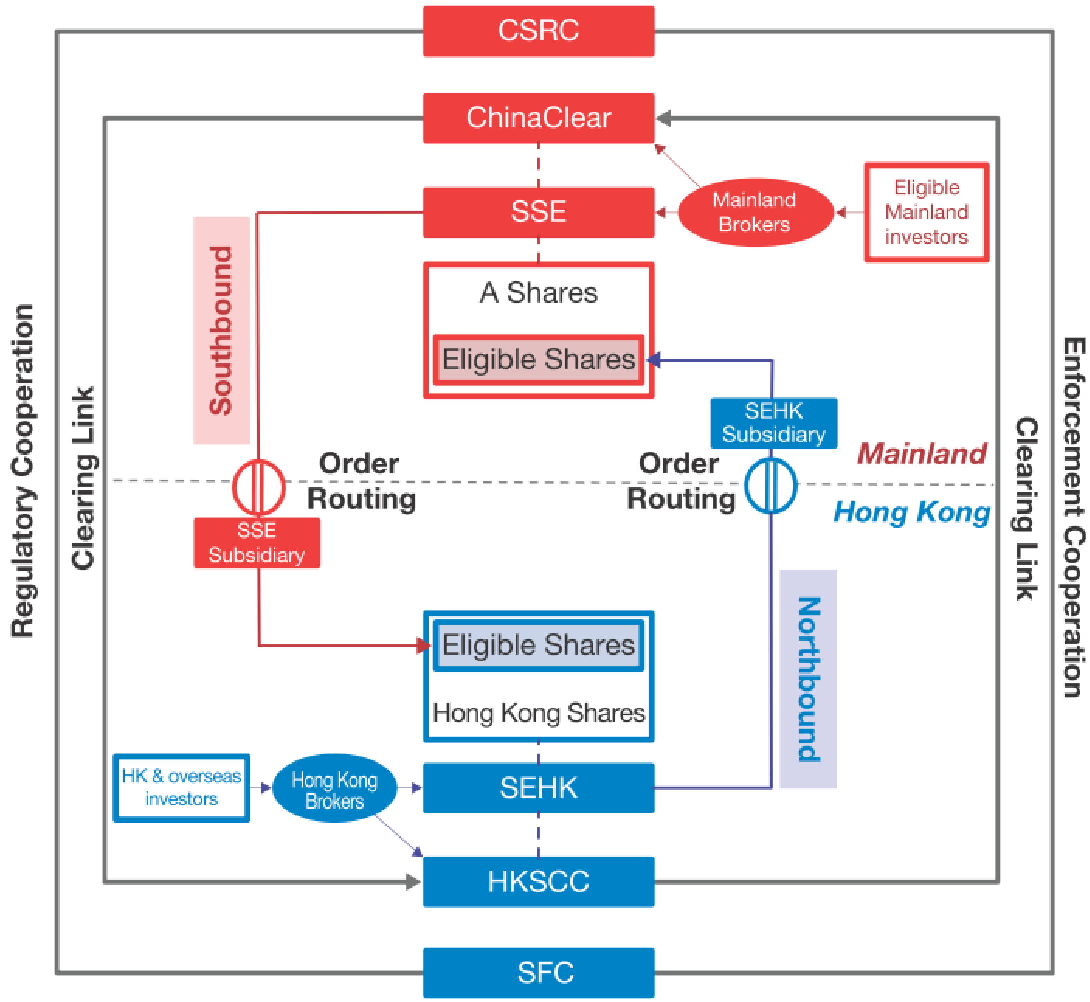
	2014/12	2015/1	2015/2	2015/3	Arithmetic	Geometric	Overall
Turnover (Buy and Sell)	159.55	-17.40	-32.43	103.77	53.37	35.26	195.20
Buy Trade	70.91	-25.33	-25.15	76.97	24.35	16.02	69.04
Sell Trade	1,439.47	-4.67	-41.57	146.89	385.03	152.52	2,016.85
No. of Trades (Buy and Sell)	140.18	4.08	-25.10	80.62	49.94	38.36	238.16
No. of Buy Trades	60.65	-2.74	-22.00	54.49	22.60	18.21	88.29
No. of Sell Trades	1,053.55	14.98	-29.30	119.61	289.71	140.37	1,959.20
Average Daily Turnover (Buy + Sell Trades)	29.78	-17.40	-9.91	38.93	10.35	8.17	34.18
Average Daily Buy Trade	-14.54	-25.33	-0.20	20.66	-4.85	-6.07	-23.16
Average Daily Sell Trade	669.73	-4.67	-22.10	68.33	177.82	92.93	862.20
Average Daily No. of Buy + Sell Trades	20.09	4.08	-0.14	23.15	11.79	11.44	53.71
Average Daily No. of Buy Trades	-19.68	-2.74	4.00	5.34	-3.27	-3.71	-14.41
Average Daily No. of Sell Trades	476.79	14.98	-5.74	49.73	133.94	85.39	836.03

Panel B: Growth Rate of Southbound Trading (in Percentages)

	2014/12	2015/1	2015/2	2015/3	Arithmetic	Geometric	Overall
Turnover (Buy and Sell)	142.24	66.86	-66.74	248.73	97.77	56.11	368.84
Buy Trade	120.22	72.75	-73.32	275.95	98.90	49.99	281.64
Sell Trade	232.87	50.82	-46.23	206.60	111.02	77.19	727.67
No. of Buy + Sell Trades	103.68	54.57	-57.33	189.03	72.48	46.27	288.22
No. of Buy Trades	93.32	57.07	-63.83	208.75	73.83	42.59	239.06
No. of Sell Trades	138.05	47.82	-38.71	155.69	75.71	57.49	451.44
Average Daily Turnover (Buy + Sell Trades)	34.58	50.17	-48.83	106.07	35.50	23.62	113.11
Average Daily Buy Trade	22.34	55.47	-58.95	122.16	35.26	18.60	73.47
Average Daily Sell Value	84.92	35.74	-17.28	81.18	46.14	40.62	276.21
Average Daily No. of Buy + Sell Trades	13.15	39.12	-34.36	70.80	22.17	16.61	76.46
Average Daily No. of Buy Trades	7.40	41.37	-44.37	82.45	21.71	13.41	54.11
Average Daily No. of Sell Trades	32.25	33.04	-5.71	51.10	27.67	26.19	150.67

Figure 1

Trading Mechanism of the Shanghai-Hong Kong Stock Connect



Source: Hong Kong Exchange and Clearing Ltd.

Legends: CSRC is the the China Securities Regulatory Commission, which is responsible for regulations of securities trading in China. SFC is the Securities and Futures Commission, which is responsible for the regulations of securities trading in Hong Kong. SSE is the Shanghai Stock Exchange. SEHK is the Stock Exchange of Hong Kong. ChinaClear is securities clearing organization in China. HKSCC is the Hong Kong Securities Clearing Company Limited, which is responsible for securities clearing in Hong Kong.

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□ □ □ □ □ □ Beyond Sustainability / Corporate Social Responsibility (CSR) – Innovative Individuals with Innovations in Operating Environment for Sustainable Impacts

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Riding on the key findings of Yeung (2014) for the key factors in the Model of Creativity Development in Learning Organization:

1) Internal – Individuality and External – Tasks
2) Operating Environment and Activities and
3) Methods to Develop Creativity, this paper has reviewed 16 research papers on innovative model and Corporate Social Responsibility (CSR) innovation from 2010 to 2014 via qualitative and quantitative analysis of N' vivo to design a checklist to evaluate the innovative capacity of organizations for corporate sustainability. Three main dimensions are identified for corporate innovations:

   (1) Individual Innovation (from 0.24 to 1.26% references) – supply chain value management (from 0.45 – 1.26% references) and supply chain risk management (from 0.38 to 0.43% references);

   (2) Organizational Innovation – co-production value (from 0.11 to 2.19% references) and social responsiveness (from 0.03 to 1.39% references); and

   (3) Innovative Operating Environment (from 0.57 to 3.64% references) – interlinked standards (from 0.08 to 1.57% references), sustained environment (from 0.21 to 1.42% references), holistic process (from 0.07 to 1.12% references) and community value (from 0.18 to 1.07% references).

□ □ □ □ □ □ Innovation in the Application of GRI to Visualize Strategic Goals for Sustainable Development – The Case of Tertiary Institution, Hong Kong

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This paper explores innovation in how educators use GRI sustainability (CSR) related guidelines to engage different stakeholders and respond to the trend of sustainable development in higher education mentioned by UNESCO. Through the case of a tertiary educational institution in Hong Kong, examples of innovative KPIs are devised to align with the strategic goals of the case institution with implications to the institutional level and the community level. The case institution measures its performance, identifies its risks with priority and reports under three main headings – Responsible Business Management, Responsible Curriculum Design, and Responsible Partnership through stakeholder mapping with action plans for measurement (2015 –2017), the risk level with KPIs of activities with Social Return of Investment (SROI), and benchmarking with self-financed institutions offering business and management related degree programmes and CSR-related activities with impacts created from media reporting. This paper thus lies at the nexus of GRI sustainability (CSR) guidelines, innovative Key Performance Indicators (KPIs) and Strategic Goals to integrate environmental, social and economic impacts and the encouragement of good governance practices throughout the lifecycles of goods and services produced for sustainability.

Keywords: Sustainable Development (SD), Innovation, Responsible, Key Performance Indicators (KPIs).

1. Introduction

In line with the UN Decade 2005-2014 on sustainability, many researcher papers have been found on the sustainable development (SD) in the higher education sector. Different institutions have their own interpretations of sustainable development. In general, sustainable development is related to economic, social and environmental impacts with responsible decision making of allocating resources to meet the present and future needs of a society. This links up to the way of management in defining and interpreting sustainability when setting and implementing their short and long term strategic goals with total involvement of academic and administrative staff. Buying in the concept of sustainable development is the first and the most significant step in implementing sustainability related actions in an institution as the perception of staff on SD well relates to their understanding and exposure on sustainability.

According to the definition of Brundtland Commission (1992) of the United Nations, "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." The basic element of sustainability is the economic aspect to support the business in short term, and support the new products, services, processes and people in the long term. In global initiatives of the "United Nations (UN) Decade of Education for Sustainable Development" (DESD) 2005-2015, the mission of DESD outlined by United Nations United Nations Educational, Scientific, Cultural Organization (UNESCO) is to meet the needs of the present without compromising those of future generations. Education is to learn how to learn, un-learn and re-learn through on-going helping people develop values, skills, attitudes, and knowledge with the principles, values and practices of sustainable development; and this kind of proactive thinking has to be integrated into all aspects of education and training to people in all nations at different ages to develop economic, social, environmental and cultural awareness and to seek solutions for these problems. Hence, ESD is relevant to all nations and all higher institutions. Management in higher educational institutions need to keep on practicing the rationale of ESD beyond 2015 through integrating ESD in their institutional operational level in setting strategic goals and performance indicators; and school / programme level in re-visiting the curriculum for the benefit of learners and the community.

As mentioned by UNDESD, quantitative and qualitative ESD indicators are needed to be incorporated into different aspects of education for regular monitoring and reviewing purposes. This paper is going to adopt the rationale of ESD with the principles of Global Reporting Initiatives (GRI) to present a case with organizational values and strategic goals to align with relevant performance indicators on four key areas - economic, social, environmental and governance for demonstrating the linkage between stakeholder mapping and risk identification; the linkage between strategy and sustainability. The job of developing, monitoring and reviewing these ESD related performance indicators can be treated as co-production outputs of management, academic and administrative staff working in an institution. In fact, academics also need to work closely with industry practitioners to better understand the growing importance of sustainable development in higher education and in industries so as to generate meaningful economic, social, environmental, governance and cultural impacts.

2. Objectives and Contributions

In recent years, the higher educational sector has started to address the issues of sustainable development in their operations and curriculum design. This has created a dramatic need of educators, especially curriculum designers, with a mindset of sustainability and social responsibility; and the skills of writing sustainability related reports to communicate with stakeholders for accountability and transparency. This triggers the author to study the steps of setting sustainability related performance indicators to align with institutional strategic goals and to prepare sustainability report with economic, social and environmental impacts.

The purpose of this paper is to explore the application of GRI reporting principles with the seven dimensions of ISO 26000 Corporate Social Responsibility (CSR) Guidelines to identify the steps of designing relevant sustainability-related goals for continuous improvement in management level, programme level and partnership level to fulfill the gaps between academics and industries in terms of developing talents with relevant knowledge, skills, attitudes and values for the future. It is expected that ESD goals can help measure performance from different perspectives for organizational improvement and for partnership and community development.

3. Sustainable Development and Knowledge-based Economy

The concepts of sustainable development have been most debated subjects and of great importance in the future, especially in higher education sector where leaners are educated to prepare how to face the challenges for the future and how to develop themselves personally and professionally in a sustainable manner. Szitar (2014) mentioned that community development was related to sustainability which needed to have stakeholder collaboration, linking up changes with sustainability, adopting interdisciplinary and multidisciplinary approach in teaching in architectural education, for example case study and PAPSA (Presentation, Analysis, Production, Selection and Application) methods and providing solutions in a holistic manner. Pinho et al. (2015) also university not only enabled professional growth, but also in the personal level (p. 162). Besides, they highlighted that contextualization in crucial in university education, including creating a variety of contexts for leaners learning how to perceive the world, how to handle adverse situation, how to develop belonging to the syllabus, how to experience practical contents, and how to create professional network via opportunities in extracurricular activities that are complementary to their studies.

In fact, Gedzune (2013), Gedzune and Gedzune (2012) and Pohl et al. (2010) also mentioned that teacher training and engagement with reflection, action research and co-production of sustainability-related research were needed to understand the importance of a broader and inter-relating perspective on issues related to sustainable development for the future. Back to 2005, Kitagawa pointed out that the role of universities in the knowledge society was examined in light of the emergence of new research and learning systems, conditioned by forces of both globalisation and regionalization with impacts of these new relationships perceived in four principal dimensions: economy, human resources, governance and community.

As we know, the economic development of most countries is now turning from manufacturing into service production which calls for talents with professional knowledge, skills, attitude and values. Kivunja (2015) brought up that the economies had been increasingly globalised with digital technologies assuming ubiquitous presence and functional utility in peoples' lives outside educational contexts. He mentioned that educationalists needed to prepare learners for the Digital Economy, requiring the teaching of new skills rather than the traditional core subjects. Kivunja (2015) named this realization as a New Learning Paradigm, teaching students with skills most demanded in the 21st century. He put forwarded the 4Cs super skills, that is, critical thinking skill, communication skill, collaboration skill and creative skill. If learners are taught with these four super skills with sustainability contents and community development mentioned by Szitar (2014) and contexts for development mentioned by Pinho et al. (2015), it is assumed that the community will be a better one under knowledge-based economy within a digital technology environment.

4. Sustainable Development and Corporate Social Responsibility (CSR) in Higher Education

Under keen competition for resources and unexpected risks from natural and human-made disasters, people are aware of the importance of sustainability in education. In fact, the concept of sustainability can be traced back to the thirteenth century but in more recent times it appeared in the environmental literature in the 1870s (Kamara et al., 2006 quoted in Jones et al., 2011). Jones et al (2011) suggested that sustainability was about human survival and the avoidance of ecological disaster' with complex and technical meaning from a professional perspective. They argued that sustainability could be seen as the goal or endpoint of a process called sustainable development. They also mentioned that a number of attempts had been made from scholars in interpreting sustainability that theoretical frameworks of connecting the nature and society were needed to recognize social and economic development could not be viewed in isolation from the natural environment. (Amsler, 2009, p.123 quoted in Jones et al. p.258)

In 2011, Djordevic and Cotton realized that there had been a growing awareness in national and international policies to integrate sustainability into both business and educational arenas. They emphasized that education for sustainability development (ESD) was an issue of increasing importance in higher education, including the campus, curriculum, community and culture of institutions. They quoted the ideas of UNESCO that ESD was "a process of learning how to make decisions that consider the long-term future of the economy, ecology and equity of all communities". From an institutional perspective, policy and strategy related to sustainable development in higher educational institutions have to be driven from the management, for example, curriculum design and development policy, teaching and learning policy, research policy, campus design and maintenance policy. Two years later, Ryan and Tilbury (2013, p.272) mentioned that though the need to embed Education for Sustainable Development (ESD) in the higher education curriculum was well recognized in international sustainable development dialogues, substantial obstacles were encountered which called for systemic education change. They uncovered that educators needed to re-think the purpose of education with a new angle of visiting existing pedagogy practices to extend learning opportunities for learners who could contribute more for the future. They concluded a deeper reflection on teaching and learning was needed to make ESD a viable education proposition for transferring skills. They also put forward that engaging learners with experiences on sustainable development was significant as this would lead learners to further develop their critical thinking, provocative questioning skills and devising new ways of living.

Besides, Yeung (2014) also highlighted that responsible corporations needed to adopt the seven dimensions of Corporate Social Responsibility (CSR) guidelines of ISO 26000 in their operations: labor practices, consumer issues, fair operating practices, human rights, organizational governance, community involvement and development and the environment.She mentioned that the priority of the seven dimensions was subject to the strategic planning of the management and the expectations of their stakeholders. According to Cajazeira (2008 quoted in Yeung, 2014), the major principles for ISO 26000 are: accountability, transparency, ethical behavior, consideration for the stakeholders, legality, international standards, and human rights. It is the responsibility of organizations to consider the needs of the stakeholders in these seven aspects when designing work processes or executing business-related activities. In fact, ISO 26000 CSR guidelines convey a message that non-economic inputs and soft side of outcomes are the trend of quality management system (QMS).

In order to fulfill the needs of UNESCO and the gaps uncovered by scholars, this paper focuses on exploring ways to link institutional vision and strategic goals with social reporting principles and ISO 26000 CSR guidelines to define steps of engaging stakeholders, identifying possible risks and setting sustainability / CSR related goals for making the institution becoming a more sustainable one. Yeung (2014) mentioned that building quality into products and services were not sufficed for continual improvement. She called for new ways of integrating sustainability and CSR into organizational strategy for sustainable business. In fact, Mootee (2013, p. 59) brought up a similar viewpoint of Yeung (2014) that “More than 80 percent of our management tools, systems, and techniques are for value-capture efforts, not for value creation; this includes techniques such as total quality management (TQM), enterprise resource planning (ERP), Six Sigma, Lean Startup, and Agile Systems. These tools are valuable for keeping an enterprise running smoothly. But we should be focusing on value creation rather than value capture alone. This is where design thinking comes into play. Companies such as Apple, Amazon.com, Netflix, Samsung, Burberry, and BMW are winning by design and the thinking behind that design.” He mentioned that solving problems needed to have a multi-functional and multi-perspective approach that influenced many of the principles inherent in design thinking, that is, core values, identities, expectations, and views of the world. He emphasized that ‘responsibility to shape the future’ was critical and actions had to be humanized, meaningful and connective. When applying the concepts of design thinking in setting sustainability – related goals for educational institutions, it is recommended to embed the principles of empathy, an approach to collective problem solving, and a framework to balance needs and feasibility.

5. Design Thinking for Sustainable Institution

Problems that we come across may not be the same as those in the past. Hence, a new perspective for problem-solving is needed for sustainable development. Mootee (2013, p.39) put forward the idea of design thinking, a natural and inherent thinking, which was an approach to inquiry and expression that complemented and enhanced existing skills, behaviors, and techniques. He mentioned that design thinking was a date-driven analytical thinking with its own mode of analysis – one that focused on forms, relationships, behavior, and real human interactions and emotions. He recommended that design thinking could be applied in the following ways of which they were relevant for sustainable development in higher education:

“1) How a product, service, system, or business currently lives in an ecosystem;

2) How people interact with the above and the nature, frequency, and attributes of that interaction;

3) How the different elements in the ecosystem relate to one another and if any systems-level impact exists;

4) What other ecosystems exist adjacent to your ecosystem;

5) How new insights may be gained by looking broadly at communicative events within these ecosystems and how they fit together from a systems perspective;

6) What the key characteristics and patterns of behavior of new relationships are when viewed from a system level; and

7) What the patterns of people’s information behviors are and how to map them visually to make sense of them” (Mootee, 2013, p. 39)

From the above, design thinking can empower organizations and individuals to better understand their competitive and operational environment for perceiving and solving problems with realization of behavioral patterns, values attached to systems-level and processes of meeting challenges.

Apart from a system level, a process of level in programme / module design with sustainable development and social responsibility are also needed to be addressed. In the 17th International Conference on Teaching and Learning organized by UNESCO-APEID, Bajunid (2014) mentioned that any radical turning points in professional policy shifts required mid-set changes in teachers regarding their beliefs, assumptions, out the box thinking, time management, creativity, edupreneurship and wethanschaaung. “The emerging of basic literacies and new literacies demand continuous learning by teacher as perennial leaner.” Bajunid (2014) also quoted the code of practice for quality assurance in public universities in Malaysia developed by the QA Department of the Malaysian Ministry of Higher Education (2008) that the key foci of programme quality were: conceptual framework, knowledge, skills, content knowledge, pedagogical content knowledge, pedagogical and professional knowledge and skills, professional disposition and assumption system with evaluation, field experience and clinical practice, diversity, faculty qualifications, performance and development, unit governance and resources (p.6) Moreover, he highlighted that all programmes objectives should align with the following learning outcomes:

1) Knowledge;
2) Practical Skills;
3) Social Skills and Responsibilities;
4) Communication, Leadership and Team Skills;
5) Problem-solving and Scientific Skills;
6) Information Management and Life-long Learning Skills; and
7) Management and Entrepreneurship Skills.

Yeung (2014) echoed the ideas of Bajunid (2014) that the following four characteristics were desirable for a social responsible teacher in the future teaching under the digital age. Teachers need to develop techniques to cater a diversified group of students through traditional and non-traditional classroom setting, for example, blending learning and virtual learning environment to motivate students as co-producers for meaningful and relevant curriculum. The eight characteristics are:

1) Knowledge and Intellectual Skills –
   Multi-disciplinary knowledge and multi-thinking with a mindset of change

2) Processes –
   Value creation and waste reduction via curriculum review and revision

3) Autonomy, Accountability and Application –
   Acceptance of professional responsibility with people respect and continual improvement

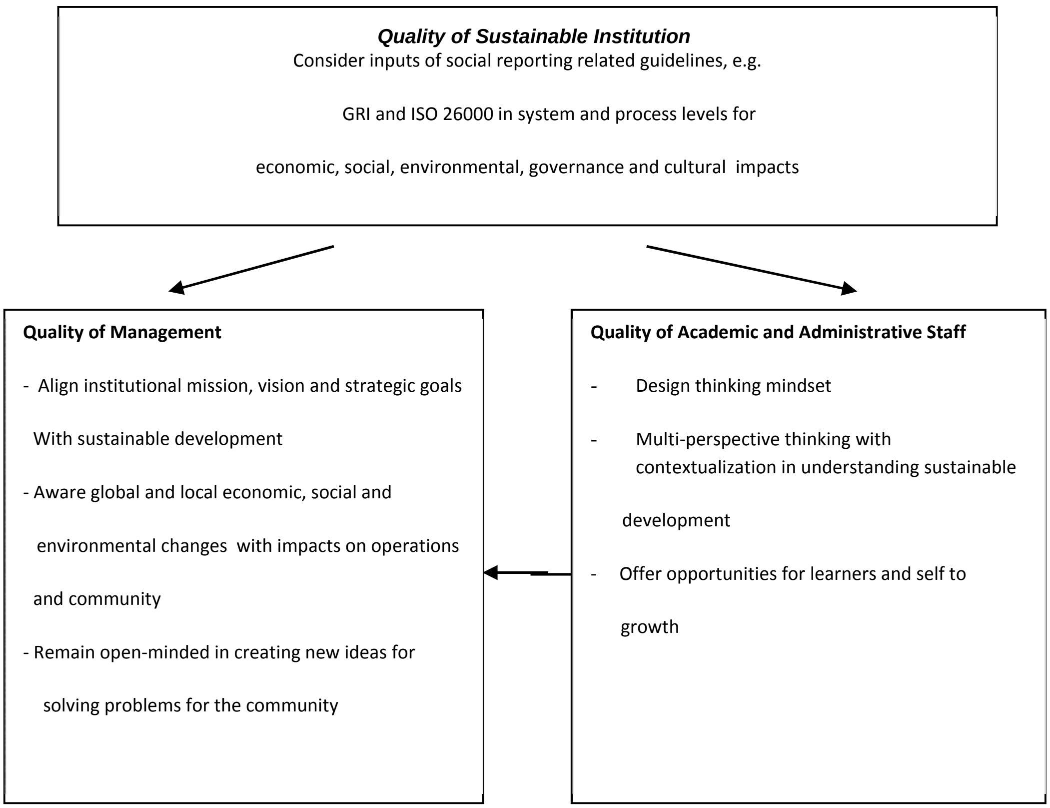
4) IT, Numeracy and Communication –
   Using technology and information with environmental concerns in teaching
   and curriculum design

In 2010, Fisher realised that corporate sustainability/ social responsibility was of utmost importance for the survival of organizations and their future generations of employees. "Organizations' product/ service offerings and vendor networks are interconnected globally and are being recognized on a global scale" (P. 29) If educators can visualise the sustainable development goals of UNESCO, crystallize the manpower projection into curriculum design, can realise the ways of implementing 4Cs into designing community development related programmes, the institution is working towards a sustainable organization for the benefit of learners, the industries, and the community as they can develop awareness of sustainability and social responsibility to their peers and influence students to learn in a sustainable way. Based on the literature of the above, the author has generated a model of sustainable institution (see Figure 1.0).

6. Methodology – Action Research Learning Approach

The paper was conducted with the rationale of action learning approach. Through the years of quality assurance, CSR assessment, curriculum design and teaching experiences gained in the case organization, the author has adopted an approach of action research to organize ongoing inquiry with conceptualization of quality, CSR

Figure 1.0 – Model of Sustainable Institution with Quality Management and Quality Staff



and sustainability raised in higher education in general and methods of advancing the institution from system and process levels with stakeholder mapping and risk identification for defining sustainability-related performance indicators. The author is expected that adopting action research approach could help to solving real problems from a holistic view and can benefit the case organization and the community as a whole. In fact, action research is a way of learning, un-learning and re-learning through a process of inquiry with the experience of not knowing 'what to do next' to finding answers from experience, expertise and reflection.

Research Questions:

1) What are the steps to cover the key dimensions to monitor the performance of a tertiary educational institution?
2) How can a tertiary educational institution turn to be a more sustainable one?

Background of Case Institution in Hong Kong

The case institution has been developing over time from a sixth-form school into a post-secondary / higher education institution offering business related mainly Bachelor's degree programmes. This section is to provide an overview of its development in the past 10 years. The management of case institution decided in early 2001 that from 2003 to around 2007, the institution should run its Associate Degree (AD) Programme in parallel with its their senior years of secondary education, in preparation for becoming a full post-secondary/higher education institution operating at the AD level when A Level courses are finally phased out. In line with Government requirements for non self-accrediting institutions, the case organization has requested the Hong Kong Council for Academic Accreditation and Vocational Qualifications (HKCAAVQ) to conduct an Institutional Review and a Programme Validation of its first AD Programme, which was accredited and ready to offer an Associate in Business Administration Programme in September 2003. From 2003 up till 2014, altogether there are 10 undergraduate degree programmes and one AD Programme with a total of student number of over 4,600 in 2014/15.

Vision

The vision of the case institution is to be a leading private university, recognized for excellence in teaching, learning and research, especially in the areas of business and management. With the following 10 strategic goals (SG 1- SG 10) in place, value can be created to our stakeholders - students, academic and non-academic staff and the community via complying the institutional requirements and programme accreditation requirements of HKCAAVQ, meeting the labor manpower projections of the Hong Kong government, and fulfilling the expectations of our potential employers in different industries.

Strategic Goals (SG) of the Case Institution

1. To afford a modern and stimulating campus environment (SG 1) to facilitate and support teaching and learning activities.
2. To develop and offer innovative academic programmes (SG 2) which respond to changing community needs.
3. To provide a holistic and challenging educational experience for students (SG 3).
4. To cultivate students' global perspective (SG 4) through internationalisation.
5. To develop strategic partnerships (SG 5) with industries and businesses.
6. To create internship opportunities (SG 6) for students to gain practical experience in the workplace.

7. To encourage and support dynamic research (SG 7) initially focusing on regional relevance and gradually broadening to more extensive horizons.
8. To strengthen governance structure (SG 8).
9. To enhance quality control (SG 9) through internal and external monitoring.
10. To explore new ways and sources of funding (SG 10) to augment the financial base of the College.

Turning Vision into Sustainability (CSR) Vision

To the case institution, CSR is the responsibility of the College for creating impacts to the community, the environment, the marketplace and the workplace through continuing commitment in educating our students, influencing our staff and doing business ethically with economic, social and environmental contributions to the community while improving the quality of life to our staff and their families as well as the local community and society at large. The Sustainability (CSR) strategy is to support the case organization vision of becoming a private university through providing quality business and management related programmes to teenagers to meet the job market needs with business and management related knowledge, skills, attitudes with social responsibility and an ethical mindset.

7. Findings

Research Questions:

1) What are the steps to cover the key dimensions to monitor the performance of a tertiary educational institution?

   The followings are the steps of visualizing sustainability (CSR) vision for the case institution:

Step 1) Setting up a CSR Working Group:

Engaging teaching, administrative staff and students of various programmes to discuss ways of maintaining quality in programmes/ students / graduates/ campus with impacts in the workplace, the marketplace, the environment and the community.

Step 2) Arranging Awareness Training for Involved Academic and Administrative Staff:

- Providing on-going (e.g. quarterly) training to primary and secondary stakeholders about the relevant sustainability / CSR practices in higher education, expecting to have actions agreed with members of the CSR working group
- Updating the progress of the 10 strategic goals aligned with the risk level identified and action plans during the on-going training
- Inviting external parties for comments on improvements in programmes/ students/ graduates/ campus when training opportunities come up
- Engaging the community of Shatin area in New Territories, Hong Kong and the society as a whole when training is relevant to their needs

Step 3) Defining Sustainability related Goals and Strategy

Table 3 demonstrates explicitly the above-mentioned 10 strategic goals of the case institution (SG 1-10) and strategy used.

Step 4) Meeting Sustainability related Reporting Guidelines to Engage Stakeholders

Based on GRI 4 criteria to identify relevant action plans (see Table 1) to prepare a sustainability report with 3rd party endorsement for recognition, for identifying rooms of improvement, and for assessing the level of responsibility in the workplace / the marketplace / the environment/ and the society.

The identification of primary and secondary stakeholders, the understanding of their needs and expectations, and the linkage between stakeholders and vision / strategic goals are the critical points in the success of visualization the sustainability (CSR) vision of the case institution. Table 1 shows clearly the linkage among stakeholders, risks, impacts and action plans for sustainability (CSR) vision.

For example:

Maximizing graduates' employment opportunities; increasing student exposure on green movements, anti-corruption, worker right protection, work-family balance, public education efforts; promoting business ethics, community services & engagement, implementing actions against global poverty, and other social innovations, etc.

Step 5) Communicating with Stakeholders for Sustainability / CSR related Achievements for Engagement and Team Spirit Enhancement

On-going and effective internal and external communication plays an important role in the College’s overall performance, student and teacher performance and reputation. Regular communication with factual information drives our staff to make continual contributions to the strategic goals and the sustainability (CSR) vision of the workplace, the marketplace, the environment and the society.

Through adopting the Hong Kong CSR Advocate Index (ISO 26000 CSR guidelines) held by Hong Kong Quality Assurance Agency (HKQAA) since 2009, the commitment in the 10 strategic goals embedding sustainability (CSR) vision covering key and supporting processes to meet the expectations of the stakeholders has been shown with continual improvement. In the past two years (2013 and 2014), the case institution obtained a full score of “5” through the professional and third party on-site verification visit of HKQAA. This is the first comprehensive Index in Hong Kong with participants coming from diversified industries, for example, educational institutions, governmental department manufacturing, and service sectors. And, the case institution is the only participant from the tertiary education sector with 6 years’ promising track record in the advocate CSR Index with ISO 9001: 2008 system in place to support process management, with comprehensive College-wide Quality Assurance (QA) mechanism to measure and improve the performance of programmes, students and teachers, and with innovative green building assessment from third party to increase the awareness of the environmental related issues in the campus.

Through participating the CSR Index, the concerns of stakeholders have been addressed. The case organization believes the CSR Index assessment is not only a self-check exercise to look for opportunities of improvements under the changing external environment for the benefit of our stakeholders, but also a good learning platform to understand that sustainable organizational development is closely related to engaging stakeholders, implementing relevant policies, measuring performances, reviewing the polices for advancing further planning for reaching the strategic goals of the College, for example:

- Students, academic and non-academic staff, programme accreditation body, the potential employers, the strategic partners, the local community and the government have been identified for continual improvements with policies, action plans and measurements;
- Governance structure enhanced;
- External and internal control strengthened;
- Innovative programmes offered to meet the needs and expectations of the community; and
- Modern campus with environmental impacts for learning offered.

To quote an example, UNESCO mentioned that the entrepreneurship education needed to be strengthened to reduce the teenage unemployment issue in 2013. The case organization has supported the Entrepreneurship Project organised by an NGO – Ocean Junior Chamber (OJC) to publish a book written by our students of different degree programmes after interviewing entrepreneurs from different industries in 2014. Recently, the project details of the book and learning outcomes of students have been shared with UNESCO international entrepreneurship education members as a good practice. Through this project, active involvement with the local community has been demonstrated through sharing project experience, conducting research, developing skills for learners to meet the challenges in the future. All but not least, CSR is both a functional and an integrative tool to visualize the mission of the case institution to develop talents for the business and management area as the future managers are expected to be socially responsible for their business from different perspectives.

Step 6) Conducting Sustainability Assessment and Benchmarking

The case institution measures its performance, identifies its risks with priority and reports under three mean headings – Responsible Business Management, Economic Impacts/ Social Impacts and Building Relationship. The stakeholder mapping with action plans for measurement (2015 –2017) and the risk level with KPIs of activities with Social Return of Investment (SROI) has been illustrated clearly in Table 1. For example:

Responsible Business Management
- Harmonized employment with stable teaching staff
- Green building assessment of the campus

Economic and Social Impacts
- New programmes offered, e.g. Asian studies and Cultural and Creative Industries undergraduate degree programmes in coming years

Building Relationship

- Building strong relationships with stakeholders, e.g. ministry of education in different countries and overseas universities for achieving the strategic goals and sustainability (CSR) vision and the vision of the case institution.

Research Questions:

2) How can a tertiary educational institution turn to be a more sustainable one?
The following Table demonstrates actionable items to align with the sustainability goals defined.

Table 1 Stakeholder Assessment and Future Measurable Goals

Stakeholder	Risk	Impact	Probably	Priority	Future Measurable Goals for Areas of Improvement in 4 Sustainability Pillars of Workplace, Marketplace, Environment, Society (2015 to 2017)
Primary Students (SG 2 - 5)	Low employability rate Student dissatisfaction	5 Reputation ruined without creating value to students and without developing talents to meet the labour market	3	5 x 3 = 15	Marketplace Sustainability Goal ISO 26000 CSR – Consumer Issues KPI – e.g. 4 meetings / year with increasing total number of strategic local/ overseas partners in internship offer from developing and developed countries with international exposure to let the students understand cultural diversity and skills of accommodation (GRI 4 – market presence/economic / social impacts) e.g. On-going meetings (formal and informal) with students, teachers, programme accreditation bodies and potential employers to review performance of SG2-5 through engaging more relevant and external stakeholders along with the market change to review

					the quality of programmes / students/ interns/ graduates/ teachers and the College as a whole Example: Develop students with skills of 4Cs (critical thinking skill for solving problems, communication skill for understanding and communicating ideas, collaborating skill for working with others, and creating skill for producing high quality work) mentioned by Kivunja (2015) to face the future challenges and to handle the sustainability related matters for community development. **Other activities can be considered to widen students' perspectives are: - green movements, - anti-corruption, - worker right protection, - work-family balance, - public education efforts, - promoting business ethics, - community services &

					- engaging concerns/actions again global poverty, and social innovations which can be integrated with in-class and beyond-class activities (Diarise the progress of identified KPIs with actions plans for improvement after meetings)
Teaching staff (SG7)	Pressure of research and heavy teaching assignments affecting the well being of teachers Dissatisfaction leading to high turnover	3 High staff turnover and unfair teaching assignment affecting programme quality and low student intake	3	3 x 3 = 9	Workplace Sustainability Goal ISO 26000 CSR – Human Rights and Staff Issues KPI e.g. Add a new strategic goal of improving the well-being of academic and non-academic staff for improving quality of life e.g. Organise large scale activities / year with participation of staff from different industries and professional counselors to identify the source of pressure and methods of releasing them with methods passed over to students when appropriate to help release their study pressure. e.g. Invite experts in mindfulness and emotional quotient for maintaining quality of workplace and quality of family life to teaching staff and non-teaching staff

					e.g. Regularly review the fairness in research, teaching assignment and administrative duties for utilize the skills of staff to increase job satisfaction ** Other on-going activities can be considered as staff development are: - green movements, - anti-corruption, - worker right protection, - work-family balance, - public education efforts, - promoting business ethics, - community services & - engaging concerns/actions again global poverty, and social innovations which can be integrated with student activities, if appropriate (GRI 4 – labor/ management relations/ equal remuneration/ labor practices grievances mechanism) (Diarize the progress of identified KPIs with actions

					plans for improvement after meetings)
College management (SG 1-10)	Programme quality not recognised Skills not relevant to employers required or expected Insufficient funding	3 Gap appeared between what offered in the College and applied/ expected in the workplace/ College Council/ Board	3	3 x 3 = 9	Society Sustainability Goal Marketplace Sustainability Goal Economic Sustainability Goal (GRI 4 – Product responsibility) ISO 26000 CSR – fair operations/ community involvement / consumer issues KPI- e.g. Fixing a certain number of meetings/ year with College management, teachers, students and relevant external parties for identifying the change in workforce structure and best practice in higher educational sector or industry to improve programme quality with 2 innovative improvements in programmes and 2 new sources of funding opportunities e.g. inviting research scholars and curriculum designers from Israel institutions (Diarise the progress of identified KPIs with actions plans for improvement after meetings)

Programme accreditation body (SG1-4/ 8-9)	Student attributes programme quality and College infrastructure not consistently meeting the requirements under the fast development of case institution	5 Risk of losing confidence from HKCAAVQ and the public	3	5 x 3=15	Marketplace Sustainability Goal (GRI 4 – Product responsibility/ Marketing communication) ISO 26000 CSR – fair operations, community involvement/ consumer issues e.g. On-going communication with a fixed number of announcements / year to staff and students for agreed outcomes / actions) with local and overseas programme accreditation bodies, psychologists and NGOs to understand the development of teenagers' emotional, mental, psychological, physical changes and let them have more opportunities to work with CEOs and blue collar to realize personal potential, skills intended to develop and career to be pursued; and these experience will be embedded into programme design or college activities to fulfil the programme accreditation bodies, if appropriate, for the changes in requirements to align with the performance/ development of the College (Diarize the progress of identified KPIs with actions plans for improvement after meetings)

Government (Education Bureau EDB) (SG 2/ 8)	Not gaining recognition and subsidy of programmes for the benefit of students	3	3	3 x 3 =9	Society Sustainability Goal (GRI 4 – Product responsibility) ISO 26000 CSR – fair operations/ community involvement KPI- e.g. On-going collection of feedback/ media reporting (10 relevant reports / year to staff and students on programmes/ students/ staff / infrastructure) e.g. Collecting updated and relevant information from government in areas of research, programmes, teaching and students…etc. for funding application or opportunities of seeking support (Diarize the progress of identified KPIs with actions plans for improvement after meetings)
Potential Employers (SG 2-6)	Not developing talents with appropriate knowledge, skills, attitude, values for potential employers	5	3	5 x 3 =15	Market Sustainability Goal Society Sustainability Goal (GRI 4 – Product responsibility) ISO 26000 CSR – fair operations /community involvement / consumer issues

	leading low employability and ruined reputation				KPI- e.g. On-going communication with a fixed number of announcements / year to staff and students for expected outcomes / actions and achievements of the College) with identified potential employers in targeted industries e.g. Inviting existing (from internship and job fairs) and potential employers to discuss the change of labor market, job structure and skills required to review the programmes (Diarize the progress of identified KPIs with actions plans for improvement after meetings)
Secondary Parents Related Government Dept. e.g. Labor Dept. Professional bodies for module	Dissatisfaction about study environment and treatment to students Minimal recognition from professional	3	3	3 x 3 = 9	Marketplace Sustainability Goal Society Sustainability Goal Environmental Sustainability Goal Workplace Sustainability Goal ISO 26000 CSR – involvement of community / environmental issues

exemption and programme recognition Suppliers of e-journals and research materials Strategic partners on programme matters, e.g.Exchange Partners/ Funding or Sponsorship Parties/ Employers	body for articulation and employability Irrelevancy and obsolete journals (mismatched with programmes and teachers' research interest) Lack of communication				KPI- e.g. On-going communication with a fixed number of announcements / year to internal and external stakeholders on all mutual concerned areas with communication of environmental issues to neighboring community, e.g. secondary schools) e.g. Organizing different kinds of activities with external secondary stakeholders for analyze potential risks and impacts of mutual concerned matters to maintain or enhance brand name (GRI 4 – Product responsibility/ Market presence/ Economic Performance / Supplier assessment on impacts on society/ Local communities/ Environmental compliance) (Diarise the progress of identified KPIs with actions plans for improvement after meetings)

8. Conclusion and Discussion

Based on the GRI social reporting principles and ISO 26000 CSR guidelines, environmental, social and economic impacts and the encouragement of good governance practices throughout the lifecycles of goods and services produced by the case institution have been integrated for sustainable development. The case organization has achieved the objective of SC sustainability to create new and relevant programmes to meet the needs of the market, protect the rights of students and staff, and grow with long-term environmental, social and economic value for all stakeholders involved in bringing a diversity of business and management programmes and services to the community of Hong Kong.

The case institution measures its performance, identifies its risks with priority and reports under three main headings – Responsible Business Management, Responsible Curriculum Design, and Responsible Partnership through stakeholder mapping with action plans for measurement (2015 –2017), the risk level with KPIs of activities with Social Return of Investment (SROI), and benchmarking with self-financed institutions offering business and management related degree programmes and CSR-related activities with impacts created from media reporting.

Examples on Responsible Business Management for Economic and Environmental Impacts are:

- Harmonised employment with stable teaching staff
- Green building assessment of the campus

Example on Responsible Curriculum Design for Economic and Social Impacts is:

- New undergraduate degree programmes will be offered in coming years

Example on Responsible Partnership for Economic and Social impacts is:

- Building strong relationships with stakeholders, e.g. ministry of education in different countries and overseas universities for achieving the strategic goals and sustainability (CSR) vision and the vision of the College

Based on the steps 1 – 6 and Table 3 of stakeholder mapping and future sustainability goals, the learning processes of applying 4Cs in sustainability - critical thinking skill, communication skill, collaboration skill and creative skill of Kivunja (2015) and the design thinking concept of Moore (2013) with ecosystem and multi-disciplinary interaction for problem-solving can be shown with the case institution. It is found that “Critical Thinking” process requires a full understanding of SD in higher education and the organizational culture of the institution in implementing SD related strategic goals. For “Communication and Collaboration”, stakeholders in academics and industries need to be engaged with actionable items for creating new and diversified learning experiences to learners and the institution itself for economic, social and environmental impacts. For “Creative Thinking”, educators need to attempt the use of design thinking when defining sustainability related goals for the benefit of the learners, the staff, the management and the community.

Though the methodology of this study is action research approach, quantitative data on implementing SD actions is recommended to be collected in the future for a better understanding of how to implement SD into different perspectives for enhancing multidisciplinary knowledge and for collaborating academic partners and industry practitioners to realize the definition of Brundtland Commission (1992) of the United Nations, “sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

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An Empirical Analysis of the Dynamic Probability of Informed Institutional Trading: Evidence from the Taiwan Futures Exchange

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This paper analyzes the informational role of institutional investors' trading using the dynamic intraday measure of the probability of informed trading (hereafter DPIN). Using a unique account-level dataset of institutional investors from the Taiwan index futures market, we show that the DPINs of foreign institutional buy trades are significantly positively related to future market returns. Moreover, compared to using trading imbalance as the informed trading measure, we find that the DPIN provides consistent predictive power for the market volatility, particularly during intense trading periods. Overall, our results also provide support for the notion that foreign intuitional traders are better informed than domestic institutional traders in the emerging markets.

Keywords: Institutional investors; Probability of informed trading; Emerging markets.

1. Introduction

The informed trading of institutional investors has been studied for more than 40 years in the literature (e.g., Kraus and Stoll, 1972; Chakravarty, 2001; Saar, 2001; Chiyachantana et al., 2004; Yan and Zhang, 2009; Dasgupta, Prat and Verardo, 2011; Puckett and Yan, 2011).[1] If institutional investors are informed with regard to undervalued or overvalued stocks, their trading will speed up the adjustment of fundamental values for stock prices. As such, institutional investors' trading behavior would be likely to stabilize the stock market and improve market efficiency. On the other hand, institutions may not fully take advantage of their information in investments and thus provide only little evidence of stock-picking skill because of the limits of arbitrage (Cohen, Gompers and Vuolteenaho, 2002; Lewellen, 2011).

The study of how institutional investors employ their information is of continual interest to both practitioners and academics; however, measuring the information of transactions for institutional investors is not an easy task. One of the most common and widely accepted methods is the probability of informed trading (PIN), successively developed by Easley, Kiefer, O'Hara and Paperman (1996), Easley, Kiefer and O'Hara (1997a, b) and Easley, Hvidkjaer and O'Hara (2002).[2] Although the PIN has been widely accepted in previous studies, it is also well-known for its difficulty in capturing short-lived information.[3] Recently, Chang, Chang and Wang (2014) have extended the ACG (Avramov, Chordia and Goyal, 2006) model to construct a dynamic intraday version of the PIN (hereafter DPIN) and allow researchers to estimate the probability of informed trading at much finer frequencies.[4] Chang et al.'s (2014) DPIN is a newly developed measure that provides intuitive explanation and friendly application. These advantages make the DPIN an attractive alternative for directly determining the information content of all kinds of transactions in the market. To date, the DPIN has received little examination in the literature, and thus this paper seeks to examine different types of institutional trading using the DPIN and provide further evidence for its application.

We select an emerging market, the Taiwan futures exchange (TAIFEX), as our target to conduct the examination. Using a unique dataset from the TAIFEX, we can precisely classify domestic institutional transactions and foreign institutional transactions. Given the

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[1] Kraus and Stoll (1972) find that block trades can affect market efficiency. Chakravarty (2001) confirms the influenced of informed trading on medium-size trades in favor of the stealth-trading hypothesis. Saar (2001) and Chiyachantana et al. (2004) both investigate the information content of institutional trades. Dasgupta, Prat and Verardo (2011) provide a theoretical equilibrium model to confirm the association between institutional herd behavior and both short- and long-term returns.

[2] The PIN measure is generally used in many fields of corporate finance, investment, and market microstructure, for example, in the studies of Easley et al. (1996), Brown et al. (2004), Vega (2006), Zhao and Chung (2006), Chan et al. (2008), Duarte and Young (2008), and Brockman and Yan (2009).

[3] In order to estimate the PIN measure, one must aggregate very fine intraday data, which occur at approximately five-minute intervals within the trading day across multiple days (Easley et al., 1997a, b). The resulting estimate measures informed trading over a very long horizon from one month to one quarter. In addition, over such long horizons it is likely that the actual impact of short-lived private information may become diluted or masked by other factors.

[4] Specifically, at 15-minute intervals throughout the trading day, such frequencies being more in line with the speed at which traders react to and digest information in modern financial markets. Our dynamic DPIN measure may be better suited to capturing information based on trading activity at higher frequencies, even within the trading day.

general viewpoint that foreign institutional traders may enjoy an information advantage over domestic institutional traders in a local market such as the TAIFEX,[5] the advantage of our dataset is relevant for our analyses. Comparing different types of institutional trading using the DPIN, we can test whether it captures informed trading well, and also investigate the information content of foreign and domestic institutional trades.

As a comparison to the DPIN, we also use the trade imbalance (TIB) to examine the information content of different institutional trading.[6] Some previous studies have examined the information content of trading by testing the price impact of trading activities. Of these, many use TIB to measure trading activity as this measure can proxy for both of the direction and magnitude of price changes (see, e.g., Chordia, Roll and Subrahmanyam, 2008; Easley, Engle, O'Hara and Wu, 2008; Subrahmanyam, 2008; Barber, Odean and Zhu, 2009; O'Hara, Yao and Ye, 2011).[7] Therefore, in addition to providing further empirical evidence on the application of the DPIN, this study also compares the difference (if any) between the newly developed measure (DPIN) and the conventional measure (TIB). By doing so, we believe we can enhance our understanding of the proxy of informed trading.

To study the validity of the DPIN and the TIB for both domestic and foreign institutional investors, we test return impact and volatility impact for each measure. Chang, Hsieh and Wang (2009) show that foreign institutional traders are better informed concerning price movements and variations than domestic traders in the local market; in the same vein, we consider both return and volatility in our analyses.

Our empirical findings are summarized as follows. First, we show that the DPIN of foreign institutional buying trades is significantly positively related to the market return. This finding suggests that the DPIN is able to capture informed trading on the buying side of foreign institutional traders. Second, we show that the DPIN as the informed measure provides more stable performance than the TIB for volatility predictability, particularly during an intense trading interval within a day. The overall results indicate that the DPIN is more suitable for measuring the informed trading of foreign institution investors than the TIB.

For domestic institutional traders, we find weak prediction of returns, revealing that the DPIN does not fully measure the informed trading of domestic institutional traders. Return predictability for the domestic institutional DPIN can be found only during intense trading

[5] For example, several prior studies (Grinblatt and Keloharju, 2000; Huang and Shiu, 2009) show that foreign institutional investors are more likely to select winners in the markets than domestic investors, implying that foreign institutional traders are better informed than their local competitors.

[6] Kyle (1985) and Admati and Pfleiderer (1988) focus on order imbalance as a signal of informed trades. It is assumed in these models that market makers will adjust prices upwards (downwards) when there are excess buy (sell) orders.

[7] Chordia, Roll and Subrahmanyam (2002, p.112) describe a simple and clear case: "Consider, for example, a reported volume of one million shares. At one extreme, this might be a million shares sold to the market maker while at the other extreme it could be a million shares purchased. Perhaps more typically, it would be roughly split, about 500,000 shares sold to and 500,000 shares bought from the market maker. Each scenario has its own specific implications for price movement or liquidity changes."

intervals, when the same cannot be seen using the TIB. On the other hand, the TIB and the DPIN of domestic institutional traders perform indifferently in relation to volatility impact. To sum up the findings regarding domestic institutional trading, the DPIN appears to have slightly better ability in measuring the informed trading of domestic institutional traders than the TIB.

Our investigation provides support not only for the information role of foreign institutional traders in the emerging market, but also contributes to the discussion regarding the validity of the DPIN in capturing short-lived information. Earlier studies usually report that foreign institution investors are better informed than other types of investors based on analysis using the PIN or the TIB. Our paper shows that the DPIN may be able to capture the information content of foreign institutional trading more accurately at higher frequencies. In the spirit of the definition of the DPIN given by Chang et al. (2014), the results also imply that foreign institutions are more likely to be contrarian traders, which is consistent with the argument of Barber and Odean (2011).

The remainder of this paper is organized as follows. Section 2 describes the data and methodology. Section 3 presents the empirical results for foreign institutional investors and domestic institutional investors. Section 4 concludes.

2. Data and methedology

2.1. *Data and variable definition*

We obtain the transaction data for TXF contracts from the Taiwan Futures Exchange (TAIFEX).[8] TXF is the major and most actively traded index futures product on the TAIFEX. Our dataset covers the period from January 1, 2003 to December 31, 2007. The dataset contains the date and time of the transactions, the indicator of opening or closing position, the indicator of trading direction (buy or sell),[9] and the quantity demanded or offered. Most importantly, it provides the identification of traders, which enables us to categorize the type of trader as foreign institutions or domestic institutions. As our analysis focuses on intraday horizons, we divide a single trading day into twenty 15-minute trading intervals, with each buy or sell trade being assigned to one of these intervals, depending on when the trade occurred during the day.

As mentioned, we use two measures of institutional informed trading, the DPIN and the TIB, to investigate the trading behavior of foreign institutional investors. The DPIN is defined according to the model of Chang et al. (2014), whereas the TIB follows the general definition in the literature. All measures are calculated on the basis of 15-minute intervals. The return of index futures is computed by the first difference of the natural log of the mid-

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[8] At the end of 2007, TAIFEX was ranked 21 among 54 derivatives exchanges reported to the Futures Industries Association. The TAIFEX is ranked eighth among emerging markets. Trading on the TAIFEX is conducted from 8:45 AM to 1:45 PM Monday to Friday (excluding public holidays).

[9] Compared to Lee and Ready (1991), determining the method of trade direction allows us to measure the trading activities of the investors more accurately, eliminating the measurement errors of trading volume

price of the bid–ask spread at the end of each intraday interval.[10] Our estimation for the volatility of index futures is consistent with the method of Kuo, Chung and Chang (2014).[11]

2.1.1. *DPIN measure*

Following Chang et al. (2014), the DPIN is constructed by extending the ACG model. The buy (sell) trades in the presence of negative (positive) unexpected returns are classified as informed trades, whereas buy (sell) trades in the presence of positive (negative) unexpected returns are classified as uninformed trades. To calculate the unexpected component of returns, we extract the residuals from the following regression:

$$R_t = \delta_0 + \sum_{k=1}^{4} \delta_{1,k} D_{kt}^{day} + \sum_{k=1}^{20} \delta_{2,k} D_{kt}^{Interval} + \sum_{k=1}^{6} \delta_{3,k} R_{t-k} + \varepsilon_t \,, \tag{1}$$

Where R_t is the index futures returns at intraday interval t, D_{kt}^{day} represents day-of-week dummy variables for Tuesday through Friday, and $D^{interval}$ represents dummy variables corresponding to the particular 15-minute interval at which returns are measured. Thus, the residual ε_t captures the variation in returns left over after day-of-week effects, intraday time effects, and the effect of past returns have been accounted for, and therefore serves as a proxy for unexpected returns.

Let NB_t, NS_t, and NT_t represent the number of buy, sell, and total trades, respectively, for index futures returns at interval t. Then, the DPIN is constructed as follows:

$$DPIN_{base_t} = \frac{NB_t}{NT_t}(\varepsilon_t < 0) + \frac{NS_t}{NT_t}(\varepsilon_t > 0) \,, \tag{2}$$

As can be seen, the DPIN represents the proportion of contrarian trades taking place during the 15-minute interval, which is based on the interpretation of Chang et al. (2014) regarding the trading behavior of informed investors.

2.1.2. *TIB measure*

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[10] The return of index futures is defined as the first difference of the natural log of the TAIFEX (S_t) in each trading interval: $R_t = 100*(\ln S_t - \ln S_{t-1})$, the annualized rate of return multiplied by (20 × 252).

[11] We refer to Kuo et al. (2014) to construct the measure of volatility. We estimate a GARCH(1, 1) model to obtain the volatility of futures:

$$R_t = \alpha_0 + \varepsilon_t \quad \varepsilon_t \mid \Omega_{t-1} \sim N(0, h_t)$$

$$h_t = \eta_0 + \eta_1 \varepsilon_{t-1}^2 + \eta_2 h_{t-1} + \theta_3 TA_t$$

where R_t is the return of index futures at intraday interval t; TA_t is futures trading activity by total volume at interval t; Ω_{t-1} denotes the information set available up to time t; h_t is the conditional futures variance term at interval t; ε_{t-1}^2 are the lagged squared residuals from the return equation.

Based on the general definition in the literature, e.g., Chordia and Subrahmanyan (2004), the trading imbalance (TIB) is defined as:

$$TIB_t = \frac{B_t - S_t}{B_t + S_t}, \tag{3}$$

where B_t and S_t are the buying volume and selling volume of foreign institutional traders at interval t, respectively.

2.2. *Regression specifications*

2.2.1. *The relation between returns and trading activities*

First, we use the DPIN and the TIB as proxies of trading activities and examine their association with market returns. However, we would like to note that the DPIN measures the likelihood of informed trading and presents no signs, whereas the index future returns are signed in the positive (buy) or negative (sell) direction. Therefore, when we examine the relation between index future returns and DPINs, we separate the DPIN into $DPIN_{buy}$ and the $DPIN_{sell}$ accordingly. We perform the following time series regressions with Newey–West robust standard errors for institutional trading activities:

$$R_t = \alpha_0 + \sum_{k=1}^{4} \delta_k DPIN^i_{buy_{t-k}} + \sum_{k=1}^{4} \eta_k DPIN^i_{sell_{t-k}} + \sum_{k=1}^{4} \beta_k R_{t,k} + \varepsilon_t \tag{4}$$

$$R_t = \alpha_0 + \sum_{k=1}^{4} \gamma_k TIB^i_{t-k} + \sum_{k=1}^{4} \beta_k R_{t-k} + \varepsilon_t , \tag{5}$$

where R_t denotes the index futures return for the t interval. $DPIN^i_{buy_t}$ is the buying component, defined as the number of buy transactions divided by the total number of trades for group i in interval t, written as $DPIN^i_{buy_t} = \left[NB^i_t / NT^i_t \right](\varepsilon_t < 0)$, and $DPIN^i_{sell_t}$ is the selling component, defined as the number of sell transactions divided by the total number of trades of trades for group i in interval t, written as $DPIN^i_{sell_t} = \left[NS^i_t / NT^i_t \right](\varepsilon_t > 0)$. The TIB measure is computed using buy and sell trades for group i in interval t, written as $TIB^i = (B^i - S^i)/(B^i + S^i)$.

2.2.2. *The relation between volatility and trading activity*

Next, our paper examines the association between volatility and trading activity. A natural question is whether volatility is significantly affected by the DPIN or the TIB. We regress the volatility on the DPIN and absolute of the TIB, and see whether the trading activities of foreign institutional investors and domestic institutional investors have an impact on market volatility. The regression models are shown as follows.

$$Vol_t = \alpha_0 + \sum_{k=1}^{4} \theta_k DPIN_{t-k}^{i} + \sum_{k=1}^{4} \lambda_k Vol_{t-k} + \varepsilon_t \,, \tag{6}$$

$$Vol_t = \alpha_0 + \sum_{k=1}^{4} \rho_k \left| TIB_{t-k}^{i} \right| + \sum_{k=1}^{4} \lambda_k Vol_{t-k} + \varepsilon_t \,, \tag{7}$$

where Vol_t denotes the volatility of index futures for the t interval. The $DPIN_t^i$ and the TIB_t^i are defined as in Equation (2) and Equation (3), respectively.

2.3. *DPIN and TIB statistics*

Table 1 reports the intraday DPIN and TIB of foreign institutional investors and domestic institutional investors from 2003 to 2007 in Panel A and Panel B, respectively. The DPIN is also displayed as the buy side DPIN ($DPIN_{buy}$) and the sell side DPIN ($DPIN_{sell}$). Statistics for all the measures are calculated as the daily average of all 15-minute intervals. As reported in Panel A, the means of DPIN, $DPIN_{buy}$, $DPIN_{sell}$, and TIB for foreign institutional investors are 0.4979, 0.2432, 0.2547, and -0.0085, respectively, while the statistics for domestic institutional investors in Panel B are 0.4993, 0.2435, 0.2557, and -0.0119, respectively. The results present no significant differences between the two types of institutional investors.

We further report the correlation coefficients among variables for foreign institutional investors and domestic institutional investors in Panel C and Panel D, respectively. For foreign institutional investors, $DPIN_{buy}$ is significantly negatively correlated with returns (-0.68%), whereas $DPIN_{sell}$ is significantly positively correlated with returns (0.65%). For domestic institutional investors, $DPIN_{buy}$ is significantly negatively correlated with returns (-0.78%), whereas $DPIN_{sell}$ is significantly positively correlated with returns (0.78%). Overall, the correlation among variables is consistent with the theoretical presumption that DPIN captures buy (sell) trades in the presence of negative (positive) unexpected returns. In addition, the TIB is negatively correlated with returns for foreign institutions and positively correlated with returns for domestic institutions; the TIB is also negatively correlated with volatility for foreign institutions and positively correlated with volatility for domestic institutions. However, none of the coefficients are significant (weak to minimal). In sum, the DPIN rather than the TIB presents a much stronger association with market prices, which may imply that the DPIN is a superior proxy for price information.

[Insert Table 1 about here]

3. Empirical results

3.1. *Trading activity of foreign institutional investors*

Further to earlier findings, we examine the trading activity of foreign institutional investors using the DPIN and the TIB in this section. First, we study the return predictability of foreign institutional trades. The results are presented in Table 2. As reported, the coefficient of $DPIN_{buy_{t-1}}$ is significantly positive in Model (1), and remains significantly positive when controlling for other lagged DPINs. In contrast, although TIB_{t-1} is significantly positively related to market returns, it loses its significance when other lagged TIBs are included in the regression. In sum, the results indicate that the DPIN seems to be a better measure of the trading activity of foreign institutional investors than the TIB in terms of capturing their price information. This finding is consistent with Barber and Odean’s (2011) argument that informed institutional investors tend to be contrarians.

[Insert Table 2 about here]

Similar to Table 2, Table 3 studies the volatility information of foreign institutional trades. We find that both $DPIN_{t-1}$ and $|TIB_{t-1}|$ are significantly related to current market volatility regardless of whether or not the other lagged DPINs and TIBs are included. In addition, all model specifications present very similar regression power, which suggests that the DPIN of foreign institutions provide information content no different to that obtained from the TIB in predicting market volatility. Interestingly, as the coefficient of $DPIN_{t-1}$ is negative, the result is consistent with Brennan and Cao (1996), which suggests that investors who adopt contrarian strategies are likely to be informed. Similarly, Avramov et al. (2006) show that informed traders generally reduce volatility by contrarian trading.

[Insert Table 3 about here]

3.2. *Trading activity of foreign institutional investors during intense trading intervals*

A central prediction of traditional microstructure theory is that trading takes place because investors have different beliefs or because of differences in information. The role of the number of trades in price formation is also highlighted by Easley and O’Hara (1992), who show that the presence or absence of trades may provide information to market participants. Specifically, the larger the number of trades, the higher the probability that new information has been obtained. Therefore, we also test whether the foreign institutional trades provide different information on returns during intense trading intervals. We impose additional dummies on Equations (4) and (5) to account for intense trading intervals within a day. The regression model is as follows:

$$R_t = \alpha_0 + \sum_{k=1}^{4} \delta_k DPIN^i_{buy_{t-k}}(LT_t^{i,buy}) + \sum_{k=1}^{4} \eta_k DPIN^i_{sell_{t-k}}(LT_t^{i,sell}) + \sum_{k=1}^{4} \beta_k R_{t,k} + \varepsilon_t\,, \tag{8}$$

$$R_t = \alpha_0 + \sum_{k=1}^{4} \gamma_k TIB^i_{t-k}(LT_t^i) + \sum_{k=1}^{4} \beta_k R_{t-k} + \varepsilon_t\,, \tag{9}$$

where $LT_t^{i,buy}(LT_t^{i,sell})$ is the "intense trading" indicator, equal to 1 if the value of $DPIN_{buy_t}^{i}(DPIN_{sell_t}^{i})$ and TIB_t^i are ranked as the top 10% on that day, and zero otherwise. Table 4 reports the regression results for Equations (8) and (9). Again, we find that the coefficient of $DPIN_{buy_{t-1}}$ is significantly positive for Models (1) and (2), which is consistent with the findings reported in Table 2. However, for two models we find no evidence that *TIBs* during intense intervals are able to predict current returns. In sum, regarding the prediction of returns, the results in Table 4 show that DPINs rather than TIBs are more likely to be superior as measurements in capturing information advantageous to foreign institutional investors when trades are clustered.

[Insert Table 4 about here]

Similarly, we further estimate the following modified regression models for market volatility based on Equations (6) and (7):

$$Vol_t = \alpha_0 + \sum_{k=1}^{4} \theta_k DPIN_{t-k}^{i}(LT_t^i) + \sum_{k=1}^{4} \lambda_k Vol_{t-k} + \varepsilon_t , \tag{10}$$

$$Vol_t = \alpha_0 + \sum_{k=1}^{4} \rho_k \left| TIB_{t-k}^{i} \right| (LT_t^i) + \sum_{k=1}^{4} \lambda_k Vol_{t-k} + \varepsilon_t , \tag{11}$$

where all variables are defined as in previous equations. Table 5 presents the results.

Consistent with the results reported in Table 3, both $DPIN_{t-1}$ and $|TIB_{t-1}|$ significantly related to current market volatility during intense trading sessions regardless of whether or not the other lagged DPINs and TIBs are included. In addition, $DPIN_{t-2}$ also has a significant impact on volatilities, whereas $|TIB_{t-2}|$ presents insignificant impact. However, comparing the explanatory power, there is little difference between DPINs and TIBs. Interestingly, while the results in Table 3 show that both DPIN and TIB have a negative impact on market volatility, the results of Table 5 are the opposite. Both $DPIN_{t-1}$ and $|TIB_{t-1}|$ have a positive impact on volatility.

Extensive evidence indicates that trading volume and return volatility are positively correlated (Karpoff, 1987; Gallant, Rossi and Tauchen, 1992).[12] Jones, Kaul and Lipson (1994) find that only trade frequency affects price volatility. On the other hand, the larger the number of trades, the higher the probability that new information has been acquired (Kyle 1985). French and Roll's (1986) price formation theory also points out that price variation is caused by the provision of information. Therefore, the positive association between

[12] Gallant et al. (1992) find a positive correlation between conditional volatility and volume, wherein large price movements are followed by high volumes.

volatility and the DPIN or the TIB during intense trading intervals shown in Table 5 might be evidence that informed trading causes price volatility. As our earlier findings have shown, informed trading can also reduce volatility, and thus it is likely that the informed trading of foreign institutional investors has a twofold impact on volatility, and appears as an asymmetric influence for normal trading intervals and intense trading intervals.

[Insert Table 5 about here]

Overall, the examination of intense trading intervals using the DPIN and the TIB provides support for our earlier findings. Measuring the trading activity of foreign institutional investors through the DPIN offers a better ability to capture their information advantage regarding market returns.

3.3. *Trading activity of domestic institutional investors*

So far, our analyses have focused on the trading activity of foreign institutional investors, and the findings show that the DPIN performs better than the TIB in representing informed trading. For comparison, we extend the tests to domestic institutional investors. We examine their trading activity using the DPIN and the TIB as in the analyses completed in Sections 3.1 and 3.2.

Table 6 presents the relation between returns and trading activity for domestic institutional investors. Unlike the results reported in Table 2, we find that the DPIN for domestic institutional investors does not have a significant impact on market returns, whereas the TIB has a significant impact on returns in each model specification. The findings in Table 6 are not consistent with those in Table 2, indicating that the TIB is more suited to measuring return information for domestic institutional trades than the DPIN. The finding also implies that domestic institutional investors are less likely to behave as contrarian traders compared to foreign institutional traders.

[Insert Table 6 about here]

Table 7 presents the relation between volatility and trading activity for domestic institutional investors. Consistent with the findings for foreign institutional investors in Table 3, the result shows that both the DPIN and the TIB have a significant negative impact on volatility in each model specification. Again, the results confirm that the DPIN and the TIB are no different in measuring the volatility information of institutional investors.

[Insert Table 7 about here]

3.4. *Trading activity of domestic institutional investors during intense trading intervals*

The analyses using trades during intense trading intervals are also applied for domestic institutional investors. We rerun the regression models (Equations (8) to (11)) for the DPIN and the TIB of domestic institutional investors. First, Table 8 reports the results of the impact on returns. Interestingly, in contrast to the finding in Table 6 showing that the DPIN of domestic institutional investors has inferior ability in showing the impact on returns, the coefficient of $DPIN_{buy_{t-1}}$ for domestic institutional investors in Table 8 is significant, whereas that of TIBt-1 is insignificant. Therefore, Table 8 shows that the DPIN is still a more suitable measure for capturing the trading activity of domestic institutional investors during intense trading intervals, as shown also for foreign institutional investors.

[Insert Table 8 about here]

Finally, Table 9 reports the results of regressing volatility with the trading activity of domestic institutional investors during intense trading intervals. It is no surprise that the findings show that both the DPIN and the TIB have significant impacts on market volatility. However, in contrast to what we have shown for the DPIN and the TIB in relation to foreign institutional investors, the DPIN and the TIB for domestic institutional investors have the opposite effects. The DPIN has a positive impact on volatility, whereas the TIB has a negative impact on volatility. The results are not altered by including other lagged DPINs or TIBs.

[Insert Table 9 about here]

3.5. *Discussion*

Although there is slight divergence in our findings regarding the validity of the DPIN for foreign institutional investors and domestic institutional investors, it still appears that the DPIN performs considerably better in capturing informed trades in a range of situations than the TIB. The DPINs of foreign institutional investors have more significant impact on returns than TIBs in all trading sessions and intense trading intervals, and the DPINs of domestic institutional investors also have more significant impact on returns than TIBs in intense trading sessions. For volatility information, it seems that the DPIN and the TIB present no distinct difference in terms of the volatility effect. However, it is still apparent that the DPIN has more consistent impact on market volatility than the TIB. Overall, the findings indicate the suitability of the DPIN as a measure to proxy for informed trading, especially when we are interested in foreign institutional traders. In addition, the results imply that informed foreign institutional traders generally behave as contrarians, as in the setting of Chang et al. (2014) and as argued by Barber and Odean (2011).

4. Conclusions

This study examines the validity of the DPIN developed by Chang et al. (2014). Using the trades of foreign institutional investors and domestic institutional investors on the TAIFEX, we study the impact of the DPIN on market returns and volatilities and compare its effect to that of the TIB. We show that the DPIN carries more return information than the TIB, especially for foreign institutional investors. This finding suggests that the DPIN is able to capture the informed trading of foreign institutional traders. Furthermore, the DPIN as the informed trading measure provides stable performance throughout different trading intervals within a day. Compared to the traditional informed trading measure, i.e., the PIN, Chang et al.'s (2014) DPIN is a newly developed measure that provides intuitive explanation and friendly application without complex estimation. Our findings confirm its feasibility. We also believe that it is a suitable alternative approach to discern directly the intraday information content of transactions.

In addition, according to the assumption underpinning the construction of the DPIN, informed traders are more likely to behave as contrarians; thus, our results also suggest that informed foreign institutional investors generally behave as contrarians. A similar argument can be seen in Barber and Odean (2011), who claim that the informed trader has more incentives to act against price moves.

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Table 1 Characteristics of intraday trade volume measure

Panel A and Panel B of Table 1 report interval means and medians for the DPIN and TIB of institutional investors. Panel C and Panel D show correlations among all regression variables. Samples Panel A reports foreign institutional investor values and Panel B the domestic institutional investor values. *Return* denotes the index return, computed from the difference of the natural log of the mid-point of the bid–ask spread at the end of an intraday interval. *Volatility* is the GARCH(1,1) model developed by Bollerslev (1986), incorporating commonly used volatility measures. The DPIN measure is computed as $DPIN^{i}_{buy_t} = \left[NB_t / NT_t\right](\varepsilon_t < 0)$, and $DPIN^{i}_{sell_t} = \left[NS_t / NT_t\right](\varepsilon_t > 0)$. The TIB measure is computed as $TIB^{i}_{t} = (B^{i}_{t} - S^{i}_{t}) / (B^{i}_{t} + S^{i}_{t})$ for interval t. The data are from January 1, 2003 to December 31, 2007, covering 1,238 trading days.

Panel A Summary statistics for foreign institutional investors

	Mean	Std. Dev.	Skewness	Kurtosis	Obs.
$DPIN$	0.4979	0.3999	0.0214	1.3739	19740
$DPIN_{buy}$	0.2432	0.3734	1.1784	2.6972	19740
$DPIN_{sell}$	0.2547	0.3800	1.0823	2.4562	19740
TIB	-0.0085	0.7998	0.0390	1.3748	19740

Panel B Summary statistics for domestic institutional investors

	Mean	Std. Dev.	Skewness	Kurtosis	Obs.
$DPIN$	0.4993	0.2213	0.0624	2.3935	24710
$DPIN_{buy}$	0.2435	0.2909	0.7551	2.1995	24710
$DPIN_{sell}$	0.2557	0.2982	0.7045	2.1122	24710
TIB	-0.0119	0.4424	0.0080	2.3927	24710

(Continued)

Panel C Correlations for foreign institutional investors

	Return	*Volatility*	*DPIN*	$DPIN_{buy}$	$DPIN_{sell}$	*TIB*
Return	1					
Volatility	-0.0129	1				
DPIN	-0.0077	-0.0069	1			
$DPIN_{buy}$	-0.6812	0.0238	0.4084	1		
$DPIN_{sell}$	0.6548	0.0216	0.4413	-0.5992	1	
TIB	-0.0051	-0.0291	-0.0200	0.4093	-0.4394	1

Panel D Correlations for domestic institutional investors

	Return	*Volatility*	*DPIN*	$DPIN_{buy}$	$DPIN_{sell}$	*TIB*
Return	1					
Volatility	-0.0112	1				
DPIN	0.0196	-0.0654	1			
$DPIN_{buy}$	-0.7826	0.0121	0.2422	1		
$DPIN_{sell}$	0.7773	-0.0393	0.3036	-0.8481	1	
TIB	0.0316	0.0368	-0.0224	0.2571	-0.2714	1

Table 2 Intraday trade volume measure for the influence of foreign institutional investors on returns

This table presents the results with Newey–West corrected *t*-statistics for time-series regressions from January 1, 2003 to December 31, 2007 with index future returns as the dependent variable. R_t denotes the index futures return for the *t* interval $DPIN^i_t$ is the number of buy transactions divided by the total number of trades for group *i* institutional investors in interval *t*. DPIN measure is computed as $DPIN^i_{buy_t} = \left[NB^i_t / NT^i_t \right](\varepsilon_t < 0)$. $DPIN^i_{sell_t}$ is the number of sell transactions divided by the total number of trades for group *i* institutional investors in interval *t*, computed as $DPIN_{sell_t} = \left[NS^i_t / NT^i_t \right](\varepsilon_t > 0)$. The TIB measure is computed as $TIB^i_t = (B^i_t - S^i_t)/(B^i_t + S^i_t)$ for interval *t*. The regression model is as follows:

$$R_t = \alpha_0 + \sum_{k=1}^{4} \delta_k DPIN^i_{buy_{t-k}} + \sum_{k=1}^{4} \eta_k DPIN^i_{sell_{t-k}} + \sum_{k=1}^{4} \beta_k R_{t,k} + \varepsilon_t , \tag{4}$$

$$R_t = \alpha_0 + \sum_{k=1}^{4} \gamma_k TIB^i_{t-k} + \sum_{k=1}^{4} \beta_k R_{t-k} + \varepsilon_t , \tag{5}$$

***indicates significance at the 1% level; **indicates significance at the 5% level; *indicates significance at the 10% level.

	Intercept	$DPIN_{buy_{t-1}}$	$DPIN_{sell_{t-1}}$	$DPIN_{buy_{t-2}}$	$DPIN_{sell_{t-2}}$	$DPIN_{buy_{t-3}}$	$DPIN_{sell_{t-3}}$	$DPIN_{buy_{t-4}}$	$DPIN_{sell_{t-4}}$	$Adj-R^2$	Obs.
(1)	-0.0008	0.4851 ***	-0.0411							0.0013	19739
	(-0.0087)	(2.7743)	(-0.2740)								
(2)	-0.3761	0.4011*	0.0160	0.3025	0.4516 **	0.4322 **	0.4052*	0.1064	-0.2265	0.0019	19739
	(-1.9157)	(1.6843)	(0.0823)	(1.5740)	(2.0107)	(1.9961)	(1.7973)	(0.4665)	(-1.0867)		

	Intercept	TIB_{t-1}	TIB_{t-2}	TIB_{t-3}	TIB_{t-4}	$Adj-R^2$	Obs.
(3)	0.1081	0.1170 *				0.0012	19739
	(1.6027)	(1.8270)					
(4)	0.0892	-0.1259	-0.1753	0.3230 **	0.3308***	0.0024	19739
	(1.1132)	(-1.0315)	(-1.3279)	(2.5316)	(2.6211)		

Table 3 Intraday trade volume measure for the influence of foreign institutional investors on volatility

This table presents the results of the Newey–West corrected t-statistics for time-series regressions from January 1, 2003 to December 31, 2007 with the volatility of index futures as the dependent variable. Vol_t is the GARCH(1,1) model developed by Bollerslev (1986), incorporating commonly used volatility measures. The DPIN measure is computed as $DPIN^i_{buy_t} = \left[NB^i_t / NT^i_t \right](\varepsilon_t < 0)$, and $DPIN^i_{sell_t} = \left[NS^i_t / NT^i_t \right](\varepsilon_t > 0)$. The TIB measure is computed as $TIB^i_t = (B^i_t - S^i_t)/(B^i_t + S^i_t)$ for interval t. The regression model is as follows:

$$Vol_t = \alpha_0 + \sum_{k=1}^{4} \theta_k DPIN^i_{t-k} + \sum_{k=1}^{4} \lambda_k Vol_{t-k} + \varepsilon_t , \tag{6}$$

$$Vol_t = \alpha_0 + \sum_{k=1}^{4} \rho_k \left| TIB^i_{t-k} \right| + \sum_{k=1}^{4} \lambda_k Vol_{t-k} + \varepsilon_t , \tag{7}$$

***indicates significance at the 1% level; **indicates significance at the 5% level; *indicates significance at the 10% level.

	Intercept	$DPIN_{t-1}$	$DPIN_{t-2}$	$DPIN_{t-3}$	$DPIN_{t-4}$	$Adj-R^2$	Obs.
(1)	0.0192 ***	-0.0048 ***				0.5684	19739
	(26.6551)	(-7.8454)					
(2)	0.0195 ***	-0.0054 ***	-0.0011	-0.0003	0.0026 ***	0.5616	19739
	(16.2112)	(-6.6164)	-(1.4722)	(-0.5063)	(4.4138)		

	Intercept	TIB_{t-1}	TIB_{t-2}	TIB_{t-3}	TIB_{t-4}	$Adj-R^2$	Obs.
(3)	0.0221***	-0.0068 ***				0.5686	19739
	(20.5824)	(-6.9445)					
(4)	0.0265***	-0.0038 ***	-0.0025 **	-0.0050 ***	-0.0008	0.5622	19739
	(15.2654)	(-4.1442)	(-2.0392)	(-3.3533)	-(0.9142)		

Table 4 Intraday trade volume measure for the influence of foreign institutional investors on returns, conditioned on the intense trading interval

This table presents the results of the Newey–West corrected t-statistics for time-series regressions from January 1, 2003 to December 31, 2007 with the returns of index futures as the dependent variable. R_t denotes the index futures return in the t interval. $DPIN_t^i$ is number of buy transactions divided by the total number of trades for group i institutional investors in interval t. The DPIN measure is computed as $DPIN_{buy_t}^i = \left[NB_t^i / NT_t^i\right](\varepsilon_t < 0)$. $DPIN_{sell_t}^i$ is the number of sell transactions divided by the total number of trades for group i institutional investors in interval t, as $DPIN_{sell_t} = \left[NS_t^i / NT_t^i\right](\varepsilon_t > 0)$. The TIB measure is computed as $TIB_t^i = (B_t^i - S_t^i)/(B_t^i + S_t^i)$ for interval t. $LT_t^{i,buy}(LT_t^{i,sell})$ is a "large trades" indicator variable that equals 1 if $DPIN_{buy_t}^i$ ($DPIN_{sell_t}^i$) and TIB_t^i were located in the top 10% of the current day, and zero otherwise. The regression model is as follows:

$$R_t = \alpha_0 + \sum_{k=1}^{4} \delta_k DPIN_{buy_{t-k}}^i (LT_t^{i,buy}) + \sum_{k=1}^{4} \eta_k DPIN_{sell_{t-k}}^i (LT_t^{i,sell}) + \sum_{k=1}^{4} \beta_k R_{t,k} + \varepsilon_t , \tag{8}$$

$$R_t = \alpha_0 + \sum_{k=1}^{4} \gamma_k TIB_{t-k}^i (LT_t^i) + \sum_{k=1}^{4} \beta_k R_{t-k} + \varepsilon_t , \tag{9}$$

***indicates significance at the 1%level; **indicates significance at the 5%level; and *indicates significance at the 10%level.

	Intercept	$DPIN_{buy_{t-1}}$	$DPIN_{sell_{t-1}}$	$DPIN_{buy_{t-2}}$	$DPIN_{sell_{t-2}}$	$DPIN_{buy_{t-3}}$	$DPIN_{sell_{t-3}}$	$DPIN_{buy_{t-4}}$	$DPIN_{sell_{t-4}}$	$Adj-R^2$	Obs.
(1)	0.0464	1.6121 ***	0.1264							0.0015	19739
	(0.6504)	(3.0167)	(0.3257)								
(2)	0.0592	1.8392 ***	0.1719	-0.1043	-1.2580**	0.1893	-0.1852	0.1431	0.1461	0.0022	19739
	(0.6242)	(2.6893)	(0.3508)	(-0.2474)	(-1.9768)	(0.3772)	(-0.3689)	(0.3434)	(0.3097)		

	Intercept	TIB_{t-1}	TIB_{t-2}	TIB_{t-3}	TIB_{t-4}	$Adj-R^2$	Obs.
(3)	0.1159*	-0.3025				0.0012	19739
	(1.6833)	(-0.6043)					
(4)	0.1225	-0.2803	-0.7218	0.1976	-0.1913	0.0019	19739
	(1.4949)	(-0.5277)	(-1.3877)	(0.3703)	(-0.3323)		

Table 5 Intraday trade volume measure for the influence of foreign institutional investors on volatility, conditioned on the intense trading interval

This table presents the results of the Newey–West corrected t-statistics for time-series regressions from January 1, 2003 to December 31, 2007 with the volatility of index futures as the dependent variable. Vol_t is the GARCH(1,1) model developed by Bollerslev (1986), incorporating commonly used volatility measures. The DPIN measure is computed as $DPIN^i_{buy_t} = \left[NB^i_t / NT^i_t\right](\varepsilon_t < 0)$, and $DPIN^i_{sell_t} = \left[NS^i_t / NT^i_t\right](\varepsilon_t > 0)$. The TIB measure is computed as $TIB^i_t = (B^i_t - S^i_t)/(B^i_t + S^i_t)$ for interval t. (LT^i_t) is a "large trades" indicator variable that equals 1 if $DPIN^i_t\,(TIB^i_t)$ was located in the top 10% of the current day, and zero otherwise. The regression model is as follows:

$$Vol_t = \alpha_0 + \sum_{k=1}^{4} \theta_k DPIN^i_{t-k}(LT^i_t) + \sum_{k=1}^{4} \lambda_k Vol_{t-k} + \varepsilon_t, \tag{10}$$

$$Vol_t = \alpha_0 + \sum_{k=1}^{4} \rho_k \left|TIB^i_{t-k}\right|(LT^i_t) + \sum_{k=1}^{4} \lambda_k Vol_{t-k} + \varepsilon_t, \tag{11}$$

***indicates significance at the 1% level; **indicates significance at the 5% level; *indicates significance at the 10% level.

	Intercept	$DPIN_{t-1}$	$DPIN_{t-2}$	$DPIN_{t-3}$	$DPIN_{t-4}$	$Adj-R^2$	Obs.
(1)	0.0163 ***	0.0122 ***				0.5687	19739
	(26.7186)	(7.4349)					
(2)	0.0165 ***	0.0141 ***	0.0092 ***	0.0013	-0.0027	0.5624	19739
	(25.3577)	(7.2770)	(4.9267)	(0.4951)	(-1.4875)		

	Intercept	TIB_{t-1}	TIB_{t-2}	TIB_{t-3}	TIB_{t-4}	$Adj-R^2$	Obs.
(3)	0.0167 ***	0.0063 ***				0.5680	19739
	(26.2762)	(3.2396)					
(4)	0.0173 ***	0.0061 ***	0.0001	-0.0001	-0.0004	0.5610	19739
	(23.7398)	(2.9091)	(0.0905)	(-0.0704)	(-0.2691)		

Table 6 Intraday trade volume measure for the influence of domestic institutional investors on returns

This table presents the results of the Newey–West corrected t-statistics for time-series regressions from January 1, 2003 to December 31, 2007 with index future returns as the dependent variable. R_t denotes the index futures return in the t interval $DPIN_t^i$ is number of buy transactions divided by the total number of trades for group i institutional investors in interval t. The DPIN measure is computed as $DPIN_{buy_t}^i = \left[NB_t^i / NT_t^i\right](\varepsilon_t < 0)$. $DPIN_{sell_t}^i$ is number of sell transactions divided by the total number of trades for group i institutional investors in interval t, computed as $DPIN_{sell_t} = \left[NS_t^i / NT_t^i\right](\varepsilon_t > 0)$. The TIB measure is computed as $TIB_t^i = (B_t^i - S_t^i)/(B_t^i + S_t^i)$ for interval t. The regression model is as follows:

$$R_t = \alpha_0 + \sum_{k=1}^{4} \delta_k DPIN_{buy_{t-k}}^i + \sum_{k=1}^{4} \eta_k DPIN_{sell_{t-k}}^i + \sum_{k=1}^{4} \beta_k R_{t,k} + \varepsilon_t , \tag{4}$$

$$R_t = \alpha_0 + \sum_{k=1}^{4} \gamma_k TIB_{t-k}^i + \sum_{k=1}^{4} \beta_k R_{t-k} + \varepsilon_t , \tag{5}$$

***indicates significance at the 1% level; **indicates significance at the 5% level; *indicates significance at the 10% level.

	Intercept	$DPIN_{buy_{t-1}}$	$DPIN_{sell_{t-1}}$	$DPIN_{buy_{t-2}}$	$DPIN_{sell_{t-2}}$	$DPIN_{buy_{t-3}}$	$DPIN_{sell_{t-3}}$	$DPIN_{buy_{t-4}}$	$DPIN_{sell_{t-4}}$	$Adj-R^2$	Obs.
(1)	0.1843	0.4174	-0.5131							0.0012	24706
	(0.9408)	(1.0650)	(-1.3337)								
(2)	-0.2294	0.3996	-0.5421	0.2692	-0.0009	0.5812	0.8608 **	-0.1038	0.0906	0.0011	24706
	(-0.5853)	(1.0017)	(-1.3606)	(0.5789)	(-0.0021)	(1.3263)	(2.1489)	(-0.2428)	(0.2215)		

	Intercept	TIB_{t-1}	TIB_{t-2}	TIB_{t-3}	TIB_{t-4}	$Adj-R^2$	Obs.
(3)	0.1651 *	0.6957 ***				0.0015	24706
	(1.8451)	(3.6789)					
(4)	0.1680 *	0.5404 ***	0.1021	0.3036	0.0442	0.0015	24706
	(1.8924)	(2.6572)	(0.4847)	(1.3284)	(0.2081)		

Table 7 Intraday trade volume measure for the influence of domestic institutional investors on volatility

This table presents the results of the Newey–West corrected t-statistics for time-series regressions from January 1, 2003 to December 31, 2007 with the volatility of index futures as the dependent variable. Vol_t is the GARCH(1,1) model developed by Bollerslev (1986), incorporating commonly used volatility measures. The DPIN measure is computed as $DPIN^{i}_{buy_t} = \left[NB^{i}_{t} / NT^{i}_{t}\right](\varepsilon_t < 0)$, and $DPIN^{i}_{sell_t} = \left[NS^{i}_{t} / NT^{i}_{t}\right](\varepsilon_t > 0)$. The TIB measure is computed as $TIB^{i}_{t} = (B^{i}_{t} - S^{i}_{t})/(B^{i}_{t} + S^{i}_{t})$ for interval t. The regression model is as follows:

$$Vol_t = \alpha_0 + \sum_{k=1}^{4} \theta_k DPIN^{i}_{t-k} + \sum_{k=1}^{4} \lambda_k Vol_{t-k} + \varepsilon_t , \tag{6}$$

$$Vol_t = \alpha_0 + \sum_{k=1}^{4} \rho_k \left|TIB^{i}_{t-k}\right| + \sum_{k=1}^{4} \lambda_k Vol_{t-k} + \varepsilon_t , \tag{7}$$

***indicates significance at the 1% level; **indicates significance at the 5% level; *indicates significance at the 10% level.

	Intercept	$DPIN_{t-1}$	$DPIN_{t-2}$	$DPIN_{t-3}$	$DPIN_{t-4}$	$Adj-R^2$	Obs.
(1)	0.0228 ***	-0.0137 ***				0.5781	24706
	(18.7043)	(-8.3619)					
(2)	0.0261 ***	-0.0137 ***	-0.0021*	-0.0017	-0.0027**	0.5780	24706
	(13.3868)	(-8.8208)	(-1.8448)	(-1.2151)	(-2.1373)		

	Intercept	TIB_{t-1}	TIB_{t-2}	TIB_{t-3}	TIB_{t-4}	$Adj-R^2$	Obs.
(3)	0.0183 ***	-0.0061 ***				0.5768	24706
	(19.4856)	(-6.1530)					
(4)	0.0201 ***	-0.0050 ***	-0.0030**	0.0004	-0.0029 ***	0.5767	24706
	(15.9852)	(-5.0343)	(-2.2722)	(0.3498)	(-2.7861)		

Table 8 Intraday trade volume measure for the influence of domestic institutional investors on return, conditioned on the intense trading interval

This table presents the results of the Newey–West corrected *t*-statistics for time-series regressions from January 1, 2003 to December 31, 2007 with the return of index futures as the dependent variable. R_t denotes the index futures return in the *t* interval. $DPIN_t^i$ is number of buy transactions divided by the total number of trades for group *i* institutional investors in interval *t*. The DPIN measure is computed as $DPIN_{buy_t}^i = \left[NB_t^i / NT_t^i\right](\varepsilon_t < 0)$. $DPIN_{sell_t}^i$ is the number of sell transactions divided by the total number of trades for group *i* institutional investors in interval *t*, computed as $DPIN_{sell_t} = \left[NS_t^i / NT_t^i\right](\varepsilon_t > 0)$. The TIB measure is computed as $TIB_t^i = (B_t^i - S_t^i)/(B_t^i + S_t^i)$ for interval *t*. $LT_t^{i,buy}$ ($LT_t^{i,sell}$) is a "large trades" indicator variable that equals 1 if $DPIN_{buy_t}^i$ ($DPIN_{sell_t}^i$) and TIB_t^i were located in the top 10% of the current day, and zero otherwise. The regression model is as follows:

$$R_t = \alpha_0 + \sum_{k=1}^{4} \delta_k DPIN_{buy_{t-k}}^i (LT_t^{i,buy}) + \sum_{k=1}^{4} \eta_k DPIN_{sell_{t-k}}^i (LT_t^{i,sell}) + \sum_{k=1}^{4} \beta_k R_{t,k} + \varepsilon_t , \quad (8)$$

$$R_t = \alpha_0 + \sum_{k=1}^{4} \gamma_k TIB_{t-k}^i (LT_t^i) + \sum_{k=1}^{4} \beta_k R_{t-k} + \varepsilon_t , \quad (9)$$

***indicates significance at the 1% level; **indicates significance at the 5% level; *indicates significance at the 10% level.

	Intercept	$DPIN_{buy_{t-1}}$	$DPIN_{sell_{t-1}}$	$DPIN_{buy_{t-2}}$	$DPIN_{sell_{t-2}}$	$DPIN_{buy_{t-3}}$	$DPIN_{sell_{t-3}}$	$DPIN_{buy_{t-4}}$	$DPIN_{sell_{t-4}}$	$Adj-R^2$	Obs.
(1)	0.0951	2.0555**	0.1881							0.0013	24706
	(0.9478)	(2.5352)	(0.2150)								
(2)	0.0905	2.0638**	0.1842	-0.5050	-0.4740	0.4542	0.7701	-0.1181	-0.0033	0.0011	24706
	(0.8475)	(2.5251)	(0.2092)	(-0.5739)	(-0.6493)	(0.6855)	(1.2671)	(-0.1753)	(-0.0049)		

	Intercept	TIB_{t-1}	TIB_{t-2}	TIB_{t-3}	TIB_{t-4}	$Adj-R^2$	Obs.
(3)	0.1281	0.4951				0.0010	24706
	(1.3400)	(1.2932)					
(4)	0.1325	0.5075	-0.3586	0.4050	-0.1544	0.0010	24706
	(1.2951)	(1.3303)	(-0.8288)	(0.9621)	(-0.3117)		

Table 9 Intraday trade volume measure for the influence of domestic institutional investors on volatility, conditioned on the intense trading interval

This table presents the results of the Newey–West corrected t-statistics for time-series regressions from January 1, 2003 to December 31, 2007 with the volatility of index futures as the dependent variable. Vol_t is the GARCH(1,1) model developed by Bollerslev (1986), incorporating commonly used volatility measures. The DPIN measure is computed as $DPIN^i_{buy_t} = \left[NB^i_t / NT^i_t\right](\varepsilon_t < 0)$, and $DPIN^i_{sell_t} = \left[NS^i_t / NT^i_t\right](\varepsilon_t > 0)$. The TIB measure is computed as $TIB^i_t = (B^i_t - S^i_t)/(B^i_t + S^i_t)$ for interval t. (LT^i_t) is a "large trades" indicator variable that equals 1 if $DPIN^i_t$ (TIB^i_t) was located in the top 10% of the current day, and zero otherwise. The regression model is as follows:

$$Vol_t = \alpha_0 + \sum_{k=1}^{4} \theta_k DPIN^i_{t-k}(LT^i_t) + \sum_{k=1}^{4} \lambda_k Vol_{t-k} + \varepsilon_t, \qquad (10)$$

$$Vol_t = \alpha_0 + \sum_{k=1}^{4} \rho_k \left|TIB^i_{t-k}\right|(LT^i_t) + \sum_{k=1}^{4} \lambda_k Vol_{t-k} + \varepsilon_t, \qquad (11)$$

***indicates significance at the 1% level; **indicates significance at the 5% level; *indicates significance at the 10% level.

	Intercept	$DPIN_{t-1}$	$DPIN_{t-2}$	$DPIN_{t-3}$	$DPIN_{t-4}$	$Adj-R^2$	Obs.
(1)	0.0144 ***	0.0455 ***				0.5844	24706
	(20.2767)	(11.1331)					
(2)	0.01493 ***	0.0456 ***	-0.0053	-0.0091	-0.0099	0.5850	24706
	(21.1546)	(11.1214)	(-2.1330)	(-6.5553)	(-4.4407)		

	Intercept	TIB_{t-1}	TIB_{t-2}	TIB_{t-3}	TIB_{t-4}	$Adj-R^2$	Obs.
(3)	0.0161 ***	-0.0028 ***				0.5764	24706
	(20.1711)	(-2.4684)					
(4)	0.0161 ***	-0.0027 **	-0.0024 **	-0.0001	0.0022	0.5762	24706
	(19.8654)	(-2.3699)	(-2.2311)	(-0.0811)	(1.2994)		

Do Foreign Institutional Investors Have Private Information for Market Index Futures? The Natural Experiment on the TAIFEX

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When traders trade for the market index futures, usually they act on the same public information set regarding the state of the economy. It is, therefore, less straightforward to claim that specific trader group has inside information on “the whole market”. However, working with six-year market index futures transaction data from the Taiwan Futures Exchange (TAIFEX), this paper shows that foreign institutional investors still have private information for the market. By French and Roll’s (1986) decomposition for price formation, we find that no change occurs for the public information flow during our sample period but that price volatility changes significantly between periods. Excluding the cause of mispricing, we find that the price variation is more likely to be caused by the private information of foreign institutional trading. In addition, information-related intraday patterns of volatility and bid-ask spread react to the changes in order submission behaviors of foreign institutional traders, suggesting that the private information of the index futures market and foreign institutional trading are closely-related. We provide evidence that private information is not irrelevant in the index futures market and that foreign institutional traders in fact carry private information and cause price variation in such a market.

Keywords: Foreign Institutional Investors; Market Index Futures; Private Information; Bid-Ask Spread; Volatility U-shape.

1. Introduction

Foreign institutional investors, particularly in those emerging markets, own private information that has not been revealed to the public, and thus foreign institutional investors are usually viewed as better informed and more sophisticated traders than individual investors (Seasholes (2000); Grinblatt and Keloharju (2000); Froot and Ramadorai (2001); Albuquerque, Bauer, and Schneider (2009); Barber, Lee, Liu, and Odean (2009);). However, the corollary of the information role of foreign institutional investors in the equity market, particularly for individual stocks, may face a challenge in the index futures market. Private information is not necessarily relevant for market index futures trading, for example, if all participants in the market are projecting on the same public information set regarding the state of the market.[1] This study, therefore, provides evidence on price formation to determine the information source using a comprehensive data set of market index futures from the Taiwan Futures Exchange (TAIFEX). Over our sample period from 2003 to 2008, the participation proportion of foreign institutional investors on the TAIFEX increases from 4% to 24%.[2] Different levels of foreign institutional trading across different periods allow us to investigate the influence of foreign institutional investors on the market variation on the TAIFEX. More important, we can directly answer the question of whether foreign institutional investors have private information on such a market.

The notion that trading increases volatility is central to the theory of price formation (French and Roll (1986)). Previous researchers conclude that three dimensions can explain this phenomenon: (i) Public information arrives primarily during trading hours; (ii) private information induces trades that affect price during trading hours; and (iii) errors in pricing are more likely to occur during trading hours. To discriminate among these explanations, French and Roll (1986) show that return volatility continues to decrease during stock market closures even though concurrent public information flow does not change. Given that public information does not appear to be the cause, they further examine the other two alternatives. They find that pricing errors play only a small role and thus conclude that private information is the main source of high trading-time volatility on the NYSE.

French and Roll's (1986) conclusion is widely proposed in the empirical literature regarding price formation in the stock market. We fill a gap in the literature by implementing their argument with regards to the index futures market, which remains unclear. In particular, given the argument that foreign institutional investors trade on private information to their

[1] The seminal work of Chan (1992) studies the intraday lead–lag relation between returns of the major market cash index and returns of the major market futures index; he finds strong evidence that the futures market leads the cash index and weak evidence that the cash index leads the futures market. His work hence suggests that the index futures market is the main source of market-wide information. As previously discussed, when we view the futures index as a market indicator, it is a common assumption that all participates in the index futures market are projecting on the same public information set regarding the state of the economy. Thus, a corollary is that private information is irrelevant in futures market.

[2] The partition proportion is based on the average daily percentage of foreign institutional trades in the overall market.

advantage, do they have this private information for trading in an index futures market?[3]

We perform several stages of analysis. The first stage of our experiment, which is similar in spirit to the analysis of French and Roll (1986), provides a preliminary picture of the role of foreign institutional investors for price formation on the TAIFEX.[4] Because no plausible analog exists to the inside information so common to the stock market, concurrent market variance increases accompanied by the participation of foreign institutional investors in the market implies lasting information production. Because the flow of public information can also change over time, an unchanged flow of public information across different time regimes is clearly relevant to the inference whether foreign institutional traders have private information. In line with Ito, Lyons, and Melvin (1998), we test the flow of public information over our sample period. Specifically, we test whether daily news reports within our sample period increased or revealed any specific pattern. We examine the flow of news reports in the major financial newspaper of Taiwan as a measure of public information flow, as is commonly used in the literature.[5]

Because pubic information flow remains unchanged across our sample period, we eliminate the possibility of public information as the cause of price formation. We therefore focus our analysis on discriminating between the two other alternatives: private information and pricing errors. As mentioned in French and Roll (1986), when we use volatility to make inferences about the information source, consistency with the private-information alternative does not rule out mispricing. Therefore, we estimate mispricing's contribution in price variation. If the mispricing in variance falls or keeps constant as the growth of foreign institutional traders, we can waive the worry that changes in price variance coming wholly from mispricing.

The second stage of our analysis focuses on intraday changes in volatility. Earlier studies have shown empirical evidence of a U-shaped pattern embodied on intraday volatility (Wood, McInbish, and Ord (1985); Harris (1986); Andersen and Bollerslev (1997), among many others).[6] Furthermore, Foster and Viswanathan (1993) track the intraday U-shape to determine whether private information is used in trading to make the volatility smile. Because Easley and O'Hara (1992) also show that information asymmetry declines over the entire trading period, we link U-shaped volatility to private information by comparing the changes in the U-shape over time. Ito et al. (1998) show that the introduction of lunch-hour trading induces greater information revelation in that period, leading to the presence of a volatility U-shape in the Tokyo FX market. They conclude that the results support the predictions of a

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[3] A range of empirical works have contributed to the discussion about the information content of foreign institutional investors by investigating their trading behavior including return predictability (Nagel (2005); Chang, Hsieh, and Wang (2009)), price impact (Stoll (2000); Chan and Fong (2000)), trading profitability (Barber, Lee, Liu, and Odean (2011)), and volatility predictability (Chang, Hsieh, and Wang (2010)).

[4] Researchers have widely adopted French and Roll's (1986) approach to classify the information source within price changes (e.g., Fama and French (1988); Berry and Howe (1994); Chordia, Roll, and Subrahmanyam (2008, 2011).

[5] In their study of the FX market in Japan, Ito et al. (1998) use the number of news headlines as a measure of public information flow. Goodhart (1989) and Peiers (1997) adopt a similar measure.

[6] Admati and Pfleiderer (1988), Foster and Viswanathan (1990), and Slezak (1994) also address the theory on U-shapes.

private-information model, implying that the information content of trading can be represented in the intraday volatility shape.[7]

In addition to the changes of volatility shape, the bid–ask spread can be another important microstructure measure to examine private information. Stoll (1989) shows that the component of adverse information costs in the quoted spread is as high as 43%, indicating that the bid–ask spread to large extent represents the level of information asymmetry in the market. Because the extent of information asymmetry is associated with private information in the market, the time variation of the quoted spread should reflect the changes in informed trading. For example, Glosten (1994) shows that the market has a positive bid–ask spread arising from the possibility of trading on private information. Accordingly, the third stage of our analysis focuses on changes in bid–ask spread.

In line with the U-shaped feature of intraday volatility, Madhavan, Richardson, and Roomans (1997) suggest that the U-shaped intraday spread is induced by the combined effect of a decline in information asymmetry and an increase in the order process component during the day.[8] While Madhavan et al. point out that informed trading may concentrate in early trading hours in a hybrid market such as the NYSE, some studies extend the interest for pure limit-order market and report comparable results. For example, Brockman and Chung (1999) and Chan (2000) study the bid–ask components on the Stock Exchange of Hong Kong. De Jong, Nijman, and Roell (1996) examine the bid–ask component on the Paris Bourse. Particularly focusing on adverse selection costs, Ahn, Cai, Hamao, and Ho (2002) find that the bid–ask spread of the Tokyo Stock Exchange also exhibit U-shaped pattern. Different from but not contradictory to Madhavan et al., Ahn et al. conclude that the evidence of an increase in information asymmetry around the end of the trading day suggests that transactions around this period convey private information. In sum, consistent with the second stage of our analysis, in the third stage of our analysis we link the uneven pattern of the intraday spread to private information by comparing their changes in shape over time.

As yet, our use of the term *private information* is less explicit. Because our study examines the information source of foreign institutional traders in the index futures market, the accurate definition of private information should be made clear before undertaking our analysis. Ito et al. (1998), who examine the information source in the FX market, suggest an explicit definition of private information. According to Ito et al., the information must satisfy two criteria: (i) It is not common knowledge, and (ii) it is price relevant. To be considered price relevant, private information can incorporate the permanent price impact or, under Ito et al.'s definition, the temporary price effects. The index futures market, as previously mentioned, projects the whole market or the economy; its information source is similar to the FX market. Therefore, we propose the same taxonomy of the definition of private information as that of Ito et al. Appendix A provides a detailed taxonomy on private

[7] Before December 21, 1994, the Tokyo FX exchange was restricted from trading over the lunch break (12:00 PM to 1:30 PM). The restriction was introduced in 1972. However, due to the migration of trading volume to other exchanges, the committee of Tokyo FX exchange removed the restriction on December 21, 1994.

[8] Mclnish and Wood (1992) report a U-shaped pattern in bid–ask spread for NYSE stocks. In addition, Madhavan (1992) considers a model in which information asymmetry is gradually resolved during the trading day. Madhavan's model predicts that the bid–ask spread will decline throughout the day.

information.

The seminal work of French and Roll (1986) on the closure of the NYSE provides us with a starting framework of analysis. Other relevant papers include Barclay, Litzenberger, and Warner (1990), Amihud and Mendelson (1991), Ito and Lin (1992), and Ito et al. (1998). All these studies examine the information flow in the Tokyo Stock Exchange (TSE), a pure limit-order market as is the TAIFEX. By investigating the changes in weekend or lunch volatility in the TSE, these studies link trading to the associated process of information dissemination. The study by Hsieh and Kleidon (1996), who use spread and volatility patterns measured simultaneously across different trading centers to evaluate models of asymmetric information, is also relevant. Another branch of related empirical work is about foreign institutional traders, especially about whether they have an information advantage over their local competitors in the same market. Current empirical findings are not fully conclusive. For instance, Grinblatt and Keloharju (2000), Froot, O'Connell, and Seasholes (2001), Seasholes (2000), and Froot and Ramadorai (2008) find that foreign investors' trades lead price movements, implying that foreign institutional traders have an information advantage. Conversely, Choe, Kho, and Stulz (2005) amd Dvorak (2005) find no evidence of better-informed foreign investors in Korea and Indonesia, respectively. Similarly, at the market level, Griffin, Nardari, and Stulz (2004) show that, after controlling for the contemporaneous relation between flows and returns, foreign investors are generally not able to time the market at the daily frequency. All the preceding findings, however, focus on the stock market, which is essentially projecting complex information sources, including inside information. By focusing on the index futures market, our study sheds new light on the understanding of foreign institutional trading in derivatives markets. The conclusion is particularly important to emerging markets as foreign institutional traders have been participating more deeply in these markets and may play an increasingly influential role in developing markets.

The remainder of this study is divided into following sections. Section 2 describes the data and the analysis approach. Section 3 reports the empirical findings and robustness tests, and Section 4 concludes.

2. Data and analysis approach

2.1 *Data Description*

Our detailed transaction data comprise the detailed history of order flows of TAIEX futures (hereafter, TXF) on the TAIFEX covering the period from January 1, 2003 through December 31, 2008.[9] For each order, the data set reports the date and time of arrival of the order, its direction (buy or sell), the quantity demanded or offered, and, most important for our purposes, the identification of traders. The trader code enables us to categorize foreign institutional trading.[10] TXF is the major index futures contract on the TAIFEX and also the

[9] TAIEX is the abbreviation of Taiwan Stock Exchange Capitalization Weighted Stock Index, which is constructed by the Taiwan Stock Exchange.

[10] In addition to the transaction data set directly obtained from the TAIFEX, we also use the data set of intraday

most actively traded product. Its underlying index, the Taiwan Stock Exchange Capitalization Weighted Index, is a value-weighted index of all individual stocks traded on the Taiwan Stock Exchange.

From 2003 to 2008, daily average trading volume of foreign institutional traders on the TAIFEX grows quickly compared to that of other traders. The increase in foreign institutional trading can be separated into three periods: (i) January 2003 to December 2005, (ii) January 2006 to August 2007, and (iii) September 2007 to December 2008. In the first period, the growth in the overall market is relatively steady, but the volume continues to advance over time. In the second period, the TAIFEX permanently reduced the trading tax rate from 0.025% to 0.01% for index futures trading from January 1, 2006. This 60% fee reduction was designed to stimulate market participants and induce more trading activity. Indeed, the growth of foreign institutional trading is more rapid after 2006. This phenomenon is consistent with Chordia, Roll, and Subrahmanyam (2011), who find that the reduced transaction cost contributed significantly to the trading volume uptrend in the NYSE from 1993 through 2008. The second regime ends in August 2007, which is right before the beginning of the global financial crisis in the following month. The separation is self-evident because the financial crisis affects the market comprehensively and brings structural changes to trading.

Figure 1 shows that from the period 1 to the period 3 foreign institutional trading each day increases from 3,783 to 89,426; the growth is more than twentyfold. Over the same time periods, the growth for domestic institutions and individuals is only around sixfold and twofold from period 1 to period 2 and from period 2 to period 3, respectively. In addition, the percentage of foreign institutional trading in period 1, period 2, and period 3 is 3.74%, 11.22%, and 24.46%, respectively, while the trading percentage for domestic institutions in each period is 18.91%, 33.42%, and 31.66%, respectively, and the trading percentage for individual traders in each period is 77.36%, 55.54%, and 43.88%, respectively. Neither domestic institutional trading nor individual trading present a monotonic uptrend, whereas the uptrend in foreign institutional trading across different periods represents a distinct low, medium, and high regime of foreign institutional trading on the TAIFEX.

[Insert Figure 1 Here]

2.2 *Changes in the public information flow and the price variation*

We first examine the changes in the public information set over the sample period. To this end, we refer to the seminal work of Ito et al. (1998) to perform the comparison. We analyze the impact of public information changes by using news reports about the market in the major financial newspaper of Taiwan across different regimes within our sample period.

To proxy the public information set by the number of news reports, we measure the changes in the public information flow by the standard deviations of the number of daily news. Specifically, the increases (decreases) in the standard deviations of the number of daily news represent a larger (smaller) public information flow; if the standard deviation of the number of daily news keeps constant, the public information flow remains unchanged.

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futures prices of the Taiwan Economic Journal (TEJ) database.

After examining the changes in public information set, we calculate and examine the price variation in the index futures market. To demonstrate a complete comparison, we adopt different intraday frequency to measure price variation. We calculate realized volatility by 1-minute, 5-minute, 10-minute, and 15-minute returns and estimate daily volatility using a GARCH(1,1) model for additional examination.[11] To avoid biases related to using high-frequency data, we calculate all intraday returns by the mid-point of bid and ask prices in each given time interval and define the return as the log-difference of the mid-price between time intervals. We measure the intraday price volatilities with all available returns within a day and perform the comparison for volatilities across different periods based on daily observations. If the price variation is solely driven by the variation of public information, price volatility should have corresponding changes as those in the variation of public information.

2.3 *Mispricing errors and the private information*

Following the method in section 2.2, we can conclude whether price variation is solely caused by the public information; a negative result implies that increased foreign institutional trading incorporates more private information into market prices. The rejection, however, also includes the possibility of mispricing. Discriminating between private information and mispricing errors requires additional evidence. To this end, two seminal works help us to discriminate between private information and mispricing errors. French and Roll (1986) denote an upper bound for the mispricing error component of the return in a given period *t* as

$$1-\frac{V_l}{V_s}=\frac{V(E_t)}{V(R_t)}' \tag{1}$$

where V_l is the return variance over the long holding period, V_s is the cumulated variance over short subintervals; $V(R_t)$ is the return variance in period *t*; and $V(E_t)$ is the concurrent the fraction of variance from mispricing. Appendix B provides a detailed description of French and Roll’s variance decomposition. Although the French–Roll method is insightful, Ito et al. (1998) argue that their method for distinguishing mispricing from private information has its shortcoming. Specifically, their assumption requires that the private information effects are permanent and mispricing effects are temporary. However, among certain classes of private information price effects are only temporary and mispricing therefore is also persistent. Because interpreting the bound’s level is difficult, they argue that addressing how trading changes the bound can better exploit the information content of trading in the regime shift. Following the spirit of Ito et al. and French and Roll, in the next stage of our analysis we study the impact of mispricing using Equation (1). We carefully adopt several measurements to calculate variance ratios on the daily basis, including 5-minute variance over 1-minue variance, 10-minute variance over 1-minue variance, 15-minute variance over 1-minue variance, and 15-minute variance over 5-minue variance. Then, we perform the comparisons for deviations of variance ratios (i.e., the bound) across different periods. If the deviations of

[11] In our original data, each quote is time stamped to the second. We report results based on data with periodicity of one minute, constructed by taking the price closest to each minute.

variance ratios change accordingly as the changes in price volatilities across different periods, the results suggest that mispricing plays an important role in price formation and is inconsistent with the no-private-information null. [12]Volatility changes in different trading sessions within a day can discriminate further between private information and mispricing. Therefore we separate whole day trading hours into three trading sessions, early morning (8:45 AM to 10:15 AM), late morning (10:15 AM to 12:15 PM), and lunch (12:15 PM to 1:45 PM) and test the volatility shapes among sessions in each day across different periods. The literature reports that information asymmetry within trading hours contributes to the U-shaped intraday pattern of volatility; accordingly, the pattern change is more likely due to the shift in trade submissions of foreign traders if we observe the changes in volatility among different trading sessions. More specifically, we calculate the proportion of trade submission from foreign traders in the session of early morning, late morning, and lunch, respectively. If the distribution is unchanged among the three sessions through time, the intraday volatility U-shapes should be also unchanged because no shift in private information occurs between trading sessions. If the proportion of trades submissions shifts to the late morning session, the U-shape will flatten; conversely, if the proportion of trade submissions shifts to the early morning or lunch session, the U-shape will be deepen. By conducting this exercise, we generate predictions for how intraday volatility responds to different trading regimes. If we can verify the prediction, we can recognize the existence of private information for foreign institutional traders in the index futures market.

Aside from the U-shape pattern, prior studies have stylized that intraday bid–ask spread also has a U-shaped pattern similar to intraday volatility (Mclnish and Wood (1992), among many others). Because the U-shaped pattern in intraday spread can be attributed to the existence of information asymmetry, the additional prediction of private information relates to the changes in U-shaped pattern of bid–ask spread among different regimes.

2.4 *Robustness tests for exogenous controls*

The natural experiment on the TAIFEX is not a pure regime shift with increasing foreign institutional trades, because concurrent growth occurs in the trading volume for domestic institutional traders. To make our preceding tests more powerful, we exclude the possible effect from domestic institutional trading, which may also contain the private information. We therefore identify two periods – 2004 and 2005 – to make additional comparisons. We choose these two years because only the period from 2004 to 2005 has declining trading volume growth in our sample period. Interestingly, in these two years, only foreign institutional trading (daily average volume) grew, from 4,700 contracts to 5,600 contracts, while the trading volume of domestic institutions is relatively unchanged. This difference provides us with an opportunity to test the private information of foreign institutional trader

[12] The variance of the information component in the price return does not change because private information does not exist and the public information is unchanged; therefore trading variance cannot possibly increase with a failing or constant fraction due to error component, because the changes in total variance can only come from mispricing.

by comparing the changes in intraday volatility or bid–ask spread U-shapes between 2004 and 2005 and determine whether our findings are consistent with those in section 2.3.

We also perform a similar comparison between 2006 and 2007. From 2006 to 2007, foreign institutional traders are the only trader group that increases in trading proportion (8.55% to 13.78%) whereas the trading proportion of domestic institutional traders decreases slightly (26.09% to 24.17%). This separation once again provides us with an opportunity to exclude the impact of domestic institutional traders because it is less likely that decreasing domestic institutional trading will carry more private information into the market.

2.5 *Robustness tests using the model of Schlag and Stoll (2005)*

Our analysis directly investigates the information source of price formation in the market by decomposing the causes of price volatility into three parts – public information, private information, and mispricing – to determine whether the production of private information is associated with foreign institutional traders. To also assess the price impacts of foreign institutional trading, we adopt the model of Schlag and Stoll (2005) to estimate a regression of the following form:

$$R_t = \alpha_t + \delta_0 BUY_t + \sum_{i=1}^{4} \delta_i BUY_{t-i} + \eta_0 SELL_t + \sum_{i=1}^{4} \delta_i SELL_{t-i} + \sum_{i=1}^{4} \omega_i R_{t-i} + \varepsilon_t, \qquad (2)$$

where represents index futures return, BUY_t is the buy order of foreign institutions at time *t*, and *t*, and $SELL_t$ is the sell order of foreign institution at time *t*. Without loss of generality, we control four lags for *BUY/SELL* orders and returns. The variables are calculated based on a 15-minute intraday interval.

Note that the coefficients □δ and η are similar to Kyle's (1985) lambda measure of price impact. On the basis of the current lambda and the lambda coefficients for lagged orders, Schlag and Stoll (2005) propose two hypotheses about the relation of price change and signed volume: the information hypothesis and the liquidity hypothesis. The expected signs of the coefficients on current and one-lag *BUY/SELL* orders under the two hypotheses are specified as follows:

Information Hypothesis

For *BUY*: Lag 0 is positive; Lag 1 is zero.

For *SELL*: Lag 0 is negative; Lag 1 is zero.

Liquidity Hypothesis

For *BUY*: Lag 0 is positive; Lag 1 is negative.

For SELL: Lag 0 is negative; Lag 1 is positive.

If the information hypothesis is supported, the price impact is informed; conversely, if the liquidity hypothesis is supported, the liquidity demand rather than private information causes the price impact. We perform the regressions for each period and discern the information content of price impact in different regimes.

3. Empirical findings

3.1 *Are market variations solely caused by the public information?*

We first examine the number of news reports based on one of the major financial newspaper in Taiwan, *Economic Daily News*, across three periods. Our statistics of news reports are hand-collected and compiled by investigating daily news in the whole sample years. We include only the news related to market-wide information. Panel A of Table 1 reports that the average daily number of news about the Taiwan market decreases from period 1 to period 2 and increases in period 3. Because we measure public information by the number of daily news reports, the variation of public information should be represented by the standard deviation of the number of daily news. In Panel A, standard deviation of the number of news increases from period 1 to period 2 but remains unchanged to period 3 because the variance difference tests are statistically insignificant.

[Insert Table 1 Here]

It is well-known that the Taiwan market is affected by the U.S. market; therefore, we also count the number of news about the U.S. market and report the statistics in Panel B of Table 1. Although the pattern of the number of news articles in Panel B is similar to that in Panel A, the variation of public information is slightly different. The standard deviation of the number of news articles decreases in period 2 but increases in period 3. To obtain a comprehensive picture regarding the public information flow, we combine the numbers of news articles related to the Taiwan market and to the U.S. market and report statistics in Panel C. Again, the pattern of the number of news articles in Panel C is similar as those reported in Panels A and B. For the standard deviations, however, it presents a stable pattern through time. No significant change in variation occurs between each period. The results in Panel C indicate that the flow of public information throughout the sample period is unchanged.

As previously mentioned, if price variation in the market is solely driven by public information, the dynamics of price volatility should mimic the pattern of the volatility of public information. Figure 2 draws a brief time-plot for 1-minute and 10-minute realized intraday volatility with trend curves. As the figure shows, the volatility increases in the late sample period, while the mid-sample period has the lowest volatility.

[Insert Figure 2 Here]

We next examine the dynamics of market volatility in the three different regimes. We estimate the volatility by five different realized volatilities and one GARCH model. Table 2 reports the results. All volatility measures, except for 1-minute realized volatility, present very similar patterns. Specifically, volatility slightly decreases from period 1 to period 2 but increases dramatically from period 2 to period 3. No significant change occurs in 1-minute realized volatility from period 1 to period 2. It changes from period 2 to period 3 in a manner similar to the other measures; average 1-minute realized volatility is about 0.442 in period 2, which increases almost twofold to 0.811 in the period 3. Given unchanged public information flow from period 2 to period 3, the results in Table 2 imply that private information on the TAIFEX causes price variation to some extent.

[Insert Table 2 Here]

3.2 *Does the mispricing or the private information cause the variation?*

The findings in Table 2 do not exclude the possibility that price variation may be primarily caused by mispricing rather than the private information. A simple way to discern the causes of price variation is to test the changes in mispricing. If the changes in mispricing are inconsistent with the changes in price volatility, it is less likely that price variation solely results from pricing errors in the market. By Equation (1), we calculate a variance ratio deviation as the bound of mispricing and examine the differences between each period. It is clear from Table 3 that all variance ratio deviations decrease from period 1 to period 2; this decrease pattern is similar to the pattern found in Table 2. The changes between period 2 and period 3, however, are inconsistent with corresponding changes in volatilities. Finally, the deviations of the 5-to-1 variance ratio continues to decrease from period 2 to period 3 whereas the deviations of other variance ratios are generally unchanged during the same time period.

[Insert Table 3 Here]

Given that public information remains unchanged and the volatility increases from period 2 to period 3, the decrease in mispricing in Table 3 rule out the possibility that mispricing causes the increase in volatility. This finding provides evidence of the existence of the private information in the index futures market because the increase in the market volatility from period 2 to period 3 should be caused by private information. However, we still obtain ambiguous results for the comparison between period 1 and period 2 because both the bound of mispricing and price volatility decrease. To access the private information of the market more precisely, we enrich our investigation by adding evidence of intraday dynamics in volatility shapes and bid–ask spread shapes.

3.3 *U-shapes in the intraday volatility and bid–ask spread*

As discussed in section 2.3, our motivation is to examine the order submissions of foreign institutional traders to determine whether any change occurs for the quotes distribution among the three different intraday trading sessions: early morning, the late morning, and lunch. In Table 4, we calculate the daily percentage of quotes submitted by foreign institutional traders in late morning session for each trading day of each period and conduct difference tests between the periods.

[Insert Table 4 Here]

The results in Table 4 show that the order submissions of foreign institutions are relatively more concentrated in the late morning session through time. The average (median) daily percentage of submission is around 30% (30%), 32% (31%), and 33% (32%) in period 1, period 2, and period 3, respectively. A monotonic increase occurs across the periods although only the difference between period 2 and period 3 is statistically significant.[13] Given the findings in Table 4, intraday volatility and bid–ask U-shapes should flatten through time if foreign institutional traders carry more private information into the late morning session compared to the early morning and the lunch session.

To capture intraday volatility and bid–ask spread patterns, we calculate early morning-to-late morning (E/L) volatility and bid–ask spread ratios and lunch-to-late morning (L/L) volatility and bid–ask spread ratios. If the intraday volatility or bid–ask spread has a U-shape, both the E/L ratio and L/L ratio should be greater than 1. We use 1-minute and 5-minute realized volatility for the volatility analysis and quoted spread (QSPR) and percentage spread (PSPR) for the bid–ask spread analysis.[14] Tables 5 and 6 report the results for the intraday volatility and the bid–ask spread, respectively.

[Insert Table 5 Here]

[Insert Table 6 Here]

Table 5 shows that the intraday volatility in period 1 has a distinct U-shape, which is consistent with the findings reported in prior literature. Interestingly, in period 2 and period 3, the volatility U-shape is obviously flattened. At least one of the E/L and L/L ratios decreases between two periods, and the changes are statistically significant. We also plot the U-shapes for each period in Figure 3; the figure provides a clearer picture of the erosion of the U-shape through time.

[Insert Figure 3 Here]

Table 6 shows very similar patterns for QSPR and PSPR. Again, a distinct bid–ask spread U-shape is present in period 1, but the shape flattens in period 2 and period 3. Figure 4 shows graphically this flattening over time.

[Insert Table 6, Figure 4 Here]

In sum, the findings regarding changes in intraday shapes for volatility and bid–ask spread provide evidence of a shift in private information not only between period 2 and period 3 but also between period 1 and period 2. The changes of shapes are associated with the changes in order submissions of foreign institutional traders.

[13] The difference between period 1 and period 2 is statistically significant in the one-way test but only marginally significant in the two-way test.

[14] We also apply 10-minute and 15-minute realized volatility for the volatility analysis. The findings are consistent with those using 1-minute and 5-minute volatility. For brevity, we do not report the results in the table.

3.4 *Excluding the possible effect for domestic institutional trading*

In sections 3.1 to 3.3 we show that private information drives market volatility on the TAIFEX and that the source of the private information is more likely related to foreign institutional traders. Across our sample period, foreign institutional traders carry more private information into the market. However, domestic institutional trading may possibly increase at the same time, although the increase in their trading proportion is less than that of foreign institutional trading. To exclude the possible influence of domestic institutional traders, we make two additional comparisons in Tables 7 and 8.

[Insert Table 7 Here]

[Insert Table 8 Here]

Table 7 presents the comparisons of the intraday volatility U-shape. After controlling for domestic institutional trading, we still observe that the volatility U-shape flattens from 2004 to 2005 and from 2006 to 2007. Table 8, which shows the results of the comparisons of the bid–ask spread, provides evidence of a flattened intraday bid–ask spread U-shape.[15] Overall, from 2004 to 2005 and from 2006 to 2007, domestic intuitional traders are less able to cause market-wide changes because their trading in these periods is relatively unchanged. However, both Tables 7 and 8 show that a shift of the private information in the market and flattening of the intraday U-shape still occurs for either volatility or bid–ask spread.

3.5 *Robustness Tests Using Schlag and Stoll's (2005) Model*

Thus far we provide evidence that the private information of foreign institutional traders cause changes in the index futures market. However the question remains of whether foreign institutions, which are a relatively small trader group that trade only 15% to 25% of the total market, can create a market-wide change. Therefore we conduct a regression analysis using the model of Schlag and Stoll (2005) to specify the price impact from foreign institutional trading.

Table 9 presents the results across the three time periods. The result for period 1 only partially supports the liquidity hypothesis. Although both contemporaneous coefficients and one-lagged coefficients are significant, the sign of coefficients of BUY_t and BUY_{t-1} are inconsistent with the expectation. In addition, the result for period 2 is consistent with the expectation of the liquidity hypothesis. Interestingly, unlike the other periods, the result for period 3 supports the information hypothesis. The information effect in period 3 implies that foreign institutional trading from period 1 to period 3 becomes more informative. Thus, with the accompanied increased trading proportion of foreign institutional traders, the regression

[15] We compare the distribution of order submissions of foreign institutional traders for the same year pairs before the robustness test in Tables 7 and 8. Similar to the findings in Table 4, the percentage of order submissions in the late morning session is relatively higher in 2005 and 2007. For brevity, the results are not reported.

analyses using the model of Schlag and Stoll (2005) support our prior findings.

[Insert Table 9 Here]

4. Conclusions

Our primary aim is to extend the line of research regarding the private information of foreign institutional traders in the index futures market. By dividing our sample period into three subperiods based on different levels of participation of foreign institutional traders, we compare the information content in each regime and then infer whether the participation of foreign institutional investors incorporates the private information into market prices.

Our analyses and findings are summarized as the following. First, we test the relation between the flow of public information and intraday volatilities and show that the public information is not the only cause of price variation in the index futures market. We find that public information flow is quite stable throughout the sample period, whereas the price volatility varies across different periods. This finding suggests that private information or mispricing contribute to price formation. Second, we test the role of mispricing in price volatility and find that the changes in mispricing cannot fully explain the price variation. This result supports the argument that private information affects price formation on the TAIFEX. Third, we test the intraday volatility and bid–ask spread patterns to discern the influence of foreign institutional trades through time. We find that the information-related U-shapes of intraday volatilities and bid–ask spreads flatten as foreign institutional trades increase in the late morning session (10:15 AM to 12:15 PM).

Finally, as robustness checks we reexamine the changes in intraday U-shapes by making comparisons that take the influence of domestic institutional traders into consideration. These findings support our prior results. In addition, we test the information content of the price impact of foreign institutional traders using Schlag and Stoll's (2005) model. The results show that foreign institutional trading is more informative as the proportion of foreign institutional trading in the market increases. The results also indicate that foreign institutional traders carry more private information by trading through time.

Overall our findings are consistent with the commonly held view that foreign institutional investors own private information that is not available to the public. Further, we extend the literature by challenging the common assumption that all participants in the index futures market project the same public information set regarding the state of the economy. We suggest that private information in such a market causes price variance that cannot be accounted for by public information or mispricing. As such, we provide evidence that foreign institutional investors have private information for the index futures trading.

APPENDIX A: The taxonomy of private information

To root the taxonomy in theory, we consider the theoretic setting of Ito et al. (1998). The code of their definition about private information is that superior information about temporary price effects qualifies as private information. We begin by considering a canonical two-period trading model in which trading occurs initially at price P_0 and then again at P_1, and then a terminal payoff F is realized at t=2. In this framework, information on the terminal payoff F can be viewed as *fundamental* private information. In contrast to fundamental private information, information unrelated to the payoff F but relevant to interim prices P_0 and P_1 as *semifundamental* private information. P_0 and P_1 are assumed to be determined by many arguments beyond the expectation of the payoff F, for example, traders' risk aversion, traders' trading constraints, the supply/demand of the risky asset, and other features of the trading environment. All these features affect P_0 and P_1 but do not alter the expectations of F; superior knowledge of them, therefore, qualifies as semifundamental private information in the index futures market.

APPENDIX B: The variance decomposition (French and Roll (1986))

French and Roll (1986) drive the components of return variance from an identifying assumption: Mispricing has temporary effects on price but private information has permanent effects. First, we decompose the return in period t, R_t, into two components, an information component I_t and an error component E_t:

$$R_t = I_t + E_t$$

where the error component can both a pricing error and a measurement error. Because the error component's effect on price is temporary, the variance of returns over long holding periods reflects only the information component, whereas the cumulated variance over short intervals includes both components. Letting V_l denote the long-term return variance and V_s denote the short-term return variance, then $1 - V_l / V_s$ $(=V(E_t)/V(R_t))$ provides an upper bound on the fraction of variance from mispricing. This deviation is the upper bound because $V(E_t)$ includes the effect of bid–ask bounce. This measure essentially assumes that the components are uncorrelated: $V(R_t) = V(I_t) + V(E_t)$.

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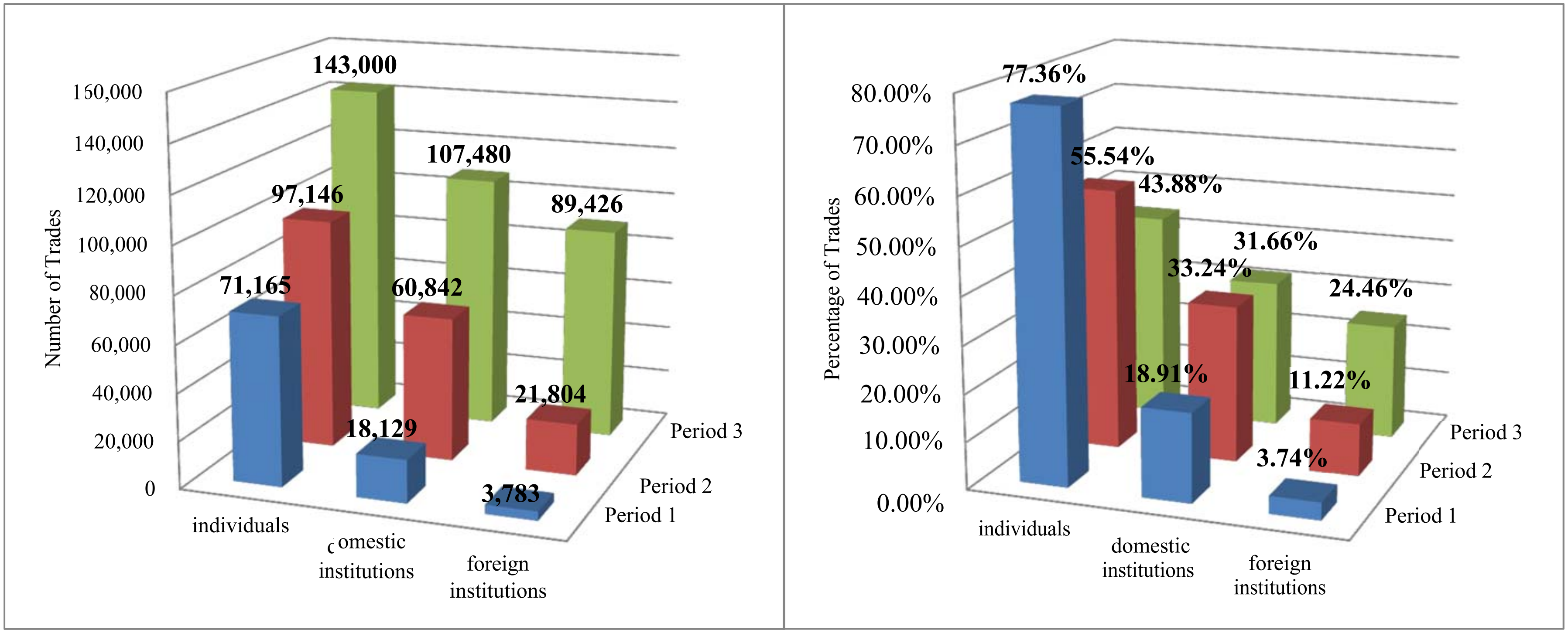

Figure 1: The number and Percentage of Trades for Each Investor in Different Periods. This figure presents the daily average trading volume for foreign institutional investors, domestic institutional investors, and individual investors in different periods. The sample period is from January 2003 to December 2008, which includes 1,484 trading days. Period 1 is from January 2003 to December 2005. Period 2 is from January 2006 to August 2007. Period 3 is from September 2007 to December 2008. The left plot is based on the number of trades (contract), and the right plot is based on the trading percentage.

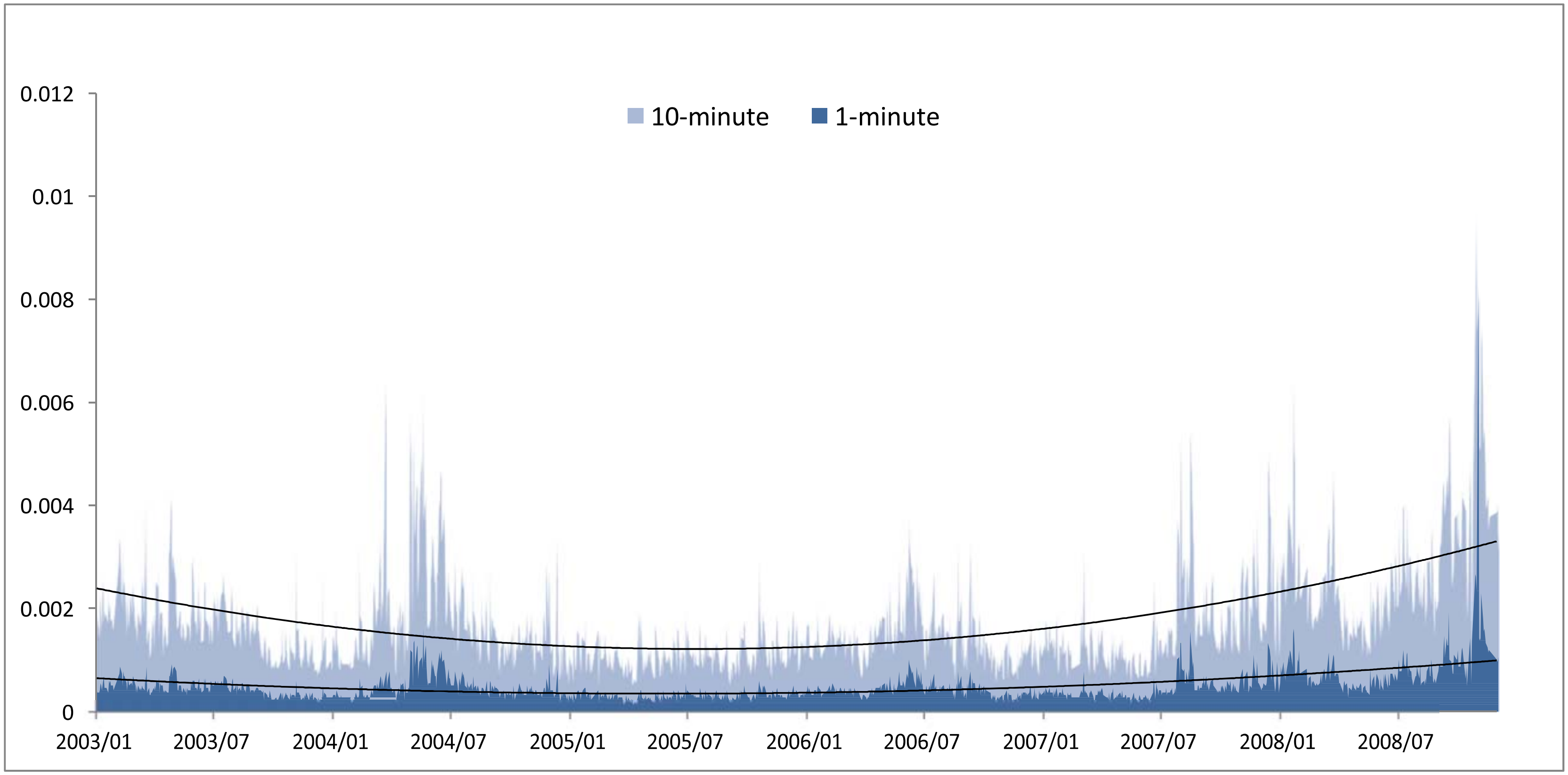

Figure 2: Intraday Volatility through Time. This figure presents the time dynamics of return volatilities of the TXF index by two measures: 1-minute return volatility and 10-minute return volatility. The sample period is from January 2003 to December 2008, which includes 1484 trading days. The volatilities are calculated by corresponding intraday returns for each trading day. The returns are calculated as the changes in the log of the bid–ask midpoint. Two solid cures are nonlinear trend lines for return volatilities.

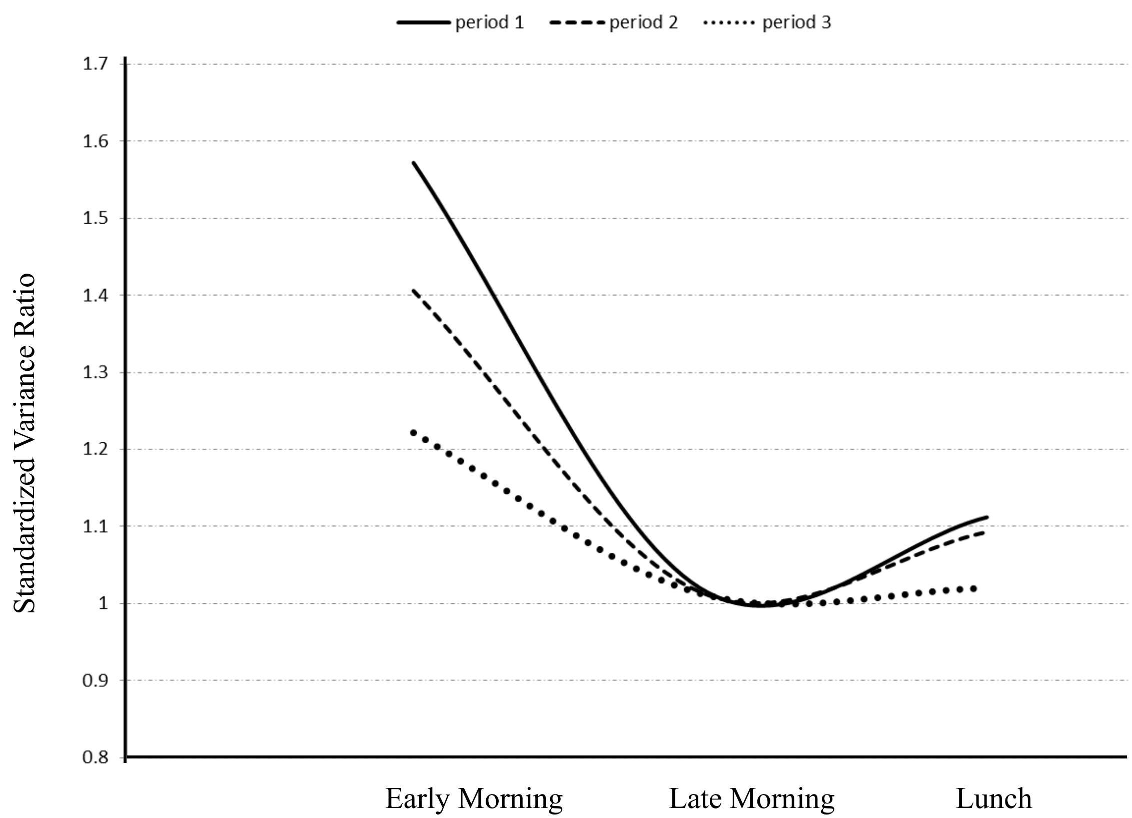

Figure 3: Intraday Volatility U-Shapes by Different Periods. This figure presents the return variance of the TXF index for three intraday trading sessions: early morning (8:45 AM–10:15 AM), late morning (10:15 AM – 12:15 PM), and lunch (12:15 AM–1:45 PM), Taipei time. The sample period is from January 2003 to December 2008, which includes 1,484 trading days. The return variances are calculated by1-minute returns for each session. The returns are calculated as the changes in the log of the bid–ask midpoint. For cross-period comparison, we standardize each variance by the variance of late morning session for each period (the variance of late morning session is hence equals 1). The lines are smoothed interpolations of the three variance estimates.

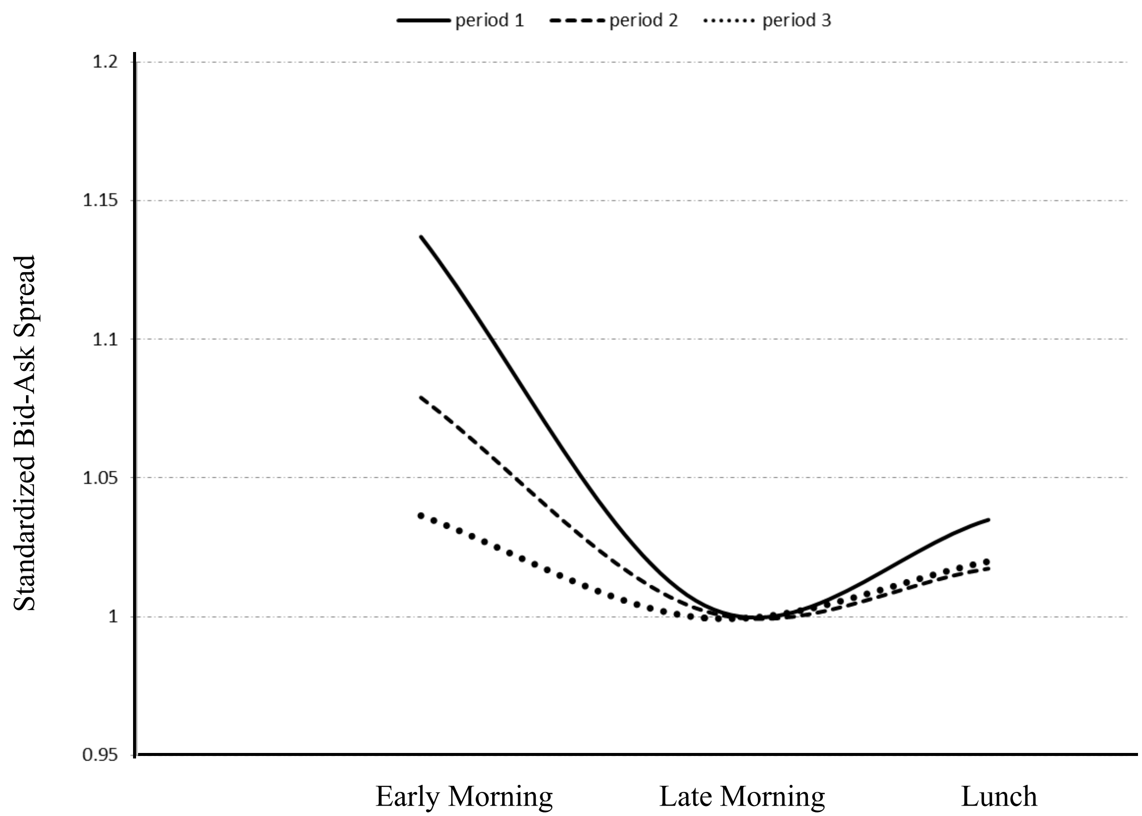

Figure 4: Intraday Bid-Ask Spread U-shapes by Different Period. This figure presents the quoted spread of the TXF index price for three intraday trading sessions: early morning, (8:45 AM–10:15 AM), late morning (10:15 AM – 12:15 PM), and lunch (12:15 AM–1:45 PM), Taipei time. The sample period is from January 2003 to December 2008, which includes 1,484 trading days. The numbers of quoted spreads in this plot are calculated as the mean of all spread value (best ask – best bid) for each session. For cross-period comparison, we standardize the number of spread by the spread of late morning session for each period (the spread of late morning session is hence equals 1). The lines are smoothed interpolations of the three spread estimates.

Table 1: The Public Information Flow: Daily Number of News reports

This table reports the public information flow in term of the number of news reports about the market status by the news database, *Economic Daily News*. Panel A reports the news about the Taiwan market, including the stock market and futures market. Because the Taiwan market is affected by the U.S. market, Panel B reports the news about the U.S. market. Panel C aggregates the number of the Taiwan news and the U.S. news. The *t*-test, Wilcoxon test, and *F*-test are used to test means, medians, and, variances across different periods, respectively. The statistics of tests are reported in the last six columns. ***, **, and * represent a significance level of 1%, 5%, and 10%, respectively.

News source	Period 1 2003.01–2005.12			Period 2 2006.01–2007.08			Period 3 2007.09–2008.12			Mean test H_0: P1=P2	Median test H_0: P1=P2	Variance test H_0: P1=P2	Mean test H_0: P2=P3	Median test H_0: P2=P3	Variance test H_0: P2=P3
	Avg.	Med.	Std.	Avg.	Med.	Std.	Avg.	Med.	Std.						
Panel A: News of the Taiwan Market															
Economic Daily News	9.02	9	3.84	8.00	8	4.20	10.85	11	4.12	–4.75***	–5.98***	1.20**	11.06***	11.77***	1.04
Panel B: News of the U.S. Market															
Economic Daily News	3.03	3	2.37	2.30	2	2.08	4.21	4	2.55	–6.65***	–6.81***	1.29***	13.38***	13.24***	1.50***
Panel C: Two markets combined															
Economic Daily News	12.06	11	5.45	10.32	10	5.42	15.08	15	5.66	–6.25***	–7.24***	1.01	14.03***	14.30***	1.09

Table 2: Intraday Volatility across Different Periods

This table reports the statistics of intraday volatility by different frequency and measurements—realized volatility (RV) and GARCH (1,1) estimates. The sample period is from January 2003 to December 2008, which includes 1,484 trading days. Volatilities are estimated by intraday returns or daily returns. The returns are calculated as the changes in the log of the bid–ask midpoint. The units of realized volatilities are multiplied by 10^3. The units of GARCH estimations are multiplied by 10^2. The *t*-test and Wilcoxon test are used to test means and medians across different periods, respectively. The statistics of tests are reported in the last four columns. ***, **, and * represent a significance level of 1%, 5%, and 10%, respectively.

Volatility type	Period 1 2003.01–2005.12				Period 2 2006.01–2007.08				Period 3 2007.09–2008.12				Mean test H_0: P1=P2	Median test H_0: P1=P2	Mean test H_0: P2=P3	Median test H_0: P2=P3
	Max.	Min.	Avg.	Med.	Max.	Min.	Avg.	Med.	Max.	Min.	Avg.	Med.				
RV (1-min)	1.650	0.175	0.435	0.369	1.569	0.176	0.442	0.406	8.284	0.298	0.811	0.700	0.554	1.505	11.370***	17.089***
RV (5-min)	4.652	0.356	1.071	0.956	3.764	0.422	1.001	0.903	8.270	0.715	1.844	1.634	–2.373**	–2.335**	14.922***	16.691***
RV (10-min)	6.651	0.477	1.573	1.390	5.645	0.586	1.480	1.321	8.925	1.080	2.710	2.426	–2.082**	–1.565	15.230***	16.285***
RV (15-min)	7.697	0.527	1.865	1.634	6.391	0.639	1.764	1.605	11.43	1.086	3.194	2.868	–1.871*	–1.165	14.801***	15.773***
GARCH (Daily)	2.084	0.872	1.311	1.261	2.144	0.784	1.226	1.188	5.470	1.269	2.014	1.874	–4.918***	–4.773***	23.73***	20.683***

Table 3: Mispricing across Different Periods

This table reports the statistics of mispricing errors by different frequencies. The sample period is from January 2003 to December 2008, which includes 1,484 trading days. The mispricing is defined as

$$1 - \frac{V_l}{V_s},$$

where V_l is the return variance over the long holding period, and V_s is the return variance over short subintervals. The return variances are calculated by corresponding intraday returns for each trading day. The returns are calculated as the changes in the log of the bid–ask midpoint. The *t*-test and Wilcoxon test are used to test means and medians across different periods, respectively. The statistics of tests are reported in the last four columns. ***, **, and * represent a significance level of 1%, 5%, and 10%, respectively.

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Deviation Frequency	Period 1 2003.01–2005.12				Period 2 2006.01–2007.08				Period 3 2007.09–2008.12				Mean test H_0: P1 = P2	Median test H_0: P1 = P2	Mean test H_0: P2 = P3	Median test H_0: P2 = P3
	Max	Min	Ave	Med	Max	Min	Ave	Med	Max	Min	Ave	Med				
5-min variance over 1-min variance	0.93	0.01	0.25	0.22	0.52	0.01	0.16	0.13	0.48	0.00	0.14	0.11	10.56***	8.41***	1.80*	1.84**
10-min variance over 1-min variance	1.53	0.00	0.32	0.27	0.97	0.00	0.23	0.18	1.37	0.00	0.25	0.18	7.71***	6.66***	–1.24	0.52
15-min variance over 1-min variance	1.71	0.00	0.32	0.23	0.90	0.01	0.24	0.19	0.90	0.01	0.24	0.18	5.33***	3.75***	0.30	0.75
15-min variance over 5-min variance	0.62	0.00	0.16	0.13	0.59	0.00	0.15	0.12	0.88	0.00	0.16	0.12	1.07	1.65*	–0.96	–0.22

Table 4: Quotes Distribution among Intraday Intervals across Different Periods

This table reports the daily percentage of quotes submitted by foreign institutional traders in late morning trading (10:15 AM–12:15 PM) session for each trading day of each period. The sample period is from January 2003 to December 2008, which includes 1,484 trading days. The *t*-test and Wilcoxon test are used to test means and medians across different periods, respectively. The statistics of tests are reported in the last four columns. ***, **, and * represent a significance level of 1%, 5%, and 10%, respectively.

	Period 1 2003.01–2005.12				Period 2 2006.01–2007.08				Period 3 2007.09–2008.12				Mean test H_0: P1 = P2	Median test H_0: P1 = P2	Mean test H_0: P2 = P3	Median test H_0: P2 = P3
	Max	Min	Ave	Med	Max	Min	Ave	Med	Max	Min	Ave	Med				
Quotes in late morning session (%)	100	0.0	30.4	30.3	73.1	4.08	31.5	31.1	100	2.68	32.9	32.2	–1.45	–1.38	–1.99**	–1.92**

Table 5: How does the intraday volatility U-Shape change?

This table presents the return variance ratio based on three intraday trading sessions: early morning (8:45 AM–10:15 AM), late morning (10:15 AM – 12:15 PM), and lunch (12:15 AM–1:45 PM), Taipei time. The sample period is from January 2003 to December 2008, which includes 1,484 trading days. The return variances are calculated by 1-minute and 5-minute returns for each session. The returns are calculated as the changes in the log of the bid–ask midpoint. For each period, the left column is the ratio of the variance in the early morning session over the variance in the late morning session (E/L), and the right column is the variance in the lunch session over the variance in the late morning session (L/L). The *t*-test and Wilcoxon test are used to test means and medians across different periods, respectively. The statistics of tests are reported in the last four columns. ***, **, and * represent a significance level of 1%, 5%, and 10%, respectively.

		Period 1 2003.01–2005.12		Period 2 2006.01–2007.08		Period 3 2007.09–2008.12		H_0: P2=P1		H_0: P3=P2	
		Early Morning / Late Morning	Lunch / Late Morning	Early Morning / Late Morning	Lunch / Late Morning	Early Morning / Late Morning	Lunch / Late Morning	E/L	L/L	E/L	L/L
1-min	Mean	1.5520	1.0920	1.3859	1.0730	1.2017	0.9943	6.68***	0.88	5.03***	3.70***
	Median	1.4879	1.0208	1.3549	1.0115	1.1279	0.9538	4.54***	0.17	8.53***	3.39***
5-min	Mean	1.5436	1.1088	1.3489	1.1217	1.1941	1.0398	6.88***	0.50	3.99***	2.82***
	Median	1.4878	1.0249	1.3211	1.0331	1.1451	0.9863	4.67***	0.64	5.40***	2.74***

Table 6: How does the intraday bid-ask spread U-Shape change?

This table presents the bid-ask spread ratio based on three intraday trading sessions: early morning (8:45 AM–10:15 AM), late morning (10:15 AM – 12:15 PM), and lunch (12:15 AM–1:45 PM), Taipei time. The sample period is from January 2003 to December 2008, which includes 1,484 trading days. The spreads are defined by quoted spread (QSPR) and percentage spread (PSPR), calculated as (best ask – best bid) and (best ask – best bid)/midpoint price, respectively. For each period, the left column is the ratio of the mean (median) spread in the early morning session over the mean (median) spread in the late morning session (E/L), and the right column is the mean (median) spread in the lunch session over the mean (median) spread in the late morning session (L/L). The *t*-test and Wilcoxon test are applied to test means and medians across different periods, respectively. The statistics of tests are reported in the last four columns. ***, **, and * represent a significance level of 1%, 5%, and 10%, respectively.

		Period 1 2003.01–2005.12		Period 2 2006.01–2007.08		Period 3 2007.09–2008.12		H_0: P2=P1		H_0: P3=P2	
		Early Morning / Late Morning	Lunch / Late Morning	Early Morning / Late Morning	Lunch / Late Morning	Early Morning / Late Morning	Lunch / Late Morning	E/L	L/L	E/L	L/L
QSPR	Mean	1.1370	1.0349	1.0790	1.0173	1.0364	1.0199	6.60***	2.19**	4.50***	0.31
	Median	1.1103	1.0123	1.0720	1.0078	1.0234	1.0125	5.54***	0.98	5.49***	0.13
PSPR	Mean	1.1373	1.0353	1.0791	1.0176	1.0358	1.0206	6.51***	2.15**	4.49***	0.36
	Median	1.1095	1.0110	1.0751	1.0058	1.0210	1.0109	5.55***	0.96	5.49***	0.20

Table 7: Paired years comparisons: Intraday volatility U-shape

This table presents the return variance ratio based on three intraday trading sessions: early morning (8:45 AM–10:15 AM), late morning (10:15 AM – 12:15 PM), and lunch (12:15 AM–1:45 PM), Taipei time. Panel A is the comparison of 2004 and 2005. Panel B is the comparison of 2006 and 2007. The return variances are calculated by 1-minute and 5-minute returns for each session. The returns are calculated as the changes in the log of the bid–ask midpoint. For each period, the left column is the ratio of the variance in the early morning session over the variance in the late morning session (E/L), and right column is the variance in the lunch session over the variance in the late morning session (L/L). The *t*-test and Wilcoxon test are used to test means and medians across different periods, respectively. The statistics of tests are reported in the last four columns. ***, **, and * represent a significance level of 1%, 5%, and 10%, respectively.

Panel A: Comparison 1

		2004		2005		H_0: no changes between years	
		Early Morning / Late Morning	Lunch / Late Morning	Early Morning / Late Morning	Lunch / Late Morning	Early Morning / Late Morning	Lunch / Late Morning
1-min	Mean	1.6229	1.0907	1.5123	1.0339	2.82***	1.75*
	Median	1.5722	1.0021	1.4471	0.9700	2.72***	1.54
5-min	Mean	1.6033	1.0935	1.5014	1.0433	2.38**	1.39
	Median	1.5604	0.9817	1.4467	1.0041	2.63***	0.78

Panel B: Comparison 2

		2006		2007		H_0: no changes between years	
		Early Morning / Late Morning	Lunch / Late Morning	Early Morning / Late Morning	Lunch / Late Morning	Early Morning / Late Morning	Lunch / Late Morning
1-min	Mean	1.3727	1.0843	1.3222	1.0412	1.46	1.69*
	Median	1.3506	1.0098	1.2919	1.0107	2.08***	1.24
5-min	Mean	1.3198	1.1285	1.3052	1.0903	0.37	1.02
	Median	1.3076	1.0319	1.2569	1.0307	0.63	1.12

Table 8: Paired years comparisons: Intraday bid-ask spread U-shape

This table presents the bid–ask spread ratio based on three intraday trading sessions: early morning (8:45 AM–10:15 AM), late morning (10:15 AM – 12:15 PM), and lunch (12:15 AM–1:45 PM), Taipei time. Panel A is the comparison of 2004 and 2005. Panel B is the comparison of 2006 and 2007. The spreads are defined by quoted spread (QSPR) and percentage spread (PSPR), calculated as (best ask – best bid) and (best ask – best bid)/midpoint price, respectively. For each period, the left column is the ratio of the mean (median) spread in the early morning session over the mean (median) spread in the late morning session (E/L), and right column is the mean (median) spread in the lunch session over the mean (median) spread in the late morning session (L/L). The *t*-test and Wilcoxon test are used to test means and medians across different periods, respectively. The statistics of tests are reported in the last four columns. ***, **, and * represent a significance level of 1%, 5%, and 10%, respectively.

Panel A: Comparison 1

		2004		2005		H_0: no changes between years	
		Early Morning / Late Morning	Lunch / Late Morning	Early Morning / Late Morning	Early Morning / Late Morning	Early Morning / Late Morning	Early Morning / Late Morning
QSPR	Mean	1.1634	1.0471	1.0646	0.9950	5.83***	3.97***
	Median	1.1257	1.0154	1.0653	0.9835	6.77***	3.35***
PSPR	Mean	1.1639	1.0482	1.0646	0.9906	5.88***	3.94***
	Median	1.1302	1.0125	1.0657	0.9837	6.78***	3.32***

Panel B Comparison 2

		2006		2007		H0: no changes between years	
		Early Morning / Late Morning	Lunch / Late Morning	Early Morning / Late Morning	Lunch / Late Morning	Early Morning / Late Morning	Early Morning / Late Morning
QSPR	Mean	1.0845	1.0270	1.0559	1.0122	2.64***	1.56
	Median	1.0812	1.0246	1.0534	0.9972	3.10***	2.02**
PSPR	Mean	1.0845	1.0272	1.0560	1.0128	2.59***	1.48
	Median	1.0806	1.0229	1.0544	0.9963	3.04***	1.95*

Table 9: Price Impact Test: Schlag and Stoll (2005) Model

This table presents the results of the regression estimates using Schlag and Stoll's (2005) model. The variables are calculated based on 15-minute intraday intervals. The sample period is from January 2003 to December 2008, which includes 29,680 intraday time intervals. The regression model is defined as

$$R_t = \alpha_t + \delta_0 BUY_t + \sum_{i=1}^{4} \delta_i BUY_{t-i} + \eta_0 SELL_t + \sum_{i=1}^{4} \delta_i SELL_{t-i} + \sum_{i=1}^{4} \omega_i R_{t-i} + \varepsilon_t,$$

where R_t is futures index return at time t, BUY_t is the buy order of foreign institutions at time t, and $SELL_t$ is the sell order of foreign institution at time t. For brevity, only the coefficients of current quotes and lagged quotes are reported. The returns are calculated as the changes in the log of the bid–ask midpoint. The *t-test* is applied to test the coefficients; *t*-statistics are in the parentheses. ***, **, and * represent a significance level of 1%, 5%, and 10%, respectively.

	Intercept	Buy_t	$Sell_t$	Buy_{t-1}	$Sell_{t-1}$	Buy_{t-2}	$Sell_{t-2}$	Buy_{t-3}	$Sell_{t-3}$	Buy_{t-4}	$Sell_{t-4}$	Adj R^2
Period 1	49.231**	–0.948***	–0.588***	–0.397*	–0.770***	0.459	–0.271	0.126	0.030	0.449**	0.203	0.68
2003.01–-2005.12	(2.183)	(–4.610)	(–3.304)	(–1.772)	(4.015)	(2.038)	(1.409)	(0.571)	(–0.158)	(2.231)	(–1.174)	
Period 2	39.34	1.375***	–1.672***	–0.544***	0.871***	0.024	–0.010	–0.324*	0.200	0.021	0.015	1.84
2006.01–-2007.08	(1.268)	(8.441)	(–10.663)	(–3.061)	(5.045)	(0.135)	(–0.579)	(–1.906)	(1.230)	(0.135)	(0.104)	
Period 3	–40.85	0.907***	–1.294***	–0.080	0.013	0.378	–0.052	0.140	0.111	–0.210	–0.021	1.45
2007.09–-2008.12	(–0.539)	(4.168)	(–5.912)	(–0.339)	(0.055)	(1.617)	(–0.221)	(0.637)	(0.486)	(–1.108)	(–0.104)	

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How bank capital buffer and insolvency risk vary across European countries: Business cycle, income diversification and bank regulation

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This paper examines business cycle, income diversification, regulatory and supervisory determinants of capital buffer and insolvency risk by using a panel data of EU27 countries from 2001 to 2011. The results show that capital buffer fluctuates procyclically over the business cycle and diversification benefits exist in encouraging banks to hold higher capital buffers. Banks are more likely to increase probability of failure during economic boom due to engaging excessively in risky activities. Economic downturn in countries with tighter capital regulation diminishes benefits of capital buffer, therefore, increase level of bankruptcy risk. Banks tend to be safer under upturn cycle given that their country has generous deposit insurance. Deposit insurance can be substitutes for income diversification in diminishing capital buffer. Official supervision reduces banks' incentive to hold capital buffers and increase the likelihood of failure. Better private monitoring practice has a clear positive impact on capital buffers and making banks to reduce risk-taking incentives. Business cycle and improved accounting transparency are substitutes in reducing banks' incentive to hold larger capital buffers, thereby increasing banks' risk-taking incentives. Given the condition of tighter restriction on bank activities and business cycle upturn, banks are more stable and might not need to increase capital.

Keywords: Capital buffer, insolvency risk, business cycle, income diversification, bank regulation, supervision

JEL Classification: G200, G210, G380

1. Introduction

The banking industry in general as well as European banking sector in particular has experienced a significant amount of bank failures during the recent financial crisis and economic recession. The experiences from these crises have attracted shareholders, bank themselves as well as regulators about the importance of holding sufficient capital buffers. According to the Basel capital adequacy requirements, banks have to maintain their capital buffers above the minimum requirement of 8 percent as a cushion to absorb negative capital shocks. Banks may also need to hold extra capital as an indication of soundness to the market and please the expectations of rating agencies (Jackson et al., 1999). Therefore, the supervision of capital buffers over the business cycle plays a crucial role in maintaining the financial stability of the banking system.

Under the Basel III (Basel committee, 2013) banks have to build up the excess capital above the minimum requirement by regulators so that capital buffer can be used in financial distress. As building up capital is cheaper and easier in an economic boom than in an economic recession (Ayuso et al.2004). Several authors have found that capital buffer is more likely to decrease in economic expansion and increase during economic recession (i.e. Jokipii and Milne, 2008; Ayuso et al., 2004; Estrella, 2004; Lindquist, 2004). Meanwhile, others argue that capital buffer is more likely to increase in business upturn and decrease in business downturn (i.e. Jokipii and Milne, 2008; Ayuso et al., 2004 and Borio et al; Lindquist, 2003). This paper will examine the question about whether bank's capital buffers behave procyclically or anticyclically over the business cycle.

On the other hand, in order to increase capital buffer, income diversification is considered as a fundamental strategy for the banks' revenue growth. The motivations for diversifying the sources of bank revenue as well as its impacts have attracted lots of interest in the literature (Stiroh and Rumble, 2006; Stiroh, 2004; DeYoung and Roland, 2001). Diversifying may lead to be better bank performance, hence increase capital buffer (Perold, 2011; Demirgüc-Kunt and Huizinga, 2010 and Elsas et al., 2010; Chiorazzo et al., 2008; Stiroh and Rumble, 2006; Stiroh, 2004a; Gallo et al., 1996) or it might result in reducing banks' revenue, hence decrease capital buffer (Berger and Ofek,1995; Jensen, 1986). However, Stiroh (2004b) argues that a greater dependence on non-interest income, especially trading revenue, is correlated to higher risk and lower risk-adjusted profits across commercial banks. This research will therefore investigate whether the increase in income diversification is connected with changes in banks' capital buffer and insolvency risk and whether income diversification contributes to lessen the possibility of bank default and helps banks build up their capital buffer.

This paper examines business cycle, income diversification, regulatory and supervisory determinants of capital buffer and insolvency risk by using a panel data of EU27 countries from 2001 to 2011. According to the author's knowledge, this research is the first study to look at the interrelated relationship among business cycle, income diversification, capital buffer and insolvency risk as Shim (2013) examine on portfolio risk rather than insolvency risk. The results show that capital buffer fluctuates procyclically over the business cycle and diversification benefits exist in encouraging banks to hold higher capital buffers. Banks are more likely to increase probability of failure during economic boom due to engaging excessively in risky activities.

On the other hand, the regulation and supervision in the context of capital buffer and insolvency risk is largely unexplored. This paper aims to fill the gap by bringing a range of the regulatory and supervisory practices as determinants of capital buffer and insolvency risk. Furthermore, this study significantly contributes to our understanding about the influence of business cycle and income diversification on capital buffer and insolvency risk given the condition on regulation and supervision, therefore, offers effective implications for regulatory policy. Economic downturn in countries with tighter capital regulation diminishes benefits of capital buffer, therefore, increase level of bankruptcy risk. Banks tend to be safer under upturn cycle given that their country has generous deposit insurance. Deposit insurance can be substitutes for income diversification in diminishing capital buffer. Official supervision reduces banks' incentive to hold capital buffers and increase the likelihood of failure. Better private monitoring practice has a clear positive impact on capital buffers and making banks to reduce risk-taking incentives. Business cycle and improved accounting transparency are substitutes in reducing banks' incentive to hold larger capital buffers, thereby increasing banks' risk-taking incentives. Given the condition of tighter restriction on bank activities and business cycle upturn, banks are more stable and might not need to increase capital.

The remainder of the paper is organized as follows. Section 2 reviews literature. Section 3 describes data and methodology. The empirical results are presented in Section 4. Section 5 concludes.

2. Brief literature review

2.1. Business cycle determinant

Lindquist (2003) finds a positive impact of the business cycle on the capital buffer of Norwegian banks. Ayuso et al. (2004) suggest that banks should build up their capital buffers in an economic boom as it is easier to build up the capital in an economic upturn than in an economic downturn. If banks expanding their loan portfolio in an economic upturn without building up their capital buffers accordingly then, banks' capital buffers cannot absorb the materializing of credit risk when the recession sets in. Hence, banks are forced to increase their capital buffers through a cutback in lending. Moreover, Ayuso et al. (2004) and Borio et al. (2001) debate that given a countercyclical materialization of credit risk, a countercyclical fluctuation of capital buffers may be indication for banks' short-sightedness. The capital buffers co-move positively with the business cycle, dropping in recessions for co-operative banks and small banks (Jokipii and Milne, 2008).

Turning to insolvency risk, Jiménez and Saurina (2006) find that riskier borrowers can access bank lending in economic boom, hence, banks' capital cushions tend to be eroded during this period. Another strand of literature argues that insolvent banks may bet themselves by taking riskier credit policies with higher returns but also higher risk (Salas and Saurina, 2002). Furthermore, Rajan (1994) argues that banks tend to relax credit standards to hide loss on non-performing loans and protect their own reputation during upturn. It is predicted that banks tend to be more financial distressed in economic boom. Since a borrower's default may transfer information about an increasing likelihood of other firms' constraint in the same industry (Dahiya et al., 2003), banks may lose their reputational values due to this poor signal of loan management. Whenever reputational considerations diminish because of negative shock, banks are motivated to tighten credit polices (Rajan, 1994). Hence, Jiménez and Saurina (2006) find that banks become conservative in lending activities during economic downturn. Granting loans to fewer but well-performed firms helps banks to have enough capital cushion in order to withstand through economic-wide recession (Dell's Ariccia and Marquez, 2006). Since Zscore is a measure of insolvency risk in this study, lower Zscore indicates increased probability of failure.

Taken together, this study hypothesizes as follows:

H.1a. *Business cycle is positively related to capital buffer, i.e. capital buffer increases in economic expansion and decreases during economic recession.*

H.2a. *Business cycle is negatively associated with insolvency risk, i.e. insolvency risk increases in expansion and decreases in recession.*

One contradictory set of theories suggest that, when examining the relationship between the most advantageous forward looking capital buffers and deterministic cycles of loan losses, Estrella (2004) finds that banks will build up capital buffers in anticipation of loan losses because loan losses themselves tend to drop behind the business cycle. This implies that actual capital buffers will increase during cyclical down turns, i.e. negative cyclical co- movement. Other theory finds that, the cyclical behavior of European bank capital buffers changes in accordance to type and size of bank (Jokipii and Milne, 2008). Capital buffers increase in recession for savings banks, commercial banks and large banks. Lindquist (2004) also finds a negative impact of the business cycle on the capital buffer of Norwegian banks.

Earlier literature (Dell's Ariccia and Marquez, 2006; Goodhart et al., 2005) offers a link of business cycle and crisis to the quality of bank's investment portfolio. Crockett (2001) finds that banks are expected to build up excess capital in economic boom because there may be an increase in portfolio risk during this period. While banks use bankruptcy prediction model to monitor credit risk, prior literature (Hol, 2007; Chen, 2006; Westgaard and Van der Wijst, 2001) suggests that weak firms are more likely to be insolvent during recession period, however, business upturn tends to favor weak firm a temporary extension. As a result, Van den Heuvel (2002) content that banks with strong capital buffers tend to over-lend during business upturn.

However, Dell's Ariccia and Marquez (2006) argue that the trend of financial turmoil tends to occur after the strong credit expansion since lending boom raises sensitivity of banks' profitability to aggregate shocks, hence, higher failure exposure in economy-wide recession. Insofar the expansion in credit moves toward the end, acceleration in riskier lending erodes banks' capital buffers (Van den Heuvel, 2002). Nevertheless, Kim and Santomero (1988) claim that banks are required to hold enough capital to absorb larger losses to prevent bankruptcy. As larger shift toward riskier assets offsets the capital buffers, banks are more likely to fail (Koehn and Santomero, 1980). It seems that banks may be financial distressed in economic downturn rather than upturn. Therefore, the following hypothesis is posited:

H.1b. *Business cycle is negatively related to capital buffer, i.e. capital buffer decreases in business upturn and increases in business downturn.*

H.2b. *Business cycle is positively associated with insolvency risk, i.e. insolvency risk decreases in expansion and increases in recession.*

2.2. Income diversification determinant

The motivations for diversifying the sources of bank revenue have received extensively interest in the literature (Stiroh and Rumble, 2006; Stiroh, 2004 and DeYoung and Roland, 2001). Banks are probably to increase the production and sale of fee-based financial services to take the advantage cost scope of economies by sharing inputs in joint production. Gallo et al. (1996) argue that banks might exploit revenue scope economies by providing cross-selling chances to customers who are keen to pay for the extra convenience of financial supermarkets. A substantial body of literature (Demirgüc-Kunt and Huizinga (2010); Elsas et al. (2010); Chiorazzo et al. (2008) and Stiroh and Rumble (2006)) concludes that banking performance could be improved through a diversity of revenues, therefore, capital buffer tends to increase by holding more retained earnings.

However, Stiroh and Rumble (2006) argue that there is the deteriorating correlation of the risk return trade-off for US banks. They state that the earnings profit from diversification produced by expansion in non-interest income is outweighed by the volatility rising, resulting in a non-commensurate arising in stock returns. Furthermore, Stiroh (2004b) accomplishes that a greater dependence on non-interest income, especially trading revenue, is related with higher risk and lower risk-adjusted profits across commercial banks. Baele et al. (2007) study European banks over the time from 1989–2004 to suggest that banks which have higher non-interest income tend to have higher market betas and hence higher systematic risk. Similarly, Lepetit et al. (2008a) find that banks which tend to expand into non-interest income activities face higher insolvency risk.

In a recently study during the financial crisis, DeYoung and Torna (2013) analyse the contribution of income diversification on bank failure. They find that the movement toward non-traditional banking activities has importantly effected on the possibility of bank failure depending on the bank's financial conditions. Engagement in these activities increases the likelihood of failure for financially concerned banks. Hence, the hypothesis is formalised as below:

H.3a. *Income diversification is more likely to increase capital buffer.*

H.4a. *Income diversification is more likely to increase insolvency risk.*

Countervailing arguments, however, challenge the view that if increasing the share of non-interest income in the bank's revenue portfolio diminishes overall earnings volatility then banks may have to reduce their capital requirements (Demirguc-Kunt and Huizinga, 2010). Furthermore, Sinkey and Nash (1993) report a higher and more volatile returns as well as higher likelihood of insolvency than for banks with traditional product mixes when examining commercial banks which specializing in credit card lending. Stiroh (2004b) also emphasizes rising volatility of bank earnings arise from shifting into non-interest activities such as trading activities. In a study of Italian banks, Acharya et al. (2002) find that diversification of bank assets does not assure to produce exceptional performance to guarantee a higher retained earnings for capital cushion.

Enriching the diversification of assets and liabilities permits banks to enhance their risk and return trade-off. In other words, at any given level of risk, return is increased or evenly at any given rate of return, insolvency risk is decreased. Stiroh (2004) examines the potential diversifying repayments from the movement into non-interest income sources of bank revenue. He suggests that the rising in non-interest revenue in the US commercial banks has contributed to higher levels of bank income over time and has also reduced the volatility of bank profits, hence, reducing the possibility of insolvency risk. Pennathur et al. (2012) study the effect of ownership structure of Indian banks on the income diversification and risk relationship and they find that higher fee-based income is correlated with lower default risk for private domestic banks as well as public sector banks. These results are consistent with a cross-country study of Sanya and Wolfe (2011) who examined a sample of listed banks in 11 emerging countries. The authors find that by expansion into non-banking activities result in arising profitability and decrease bank insolvency risk. Nguyen et al. (2012) also find the benefits from diversification revenues in South Asian countries. Their results give that banks with greater market power tend to decrease their default risk when banks shift into non-interest activities. Then, the contradictory hypothesis is postulated:

***H.3b.** Income diversification is more likely to decrease capital buffer.*

***H.4b.** Income diversification is more likely to decrease insolvency risk.*

2.3. Regulatory and supervisory determinant

It is postulated that the influence of business cycle and income diversification on capital buffers and insolvency risk varies across countries, depending on bank regulation and supervision. Hence, this section analyze the impact of capital requirement, deposit insurance, official supervisor power, private monitoring practices and restriction on bank activities.

2.3.1. Capital requirement

The traditional approaches to bank regulation highlight the positive features of capital requirement (Dewatripont and Tirole, 1994). Furlong and Keeley (1989) demonstrate that capital requirements reduce risk-taking. They argue that capital serves as a buffer against loss and failure and banks are required to hold a minimum capital requirement. Hence, it can postulate as follows:

H.5. Capital requirement tends to increase capital buffer, therefore, lower probability of financial distress

2.3.2. Deposit insurance

There is a general agreement that more deposit insurance encourages banks to take greater risks (Hovakimian, 2003; Hovakimian and Kane, 2000; Merton, 1977). Demirguc-Kunt and Detragiache (2002) find a negative relationship between deposit insurance and banking stability and emphasize the destabilizing effect of guarantees in the increased likelihood of banking crises. Fonseca and González (2010) suggest that more generous deposit insurance diminishes market discipline but increase bank charter value, negatively influence on capital buffer. Hence, the sixth hypothesis is:

***H.6.** More deposit insurance makes capital buffer less important in reducing the cost of financial distress, therefore, increase probability of bank failure.*

2.3.3. Official supervisor power

Fonseca and González (2010) document that if official bank supervision is a stand-in for private supervision, it may negatively influence on capital buffer. Any official practice that curbs investors' incentives in monitoring banks would make the cost of funding less sensitive to bank risk. In a similar line, Shehazad et al. (2009) find that official supervision eliminates benefits of bank ownership concentration in reducing bank risk-taking. There it is expected as follows:

***H.7.** More official supervisory power constrains banks' capital buffer and higher excessive risk-taking.*

2.3.4. Private monitoring practices

Investor monitoring of banks requires the information disclosure mechanisms to provide information on the value of banks' claims (Nier and Baumann, 2006). Fonseca and González (2010) find that banks in countries with stricter accounting standards have higher capital buffers. On the other hand, the quality of firms' information disclosure is negatively related to credit spreads. Reduction in spreads may raise bank valuations, and eliminate banks' risk-taking incentives, therefore, encouraging greater capital buffers (Yu, 2005). Based on this argument, the following hypothesis is:

***H.8.** Stricter private monitoring practices encourage banks to hold larger capital buffer and reduce the cost of financial distress.*

2.3.5. Restriction on bank activities

Tighter restriction on bank activities limit the ability of banks' managers to involve in risky investments (Fonseca and González , 2010), reducing retained earnings, therefore, limited resources for capital buffer. The last hypothesis is:

H.9. *Tighter restriction on bank activities constrains banks' risk-taking incentives and fewer resources for capital buffer.*

3. Methodology and data

3.1. Data

Since Basel III is expected to be broadly implemented by all active banks at EU-wide level (BCBS, 2014), this study will examine the enlarged EU27 countries covers time series of 11 years from 2001 to 2011, including commercial banks, saving banks, cooperative banks, real estate and mortgage banks, investment banks and bank holding companies. Malta has no banks relative to this requirement, so Malta is omitted. In May 2004, the EU experienced the largest enlargement as 10 countries joined the EU, including Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia. Bulgaria and Romania then entered the EU in January 2007. Because those countries have joined the EU, the structure of their banking industries have not been in line yet, so they could create outliers to the sample. Hence, extreme outliers are dropped. There is a point which Estonia, Latvia, Slovakia are removed from this outlier process. The sample then includes 23 EU countries with exception of Estonia, Latvia, Malta and Slovakia and 4,114 banks.

Bank-specific variables are obtained from Bankscope. The information on the regulatory and supervisory variables is obtained from World Bank database by Barth et al. (2004) relative to updated version in 2008. The country-specific controls obtained from the World Bank.

3.2. Econometric model

Earlier literature on bank's capital adjustments (Jokipii and Milne, 2011; Shim, 2010; Flannery and Rangan, 2006) uses partial adjustment framework to estimate the adjustment speed toward its desired level. Following Shim (2013), this research aims to build a partial adjustment framework to investigate whether banks establish capital buffers during economic upturn to reduce the probability of insolvency risk in economic downturns or whether they keep their capital buffers at a certain level by reducing their risky non-interest income activities in recession. The banks' capital buffer and insolvency risk adjustment models, which observe changes in capital buffer and insolvency risk in period t are a function of the target capital buffer and insolvency risk, the one-year lagged buffer and risk level and exogenous shocks as follows:

$$\Delta\, CAP_{i,k,t} = \alpha\left(CAP^{*}_{i,k,t} - CAP_{i,k,t-1}\right) + \varepsilon_{i,k,t} \tag{1}$$

$$\Delta\, RISK_{i,k,t} = \beta\left(RISK^{*}_{i,k,t} - RISK_{i,k,t-1}\right) + \delta_{i,k,t} \tag{2}$$

Where $\Delta\, CAP_{i,k,t}(CAP_{i,k,t} - CAP_{i,k,t-1})$ and $\Delta\, RISK_{i,k,t}(RISK_{i,k,t} - RISK_{i,k,t-1})$ capture the observed changes in capital buffer and insolvency risk of bank i in country k between two periods. α and β indicate the speeds of adjustments. The actual and target capital buffers (insolvency risk) of bank i in country k at year t are denoted by $CAP_{i,k,t}\,(RISK_{i,k,t})$ and$CAP^{*}_{i,k,t}\,(RISK^{*}_{i,k,t})$, respectively. $CAP_{i,k,t-1}\,(RISK_{i,k,t-1})$ represents the actual capital buffer (risk) in the previous year. $\varepsilon_{i,k,t}$ and $\delta_{i,k,t}$ are the error terms.

However, Flannery and Rangan (2006) argue that the target capital buffer (insolvency risk), i.e. $CAP^{*}_{i,k,t}\,(RISK^{*}_{i,k,t})$, respectively are not observable. As indicated in the above literature, they depend on the business cycle, income diversification and the heterogeneity in the banks' risk-behaviors. Therefore, the impact of business cycle and diversification on the changes of banks' capital buffer and insolvency risk is primary interest of this research. The empirical models including business cycle, diversification variables and financial characteristics can be written as:

$$\begin{aligned}\Delta CAP_{i,k,t} = {} & \alpha_0 + \alpha_1 CYCLE_{k,t} + \alpha_2 INCDIV_{i,k,t} + \alpha_3 \Delta RISK_{i,k,t} - \alpha_4 CAP_{i,k,t-1} + \alpha_5 B_{i,k,t} \\ & + \alpha_6 C_{k,t} + \alpha_7 REGSUP_k + T_t + \varepsilon_{i,k,t}\end{aligned} \tag{3}$$

$$\begin{aligned}\Delta RISK_{i,k,t} = {} & \beta_0 + \beta_1 CYCLE_{k,t} + \beta_2 INCDIV_{i,k,t} + \beta_3 \Delta CAP_{i,k,t} - \alpha_4 RISK_{i,k,t-1} + \beta_5 B_{i,k,t} \\ & + \beta_6 C_{k,t} + \alpha_7 REGSUP_k + T_t + \delta_{i,k,t}\end{aligned} \tag{4}$$

Where $CYCLE_{k,t}$ denotes for business cycle of country k at year t. $INCDIV_{i,k,t}$ is a measure of non-interest income diversification of bank i in country k at year t. According to (Rime, 2001; Shrieves and Dahl, 1992), banks' capital and risk choices are interdependent as banks manage capital relative to the level of risk-taking incentives. Hence, in order to capture simultaneous relationship between capital buffer and risk adjustments, equation (3) and (4) include $\Delta RISK_{i,k,t}$ and $\Delta CAP_{i,k,t}$ as explanatory variables, respectively. To examine whether the speed of adjustments are relevant, this study also consists of $CAP_{i,k,t-1}\, a$ and $RISK_{i,k,t-1}$ in equation (3) and (4), respectively. To control for heterogeneity of banks' risk behaviors and country-specific condition, $B_{i,k,t}$ is included as a vector of bank financial characteristics for bank i of country k in year t whereas $C_{k,t}$ indicates a vector of country-specific control variables for country k in year t. $REGSUP_k$ is a set of regulatory and supervisory variables in country k. T_t represents time fixed-effect and $\varepsilon_{i,k,t}$ ($\delta_{i,k,t}$) are the error terms.

Since equation (3) and (4) may deal with endogeneity problem because there are one-year lagged endogenous variables. Therefore, this research will follow earlier studies (Shim, 2013; Rime, 2001; Wickens, 1982) to employ three-stage least squares (3SLS) estimation in order to take into consideration the cross-equation correlations.

Table 1 presents description of variables and sources.

Capital buffer (CAP): Banks are required to hold more capital than the regulatory minimum to withstand a distressed period. Similar to Shim (2013), bank's capital buffer equals to the difference between the actual total risk-weighted capital ratio and the minimum total required capital ratio of 8%.

Insolvency risk (ZSCORE): Following the recent literature on bank risk (Demirgüc-Kunt and Huizinga 2010, Laeven and Levine 2009), Z-score is used in this research as a main indicator of insolvency risk. It is denoted by the sum of return on assets and the capital ratio, which is then divided by the standard deviation of ROA. Standard deviation of ROA is calculated on a four, five and six-year rolling time frame to show consistency results. Furthermore, non-performing loans to total loans ratio is used in robustness test since it is evident that non-performing loan significantly deteriorates before the actual banks' bankruptcy happens (Reinhart and Rogoff, 2011).

Business cycle (CYCLE): the real GDP growth is a proxy for business cycle and its data is obtained on World Development Indicator. Based on the above hypothesis development, the influence of business cycle on capital buffer and insolvency risk is undetermined.

Income diversification (INCDIV): non-interest income to operating income is a proxy for income diversification. As mentioned by DeYoung and Roland (2001), the growing share of non-interest income directly influences volatility of bank's net operating revenue growth and higher degree of total leverage. However, the above hypotheses show that the expected sign for coefficient of income diversification on capital buffer and insolvency risk is ambiguous.

Bank-specific variables are bank size, net interest margin, deposit, loan and cost-to-income ratio.

Bank size (SIZE): Bank size, which is defined as the natural logarithm of total assets, is a common proxy in researches on bank (Curry et al., 2008; Goodard et al., 2004; Molyneux and Thornton, 1992). According to Francis and Osborne (2012), larger banks tend to hold smaller capital buffer above the minimum required capital ratio. Additionally, based on too-big-to-fail hypothesis, if bank is sufficiently large, the regulator will bail out the bank in case of financial distress (Acharya and Yorulmazer, 2007). Therefore, bank size is expected to negatively associated capital buffer and insolvency risk.

Net interest margin (NIM): Chortareas et al. (2011) define that NIM measures the gap between what bank earns from borrowers and what bank pays depositors regarding to bank's function of asset transformation. The higher NIM is, the higher the margin bank is commanding, or the cheaper the funding bank is acquiring. Therefore, NIM is expected to be positively associated with capital buffer.

Deposit (DEPOSIT): refers to ratio of deposit to total assets. When money markets work poorly and interbank lending is difficult, deposit financing helps banks more stable in financing (Beltratti and Stultz, 2009).

Loan (LOAN): characterizes the asset side of the banks by using loans to total assets.

Efficiency in expense management (COST): is defined as the operating costs divided by the gross income.

Country-specific variables are inflation and financial development.

Concentration indicator (CONC): is the Hirschman-Herfindahl index, which is computed by the sum of squared market shares in terms of total assets for each country in the sample, is common indicator for market concentration. According to traditional Structure-Conduct-

Restriction on bank activities (RESTRICT): Bank activity regulatory variable is defined to measure the degree to which banks may engage in the following three fee-based activities such as securities, insurance and real estate activities. Barth et al. (2004) assess each country's regulations concerning these activities and rated the degree of regulatory restrictiveness for each activity from 1 to 4, with larger numbers representing greater restrictiveness, including unrestricted, permitted, restricted and prohibited.

Table 2 summarizes statistics of all regression variables and Table 3 reports mean values of bank variables by country. Table 4 displays correlation matrix. In general, there is no high correlation among variables.

4. Empirical results

4.1. Business cycle and income diversification determinants

Table 5 reports the results for business cycle and income diversification determinants on capital buffer and insolvency risk. In model I, Zscore with the standard deviation of ROA rolling four-year time is used as a main results and the five-year time is employed in the model II as a robustness test to show consistency in the results. In buffer model (3), positive and significant coefficient of CYCLE (0.019) on capital buffer implies that capital buffer fluctuates procyclically over the business cycle and positively significant coefficient of INCDIV (-0.002) shows that banks with higher risky non-interest income portfolio are able to increase their capital buffer, i.e. diversification benefits exist, consistent with hypothesis H.1a. and and H.3a.

In risk equation (4), negative coefficient of CYCLE (-0.546) and negative sign for INCDIV (-0.069) suggest that banks are more likely to increase probability of failure during economic boom due to engaging excessively in risky activities, consistent with H.2a. and H.4a. In other words, potential risks increase due to increasing non-interest income activities during boom cause banks to raise their capital buffers in order to take into account their increased probability of failure. Therefore, when risks materialize in the period of economic busts, banks can draw on these higher capital cushions. The impact of $\Delta CAP_{i,k,t}$ and $\Delta RISK_{i,k,t}$ in both capital buffer and insolvency risk equations (3) and (4) is not statistically significant. Both lagged dependent variable $CAP_{i,k,t-1}$ and $RISK_{i,k,t-1}$ exhibit negatively significant coefficients, confirming that due to the presence of adjustment costs, the speed of capital buffer adjustment is relatively slow, therefore, incompletely adjustment to the higher stability in the period.

The estimated coefficient of bank size is negative and significant at 1% level in buffer equation (3) but insignificant in risk equation (4). Large banks tend to hold less capital buffers possibly because of greater diversification or government's support in case of financial distress (Shim, 2013). The profitability measured by NIM has a positive impact on capital buffer but negative influence on insolvency risk, implying that more profitable banks have higher buffers, however, increasing capital buffers incur banks to involve in risky activities and to be vulnerable to financial constrain. Deposit is negatively associated with capital buffer, confirming that deposit is regarded to be stable funding, so greater deposit portion may reduce capital buffer. The estimated coefficient of deposit in risk model is significant and positive, suggesting that such a stable funding might decrease bank failure.

To examine whether the different macro-economy level across countries may change the results, country-control variables are included for further analysis. Fortunately, the coefficient of CYCLE and INCDIV in both capital buffer and insolvency risk model are unchanged. Economically, the business cycle and income diversification have considerable impact on capital buffer and insolvency risk.

4.2. Regulatory and supervisory determinants

To analyze how the regulation and supervision across countries influence on capital buffer and insolvency risk, five regulatory and supervisory variables are included. Additionally, CYCLE and INCDIV are interacted with these five regulatory measures to examine if they are substitutes. If banks in countries with well-functioning banking system, basically in better regulatory and supervisory practices, it may not need to increase capital when banks' risk profiles increase. In this case, the positive relation is expected in all the specifications. In contrast, a negative coefficient of interactive term suggests that they are substitutes in favoring higher capital buffers and lower level of insolvency risk.

Table 6 reports the results of regulatory and supervisory determinants on capital buffer and insolvency risk. Capital regulation is found to be positively associated with insolvency risk in column (2) but insignificant in column (1). Banks tend to be more stable in countries with tighter capital regulation. The negative coefficients of CAPITAL* CYCLE in column (1) and (2) confirm that capital regulation and business cycle are substitute in capital buffer and insolvency risk. Economic downturn in countries with tighter capital regulation diminishes benefits of capital buffer, therefore, increase level of bankruptcy risk. The negative coefficient of CAPITAL*INCDIV in column (1) and its positive sign in column (2) shows that the capital regulation dampens the banks' ability in risky activities and leads banks to hold smaller capital buffers.

Turning to deposit insurance, diminished benefit of capital buffer due to more deposit insurance is not found in column (3). However, the negative and significant of DEPINS in column (4) shows that deposit insurance increase the likelihood of bank failure, consistent with prior literature (Hovakimian, 2003; Demirguc-Kunt and Detragiache, 2002; Hovakimian and Kane, 2000; Merton, 1977). The significantly positive coefficient of DEPINS*CYCLE in column (4) indicates that banks may not need to increase capital during economic boom in order to reduce insolvency risk because banks tend to be safer under upturn cycle given that their country has generous deposit insurance. As indicated by negative coefficient of DEPINS*INCDIV in column (3), deposit insurance can be substitutes for income diversification in diminishing capital buffer.

Consistent with hypothesis H.7., the results in column (5) and (6) indicate that more official supervisor power reduces banks' capital buffer, however, increases banks' probability of financial distress. The results of interactive terms are not significant in these specifications.

Regarding private monitoring practice, the results in column (7) and (8) are consistent with an expectation in hypothesis H.8. that the quality of private monitoring practice has positive impact on capital buffer and insolvency risk. The negative coefficient of PRIVATE*CYCLE confirm that business cycle and improved accounting transparency are substitutes in reducing banks' incentive to hold larger capital buffers, thereby increasing banks' risk-taking incentives.

The negative coefficient of RESTRICT in column (9) indicates that banks' capital buffer decrease in countries with tighter restrictions on bank activities. Both positive coefficients of RESTRICT*CYCLE in column (9) and (10) suggest that given the condition of tighter restriction on bank activities and business cycle upturn, banks are more stable and might not need to increase capital.

5. Conclusion

This paper examines business cycle, income diversification, regulatory and supervisory determinants of capital buffer and insolvency risk by using a panel data of EU27 countries from 2001 to 2011. Partial adjustment framework and 3SLS are employed in this study. The results show that capital buffer fluctuates procyclically over the business cycle and diversification benefits exist in encouraging banks to hold higher capital buffers. Banks are more likely to increase probability of failure during economic boom due to engaging excessively in risky activities.

Economic downturn in countries with tighter capital regulation diminishes benefits of capital buffer, therefore, increase level of bankruptcy risk. Banks tend to be safer under upturn cycle given that their country has generous deposit insurance. Deposit insurance can be substitutes for income diversification in diminishing capital buffer. Official supervision reduces banks' incentive to hold capital buffers and increase the likelihood of failure. Better private monitoring practice has a clear positive impact on capital buffers and making banks to reduce risk-taking incentives. Business cycle and improved accounting transparency are substitutes in reducing banks' incentive to hold larger capital buffers, thereby increasing banks' risk-taking incentives. Given the condition of tighter restriction on bank activities and business cycle upturn, banks are more stable and might not need to increase capital.

This paper suggests basic implications for regulatory policy. First, the regulators should take into account business cycle in a number of regulation and supervision as instruments of inducing banks to hold capital and increasing financial stability. Second, regulators and supervisors should realize that the effectiveness of tighter capital regulation varies across countries and economic downturn will diminish benefit of capital requirement. Third, deposit insurance should be clearly revisited since it tends to be a substitute in diminishing banks' incentives to hold capital buffer.

Table 1

Variable description

Variables	Description	Source
Bank-specific control variables		
CAP	Capital buffer: the difference between total regulatory variable ratio and minimum required capital ratio of 8%	Calculated using the data from Bankscope
△CAP	Change in capital buffer	Calculation
ZSCORE	Insolvency risk measured by the return on assets (ROA) plus capital to asset ratio divided by the standard deviation of ROA rolling 4-year time	Calculated using the data from Bankscope
△ZSCORE	Change in insolvency risk	Caculation
INCDIV	Non-interest income to gross revenues	Bankscope
SIZE	Logarithm of bank' total assets	Bankscope
NIM	Net interest margin	Bankscope
DEPOSIT	Deposit to total assets	Bankscope
LOAN	Loan to total assets	Bankscope
COST	Cost to income ratio	Bankscope
Country-specific control variables		
CYCLE	Annual growth rate of GDP	World Bank
CONC	Market concentration, computed by the sum of squared market shares in terms of total assets for each country	Calculated using the data from Bankscope
MACGDP	Market capitalisation to GDP	World Bank
ASSGDP	Total assets of banks to GDP	Calculated using the data from Bankscope, World Bank
Regulatory variables		
CAPITAL	Capital regulatory index	Barth et al. (2004)
DEPOSIT	Deposit insurer power	Barth et al. (2004)
OFFICIAL	Official supervisory power	Barth et al. (2004)
PRIVATE	Private monitoring	Barth et al. (2004)
RESTRICT	Restrictions on bank activities	Barth et al. (2004)

Note: This table presents description of variables and sources.

Table 2

Summary statistics of variables

Variable	N	Mean	Std. dev.	Min	Max
CAP	21982	-0.328	6.727	-21.570	91.991
△CAP	18228	0.164	1.883	-72.029	65.707
ZSCORE	14865	29.444	29.923	2.038	191.889
△ZSCORE	11928	-2.649	26.966	-183.861	188.323
INCDIV	21878	27.146	13.165	-25.000	100.000
SIZE	21996	5.826	0.633	2.636	8.724
NIM	21944	2.679	1.137	-8.523	39.214
DEPOSIT	21830	68.222	17.844	0.100	99.600
LOAN	21958	58.916	15.963	0.100	99.900
COST	21917	69.160	14.731	0.409	196.933
CYCLE	21996	1.269	2.397	-14.742	9.840
CONC	21996	4.881	8.848	0.700	100.000
MACGDP	21996	51.067	24.031	3.640	190.869
ASSGDP	21996	11.571	10.358	0.100	123.100
CAPITAL	21996	6.638	1.008	3	9
DEPINS	21996	0.271	0.591	0	2
OFFICIAL	21996	8.208	1.020	5	14
PRIVATE	21996	6.141	2.232	0	8
RESTRICT	21996	5.342	0.963	3	9

Note: This table reports summary statistics of variables for the whole sample. N is number of observations. CAP is capital buffer equal to the difference between total risk-weighted capital ratio and minimum required capital ratio of 8%. △CAP is changes in capital buffer. ZSCORE is insolvency risk measured by the return on assets (ROA) plus capital to asset ratio divided by the standard deviation of ROA rolling 4-year time. △ZSCORE is change in insolvency risk. INCDIV is non-interest income to gross revenues. SIZE is bank size. NIM is net interest margin. DEPOSIT is deposit to total assets. LOAN is loan to total assets ratio. COST is cost to income ratio. CYCLE is annual growth rate of GDP. CONC is market concentration. MACGDP is market capitalization to GDP. ASSGDP is total assets of banks to GDP. CAPITAL is capital regulatory index. DEPOSIT is deposit insurer power. OFFICIAL is official supervisory power. PRIVATE is private monitoring. RESTRICT is restriction on bank activities.

Table 3
Descriptive statistics by country
(Mean value)

Country	CAP	△CAP	ZSCORE	△ZSCORE	INCDIV	SIZE	NIM	DEPOSIT	LOAN	COST	CYCLE	CONC	MACGDP	ASSGDP	CAPITAL	DEPINS	OFFCIAL	PRIVATE	RESTRICT	Obs
	(%)	(%)	(absolute value)	(absolute value)	(%)	Logarithm of total assets	(%)	(% of total assets)	(% of total assets)	(%)	Annual growth rate (%)	(%)	(% of GDP)	(% of GDP)						
Austria	0.81	0.04	29.129	-3.731	29.420	5.609	2.459	65.858	57.653	67.152	1.732	11.412	30.350	9.752	5	1	10	0	5	1787
Belgium	1.69	0.35	21.511	-3.086	17.495	6.167	2.438	58.281	49.220	69.346	1.563	22.349	66.166	9.296	3	2	11	6	5	211
Bulgaria	1.56	1	7.441	2.617	36.927	5.915	5.694	60.071	48.200	61.651	5.913	78.800	16.672	0.600	7	0	11	6	5	7
Cyprus	-0.3	0.5	18.397	2.435	22.100	5.516	6.988	83.157	46.811	65.992	2.776	37.911	45.709	0.939	7	0	12	7	8	28
Czech	3.76	-1.12	10.529	-0.974	32.367	6.064	2.138	65.244	43.319	71.932	3.191	19.055	24.238	1.135	5	1	10	6	9	62
Denmark	6.23	-0.33	17.9	-3.269	28.434	5.474	3.972	68.980	60.432	67.681	0.402	20.628	62.576	7.658	5	1	10	0	7	662
Finland	7.36	-0.93	11.284	-0.097	32.461	5.898	2.031	81.857	49.114	75.777	1.321	67.875	81.903	0.325	4	0	9	6	7	8
France	3.2	0.23	17.676	-1.515	36.731	6.264	2.529	49.127	59.391	66.675	1.235	7.384	79.473	4.785	8	2	8	7	7	1359
Germany	-1.7	0.21	31.969	-2.542	25.652	5.835	2.637	70.800	59.200	70.402	1.134	1.244	45.088	12.232	7	0	8	7	5	16041
Greece	2.93	-0.7	9.321	4.329	24.705	6.164	3.613	78.260	71.060	50.274	2.568	75.770	50.192	0.100	4	0	10	7	6	10
Hungary	3.43	0.52	10.392	-1.191	40.673	5.702	5.239	38.938	58.177	76.302	1.437	15.575	23.531	1.102	8	2	14	7	9	56
Ireland	9.32	2.74	9.569	0.000	21.730	6.473	0.380	32.550	8.600	47.917	-3.712	89.350	14.912	2.500	3	1	12	7	5	2
Italy	4.81	-0.4	27.289	0.000	29.795	5.495	3.570	53.383	54.756	77.109	1.139	12.229	43.538	1.717	4	0	7	7	9	181
Lithuania	-8.1	-0.77	2.779	-0.889	22.013	5.654	1.268	40.357	80.357	64.084	2.982	99.800	19.465	0.129	3	1	14	7	9	7
Luxembourg	-1.4	-0.05	16.256	-6.352	45.661	6.473	1.040	48.333	31.305	53.839	3.259	7.420	146.337	105.772	7	0	10	6	7	223
Netherlands	2.79	-0.22	13.259	26.144	26.144	6.344	1.919	47.225	57.600	55.923	1.348	15.018	94.459	1.754	6	1	7	8	5	103
Poland	5.86	0.33	17.898	-7.017	39.045	5.777	5.063	31.504	53.674	62.662	3.747	15.874	27.481	0.394	3	0	9	0	7	85
Portugal	18.5	-0.64	29.563	-24.944	22.277	5.637	3.342	45.564	52.364	66.919	0.218	35.752	36.582	1.064	8	0	14	6	9	25
Romania	-1.8	-0.2	7.643	3.180	43.362	5.885	4.776	62.740	49.600	39.382	5.714	100	12.210	0.140	6	1	9	0	8	5
Slovenia	5.2	-1.6	11.864	0.000	31.960	5.412	4.631	68.050	52.850	45.838	3.666	100	26.535	0.100	6	2	13	7	8	2
Spain	6.71	0.59	10.491	0.000	31.383	5.928	2.306	45.149	60.733	63.854	3.175	21.578	76.483	0.356	9	2	11	8	5	36
Sweden	6	-0.01	26.056	-3.899	24.908	5.270	3.261	80.256	75.204	60.844	2.436	26.118	103.560	3.387	4	0	5	6	8	719
UK	7.16	-0.05	11.604	-1.931	35.982	6.005	2.322	58.188	45.985	63.605	1.617	12.843	122.066	1.565	6	0	8	7	3	377

Note: This table reports summary statistics of variables with mean value by countries. CAP is capital buffer equal to the difference between total risk-weighted capital ratio and minimum required capital ratio of 8%. △CAP is changes in capital buffer. ZSCORE is insolvency risk measured by the return on assets (ROA) plus capital to asset ratio divided by the standard deviation of ROA rolling 4-year time. △ZSCORE is change in insolvency risk. INCDIV is non-interest income to gross revenues. SIZE is bank size. NIM is net interest margin. DEPOSIT is deposit to total assets. LOAN is loan to total assets ratio. COST is cost to income ratio. CYCLE is annual growth rate of GDP. CONC is market concentration. MACGDP is market capitalization to GDP. ASSGDP is total assets of banks to GDP. CAPITAL is capital regulatory index. DEPOSIT is deposit insurer power. OFFICIAL is official supervisory power. PRIVATE is private monitoring. RESTRICT is restriction on bank activities.

Table 4

Correlation matrix

	CAP	△CAP	ZSCORE	△ZSCORE	INCDIV	SIZE	NIM	DEPOSIT	LOAN	COST	CONC	CYCLE	MACGDP	ASSGDP
CAP	1													
△CAP	0.166*	1												
ZSCORE	-0.062*	-0.036*	1											
△ZSCORE	-0.012	-0.031*	0.356*	1										
INCDIV	0.169*	-0.011	-0.078*	0.007	1									
SIZE	-0.233*	0.011	-0.087*	0.024*	0.024*	1								
NIM	0.249*	0.004	0.013	-0.013	-0.158*	-0.0336*	1							
DEPOSIT	-0.254*	-0.021*	0.115*	-0.007	-0.143*	-0.307*	0.188*	1						
LOAN	-0.053*	-0.021*	0.011	0.009	-0.198*	-0.059*	0.223*	-0.058*	1					
COST	-0.124*	-0.068*	0.055*	0.009	0.131*	-0.209*	-0.023*	0.179*	-0.038*	1				
CONC	0.269*	-0.019	-0.081*	-0.007	0.045*	-0.104*	0.139*	-0.067*	0.023*	-0.106*	1			
CYCLE	0.050*	0.023*	-0.039*	-0.058*	0.089*	-0.019*	-0.015	-0.014	-0.003	-0.069*	0.096*	1		
MACGDP	0.201*	-0.012	-0.081*	0.008	0.175*	0.0516*	-0.040*	-0.124*	-0.019*	-0.132*	0.323*	0.269*	1	
ASSGDP	-0.131*	0.0001	0.027*	0.006	0.077*	0.087*	-0.161*	-0.036*	-0.164*	-0.051*	-0.136*	0.034*	0.238*	1

Note: This table reports correlation matrix. CAP is capital buffer equal to the difference between total risk-weighted capital ratio and minimum required capital ratio of 8%. △CAP is changes in capital buffer. ZSCORE is insolvency risk measured by the return on assets (ROA) plus capital to asset ratio divided by the standard deviation of ROA rolling 4-year time. △ZSCORE is change in insolvency risk. INCDIV is non-interest income to gross revenues. SIZE is bank size. NIM is net interest margin. DEPOSIT is deposit to total assets. LOAN is loan to total assets ratio. COST is cost to income ratio. CYCLE is annual growth rate of GDP. CONC is market concentration. MACGDP is market capitalization to GDP. ASSGDP is total assets of banks to GDP. CAPITAL is capital regulatory index. DEPOSIT is deposit insurer power. OFFICIAL is official supervisory power. PRIVATE is private monitoring. RESTRICT is restriction on bank activities. * denotes 1% significant level.

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Correlation matrix

	CAP	△CAP	ZSCORE	△ZSCORE	INCDIV	SIZE	NIM	DEPOSIT	LOAN	COST	CONC	CYCLE	MACGDP	ASSGDP
CAP	1													
△CAP	0.166*	1												
ZSCORE	-0.062*	-0.036*	1											
△ZSCORE	-0.012	-0.031*	0.356*	1										
INCDIV	0.169*	-0.011	-0.078*	0.007	1									
SIZE	-0.233*	0.011	-0.087*	0.024*	0.024*	1								
NIM	0.249*	0.004	0.013	-0.013	-0.158*	-0.0336*	1							
DEPOSIT	-0.254*	-0.021*	0.115*	-0.007	-0.143*	-0.307*	0.188*	1						
LOAN	-0.053*	-0.021*	0.011	0.009	-0.198*	-0.059*	0.223*	-0.058*	1					
COST	-0.124*	-0.068*	0.055*	0.009	0.131*	-0.209*	-0.023*	0.179*	-0.038*	1				
CONC	0.269*	-0.019	-0.081*	-0.007	0.045*	-0.104*	0.139*	-0.067*	0.023*	-0.106*	1			
CYCLE	0.050*	0.023*	-0.039*	-0.058*	0.089*	-0.019*	-0.015	-0.014	-0.003	-0.069*	0.096*	1		
MACGDP	0.201*	-0.012	-0.081*	0.008	0.175*	0.0516*	-0.040*	-0.124*	-0.019*	-0.132*	0.323*	0.269*	1	
ASSGDP	-0.131*	0.0001	0.027*	0.006	0.077*	0.087*	-0.161*	-0.036*	-0.164*	-0.051*	-0.136*	0.034*	0.238*	1

Note: This table reports correlation matrix. CAP is capital buffer equal to the difference between total risk-weighted capital ratio and minimum required capital ratio of 8%. △CAP is changes in capital buffer. ZSCORE is insolvency risk measured by the return on assets (ROA) plus capital to asset ratio divided by the standard deviation of ROA rolling 4-year time. △ZSCORE is change in insolvency risk. INCDIV is non-interest income to gross revenues. SIZE is bank size. NIM is net interest margin. DEPOSIT is deposit to total assets. LOAN is loan to total assets ratio. COST is cost to income ratio. CYCLE is annual growth rate of GDP. CONC is market concentration. MACGDP is market capitalization to GDP. ASSGDP is total assets of banks to GDP. CAPITAL is capital regulatory index. DEPOSIT is deposit insurer power. OFFICIAL is official supervisory power. PRIVATE is private monitoring. RESTRICT is restriction on bank activities. * denotes 1% significant level.

Table 5
Results for capital buffer and insolvency risk

Variable	(1)				(2)			
	△CAP	△ZSCORE	△CAP	△ZSCORE	△CAP	△ZSCORE	△CAP	△ZSCORE
INTERCEPT	1.789***	11.605***	1.999***	12.222***	1.821***	9.439***	2.021***	9.260***
CYCLE	0.019***	-0.546***	0.016***	-0.532***	0.020***	-0.209***	0.015***	-0.224***
INCDIV	0.002*	-0.069***	0.002*	-0.076***	0.004**	-0.041***	0.003**	-0.049***
△CAP		-0.018		-0.955		1.386		0.548
△ZSCORE	0.001		0.0008		0.004		0.003	
CAP(t-1)	-0.067***		-0.072***		-0.077***		-0.081***	
ZSCORE(t-1)		-0.512***		-0.515***		-0.414***		-0.424***
SIZE	-0.094***	-0.441	-0.106***	-0.625	-0.079***	-0.932***	-0.091***	-1.097***
NIM	0.107***	-0.619**	0.099***	-0.457*	0.133***	-0.414*	0.127***	-0.272
DEPOSIT	-0.003**	0.067***	-0.003***	0.069***	-0.004***	0.046***	-0.004***	0.049***
LOAN	-0.002*	0.023	-0.003***	0.032**	-0.002**	0.015	-0.003***	0.023**
COST	-0.017***	-0.108***	-0.018***	0.0339*	-0.019***	-0.057***	-0.019***	0.041***
CONC			-0.002	-0.112***			-0.002	-0.143***
MACGDP			-0.013***	0.104***			0.003***	0.017**
ASSGDP			0.003***	0.002			-0.015***	0.118***
Adjusted R2	0.055	0.333	0.059	0.336	0.066	0.249	0.071	0.269
Observations	11840	11840	11840	11840	10277	10277	10277	10277

Note: This table reports the results for the 3SLS estimation. In model (1): dependent variables are rCAP calculated by changes in capital buffer and rZSCORE as change in insolvency risk measured by the return on assets (ROA) plus capital to asset ratio divided by the standard deviation of ROA rolling four-year time. In model (2): dependent variables are rCAP calculated by changes in capital buffer and rZSCORE as change in insolvency risk measured by ROA plus capital to asset ratio divided by the standard deviation of ROA rolling five-year time. CAP(t-1) is the lagged capital buffer equal to the difference between total risk-weighted capital ratio and minimum required capital ratio of 8%. ZSCORE(t-1) is the lagged insolvency risk. CYCLE is annual growth rate of GDP. INCDIV is non-interest income to gross revenues. SIZE is bank size. NIM is net interest margin. DEPOSIT is deposit to total assets. LOAN is loan to total assets ratio. COST is cost to income ratio. CONC is market concentration. MACGDP is market capitalization to GDP. ASSGDP is total assets of banks to GDP. ***, ** and * denote significant at 10%, 5% and 1% level.

Table 6
The impact of regulation on capital buffer and insolvency risk

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	△CAP	△ZSCORE	△CAP	△ZSCORE	△CAP	△ZSCORE	△CAP	△ZSCORE	△CAP	△ZSCORE
INTERCEPT	0.173	-6.965	1.975***	11.399***	2.629***	13.436**	1.692***	6.997*	2.469***	21.249***
CYCLE	0.187***	2.646***	0.012**	-0.691***	-0.000	-1.610***	0.074***	0.934***	-0.037	-1.489***
INCDIV	0.033***	0.188*	0.005***	-0.046**	-0.000	0.132	0.004	-0.032	-0.005	-0.169*
△CAP		-1.241*		-0.982		-0.978***		-1.294*		-1.219*
△ZSCORE	0.002		0.001		0.000		0.001		0.000	
CAP(t-1)	-0.070***		-0.072***		-0.723***		-0.070***		-0.071***	
ZSCORE(t-1)		-0.518***		-0.517***		-0.516***		-0.518***		-0.517***
SIZE	-0.114***	-0.709*	-0.099***	-0.439	-0.101***	-0.613	-0.115***	-0.667*	-0.101***	-0.554
NIM	0.095***	-0.465*	0.097***	-0.415	0.108***	-0.394	0.103***	-0.361	0.107***	-0.288
DEPOSIT	-0.003**	0.075*	-0.004***	0.059***	-0.004***	0.062***	-0.003***	0.070***	-0.003***	0.072***
LOAN	-0.003**	0.036**	-0.003**	0.035**	-0.003***	0.028*	-0.003**	0.034**	-0.002**	0.040***
COST	-0.018***	0.028	-0.017***	0.034*	-0.017***	0.036*	-0.017***	0.033*	-0.017	0.032
CONC	0.006**	-0.030	-0.002	-0.115***	0.001	-0.091***	0.003	-0.082***	-0.000	-0.083***
MACGDP	0.002***	-0.007	0.003***	0.007	0.001	-0.009	0.001	-0.009	0.003***	0.012
ASSGDP	-0.012***	0.111***	-0.015***	0.069**	-0.011***	0.124***	-0.012***	0.109***	-0.014***	0.082***
CAPITAL	0.278	2.943***								
CAPITAL*CYCLE	-0.025***	-0.472***								
CAPITAL*INCDIV	-0.005***	0.040***								
DEPINS			0.023	-1.863**						
DEPINS*CYCLE			0.007	0.968***						
DEPINS*INCDIV			-0.004**	-0.029						
OFFICIAL					-0.074**	-0.097*				
OFFICIAL*CYCLE					0.002	0.135				
OFFICIAL*INCDIV					0.004	-0.025				
PRIVATE							0.061***	0.870***		
PRIVATE*CYCLE							-0.009***	-0.227***		
PRIVATE*INCDIV							-0.000	-0.007		
RESTRICT									-0.111**	-2.089
RESTRICT*CYCLE									0.009*	0.180**
RESTRICT*INCDIV									0.001	0.019
Adjusted R^2	0.064	0.338	0.060	0.339	0.059	0.336	0.062	0.338	0.059	0.337
Observations	11840	11840	11840	11840	11840	11840	11840	11840	11840	11840

Note: This table reports the results for the 3SLS estimation. The dependent variables are △CAP calculated by changes in capital buffer and △ZSCORE as change in insolvency risk measured by the return on assets (ROA) plus capital to asset ratio divided by the standard deviation of ROA rolling 4-year time. Explanatory variables are: CYCLE is annual growth rate of GDP. INCDIV is non-interest income to gross revenues. CAP(t-1) is the lagged capital buffer. ZSCORE(t-1) is the lagged insolvency risk. SIZE is bank size. NIM is net interest margin. DEPOSIT is deposit to total assets. LOAN is loan to total assets ratio. COST is cost to income ratio. Country-control variables are market concentration CONC , market capitalization to GDP MACGDP and total assets of banks to GDP ASSGDP. Regulatory variables include capital regulatory index CAPITAL, deposit insurer power DEPINS, official supervisory power OFFICIAL, private monitoring PRIVATE, restriction on bank activities RESTRICT. There are interactive terms between regulatory variables and CYCLE and between regulatory variables and INCDIV. Year and country dummy variables are included but not reported. ***, ** and * denote significant at 10%, 5% and 1% level.

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Perception vs. Reality: A comparative study of financial reporting quality at Chinese and U.S. firms Huang Wei Quan

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Abstract
Starting in 2010, the US regulators have taken a series of actions against accounting fraud at some US-listed Chinese reverse merger companies. Recent studies have documented spillover effects against Chinese reverse mergers not accused of accounting fraud as well as Chinese IPOs but not against US-based reverse mergers. There seems to be a perception that accounting fraud is widespread among the Chinese firms. This study documents spillover effects against the Chinese firms listed in China. We also find that the financial reporting quality of the Chinese firms is no worse than that of the U.S. firms. In fact overall results suggest that the Chinese firms may even have better financial reporting quality than the U.S. firms. This study is important to academics, regulators and investors given the increasing prominence of the Chinese firms on the global capital markets and the concerns about the financial reporting quality among the Chinese firms..
Keywords: Chinese reverse mergers, Chinese listed firms, financial reporting quality, accounting fraud, earnings quality, conditional conservatism, spillover effects, accrual anomaly.

JEL: M41, M48, N25, G14, G18

1. Introduction

Reverse mergers provide a legitimate avenue for private and foreign firms to list on a US exchange, while circumventing the costly and time-consuming requirements of an initial public offering (IPO). [1] Recently, however, reverse mergers have drawn intense scrutiny from regulators because several firms, mainly from China, were accused of accounting fraud. On July 12, 2010, the Public Company Accounting Oversight Board (PCOAB), in issuing an alert about practices not in accordance with PCAOB standards, used the example of a U.S. audit firm retaining an accounting firm in the China region to perform audit procedures (PCAOB, 2010). On June 9, 2011, the Securities and Exchange Commission (SEC) cautioned against investment in reverse mergers because of the potential for fraud and other abuses (SEC, 2011). These events, among others, have resulted in Chinese reverse mergers (CRMs) facing stock price crashes, delistings, auditor resignations, and lawsuits (Bikard, 2011; Darrough et al., 2012).[2] The backlash has spilled over to CRMs not accused of fraud, and Chinese firms that entered the US market through the IPO process, but not against U.S. reverse merger companies (Ang et al. 2012). It is therefore possible that the SEC's warning, while not specifically targeting Chinese firms, coupled with concurrent alerts from the PCAOB, gave investors the perception that accounting fraud is more widespread in Chinese firms than in comparable US firms. Against this backdrop of concerns about accounting irregularities at Chinese reverse merger firms, an intriguing question, and the focus of this study, is whether there are spillover effects against Chinese firms listed in China.

In our initial tests, we re-examine market reactions to a series of regulatory actions, between July 12, 2010 and November 9, 2012, for samples of Chinese reverse merger firms, Chinese IPO firms and US reverse merger firms. We choose these three samples for the

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[1] In a reverse merger, a shell company with negligible assets and operations acquires a private or foreign company by issuing shell shares to the owners of the private or foreign company, who then become the controlling shareholders of the merged company.

[2] See Appendix A for a timeline of major regulatory actions against the Chinese reverse mergers.

following reasons. First of all, given that the SEC cautioned investors against investing in reverse mergers in general, we would expect no difference in the market reactions between Chinese and U.S. reverse merger firms. Consistent with Ang et al. (2012), we find that Chinese reverse merger firms are more negatively affected by the U.S. regulatory actions than US reverse merger firms. The effects on US reverse mergers are modest and short-lived. Second, if, as the SEC announcement cautioned, it is reverse mergers that are prone to fraud, we expect no negative reactions for Chinese IPO firms. Again, as in Ang et al. (2012), we find significant negative market reactions for Chinese IPO firms that subject themselves to the scrutiny of the US IPO process.

The U.S. regulatory actions against Chinese reverse mergers listed in the U.S. should have been irrelevant to the Chinese firms listed in China. Note that there are no reverse merges in China. US-listed Chinese reverse mergers do not meet the stringent listing requirements to get listed in China. The Chinese firms listed in China have stronger financial performance, stronger corporate governance and better financial reporting quality than Chinese reverse mergers listed in the U.S. markets. But if the U.S. regulatory actions cause concerns about the financial reporting quality of all Chinese firms, we expect to observe spillover effects on Chinese firms listed in China as well. We document spillover effects on both A-shares (2,292 firms) held by primarily domestic investors and B shares held by both foreign and domestic investors (102 firms) although the market reactions are more negative for B-shares. Investors seem to perceive that the accounting irregularities uncovered at accused CRMs may be widespread among all Chinese firms.

Next we evaluate the earnings quality of the Chinese firms listed in China using U.S. firms as the benchmark. Using 1,334 Chinese firms listed in China and 3,287 U.S. firms over 2001-2011, we find that the earnings quality of the Chinese firms is no worse than that of the U.S. firms. Chinese firms do not carry any unique or elevated risk of accounting fraud. We repeat our analysis using nine alternative models of earnings quality plus a factor score and using samples matched on year, industry, and size and matched using the propensity score.

Results are robust. Overall results indicate that Chinese firms may even have better earnings quality than similar U.S. firms. This is consistent with Holmes (2010) who reported that accounting fraud is less common in China-based companies than in similar-sized US-based companies. This is also consistent with the anecdotal evidence that firms listed in China or Hong Kong actually show superior financial reporting quality because legal penalties for financial fraud are more severe in Hong Kong and China than in North America (Borzykowski, 2011; DeFotis, 2011).

This is the first comparative study on the earnings quality of the Chinese firms listed in China vs. the U.S. firms. This study puts the earnings quality of the Chinese firms into perspective and helps global investors assess accounting information risk for optimal asset allocation decisions. This study is timely as the Shanghai stock market has recently become open to global investors. Our study is related to concurrent CRM studies (Chen et al., 2012; Darrough et al., 2012; Givoly et al., 2012; Lee et al., 2013).

The empirical evidence on the Chinese firms listed in China is particularly important as the presence of the US-listed Chinese firms is minimal by any measure. The 2,491 firms listed in China as of June 2013 dwarf the 56 Chinese IPOs and the 159 CRMs listed in the U.S. (PCAOB, 2011). The CRMs had a market capitalization of $12.8 billion and the Chinese IPO firms had a market capitalization of $27.2 billion (PCAOB, 2011), accounting for a tiny fraction of the U.S. capital markets valued at more than $20 trillion.

This study is timely for investors who are torn between the fear of accounting fraud and the unique investment opportunities furnished by the Chinese stocks. China became the second largest economy in 2011 and its GDP doubles that of Japan in 2014. China has the fastest economic growth of 7.4% in 2014. Chinese companies are gaining an increasingly stronger presence on the global capital markets. [3] The Chinese stock market is largely immune to foreign shocks, thereby providing effective diversification for global investors (Rösch & Schmidbauer, 2008). The Chinese stock market has been a hedge as well as a safe

[3] Chinese companies made up 37% of global IPO issuance, 64% of Asia's IPO and 40% of regional (Asia ex-Japan) bond issuance in 2010 according to Dealogic (Flatt, 2011).

haven for the G7 stock markets in both sub-sample periods 1993–1999 and 2000–2008 (Lai & Tseng, 2010).

This study provides empirical evidence relevant to the U.S. congress that has been concerned about the financial reporting of Chinese firms. For instance, the US congress held hearings on "Chinese Fundraising Activities in the US Capital Markets" in 2001 and on "China's Presence in the Global Capital Markets" in 2004. The US-China Economic and Security Review Commission warned U.S. investors in 2002 about the information risks associated with investing in Chinese stocks (Baker et al., 2012). This study is also relevant to the Wall Street in its competition with emerging financial centres in Asia as more emerging market companies might choose to raise funds in Asia. China has more companies traded on the NASDAQ than any other country outside of the US (Lazaroff, 2012).

This paper continues as follows. Section 2 reviews prior literature and develops hypotheses. Section 3 discusses research design. Section 4 presents descriptive statistics and empirical results. Section 5 concludes with a summary and discussion.

2. Prior literature and hypothesis development

2.1. Spillover effects against the Chinese firms listed in China

There has been a significant increase in reverse mergers (RM) on the U.S. capital markets in the last decade. The increase is partly driven by the increasing number of Chinese private firms that went public via reverse mergers on the U. S. markets. Those Chinese firms were guided by US professional firms to choose the RM route which bypasses the scrutiny, expense and time of registering an IPO.

The appeal of the China growth story attracted investors to US-listed Chinese stocks which generated remarkable returns until early 2010. For instance, the Bloomberg China Reverse Mergers (CRM) index generated a return of 156% versus 2% return for S&P 500 from December 2008 to January 2010 (Darrough et al., 2012). The strong performance of Chinese stocks even defied negative coverage of accounting issues in the media until the

Public Company Accounting Oversight Board (PCAOB) issued Alert No. 6 on July 12, 2010 highlighting the auditing problems related to Chinese reverse mergers. CRMs have since faced negative publicity, an extraordinary flurry of regulatory actions, fraud allegations, stock price crashes, auditor resignations, suspensions, lawsuits, and FBI actions (Bikard, 2011; Darrough et al., 2012; PCAOB, 2010, 2011; SEC, 2011).[4]

There were concerns about potential spillover effects on the US-based reverse mergers (RM) which are typically small-cap firms responsible for the creation of most jobs. These concerns are legitimate as reverse merger (RM) firms have a bad reputation for accounting fraud (Flatt, 2011; Floros & Shastri, 2009; Templin, 2012). Recent studies demonstrate that RM firms exhibit lower earnings quality than firms who go public through an IPO (Chen et al., 2012; Chu et al., 2012; Givoly et al., 2012).

Recent studies (Ang et al. 2012; Darrough et al., 2012; Lee et al., 2013), however, have documented little spillover effects against RMs based in the US or other countries but significant spillover effects against CRMs not accused of accounting fraud. This result is puzzling as US-based RMs are also prone to earnings management (Chen et al., 2012; Chu et al., 2012; Givoly et al., 2012; Siegel & Wang, 2013). CRMs even exhibit better earnings quality and stronger financial performance than their US counterparts and even-matched IPO firms (Darrough et al., 2012; Humphery-Jenner, 2012; Lee et al., 2013).[5]

The spillover effects also extend to bigger and stronger Chinese IPO firms listed on the U.S. markets (Ang et al. 2012; Darrough et al., 2012). It is important to note that Chinese firms have to obtain regulatory approval in China before going public through an IPO overseas; similar screening is not applicable either to CRMs or to US-based firms. Chinese IPO firms are bigger, financially stronger, face lower risk of lawsuit for fraud, have more analyst following and lower leverage and better financial reporting quality than CRMs (Ang et al., 2012; Jindra et al., 2012). The pattern of spillover effects suggests that that the *reverse*

[4] See Appendix A for a list of regulatory actions related to Chinese reverse mergers.

[5] An alternative explanation for the bewildering pattern of spillover effects might be related to the wording or interpretation of the PCAOB alert (PCAOB, 2010, 2011) and the SEC warning (SEC, 2011) targeting Chinese firms.

merger identity of CRMs seems to be fine but its *Chinese* identity seems to be in trouble. That raises a question about the potential spillover effects on the Chinese firms listed in China that also share the *Chinese* identity. But it is not clear whether such spillover effects will extend to the Chinese firms listed in China as there are no reverse mergers in China and US-listed CRMs are not listed in China. Hence we state our first hypothesis in the null form as follows:[6]

$H1_0$: *The US regulatory actions against Chinese reverse mergers have no spillover effects on the Chinese firms listed in China.*

2.2 Financial reporting quality in China vs. the US

The economic boom since 1978 in China has generated a demand for a strong capital market.[7] The rapid development of stock markets, the influx of foreign investment and the rise of the private sector have generated a demand for a solid financial reporting system. Prior literature has documented primary determinants of financial reporting quality as follows (see Bushman & Piotroski, 2006; Thornton, 2002):

Accounting standard: China has revolutionized its accounting standard by issuing four increasingly-refined sets of accounting standard, successfully converging with IFRS (IASB, 2006; Liu et al., 2011). Street and Gray (2002) suggest that the successful convergence with IFRS in China might be driven by the incentives to overcome negative perceptions and gain investor acceptance. Prior literature (Barth et al., 2008; Daske et al., 2008) demonstrates that adopting IFRS improves financial reporting quality and facilitates efficient capital markets. Liu et al. (2011) document a significant decrease in earnings management and increase in value relevance after the mandatory adoption of IFRS in 2007 in China, suggesting that the Chinese regulatory oversight is effective. Compared with IFRS or

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[6] Darrough et al. (2012) report that the spillover effects are observed only after the PCAOB published Alert No. 6 on July 12, 2010. So it is the regulatory move rather than scandals or negative publicity that highlighted the accounting problems among the CRMs. The pronounced effects might be because the PCAOB alert is the first major regulatory move against the US-listed Chinese firms (Darrough et al., 2012) and negative publicity was previously more than offset by the appeal of the China growth story.

[7] The Shanghai and Shenzhen stock exchanges were established in December 1990 and July 1991, respectively. China had the largest IPO market in 2007 (Jia et al., 2009). By the end of 2007, the market capitalization in China reached US$4.5 trillion, second only to the United States (Liu et al., 2011).

US GAAP, Chinese standards are rigid, more specific and prescriptive, leaving much less room for earnings management (Chen, Lee & Li, 2008; Kimbro, 2005). [8]

Audit quality: China has revolutionized its auditing standards and auditing profession in an attempt to improve audit quality (Firth et al., 2011; Gul et al., 2003). Two new sets of auditing standards modelled after the International Auditing Standards became effective in 1996 and 1997, respectively (Sami & Zhou, 2008). Auditors are subject to administrative penalties, monitoring and sanctions by regulators and the Chinese Institute of Certified Public Accountants (Chen et al., 2011; Defond et al., 2000). In an unprecedented move, the Chinese Supreme Court issued a legal document in 1996 highlighting legal liabilities for auditors (Gul et al., 2003). In 2002, the Chinese Supreme Court defined auditors' liabilities for damages to investors for undetected material misstatements; negligent auditors became subject to Joint and Several liability clauses. In addition, the 2005 Security Act mandates that auditors be held liable for damages to investors (Chen et al., 2011). It is the radical change from the absence of legal risk to the presence of legal risk rather than the absolute level of legal risk that exerts a significant impact on the incentives of auditors. In contrast, the combined impact of the Private Securities Litigation Reform Act of 1995 and the 1994 Supreme Court decision caused litigation against auditors to drop off sharply despite allegations of accounting fraud in the majority of securities lawsuits in the U.S. (Coffee, 2006; Liu & Elayan, 2013).

Empirical evidence shows that the Chinese auditors are playing an increasingly effective policing role in the financial reporting process. For instance, Chen et al. (2001) report significant increases in the modified audit opinions (MAOs) following the first set of auditing standards issued in 1995. About 11% of listed companies received MAOs each year, much higher than the 0.98% in the US in 1992 (Rittenberg & Schwieger, 1993). Other studies (e.g., DeFond et al., 2000; Sami & Zhou, 2008) confirm the effectiveness of the new auditing

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[8] In China, straight line is the only depreciation method allowed with residual values fixed at 3-5%;; bad debt provision is set at 0.3–0.5% of receivables; assets cannot be re-valued without official approval from government (Kimbro, 2005).

standards in improving audit quality, earnings quality, and value relevance, and reducing information asymmetry. In 2005, the total adjusted profits (assets) after audits were 21.66% (4.03%) of total unadjusted profits (assets) before audits.

Increasing effectiveness of regulators: The China Securities Regulatory Commission (CSRC) has been the de facto regulator since the 1999 Securities Law (Firth et al., 2011; Jia et al., 2009; Layton, 2008). Partly modeled after the SEC, the CSRC is more powerful and plays a more active role than its U.S. counterpart (Liu et al., 2010). For example, all the IPO or SEO applications in China must be approved by the CSRC which has the power to approve or decline applications without giving any justification and plays a screening role to protect investors. This screening process is not applicable in the U.S. Humphery-Jenner (2012) has documented the effectiveness of the CSRC in screening Chinese firms for public listings in China or overseas. While the CSRC has stringent listing requirements, the SEC has no formal listing requirements. [9] As such, many Chinese companies find it easier to get a listing in the U.S. than in China (Aubin, 2011).

Like the SEC, the CSRC has limited resources. Layton (2008) argues that enhancing the CSRC's resources will render it an effective agency to detect, punish, and deter fraud. Towards that end, the CSRC aggressively recruits staff from regulatory agencies in Hong Kong as well as from auditing and law firms (Jia et al., 2009). In contrast, the SEC has downsized its workforce by more than 50% over the last five decades due to a steady increase in civil cases which are dealt with outside the SEC (Peng, 2007).

Empirical studies have documented increasing effectiveness of the CSRC and the stock exchanges in enforcing standards and listing rules and sanctioning fraudulent behaviour over the past two decades (Baker et al., 2012; Liebman & Milhaupt, 2008). About 20% of the listed firms were convicted by the CSRC for fraud (Sun & Zhang, 2006). The CSRC and the exchanges took 581 enforcement actions between 1994 and 2007 (Jia et al., 2009). In contrast, Karpoff et al. (2008) identify 788 enforcement actions by the SEC and the

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[9] See http://www.sec.gov/answers/listing.htm. NYSE or NASDAQ listing standards are much less onerous than the CSRC listing requirements; the post-listing obligations are more stringent in the US than in China (Humphery-Jenner, 2012).

Department of Justice between 1978 and 2006. Note that the US has far more firm-year observations during the sample period. Firth et al. (2011) identify 813 restatements in 2000-2005 in China. On average, about 3.7% of listed firms restate their financial numbers each year in China. Additionally, Liebman and Milhaupt (2008) find that public stock exchange criticisms, a novel mechanism of securities regulation, led to significant negative effects on stock prices.

Legal enforcement: China has amended its corporate law four times to strength legal enforcement (Jia et al., 2009; Zou et al., 2008). The Supreme Court issued detailed provisions on private securities litigation related to false disclosures in 2003, representing a breakthrough exposing directors and managers to civil liabilities (Zou et al., 2008). The 2005 amendments to corporate and security law unprecedentedly provide legal provisions for statutory derivative lawsuits and empowered shareholders to take legal actions against directors and managers for fraud.

Recent evidence indicates some effectiveness of enforcement. For instance, the first successful civil lawsuit was concluded against a listed company in November 2002 (Chen et al., 2006). On May 25, 2005, the court ordered Guangxia Industry Inc. to compensate its minority shareholders. The chairman of Guangxia Industry Inc. was sentenced to a three-year jail time for faking revenue. Zou et al. (2008) document a non-trivial level of perceived securities litigation risk in China. Specifically, firms with more agency problems and earnings management are more likely to seek Directors' and Officers' (D&O) insurance coverage against potential securities lawsuits. The decision to purchase D&O insurance is positively related to the presence of independent directors and litigation risk proxies. The results are consistent with prior D&O insurance studies conducted in jurisdictions with common-law traditions.

It is also reported that firms listed in China or Hong Kong actually show superior financial reporting quality because legal penalties for financial fraud are more severe in Hong Kong and China than in North America (Borzykowski, 2011; DeFotis, 2011). Criminal prosecution could face up to death penalty in China but not in the US (Chen et al., 2006). Managers face minimal penalties for overstating earnings in the US as corporate insiders rarely contribute to lawsuit settlements (Coffee, 2006; Romano, 1991). Without a system of greater managerial liability, deterrence through private enforcement is a mirage in the U.S. (Coffee, 2006).

Earnings management incentives: Healy and Wahlen (1999) classify earnings management incentives into three categories for U.S. firms: (1) capital market incentives, (2) contracting incentives, and (3) regulatory incentives. U.S. firms manage earnings in order to increase offering prices before SEOs and IPOs or stock-based acquisitions (Teoh, Welch, & Wong, 1998a, 1998b), circumvent dividend constraints (Healy & Palepu, 1990) or debt covenants (Watts & Zimmerman, 1986) or lower market assessment of earnings volatility (Trueman & Titman, 1988). U.S. firms may understate accounting earnings to gain advantages during labour union wage negotiations or management buyout takeovers (Chung et al., 2002; Perry & Williams, 1994). Executive bonuses or equity-based compensation may also induce earnings management (Bergstresser & Philippon, 2006; Watts & Zimmerman, 1986). Stock price consideration and analysts create strong incentives for earnings management in the U.S. (Graham et al., 2005).

The incentive structure of the Chinese firms is quite different. In China, controlling state shareholders pay little attention to stock prices. Analysts play a primitive role in the Chinese market and their forecasts have little impact on stock prices (Wang et al., 2008). Chinese managers have negligible shareholdings in their firms (Chen, Choi & Jiang, 2008). Option-based compensation did not exist until 2005; the use of options was minimal even after 2005 (Conyon & He, 2012; Wang & Yung, 2011). Compensation contracts of CEOs in state-controlled listed firms put less weight on accounting performance and more emphasis on social and political goals (Chen et al., 2011). Yang et al. (2012) conclude that personal incentives play a much smaller role in earnings management in China than in the U.S.

Prior literature documents three regulatory incentives for earnings management in China: 1) to meet the stringent profitability requirement for going public, 2) to meet the stringent profitability requirement for post-IPO equity offering, and 3) to meet profitability requirement to avoid trading suspensions or delisting (e.g., Aharony et al., 2010; Chen, Lee & Li, 2008; Chen et al., 2011; Firth et al., 2011; Jian & Wong, 2010). But the stringent listing requirements in China restrict the issuance of shares to the largest and most profitable firms obviating the need for earnings management. Effective 2001, the CSRC makes adjustments to accounting earnings and uses core earnings when evaluating firm profitability for the IPO and SEO approval (Chen, Lee & Li, 2008). The regulatory incentives for earnings management are also counterbalanced by potential regulatory penalties (Chen & Yuan, 2004). Managers may be barred from serving as managers or directors of a listed company and face up to death sentence for fraud; firms could lose access to capital market. The incentives to boost earnings and meet the stringent profitability requirements for IPOs eased as the Small and Medium Enterprises (SME) Board was launched to deal exclusively with securities of small and medium enterprises in June 2004.

While some studies argue that, like the U.S. firms, the Chinese firms have incentives to inflate earnings in order to issue shares at higher IPO prices (e.g., Aharony et al., 2010; Chen et al., 2011), Wang (2005) found no evidence of earnings management prior to the IPO. In fact, Kimbro (2005) finds that Chinese firms use discretionary accruals to decrease earnings prior to IPOs as China exhibits the greatest degree of IPO underpricing. Chinese firms might be interested in banking income to meet the stringent profitability requirements for post-IPO equity financing or to avoid delisting. Reputation concerns might motivate managers to manage earnings to avoid delisting (Chen, Lee & Li, 2008). The Chinese "shame" culture also means that managers have incentives to avoid losing face in the event of getting caught in fraud (Wang &Yung, 2011). Firms might manage earnings for tax purpose or tunneling incentives but they tend to offset each other such that there is no discernable earnings management (Lo et al., 2010).

In summary, while there is a perception that accounting fraud is widespread among the Chinese companies, there are reports that the Chinese firms even have higher financial reporting quality than U.S. firms. While it is true that the U.S. has a well-developed infrastructure for financial reporting, it also has to deal with major accounting scandals and restatements. While China has taken dramatic measures to improve its financial reporting system, there is plenty of empirical evidence of earnings management. A comparative review of the major determinants of financial reporting quality does not seem to yield a clear-cut conclusion. It is generally believed that the legal liability and the rigorous SEC enforcement improve earnings quality when foreign firms cross list in the U. S. Yet Eng and Lin (2012) report that Chinese firms cross-listed in the U.S. and Hong Kong do not show better earnings quality compared with those Chinese firms listed in China alone. There seems to be a consensus that more compliance and transparency is required in the U.S. than in China (Donville & Schatzker, 2012). But there is no empirical evidence on the earnings quality of the Chinese firms listed in China vs. the U.S. firms. Hence our second hypothesis is stated in the null form as follows:

H2$_0$: *There is no difference in the earnings quality between the Chinese firms listed in China and the U.S. firms.*

3. Research design

3.1 Data and samples

Data for the Chinese companies listed in China are downloaded from the China Stock Market & Accounting Research (CSMAR) database. Data for the U.S. companies are downloaded from COMPUSTAT and CRSP. Data on reverse mergers are downloaded from Dealflow; we did a Google search as a supplement.

We choose to use the 2001-2010 firm-year observations for two reasons. First of all, the Chinese stock exchanges were established in 1990 and 1991, respectively. The financial reporting infrastructure was in the preliminary stages prior to 2001 representing an outdated picture. In fact China has been experiencing significant improvements even over the sample period. Second, the number of stocks was quite small in the early years. For instance, there were 6, 13, and 70 stocks in 1990, 1991, and 1992, respectively. Third, annual report data were available until 2011 at the time the study was conducted. We truncate top and bottom 1% of the dependent and independent variables as well as control variables to improve normality and ease the impact of outliers.

We estimate the abnormal stock returns using the Fama-French (1993) three-factor model as the return-generating process. We estimate average abnormal return (AAR), cumulative abnormal return (CAAR), and test statistics as in Cowan (1992).

3.2 Measurements of earnings quality and perceived earnings quality

There is no universally accepted definition or measure of earnings quality and no single proxy is likely to cover all the dimensions of financial reporting quality. We use two alternative versions of the modified Jones model and the modified Dechow-Dichev model. The two models have been widely used in the accounting literature (e.g., Chen et al., 2012; Givoly et al., 2009; Hope et al., 2013; Wang, 2006). We also use a discretionary revenue model (McNichols & Stubben, 2008; Stubben, 2010) and the ratio of accruals to cash flows (Burgstahler et al., 2006) as well as a principal component factor as a comprehensive proxy for earnings quality. See Appendix B for details on the proxies.

In addition, we use two alternative models of conditional conservatism as the proxies for earnings quality. Greater conditional conservatism suggests that firms are more likely to recognize economic losses in accounting earnings. Thus greater conditional conservatism indicates better earnings quality given the dominant incentives of managers to inflate earnings. We also run Mishkin (1983) test for additional analysis. The first model of Mishkin test regresses accounting earnings on the operating cash flows and accruals in the previous year to gauge the information content contained in accounting accruals about the earnings in the following year. The greater information content indicates higher accrual quality. The Mishkin test also allows us to gauge the degree of overpricing of accruals and evaluate the perceived earnings quality for the Chinese firms and the U.S. firms. We also obtain abnormal returns for the deciles sorted on accruals to quantify the consequences of misperceived earnings quality for the Chinese firms and the U.S. firms, respectively.

3.3 Empirical models

We run the following regression using the 2001-2011 firm-year observations to compare the earnings quality of the U.S. firms and the Chinese firms listed in China.

$$EQ_t = \beta_0 + \beta_1 CHI_t + \gamma Controls_t + \varepsilon_t \tag{1}$$

Where *EQ* is earnings quality, the natural logarithm of one of the six proxies as well as the principal component factor; *CHI* is a dummy variable equal to one for the Chinese firms listed in China and zero otherwise; control variables are firm size, ROE, leverage, sales growth, asset growth, capital need in the following year, inventory, net loss, loss in a previous year, firm age, book to market ratio, and ROA. If the earnings quality of the Chinese firms is lower than that of the US firms, we expected to see a positive β_1. Higher *EQ* values represent lower earnings quality.

We compare the conditional conservatism of U.S. firms and Chinese firms using the two alternative models below developed by Ball and Shivakumar (2005).

$$\Delta NI_t = \beta_0 + \beta_1 D\Delta NI_{t-1} + \beta_2 \Delta NI_{t-1} + \beta_3 D\Delta NI_{t-1} \times \Delta NI_{t-1} + \beta_4 CHI + \beta_5 CHI \times D\Delta NI_{t-1} + \beta_6 CHI \times \Delta NI_{t-1} + \beta_7 CHI \times D\Delta NI_{t-1} \times \Delta NI_{t-1} + \gamma Controls + \varepsilon_t \tag{2}$$

Where ΔNI is the change in net income scaled by lagged total assets; $D\Delta NI$ is a dummy variable equal to one for negative ΔNI in the prior year. β_2 measures the persistence of positive ΔNI; β_3 measures the differential persistence of negative ΔNI. Conditional conservatism, characterized by more timely recognition of losses, means that negative ΔNI will be less persistent than positive ΔNI and predicts negative β_3. β_7 measures the differential persistence of Chinese versus US firms. If Chinese firms have less conditional conservatism, β_7 is expected to be positive.

$$ACC_t = \beta_0 + \beta_1 DCFO_t + \beta_2 CFO_t + \beta_3 DCFO_t \times CFO_t + \beta_4 CHI + \beta_5 CHI \times DCFO_t$$
$$+\beta_6 CHI \times CFO_t + \beta_7 CHI \times DCFO_t \times CFO_t + \gamma Controls + \varepsilon_t \quad (3)$$

Where *ACC* is total accruals; *CFO* is operating cash flows; *DCFO* is a dummy variable equal to one for negative *CFO*. Both *ACC* and *CFO* are deflated by lagged total assets. The role of accruals in mitigating noises in operating cash flows predicts that β_2 will be negative (Dechow et al., 1998). Conditional conservatism, characterized by more timely recognition of losses, reduces the negative correlation between *ACC* and *CFO* and predicts a positive incremental coefficient on β_3. β_3 is thus a measure of conditional conservatism. If Chinese firms have less conditional conservatism, β_7 is expected to be negative.

We estimate the forecasting equation (#4) and the valuation equation (#5) below to perform the Mishkin (1983) test.

$$\text{EARN}_{t+1} = \gamma_0 + \gamma_1 \text{ x CFO}_t + \gamma_2 \text{ x ACCR}_t + \nu_{t+1} \quad (4)$$
$$\text{Ab\_Ret}_{t+1} = \alpha + \beta \text{ x } (\text{EARN}_{t+1} - \gamma_0 - \gamma^*_1 \text{ x CFO}_t - \gamma^*_2 \text{ x ACCR}_t) + \varepsilon_{t+1} \quad (5)$$

where EARN_{t+1} is net income at Year *t+1*; CFO_t is operating cash flows deflated by lagged assets at Year *t*; ACCR_t is total accruals, the difference between EARN and CFO at Year *t*; Adj_Ret_{t+1} is abnormal returns at Year *t+1* calculated as the difference between a firm's buy-and-hold annual return ending three months after the fiscal year end, inclusive of dividends and any liquidating distributions, and the buy-and-hold return on a size matched value-weighted portfolio of firms. The forecasting coefficients gauge the persistence of *CFO* and *ACCR*. Higher coefficients on *ACCR* indicate greater information content contained in the accruals about future earnings. If the market valuation coefficient is greater than its forecasting counterpart, the market overprices that earnings component and vice versa.

4. Results

4.1 Descriptive statistics

Table 1 presents descriptive statistics. The Chinese firms have higher (lower) earnings quality for five (one) out of the six proxies than the U.S. firms. Recall that higher values of earnings quality measures indicate lower earnings quality. The Chinese firms are much smaller than the U.S. firm. Chinese firms have stronger financial performance (i.e., higher ROE and ROA and lower percentage of net losses) than the U.S. firms. This might be related to the more rigorous listing requirements in China allowing only healthy firms to go public and consistent with the faster economic growth in China. This might partially explain the better earnings quality of the Chinese firms as stronger financial performance obviates the need for earnings management. Chinese firms show much higher growth rate than the U.S. firms (sales growth, asset growth, and book to market ratio), consistent with the rapid economic growth in China. Capital need is similar between the two samples.

Untabulated results show moderate correlations among the four measures based on the modified Jones and modified DD models but weaker correlations between these four and the discretionary revenue measure. There is rather weak correlation between the ratio of accruals to cash flow and the other five measures. Financial performance based on ROE, ROA, and net losses is positively correlated with earnings quality, indicating that strong financial performance reduces the incentives for earnings inflation.

4.2 H1 results on the spillover effects

Panel A of Table 2 reports the market reactions to the U.S. regulatory actions against CRMs for three groups of firms listed on the U.S. exchanges: Chinese reverse mergers (CRM), Chinese IPO firms, and US-based RMs. Panel A shows significant negative market reactions for CRMs for most regulatory actions as well as on the aggregate. The spill-over effects also extend to the Chinese IPOs but the effects are less pronounced compared with CRMs; negative market reactions are moderate and short-lived for U.S. reverse mergers. This is consistent with the findings of recent studies on the Chinese reverse mergers (Ang et al., 2012; Darrough et al., 2012).

Panel B of Table 2 reports negative market reactions for the 2,292 A-shares (held primarily by domestic investors) and 102 B-shares (held by both domestic and foreign investors) listed in China. The spill-over effects on B-shares are more severe. The spill-over effects also extend to the Chinese firms listed in China.

4.3 H2 results on accrual quality

Table 3 presents the results on the earnings quality of the Chinese firms listed in China vs. the firms listed in the U.S. The coefficients on *CHI* are negative for all the models except when *ACC/CFO* is used as the proxy. [10] The negative coefficient indicates that the Chinese firms listed in China have higher earnings quality than the U.S. firms. Recall that higher values indicate lower earnings quality. The coefficient on *CHI* is also negative when we use the factor score as the broader proxy for earnings quality. Results are robust to control variables and robust to industry and year fixed effects. Results remain unchanged when we match Chinese firms with U.S. firms on year, industry and size as reported in Table 4. Results remain intact when we use the propensity score matching method. Results are also robust to the exclusion or inclusion of cross-listed firms in the U.S. sample. We repeat this robustness test because cross-listed firms are also subject to the U.S. financial reporting infrastructure such as standards, regulation and private litigation and cross-listed firms are relevant for investors and regulators.

The coefficients on control variables are generally consistent with previous studies. For example, the coefficients on *SIZE* are negative across the models and samples except for a few instances where *ACC/CFO* is used as the proxy. This is consistent with prior literature (Ashbaugh-Skaife et al., 2008; Chen et al., 2012; Hope et al., 2013; Wang, 2006) indicating that larger firms show better earnings quality. Consistent with Wang (2006), the coefficients on *LEV* are negative across the models and samples except when *ACC/CFO* is used as the proxy, indicating that debt contracting constrains earnings management. This is also consistent with the conservatism literature that *LEV* is positively related to conditional conservatism (Liu et al., 2013). The coefficients on both sales growth and asset growth are

[10] Hope et al. (2013) show that the ratio of accruals to cash flows and the discretionary revenue measure are likely to measure different aspects of financial reporting quality than the modified Jones and modified DD models.

positive across the models and samples although they are negative when *ACC/CFO* is used as the proxy. This is consistent with prior literature (Ashbaugh-Skaife et al., 2008; Chen et al., 2012; Hope et al., 2013; Wang, 2006). Consistent with Hope et al. (2013), the coefficients on capital need are positive across the models and samples although they are negative when *ACC/CFO* is used as the proxy, indicating that firms with upcoming debt or equity financing plans are more likely to manage accruals in an attempt to boost earnings. The coefficients on *LOSS* are positive across the models and samples, consistent with Ashbaugh-Skaife et al. (2008) and Wang (2006), indicating that firms inflate accruals to avoid reporting net losses. The coefficients on book-to-market ratio are negative across the models and samples although they are positive when *ACC/CFO* is used as the proxy, consistent with Chen et al. (2012) and Ashbaugh-Skaife et al. (2008). In short, overall results indicate that Chinese firms listed in China do not carry any unique or elevated risk of accounting fraud when we use U.S. firms as the benchmark.

4.4 Empirical results on conditional conservatism

Panel A of Table 5 shows negative coefficients for β_3, consistent with the more timely recognition of losses implied by conditional conservatism. The result indicates that U.S. firms display conditional conservatism. The result also shows negative and statistically significant β_7, indicating that Chinese firms are even more conservative than U.S. firms. The results are robust to controls for firm size and leverage (Ball & Shivakumar, 2005). Untabulated results show that the result is also robust to additional control for book-to-market ratio (*BM*), which is positively related to conditional conservatism (Liu et al., 2013). The results remain the same whether or not year and industry- fixed effects are included in the models. The results are similar when we repeat our analysis using the samples matched on year, firm size, and industry. In short, the results from the earnings changes model show that the Chinese firms are more conservative than U.S. firms.

Panel B of Table 5 shows that β_3 is positive and statistically significant, consistent with the more timely recognition of losses implied by conditional conservatism. The results suggest that U.S. firms display conditional conservatism. The coefficients β_7 are negative and statistically significant. This indicates that the Chinese firms are less conservative than U.S. firms. The results are similar when we run the regression without any controls or with controls for firm size, leverage, book to market, or year and industry fixed effects. In summary, while the results from the earnings changes model show that Chinese firms are more conservative, the results from the accruals-based model show that U.S. firms are more conservative.

4.5 Mishkin test results

Table 6 presents the results of Mishkin tests. First we evaluate the information content contained in accruals about earnings in the following year. The more information content, the higher the accrual quality. For U.S. firms, the forecasting coefficients on accruals and cash flows are 0.50 and 0.81, respectively; for Chinese firms, they are 0.52 and 0.62, respectively. In other words, the coefficient on accrual is 38% of the total coefficients on accruals and cash flows for U.S. firms; it is 46% for Chinese firms. To put it another way, the coefficient on accrual is 62% of the coefficient on cash flows for U.S. firms, compared with 84% for Chinese firms. Therefore, accounting accruals of Chinese firms provide more information about earnings in the following year than accounting accruals of U.S. firms. This result suggests that Chinese firms exhibit greater accrual quality than U.S. firms.

Second, we compare the forecasting coefficients with the valuation coefficients for Chinese and U.S. firms. Marginal significance is zero for cash flows and accruals of both U.S. and Chinese firms. Therefore, cash flows and accounting accruals are overpriced by the investors in both U.S. and China. This is consistent with the accrual anomaly documented in prior literature (Sloan, 1996; Pincus et al., 2007). But the overpricing of accruals is much more severe for U.S. firms than for Chinese firms. The valuation coefficient on accruals is 1.50, three times the forecasting coefficient of 0.50 on accruals for U.S. firms. In contrast, the valuation coefficient on accruals is 0.96, 1.85 times the forecasting coefficient of 0.52 on accruals for Chinese firms. The difference in the valuation and forecasting coefficients on accruals is 1.00 for U.S. firms, more than twice the difference of 0.44 for Chinese firms. This is consistent with the perception that U.S. firms have greater earnings quality than Chinese firms. It also indicates more severe overestimation of the accrual quality of U.S. firms. This is consistent with Alam et al. (2015) who document that investor perception of accrual quality affects market pricing of accruals leading to investment losses for investors.

5. Conclusions and discussions

Starting in 2010, U.S. regulators have taken a series of actions to address the accounting fraud at some Chinese reverse merger firms listed on the U.S. exchanges. Recent studies have documented significant spillover effects against Chinese firms not accused of fraud but not against U.S. reverse mergers. We confirm significant spillover effects against Chinese reverse mergers as well as Chinese IPOs not accused of fraud. U.S.-based reverse mergers are mostly immune. We also document significant spillover effects against the Chinese firms listed in China. This suggests that investors have switched their attention from the China growth story to accounting irregularities among Chinese firms.

There seems to be a perception that accounting fraud is widespread among Chinese firms. Yet there is no empirical research putting into perspective the financial reporting quality of Chinese firms. Misconceptions about Chinese companies are costly not only to innocent Chinese companies but also to global investors as Chinese companies are gaining an increasingly stronger presence in global capital markets. Using the 2001-2011 firm-year observations, we evaluate the earnings quality of Chinese firms listed in China by using U.S. firms as the benchmark. Overall results demonstrate that Chinese firms do not carry any unique or elevated risk of accounting fraud. In fact, we provide some evidence that Chinese firms may even have better earnings quality than U.S. firms.

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Appendix A: U.S. Regulatory Actions with regard to Chinese Reverse Mergers

July 12th, 2010: The Public Company Accounting Oversight Board (PCAOB) issued Staff Audit Practice Alert No. 6 alerting investors to the auditing problems related to Chinese reverse mergers.

September 9th, 2010: In a letter to the SEC and the PCAOB, the House Financial Services Committee questioned the accuracy of audits done for publicly traded Chinese companies and urged agencies to address the issue. Rep. Lee said, "China is the second-largest economy, and it's growing at such a rapid pace [that] there is an opportunity for exploitation and fraud.

March 14th, 2011: the PCAOB office of Research and Analysis (ORA) issued a research note entitled "Activity Summary and Audit Implications for Reverse Mergers Involving Companies from the China Region. It provides some statistics about Chinese reverse mergers which represent 26 percent of all reverse merger transactions. It reiterates its concern about the auditing problems related to the Chinese reverse mergers.

April 4th, 2011: In a speech before the Council of Institutional Investors Annual Conference, SEC Commissioner Luis Aguilar expressed deep concern over foreign reverse mergers including Chinese reverse mergers.

April 27th, 2011: in response to a congressional inquiry by the Chairman of the Committee on Oversight and Government Reform, SEC Chairman Mary L. Schapiro issued a letter seeking to assure Congress and the public that the SEC "has moved aggressively to protect investors from the risks that may be posed by certain foreign-based companies listed on U.S. exchanges" -- particularly those companies based in China. An SEC task force has been set up to probe accounting problems at foreign reverse mergers including Chinese reverse mergers.

May 26th, 2011: the NASDAQ Stock Market submitted to the SEC its revised and enhanced rulemaking proposal containing proposed additional listing requirements for reverse merger companies.

June 9th, 2011: the U.S. Securities and Exchange Commission SEC took an extraordinary step and issued a bulletin warning investors to be "proceed with caution" when considering to invest in foreign reverse merger companies that are financially weak, prone to "fraud and other abuses", and carry unique risks.

July 22nd, 2011: The NYSE and Amex submitted proposals to enhance the listing requirements for reverse mergers.

November 9th, 2011: The SEC issued orders approving more rigorous listing requirements for reverse mergers on the NYSE, Amex and Nasdaq exchanges.

Appendix B: Earnings quality models [11]

The first measure is based on the modified Jones model (Kothari et al., 2005; Hope et al. 2013). We estimate the following model for each industry-year for 2001-2010, where industry is defined as the first two digits of the SIC code with at least ten observations.

$$ACCR_{it} = \beta_0 + \beta_1\left(\frac{1}{Assets_{i,t-1}}\right) + \beta_2 \Delta REV_{it} + \beta_3 PPE_{it} + \beta_4 ROA_{it} + \varepsilon_{it} \qquad \text{(A1)}$$

Where ACCR is total accruals, measured as the change in non-cash current assets minus the change in current liabilities excluding short term debt, minus depreciation and amortization expense; *ΔRev is* the annual change in revenues; *PPE* is the net property, plant, and equipment. All of the above variables are deflated by lagged total assets. *ROA is* net income divided by average total assets.

The second measure is based on the performance-adjusted cross-sectional variation of the Jones Model (Kothari et al., 2005). We estimate the model below by industry-year (2-digit SIC code and Chinese equivalent) for 2001-2010.

$$TA_{it} = \beta_0 + \beta_1\left(\frac{1}{A_{i,t-1}}\right) + \beta_2(\Delta REV_{it} - \Delta AR_{it}) + \beta_3(PPE_{it}) + \beta_4(NI_{it}) + \varepsilon_{it} \quad \text{(A2)}$$

Where *TA* is total accruals, defined as net income minus operating cash flows;[12] $A_{i,t-1}$ *is* lagged total assets; ΔREV is the change in net revenues for firm i from year *t-1 to t;* ΔAR is the change in accounts receivable for firm i from year *t-1 to t; PPE* is the net property, plant and equipment; *NI* is the net income. All of the variables are deflated by lagged total assets. We use the absolute value of the error term as our proxy for earnings quality.

The third measure is based on the modified Dechow and Dechev (2002) model (Ball & Shivakumar, 2006; Wang, 2006).

$$ACC_t = \alpha_0 + \alpha_1 CF_t + \alpha_2 CF_{t-1} + \alpha_3 CF_{t+1} + \alpha_4 DCF_t + \alpha_5 DCF_t * CF_t + \varepsilon \qquad \text{(A3)}$$

[11] As is the convention in the literature, we drop financial services firms (SIC 6000 to 6900) as they have special accounting practices making estimating abnormal accruals difficult.

[12] We use net income rather than income before extraordinary items because the latter is not available for the Chinese firms. The extraordinary item is not applicable to the Chinese sample. In the accounting conservatism literature, Pope and Walker (1999) find country differences in income before extraordinary items between the U.K. and U.S. firms and recommend using net income rather than the latter for international samples. We find that the accrual quality measures are highly correlated using either income measure for the U.S. sample.

Where *ACC* is total accruals, measured as net income minus operating cash flows, deflated by average total assets; *CF* is operating cash flows deflated by average total assets; *DCF* is a dummy variable equal to one if the change in cash flows at *t* is less than zero.

The fourth measure is based on another version of the modified cross-sectional Dechow and Dechev (2002) model (Ball & Shivakumar, 2006; Chen et al., 2012; Givoly et al., 2009; Hope et al., 2013).

$$WCA_{i,t} = \beta_0 + \beta_1 OCF_{i,t-1} + \beta_2 OCF_{i,t} + \beta_3 OCF_{i,t+1} + \beta_4 \Delta REV_{i,t} + \beta_5 PPE_{i,t} + \beta_6 DOCF_{i,t} + \beta_7 OCF_{i,t} \times DOCF_{i,t} + \varepsilon_{i,t} \quad \text{(A4)}$$

Where *WCA* is working capital accrual, measured as the change in non-cash current assets minus the change in current liabilities other than short-term debt and taxes payable; *CFO* is cash flow from operations; *ΔRev* is annual change in revenues; *PPE* is the net property, plant, and equipment. All variables are scaled by lagged total assets; *DCFO* is a dummy variable equal to one if operating cash flows are negative. The modified DD models are estimated for each industry (i.e., two-digit SIC code or Chinese equivalent) and requires at least 20 firm-year observations per industry. The absolute value of residuals is used as a proxy for earnings quality.

The fifth measure is based on McNichols and Stubben (2008) and Stubben (2010). Specifically, we use the following regression for each industry-year (i.e., two-digit SIC code or Chinese equivalent) that has at least 20 observations:

$$\Delta AR_{i,t} = \beta_0 + \beta_1 \Delta REV_{i,t} + \varepsilon_{i,t} \quad \text{(A5)}$$

Where *ΔAR* is the annual change in accounts receivable scaled by lagged total assets; *ΔRev* is the annual change in revenues scaled by lagged total assets. The absolute value of residuals from the models is used as a proxy for earnings quality.

The sixth measure is based on the ratio of the absolute value of accruals to cash flows (Burgstahler et al. 2006; Chen et al., 2012; Hope et al. 2012). The literature review suggests that firms have incentives to overstate earnings by using reserves or engaging in aggressive accounting practices. Accruals can be temporarily inflated to boost earnings but if cash flows remain unaffected, higher ratio of accruals to cash flows indicates lower earnings quality. On the other hand, however, cookie-jar reserve earnings management could be mistakenly interpreted as higher earnings quality. Cash flows could also be managed. Nevertheless, we conduct our analysis using this measure as a robustness test. The greater the values, the lower the earnings quality.

Appendix C: Mishkin (1983) test

The Mishkin (1983) test is based on a set of jointly estimated equations, namely a forecasting equation and a valuation equation, using an iterative nonlinear least squares procedure proceeding in two stages. In the first stage, the forecasting equation and the valuation equation are estimated without any constraints imposed on the coefficients. In the second stage, the rational pricing constraint is imposed such that the valuation and forecasting coefficients are equal. The two equations are then jointly estimated to test whether the valuation coefficients are different from their forecasting counterparts.

The likelihood ratio statistic is used to test the null hypothesis that the information contained in the earnings components is fully reflected in stock prices, i.e., $\gamma_j = \gamma^*_j$, (j=1, 2, 3). The likelihood ratio is asymptotically distributed as $\chi^2(q)$ and computed as follows:

$$2n*Ln(SSR^c / SSR^u)$$

where q is the number of rational pricing constraints imposed; n is the number of sample observations; Ln is the natural logarithm operator; SSR^c is the sum of squared residuals from the constrained regressions; SSR^u is the sum of squared residuals from the unconstrained regressions. The null hypothesis of rational pricing is rejected if the likelihood ratio statistic is sufficiently large.

Table 1: Descriptive Statistics

Jones1 (Jones2) is the absolute value of earnings quality from modified Jones Model 1 (2). DD1 (DD2) is the absolute value of earnings quality from modified Dechow-Dichev Model 1 (2). DR is the absolute value of discretionary revenues. ACC/CFO is the ratio of magnitude of accruals to operating cash flows. The higher the earnings quality measures, the lower the earnings quality. Market value is the number of shares times the closing price. ROE is return on equity. LEV is the total debt divided by the lagged assets. Sales_growth (Assets_growth) is the annual growth in sales (assets) from prior year. Capital_need is the one-year-ahead percentage change in common stock, preferred stock, and long-term debt. Inventory is the inventory deflated by average assets. Loss is a dummy variable equal to one for net losses. BM is the book-to-market ratio. ROA is return on assets. The samples exclude the top and bottom 1% of all the variables and the financial services firms.

Group	**Panel A: U.S. Firms**				**Panel B: Chinese Firms**			
Variables	N	Mean	Median	STDEV	N	Mean	Median	STDEV
Jones1	23,719	0.27	0.11	0.54	8,083	0.09	0.06	0.13
Jones2	25,695	0.19	0.08	0.35	10,670	0.06	0.04	0.06
DD1	22,817	0.28	0.10	0.58	8,725	0.05	0.03	0.07
DD2	18,928	0.24	0.08	0.47	8,713	0.08	0.05	0.12
DR	24,928	0.05	0.02	0.08	8,846	0.04	0.03	0.06
ACC/CFO	28,076	1.86	0.69	4.54	12,911	1.94	0.77	4.72
Market value (MM)	28,131	2,147	371	4,751	12,911	598	220	1,702
ROE	26,018	−0.02	0.08	0.77	6,645	0.07	0.08	0.17
Leverage	25,876	0.32	0.27	0.28	11,463	0.32	0.30	0.21
Sales growth	25,913	0.11	0.06	0.36	11,900	0.19	0.14	0.42
Assets growth	25,949	0.07	0.03	0.29	11,908	0.13	0.09	0.26
Cap_need	25,104	0.13	0.02	0.45	11,849	0.13	0.02	0.39
Inventory	25,635	0.14	0.10	0.14	11,902	0.17	0.13	0.14
Loss	28,241	0.38	0.00	0.49	12,911	0.12	0.00	0.33
Book to market	23,340	0.57	0.49	0.84	7,543	0.44	0.33	0.44
ROA	25,958	−0.04	0.02	0.24	11,908	0.03	0.03	0.08

Table 2: Spill-over Effects of the US Regulatory Actions against CRMs

Panel A: spill-over effects on the Chinese firms listed in the U.S.

The table presents the three-day (t-1 through t+1) cumulative average abnormal returns (CAR) for the release of each regulatory announcement as well as the aggregate CAR using the Fama-French (1997) three-factor model. Announcements dates represent the press release dates of the regulatory statements with regard to reverse mergers. JKZ is the Jackknife Z-statistics of the cumulative average abnormal return. ***, **, * denotes a level of significance at 1%, 5%, and 10%, respectively.

	CRM: N=129		**Chinese IPO: N=158**		**US RM: N=38**	
Announcement Date	CAR	JKZ	CAR	JKZ	CAR	JKZ
E1:July 12, 2010	0.320	0.688	-1.330	-2.915***	0.100	-0.442
E2:Sep. 9, 2010	-2.340	-3.155***	0.310	-0.763	-1.042	-1.523
E3:March 14, 2011	-3.030	-4.048***	-0.500	-1.229	-1.170	-2.304**
E4:April 4, 2011	-3.300	-4.209***	-0.370	0.780	-0.280	-0.423
E5:April 27, 2011	-2.670	-3.152***	-1.760	-3.565***	-0.690	-0.778
E6:May 26, 2011	-2.930	-3.299***	-1.100	-2.347**	-0.200	-0.869
E7:Jun 9, 2011	-3.950	-4.587***	-2.860	-3.936***	0.804	1.245
E8:July 22, 2011	0.680	1.174	0.050	-0.605	0.130	-0.007
E9:Nov. 9, 2011	0.890	1.795*	-0.670	-1.874*	1.173	1.667*
Aggregate	**-12.400**	**-8.706*****	**-8.230**	**-5.580*****	**-1.132**	**-1.275**

Panel B: spill-over effects on the Chinese firms listed in China

The table presents the three-day (t−1 to t+1) cumulative average abnormal returns (CAR) for the release of each regulatory announcement and the aggregate CAR using the Fama-French (1997) three-factor model for A-Shares (held primarily by domestic investors) and B-Shares (held by foreign investors only) listed in China. JKZ is the Jackknife Z-statistics of the CAR. The aggregate market reaction is the aggregate market response for all the regulatory announcements. *, **, *** denotes a level of significance at ten, five, and one percent level. Closed denotes China exchanges are closed due to the Ching Ming Festival.

	A Shares N=2292		**B Shares N=102**	
Announcement Date	CAR	JKZ	CAR	JKZ
E1:July 12, 2010	0.860	1.631	0.550	0.871
E2:September 9, 2010	0.060	0.137	-0.020	-0.060
E3:March 14, 2011	-0.130	-0.160	-0.620	-1.437
E4:April 4, 2011	Closed	Closed	Closed	Closed
E5:April 27, 2011	-0.896	-1.987*	-1.500	-2.867**
E6:May 26, 2011	-0.680	-1.414	-1.420	-2.662**
E7:Jun 9, 2011	-1.530	-2.320**	-3.750	-4.883***
E8:July 22, 2011	-0.640	-1.361	-1.171	-2.287**
E9:November 9, 2011	-0.240	-0.185	-0.360	-0.301
Aggregate Market Reaction	**-3.196**	**-3.012*****	**-8.291**	**-7.068*****

Table 3: Earnings quality: Chinese firms listed in China vs. U.S. firms

This table reports the results from regressing earnings quality on the country dummy variable and control variables. *Jones1 (Jones 2)* is the log transformed absolute value of earnings quality from modified Jones Model 1 (2). *DD1 (DD2)* is the log transformed absolute value of earnings quality from modified Dechow-Dichev Model 1 (2). *DR* is the log transformed absolute value of discretionary revenues. *ACC/CFO* is the log transformed earnings quality from the ratio of magnitude of accruals to operating cash flows. *FRQ* is the factor score obtained from the six proxies for earnings quality using the principal component analysis. The higher the values, the lower the earnings quality. *CHI* is a dummy variable equal to one for Chinese firms listed in China and zero otherwise. *Size* is the natural logarithm of market value (number of shares times closing price). *ROE* is return on equity. *LEV* is the total debt divided by the lagged assets. *Sales_growth (Assets_growth)* is the annual growth in sales (assets) from prior year. Capital_need is the one-year-ahead percentage change in common stock, preferred stock, and long-term debt. *Inventory* is the inventory deflated by average assets. *Loss (Loss_lag)* is a dummy variable equal to one if net income is less than zero for the current (previous) year. Firm_age is the number of years listed in the capital market for Chinese firms and the number of years in the CRSP database as of the end of fiscal year for US firms. *BM* is the book-to-market ratio. *ROA* is return on assets. The table reports the coefficient estimates, the two-sided *t*-values, the number of observations, and R^2. The top and bottom 1% of all the variables are dropped. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed *t*-test).

Panel A: clustered at the firm level with the industry and year fixed effects

Variables	Jones1	Jones2	DD1	DD2	DR	ACC/CFO	FRQ
Intercept	−1.54*** (−6.25)	−2.01*** (−11.02)	−1.53*** (−9.72)	−0.44** (−2.50)	−2.01*** (−4.83)	−0.91*** (−6.30)	1.81*** (14.90)
CHI	−0.73*** (−25.22)	−0.74*** (−25.34)	−1.34*** (−47.87)	−0.41*** (−13.47)	−0.06** (−2.28)	0.40*** (16.44)	−0.75*** (−35.21)
Size	−0.07*** (−10.55)	−0.06*** (−9.40)	−0.07*** (−11.76)	−0.10*** (−15.35)	−0.10*** (−16.56)	−0.00 (−0.12)	−0.08*** (−16.81)
ROE	−0.01 (−0.41)	0.01 (0.94)	−0.02 (−1.14)	0.01 (0.31)	−0.01 (−0.81)	−0.11*** (−5.78)	−0.00 (−0.28)
LEV	−0.15*** (−3.09)	−0.40*** (−8.13)	−0.42*** (−8.68)	−0.35*** (−6.76)	−0.31*** (−6.70)	0.44*** (10.57)	−0.29*** (−7.97)
Sales_growth	0.04 (1.45)	0.15*** (6.16)	0.15*** (6.05)	0.06** (2.10)	0.07*** (2.81)	−0.17*** (−6.29)	0.07*** (4.76)
Assets_growth	0.53*** (15.58)	0.57*** (17.22)	0.19*** (5.66)	0.71*** (18.02)	0.48*** (14.24)	−0.20*** (−5.87)	0.49*** (22.16)
Capital_need	0.08*** (4.10)	0.07*** (4.12)	0.06**** (3.17)	0.07*** (3.25)	0.03 (1.63)	−0.03** (−2.46)	0.06*** (4.76)
Inventory	−0.15* (−1.70)	0.20** (2.41)	0.04 (0.50)	0.01 (0.08)	0.76*** (7.76)	0.55*** (7.50)	0.17*** (2.59)
Loss	0.12*** (4.40)	0.05 ** (2.13)	0.11*** (4.10)	0.23*** (7.68)	0.19*** (7.91)	0.95*** (40.61)	0.18*** (10.86)
Loss_lag	0.08*** (3.73)	0.06*** (2.99)	0.01 (0.59)	0.20*** (7.76)	0.03 (1.20)	0.10*** (5.43)	0.09*** (5.84)
Firm_age	−0.01** (−2.01)	−0.00 (−0.55)	−0.00 (−0.94)	−0.00 (−0.30)	−0.01*** (−3.31)	−0.01*** (−3.51)	−0.00 (−0.81)
BM	−0.12*** (−8.31)	−0.17*** (−11.54)	−0.13*** (−8.51)	−0.12*** (−7.30)	−0.04*** (−2.72)	0.15*** (10.57)	−0.11*** (−10.12)
ROA	−0.20*** (−2.81)	−0.39*** (−5.13)	−0.87*** (−11.92)	−0.49*** (−5.46)	0.05 (0.67)	0.02 (0.2)	−0.37*** (−7.93)
Year effects	Y	Y	Y	Y	Y	Y	Y
Industry effects	Y	Y	Y	Y	Y	Y	Y
N	24,174	26,087	25,245	21,786	25,448	26,220	21,217
R^2	0.17	0.20	0.23	0.18	0.11	0.21	0.37

Panel B: double-clustered at the firm and year level

Variables	Jones1	Jones2	DD1	DD2	DR	ACC/CFO	FRQ
Intercept	−0.54** (−2.35)	−0.92*** (−4.68)	−0.45 (−1.61)	−0.18 (−1.06)	−1.63*** (−9.22)	−0.89*** (−5.68)	2.02*** (12.62)
CHI	−0.70*** (−7.14)	−0.81*** (−12.87)	−1.29*** (−16.84)	−0.42*** (−4.99)	−0.09 (−0.86)	0.35*** (9.63)	−0.75*** (−20.31)
Size	−0.08*** (−7.90)	−0.07*** (−9.06)	−0.08*** (−7.72)	−0.11*** (−11.32)	−0.10*** (−11.56)	0.00 (0.01)	−0.09*** (−11.52)
ROE	−0.00 (−0.33)	0.01 (1.00)	−0.01 (−0.88)	0.00 (0.25)	−0.01 (−0.52)	−0.11*** (−4.28)	−0.00 (−0.28)
LEV	−0.42*** (−5.06)	−0.64*** (−6.32)	−0.62*** (−6.30)	−0.59*** (−6.00)	−0.48*** (−7.89)	0.44*** (12.00)	−0.54*** (−7.96)
Sales_growth	0.08 (1.49)	0.16*** (2.90)	0.12*** (3.84)	0.08 (1.41)	0.10** (2.07)	−0.18*** (−4.12)	0.09*** (3.04)
Assets_growth	0.62*** (17.49)	0.64*** (25.85)	0.23*** (5.95)	0.76*** (16.73)	0.54*** (11.57)	−0.19*** (−6.44)	0.57*** (21.61)
Capital_need	0.08*** (3.51)	0.06*** (3.08)	0.05** (2.12)	0.07** (2.02)	0.03 (1.03)	−0.04** (−2.49)	0.06*** (2.90)
Inventory	−0.16 (−0.86)	0.21 (1.38)	−0.16 (−1.40)	−0.06 (−0.41)	0.55*** (3.58)	0.53*** (7.14)	0.12 (0.76)
Loss	0.18*** (4.55)	0.12*** (3.76)	0.18*** (2.89)	0.28*** (6.73)	0.21*** (5.86)	0.97*** (32.09)	0.25*** (8.67)
Loss_lag	0.15*** (4.03)	0.15*** (3.26)	0.08** (2.25)	0.25*** (6.01)	0.04 (1.31)	0.11*** (3.93)	015*** (6.95)
Firm_age	−0.00 (−0.54)	−0.02** (−2.12)	−0.00 (−0.13)	−0.02** (−2.47)	−0.02*** (−4.33)	−0.11 (−1.62)	−0.01* (−1.86)
BM	−0.19*** (−5.26)	−0.22*** (−5.49)	−0.14*** (−4.61)	−0.16*** (−4.12)	−0.06*** (−3.75)	0.15*** (7.84)	−0.16*** (−6.83)
ROA	−0.21* (−1.90)	−0.40*** (−4.02)	−0.91*** (−12.62)	−0.53*** (−3.94)	0.00 (0.03)	−0.00 (−0.02)	−0.40*** (−4.77)
N	24,324	27,078	25,412	21,935	25,553	27,818	21,322
R^2	0.09	0.12	0.18	0.12	0.07	0.20	0.25

Table 4: Earnings quality: Chinese vs. U.S. firms matched on year, industry, and size

This table reports the results from regressing earnings quality on the country dummy variable and control variables. *Jones1 (Jones 2)* is the log transformed absolute value of earnings quality from modified Jones Model 1 (2). *DD1 (DD2)* is the log transformed absolute value of earnings quality from modified Dechow-Dichev Model 1 (2). *DR* is the log transformed absolute value of discretionary revenues. *ACC/CFO* is the log transformed earnings quality from the ratio of magnitude of accruals to operating cash flows. *FRQ* is the factor score obtained from the six proxies for accrual quality using the principal component analysis. The higher the earnings quality measures, the lower the earnings quality. *CHI* is a dummy variable equal to one for Chinese firms listed in China and zero otherwise. *Size* is the natural logarithm of market value (number of shares times closing price). *LEV* is the total debt divided by the lagged assets. *Sales_growth (Assets_growth)* is the annual growth in sales (assets) from prior year. Capital_need is the one-year-ahead percentage change in common stock, preferred stock, and long-term debt. *Inventory* is the inventory deflated by average assets. *Loss (Loss_lag)* is a dummy variable equal to one if net income is less than zero for the current (previous) year. Firm_age is the number of years listed in the capital market for Chinese firms and the number of years in the CRSP database as of the end of fiscal year for US firms. *BM* is the book-to-market ratio. *ROA* is return on assets. The table reports the coefficient estimates, the two-sided *t*-values, the number of observations, and R^2. The top and bottom 1% of all the variables are dropped. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively (two-tailed *t*-test).

Panel A: clustered at the firm level with the industry and year fixed effects

Variables	Jones1	Jones2	DD1	DD2	DR	ACC/CFO	FRQ
Intercept	−1.63*** (−4.66)	−2.55*** (−8.85)	−1.00*** (−3.30)	−0.95*** (−2.95)	−1.15 (−1.60)	−0.09 (−0.29)	2.27*** (10.14)
CHI	−0.70*** (−18.69)	−0.74*** (−20.91)	−1.31*** (−35.78)	−0.47*** (−11.45)	−0.07** (−1.96)	0.30*** (9.83)	−0.85*** (−27.62)
Size	−0.06*** (−4.45)	−0.05*** (−3.77)	−0.09*** (−6.43)	−0.09*** (−5.68)	−0.15*** (−10.80)	−0.04*** (−3.81)	−0.10*** (−8.86)
ROE	−0.02 (−0.34)	−0.00 (−0.10)	−0.09** (−2.11)	0.02 (0.44)	−0.03 (−0.72)	−0.05 (−1.19)	−0.02 (−0.71)
LEV	−0.19*** (−2.57)	−0.30*** (−4.38)	−0.27*** (−3.88)	−0.25*** (−3.16)	−0.27*** (−3.63)	0.35*** (5.43)	−0.24*** (−4.32)
Sales_growth	0.01 (0.40)	0.12*** (3.51)	0.12*** (3.39)	0.00* (0.06)	0.09*** (2.65)	−0.08** (−2.05)	0.05** (2.25)
Assets_growth	0.73*** (13.73)	0.55*** (10.89)	0.13** (2.53)	0.82*** (14.82)	0.52*** (9.85)	−0.12** (−2.22)	0.62*** (16.84)
Capital_need	0.09*** (3.21)	0.10*** (3.60)	0.07** (2.27)	0.09*** (2.79)	0.04 (1.40)	−0.03 (−1.31)	0.09*** (4.07)
Inventory	0.24** (2.00)	0.47*** (4.17)	0.02 (0.15)	0.10 (0.81)	0.59*** (4.67)	0.63*** (6.50)	0.39*** (4.24)
Loss	0.24*** (5.45)	0.14*** (3.23)	0.44*** (9.10)	0.15*** (3.08)	0.23*** (5.24)	0.88*** (21.53)	0.31*** (9.49)
Loss_lag	0.09** (2.43)	0.04 (1.10)	−0.04 (−1.02)	0.18*** (4.25)	0.06 (1.55)	0.06* (1.94)	0.09*** (3.34)
Firm_age	0.01* (1.92)	0.00 (1.14)	−0.00 (−0.37)	0.01** (2.17)	−0.00 (−1.03)	−0.01** (−2.27)	0.01** (2.17)
BM	−0.14*** (−5.43)	−0.16*** (−7.56)	−0.14*** (−5.48)	−0.12*** (−3.94)	−0.00 (−0.12)	0.11*** (5.26)	−0.12*** (−5.60)
ROA	0.07 (0.40)	−0.23 (−1.35)	−0.13 (−0.68)	−0.94*** (−4.69)	0.46*** (2.75)	−0.92*** (−3.97)	−0.24* (−1.84)
Year effects	Y	Y	Y	Y	Y	Y	Y
Industry effects	Y	Y	Y	Y	Y	Y	Y
N	9,133	9,821	9,559	8,579	9,629	9,861	8,223
R^2	0.17	0.19	0.31	0.15	0.10	0.18	0.39

Panel B: double-clustered at the firm and year level

Variables	Jones1	Jones2	DD1	DD2	DR	ACC/CFO	FRQ
Intercept	−0.89** (−2.37)	−1.15*** (−3.22)	−0.28 (−0.68)	−0.51 (−1.60)	−0.41 (−1.52)	−0.20 (−0.97)	2.42*** (9.56)
CHI	−0.70*** (−7.67)	−0.79*** (−11.71)	−1.28*** (−17.36)	−0.48*** (−4.99)	−0.09 (−0.80)	0.27*** (6.21)	−0.87*** (−21.86)
Size	−0.08*** (−5.03)	−0.07*** (−3.81)	−0.10*** (−5.57)	−0.11*** (−6.83)	−0.17*** (−12.53)	−0.32*** (−2.72)	−0.11*** (−8.41)
ROE	−0.00 (−0.03)	−0.00 (−0.00)	−0.08* (−1.70)	0.02 (0.55)	−0.02 (−0.61)	−0.05 (−1.11)	−0.02 (−0.99)
LEV	−0.34*** (−4.99)	−0.44*** (−5.61)	−0.46*** (−5.77)	−0.35*** (−4.00)	−0.37*** (−5.24)	0.30*** (3.97)	−0.41*** (−6.33)
Sales_growth	0.06 (1.00)	0.15*** (2.60)	0.11** (2.38)	0.05 (1.36)	0.14*** (3.99)	−0.09** (−2.29)	0.08*** (2.74)
Assets_growth	0.77*** (12.46)	0.58*** (11.31)	0.17*** (3.34)	0.82*** (15.98)	0.54*** (8.14)	−0.09 (−1.34)	0.66*** (15.75)
Capital_need	0.10*** (3.18)	0.09*** (2.96)	0.04* (1.69)	0.09** (2.28)	0.03 (0.70)	−0.03 (−1.54)	0.08*** (3.71)
Inventory	0.43* (1.84)	0.70*** (3.50)	0.04 (0.29)	0.34* (1.84)	0.68*** (4.48)	0.73*** (8.28)	0.63*** (3.37)
Loss	0.28*** (5.68)	0.18*** (3.87)	0.48*** (6.12)	0.17*** (2.82)	0.23*** (5.41)	0.89*** (17.36)	0.35*** (7.19)
Loss_lag	0.13*** (2.86)	0.08** (2.29)	0.01 (0.34)	0.21*** (5.23)	0.07 (1.59)	0.07** (2.42)	0.13*** (4.26)
Firm_age	0.01** (2.11)	−0.00 (−0.36)	0.00 (0.65)	0.01 (0.71)	−0.01*** (−2.70)	−0.00 (−0.03)	0.01** (2.09)
BM	−0.17*** (−3.97)	−0.19*** (−4.30)	−0.16*** (−4.13)	−0.12*** (−2.94)	−0.02 (−0.96)	0.10*** (5.51)	−0.14*** (−5.14)
ROA	−0.05 (−0.23)	−0.36** (−2.24)	−0.26 (−1.36)	−1.17*** (−3.56)	0.25 (1.36)	−0.95** (−2.32)	−0.41** (−2.04)
N	9,207	9,886	9,636	8,652	9,660	9,963	8,254
R^2	0.12	0.14	0.26	0.10	0.07	0.17	0.30

Table 5: Conditional conservatism for the Chinese firms listed in China vs. U.S. firms

This table compares the conditional conservatism of the Chinese firms listed in China vs. the US firms using two alternative models developed by Ball and Shivakumar (2005). ΔNI is the change in net income scaled by lagged total assets. $D\Delta NI$ is a dummy variable equal to one for negative ΔNI in the prior year. *ACC* is the accruals measured as the difference between net income and operating cash flows, standardized by lagged total assets. *CFO* is the operating cash flows standardized by lagged total assets. *DCFO* is a dummy variable equal to one if *CFO* is negative. *CHI* is a dummy variable equal to one for Chinese firms listed in China. *Size* is the natural logarithm of total assets. *LEV* is the total debt divided by lagged total assets. The regressions exclude the top and bottom 1% of ΔNI, ACC, and CFO. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively (2-sided *t*-stat). The *t*-statistics are based on robust standard errors with cluster analysis at the firm level to control for cross-sectional correlation as one firm contributes more than one observations to the samples.

Panel A: Regression of change in earnings on lagged change in earnings

$$\Delta NI_t = \beta_0 + \beta_1 D\Delta NI_{t-1} + \beta_2 \Delta NI_{t-1} + \beta_3 D\Delta NI_{t-1} \times \Delta NI_{t-1} + \beta_4 CHI + \beta_5 CHI \times D\Delta NI_{t-1} + \beta_6 CHI \times \Delta NI_{t-1} + \beta_7 CHI \times D\Delta NI_{t-1} \times \Delta NI_{t-1} + \gamma Controls + \varepsilon_t \quad (2)$$

Variables	Coefficients (*t*-stat)	Coefficients (*t*-stat)
Intercept (β_0)	−0.06 (−4.40)***	−0.06 (−4.60)***
$D\Delta NI_{t-1}$ (β_1)	−0.02 (−1.21)	−0.02 (−1.06)
ΔNI_{t-1} (β_2)	0.29 (2.79)***	0.29 (2.74)***
$D\Delta NI_{t-1} \times \Delta NI_{t-1}$ (β_3)	−0.72 (−3.97)***	−0.71 (−3.89)***
CHI (β_4)	0.01 (5.92)***	0.01 (5.70)***
$CHI \times D\Delta NI_{t-1}$ (β_5)	−0.02 (−6.70)***	−0.02 (−6.66)***
$CHI \times \Delta NI_{t-1}$ (β_6)	−0.02 (−0.63)	−0.02 (−0.52)
$CHI \times D\Delta NI_{t-1} \times \Delta NI_{t-1}$ (β_7)	−0.41 (−6.00)***	−0.41 (−5.96)***
$SIZE$ (β_8)	0.00 (0.68)	0.00 (0.85)
$SIZE \times D\Delta NI_{t-1}$ (β_9)	0.00 (0.48)	0.00 (0.28)
$SIZE \times \Delta NI_{t-1}$ (β_{10})	−0.02 (−2.94)***	−0.02 (−2.92)***
$SIZE \times D\Delta NI_{t-1} \times \Delta NI_{t-1}$ (β_{11})	0.01 (1.15)	0.01 (1.08)
LEV (β_{12})		0.00 (0.43)
$LEV \times D\Delta NI_{t-1}$ (β_{13})		0.00 (0.34)
$LEV \times \Delta NI_{t-1}$ (β_{14})		−0.00 (−0.43)
$LEV \times D\Delta NI_{t-1} \times \Delta NI_{t-1}$ (β_{15})		0.01 (0.70)
Year fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
R^2	0.07	0.07
Number of Observations	86,900	85,324

Panel B: Regression of accruals on operating cash flows

$$ACC_t = \beta_0 + \beta_1 DCFO_t + \beta_2 CFO_t + \beta_3 DCFO_t \times CFO_t + \beta_4 CHI + \beta_5 CHI \times DCFO_t + \beta_6 CHI \times CFO_t + \beta_7 CHI \times DCFO_t \times CFO_t + \gamma Controls + \varepsilon_t \quad (3)$$

Variables	**Coefficients (*t*-stat)**	**Coefficients (*t*-stat)**
Intercept (β_0)	−0.32 (−7.22)***	−0.33 (−8.03)***
DCFO (β_1)	−0.48 (−6.49)***	−0.40 (−5.66)***
CFO (β_2)	−0.60 (−1.97)**	−0.39 (−1.43)
DCFO× *CFO* (β_3)	2.73 (7.72)***	2.29 (6.85)***
CHI (β_4)	0.04 (12.09)***	0.05 (12.95)***
CHI × *DCFO* (β_5)	−0.03 (−1.74)*	−0.02 (−0.87)
CHI × *CFO* (β_6)	−0.19 (−8.20)***	−0.20 (−8.34)***
CHI × *DCFO*× *CFO* (β_7)	−0.71 (−2.59)***	−0.73 (−2.41)**
SIZE (β_8)	0.01 (6.57)***	0.01 (7.75)***
SIZE × *DCFO* (β_9)	0.03 (6.94)***	0.02 (6.20)***
SIZE × *CFO* (β_{10})	0.01 (0.90)	0.00 (0.30)
SIZE × *DCFO*× *CFO* (β_{11})	−0.12 (−6.29)***	−0.10 (−5.24)***
LEV (β_{12})		−0.09 (−5.08)***
LEV × *DCFO* (β_{13})		−0.04 (−1.78)*
LEV × *CFO* (β_{14})		−0.10 (−0.93)
LEV × *DCFO* × *CFO* (β_{15})		0.05 (0.49)
Year and industry FE	Yes	Yes
R^2	0.24	0.28
Number of Observations	82,048	81,357

Table 6: Mishkin test using samples matched on year, industry and size

$$\text{EARN}_{i,t+1} = \gamma_0 + \gamma_1 \text{CFO}_{i,t} + \gamma_2 \text{ACCR}_{i,t} + \nu_{i,t+1} \quad (4)$$

$$\text{Adj\_Ret}_{i,t+1} = \alpha + \beta\,(\text{EARN}_{i,t+1} - \gamma_0 - \gamma^*_1 \text{CFO}_{i,t} - \gamma^*_2 \text{ACCR}_{i,t}) + \varepsilon_{i,t+1} \quad (5)$$

U.S. firms (N = 7,398)

	Forecasting Estimate (Asymptotic SE)	Valuation Estimate (Asymptotic SE)	γ^*/γ	$\gamma^* - \gamma$
γ_1	0.81 (0.01)			
γ^*_1		1.25 (0.07)	1.54	0.44
γ_2	0.50 (0.01)			
γ^*_2		1.50 (0.13)	3.00	1.00
Test of market efficiency	$\gamma_1=\gamma^*_1$	$\gamma_2=\gamma^*_2$		Joint test
Likelihood ratio statistic	34.08	60.82		68.53
Marginal significance	0.00	0.00		0.00

Chinese firms (N = 7,398)

	Forecasting Estimate (Asymptotic SE)	Valuation Estimate (Asymptotic SE)	γ^*/γ	$\gamma^* - \gamma$
γ_1	0.62 (0.01)			
γ^*_1		0.94 (0.04)	1.52	0.32
γ_2	0.52 (0.01)			
γ^*_2		0.96 (0.04)	1.85	0.44
Test of market efficiency	$\gamma_1=\gamma^*_1$	$\gamma_2=\gamma^*_2$		Joint test
Likelihood ratio statistic	61.58	92.92		93.58
Marginal significance	0.00	0.00		0.00

ARN_{t+1} is net income at Year t+1; CFO_t is operating cash flows deflated by lagged assets at Year t; $ACCR_t$ is total accruals, the difference between EARN and CFO at Year t; Adj_Ret_{t+1} is abnormal returns at Year t+1 calculated as the difference between a firm's buy-and-hold annual return ending three months after the fiscal year end, inclusive of dividends and any liquidating distributions, and the buy-and-hold return on a size matched value-weighted portfolio of firms. The forecasting coefficients gauge the persistence of CFO and ACCR. Higher coefficients on ACCR indicate greater information content contained in the accruals about future earnings. If the market valuation coefficient is greater than its forecasting counterpart, the market overprices that earnings component and vice versa.

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The Effect of ERP Systems Competences on Business Process and Organizational Performance

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Abstract

The current ERP systems research focuses on understanding the relationship between the investment in ERP systems and the related performance impact. Due to the research designs used and the nature of the variables included in prior research models, the evidence on the contribution of ERP systems to firm performance is not entirely consistent. This study synthesizes the process-oriented and resource-based theoretical perspectives and proposes a research model that investigates the process through which organizations generate business value from their ERP systems investments. In doing so, the study examines the role of ERP systems competences and business process performance in enhancing organizational performance. The results show that the ERP technical and human competences and the complementarity between them have positive effect on business process performance. The results also show that business process performance is an important factor that mediates the relationship between ERP systems competences and organizational performance. The research findings offer valuable contributions to the theory and practice on how ERP systems enhance organizations performance.

Keywords: *ERP systems, organizational performance, business process performance, ERP systems competences.*

Introduction

The contribution of enterprise resources planning (ERP) systems to organizational performance has received great attention in prior accounting information systems (AIS) research. This attention matches the large investments that organizations have made in ERP systems over the last two decades. The evidence from early AIS studies regarding the incremental contribution of ERP systems to organizational performance is not entirely consistent (HassabElnaby et al. 2012; Wieder et al. 2006). However, few studies show some evidence of ERP systems payoff that is measurable across limited financial ratios (Poston and Grabski 2001; Hunton et al. 2003). The lack of consistent evidence of the performance impact of ERP systems is attributed to the research models and methodologies used in prior ERP systems payoff studies (Wieder et al. 2006). For instance, prior studies focus less on the impact of ERP systems at the business process level where ERP systems are supposedly used and pay more attention to the organizational-level performance impact (Matolcsy et al. 2005; Wier et al. 2007). Therefore, ignoring the business process performance impact of ERP systems will reduce the chance of finding evidence of the impact of the systems on the organizational performance (Elbashir et al. 2008; Davern and Kauffman 2000). This is because unrelated factors may confound the effect of ERP systems on the organizational performance (Melville et al. 2004; Davern and Kauffman 2000).

ERP systems are expected to enhance organizations' performance mainly because of their role in supporting business processes (re)design thereby enabling timely access to consistent information across diverse functional areas of the organization (Grabski et al. 2011; Weir et al. 2007). As such, achieving the desired performance outcome from ERP investments will require a significant amount of business process re-engineering (BPR) (Cheng and Wang 2006; Dorien and Wolf 2000). BPR will help organizations to align their business processes with the ERP systems concept, whereby business process benefits are achieved (O'Leary 2000; Weir et al. 2007). However, prior ERP systems studies take BPR for granted and assume that it is a natural outcome of any ERP systems implementation. Prior research also indicates that achieving organizational performance of ERP systems requires a great deal of organizational commitments towards investing in complementary ERP-related resources (Cheng and Wang 2006; Dorien and Wolf 2000). These resources include human and technical, which are considered the key factors for the success of ERP systems (Stratman and Roth 2002; Mata et al. 1995).

The purpose of this study is to revisit the ERP systems payoff theme and propose a research model that explains the process through which ERP systems contribute to organizational performance. In doing so, we draw on the process-oriented and the resource-based views of the firm and propose a research model that explicitly considers the role of business process performance related to BPR as mediating the relationship between ERP systems resources and organizational performance (Mooney et al. 1995; Barua et al. 2000; Tallon et al. 2000; Soh and Markus 1995; Subramani 2004). Two ERP systems resources, human and technical competences, are depicted in the research model as the antecedents of organizational performance impact of ERP systems, whereby both their individual and complementary effects on ERP performance impact were tested. Drawing on recent AIS studies, the research model examined in this study depicts the performance impact of ERP systems at the business process and organizational levels (Elbashir et al. 2008; Irani 2002; Hunton et al. 2003; Nicolaou et al. 2003).

To test the research model, we used survey to collect data from Chinese companies that are listed in the Shanghai and Shenzhen stock exchange which adopted ERP since 1999. We targeted multiple respondents, including CFOs and CIOs and functional managers from 421 organizations. We received usable responses from 65 organizations which represent a response rate of 15%. Our results show that both ERP technical and human competences are positively related to business process performance and indirectly, positively affect organizational performance through business process performance. Our results also indicate that the complementarity between ERP technical and human competences has positive contribution to the business process performance.

This study makes several contributions to the ERP literature. First, we apply the concept of IT competences to the ERP setting and break down ERP competences into technical and human aspects while examining their roles, separately and jointly, in ERP business value creation. Second, we propose theoretically and examine empirically the framework of the impact of ERP systems technical and human competences on firm performance via business process. Our proposition and examination enriches ERP theory and presents some evidence in relation to the process of ERP systems business value creation. Finally, our empirical results justify the breakdown of ERP resources into technical and human parts by showing different effects (i.e. directly and indirectly) of the technical and human competences of ERP systems on organizational performance.

The remainder of the paper is organized as follows: the next section describes the theoretical foundation and research hypotheses. Then, the methodology and results are described. Finally, the findings, limitations, and recommendations for future research are discussed.

Theory and Hypotheses Development

Demonstrating the bottom-line contribution of ERP systems has been a major challenge for AIS researchers over the last two decades (Stratman 2007; Wier et al. 2007). Early studies show that ERP systems investments have limited effect on organizational performance (McAfee 2002; Poston and Grabski, 2001). However, there is now a consensus among researchers that ERP systems can help organizations to improve their operational efficiency and effectiveness (Wier et al. 2007). The challenging research question now is not whether ERP systems create business value, but a richer understanding of the processes through which ERP systems create value to the organization (Melville et al. 2004). Answering these questions requires opening the "black box" of the basic research model of ERP systems that was tested in prior ERP payoff studies, which proposes a direct relation between ERP systems investments and organizational performance. Decoding the "black box" will require examining both the organizational resources that complement ERP systems investments and the processes through which organizations convert ERP systems investments into organizational performance.

The resource-based view suggests that acquiring ERP systems guarantees neither positive return on investment nor improvement in other indicators of competitive advantages (Stratman, 2007; Beard and Sumner, 2004; Mata et al. 1995). This is because ERP systems are a public commodity that can easily be procured in the market by all organizations. To achieve competitive advantages from their ERP systems investments, organizations will need to invest in other complementary resources including technical and managerial resources (Melville et al. 2004; Barua et al. 2000). These resources are necessary for exploiting ERP systems investments and creating capabilities and competences that are necessary for enhancing competitive advantage

(Barney et al. 2001; Teece et al 1997; Mata et al. 1995). Drawing on the Melville et al. (2004) framework of IT business value, we propose technical and human competences, and the synergy between them as the drivers of business process performance.

Most prior ERP systems payoff studies used organizational performance as the dependent variable of the research models. Recent studies argue that the organizational performance impact of ERP systems can be best measured at its immediate (business process) where the systems are used (Mooney et al. 1995; Tallon et al. 2000; Subramani 2004; Melville et al. 2004; Ray et al. 2005; Grabski et al. 2011; Weir et al. 2007). Failing to examine the ERP systems payoff at the business process level may reduce the ability to explain effectively how, why, or why not the business value is created from ERP systems (Elbashir et al. 2008). We examine the business value of ERP systems in this study at both the business process and organizational levels.

Figure 1 depicts the conceptual model tested in this study. We draw on the process-oriented approach and the resource-based view perspective to motivate and test a set of factors as the enablers of the performance impact of ERP system. The performance impact of ERP systems is examined at both the business process and organizational levels. Two ERP systems competences constructs, *human* and *technical*, are modeled to have association individually and jointly with the business process performance of ERP systems. The research model also suggests that the business process performance mediates the relation between the ERP competence constructs and organizational performance.

[Insert Figure 1: the conceptual model here]

ERP systems competence and business process performance

The value of ERP systems stems from thier ability to integrate diverse business processes and functional areas as well as enabling management's need for timely access to consistent information that are required for managerial decisions (Grabski et al. 2011). Important performance outcomes of ERP systems are informational, automational, and transformational benefits (Ramirez et al. 2010). The *informational* benefits are enabled by the ERP systems as a result of managing all transactional data that are generated by business processes and functional areas to create a database across the whole organization. The *automational* benefits include operational efficiency of the business processes, such as saving in time and labor costs that arise as the result of using the ERP systems to automate business processes. The *transformational* benefits arise as the result of using the ERP systems to (re)design business processes and innovative activities that contribute to the enhancement of the operational effectiveness (Subramani 2004).

Achieving business process benefits from ERP systems investments is not a straightforward process and will require the firm to build specialized ERP resources including technical and human competences that will enable the organization to leverage the installed ERP systems (Stratman and Ruth 2002).

We include these two competences, ERP technical and human, in our research model as the antecedents of the ERP performance (Melville et al. 2004).

ERP Technical competences is a multifaceted construct that captures the technical knowledge and expertise that organizations need prior to and post ERP systems implementation. These include competencies that enable strategic planning for the system, provision of the necessary physical and human resources, and resolving ERP technical challenges (Meliville et al. 2004, Stratmen and Roth 2002). Technical competencies enable organizations to implement BPR techniques and align the newly (re)designed business processes with an effective implementation of the ERP system. ERP technical competencies also allow organizations to engage in continuous improvement of their ERP systems implementation to continuously improve the alignment of systems and business processes. Such an alignment will help the organization to achieve operational efficiency and effectiveness of their business processes. This leads to the following hypothesis:

H_1: *ERP technical competences are positively related to the business process performance.*

ERP human competences is a multifaceted construct that refers to the managerial knowledge, expertise, and skills that organizations possess that are used to manage the ERP systems projects (Stratmen and Roth 2002). These competences involve understanding the business processes requirements and the consequences of BPR, understanding the role of ERP systems in supporting business strategies, managing ERP systems, and fulfilling the needs of the users of ERP systems. Therefore, ERP human competences will enhance all the stages of ERP systems implementation and creating better alignment of the systems and the business process that results in enhanced business process performance. This leads to the following hypothesis:

H_2: *ERP human competences are positively related to the business process performance.*

The complementarity between human and technical competences:

Complementarity describes the enhancement of a resource and its ability to produce greater return to the organization in the presence of another complementary resource (Zhu 2004; Migrom and Roberts, Barua et al. 2000). Technical and human competences complement each other and create synergies that lead to enhanced ERP systems performance. For instance enhancing strategic ERP planning, which is a technical competency will entail the organization to collect and use information to create new knowledge on ERP strategy. However, this process will also enhance managerial competences related to how to fill in the knowledge gap of the organization which is necessary for better ERP systems implementation. While the two competences contribute individually to the performance of business process, the synergy between the two resources will have an incremental contribution.

If duplicating the ERP human and technical competences by firms is not an easy process, duplicating the synergy between these two competences is even more difficult due to the path-dependent process that will involve time, complex resources and capabilities to build (Zhu 2004). Drawing on H_1 and H_2, this lead to the following hypothesis:

H_3: *The Complementarity between ERP human and technical competences are positively related to the business process performance.*

Business process performance and organizational performance:

First-order business processes benefits are the leading indicators of organizational competitive benefits (Elbashir et al. 2008). An organization's performance impact of ERP systems depends on the effectiveness of the ERP system in facilitating the business processes redesign and generating both the operational efficiency and effectiveness benefits (Subramani 2004; Ray et al. 2005). Organizations that generate greater benefits from their ERP system investments across their business processes will be able to generate organizational performance. Consistent with the two-stage model of benefits suggested in prior literature (Elbashir et al. 2008; Melville et al. 2004; Subramani 2004), business processes benefits from ERP systems are expected to enhance the organizational-level performance (sales growth, profit margin, ROI). This leads to the following hypothesis:

H_4: *Business process performance impact of ERP systems are positively related to the organizational-level performance.*

Control Variables:

We include the firm size and ERP systems sophistication constructs as control variables in the research model to discount rival hypotheses that relate to firm-specific factors driving the performance impact of ERP systems at business processes and organizational levels.

Firm size is used in prior IS literature to proxy for the size of the organization resource base that can enhance ERP performance (Zhu 2004; Subramani 2004). Large firms are more able to invest speculatively in different ERP systems supporting activities and resources such as employee training (Chatterjee et al. 2002; Subramani 2004). We use the logarithm of the total assets as the proxy for firm size (Melville et al. 2004).

ERP systems sophistication is included in the research model to capture the level of organization's deployment of ERP systems modules. Organizations that implement more ERP systems module may have a better chance to achieve business value. This is because increased ERP systems models will support a larger proportion of the business processes (Armstrong and Sambamurthy 1999). We use the number of ERP systems modules implemented by the organization (e.g. financial, HR, and inventory management.) to capture the level of ERP systems sophistication.

Research design

Data was gathered through a large survey that targeted 421 Chinese companies that are listed in Shanghai and Shenzhen Stock Exchanges, which have adopted ERP systems between 1999 and 2007. Multiple responses were solicited from each organization at different managerial levels including CFO, CIO and ERP systems users. This strategy enabled the collection of rich data while eliminating biased responses (Huber and Power 1985; Sethi and King 1994). 215 responses were received from 65 organizations to realize a response rate of 15%. The average response of the multiple responses is used to represent the organization.[1] An ANOVA test was conducted to test for non-response bias. Early and late responses were compared in paired samples of 10 and 20 responses. The results show that there were no significant differences ($p < .05$) on any of the variables of the study. We also conducted Harman's one-factor common method test (Podsakoff & Organ, 1986). The results show neither a single factor emerged from the exploratory factor analysis nor did one general factor account for the majority of the variance in the measurement items used in the model.

Table 1 displays the descriptive statistics of 65 companies that responded to the survey. The surveyed companies are medium to large enterprises with a

[1] Following Armstrong and Sambumurthy 1999, we used correlations among the responses of multiple respondents on the main constructs of the study to test for consistency among respondents of the same organization. The results show that all the correlations are positive and significant at the 1% level of significance.

mean of 988 million Yuan in total assets. More than 50% of respondents' age fall between 36-45 and about 50% of the respondents have 11-15 years of work experience.

Operationalization of the Constructs:

Organizational Performance is a high-order construct which refers to overall firm performance which is captured at the financial and non-financial dimensions. 18 items were adapted from prior studies to measure these two dimensions whereby ten items relate to financial and eight items to non-financial dimensions (Shang and Seddon 2000; Kaplan and Norton 1992; Melville et al. 2004; and Mukhopadhyay and Kekre 2002). The confirmatory factor analysis (CFA) test supports the use of 12 items, six of them loads on non-financial dimension and the remaining six items loads on the financial dimensions of firm performance. The measurement items for the organizational performance measure are reported in Appendix A.

Business processes performance of ERP systems refers to the performance outcome of ERP systems at the business process level that is attributable to the contribution of the systems to enable the BPR. Business process performance is operationalized as a second-order construct using eight items that capture two dimensions of BPR benefits, *cost rationalization* and *work restructure* (Lawler et al. 2001; Ramirez et al. 2010). The CFA supports the use of seven items, three for cost rationalization and four for work restructuring. (See Appendix A).

ERP systems competences refer to a portfolio of managerial and technical skills and expertise that are necessary for enabling the deployment of ERP systems to enhance the business process of the organization (Stratman and Ruth 2002). ERP systems competences are conceptualized as a high-order construct with two second-order dimensions that are proposed by Stratman and Roth (2002) : (1) ERP systems technical competences, which are measured with 40 items that capture the following four first-order dimensions of technical competences: ERP training, IT skills, strategic ERP planning, and executives commitment; (2) ERP systems human competences, which are measured with 39 items that capture four first-first order dimensions human competences: business process skills, learning, change readiness, and project management. Consistent with prior studies (e.g. Elbashir et al. 2011) we created four composite variables for each of the two ERP systems competences by averaging the respondents' score for each of the four dimensions of the two ERP competences. The measurement items of the ERP systems technical and human competences are reported in Appendix A.

The initial draft of the measurement items included in the instrument was validated using feedback and comments received from a group of ERP experts who work at a leading ERP software company in Asia-Pacific region. This was followed by a pilot test that was conducted with ten senior executives including financial managers and CIOs who were asked to answer the survey and comment on its content and structure. The feedback at the pilot test stage was incorporated in the final draft of the survey. The final list of the measurement items are shown in Appendix A. The final survey version was translated into Chinese (Mandarin) language using expert translator. To ensure the accuracy of the translation, the Chinese-translated version of the survey was retranslated by another expert to English. Then, the translated version was compared with the original English version. The results of the comparison show no difference between the meanings of the same questions in the two versions of the survey.

Data Analysis and Results

Partial Least Square (PLS) was used to test the properties of the scales used to measure the constructs (measurement model) and examine the strength of the relations between the constructs (structural model). PLS is the most suitable structural equation modeling (SEM) technique compared to other SEM techniques such as LISREL. This is due to the small sample size used in this study and the formative constructs tested in the research model (Gefen et al. 2000; Chin et al. 2003).[2] The bootstrap resampling method (1000 samples) in PLS was used to estimate the t-value, which determines the significance of the path coefficients.

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[2] We have tested for possible multicollinearity in relation to the measurement items of the formative constructs (technical and human). The variance inflation factor (VIF) scores for the items of the formative measures are between 2 and 4 which are within the acceptable range (Petter et al. 2007). These results indicate that multicollenarity does not represent any major threat to the validity of results reported in this study.

Properties of the Measurement Model

Multiple tests, suggested in prior studies, were performed to assess the construct validity and reliability (Churchill 1979; Straub 1989). The output from PLS in relation to the measurement model was used to examine the properties of the measures including internal consistency and the convergent and discriminant validity of the measurement items. Items that loaded 60% or above were retained in the measurement model (Hulland 1999). We use the indicator weight rather than loading to test the formative construct validity.

Reliability refers to the extent to which the measurement items used are consistent in what they intend to measure (Straub 1989; Hulland 1999; Zhu and Kraemer 2002). Table 2 shows the composite reliability for all constructs are above the cut-off of 0.70 (Nunnally 1978). This indicates that all the constructs measures have very good reliability (DeVellis 1991).

Content validity: The construct measures used in the study are supported by the prior literature and represent the domains that they were intended to measure (Carmines and Zeller 1979). Subsequent tests including a pilot test that used peers and experts' opinion were conducted to add to the confidence the researchers placed on the content validity of the measures.

Convergent validity examines whether measures that should be related are related (Hair et al. 1998). Item loading together with the average variance extracted (AVE) were used in the study to examine the convergent validity of the constructs that are measured with reflective items (Straub 1989). Table 1 shows that all the items have significant loadings, which indicate their significant contribution to the measured construct. Moreover, AVE for all the constructs are above 0.50 which demonstrates the convergent validity of the measurement items (Fornell and Larcker 1981). This also indicates that each of the measured constructs explain more than 0.50 of the variation in the observed variables.

[Insert Table 2: Individual item loadings, composite reliability, average variance extracted (AVE) statistics.]

Discriminant validity examines the relationship between measures of similar and different constructs to provide more evidence that the scales used are measuring distinct constructs. Table 3 shows that the values of the square root of the AVE (on the diagonal) are all greater than the inter-construct correlations (off the diagonal). This demonstrates that the measures exhibit satisfactory discriminant validity.

[Insert Table 3: Inter-Construct Correlations and Square Root of EVA Statistics]

An additional test of discriminant validity was also conducted in this study. All measurement items were assessed to ensure that each measurement item has a higher loading on its assigned factor than on the other factors (Chin 1998; Gefen et al. 2000). The results are presented in Table 4. Each of the measurement items loaded higher on the appropriate construct than on the other constructs (Chin 1998; Gefen et al. 2000). These results provide further support for the adequacy of discriminant validity of the measures used in this study.

[Insert Table 4: Measurement Items Loading and Cross-loading]

Results:

The test of the structural model involves estimating the path coefficients that link between the latent variables under investigation and R^2, which represents the amount of the variation in the dependent variables that is explained by the independent variables (Wixom and Watson 2001). Overall, the result suggests the model has good predictability. The coefficients for all paths between the constructs tested in the model are significant and above 0.21. The results also indicate that 67% of the variance in organizational performance and, 50% of the variance in business process performance are explained by the model.

[Insert Figure 3: Path Coefficients and R^2 Values of the Structural Model of ERP systems Payoff]

Significance of the Control Variables:

The results regarding the control variables are summarized in Panel B of Table 5. Surprisingly none of the control variables are significantly related to business process or organizational performance. In particular, the result fails to support the theoretical argument of prior IT payoff studies that firm size and the level of IT sophistication enhance organizational performance. One plausible explanation is that the effect of firm size and the level of IT sophistication are better captured by ERP systems competences that are included in the model.

[Insert Table 5: Panel B: Control Variables]

Hypothesis testing:

Hypotheses were tested within the structural equation model shown in Figure 1 based on the magnitude and significance of path coefficients estimated using PLS. The hypothesis that posit the complementarity between technical and IT resources was tested by using the incremental change in R^2 due to the introduction of the interaction term in addition to the magnitude of the interaction term's path (Zhu 2004).

In H_1 and H_2, we predict that the ERP systems technical and human competences will be positively associated with the business process performance. The results shown in Figure 2 and Table 5 support the two hypotheses with strong and significant direct relationships. The coefficients of the structural path were 0.21 ($p < .0.05$) and 0.34 ($p < .0.01$), respectively. This result supports the theorization that improvement in ERP systems technical and human competences, have a positive influence on the business processes performance.

In H_3, we predict that the complementarity between ERP systems technical and human competences is positively associated with the business process performance. The basic premise underlying the research model is that the research model with the complementarity between technical and human competencies is superior to the alternative research model without the complementarity. We tested the two models and compared the results (Table 6). As shown by the increase in R^2, our research model using the Complementarity has superior predictive value of business process performance when compared to the models that only capture the main effects of the two ERP systems competences separately. The magnitude of the relationship between the complementarity and business process performance provides further evidence of the importance of dually developing technical and human competences in order to leverage the value of ERP systems at the business process level. The variance explained in the business process performance construct as the result of the introduction of the interaction term has increased by 13% (from 37% to 50%), while the coefficient of the structural paths leading from the Complementarity to business process performance was 0.38. This result supports the theorization that the strength of the Complementarity has a positive influence on the business processes performance.

H_4, examines whether business process performance impacts organizational performance. The results shown in Figure 2 and Table 5 support H_4 (0.81, $p <$

0.001). These findings support the theorization that improvements in business process performance translate into improved organizational performance.

[Insert Table 5: Panel A: Summary of Hypotheses Test Results]

Following the test for the direct effects in our model, we examined the indirect effect of the ERP systems competences on organizational performance via business process performance. As noted in the theory section, the business process performance is viewed as being driven by the level of the ERP systems competences that the organizations build over time. We estimate the path coefficients of the indirect effects using the product term of the coefficients of the associated direct paths. We used bootstrap procedures to construct 95 percent ($p < 0.05$) confidence intervals for testing the significance of the indirect effects (Hayes 2009). The indirect effects and total effects are reported in Table 7.

The results show that the technical competences indirectly affect organizational performance through business process performance (0.17, $p < 0.05$). The human competences are also significantly indirectly related to organizational performance through business process performance (0.28, $p < 0.05$). These results indicate that ERP systems competences contribute directly to the business process performance and indirectly to organizational performance.

We also conducted the mediation test suggested by Baron and Kenny (1986) to examine whether business process mediates the relation between the two ERP competences and organizational performance.[3] The results of the tests indicate that the business process performance fully mediates the relations between ERP systems technical and human competences and organizational performance.

Discussion, Conclusion and Implications

This study aims to improve our understanding on how ERP systems resources promote firm performance. The study synthesizes perspectives from the process-oriented and resource-based view literature in order to propose and test an integrated research model of the business value of ERP systems. Drawing on the process-oriented view, the study posits that business process performance is an important stage towards achieving enhanced organizational performance. The empirical data provided a strong support for the hypotheses suggested in the research model.

We hypothesized that ERP systems competences represented by technical and human competences are important antecedents of ERP business value. Our

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[3] We followed the four steps suggested by Baron and Kenny (1986) to test the extent to which business process performance mediates the relation between the two ERP systems competences and organizational performance: (1) Test that ERP systems competences predicts organizational performance. (2) Test that ERP systems competences predicts business process performance. (3) Test that ERP systems competences and business process performance are simultaneously predict organizational performance. (4) Test that business process performance mediates (completely or partially) the relation between ERP competences and organizational performance.

path analysis results show that both ERP technical and human resources directly relate to business process performance and indirectly affect organizational performance through business process performance. The findings imply that developing ERP competences is a resource-intense, path-dependent process that requires skilled personnel as well as a wide range of relevant IT components. The result of this study suggests that organizations that have developed ERP competences will have the necessary ERP resource foundations that will enable them to exploit the implemented ERP systems in their business strategies and activities. ERP technical and human competences are found to have a significant impact on business process and organizational performance.

This study makes several contributions. First, the study represents an important attempt to open the "black box" of ERP systems investments and understand the mechanisms through which ERP systems create business value. A large number of studies have investigated the relation between ERP systems investments and ERP systems payoff. However, when it comes to the question of how organizations create such value from ERP systems, the literature falls short. Therefore, a theory explaining how investments in ERP systems can be turned into organizational performance is an outstanding challenge to the AIS community. The resulting analysis presented in this study serves to explain why some organizations are able to leverage their ERP systems investments and generate a higher competitive advantage than others.

Business process performance related to BPR, which has not been examined adequately in prior literature, is found to be a major driver of organizational performance. This finding suggests future ERP systems payoff studies should capture the BPR and business process performance in the research model. Second, the study provides evidence that ERP technical and human competences are important antecedents for the successful deployment of ERP systems. In order to further enhance ERP systems performance, organizations need to develop these competencies and create a synergy between these resources. Third, despite the growing literature of the business value of ERP systems, there is a dearth of research that tests the link between the business process and organizational performance of ERP systems. This study links the two performance outcomes by examining a research model that predicts a relation between the business process performance impact of ERP systems and organizational performance. In doing so, the study argues that acquiring and developing high quality ERP systems software applications is not necessarily sufficient for organizations to create business value (Mata et al. 1995; Carr 2003). Business value from ERP systems is determined by the business process performance impact that organization accrue from using these systems (Parsons 1983; Porter and Millar 1985; Armstrong and Sambamurthy 1999; Piccoli and Ives 2005).

Finally, the study provides some insights regarding the claim that "IT Doesn't Matter" (Carr 2003) that was made in prior IT payoff studies. Failing to differentiate between ERP systems and ERP competences, which represent the organization's ability to exploit ERP systems, is a fundamental flaw that may lead businesses to make the erroneous conclusion that "IT doesn't matter". Developing high quality ERP competences is path dependent and takes a longer time. Therefore, organizations should continue investing in ERP competences, including technical and managerial knowledge and skills that convert ERP systems investments into capabilities that are fundamental for successful business strategies.

Limitations

The findings of this study should be considered in the light of its inherent limitations. First, the findings are based on self-reported data, which may be subject to common method variance or potential respondent "self-selection" bias. However, the multiple tests (reliability and CFA) and the good psychometric properties reported in the study support the validity of the results. Moreover, capturing data from multiple respondents of the same organization may be viewed as offsetting any respondents' bias. Prior studies also found that senior and middle managers' perception to be a good proxy for organizational performance (Dess and Robinson 1984; Mahmood and Soon 1991; Sethi and King 1994; Tallon et al. 2000; Zhuang and Lederer 2003). Future research can extend this study by using archival data instead of survey data, time series data, objective performance measures, quantifying the organizational structure and culture changed as the result of the ERP implementation, and adopting a field or case study methodology.

Second, the model suggests causal relations and multistage (i.e. process performance, and then organizational performance) while using cross sectional data which only allows testing the association between the variables of the research model. As the study attempts to understand a complex phenomenon in a natural setting and generalize the findings, the experimental method may not be the best option. Future research should consider using longitudinal data.

Third, the study did not capture the size of organizations' investments in ERP systems which could have some influence on the level of organizational performance impact of ERP systems. However, the study includes a control variable to capture the number of ERP modules used by the firm, which can represent the level of the organizations' maturity with ERP systems and the level of investment.

Fourth, the study did not control for factors that may moderate the relation between business processes benefits and organizational performance such as competitive response and environmental change. This is an area for future research.

In summary, the empirical results reported in this study provide explanations for some of the inconsistencies in the findings reported in prior ERP payoff studies. The study clearly differentiates between ERP infrastructure as the

ERP foundation and ERP competences that enable the deployment of the ERP infrastructure to support business process and functions. The result shows that business process performance is an important variable, and when included the explanatory power of the model increase significantly. The findings also demonstrate a positive indirect relation between ERP competences and organizational performance via business process performance.

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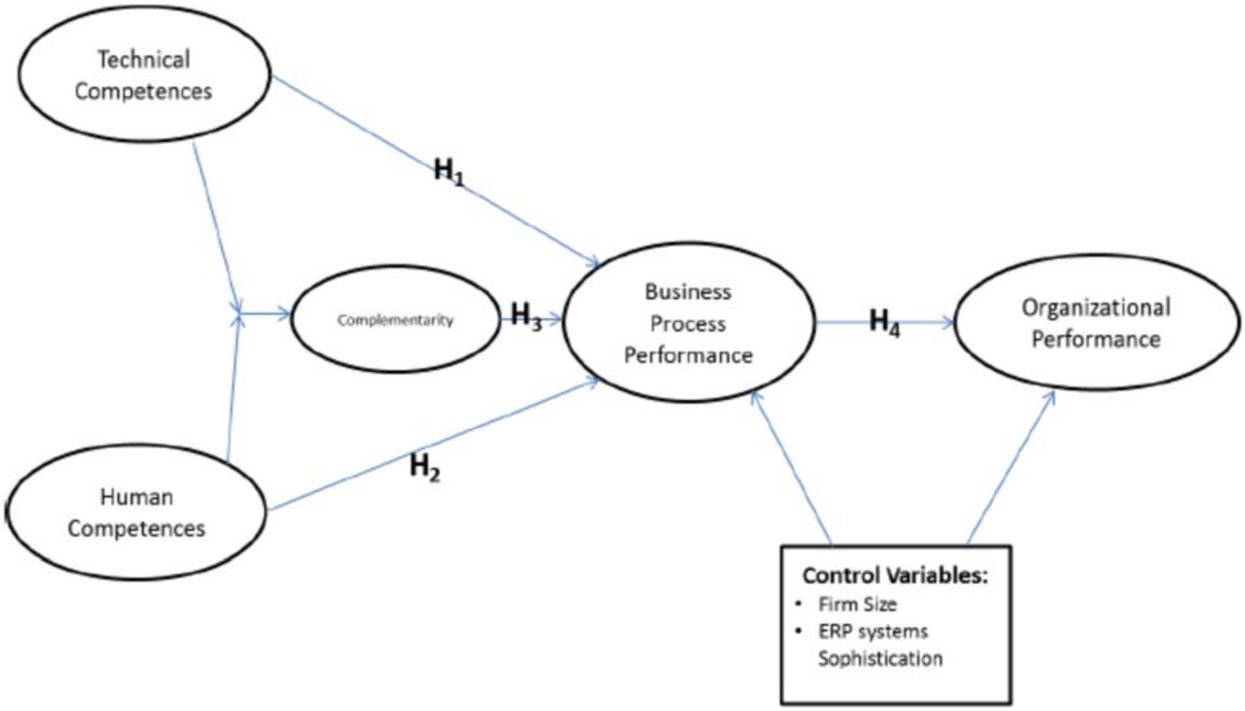

Figure 1: The conceptual Model

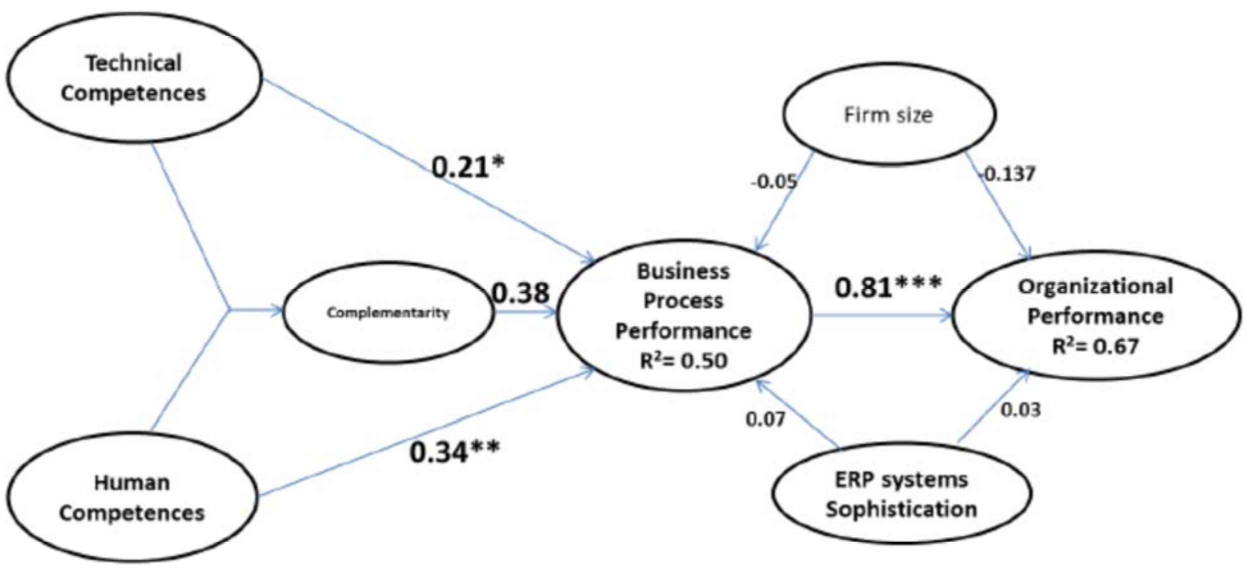

Figure 2: Path Coefficients and R^2 Values of the Structural Model of ERP systems Pay-off

Table 1: The questionnaire and descriptive statistics (65 listed companies)

Initial issue				Measurement	
ERP Software Category (based on UFIDA classification)					
Financial Accounting				65 (100%)	
Management Accounting				13 (20%)	
Supply Chain Management (SCM)				21 (32.31%)	
Customer Relationship Management (CRM)				12 (18.46%)	
Manufacturing and product management				16 (24.62%)	
Human Resource Management (HRM)				13 (20%)	
Office automation (OA)				26 (40%)	
Decision Support System				4 (6.16%)	
Group Management				7 (10.76%)	
Internet sales				4 (6.15%)	
Enterprise Application Integration				5 (7.70%)	
	N	Mean	Std.	Min	Max
Total assets (Yuan in Million)	65	988.10	849.33	106.33	2354.34
Age*	215	2.49	0.59	1	3
Less than 25 years old	10(4.7%)				
26-35 years old	87(41.3%)				
36-45 years old	116(54%)				
Work Experience **	215	2.56	0.91	1	4
Less than 5 years	36(16.7%)				
6-10 years	49(22.8%)				
11-15 years	105(48.4%)				
More than 15 years	28(12.1%)				

* On the questionnaire, Age = 1, if younger than 25 years old, = 2 if aged 26 to 35 years old, = 3 if aged 36 to 45 years old.

** On the questionnaire, Work experience = 1, if less than 5 years, = 2, if 6 to 10 years = 3, if 11 to 15 years, = 4 if more than 15 years.

Table 2: Individual item loadings, composite reliability, average variance extracted (AVE) statistics.

Measurement Items	Loading	Standard Error	*T*-Statistics
Dimensions of Firm performance			
1. The Financial Dimension of Firm Performance: (Composite Reliability = 0.91, AV E = 0.62)			
PEFI1: Operating income	0.819	0.044	18.602
PEFI2: Sales growth rate	0.790	0.049	16.047
PEFI3: Return on investment (ROI)	0.854	0.029	29.533
PEFI4: Return on assets (ROA)	0.811	0.056	14.397
PEFI5: Operating return on assets (OIA)	0.761	0.062	12.236
PEFI8: Selling, general and administrative expenses over sales (SGAS)	0.662	0.080	8.279

2. The Non-Financial Dimension of Firm Performance: (Composite Reliability = 0.86, AV E = 0.52)			
PENF2: Ratio of good output to total output at each production process	0.658	0.082	8.066
PENF3: Manufacturing lead time	0.750	0.061	12.197
PENF4: Rate of material scrap loss	0.835	0.041	20.370
PENF5: Labor efficiency variance	0.762	0.051	15.065
PENF6: Number of new patents	0.633	0.124	5.099
PENF10: Personnel development	0.648	0.080	8.114
Dimensions of Business Process Performance			
1. Work restructure Benefits: (Composite Reliability = 0.89, AV E = 0.66)			
PEBP1: Process simplification	0.770	0.063	12.182
PEBP2: improve the coordination among different units of the firm	0.856	0.032	26.867

PEBP3: Major information system redesign	0.831	0.040	21.042
PEBP4: Enriched multi-skilled individual jobs	0.798	0.044	18.295
2. Cost rationalization Benefits: (Composite Reliability = 0.81, AV E = 0.59)			
PEBP5: The efficiency and productivity of business processes	0.793	0.058	13.713
PEBP6: Doing the same work with fewer	0.761	0.053	14.490
PEBP7: Doing the same work with less supervision	0.754	0.067	11.192

Dimensions of ERP Systems Competences

A. Human Competences: (Formative measures)			
	Weight	Standard error	T-statistics
1. ProMgt: Project management	0.226	0.230	0.982
2. BPSkills: Business process skills	0.403	0.263	1.533
3. **Learn:** learning	0.116	0.179	0.645
4. ChangeRead: change readiness	0.863	0.100	8.662
B. Technical Competences: (Formative measure)			
	Weight	Standard	T-
1. Train: Training	0.308	0.214	1.440
2. ITSkills: IT skills	0.948	0.084	11.282
3. StratItPlan: Strategic IT planning	0.484	0.201	2.412
4. ExecutCom: Executive commitment	0.465	0.187	2.490

Table 3: Inter-Construct Correlations and Square Root of Average Variance Extracted statistics (n=65)

	1	2	3	4
1. Financial	**0.79**			
2. Non-financial	0.69	**0.72**		
3. Cost rationalization	0.70	0.71	**0.77**	
4. Work restructure	0.70	0.69	0.73	**0.81**

a Diagonal elements are the square roots of the average variance extracted statistics. Off-diagonal elements are the correlations between the latent variables calculated in PLS.

Table 4: Measurement Items loading and cross-loading

	Financial	Non-financial	Work restructure	Cost rationalizati
PEFI1	**0.819**	0.564	0.537	0.655
PEFI2	**0.790**	0.488	0.477	0.445
PEFI3	**0.854**	0.557	0.540	0.575
PEFI4	**0.811**	0.638	0.553	0.504
PEFI5	**0.761**	0.494	0.570	0.566
PEFI8	**0.662**	0.522	0.662	0.580
PENF2	0.493	**0.658**	0.536	0.623
PENF3	0.413	**0.750**	0.544	0.562
PENF4	0.547	**0.835**	0.540	0.607
PENF5	0.557	**0.762**	0.536	0.466
PENF6	0.460	**0.633**	0.389	0.354
PEBP1	0.545	0.512	**0.770**	0.601
PEBP2	0.629	0.598	**0.856**	0.614
PEBP3	0.622	0.554	**0.831**	0.576
PEBP4	0.486	0.585	**0.798**	0.589
PEBP5	0.544	0.540	0.509	**0.793**
PEBP6	0.614	0.628	0.614	**0.761**
PEBP7	0.460	0.453	0.557	**0.754**

Table 5: Path Coefficients – Test Variables

Panel A: Path/Hypothesis	**Path Coefficient**	**T- value**
ERP Technical Competences ---> Process Performance	0.209	1.892*
ERP Human Competences --- -> Process Performance	0.343	3.189**
Business Process Performance ----> Organizational Performance	0.810	16.393***
Panel B: Control Variables		
Firm size ---> Business Process Performance	-0.051	0.542
Firm size ---> Organizational Performance	-0.137	1.740
ERP Sophistication ---> Business Process Performance	0.069	0.745
ERP Sophistication ---> Organizational Performance	0.026	0.324

* Indicates that the coefficient is significant at the $p < .05$
** Indicates that the coefficient is significant at the $p <. 01$
*** Indicates that the coefficient is significant at the $p <. 001$

Table 6: test of the complementarity

		Business Process Performance	
Model	**Independent Variable**	**Coefficient**	R^2
Model 1:			37%
	Human competences	0.43	
	Technical competences	0.27	
Model 2: (Figure 2)			50%
	Human competences	0.34	
	Technical competences	0.21	
	Complementarity	0.38	
Increase in R^2 Model 1 vs. Model 2			13%

Table 7: Indirect Effects and 95% Bootstrap Confidence Interval

ERP human competences -----> Business process performance -----> organizational performance	0.28 (-0.085 - 0.455)
ERP technical -----> Business process performance -----> organizational performance	0.17 (-0.103 – 0.433)

Appendix A

Please indicate the extent to which you agree or disagree with each of the following statements by circling the relevant number (1= strongly disagree and 7 = strongly agree):

Technical ERP Resources:

Strategic IT Planning

1. We constantly review our IT capabilities against strategic goals.	1	2	3	4	5	6	7
2. IT plans are redesigned as required to meet evolving conditions.	1	2	3	4	5	6	7
3. Strategic IT planning is a continuous process.	1	2	3	4	5	6	7
4. Written guidelines exist to structure strategic IT planning in our organization.	1	2	3	4	5	6	7
5. Top management is not involved in strategic IT planning. (reversed coded)	1	2	3	4	5	6	7
6. Strategic IT planning includes inputs from all functional areas.	1	2	3	4	5	6	7
7. The business impact of proposed ERP system changes is not evaluated against strategic goals.	1	2	3	4	5	6	7
8. IT plans for functional areas are driven by the overall ERP Entity IT plan	1	2	3	4	5	6	7
9. IT planning is driven by the ERP Entity`s strategic business plan.	1	2	3	4	5	6	7

Executive Commitment

1. Functional managers willingly assign resources to the ERP project as they are needed.	1	2	3	4	5	6	7
2. The need for long-term ERP support resources is recognized by management.	1	2	3	4	5	6	7
3. Executive management is enthusiastic about the possibilities of ERP.	1	2	3	4	5	6	7
4. Executives have invested the time needed to understand how ERP will benefit the enterprise.	1	2	3	4	5	6	7
5. Executives mandate that ERP requirements have priority over unique functional concerns.	1	2	3	4	5	6	7
6. Top management has clearly defined commitments. the ERP Entity's business goals.	1	2	3	4	5	6	7

7. All levels of management support the overall goals of the ERP Entity.	1	2	3	4	5	6	7
8. Employees who support the ERP project are distracted by other commitments.	1	2	3	4	5	6	7

IT Skills

1. The internal IT staff have the ability to conduct routine ERP system maintenance.	1	2	3	4	5	6	7
2. There is a high degree of technical expertise in the IT organization.	1	2	3	4	5	6	7
3. The database administrator is an expert in the ERP database management system.	1	2	3	4	5	6	7
4. Internal IT team members understand custom ERP software programs.	1	2	3	4	5	6	7
5. The IT staff are able to efficiently implement ERP system upgrades.	1	2	3	4	5	6	7
6. The IT staff have the technical ability to conducta formal validation of all system changes.	1	2	3	4	5	6	7
7. IT staff are able to analyze the technical impact of proposed system changes.	1	2	3	4	5	6	7
8. The IT staff actively builds relationships with business managers.	1	2	3	4	5	6	7
9. IT staff offer ideas on how IT can be used to achieve business goals.	1	2	3	4	5	6	7
10. IT staff communicate with functional use groups in the ERP Entity.	1	2	3	4	5	6	7
11. The IT organization provides a service to the business.	1	2	3	4	5	6	7
12. IT project members have limited ERP software expertise.	1	2	3	4	5	6	7
13. IT staff are not responsive to the needs of business managers.	1	2	3	4	5	6	7

ERP Training

1. Specific user training needs were identified early in the implementation.	1	2	3	4	5	6	7
2. A formal training program has been developed to meet the requirements of ERP system users.	1	2	3	4	5	6	7

3. Training materials have been customized for each specific job.	1	2	3	4	5	6	7
4. We seldom update training materials to reflect system changes.	1	2	3	4	5	6	7
5. Training materials target the entire business task, not just the ERP screens and reports.	1	2	3	4	5	6	7
6. Employees are tracked to ensure that they have received the appropriate ERP system training.	1	2	3	4	5	6	7
7. All users have been trained in basic ERP system skills.	1	2	3	4	5	6	7
8. ERP system training review sessions are scheduled.	1	2	3	4	5	6	7
9. The training needs of each user group have not been identified.	1	2	3	4	5	6	7
10. Training is conducted by consultants.	1	2	3	4	5	6	7

Human ERP Resources:

Business Process Skills

1. There is a high level of business process knowledge within the ERP Entity.	1	2	3	4	5	6	7
2. Employees understand how their actions impact the operations of other functional areas.	1	2	3	4	5	6	7
3. Employees understand how their daily business activities support the goals of the ERP Entity.	1	2	3	4	5	6	7
4. Managers are not clear on how ERP-focused business processes support the goals of the ERP Entity.	1	2	3	4	5	6	7
5. The operational processes of the ERP Entity are formally documented.	1	2	3	4	5	6	7
6. Our ERP Entity's business process documentation reflects actual operational activities.	1	2	3	4	5	6	7
7. Functional managers are able to document cross-functional business process flows.	1	2	3	4	5	6	7
8. Business process design is driven by customer requirements.	1	2	3	4	5	6	7
9. Managers are skilled at analyzing business processes for customer benefits.	1	2	3	4	5	6	7

Learning

1.	Benchmarking is used to identify cutting-edge ERP techniques.	1	2	3	4	5	6	7
2.	We keep track of ERP developments related to our industry.	1	2	3	4	5	6	7
3.	Cross-functional groups meet regularly to discuss new uses for the ERP system.	1	2	3	4	5	6	7
4.	Internal groups meet regularly to share new methods of using the ERP system.	1	2	3	4	5	6	7
5.	ERP improvement suggestions are regularly collected from multiple employee levels.	1	2	3	4	5	6	7
6.	Business experiments are conducted to evaluate potential improvements in the way we use ERP.	1	2	3	4	5	6	7
7.	ERP experimentation is encouraged even if the proposed improvement is unsuccessful.	1	2	3	4	5	6	7
8.	External ERP experts are invited to suggest better ways to use the ERP system.	1	2	3	4	5	6	7
9.	Users are discouraged from exploring alternative methods of using ERP to generate business value.	1	2	3	4	5	6	7
10.	The potential customer benefit of new ERP techniques is not formally evaluated.	1	2	3	4	5	6	7

Change Readiness

1.	Employees understand how they fit into the new ERP Entity.	1	2	3	4	5	6	7
2.	Employees have input into how their jobs will change with new ERP business processes.	1	2	3	4	5	6	7
3.	Management actively works to alleviate employee concerns about ERP.	1	2	3	4	5	6	7
4.	An ERP support group is available to answer concerns about ERP job changes.	1	2	3	4	5	6	7
5.	The roles of all employees under the ERP system have been clearly communicated.	1	2	3	4	5	6	7
6.	The change readiness of employees impacted by the ERP system is regularly assessed.	1	2	3	4	5	6	7
7.	Employees are not prepared for a series of ERP-related changes as the system evolves.	1	2	3	4	5	6	7
8.	ERP-focused changes to the employee reward system have been communicated.	1	2	3	4	5	6	7
9.	Employees recognize the need for organizational change.	1	2	3	4	5	6	7

Project Management

1. The tasks to be performed during the ERP project are clearly de	1	2	3	4	5	6	7
2. The responsibilities of project team members are clearly definec	1	2	3	4	5	6	7
3. There is a formal management process to track external cc activities.	1	2	3	4	5	6	7
4. Problems found during reviews of external project members tracked to closure.	1	2	3	4	5	6	7
5. Measurements are used to determine the status of project tasks.	1	2	3	4	5	6	7
6. Project tasks are reviewed on a periodic basis.	1	2	3	4	5	6	7
7. The ERP project leader is able to track project tasks to completi	1	2	3	4	5	6	7
8. The ERP project leader is experienced in project management.	1	2	3	4	5	6	7
9. Project tasks are reviewed on an event-driven basis.	1	2	3	4	5	6	7
10. The relative priority of different categories of change requests documented.	1	2	3	4	5	6	7
11. Resources are assigned to ERP system change requests acco prioritization rules.	1	2	3	4	5	6	7
12. ERP project tasks are tracked against proposed business benefit	1	2	3	4	5	6	7

Business Process Performance

1. Process simplification	1	2	3	4	5	6	7
2. improve the coordination among different units of the firm	1	2	3	4	5	6	7
3. Major information system redesign	1	2	3	4	5	6	7
4. Enriched multi-skilled individual jobs	1	2	3	4	5	6	7
5. The efficiency and productivity of business processes	1	2	3	4	5	6	7
6. Doing the same work with fewer people	1	2	3	4	5	6	7
7. Doing the same work with less supervision	1	2	3	4	5	6	7
8. A lower overall cost structure.	1	2	3	4	5	6	7

Non-financial performance							
1. Materials efficiency variance	1	2	3	4	5	6	7
2. Ratio of good output to total output at each production process	1	2	3	4	5	6	7
3. Manufacturing lead time	1	2	3	4	5	6	7
4. Rate of material scrap loss	1	2	3	4	5	6	7
5. Labor efficiency variance	1	2	3	4	5	6	7
6. Number of new patents	1	2	3	4	5	6	7
7. Number of new products launches	1	2	3	4	5	6	7
8. Time-to-market new products	1	2	3	4	5	6	7
9. Employee satisfaction	1	2	3	4	5	6	7
10. Personnel development	1	2	3	4	5	6	7

Financial performance							
1. Operating income	1	2	3	4	5	6	7
2. Sales growth rate	1	2	3	4	5	6	7
3. Return on investment (ROI)	1	2	3	4	5	6	7
4. Return on assets (ROA)	1	2	3	4	5	6	7
5. Operating return on assets (OIA)	1	2	3	4	5	6	7
6. Cash flow from operation	1	2	3	4	5	6	7
7. Cost of goods sold divided by sales (CGSS)	1	2	3	4	5	6	7
8. Selling, general and administrative expenses over sales (SGAS)	1	2	3	4	5	6	7

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FAMILY FIRM AND BOARD COMPOSITION – EVIDENCE FROM TAIWAN

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Boards of directors play an important role in the corporate governance mechanisms of publicly listed companies. Existing empirical studies on corporate boards of directors have focused primarily on large U.S. and U.K. firms with dispersed ownership and have closely examined the relationship between managerial ownership and board composition (Lasfer, 2006). In contrast to widely held firms, family firms tend to hold a concentrated ownership structure, which can lead to a particular type of agency problem. The different agency environment in family firms suggest that it is important to study whether and how family-controlled ownership influences board composition.

One characteristic of widely held firms is the separation of ownership and control, which gives rise to agency conflicts, namely principal-agent conflicts between the interests of owners (principals) and managers (agents) (Jensen & Meckling, 1976). Because professional managers do not bear a significant share of the financial effects of their decisions, managers have incentives to take actions contrary to stockholders' interests (Fama & Jensen, 1983). In listed family-controlled firms, concentrated family ownership reduces traditional owner-manager conflicts because "the family's wealth is so closely linked to firm welfare, families may have strong incentives to monitor managers and minimize the free-riding problem inherent with small, diffused shareholders" (Anderson & Reeb, 2003: 1305). However, concentrated ownership has led to the development of a new agency conflict between minority shareholders and the controlling owners, generally referred to as principal-principal conflicts. Because the interests of controlling and minority shareholders are not closely aligned, controlling shareholders are perceived to have strong opportunistic incentives to expropriate wealth from minority shareholders by making decisions that maximize their personal interests (Anderson & Reeb, 2003). Thus, in family firms, corporate boards could play an important role in limiting the power of controlling shareholders to expropriate the interests of minority shareholders by scrutinizing important decisions (Yeh & Woidtke, 2005).

Although family-controlled firms exist in developed countries, they are not as common as in East Asian countries, including Taiwan. As Young et al. (2008) point out, principal-principal conflicts are characterized by extensive family ownership and control, poor institutional protection of minority shareholders, and weak governance' environment. Hence, controlling owners have greater incentives to influence firms' decision making in Taiwan due to its relatively high concentration of ownership, weak legal systems, and abundance of family firms. In such instances, board composition may also be influenced by controlling shareholders (Yeh & Woidkte, 2005). Shyu and Lee (2009) find that in Taiwanese listed firms, an average of 71% of board members are controlled by a family group. Therefore, Taiwan provides an ideal setting for examining the effect of family ownership on board composition in an institutional environment that differs noticeably from its counterpart in developed countries.

Further, It will be investigated the extent to which an external monitoring mechanism—namely, institutional shareholders—impacts board composition. When institutional shareholders are block-holders with relatively large equity stakes, they have the capacity to influence managerial decisions and actions (Yoshikawa & Rasheed, 2010). Mak and Li (2001) argue that institutional shareholding can reduce the likelihood of expropriation by family owners through improvements in board composition. Additionally, since the dependent variable "outsider proportion" is disproportionally clustered around selected values, this study differs from most previous studies in that an ordered-probit regression model will be used to examine the relationship between corporate ownership and board composition. As a result, the results can provide insight into the differential impact of the external and internal structure of corporate ownership in Taiwan on board composition.

Hypothesis 1: Family ownership is negatively associated with the proportion of outside directors on the board.

Hypothesis2: Institutional ownership is positively associated with the proportion of outside directors on the board.

Data and Sample:

The empirical analysis is conducted using corporate data on all companies listed on the Taiwan Stock Exchange from 2005 to 2012. Financial companies are excluded from this study, as the nature of corporate governance in financial companies differs from that in non-financial companies (Filatotchev et al., 2005). After removing observations with missing data, the final sample size is 1,271 firms and 7,919 firm-year observations. All the data are obtained from a database maintained by the Taiwan Economic Journal (TEJ), a leading credit analysis research agent. TEJ provides detailed and complete financial information on companies in Taiwan.

Dependent variables: The proportion of outsider directors and outside director ratings

As mentioned previously, this study adopts three models to examine the influence of corporate ownership structure on outside directors: the ordered-probit, fixed-effects, and random-effects regression models. Therefore, the dependent variable is defined in two ways. First, a continuous variable (%OUTDIR) is used to measure outside directors based on the percentage of outside directors to the total number of directors on the board.

Using a secondary variable (R_OUTDIR), firms will be further grouped into nine categories in terms of the proportion of outsider directors, and numerical values will be assigned to the nine categories in order to conduct an ordered-probit analysis.

Categories of outside directors are presented as:

The proportion of outside	Assigned rank
0.000- 0.100	1
0.101- 0.200	2
0.201- 0.300	3
0.301- 0.400	4
0.401- 0.500	5

0.501- 0.600	6
0.601- 0.700	7
0.701- 0.800	8
0.801- 1.000	9

The firms that have a proportion of outsider directors ranging from 0.801-1.000 are assigned a value of 9, 0.701- 0.800 of 8, 0.601- 0.700 of 7, 0.501- 0.600 of 6, 0.401- 0.500 of 5, 0.301- 0.400 of 4, 0.201- 0.300 of 3, 0.101- 0.200 of 2 and 0.000- 0.100 of 1.

Independent variables: Corporate ownership structure

Traditionally, corporate ownership has been operationalised along two dimensions: internal ownership (managerial ownership) and external ownership (institutional/block-holder ownership) (Mark & Li, 2001). Rather than taking the perspective of managers, this study focuses on family ownership as an internal ownership characteristic. Therefore, the corporate ownership structure investigated in this study includes family and institutional shareholding. Family ownership (FAMOWN) is measured by a numerical measure that indicates the percentage of common stock owned by family members, with a larger value indicating greater family interests in the firm. Institution ownership (INSOWN) is the percentage of shares that institutions own in the firm divided by the total number of outstanding shares.

Control variables:

To isolate the effects of test variables on the proportion of outside directors, several control variables based on the literature will be used. These control variables include firm size, return on assets, financial leverage, the operating cash flow, and sales growth. Firm size (SIZE) is the natural logarithm of total assets. Return on assets (ROA) is calculated as operating income divided by total assets. Financial leverage (LEV) is the ratio of financial liabilities to total assets. The operating cash flow (CFO) is defined as the cash flow from operations scaled by lagged total assets. Sales growth (SALEGR), measured as the year to year percentage change in total sales.

Research Method:

Iwasaki (2008) groups firms into nine categories based on the proportion of outside directors and define R_{it} to be the category of company i in year t. R_{it} is continuous, and its range is the set of real numbers. It presents the rank of %OUTDIR of a company. The ordered-probit model consists of two parts. The first part maps the outside director categories R_{it} into a partition of the unobserved linking variable R_{it}^* as follows:

$$R_{it} = \begin{cases} 1 & \text{if } R_{it}^* \le \mu_1 \\ j & \text{if } \mu_{j-1} < R_{it}^* \le \mu_j \quad \forall j \in J \\ 9 & \text{if } R_{it}^* \ge \mu_8 \end{cases}$$

Where $J = 1,2,3,4,5,6,7,8$. μ_r $r = 1,2,3,4,5,6,7,8$ are threshold variables that define the partitions of the range of R^*_{it} associated with each value of a rank and are independent of t.

The second part of the ordered-probit model relates R^*_{it}'s to the observed variables that measure the ownership structure variables of company i by means of a linear model.

$$R^*_{it} = \beta' X_{it-1} + \varepsilon_{it}$$

where β is the vector of slope coefficients of explanatory variables. X_{it} is vectors of observed explanatory variables measured at year t. The random variable ε_i is an unobserved error term with standard normal distribution and constant variance. Since the percentage of outsiders on the board and ownership structure determinations are simultaneous, modeling the relationship between the two can incur endogeneity problems if contemporaneous ownership structure and outside directors ratio are used. To control for endogeneity problems, the methodology of Harford et al. (2008) will be followed to examine whether the lagged value of the firm's %OUTDIR and governance variables are related to a firm's future %OUTDIR.

From the slope parameter and threshold estimates, it is relatively straightforward to calculate the probability of a company falling into in rank r. Given the cumulative normal function $\Phi(\beta' X)$, the probability of categorization for a company can be shown as below:

$$\Pr(R = r) = \begin{cases} \Phi(\mu_r - \beta' X) & \text{if } r = 1 \\ \Phi(\mu_r - \beta' X) - \Phi(\mu_{r-1} - \beta' X) & \text{if } r = 2,3,4,5,6,7,8 \\ 1 - \Phi(\mu_{r-1} - \beta' X) & \text{if } r = 9 \end{cases}$$

where $\beta' X$ is a set of specific values of X for the estimated coefficients β and the threshold values μ's. It could be detected the influence of governance variables on %OUTDIR by calculating the marginal effects of the explanatory variables on the probability of %OUTDIR. For example, the marginal effect of family ownership (FAMOWN) on the probability of rank 4 %OUTDIR is:

$$\frac{\partial \Pr(R = 4)}{\partial FAMOWN} = [\Phi(\mu_3 - \beta' X) - \Phi(\mu_4 - \beta' X)] \times \beta_2$$

Notice that the sum of the marginal effect equals zero.

Additionally, this study employs the fixed-effects and random-effects regression models to compare the results of the ordered-probit model. Consequently, An analysis reports fixed-effects, random-effects estimation to control for the endogenous problem and provides a comparison of the results of the ordered-probit regression model.

Work to be Done:

After the completion of a panel data analysis, the effects of ownership structure on the proportion of outside directors will be examined. Questions and answers will be elaborated and worked out on the following three tasks.

1. **Estimated results of fixed-effect, random-effect and ordered-probit models**
2. **Marginal effects of ordered-probit model**
3. **Impacts of family ownership on board composition of different models**

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Consumer social resources and value co-creation: an empirical study in education services

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Consumer role in value co-creation is recently an emerging theme in service research. In the contemporary networked economy, consumer social resources, specifically social capital and social identity, are opportunely suggested as the determinants of value co-creation. A survey study with SEM analysis of 334 consumers in 9 educational institutions shows 10 out of 11 hypotheses empirically supported. The findings reinforce that social capital and social identity, as operant resources, direclty influence consumer satisfaction and loyalty, and in an indirect way through value co-creation.
Keywords: *value co-creation, social capital, social identity, operant resources.*

1. Introduction

Service dominant logic (S-D logic), a mainstream in service literature, provides that consumer value co-creation is a fundamental way to create organizational competitive advantages (Prahalad & Ramaswamy, 2004), or to realise value propositions (Vargo & Lusch, 2008). Co-creation is essentially both networked and social (Vargo & Lusch, 2008), and often seen as the outcomes of the process of resource integration (Hilton et al, 2012) in which, customer operant resources is apparent (Vargo & Lusch, 2008).

In the modern business environment, service value is positioned in value networks that comprise various actors including service providers, customers, potential customers and other stakeholders. The value networks in turn, on one hand, are often based on the vast social networks supported by modern information and communication infrastructures (Lusch et al, 2010), and, on the other hand, strongly depend on the roles of social actors (Vargo & Lusch, 2008).

Taking the view of value proposition forming by social networks and social actors, our objective is to examine which consumer socially operant resources affect and how their impact on customer co-creation is. To be specific, this study investigates customer social capital and social identity as the antecedents of their co-creation behaviors in an education services context, and clarifies consumer satisfaction and loyalty as the consequences of the value co-creation.

The paper is structured as the following. Next is the theoretical background along with hypothesized model where, the concepts of value co-creation, consumer social resources and satisfaction and loyalty are brought together and the research hypotheses are stated. The methods and findings of our model testing are presented then. Finally, some managerial implications, contribution to the literature, and conclusions are drawn.

2. Theoretical framework and hypothesized model

Defintions of consumer loyalty, satisfaction, co-creation, social capital and social identity

Consumer loyalty in this study is defined as a consistent commitment to rebuy or repatronize preferred product or service (Oliver, 1999). Against Oliver's (1999) popular pattern of cognitive-affective-cognative, this definition better suits the phase of cognative or behavior intention, which is also often assumed by most consumer behavior researchers such as Zeithaml et al (1996).

This paper adopts the view of overall satisfaction that is a consumer's cumulative evaluation of service outcome against a standard of pleasure versur displeasure (Oliver, 1999). In comparison to the transaction specific satisfaction, the cumulative one may be a better antecedent of loyalty (Oliver, 1996) and it is just the reason for our choice herein. Assuming that satisfaction occurs when consumption fulfillment is pleasurable (Oliver, 1997), our examining consumer different needs as determinants to achieve the needs fulfillment is invoked (Au et al, 2008) as presented below.

Value co-creation or value co-production is used interchangeably or differently in the same management literature (Hilton et al, 2012). The differences can be that, while the former takes place in the usage stage, the latter may show itself within the production preparation process (Etgar, 2008). This paper needs not distinguish the two concepts, and defines co-creation as joint activities by customers and service providers (and perhaps, others) involved in direct interactions for the benefits of one or more parties (Gronroos, 2012).

Gronroos (2012) recently synthesized a conceptual model of value co-creation relying on both well known Eiglier and Langeard's (1975) servuction model and Gronroos's (1978) interactive marketing model. The core of the comprehensive conceptualization is the combination between the resource categories and co-creation activities, in which resources are inputs and activities are relevant outcomes. In the same vein, co-creation is considered resource integration (Hilton et al, 2012). Hilton et al also noted that supplier resources has historically received great interest in the literature, but now customers as resource integrators are getting increased attention. Out of three sorts of customer resources as physical, cultural and social ones, the study only examine the customer social resources that are the vast social support ranging from professional networks and relationships of friends and families to various communities of practice (Arnould et al, 2006).

To be specific, this paper focuses on the customer social capital and social identity. Whereas the former is generally the intangible resources based on the relationships among the members of social communites and networks (Nahapiet & Ghoshal, 1998), the latter refers to one's knowledge on whether or not (s)he belongs to some social group or category (Hogg & Abrams, 1988). The two focal social resources are to some extent representatives of social networks and social actors that are the intrinsic nature of value co-creation as introduced previously. It should be noted that the two sorts of resources adopted are also the typical forms of operant ones (i.e knowledge, skills, relationships, etc) that according to S-D logic are playing the increasingly important roles as key source of competitive advantage (Vargo & Lusch, 2008).

Social capital as determinants of co-creation and satisfaction

Although social capital can occur at many different levels ranging from individuals, organizations, inter-organizations to societies (Tsai & Ghoshal, 1998), it in this study is defined as the combination of the real and potential resources involved in the relational networks possessed by an individual (Nahapiet & Ghoshal, 1998). Alternativey, it is viewed as the personal perceptions of one's ability to extract benefits from the relevant social structures and relations (Portes, 1998). To this end, social capital should be characterized as the three dimensions: structural, cognitive and relational (Nahapiet & Ghoshal, 1998).

Structural capital is the overall pattern of social interactions or links between individuals in a network, which refers to where one's location is in the structure, or who one reach (Burt, 1992), how strong the tie strength is (e.g. intensity and frequency of communications) (Granovetter, 1973). In this study, the structural dimension is understood as the meaningful links between consumers or students and education service provider, on and by which the former gets itself involved in the whole process of posing service requirements, fine tunes service specification, tests out service scheme, consumes service packages, etc. Such channels explicitly foster the integration and exchange of knowledge of partners to anticipate value (Nahapiet & Ghoshal, 1998) and facilitate cooperative behavior (Putnam et al, 1993).

Relational capital is the trusted reciprocity of any relations in a network, which refers to any exchange is mutual and fair to any parties (Blau, 1964). In this study, the relational dimension is identified as student's specific interactions with education service provider such as trustworthiness, friendliness and commitment to the process of service production and delivery. When such social trusts are established in a network, business partners spend much more their time and efforts into joint activities (Nahapiet & Ghoshal, 1998).

Cognitive capital is the public good aspect of social relationships (Coleman, 1990), which refers to the common norms and shared understanding toward the benefits of the network (Nahapiet & Ghoshal, 1998). Focusing on its own interest, this paper considers the cognitive dimension as student's sharing ideas and their joint enhancement of conditions and capabilities to work together with education service provider and others for the whole service value. This sharing apparently binds different members of the collective and makes collaborative actions possible (Cohen & Prusak, 2001).

In brief, social capital is a sort of productive resources that have analytically two key properites: (i) facilitate collaboration and participation, and (ii) serve mutual benefits of individual and the whole network (Putnam, 1995). For the first feature, recent studies also provide support for the influence of social capital, for example, on knowledge sharing in virtual communities (Chiu et al, 2006), on knowledge acquisition in technology-based firms (Yli-Renko et al, 2001), on firm resource exchange and combination (Tsai & Ghoshal, 1998), or on firm innovation (Martínez-Cañas et al, 2012). Therefore, we propose the following hypotheses:

H1a: Structural capital is positively related to value co-creation

H1b: Relational capital is positively related to value co-creation

H1c: Cognitive capital is positively related to value co-creation

Concerning the second feature, consumer cooperative interactions with service provider reflect the whole service process that is changing from single transaction type to relationship type over time (Gronroos, 1994). With respect of consumers, the service value centers around their needs to be satisfied (Etgar, 2008). According to Etgar (2008), the needs to be fulfilled may be in the form of: (i) consumer preferences as well as differentiation toward customized performance, (ii) consumer seeking of socially status and esteem as well as consumer desire for control; and (iii) consumer self-expression and uniqueness as well as self-oriented appreciation of value as freedom, enjoyment, confidence etc. Such needs are completely inline with Au et al (2008)'s equitable needs fulfillment model that shows the three respective kinds of fulfillments: performance, relatedness and self-development ones. It is also noted that the three needs fulfillment are just the predictors for consumer satisfaction in Au et al (2008)'s work. In the same argument, Sun et al (2012) empirically reported the positive influence of social capital on customer satisfaction with IT services. This possibly leads to the following hypotheses:

H2a: Structural capital is positively related to consumer satisfaction

H2b: Relational capital is positively related to consumer satisfaction

H2c: Cognitive capital is positively related to consumer satisfaction

Social identity as determinants of value co-creation and satisfaction

Social identity is conceptualized as individual's perception of what constitutes to the "us" (Tajfel & Turner, 1986). For each individual, social identity shows itself as the process of self-categorization (which positions the person into social groups or communities such as engineers, students, etc) as well as the process of comparison (by which the person identifies some similarities with other members and some dissimilarities with non-members). As a result, in view of social identity, the community objectives, concerns and even bias strongly shape individual member's attitudes and behaviors (Turner et al, 1987). Recently empirical evidence reported that social identity positively influences on knowledge sharing of participants in an e-learning environment (Hwang, 2010).

In education, considering himself/herself as an active member of an educational institution, he/she could adapt his/her intentional and actual behaviros to those that are inherently determined by the institution. In other words, student social identity on their learning environment is also a sort of their motivation to collaborate with others to make progress for each and every of them. Thus, we propose:

H3: Social identity positively influences value co-creation.

In the same vein, when consumers spend more their efforts on social identity along with the interactive process of service development and delivery, their learning needs are fulfilled and, hence, their satisfaction is also formulated (Au et al, 2008). We, therefore, hypothesize the following:

H4: Social identity positively influences consumer satisfaction.

Satisfaction as outcome of value co-creation

The current education contexts commonly follow the learner-centric paradigm, and hence, student engagement and esatisfaction is also more imprortant. Theoretically, consumer satisfaction with services is the direct result of their experience on the service delivered (Westbrook, 1987). More, their experience is also reinforced when consumer put themselves into value co-creation activities that are increasingly popular in the age of consumer connectedness and empowerment of service providers (Prahalad & Ramaswamy, 2004). For this, the following hypothesis is suggested:

H5: Value co-creation positively influences consumer satisfaction.

Loyalty as joint outcome of co-creation and satisfaction

Consumer loyalty is defined here as their commitment to a particular service offered by some provider, and often embodied in their intention to stay with consuming the service (Zeithaml et al, 1996). Similar to satisfaction, consumer loyalty is subject to their service experience, and as a more specific manner, their activities and enjoyment in service interaction leads them to recommend the provider to others (Lam et al, 2004). On this link, we advance the following hypothesis:

H6: Value co-creation positively influences loyalty.

Finally, service marketing literature tradionally suggests that satisfaction is also a key determinant of consumer attitudinal and behavioral loyalty (Geyskens et al, 1999). We, thus, come to the following hypothesis:

H7: Satisfaction positively influences loyalty.

3. Methods

Sample design

Co-creation activities commonly appear in high interaction services (Auh et al, 2007), under many forms such as interaction intensity in service encounter, level of interdependence between providers and consumers, or information richness in service development and delivery (Kellogg & Chase 1995). For educational settings, as contacts among learners, and especially, contacts between learners and teachers are key interactions of service experience, the survey respondents selected are students those who have participated and are participating the schools in HCM City, VietNam.

Data is gathered through the convenience sampling with questionnaires distributed directly to students of 9 institutions including college and vocational schools as well as English training centers. A total responses of 376 was received over 2 months of questionnaire delivery. Finally, after removing the responses of excessive missing information, 334 valid responses were ready for further analysis. Of the entire valid sample, 53,9% were female; 50% were between 18 and 26 years old, 30.2% between 27 and 30 years old, 16.5% between 31 and 45 years old, and 3.3% over 45 years old; 55% studied for a university degree or a higher education level, 24.9% participated in foreign language training, 10.8% in soft skills training, and 9.3% in other vocational training.

Measurement

All measurement items of theoretical constructs are adapted and revised from previous studies with the support of a focus group of two lecturers of service marketing field and three students of business administration field. The measurement scale adopted is a fivepoint Likert-type one ranging from 1 as completely disagreed to 5 as completely agreed.

The scale of social capital is adapted from Sun et al (2012), of social identiy from Hwang (2010), of co-creation from Auh et al (2007), and of satisfaction and of loyalty from Yang & Peterson (2004).

Data analysis

Anderson & Gerbing (1988)'s two-step SEM approach is implemented using SPSS/AMOS 21.0 to firstly evaluate measurement model and then structural model. For measurement model, Cronbach's alpha and exploratory factor analysis (EFA) were used for pretest of research instrument. Then confirmatory factor analysis (CFA) was applied for testing its convergent and discriminant validity, composite reliability and overall fit (Hair et al, 2006). For structural model, SEM technique with Maximum Likehood estimation and Bootstrap approach to evaluate the overall fit of research model and hypotheses (Hair et al, 2006).

Findings

Measurement model

In instrument pretest, Cronbach's alpha results show that after elimating three items of total item correlation coefficient of less than 0.3, all measurement scales exceed the mimimum reliability (0.6) (Chau, 1997), and EFA check indicates that the factor structure of theoretical constructs is acceptable when all facor loadings are greater than the threshold of 0.5 (Nunnally & Bernstein, 1994).

Next, CFA results reveal that the model fit indices, against cut-off values suggested by Chau (1997), are satisfactory, with CMIN/df=2.011 (<3), RMSEA=0.055 (<0.08), GFI=0.901 (>0.9), TLI=0.928 (>0.9) và CFI=0.941 (>0.9).

The convergent validity of the instrument is acceptable with that both the composite reliability (CR) values are all greater than 0.7 and average variance extracted (AVE) values range from 0.49 to 0.69 (recommended cut-off is usually 0.5 (Bagozzi & Yi, 1988)). The discriminant validity of the constructs is adequate when the square roots of average variance extracted are greater than the correlation between two latent variables (Bagozzi & Yi, 1988). In summary, Table 1 and Table 2 show that the measurement model exhibits an adequate fit with the gathered data.

Table 1. Loadings, average variance extracted (AVE) and composite reliability (CR

Constructs	Indicators	Standardized factor loadings	AVE	CR
Co-creation	DS23	0.76	0.68	0.86
	DS19	0.86		
	DS20	0.85		
Satisfaction	HL18	0.90	0.69	0.90
	HL16	0.73		
	HL14	0.79		
	HL17	0.62		
Loyalty	TT29	0.85	0.67	0.86
	TT32	0.75		
	TT31	0.86		
Social identity	ND27	0.81	0.58	0.80
	ND25	0.80		
	ND28	0.66		
Relational capital	TC5	0.87	0.50	0.74
	TC8	0.64		
	TC6	0.58		
Cognitive capital	TN9	0.70	0.49	0.77
	TN12	0.72		
	TN11	0.70		
	TN10	0.57		
Structural capital	HT1	0.81	0.55	0.79
	HT2	0.66		
	HT3	0.74		

Table 2: Correlations and average variance extracted (AVE) (diagonal elements (in bold) are the square root of AVE)

Factors	AVE	Factors						
		COC	SAT	LOY	IDE	REL	COG	STR
COC	0.68	**0.82**						
SAT	0.69	0.61	**0.83**					
LOY	0.67	0.65	0.69	**0.82**				
IDE	0.58	0.70	0.55	0.56	**0.76**			
REL	0.50	0.62	0.50	0.47	0.62	**0.70**		
COG	0.49	0.37	0.20	0.28	0.33	0.34	**0.68**	
STR	0.55	0.48	0.43	0.40	0.39	0.32	0.14	**0.74**

Structural model

The first step is to test the assumed casual relationship among the constructs. The model fit indices are adequate (Table 3): chi-square statistic=1.984 (<3); GFI=0.900, TLI=0.930, CFI=0.941 (all is greater than 0.9), RMSEA=0.054 (<0.08). Next is to test the model hypotheses. The results (Figure 1) shows that 10 out of 11 hypothezied paths are empirically supported at the 0.001 and 0.05 levels of significance.

Table 3. Tests of structural model

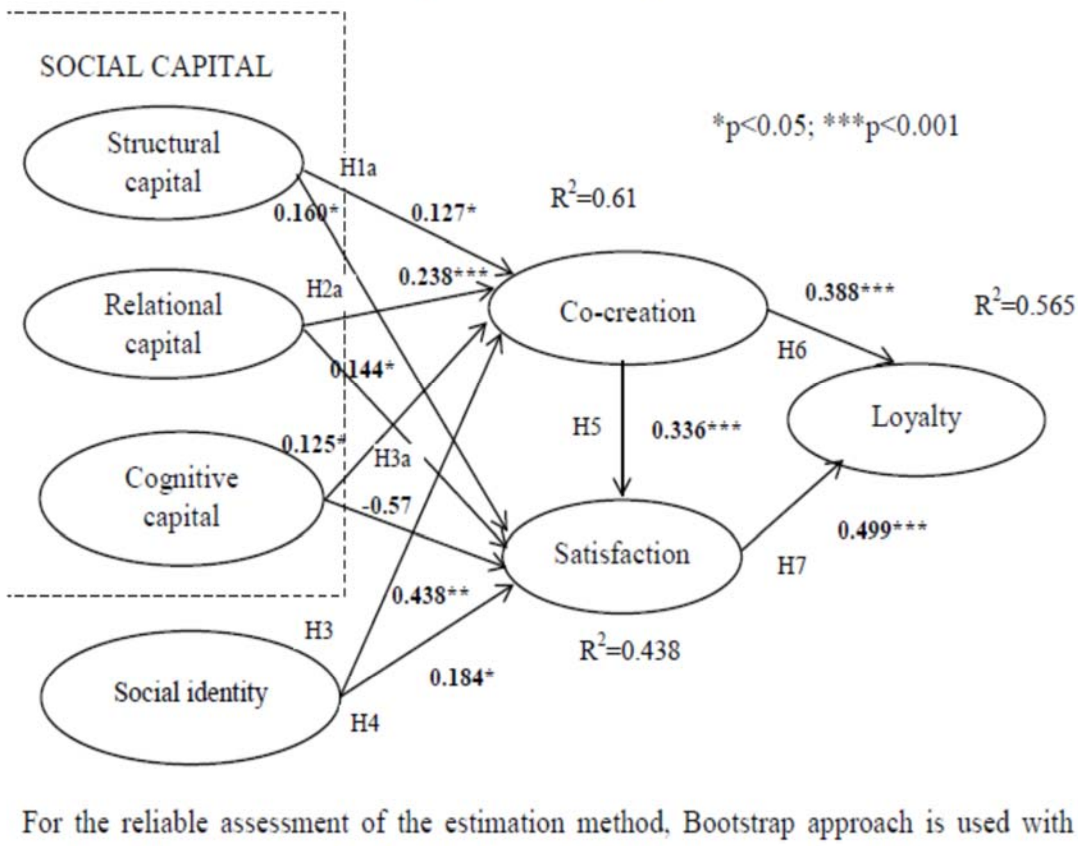
Hypotheses	*Regression relationships*	*Regression coefficients*	*Directions*	*Results*
H1a	Structural capital → Co-creation	0.217	+	Supported
H1b	Relational capital → Co-creation	0.238	+	Supported
H1c	Cognitive capital → Co-creation	0.125	+	Supported
H2a	Structural capital → Satisfaction	0.160	+	Supported
H2b	Relational capital → Satisfaction	0.144	+	Supported
H2c	Cognitive capital → Satisfaction	-0.57	-	Unsupported
H3	Social identity → Co-creation	0.438	+	Supported
H4	Social identity → Satisfaction	0.184	+	Supported
H5	Co-creation → Satisfaction	0.336	+	Supported
H6	Co-creation → Loyalty	0.388	+	Supported
H7	Satisfaction →Loyalty	0.449	+	Supported
Model fit indices				
	Chi-square statistic (CMIN/df)	1.984		
	GFI	0.900		
	TLI	0.930		
	CFI	0.941		
	RMSEA	0.054		

Hypotheses H1a, H1b, H1c and H3 that are supported show the positive influence of both student social capital and social identity on their co-creation behaviors. In specific, social identiy is the stronger determinant with the highest regression coefficient of 0.438. Next, the positive influence of student social capital on their satisfaction is also confirmed with the two dimensions of structural capital and relational capital while the dimension of cognitive capital has not the significant relation. As a result, hypotheses H2a and H2b are supported but H2C is not.

Co-creation shows the positive and significant influence on both student satisfaction and loyalty, which is that both hypothesis H5 and H6 are supported respectively. In comparison to co-creation, social identity also exhibits an active effect on student satisfaction but with a lower strength. In addition, that hypothesis H7 is supported, which is quite consistent with previous studies, also show the strong and significant link (regression coefficient of 0.449) between student satisfaction and loyalty.

Concerning the explanatory power via the determined coefficient R^2, social identity and social capital account for 61% variance of co-creation. While social identity, social capital and co-creation account for 43.8% variance of satisfaction that in turn, along with co-creation account for 56.5% variance of loyalty.

Figure 1. Model testing results



For the reliable assessment of the estimation method, Bootstrap approach is used with the number of bootstrap samples N=500. The result (Table 4) shows that the boostrap estimates have sufficiently small variations, and they are statistically insignificant. Consequently, the model estimation is adequate.

Table 4. Bootstrap estimates with N=500

Parameter			ML	SE	SE-SE	Mean	BS	SE-BS
COC	←	IDE	,439	,104	,003	,427	,011	,005
COC	←	REL	,238	,102	,003	,239	,001	,005
COC	←	COG	,123	,054	,002	,126	,001	,002
COC	←	STR	,217	,069	,002	,220	,004	,003
SAT	←	IDE	,181	,121	,004	,186	,002	,005
SAT	←	REL	,135	,104	,003	,146	,002	,005
SAT	←	STR	,166	,078	,002	,169	,008	,003
SAT	←	COC	,318	,130	,004	,325	,011	,006
SAT	←	COG	,387	,064	,002	-,061	,004	,003
LOY	←	COC	,451	,099	,003	,394	,006	,004
LOY	←	SAT	,123	,098	,003	,443	,006	,004

4. Conclusion

Discussion

The present study empirically validates the power of co-creation in the explanation of consumer satisfaction and loyalty in education services. The actively participatory roles of students could lead to their satisfaction and long time collaboration with their schools.

Our findings show that, in a consistency with previous studies, co-creation has a positive influence on satisfaction (as in Dong et al, 2008) and on loyalty (as in Auh et al, 2007). A small difference is that, while in Dong et al (2008), the effect of co-creation on satisfaction is stronger than that is on loyatlty, in this paper, the effect of co-creation on loyatlty is stronger than that is on satisfaction. Our result, based on Ajzen (1991)'s theory of planned behavior (TPB) where it is claimed that the formation of attitude (e.g. satisfaction) is established in prior to that of behavioral intention and actual behavior (e.g loyalty), is more theoretically fit than that of Dong et al (2008). Consequently, the meaningful challenge of customer value via co-creation (Hilton et al, 2012) is empirical validated in our model.

Our study also adequately confirms that social capital and social identity are the predictors of co-creation in educational services. The determinants are posivitely and significantly related to co-creation as expectedly. The interesting note is that the influencing strength of social identiy is higher than that of social capital. This is a primary distinction between our study and Yoon's (2004) where social identiy acted only a moderator for the relationship between social capital and usage of social network services, a sort of co-creation (Prahalad & Ramaswamy, 2004).

Theoretical implications

The paper offers a new understanding of service marketing, which is the role of predictors of social capital and social identity toward consumer co-creation activities. This may be a newly theoretical insight in comparison to Auh et al's (2007) where co-creation is explained by consumer competencies, consumer motivation and the clear communication between consumer and provider.

Next our results also demonstrate a simultaneously positive effect of social capital, social identity and co-creation on consumer satisfaction. This outcome could provide an insightful complement to (i) Dong et al's (2008) work where satisfaction is predicted only by co-creation, and (ii) Sun et al's (2012) study where social capital is a direct determinant for satisfaction. Consequently, with the strongest influence of social capital (against social identity and co-creation) on satisfaction, the role of partial mediator of co-creation between social capital as well as social identiy and satisfaction could be revealed.

Managerial implications

The study's findings suggest some practical implications for service providers. Firstly, at their's looking forward to consumer co-creation, they may get benefits because it direcly leads to consumer satisfaction and loyalty. Secondly, for their enhancing consumer co-creation, they may exploit consumer perceived social identity and social capital. This is to focus both identification of consumer communities throughout service development and delivery (i.e. social identity) and interaction within community and across community (i.e. social capital). Service providers necessarily consider the focus as their long term investment, starting with changing in their perceptions of service climate, and then empowering frontline employees (Heskett et al, 1994) to draw and support their consumers during service process as relevant and powerful service co-creators.

Thirdly, from view of customer, students by themselves need to reinforce their active collaboration in school activities for their own benefits in both the learning process and outcomes. Next, consumers in general are required to improve their social capital as both the requirements of globalization contexts with ubiquitously networked connections and the motivation leads them to fully experience services as Cova (1997) commented on the valuable link between communities and contemporary consumption. Finally, on this link, the role of social identity cannot be missed in shaping consumer behaviors. Specially, in education services, social identity helps students to position and consider themselves as responsible members of educational institutions to seek and contribute to both organizational and individual benefits.

Limitations and further research

The convenience sampling of the study may not help us to have good representative of the general population of education service consumers in HCM City, VietNam. Therefore, the generalization of its findings should be validated more, for example in other service settings such as health care, finance, consultancy of business development, etc.

Furthermore, in addition to social capital and social identity as typical social resources, other consumer resources which belong to cultural and physical ones (Arnould et al, 2006) could be prospective determinants of co-creation in next research avenue.

Conclusion

The study confirms that consumer co-creation is an important predictor for their satisfaction and loyalty. Consequently, service providers may focus on the meaningful determinants of co-creation such as social capital and social identity of their consumers. It can be an interesting point of the paper findings, which highlights that some sort of consumer socially operant resources rather than consumer motivation could act as significant antecedents of co-creation, a typical behavior of service world, and hence, to maintain key source of competitive advantage of service providers as indicated within S-D logic.

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Financial statements based Approach to Bank Risk Aggregation

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Abstract: Due to the problem of data sparseness, financial statements based approach to bank risk measurement and aggregation is receiving increasing attention from researchers. However, most of the studies curtly ignore off-balance sheet items when measuring risk based on financial statements. The more detailed disclosure of off-balance sheet items in financial reports makes it possible to incorporate off-balance sheet items into risk measurement. Specifically, other than balance sheet assets, off-balance sheet items are corresponded with risk exposures, which making risk exposures more accurate and rational.

In the experiment, we construct two hypothetical banks of different sizes based on Chinese banks and calculate their economic capital respectively. The results show that : (1) Ignoring off-balance sheet items in risk integration will lead to deviations. The total risk of large bank is overestimated while small bank's total risk is underestimated; (2) By comparing economic capital with regulatory capital, we find that large bank operates more robustly, which is corresponded with lower profitability of large bank.

Keyword: Risk aggregation, Financial statement, Off-balance sheet, Risk measurement

1. Introduction

Recent days, in order to circumvent the limitations of the credit scale, commercial banks accelerate the expansion of off-balance activities. A popular explanation for the explosive growth in banks' off-balance sheet activities is to reduce regulatory taxes, such as capital adequacy requirements. And as part of the financial innovation process, engaging in off-balance sheet activities has become a tendency for banks. At the end of 2011, off-balance sheet financial derivatives and credit items of the four largest state-owned banks are 5682 and 7958 billion, which account for 11.1% and 15.5% of balance sheet total assets respectively. Moreover, their off-balance sheet items grow at an average rate of 3.8% in the first half of 2012. In addition, from the perspective of regulatory standards, the business scope under supervision extends from balance sheet items to off-balance sheet items. A risk-based capital requirement for some off-balance sheet activities has enacted. Some characteristics of off-balance sheet activities, such as blind expansion and high-risk, making the existence of off-balance sheet items is a key cause for financial crisis which started in 2007. The role of banks' off-balance sheet activities are highlighted in the public commentary on sub-prime crisis (Barrell and Davis, 2008). Therefore, we should not ignore off-sheet items in risk measurement.

For the purpose of incorporating off-balance sheet items into risk measurement, financial statements based on approach is a feasible method. The core of this method is utilizing actual data from a set of commercial banks' financial statements to develop empirical proxies for different risk types. While many previous studies used simulated risk data, which can hardly measure risk in an authentic way. After getting distributions of different risk types, aggregating different risk types to acquire total risk and calculate economic capital. The reason why total risk is necessary for banking supervision is that different types of risk may interact with each other and they are inseparable (Jarrow and Turnbull, 2000). The correlation among risks may lead to further losses in some extreme situations (Li & Feng et al. 2012) Economic capital is increasingly receiving attention because with the outbreak of subprime crisis, many large-scale UK and US banks collapsed or were forced to raise capital during 2007–2009. This phenomenon reflects that previous regulatory capital can't guarantee the soundness of banks. Furthermore, capital management and allocation are key issues for top management decisions (Li et al. 2015). As a result, the way to get accurate economic capital through risk aggregation becomes a research hotspot. A significant example is that economic capital modeling has become fundamental planks of Pillar 2 compliance (Alexander and Sheedy, 2008).

Many papers focusing on risk measurement and aggregation is based on financial statements. Kretzschmar et al. (2010) split aggregate asset positions by exposure type and credit class to study whether the current dominant practice leads to undercapitalization of banks before subprime crisis. In their research, a simplifying assumption is taken that derivatives are excluded in the assets portfolio and off-balance sheet exposures for credit lines are not specifically modeled. However, in reality, the proportion of undrawn credit lines varies widely across asset portfolios. Therefore, such a simple assumption for off-balance sheet exposures makes the effectiveness of qualitative conclusions can't be guaranteed. Given the importance of off-balance sheet items, Drehmann et al. (2010) not only take account of the repricing characteristics of assets and liabilities, which have been considered by Alessandri & Drehmann (2010) when integrating credit and interest rate risk, but also square up the repricing characteristics of off-balance sheet items. Such a modification makes the hypothetical bank's interest rate sensitivity gap more accurately to reflect that of a realistic commercial bank. Researches has realized that one drawback of making balance sheet as a data source is that we cannot obtain first-hand risk profit & loss data. Fortunately, Kuritzkes and Schuermann (2007) found that mapping income statement of US banks into risk types is a way to get risk profit & loss directly. However, the income statements are of significant difference in US and China. For this reason, Li & Yi et al. (2012) utilize quarterly panel data of Chinese income statement to model risk contributions and then employ copula method to measure Chinese bank's total risk.

It is worth noting that above researches only focus on one financial statement, either income statement or financial statement. While Inanoglu and Jacobs (2009) match risk types with items from both income statement and balance sheet. In particular, balance sheet items are regarded as proxy of liquidity risk whereas profit & loss items are proxies of other risk types, which creating the problem of data inconsistency. Rosenberg and Schuermann (2006) establish corresponding relationship between risk types and balance sheet to acquire risk exposures and map risk types into income statement to obtain risk profit & loss, which making full use of information in financial statements. Although Rosenberg and Schuermann (2006) realize that off-balance sheet items can be larger, they still follow the usual treatment of ignoring off-balance sheet items, which may lead to inaccurate results because both balance sheet assets and off-balance sheet assets can generate profit or loss. In general, the income generated by off-balance sheet items accounted for over 50% of total income in American banks and in China, this proportion is 8% on average. Therefore, previous studies did not make full use of off-balance sheet data, which may lead to deviation in conclusions. What's more, the more detailed disclosure of off-balance sheet activities makes it possible to incorporate off-balance sheet items to measure risk.

The objective of this paper is to model risk distributions more accurately and rationally by bringing off-balance sheet items into risk measurement. Specifically, by mapping risk types into income statement and balance sheet & off-balance sheet assets we obtain risk profit & loss and risk exposures, respectively. For the purpose of modeling risk distributions, risk returns are calculated by dividing risk profit & loss to risk exposures. Then weighted average method is employed to measure total risk. In the empirical study, the data source is quarterly financial statements data of all Chinese listed commercial banks from 2007 to 2013. And a large and a small hypothetical bank are constructed from Chinese listed commercial banks to examine our approach.

2. Approach

2.1 Risks in This Research

It is generally accepted that any large, international active financial institutions, regardless of the business they are engaged (e.g. banking, brokerage, insurance or wealth management), are faced with at least three risk types: credit risk, market risk and operational risk (Inanoglu and Jacobs, 2009). As subprime crisis broken out, liquidity risk has attracted widely attention because it played an important role in the entire financial system. Lin (2000) also found that banks are faced with different types of risks, such as credit risk, market risk, operational risk and liquidity risk. Therefore, we will aggregate these four risk types.

Credit risk refers to the potential loss caused by counterpart or debtor defaults in the process of trading credit products (BCBS, 2004). Market risk is the impact on earnings brought about by adverse price movements in the bank's principal trading positions (BCBS, 2005). Liquidity risk is the risk that a given security or asset cannot be traded quickly enough at reasonable price in the market to prevent a loss or make a required profit (IOSCO, 1998). A widely used definition of operational risk is the one contained in the Basel II regulations. This definition states that operational risk is the loss resulting from inadequate or failed internal processes, people and systems, or from external events.

2.2 The Correspondence between Risks Types and Financial Statements

The risk exposures and risk profit & loss can be acquired by mapping risk types into balance sheet & off-balance sheet assets and income statement respectively. The specific corresponding relationship is shown in figure 1.

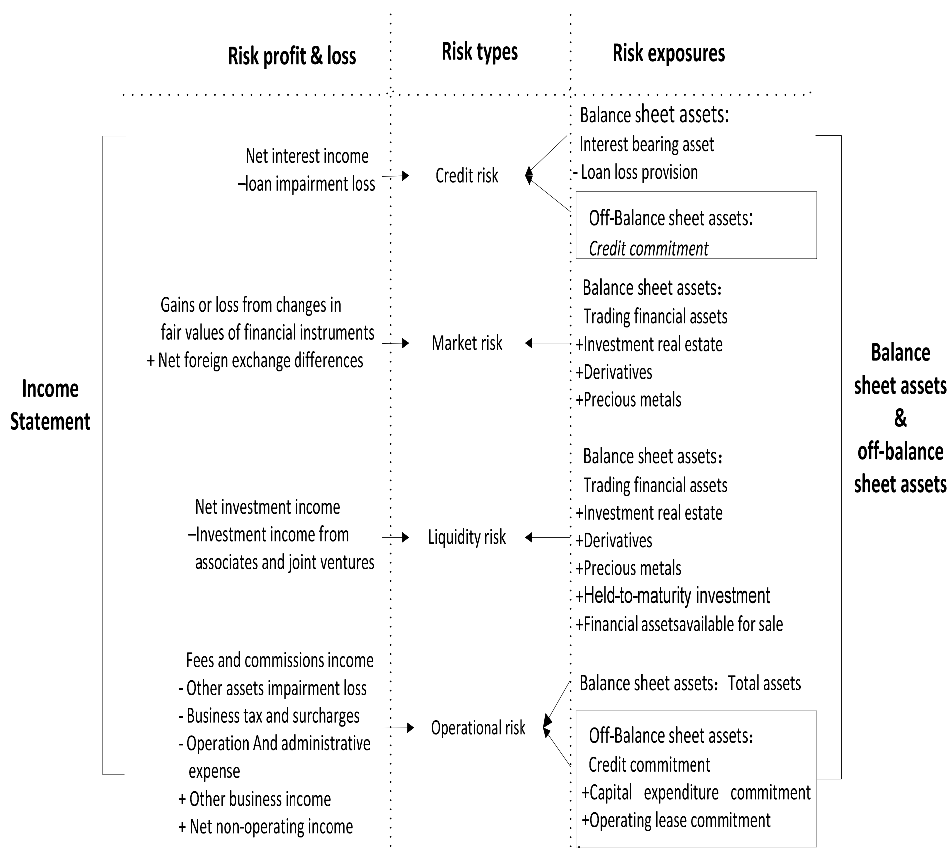

Figure 1 The correspondence between risk types and financial statements

The major source of credit risk is interest-bearing assets, which include loan, due from central bank, due from banks and other financial institutions, accounts receivable investment, buying back the sale of financial assets, lending to banks and other financial institutions and bond-investment. The changes in scale of interest-bearing assets will cause fluctuations in net interest income. In addition, if there is obvious evidence to show that the loan impairs, we should record loan impairment loss. So credit risk profit & loss equals to net interest income less loan impairment loss. For credit risk exposure, it consists of interest-bearing assets, loan loss provisions and off-balance sheet credit commitment. To be specific, credit commitment is classified into guarantee business and credit business. Guarantee business is made up of bank's acceptance bill, letter of credit and letter of guarantee. The reasons why credit commitment is part of credit risk exposure are as follows. Banks acting as guarantors in guarantee business will assume credit risk because if applicants renege banks have to perform the contract. And credit business consists of loan commitment and line of credit card, which are loans in nature. With respect to market risk, gains or losses from fair values of financial instruments are affected by price fluctuations of financial instruments while net foreign exchange differences are determined by changes of foreign exchange. Sum of these two items are equal to market risk profit & loss. For market risk exposure, the value of trading financial assets, investment real estate, derivatives and precious metal are influenced by market factors (i.e. price, interest rate, foreign exchange)so they are elements of market risk exposure. At the request of new accounting standards which issued at 2006, off-balance sheet derivatives are accounted at fair value in the balance sheet derivatives account.

As for liquidity risk, net investment income reflects the gains or losses from the process of trading ready to liquidate financial assets. However, investment income from associates and joint ventures is generated by long-term equity investment, which is made to control or influence other companies other than get short-term investment income. Therefore, liquidity risk profit & loss is equal to net investment income less investment income from associates and joint ventures. The financial assets held to liquidate immediately at required belong to liquidity risk exposure. Specifically, they are trading financial assets, investment real estate, derivatives, precious metals, held-to-maturity investment and financial assets available for sale. Similar to market risk, off-balance sheet derivatives which undertake liquidity risk have been disclosed in the balance sheet.

Finally, the remaining items in the income statement are matched up with operational risk. Rosenberg and Schuermann (2006) deem that all assets and activities of the bank are in some way subject to operational risk. We follow this standpoint to get operational risk exposure, which equals to balance sheet total assets plus off-balance sheet total assets. In particular, off-balance sheet business consists of credit commitment, derivatives and investment banking. Unfortunately, the disclosure of off-sheet items is limited and different among banks. Hence, we just consider credit commitment, capital expenditure commitment and operating lease commitment.

2.3 Procedure of Risk Measurement and Aggregation

The risk profit & loss is not comparable among different banks because banks are different in terms of scale, capital allocation, investment strategy and management level. So after collecting original risk data, we need to preprocess the data to get risk return which is comparable among banks. Value-at-Risk (VaR), pioneered by J.P. Morgan, has become a standard measure for financial risk. Therefore, it is still being employed here for risk measurement. Finally, weighted-average method is applied for risk aggregation and calculation of economic capital. The procedure of data preprocess can be divided into four steps:

Firstly, risk return which is defined as risk profit & loss to risk exposure is the target. So the risk return is simply

$$r_{i,j,t} = \left(\frac{R_{i,j,t}}{RE_{i,j,t}} \right) \quad (1)$$

where $R_{i,j,t}$, $r_{i,j,t}$ and $RE_{i,j,t}$ stand for risk profit & loss , risk return and risk exposure of bank i, risk j at time t ,respectively.

In the second step, we perform mean adjustment for risk return so as to get expected risk return, which can be written as

$$r'_{i,j} = \left(\frac{1}{T_i} \sum_{t=1}^{T_i} r_{i,t} \right) \quad (2)$$

where T_i is the number of quarters of bank i and $r'_{i,j}$ is the expected risk return of risk j, bank i.

The next step aims to get random fluctuations of risk returns, which reflect the macroeconomic background and operating conditions of banking. The random fluctuations of risk returns is defined as

$$\Delta_{i,j,t} = r_{i,j,t} - r'_{i,j} \quad (3)$$

Finally, in order to meet the requirements of analyzing a specific bank (i.e. i=k), we assume that the risk distributions of all banks are independent identically distributed. After combing random fluctuations of risk returns and a specific bank's expected risk returns, the specific bank's risk returns which is used to model risk distributions are already obtained.

$$r_{k,j,t} = r'_{i,j} + \Delta_{k,j,t} \quad (4)$$

The following is choosing a tool to measure risk. VaR has nevertheless become a standard for measuring and assessing risk (Inanoglu and Jacobs, 2009). The definition of VaR at a specific level $\alpha \in (0, 1)$ is written as

$$VaR = \inf\{l : P(L \le l) \le (1-\alpha)\} \quad (5)$$

which means that VaR is the smallest number l which makes the probability of loss L exceeding l is not larger than(1-α).

After getting VaR of four risk types, weighted average method is employed to aggregate risk. The principal of weighted average method is assuming that the linear correlation coefficient among different risk types is 1 and the risk contribution to total risk is reflect by risk weight, which is the relative size of risk exposure. The specific formulas are shown as

$$\text{Add-}VaR_i(\alpha) = \sum w_{i,j,t} VaR_j(\alpha) \qquad (6)$$

$$w_{i,j,t} = \frac{RE_{i,j,t}}{\sum RE_{i,j,t}} \qquad (7)$$

where $\text{Add-}VaR_i(\alpha)$ refers to the total risk of bank i; $w_{i,j,t}$ is the weight of risk j and bank i at time t; $VaR_j(\alpha)$ is the VaR of risk j when confidence level is (1-α); $RE_{i,j,t}$ is the exposure of risk j and bank i at time t.

The weighted average method is similar to simple summation approach in principle, which assumes all inter-risk correlation coefficients are equal to one and ignores potential diversification benefits. This assumption imposes an upper bound on the true capital figure so it is perceived as a conservative approach (Embrechts et al. 1999).

3. Empirical Analysis

3.1 Data Description

The risk data is collected from financial statements of all 16 A-share listed Chinese commercial banks which are displayed in figure 2. In order to get data as much as possible, we collect a panel of quarterly data from 2007Q1 to 2013Q3. However, the quarterly data of ABC and CEB between 2008 and 2009 are unavailable because they were listed at 2010. Besides, 2007Q2 data of BOB, 2007Q1 data of NJCB, NBCB and CCB is not available. In total, we obtain 407 pieces of valid data to model risk distributions.

It is noteworthy that the value of off-balance sheet assets, loan impairment loss and loan loss provision is only disclosed in annual and semi-annual report. For the purpose of getting quarterly risk returns, we assume that the Q1value of off-sheet assets is equal to that of semi-annual, the Q3value of off-sheet assets is equal to that of annual. As for loan impairment loss and loan loss provision, we use semi-annual and annual data to calculate the mean of two ratios. One is the ratio of loan impairment loss and assets impairment loss. Another is the ratio of loan loss provision and loan. Then these two averages are applied to quarterly financial statements to obtain quarterly loan impairment loss and loan loss provision.

The objective of this paper is to calculate economic capital of Chinese commercial banks while our results are not specific to a realistic commercial bank. To resolve this problem, we construct hypothetical banks, in accordance with Rosenberg and Schuermann

(2006), Kretzschmar et al. (2010), Alessandri and Drehmann (2010). In particular, a large hypothetical bank and a small hypothetical bank are established for comparison. The large hypothetical bank is the average of the three largest banks (ICBC, BOC and COB) while the small hypothetical bank is the average of the three smallest banks (BOB, NJCB and NBCB).

ICBC	Industrial and Commercial Bank of China	CITIC	China CITIC bank
BOC	Bank of China	HXB	Bank of China
CCB	China Construction Bank	CIB	Industrial Bank Co., Ltd.
ABC	Agricultural Bank of China	PAB	Ping An Bank
BCM	Bank of Communications	BONJ	Bank of NanJing
CMB	China Merchants Bank	BOB	Bank of BeiJing
SPDB	Shanghai Pudong Development Bank	BONB	Bank of NingBo
CMBC	China Minsheng BankingCorp.,Ltd.	CEB	China Everbright Bank

Figure 2 The Chinese listed commercial banks and their abbreviations

3.2 Empirical Results

The results in table 1 are Add-VaR of two hypothetical banks which reflects the total loss per asset when all risk types take place simultaneously. We know that small bank's absolute value of Add-VaR is larger than that of large bank at any confidence level. This implies that either in extreme environment or relative modest condition, the total loss per asset of small bank is larger. To be specific, at 99.9% confidence level, Add-VaR is -0.63%for large bank while -0.81% for small bank. At 90% confidence level, Add-VaR change to -0.12% and -0.20 for large bank and small bank, respectively.

Table 1 VaR of large and small hypothetical banks in 2013Q3 by weighted average method

Confidence level	99.9%	99%	98%	95%	90%
Large hypothetical bank	-0.0063	-0.0044	-0.0035	-0.0028	-0.0012
Small hypothetical bank	-0.0081	-0.0057	-0.0047	-0.0038	-0.0020

Table 2 illustrates the amount of economic capital for 2013Q3 with the unit of one billion CNY. At extreme condition, expressed by99.9% confidence level, the economic capital equals 243 billion CNY for large bank and 15billion CNY for small bank. At 90% confidence level, which means a relative modest market environment, the amount of economic capital is 48 and 4 billion for large bank and small bank, respectively.

Table 2 2013Q3 economic capital of hypothetical banks (Unit: billion CNY)

Confidence level	99.9%	99%	98%	95%	90%
Large hypothetical bank	-242.8271	-170.5955	-135.8897	-107.8299	-47.8591
Small hypothetical bank	-14.6939	-10.3180	-8.4297	-6.9588	-3.6414

3.3 Results Analysis

The empirical results are analyzed in two dimensions: regulatory capital and economic capital without off-balance sheet items. Comparing economic capital with regulatory capital, we conclude that whether regulatory capital is enough to cover bank risks, which of great importance for robust operation. And the difference created by off-balance sheet items tells us the role of off-sheet items played in risk aggregation. What's more, we also want to have an overlook about the trends of Add-VaR and economic capital from 2007 to 2013, which can reveal some difference between large banks and small banks.

At the request of China Banking Regulatory Commission (CBRC), the minimum ratio of regulatory capital to risk-weighted assets is 8% for a bank. Therefore, 8% is applied to calculate annual regulatory capital the bank should maintain. At the result of lacking of risk-weighted assets of 2013, we conduct time series analysis for 2007 - 2012 annual risk-weighted assets to obtain the predictive value of 2013 annual risk-weighted assets. As we all know, both regulatory capital and economic capital are the concepts of capital stock for a given time extension. Due to the probationary period for regulatory capital is one year time, so the economic capital we obtain cannot be compared with annual regulatory capital directly because panel quarterly data is used in empirical experiment. According to the square root of time rule, T periods of VaR can be obtained by multiplying $\sqrt{T}$ and VaR for a single period. Thus, the quarterly economic capital multiplied by $\sqrt{4}$(i.e. 2) can be transformed into annual economic capital.

The main contribution of this paper is paying attention to off-balance sheet items in risk aggregation. So comparing economic capital obtained under conditions of considering off-balance sheet items or ignoring off-balance sheet items can help us to understand the role of off-balance sheet items played in measuring total risk. Figure 3 shows the results of 2013 annual regulatory capital and economic capital at 99.9% confidence level with the unit of one billion CNY.

	Large hypothetical bank	Small hypothetical bank
Economic capital (without off-balance sheet items)	496.4526	29.0822
Economic capital (with off-balance sheet items)	**485.6542**	**29.3878**
Regulatory capital	718.8705	30.1408

Figure 3 2013 annual economic capital and regulatory capital (Unit: billion CNY)

The results shown in figure 3 tell us that the regulatory capital is enough to cope with risks faced by commercial banks because it is larger than economic capital. This is in line with the current robust operation of Chinese commercial banks. Li et al. (2013) found that Chinese banking system is in a stable state, which is backed up with the evidence that chance of large scale contagion in Chinese banking system is quite low.

Furthermore, regulatory capital is significantly greater than the economic capital for large bank while slightly larger than economic capital for small bank. This shows that large banks operates more robustly compared with small banks. And CBRC has realized that large banks have stronger ability of risk control and better capital adequacy than small banks. In a word, the stability of Chinese commercial banks is optimistic and this is good news because cumulative output loss caused by banking crisis reached as much as 15%–20% of annual GDP (Hoggarth et al. 2002).

Figure 3 also tells us that ignoring off-balance sheet items in risk measurement will lead to deviation. And some previous studies have paid attention to the riskiness of off-balance sheet activities. Traditionally, off balance sheet activity was seen as a risk reducing tool. With the deepening of studies, researchers found that the effect generated by off – balance sheet is not consistent. Upper (2011) established that the possibility of contagion for banks with large derivatives will be underestimated when off –balance sheet exposures are ignored. The findings established by Karim et al. (2013) appear to be the case that off balance sheet activity is not risk-increasing risk, and may have had a reverse effect on risk. Papanikolaou & Wolff (2014) got the conclusion that off-balance sheet leverage exposures increases the individual risk of banking firms making them vulnerable to financial shocks. In other words, off-balance sheet items are negatively linked to the soundness of the whole banking system. So there is not a consistent view. The conclusion we got is that the deviation in risk measurement generated by off-balance sheet items is different between large banks and small banks. Particularly, small bank's risk is underestimated if off-balance sheet items are ignored because the economic capital is larger when taking account of off-sheet items in risk aggregation. Unlike small banks, large bank's risk is overestimated if ignoring off-sheet items because the economic capital is smaller when considering off-sheet items. This conclusion is also consistent with our knowledge that small bank is more inclined to engage in high-risk off-balance sheet activities because high risk means high returns. The explosive growth of off-balance sheet activities is aimed to avoiding supervision and pursuing higher yield among intense competition. Papanikolaou & Wolff (2014) demonstrate that the banks which focus on traditional business typically face less risk compared to those engaged in modern financial innovation and new financial services. And stated-owned banks play a leading role in traditional deposit & loan market, so small banks only engaged in high-risk off-balance sheet activities for making profit. The explosion of off balance sheet activities allowed banks to generate an increase in non-interest income and additional fee while placing the assets off the balance sheet. This improved profitability further by not carrying costly regulatory capital for these assets (Karim et al. 2013).

To illustrate more intuitively, figure 4 tells us that the difference of relative scale of off-balance sheet items between large banks and small banks is the reason for different directions of deviation. The vertical axis reflects the magnitude of change in total risk, Add-VaR and economic capital after incorporating off-balance sheet items in risk aggregation.

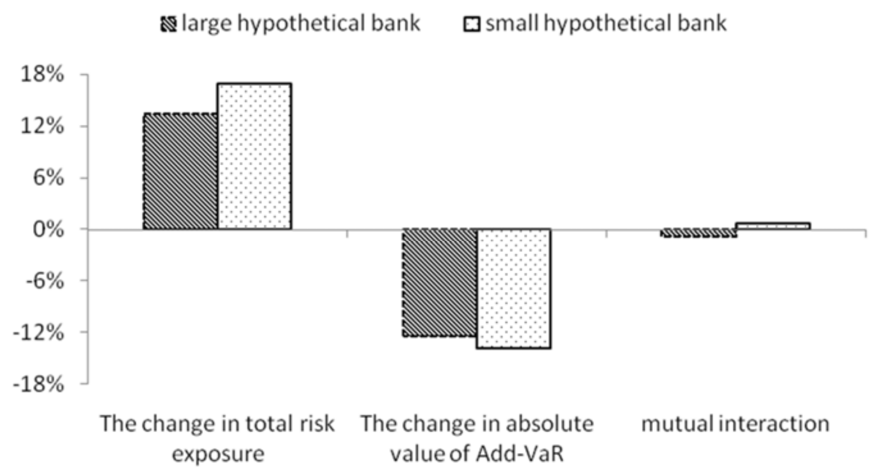

Figure 4 Changes brought about by off-balance sheet items

From figure 4, it is clearly that the mutual interaction, which reflects changes in economic capital, is different between banks of different sizes. Specifically, the increase in total risk exposure is the ratio of off-balance sheet assets to balance sheet total assets. And this increase means that the denominator of risk return increases. Therefore, Add-VaR decreases after considering off-balance sheet items. As for mutual interaction, changes in economic capital I mean, is the combination of both risk exposure and Add-VaR so it determined by relative scale of off-balance sheet items. Therefore, the relative scale of off-balance sheet items is the essential reason for the difference in mutual interaction. However, the mutual interaction changes a little after considering off-sheet items. There are two causes for this result. First, from the perspective of mathematical formula, economic capital is the product of absolute value of VaR and risk exposure. The risk exposure increases while absolute value of VaR decreases when off-sheet items are considered. Under the mutual interaction, the economic capital takes place a small change. Another reason is that the scale of off-balance sheet items is significantly smaller compared with the balance sheet total assets. At the end of 2011, the four largest stated-owned banks' average ratio of off-balance sheet assets to balance sheet assets is 26.6% while the corresponding ratio exceeds 100% in US or European banks. However, with the rapid expansion of off-balance sheet items, the deviation in risk aggregation without off-balance sheet items will be increasingly larger.

The commercial banks' profitability also catches our attention because too much economic capital will hinder commercial banks' earnings. The profitability can be reflected by computing overall risk return based on financial statements method. Uniquely, overall risk exposure is the sum of credit risk exposure, market risk exposure, liquidity risk exposure and operational risk exposure. And overall risk profit & loss equals to net income. By preprocessing risk data, we can get overall risk return, which is illustrated in table 3 as the measurement of profitability.

Table 3The profitability of hypothetical banks

Confidence level	99.9%	99%	98%	95%	90%
Large hypothetical bank	0.0007	0.0008	0.0010	0.0015	0.0018
Small hypothetical bank	0.0008	0.0009	0.0011	0.0016	0.0016

Table 3 tells us that the commercial banks' profitability varies with different scales. Large commercial bank's overall risk return is 0.01% lower than that of small commercial bank at any confidence level. This means that the large commercial bank is less profitable. And this is corresponded with the result we just find by comparing economic capital and regulatory capital that large commercial bank are most robust in operation. The regulatory capital far exceeds economical for large bank while small bank's regulatory capital has small amounts over the economic capital. And regulatory capital is the funds banks put aside for coping with risks so it can't participate in lending or investment. Therefore, excessive regulatory capital reduces the profitability of large commercial banks.

In addition, the trends of Add-VaR and economic capital at 99.9% confidence level from 2007Q1 to 2013Q3 help us to grasp the changes of total risk faced by commercial banks.

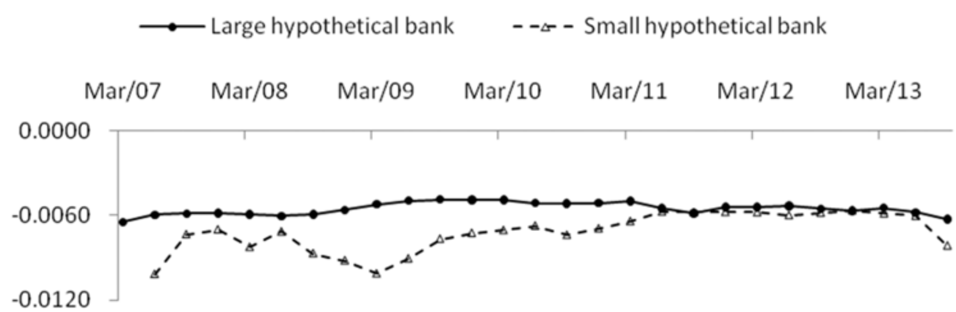

Figure 5The trend of hypothetical banks' Add-VaR at 99.9% confidence level

The vertical axis of figure 5 represents Add-VaR of hypothetical banks at 99.9% confidence level. From figure 5, we know that small bank's absolute value of Add-VaR is larger than that of large bank at 99.9% confidence level. This means that small bank's loss per asset is larger. What's more, Add-VaR of the small bank fluctuates more drastically, which caused by the massive change of business mix. For us, this implies that the total risk faced by small banks changes widely as time going.

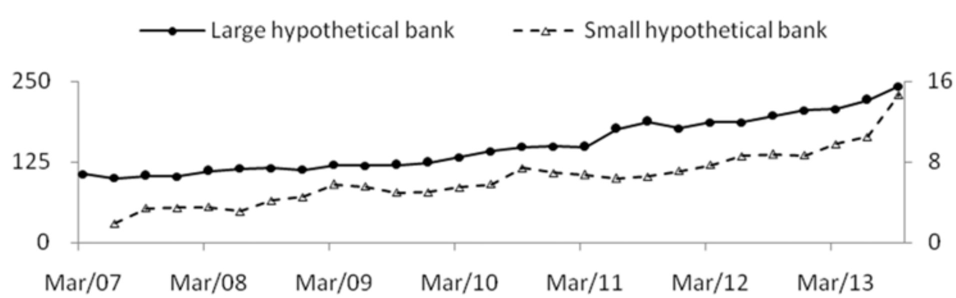

Figure 6The trend of hypothetical banks' economic capital at 99.9% confidence level

(Unit: billion CNY)

The trend of economic capital from 2007Q1 to 2013Q3 at 99.9% confidence level is shown in figure 6. The vertical axis reflects the amount of economic capital. Obviously, the economic capital for large bank is larger than that of small bank although small bank's absolute value of Add-VaR is even larger. The reason is that large bank operates in a large scale, in another words, the risk exposures are larger. This indicates that large commercial bank will face more losses if risk event triggers so that it needs more economic capital to respond to the potential losses. Similarly, small bank need less economic capital is that its operation scale, what I mean is total risk exposure, is smaller compared with the large bank.

4. Conclusion

By mapping risk types to financial statements we get risk data to model risk distributions. Uniquely, the off-balance sheet items are corresponded with risk exposures making the risk exposures more accurate and rational. For the purpose of studying the difference between large banks and small banks, two hypothetical banks of difference sizes are established.

The empirical results show that the loss per asset of small bank is larger and its Add-VaR fluctuates more drastically as time going. However, small bank needs less economic capital because it operates with a small scale compared with large bank. In addition, regardless of the off-balance sheet items will produce deviation in total risk measurement. To be specific, the total risk of large bank is overestimated while underestimated for small bank if off-sheet assets are ignored. And with the rapid growth of off-balance sheet items, the deviation of risk aggregation will be increasingly obvious. So the off-balance sheet items are of great importance in risk aggregation. As for profitability and robustness of Chinese commercial banks, large commercial bank operates more robust while with lower profitability. The overall risk return for large bank is less than that of small bank, which is due to excessive regulatory capital.

This study still has several limitations. Firstly, due to data availability, we just use part of the off-balance sheet data and this can be resolved by more standardized disclosure requirements for off-balance sheet items; Secondly, the correspondence between risk types and financial statements is kind of rough. For example, net interest income not only reflects credit risk, but also reflects market risk. And net investment income assumes market risk and liquidity risk at the same time. Besides, whether all assets are subjected to operational risk is still under question. In the future studies, the employment of other information may calibrate the corresponding relationship to some extent.

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□ □ □ □ □ □ IMPACT OF THE TRANS-PACIFIC PARTNERSHIP NEGOTIATIONS AND SUSTAINABLE EXPORT DEVELOPMENT FOR VIETNAM'S ENTERPRISES

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Abstract

The Trans-Pacific Partnership (TPP) agreement seems to have reached a crossroads: it could either be a building block toward achieving economic integration in Asia and the Pacific, or trigger the formation of two large trade blocs which will work independently of one another. When the Government of Japan announced its participation in the TPP negotiations in March 2013, the partnership began to attract greater interest from other East Asian countries.

Members may be interested in understanding the potential economic impact and significance of TPP and the economic characteristics of the other TPP countries as they evaluate the potential impact of the proposed TPP on the U.S. economy and the commercial opportunities for expansion into TPP markets.

This report analyzes the opportunities and challenges of the TPP will impact the economic of Vietnam, as well as the opportunity to export goods from Vietnam into the TPP countries and analyze strategies sustainable exports development for Vietnam's enterprises

Keywords: Trans-Pacific Partnership, TPP, free trade agreement , Sustainable Export , Vietnam imports-exports, economic relations,…

1. Introduction

The Trans-Pacific Partnership (TPP) is a potential Free Trade Agreement (FTA) among 12 countries and perhaps more. The United States (US) and 11 other countries of the Asia-Pacific region Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, and Vietnam are negotiating the text of the FTA. With over 20 chapters under negotiation, the TPP partners envision the agreement to be "comprehensive and high-standard," in that they seek to eliminate tariffs and nontariff barriers to trade in goods, services, and agriculture, and to establish or expand rules on a wide range of issues including intellectual property rights, foreign direct investment, and other trade-related issues. They also strive to create a "21st-century agreement" that addresses new and cross-cutting issues presented by an increasingly globalized economy.

Its intention to negate the "spaghetti bowl" effect is however doubted by many (Ravenhill John, 2009). For example, the existing complex Rules of Origin (ROO) for textiles and apparel are expected to be incorporated unchanged into the TPP agreement, and will not be replaced by a single, over-arching ROO (Ian F. Fergusson, 2014). In all previous FTAs, the US had used the "yarn forward" rule which requires that the material (cotton or synthetic fiber) for a textile product be sourced within the FTA area, and representatives of the US textile industry have argued for an even tighter "yard forward" rule to be included in the TPP (Ian F. Fergusson, 2014). In contrast, some TPP countries, including Vietnam, seek a less restrictive "cut and sew" rule which will allow its products manufactured from materials of non-TPP origin to benefit from the TPP. Therefore, if compromise positions are not reached eventually, the ROOs of TPP will fail to be liberal, effective and simple rules and may become just one more strand of noodle in the bowl (Shiro Patrick Armstrong, 2011).

The proposed TPP and its potential expansion are important due to the economic significance of the Asia-Pacific region for both the US and the world. The region is home to 40% of the world's population, produces over 50% of global Gross Domestic Product (GDP), and includes some of the fastestgrowing economies in the world. With the addition of Canada and Mexico, TPP negotiating partners made up 31% of US goods and services trade in 2011, and the Asia-Pacific economies as a whole made up over 56%. The TPP would be the largest US FTA to date by trade value (Brock R. Williams, 2013).

2. Some characteristics of TPP

Agreement negotiation in the scale and ambition as TPP Agreement is a complicated and time-consuming task. However, high level ranking officials of the negotiation participating countries feel confident the successful formation of the description of the main negotiating areas of the agreement will provide the basis and essential driving force for the success of the agreement. The characteristics making this historic agreement include:

(1) Comprehensive market access in all sectors, including the elimination of tariffs and other barriers to trade and investment between the member states, as well as job generation for people. The agreement aims at promoting the mutual market access for goods of members

countries in a comprehensive way with free-tax, eliminating service restrictions simultaneously in order to create new opportunities for employees and enterprises as well as immediate benefits to consumers.

(2) As a regional agreement, TPP participating countries agree to build a unified tariff as well as a general rule of origin so that enterprises can take advantage of the agreement more easily. This regional approach will boost regional trade network, thereby enhance competitive capacity of enterprises and encourage the use of TPP input products.

(3) Cross-cutting trade issues by building on work being done in Asia-Pacific Economic Cooperation (APEC) and other fora by incorporating four new cross-cutting issues in the TPP, namely:

- Regulatory coherence: Binding specific policy environment between countries;

- Competitiveness and business facilitation of each member country's economy;

- Small and medium sized enterprises (SMEs): Commitment of addressing concerns of SMEs so that these enterprises can look for advantages within TPP and trade internationally;

- Development: directing trade policy toward poverty reduction, strengthening social responsibilities of enterprises.

(4) On one hand, new technology will create new opportunities for trade and investment between the Member States, but also raise potential issues to be addressed in the agreement to boost trade, goods and services and to ensure mutual benefits of the economies of all TPP members, on the other hand.

(5) TPP performs opening mechanism, accordingly, in the future, the country concerned may participate the negotiation for the participation. In other words, TPP aims at ultimate goal of expanding to other countries in the Asia - Pacific.

Negotiating groups have been consulting countries which express their interests of joining the agreement in joining the agreement, in order to help these countries realize objectives agreed by TPP. Currently, many countries and territories have expressed their interest in participating in the negotiations including: South Korea, Taiwan, Philippines, Laos, Thailand, Colombia, Costa Rica. It is worth noting that although TPP is a Trans-Pacific FTA; China, the world second largest economy still stands outside, while the US is the most active nation to promote the negotiations.

The TPP opening shows an advantage that only with TPP negotiation each country can get FTA with many partner countries. However, this advantage also creates difficulty as the more countries participate, the more difficult to reach final agreement as well as the more prolonged negotiating time.

3. Vietnam's Merchandise trade with FTA and TPP partners

3.1. *Vietnam's FTA*

With rapid increase of FTA for Free Trade Area, Vietnam has actively launched FTA establishment process. Results are:

♦ Signed:

1. Association of South East Asian Nations (ASEAN)-FTA: Signed in 1996. most of commitments have been implemented

2. ASEAN-Australia/New Zealand FTA: Signed in 2009; Effective from 2010

3. ASEAN-India FTA: Signed in 2009; Effective from 2010

4. ASEAN-Korea FTA: Effective from 2007

5. ASEAN-Japan FTA: Signed in 2008 within ASEAN-Japan Comprehensive Economic Partnership Agreement (AJCEPA)

6. ASEAN-China FTA: Signed in 2004; Effective from 2010

7. Vietnam-Japan FTA: Signed in and effective from 2008

8. Vietnam-Chile FTA: Signed in Nov. 2011; Effective from 2013

♦ Under negotiations

1. Regional Comprehensive Economic Partnership (RCEP)- (ASEAN+6*) in 2012

2. ASEAN- European Union (EU) FTA in 2007 (still under negotiation)

3. TPP : Under negotiation since 2008

4. Vietnam-EU FTA: Negotiation since 2012

5. Vietnam-Korea FTA: Negotiation since 2012

6. Vietnam- European Free Trade Association (EFTA) (Swiserland, Norway, Liechtenstein, Iceland) FTA since 2012

7. Vietnam-Customs Union (Russia, Belarus and Kazakhstan) FTA since 2013

♦ Under examination

. Vietnam-Canada FTA

♦ FTA Commitments

Vietnam pledges to open market and to tax reductions, focus on investment environment, intellectual property, sustainable development accordingly to FTA

- Regarding the liberalization level: Basically, it is higher than commitments to World Trade Organization (WTO) accession. Of these, approximately 90% of tariff lines (accounting tariff lines of import tax) with the time frame of cutting down to 0% within 10 years, of which some tariff lines are flexible in the range of extended period from 2 to 6 years. Of which, the degree of liberalization in ASEAN Free Trade Area (AFTA)/ Common Effective Preferential Tariff (CEPT) / ASEAN Trade in Goods Agreement (ATIGTA) commitments is highest (99% of 8-digit tariff lines), the lowest is in the ASEAN-India Free Trade Association (AIFTA)/ ASEAN-India Trade in Goods (AITIG) commitments (80% of 6-digit tariff lines) and the commitment ASEAN-Japan Comprehensive Economic Partnership (AJCEP) (88,6% of 10-digit tariff lines).

- On tax cuts roadmap: With AFTA, ASEAN–China Free Trade Area (ACFTA) and ASEAN-Korea Free Trade Area (AKFTA) tax cuts will be implemented according to the schedule prescribed for the annual reduction step (AFTA: 1996 to 2006 - from 2015 to 2018, AKFTA: 2007 - 2016 to 2018). Road map for reduction of the remaining FTA: AJCEP, AIFTA, ASEAN-Australia-New Zealand Free Trade Agreement (AANZFTA), Vietnam-Japan Economic Partnership Agreement (VJEPA); will be gradually reduced each year to reach the final tariff commitments. (AJCEP: 2008-2018-2024; VJEPA: 2009-2019 2025; AANZFTA: 2010 – 2018 -2020 and AIFTA: 2010 – 2018 - 2021).

- Tariff Commitments of Vietnam in Vietnam-Chile FTA: Vietnam committed to eliminate tariffs on 87.8% of tariff lines in the current import tariff (accounting for 91.22% of imports from Chile to Vietnam in 2007) in 15 years. In 12.2% of the remaining tariff lines, 4.08% of the tariff lines under the exclusion list (no reduction and elimination), 3.37% of tariff lines remain the same tax base and 4.75% of tariff lines are partially tax reduction.

3.2. *Vietnam's Merchandise trade with TPP partners*

The TPP would strengthen ties between Asia and the Americas, create a new template for the conduct of international trade and investment, and potentially lead to a comprehensive FTA in the Asia-Pacific. It could stimulate trade by benefiting the competitive industries of both emerging-market and advanced economies. And it could yield an innovative model for consolidating the “noodle bowl” of existing trade agreements. Asian agreements, in turn, have aimed to promote the ASEAN Economic Community in 2015, improve political relations in Northeast Asia. The TPP emerged as a US priority some years ago, but it has recently become identified with the “rebalancing” of US foreign policy toward sustaining a US presence in Asia.

In addition, that Japan prepares to join TPP is also a good news for Vietnam. “That Japan enter TPP and boost agricultural investment in the Mekong Delta is a great opportunity that Vietnam must catch so that the agriculture sector can absorb a big amount of capital, technology and expand the market”, said Le Dang Doanh. According to Le Dang Doanh’s analysis, once entering TPP, Japan must open their agriculture sector. As a result, Japanese agricultural products will have to compete in prices with other countries’ agricultural products.

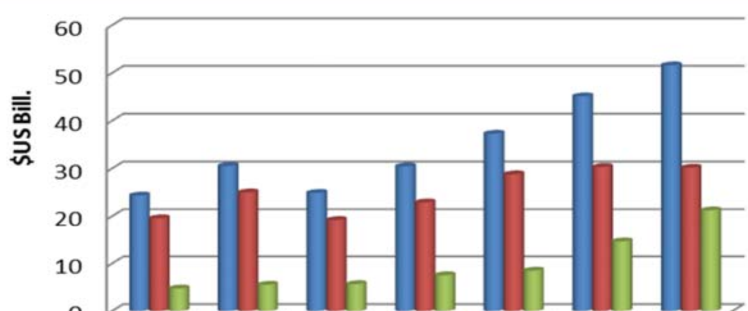
Therefore, Japan arrives to a decision to boost investment into Vietnamese agriculture as Vietnam is a member of TPP with big potential in this sector. When exporting to Japan, the tax rate will be 0%. At the same time, this can meet the condition that export products must have 70% of the intra-TPP.

Merchandise exports from Vietnam to the US have helped the poor in the Southeast Asian country very much because the process of making those goods used local laborers and created jobs, said Cu Chi Loi, director of the Institute of American Studies under the Vietnam Academy of Social Sciences.

In 2014, the US overtook the EU to become Vietnam's biggest export market, a position the European bloc had held since 2012, according to the General Statistics Office (GSO) of Vietnam. Vietnam raked in $28.5 billion from exports to the US last year, up 19.6 percent compared with 2013. The fastest growth rate was seen in such groups as textiles and garments (13.9 percent), footwear (26.1 percent), wood and wooden products (12.8 percent), and electronics, computers and components (45 percent).

Vietnam becomes the 2nd largest textile and garment exporter to the US, the 3rd largest textile and garment exporter to Japan.

Figure 1: Merchandise Trade with TPP Countries (2007-2013)



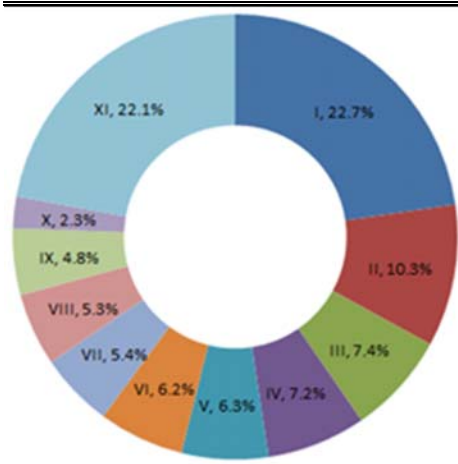
	2007	2008	2009	2010	2011	2012	2013
Exports	24.343	30.525	24.894	30.444	37.286	45.116	51.614
Imports	19.586	24.994	19.217	22.903	28.79	30.334	30.164
Trade Balance	4.758	5.532	5.678	7.542	8.494	14.637	21.228

Source: Author's calculations from General Department of Vietnam Customs data

Vietnam's major commodities exports to the TPP countries including: Textiles and garments; Crude oil; Computers, electrical, spare-parts; Foot-wears; Fishery products; Wood and wooden products; Machinery, equipment, tools; Transportation, parts and accessories; Phones and parts; Handbags, purses, suitcases, headgear ; Others products (Figure 2).

Figure 2: Major commodities Exports to TPP members 2013

No.	Major commodities Exports to TPP member	Exports in TPP (%)
I	Textiles and garments	22,7%
II	Crude oil	10,3%
III	Computers, electrical, spare-parts	7,4%
IV	Foot-wears	7,2%
V	Fishery products	6,3%
VI	Wood and wooden products	6,2%
VII	Machinery, equipment, tools	5,4%
VIII	Transportation, parts and accessories	5,3%
IX	Phones and parts	4,8%
X	Handbags, purses, suitcases, headgear	2,3%
XI	Others products	22,1%



4. Impact assessment as Vietnam joins TPP

Vietnam's participation in the negotiation for TPP participation have been bringing multidimensional impacts on the economy in general as well as enterprises and people in particular. In details:

4.1. Positive impacts of TPP

Export increases are 45-75 percent higher, in dollar terms, than the corresponding income gains, but follow similar patterns. The largest gains (in either absolute or relative terms) from the addition of Japan are for the US, Australia and Vietnam. The largest gains from the addition of Korea are for Mexico, Japan and Vietnam.

In general assessment, TPP brings huge opportunities to Vietnam for the economic growth; promoting goods and service exports to the markets of Member States in the agreement, particularly the US market, with preferential tax rate of only 0-5%. And when Japan also joins TPP negotiation, Vietnam can achieve even greater benefits such as trade facilitation and efficiency enhancement in the supply chain, service sector modernization, exports tax reduction, and import restriction improvement ...According to Prof. Peter Petri, University of Brandeis - senior adviser of United States Agency for International Development (USAID)/Support for Trade Acceleration (STAR) Project, as the least developed countries among TPP participating countries, Vietnam is expected to get the largest benefits from this economic intensive and extensive integration, specifically, according to Mr. Petri, if taking the milestone of 2025 and Vietnam's becoming a TPP member, Vietnam's GDP will greatly increase, about 26.2 billion dollars greater (assuming that TPP has 11 members) or 35.7 billion dollars greater (if TPP includes Japan) compared with basic rate of 340 billion dollars (Table 1). In other words, Vietnam's GDP in 2025 when involved in TPP will be higher compared to TPP non- participation of Vietnam, approximately 7.7% (or 10.5% if Japan also joins TPP).

Table 1. Income gains under alternative scenarios, 2025

Economy	GDP 2025 ($Bill. 2007)	Income gains ($ bill. 2007)			Percent change from baseline		
		TPP11	TPP13	TPP16	TPP11	TPP13	TPP16
TPP track economies	**26,502**	**54.5**	**128.7**	**175.3**	**0.2**	**0.5**	**0.7**
United States	20,273	23.9	77.5	108.2	0.1	0.4	0.5
Australia	1,433	2.8	8.6	9.8	0.2	0.6	0.7
Canada	1,978	7.0	9.9	12.4	0.4	0.5	0.6
Chile	292	2.0	2.6	3.5	0.7	0.9	1.2
Mexico	2,004	13.1	21.0	31.2	0.7	1.0	1.6
New Zealand	201	2.9	4.5	4.7	1.4	2.2	2.4
Peru	320	2.8	4.5	5.4	0.9	1.4	1.7
Asian track economies	**20,084**	**-22.8**	**-55.9**	**43.1**	**-0.1**	**-0.3**	**0.2**
China	17,249	-20.2	-46.8	-82.4	-0.1	-0.3	-0.5
Hong Kong	406	-0.3	-0.8	-1.3	-0.1	-0.2	-0.3
Indonesia	1,549	-1.1	-3.5	62.2	-0.1	-0.2	4.0
Philippines	322	-0.5	-1.1	22.1	-0.1	-0.3	6.9
Thailand	558	-0.7	-3.7	42.5	-0.1	-0.7	7.6
Two-track economies	**8,660**	**50.6**	**245.9**	**270.5**	**0.6**	**2.8**	**3.1**
Brunei	20	0.1	0.2	0.4	0.5	1.1	1.8
Japan	5,338	-1.2	119.4	128.8	-	2.2	2.4
Korea	2,117	-0.4	45.8	50.2	-	2.2	2.4
Malaysia	431	20.8	26.3	30.1	4.8	6.1	7.0
Singapore	415	5.1	8.1	12.3	1.2	2.0	3.0
Vietnam	**340**	**26.2**	**46.1**	**48.7**	**7.7**	**13.6**	**14.3**
Others	47,977	-7.8	-24.0	-38.0	-	-	-0.1
Russia	2,865	-0.5	-2.0	-3.0	-	-0.1	-0.1
Chinese Taipei	840	0.2	-2.9	-6.4	-	-0.3	-0.8
Europe	22,714	-1.1	-3.4	-4.9	-	-	-
India	5,233	-1.2	-3.8	-6.9	-	-0.1	-0.1
Other ASEAN	**83**	**-0.3**	**-0.4**	**-0.5**	**-0.3**	**-0.5**	**-0.6**
Rest of world	16,241	-4.9	-11.4	-16.3	-	-0.1	-0.1
World	**103,223**	**74.5**	**294.7**	**450.9**	**0.1**	**0.3**	**0.4**
Memorandum							
ASEAN+3	28,828	27.5	189.5	313.1	0.1	0.7	1.1
APEC	58,951	81.9	313.7	479.5	0.1	0.5	0.8

Source: Petri; Plummer and Zhai (2012), www.asiapacifictrade.org

a) Export promotion

Since the renovation in 1986, Vietnam has always regarded export as a motivation for the economy growth. With that strategy, Vietnam's export turnover has increased from $ 340 million in 1986 to $ 114.6 billion in 2012. Import turnover has also increased from $ 600 million to $114.3 billion in the same period. Economy opening (measured by the ratio of total import and export turnover over GDP has increased from 26% in 1990 to 186% in 2014, bringing Vietnam to one of the countries with the largest opening in the world.

The biggest goal of Vietnam’s joining TPP is to strengthen export to TPP member countries through their duty exemption or reduction for Vietnamese goods. Because TPP poses high demand of completely eliminating import duty right after the agreement takes effect, except for items of 3-5 or 10 year roadmap. Meanwhile, the Asia - Pacific currently accounts for 70% of total export turnover and 80% of total import turnover of Vietnam. Many major export markets of Vietnam became the members of TPP as US or upcoming Japan.

Assuming that Vietnamese export goods meets full conditions of the origin of TPP to enjoy preferential tariff of 0% among TPP, Vietnam's exports without TPP participation in 2025 will be $ 239 billion, and will rise by $ 67.9 billion (28.4%) to $ 307 billion with TPP membership (12 members including Japan).

The items with greatest increase include textiles, garments, footwear, and increase by 45.9% (from $ 113 billion to $ 165 billion) (calculated by Professor Petri).

In other words, TPP participation is expected to be the best route for exports of Vietnam to compete on price when partner’s market access. He cited: "Currently, China accounts for 50-60% of US garment and footwear market and Vietnam makes up about 10%. But China's exports will be halted because of increasing wages and its export policy re-orientation. So imagine if Vietnam wins that majority 50%?”.

Notably, Vietnamese rice will also have the opportunity to become a big exporter as the main rivals, including Thailand, India have not joined TPP negotiation ... On the other hand, so far, China, a major competitor of Vietnam has not offered its interest of participating in the agreement and this is an opportunity for Vietnam products to get price advantage if taking advantage of preferential tariff when accessing to internal-group markets.

b) Eliminate most tariffs and most immediate benefit from TPP joining of Vietnam.

In fact, any negotiations on the free trade agreement always discuss tariffs. However, TPP sets a high requirement of import duties elimination immediately after the agreement comes into force (excluding goods of 3, 5 or 10-year roadmap). This requirement has poses both opportunities and challenges for Vietnamese enterprises. According to statistics given by the Ministry of Industry and Trade, the US is the second largest trade partner of Vietnam, following after the EU, with imports from Vietnam reaching $ 19.6 billion in 2012, accounting for 17.1% of total Vietnamese exports. Japan ranks the 4th, with $ 13.1 billion, accounting for 11.4%. Some of Vietnam's export items including textiles, footwear, seafood and furniture are believed to have many advantages.

In fact, as some major export goods of Vietnam such as seafood: fish, shrimp, crab ... exported to Australia outside markets (New Zealand and Peru) have been applied duty rate of 0%; unprocessed seafood or furniture (mainly exported to the US market) have enjoyed tax rate of nearly 0% so benefits from these above groups will not be shown clearly when Vietnam signs TPP agreement.

However, TPP is expected to bring tariff incentives to major export products

of Vietnam such as textiles, footwear, especially to the US market. For years, US, EU, Japan have played as traditional and important markets in Vietnam's textiles exports (in which US is the largest export market). In 2014, Vietnam's textile export turnover to the US reached $ 9.96 billion, accounting for nearly 36% of total textile exports of the country ($ 29.3 billion) and accounted for approximately 9.26% of the US textile market. So far, most of Vietnam's garment exported to the US have been imposed the average tax rate of 17.3%, the highest rate of 32%, so TPP offers greater expectations, because that time Vietnam's textiles will have the opportunity to enjoy the tax rate of 0%, exports could rise 12-13% per year, instead of 7% per year currently.

Currently, Vietnam ranks second after China in footwear exports to the US market. In 2012, Vietnam's footwear exports to the US market reached $ 2.24 billion. However, in the US, Vietnam's footwear only accounted for 6% in the quantity and 8% in the values. At the signing of TPP, the average import tariff of 14.3% currently (in the US market) will be reduced to 0%. It will be a great opportunity for Vietnam to approach world's big footwear, handbags brands. However, to get this opportunity, Vietnam's footwear, handbags sectors may encounter many challenges, competititiveness with foreign investment enterprises, serious requirements on delivery quality and technical barriers, domestic market mastering capability, raw material localization ratio to ensure the eligibility for preferential tax ...

Besides, there will also be some benefits from import tax reduction from TPP countries,

specifically, consumers and production sectors using raw materials imported from these countries as input materials will benefit from goods, cheap raw materials, reduce the cost of living and production, which can improve competitiveness of these industries ...

c) TPP will create great opportunity for Vietnam to attract Foreign Direct Investment (FDI).

Among TPP participating countries, Asia only includes Malaysia, Singapore, Brunei and may be Japan. Thus, viewing from a certain aspect, Vietnam will only have to compete with Malaysia to attract FDI. In relation to the regional "rivals" today as Thailand, Indonesia, Myanmar, as a TPP member state, Vietnam will more or less advantageous in the race of FDI attraction. Currently, Japan, Singapore, Malaysia, US- countries participating in the TPP negotiations- are the leading investors in Vietnam and probably enterprises of these countries will continue to ramp capital in Vietnam to take advantage of cheap labor, open export markets. Of course, not only investors from TPP members, but also from others countries and regions will also be more interested to Vietnam because of advantages brought by TPP, including Korea, China.

Foreign investors will look at the opportunities generated by open export markets open, low tariff, to come to Vietnam. Additionally, cheap, diligent, clever labor, Vietnam will attract more FDI. Recently, many foreign investors have come to Vietnam for investment promotion or expansion with a view to catching opportunities of recovery economy and Vietnam's TPP membership. In 2013, there have been $ 453 million of FDI capital invested in textile and fiber sectors. It is expected to be about $ 1 billion invested in this sector in the future. In fact, investors shall pay attention to sectors with many exports advantages, especially textiles and footwear.

Mr. Chris Freund, CEO of Mekong Capital also said that an increasing number of foreign investors shall come to Vietnam to benefit tax when exporting goods to TPP countries,

especially the US and Japan - two world's big import markets, ranking the top and the fourth respectively. To take advantage of this opportunity in the shortest time, foreign investors will take Mergers and Acquisitions (M&A) to save time. So, M & A activities in Vietnam shall boom with the TPP participation of Vietnam.

d) With the opening of Vietnam market for goods and services from TPP countries, it is expected to have a more competitive business environment making goods and services

cheaper with better quality. With more technology, machinery, materials at lower prices, as well as new management models, and methods, enterprises will do business more efficiently. Moreover, there is expectation about benefits from foreign investment expansion, including the generation of production, jobs, revenues from taxes ...

đ) From the perspective of state management, following advantages brought by WTO,

TPP may offer a effective wave of institutional and administrative reform matching with international common practice. According to Le Dang Doanh, "Joining TPP will promote reform in Vietnam". One of the reforms will be on the rights of employees. With TPP, employees will be free to form unions, free to negotiate labor contract with employers. This may conflict with Vietnam's Trade Union Law, and force Vietnam to adjust to suit with international commitments. Joining TPP also requires Vietnamese policy makers to complete the legal framework to attract foreign investment. It is also required to determine incentives rights of state-owned enterprises to comply with the fair play rules among enterprises, to change government's expenditure policy, transparentize information.

e) In addition, Vietnam’s TPP joining is also an opportunity to balance trade exchange

with powerful markets, including solving the high deficit in business relationship with China. Considering overall benefits to the Vietnamese economy when joining TPP in spite of some certain disadvantages as described below, the benefits (in theory at least) are still greater compared to TPP non-participation.

4.2. Negative impacts of TPP

Besides said above favorable factors, Vietnem's TPP participation could impose some certain negative impacts that Vietnam should consider to proactively offer measures to deal with.

a) According to the reciprocity the principle in the international trade, Vietnam's exports benefiting from the tax reduction in TPP also means that goods from TPP partner countries imported into Vietnam will also enjoy corresponding benefits. As a result:

b) Budget revenues received from import duty will reduce because the import duty will

reduce to 0%. However, revenue reduction is expected not to be at large quantity as many countries within TPP have got FTA with Vietnam;

c) Domestic competition will be more fierce thanks to an increase in imports from TPP

members countries in Vietnam because of the removal of the average tax rate of 11.7% at present, and the price and quality will be more competitive as well. This will have certain impact on domestic market, demanding Vietnamese enterprises to actively adapt enhance business production capacity and improve product quality and competitiveness.

It is worth noting that according to a representative from Vietnam Textile (Vinatex), in the future, there will be a Chinese investment wave into Vietnam's textile sector, mainly garment sector. So, it will make it more difficult for Vietnamese enterprises to compete with TPP agreement. Meanwhile, Vietnam's garment enterprises have currently shown poor competition, mostly due to made-by-hand process and their over-dependence on raw materials imported from China.

Partner countries use technical barriers to protect domestic production.

Anti-dumping lawsuits occurring in recent years show that this is a great threat to

Vietnam manufacturers in competing on the international market. Domestic business community shows their high concerned about the high and complex demand of origin in TPP while export raw materials of Vietnam, especially garments, footwear, mainly are mainly imported from non-TPP member countries. In addition, intellectual property protection highly emphasized by the US also poses concerns to the Vietnamese's access to medicines, knowledge, science, cultural and spiritual property.

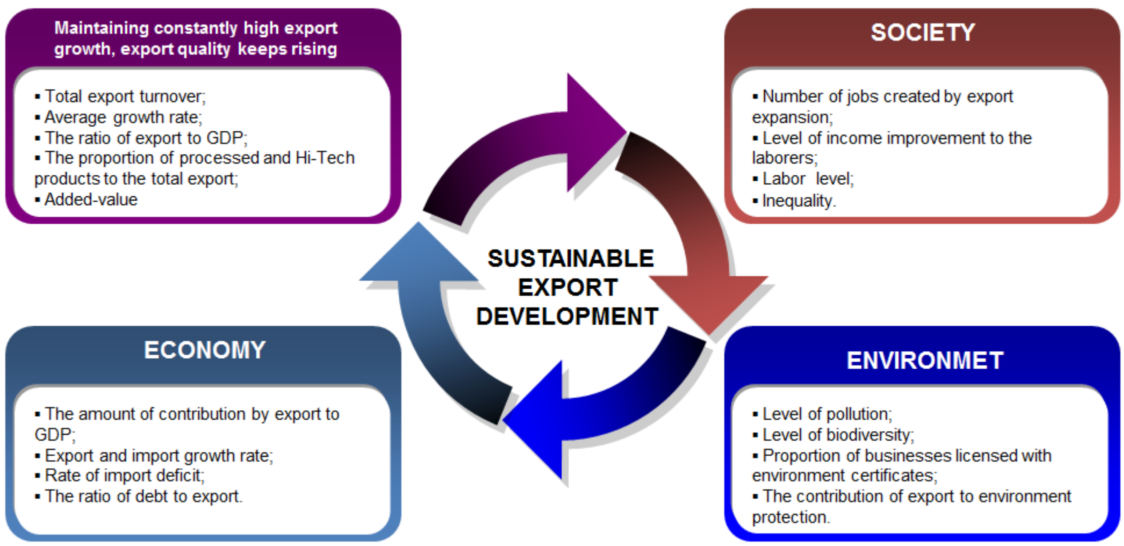
5. Sustainable Export Development in Vietnam's Enterprises

5.1. Summary of sustainable export

Sustainable development has become an inevitable global trend. It is also the goal of nations worldwide. Generally speaking, sustainable development indicates development meeting the demands of the existing generation without having any impacts on demand satisfaction of future generations. In other words, sustainable development ensures the quality of development, harmonizing economic goals with social and environment ones.

Ensuring sustainable development of an economy requires sustainable development in all sectors, in which trade in general, export in particular, are parts of the whole process. For countries having export-oriented economy, sustainable export contributes to the overall sustainable development of the economy. Sustainable export is maintaining high and steadfast export growth with constantly improved export quality, thus contributing to economic growth and stability, social order and environment protection. Sustainable export is the combination of these two factors. Firstly, maintaining high and steadfast export growth with constantly improved export quality. Secondly, harmonizing the different elements of sustainable development, namely the economic, social and environment (Figure 3).

Figure 3: Sustainable Export Development



Source: Compiled from multiple authors

Export is an economic activity, part of the overall economic activities, therefore, sustainable export is quite similar to economic sustainable development, meaning that maintaining constantly high growth, ensuring growth quality on the basis of increasing export added value, shifting export structure towards modernity, ever-rising competitiveness of export products. Inconsistent export growth poses many risks especially when there are sharp fluctuations due to inappropriate structure, low competitiveness of export products, decline in export growth, thus destabilizing the macro-economy. Therefore, inconsistent export growth cannot be seen as sustainable export.

Sustainable export should also meet the requirements of sustainable development for harmonization among economic, social and environment elements. Constantly high export growth with increasing quality but heavily relies on exploiting natural resources and causes much pollution, in other words, trading off the environment for high export growth, should not be seen as sustainable export. Or export only serves the interests of a particular group of people, especially in exploiting natural resources. This situation happens mostly in countries where there is low democracy, dictatorship, centralization of power. In this case, unfair benefit sharing exits, therefore it should not be considered sustainable export.

In Vietnam, export is a strategic orientation in economic development. During the years of the Renewal Policy, export is among the major motivators of economic growth, helping solve some social issues and protect the environment. However, export in Vietnam during the past years has not been sustainable. The quality of export growth has been insubstantial, risky and export has not presented the cause of industrialization and modernization. Export has been overusing natural resources, causing environmental pollution and ecological imbalance. Current export also raises social issues, such as unfair distribution of benefits from export. The Government has established Decision 432/QĐ-TTg dated April, 12, 2012 of the Prime Minister on ratifying Sustainable Development Strategy for Vietnam, period 2011 – 2020.

During the negotiation of TPP and RCEP, etc., the export orientation of Vietnam is to adopt policies enhancing export quality, supporting export structure shifting towards adding value, restricting exploitation of natural resources and environmental pollution. Export should also be part of the solution to social issues, such as creating jobs, increasing income and reducing inequality in income distributions, etc.

In order to ensure sustainable export, sound and appropriate policies grounded in science research should be in place. These policies take the harmonization of the economic, social and environment goals into consideration. However, over the past years, the formulation of sustainable export policies has not been grounded in the theoretical basis and reality of sustainable development. Therefore, it is important to establish scientific criteria as the basis for managers to develop policies ensuring sustainable export. The main purpose of this article is to clarify the concept, contents and criteria for sustainable export, to access export activities of Vietnam in accordance with the criteria for sustainable development and to propose some solutions to foster sustainable export in Vietnam in the coming years.

5.2. Criteria for sustainable export

5.2.1. Criteria for stability and quality of export growth

- The scale and average growth rate of export turnover at a certain time. This criteria indicates the maintenance of the export scale and growth, which is the annual export turnover and the average export growth. The scale of the export turnover is demonstrated by the ratio of a country's export turnover to the total export turnover of the world or a particular region. The average growth rate of export should be compared to GDP growth rate.

- The ratio of export to GDP is also an indicator for the sustainability of export activities on the economic terms. Accordingly, the rapid growth of the ratio of export to GDP shows the openness of an economy within the context of international economic integration.

- The quality of export growth is demonstrated by the structure of export in terms of commodities' categories as well as the processing level. For example, the ratio of export turnover for high-technology goods to the total export revenue of a country shows the industrialization level of that country as well as the value-added rate of the export goods.

- The increase of the value of export goods. This is a very important index to evaluate the efficiency of exporting activities as well as the competitiveness of export goods.

The sustainability of exporting activities is also indicated by other elements, for example the quality of operation of the financial and banking system, export-facilitating services, socio-economic infrastructure and the distribution channel, etc.

5.2.2. Criteria for economic sustainability

- The contribution of export to GDP growth is shown by the percentage of export on GDP growth or the percentage point of export on GDP growth.

- Index of debt over export. Actually, this index demonstrates the safety level in terms of financial capabilities of a country, i.e. the contribution of export to the foreign reserve and balance of payments. If the index of debt over export increases constantly during a long period, it means that both debt and deficit in the balance of payments have gone over the limit. Otherwise, if this index has a tendency to decrease, it means that the current debts are within limits and the country is able to pay her debts.

- The ratio of export growth to import growth also displays the macro-stability of the economy. If this ratio is greater than 1, it reflects the healthiness of the balance of trade thanks to export growth. This ratio also indicates the healthiness of the current account balance.

5.2.3. Criteria for environment sustainability

- The level of environmental pollution is calculated by the concentration of environment elements such as air, water, land and solid waste, etc, for example, the connection between export growth and level of environmental pollution or the level of environmental improvement. Sectors having great impacts on the environment include agriculture, textile, footwear, chemicals, steel, cement, etc.

- The level of maintaining renewable resources and the level of using non-renewable resources. For example, deterioration of biodiversity or improving it under the impact of export expansion, such as aquaculture export and narrowing mangrove forests, export growth in forestry products and narrowing primary forests, affecting the number of sacred plants and animals, etc.

- The proportion of businesses licensed with environment-friendly certificates. For example, the proportion of businesses licensed with International Organization for Standardization (ISO) 14000 certificate.

-The amount of contribution by export to environment protection expenses. In reality, it is unfeasible to separate the contribution by export to environment protection activities. However, we can see this contribution through export's contribution to economic growth.

- The ability of the administration to manage export activities, which can eliminate the negative impacts on the environment, as well as the awareness of the people to protect the environment. This criteria is reflected in policies aimed at boosting exports, at the same time protecting the environment.

5.2.4 Criteria for evaluating social sustainability

- The level of new jobs being created brought by export expansion. This can be seen through analyzing the relationship between export expansion and labor attraction, thus creating new jobs.

- The improvement level of people's income brought by export activities. Index of income, the rate of poverty can be used to evaluate social sustainability regarding export.

- The proportion of export businesses adopting measures to improve the working environment and conditions, for example the application of Social Accountability (SA) 8000.

- Social sustainability regarding export can be evaluated through analyzing mechanisms of sharing benefits from export, for example demonstrations, strikes by the workers, surveys on income inequality, etc.

- The sustainability of export can be accessed through policies in favor of export, for example export subsidies, export tax return, export insurance, etc.

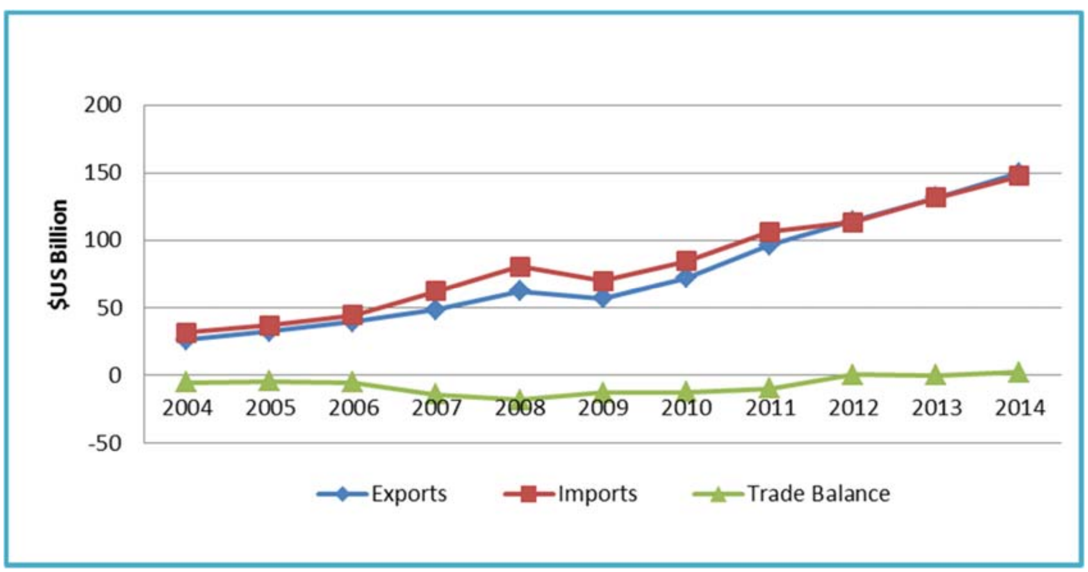
5.3. Accessing Vietnam's export activities in accordance with the criteria for sustainable development

5.3.1. The scale and export growth of Vietnam period 2004 – 2014

Export growth of Vietnam period 2004 - 2014

Accessing export turnover of Vietnam period 2004 – 2014: Export fluctuated more sharply than ever before. In 2008, export rose dramatically, at 29.1%. However, in 2009, under the impact of the global financial crisis, export declined at 8.9%, but in 2010, rose again at 26.5% and continued rising to 34.2% in 2011; rose at 18.2%; 15.3%; 13.7% in 2012, 2013, 2014 respectively (Table 2).

Figure 4: Imports-Exports value and Trade balance 2004-2014



Source: Author's calculations from General Department of Vietnam Customs data

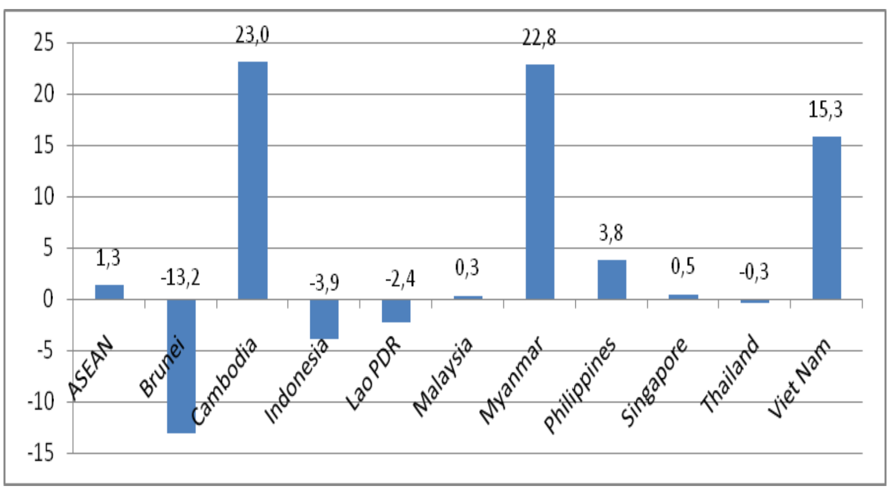
Table 2: Import-Export value , GDP and Trade Balance

Year	Exports ($US Bill.)	Exports growth rate (%)	Imports ($US Bill.)	Imports growth rate (%)	Trade Balance ($US Bill.)	GDP growth rate (%)	Exports /GDP (%)
Năm 2004	26,51	31,54	31,95	26,52	-5,44	7,79	58,4
Năm 2005	32,44	22,4	36,98	15,7	-4,54	8,44	61,1
Năm 2006	39,83	22,8	44,89	21,4	-5,06	8,17	65,3
Năm 2007	48,56	21,9	62,68	39,6	-14,12	8,5	68,2
Năm 2008	62,69	29,1	80,71	28,8	-18,03	6,18	71,3
Năm 2009	57,10	-8,9	69,95	-13,3	-12,85	5,32	59,3
Năm 2010	72,24	26,5	84,84	21,3	-12,6	6,78	70.9
Năm 2011	96,91	34,2	106,75	25,8	-9,84	5,89	80,8
Năm 2012	114,53	18,2	113,78	6,6	0,75	5,25	82,5
Năm 2013	132,03	15,3	132,03	16,1	0,0003	5,4	77,5
Năm 2014	150,19	13,7	148,05	12,1	2,14	5,42	80,2

Source: Calculated from GSO data of Vietnam.

According to the GSO and ASEAN Community in Figures (ACIF) SE 2014, commodity export turnover of Vietnam reached US$132 billion, 15.3% higher than 2012 (Figure 5). In comparison with other Association of ASEAN countries, Vietnam's exports in 2013 continued to maintain relatively stable growth rate and much higher than that of ASEAN as the whole.

Figure 5: Export Growth Rate of ASEAN Countries in 2013 (Percentage)



Source: GSO and ACIF SE 2014

In 2013, three exporting items valued over US$10 billion, making up 37.7% of total export value. The highest item was phones and parts with US$21.2 billion, followed by textile US$17.9 billion and computers, electronic goods and parts with US$10.6 billion. The exporting group which valued from US$5 billion to US$10 billion, accounted for 25.7% of total export value, including 5 items, i.e. footwear, crude oil, seafood, machinery, equipment and their components, wood and wooden products. Group which valued from US$1 billion to 5 billion comprised of 14 items, making up 22.0%. The rest under US$1 billion accounted for 14.6%. Most of the major exporting items of Vietnam in 2013 gained relatively high growth rate, in which phones and parts increased by 67.1% against 2012; computers, electronic goods and parts increased by 35.3%; textiles, footwear maintained high and stable growth of 18.8% and 15.6% respectively; seafood products rose by 10.2%. Particularly, coffee exports decreased by 26%; rice by 20.4%; rubber by 12.8%.

According to statistics from the Ministry of Industry and Trade; and Dr. Tran Du Lich, Member of the National Assembly's Economic Commission, in the 2011 - 2014 period, Vietnam's export growth rate is always three times higher than its GDP growth rate and higher than its import growth rate. Merchandise export growth was 19.4 percent a year on average. Export value jumped from US$96.9 billion in 2011 to estimated US$150,19 billion in 2014. Export structure was shifted in a positive direction, featured by a lower proportion of crude exports and a higher proportion of processed products and industrial products. Export scale was expanded, focusing on key exports. More exports brought in over US$1 billion a year for the country year after year. In 2014, Vietnam is expected to have 24 exports each generating over US$1 billion of income, accounting for 86 percent of total export items. Export markets are being expanded and have reached most markets around the world. Many products have established strong standings and competitiveness in demanding markets like the EU, Japan and the US.

Regarding the ratio of export commodities to GDP, it stood at 64.3% in 2008, after joining the WTO; at 77% in 2013; at 80,2% in 2014, which was much higher than the period prior to the Renewal Policy and integration process. Vietnam's ratio is quite high regionally and globally. It is hopeful that this ratio will be even higher when the TPP is concluded and Vietnam utilizes the export opportunities offered by TPP members.

At the end of December, 2014, the balance of trade by commodity enjoyed surplus at US$ 2.14 billion, therefore it is quite obvious that Vietnam will continue getting export surplus, or even the surplus of the balance of trade will double or triple those of 2012 and 2013. After two decades of constant deficit in the balance of trade, the spectacular reverse during the past three years has performed an export miracle for Vietnam with the annual growth rate at 14%, setting a record of US$ 150.19 billion.

Export markets of Vietnam

EU continued being the largest export market of Vietnam with export turnover at US$ 24.3 billion in 2013, accounting for 18.4% of the total export turnover and rising by 19.8% (approximately US$ 4 billion) compared to 2012. The major export commodities to EU included: variations of telephone and components valued at US$ 8.1 billion; sandals at US$ 2.9 billion; textile at US$ 2.7 billion; computers and components at US$ 2.2 billion. The U.S. got the second position with export turnover at US$ 23.8 billion, accounting for 18% and rising by 21.2% compared to 2012. The U.S. was also a major market for Vietnam's main export commodities, such as textile valued at US$ 8.6 billion, sandals at US$ 2.6 billion, timber and wooden products at US$ 2 billion. Vietnam' export to Japan in 2013 reached US$ 13.6 billion, accounting for 10.3%, up 4.3% against 2012. ASEAN was among the most significant trading partners of Vietnam and the motivator helping Vietnam maintain economic and export growth over the past years. In 2013, ASEAN – Vietnam two-way trade reached US$ 39.7 billion, increased by 3.9% compared to 2012 and taking up 15% of Vietnam's total import-export turnover. Currently, Vietnam ranked 5th in terms of import-export turnover with ASEAN, behind Singapore (US$ 206.7 billion), Malaysia (US$ 119.1 billion), Thailand (US$ 103.7 billion), Indonesia (94.7 billion).

5.3.2. The quality of export growth

The quality of export growth from the perspective of export structure shifting

Main export products include outsourced commodities and raw materials. Particularly in 2012, the proportion of export turnover for raw material was still large (Crude oil, coal, ores and minerals alone reached US$ 9.65 billion, accounting for 8.4%). Agricultural, forestry and aquaculture, unprocessed or preliminarily processed products still kept high proportion (valued at US$ 27 billion, accounting for 23.6%). Outsourced and assembled products also took the large share (the turnover of textile, sandals, textile fiber and materials, footwear, computers, electronic components and others was over US$ 33 billion, accounting for 29%). The above three categories of commodities had already took up more than 60% of national export turnover.

According to Deputy Minister Le Danh Vinh and economic experts, Vietnam's export structure over the past years had significantly changed, for example, the proportion of processed commodities increased while that of raw materials declined, export markets were diversified and both the private sectors and foreign direct investment enterprises took the bigger roles. Despite growth, export in Vietnam had not been sustainable. Export scale was still small and incommensurate with the potentials. Most of the export commodities were produced by foreign direct investment enterprises and mostly based on cheap labor and outsourcing, rather than commodities with high technology contents. Vietnam only made use of available comparative advantages to develop export and she had not fully utilized competitive advantages to produce commodities with high technology contents and added value. Export products were still low in value and had not been present in the manufacturing and circulation chains of regional and global Transnational Corporations. Moreover, the shifting of export structure in Vietnam lately had not clearly demonstrated the industrialization and modernization trend, evidenced by the proportion of raw, preliminarily processed commodities and products of low value was still large.

The added value of export

Although the growth rate of Vietnam's export is very high, the added value by export commodities is still modest compared to the total export turnover. The reason for low added value is the fact that export is mostly based on natural resources exploitation, cheap labor, low-technology manufacturing requiring intensive labor to produce mid-tech components. The export policies over the past years mainly focused on quantity targets and did not pay enough attention to export quality and efficiency.

Many of the export products, including those with large turnover, do not have their own brands, normally export of these products are made through another partner, therefore prices are often lower than other countries' products of the same type.

The competitiveness of export commodities

Lately, there has been improvement in the competitiveness of Vietnam's export products, but, basically, this competitiveness is still low compared to other countries in the region, particularly China and ASEAN members. Vietnam is highly competitive in sectors engaging natural resources and cheap labor. However, when compared to Thailand, China, Vietnam's competitiveness in labor-intensive sectors, such as textile, footwear, assembling, etc., is still low.

The possibility to join the global value chain

Vietnam has only joined segments that create the least value in the global value chain. These segments include outsourcing, assembling, providing raw input materials. If Vietnam's competitiveness is not improved adequately, her capacity to join segments creating high added value will be restricted, thus preventing constantly rapid export growth.

5.3.3. The contribution by export to macroeconomic growth and stability

Contribution to GDP growth

Export growth has contributed greatly to GDP growth, by creating more jobs, consuming farm produce and cutting inventory. This outcome confirms the gradual efficiency of the export guidelines over the past years, also reflects the ever-expanding export production ability. Furthermore, export growth has significantly helped with controlling import surplus. Trade surplus in 2014 was maintained at US$ 2 billion.

During the recent years, foreign direct investment enterprises have also contributed substantially to economic and export growth. In 2014, foreign direct investment sector keeps on with holding a high position in creating value and driving export growth. In 2014, the export turnover of foreign direct investment enterprises was estimated to be US$ 101.8 billion, up 15.4% against 2013, accounting for 67.9% of the national export turnover.

Ensuring macroeconomic stability

Besides strengthening the balance of payments, export increases the foreign reserve. The currents debts of Vietnam are still within the safety limits. The ratio of debts to GDP is about 40% and the ratio of debts to export is on the decrease and lower than the alarming rate. However, export still poses potential risks to the economy's stability. Firstly, the structure of export commodities is holding risks to the national budget revenue and export development in the context of free trade. Secondly, the high protectionist trade policy for capital intensive sectors but employing just a few people and towards replacing importation, thus distorting investment and bringing about unsustainable GDP growth, as well as burdening the country with foreign debts in the upcoming context of free trade. Thirdly, given the current high level of openness, the national economy heavily depends on the global economy. Hence, if reforms and improvement of competitiveness do not accelerate, fluctuations on the global market will surely radically affect macroeconomic stability and social safety. Fourth, safety for the laborers in the export-oriented sectors is not high, therefore, it is very likely that the laborers will lose their jobs and receive less payment when there are sharp market fluctuations.

5.3.4. Export and environment issues

Export in connection with the maintenance and improvement of resources and biodiversity

The considerable economic benefits brought by agricultural, aquaculture commodities stimulates the producers to preserve and further develop them. Science-based farming techniques restricting chemical fertilizers while promoting organic ones and crop rotation have positive effects in enriching soil fertility, etc. The development of plants' varieties with high economic value by utilizing traditional sacred genes, such as lychees, bananas, forest specialities, has helped maintain and further develop resources and biodiversity, thus ensuring ecological balance.

However, export activities of the country over the recent years have disturbed biodiversity, most notably the promotion of agricultural and aquaculture exports based on width has narrowed the forests, affecting terrestrial and coastline ecological balance due to expansion of cultivated area. Fry and many aquatic species are disappearing due to destructive fishing methods by dynamite and small meshes. Natural forests of our country are being narrowed by the expansion of farmland for growing high export value plants, such as rubber, coffee and cashew nuts. Illegal timber harvesting is also leading to narrowing the primary forests. Wildlife trafficking is the main reason for biodiversity decline, only behind forest fires and deforestation. Therefore, if Vietnam's export continues to be grounded into the width-oriented model on the basis of mobilizing the available comparative advantages, it will be challenging for Vietnam's export growth to remain high. Besides, increasing competitiveness worldwide under the impact of the global economic recession is putting pressure on Vietnam to rapidly shift to a new model of growth.

Export in connection with environmental pollution and improvement

Export-oriented economic development has created favorable conditions for Vietnam to garner high technologies causing low or zero pollution and saving materials. Applying innovative, clean technologies, environment-friendly production methods and outstanding breeds and seeds has facilitated crop yields and livestock, thus decreasing the expansion of farm land and positively affects biodiversity preservation.

However, national export still holds potential risks of environmental pollution. Improper and excessive usage of fertilizers, crop protection chemicals aiming at producing good crop yields and livestock, is among the factors causing environmental pollution, especially facilities for agricultural, aquaculture products, textile, footwear, craft, wooden furniture, etc. Exploiting minerals for export, particularly coal and other minerals by artisanal mining, causing soil, water and air pollution and declining biodiversity.

Capacity to meet environment requirements and standards

Many businesses have applied new production methods, renovated technologies, saved input materials, changed fishing and farming methods in order to better utilize resources and biodiversity, such as aquaculture, agricultural and forestry products. By doing so, it has enhanced the competitiveness of Vietnam's products and restricting environmental pollution within the country.

However, it is still challenging for the businesses to meet environment requirements for export commodities. Due to limited awareness, obsolete processing technologies, lack of information about importing countries' regulations, it is common that Vietnamese exporters do not comply with environment and hygiene requirements by the importers.

Therefore, the new model of growth should be based on in-depth development, making use of mobile competitive advantages to boost export productivity, quality and efficiency, by means of institutional reform, innovative technology application, human resource improvement, modern infrastructure development. Shifting from export development based on width to depth, from relying mostly on available comparative advantages to mobile competitive ones is the decisive factor for the quality of export growth, maintaining high growth, improving economic efficiency, enhancing the competiveness of export commodities, in tandem with the dramatic market changes, thus minimizing risks by adverse global fluctuations.

5.3.5. Export in connection with social issues

Export in connection with jobs and income

Export has helped stimulate GDP growth, thus increasing per capita income. Per capita export turnover of our country rose from US$ 31 billion by 1991 to US$ 1,290 and US$ 1,435 by 2012 and 2013 respectively, and increased greatly compared to US$ 830.5 by 2010. Export expansion of intensive-labor sectors, such as footwear, textile, craft, aquaculture and agricultural products, wooden furniture, has created a great number of jobs and increased income for part of the low-income population, especially those working in agriculture. However, Vietnam's export is still based on width, thus the skills of the laborers are still modest and their incomes are unstable.

Export in connection with social equality

First of all, trade liberalization has deepened the gap between the rich and the poor and increasing inequality among regions and people of different social strata. Various trade opportunities lead to various incomes. Above all, unsuitable trade policies also bring about unequal distribution of economic benefits among people of different social strata. The low-income population and those working in agriculture are disadvantaged in sharing added value brought by integration and free trade.

Export in connection with labor quality and skills

Export development by transferring and creating new technologies and advanced management methods has contributed to training managers and business persons. The integration process has also been instrumental in strengthening human resources in all aspects of modern life. However, as export quality is slow in getting improved and export growth is mostly driven by cheap labor, therefore, it takes quite some time to fully strengthen export growth. This will affect the shifting among sectors to shield against sharp market fluctuations.

6. Policy Recommendations to sustainable export in Vietnam

6.1. Improving the quality of export growth

Enhancing business climate, creating a fair and healthy business climate for all the enterprises

First of all, it is necessary to improve the legal system to enhance the business climate in Vietnam in the direction of ensuring the legal basis and equal business conditions, applying “common rules” of the domestic and international market. In order to do this, timely and flexible policy response is required so that protective measures, incentives to domestic manufacturing can be applied if necessary, in accordance with commitments to opening the markets and international economy integration as stipulated in regional free trade agreements and international agreements Vietnam has signed (WTO, FTAs, AFTA, RTAs, ...) as well as agreements Vietnam are currently negotiating, namely TPP, RCEP.

Next, it is necessary to formulate a policy on competitiveness in order to foster and promote fair and healthy competition, thus contributing to the overall business climate and maintaining sustainable economic growth. This policy should avoid discrimination among economic sectors and types of businesses (State-owned, private or foreign) and the disguise of inappropriate subsidy, monopoly, which are major barriers to national development. A sound policy of competitiveness will also help increase social productivity and bring significant economic reforms.

Building a strategy for enhancing the competitiveness for Vietnamese export products

The competitiveness enhancement of the export products is mainly based on increasing the high technology contents, quality of the labor in order to raise the added-value of export products, heading towards ingenious and high value-added orders. Given the reality of Vietnam at the moment, we cannot immediately join fully the Research and Development and the Design, but we can absolutely be part of the two following segments, namely Branding and Distribution. Therefore, the strategy for competitiveness enhancement of Vietnamese export should focus on these segments.

Along with enhancing the competitiveness of export products, at each of a specific period, the Government should approve and enforce the Program specifying key export products of each of the sector. The businesses are also oriented by the Government towards developing strategies for doing business, export products for both short and long term, concurrently, making wise choice of “strategic product lines”, thus having focal investment and diminishing risks. Besides, it is required to continue diversifying the export structure and the comparative advantages of Vietnam towards: firstly, developing new major exported products; secondly, shifting towards products with high added value and high technology contents.

Shifting the structure of comparative advantages and export products

Moving towards terminating exporting products in the form of raw material, preliminarily processed products, gradually increasing exporting processed ones; rapidly moving away from outsourcing light-industry products and crafting, instead enhancing exporting hi-tech products, thus increasing export values and achieving sustainable export.

In order to raise the value of export, the solution is to refrain from increasing exporting raw material or preliminarily processed products which has low added-value (moreover, currently the export volume of raw material is already high while resources are depleted). Instead, the solution is to shift the comparative advantages structure towards exporting processed products, cutting-edge products with high added value. Moreover, guidelines are needed to foster rapid advancing from outsourcing and assembling towards higher segments in the global value-added chain.

The focal measures include:

- Developing high-quality human resources and boosting Research and Development (R&D), advancing Design and Manufacturing with a view to rapidly shifting the export growth model from primarily relying on available advantages of resources, abundant and cheap labor, towards getting mobile advantages of skilled labor, science and technology.

Besides developing skilled labor, attracting R&D, Design and Manufacturing activities by Transnational Corporation (TNC) is considered as top priority. This is a shortcut to develop R&D in Vietnam. In order to achieve this, Vietnam should improve technology development and transfer policy in the direction that encouraging R&D activates right in Vietnam by TNCs and enhancing protection of intellectual property, industrial patents on science and technology and industrial products. Protection of intellectual property has always been the concern of TNCs upon their investment in a particular country. If TNCs' intellectual property is well protected in Vietnam, they will not hesitate to invest capital and transfer technology to partner businesses in Vietnam. This will offer an opportunity for Vietnamese businesses to approach new technology and know-hows, getting more investment in R&D, thus enabling them to join more important segments of the global value chains created by TNCs.

- Creating a business climate conducive to attracting foreign direct investment, thus increasing investment capital, transferring innovative technologies and management skills by TNCs.

First of all, the Government should adopt policies encouraging all economic sectors to invest in export. The investment by the State Budget should prioritize creating infrastructure, training human resources, R&D and promoting trade and investment.

Besides the maximum mobilizing of all the internal resources for export development, it is necessary to create favorable business climate, carry out administration reforms, aiming at attracting foreign direct investment to increase the overall investment capital. Particularly, the focus is on stimulating investment from foreign businesses who are already operating in Vietnam, especially Multinational Corporation (MNC)/TNCs and their transfer of innovative technologies and management skills in high technology, intellectual work, thus adding value to export.

- Upgrading the infrastructure and further developing industrial zones and clusters, calling for the investment from the private sector, including from foreign companies, in commensurate with the potentials and the demands of such a dynamic region, thus developing the overall infrastructure in general and the industrial zone's infrastructure in particularly, heading for export-designated industrial zones, clusters.

- Fostering the development of supporting industry, attracting foreign investment and encouraging businesses of all sectors to join in developing supporting industry, thus increasing the proportion of localization in export products.

The Government should create a stable climate for FDI businesses and adopt specific, long-term policies and mechanisms facilitating supporting industry, thus providing components and accessories for export. In reality, the localization of components and accessories should begin with attracting foreign direct investment from international providers, after that, gradually improving the capacity of domestic providers. At the initial stage of industrialization process of Vietnam, foreign direct investment businesses play the leading role and make up the majority in the supporting industry.

In addition to attracting foreign investment in supporting industry, the Government should implement policies encouraging businesses of all economic sectors to join in the development of supporting industry, particularly small and medium ones, also consolidating the linkages and the bonds among state-owned businesses with the private and the foreign ones.

- Making choice of active participation into the global value chain, selecting a specific field, focusing on products of strength, thus generating high competitiveness, moving towards becoming an important part in the global value chain regarding major exported products.

The businesses should be oriented by the Government to develop domestic chains of export products in the direction that taking shortcut is possible, not necessarily taking step by step of the value-added chain, thus setting a precedent for participating the global chain. On that note, businesses should be proactive in joining the above chains, wisely selecting prioritized segments to make good use of the comparative advantages, enhancing management and leadership capacity of the chains.

Seeking for niche markets and enhancing trade promotion activities, expanding export markets

Capture niche markets. In order to expand export markets, besides capturing and maintaining traditional markets by raising the quality of products and offering competitive prices, it is crucial to seek for niche markets ands offer suitable export products that can meet the demands of these markets.

Strengthening trade promotion. Information collection and dissemination as well as forecasting tasks should be strongly promoted to direct manufacturing and export activities. Research on establishing a Trade Promotion Fund should be carried out with the participation of businesses. This Fund will support businesses in trade fairs, exhibitions and expos, etc. Major export promotion programs should also be effectively conducted. The role of diplomatic, trade representative agencies overseas needs to be consolidated. The Government should encourage and facilitate businesses to open branches, representative offices or trade centers overseas, so that businesses are able to capture the demands, tastes of the market, as well as promote products, brands and sign contracts for product consumption.

6.2.Harmonize export growth with environment protection

- Raising the awareness of competent agencies and businesses of environment protection: The measures include launching training programs about environment protection and sustainable development and enhancing information dissemination.

- Integrating environment protection right into the process of strategy developing and investment project planning: Resolutely refusing to put facilities below environment protection standards into operation. Firstly, adjusting export development strategy under consideration of environment issues. There should be a scientific analysis of the interaction between targeted export growth and the environment impacts by export growth.

- Assisting businesses with the application of environment-friendly manufacturing processes and technologies: Stimulating the development of science and technology, especially environment-friendly ones. There should be incentives for importing innovative, green machinery and technologies, particularly pollution tackling and treatment ones. Researches on environment-friendly manufacturing processes and application at businesses are strongly encouraged, such as safe vegetable, meat, aquaculture, etc production processes. The businesses are also supported to get environment certificates for export products for example inspection centers, technology consultation and assistance centers. They are also financially supported when it comes to getting environment certificates through environment or export supporting funds. Moreover, businesses are also supported with information, technologies, for example developing environment-friendly business strategies; increasing the availability of input materials; strengthening the cooperative ties between small and medium enterprises with other businesses which are experienced in applying environment standards and regulations; assisting businesses in applying advanced environment management models, namely ISO 9000,ISO 14000, Hazard Analysis & Critical Control Points (HACCP), etc.

- Building national standards in commensurate with international ones:

+ Disseminating international environment regulations and standards to the managers and businesses, for example, the ones relating to WTO: Technical Barriers to Trade (TBT), Sanitary and Phytosanitray (SPS), Trade-Related Aspects of Intellectual Property Rights (TRIPS), ASEAN; multilateral environment agreements concerning trade: Biological Diversity (CBD), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Basel Convention, etc.; environment regulations and standards of other countries and of markets, such as the US, EU, Japan, etc. The purpose is to make businesses realize the importance of such regulations and standards when they export their products.

+ Building national standards: The building of national standards is very crucial in encouraging businesses to operate accordingly to domestic environment requirements as well as enhancing their competitiveness, reputation when integrating internationally.

- Improving policies and guidelines regarding the environment and export: Constant researches and specifically adding the List of commodities restricted or banned from export or commodities presenting hazards to the environment are required. There should also be constant modifying and adding categories of tax or export tariffs to stimulate export, concurrently, eliminating over-exploitation of natural resources.

- Applying rules and regulations, economic tools in environment management, enhancing examination and inspection: It is necessary to establish criteria for sustainable development under consideration of environment protection. It is also required to improve and establish national environment standards, or even standards for a particular sector, in line with international standards. Environment management is heightened, violations against environment protection are strictly and promptly dealt with. Information dissemination mechanisms on environment issues to export-related bodies and agencies are greatly enhanced, including managers, manufacturers, exporters and local communities.

- Encouraging the participation by the community into environment protection, promoting international cooperation in environment protection, i.e. making environment protection a communal task. There are supporting policies and incentives for communities at regions with high biodiversity in order to help them utilize, at the same time, preserve and further develop these regions. It is also important to make good use of international technical assistance in building and applying environment-friendly manufacturing models.

- There should be supporting polices as well as special inspection and control over sectors that have direct impacts on the environment, for example agriculture, aquaculture raising and exports, forestry products or minerals, etc.

6.3. Harmonizing growing export and solving social issues

- Creating mechanisms of equally sharing benefits in trade. Above all is the benefit sharing mechanism in using natural resources.

- Creating widespread social welfares to cope with inequalities in income, unemployment, bankruptcy, trade risks.

- Extending support to labor-intensive sectors, such as aquaculture, agricultural products, textile, footwear, craft, wooden furniture, in case when there are sharp fluctuations adversely affecting export, thus making farmers and laborers loose their livelihood and work.

- Applying measures that help with improving the working environment for the workers, also meeting the requirements of importers, particularly in textile, footwear (the application of SA 8000 standards).

- The Government, along with competent bodies and agencies, should further strengthen market forecast, thus minimizing adverse impacts on the producers.

7. Conclusion

Vietnam is getting more and more fully integrated into the region and the world. Moreover, global competition is becoming more intense. This context requires Vietnam to urgently adopt a new model of growth. The structure shifting of comparative advantages and export aiming at advancing the competitiveness of manufacturing and export sectors in general, national major export commodities in particular, has become an urgent requirement for Vietnam on her pathway of new growth towards 2020. For Vietnam, this requirement could be satisfied by working out a strategy for strengthening the competitiveness of export commodities, further diversifying and shifting structures of export and comparative advantages on the basis of gradually reducing the export proportion of raw and preliminarily processed commodities and natural resources while increasing that of processed and hi-tech products, prioritizing utilizing competitive advantages based on: Adopting policies facilitating innovating technologies; Strengthening human resources; Stimulating foreign investment, thus promoting R&D, Design and Manufacturing; Upgrading infrastructure at industrial zones and clusters as well as developing supporting industry; moving to higher segments of the global production chain.

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Application of simultaneous equation in finance research: Methods and empirical results

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The main purposes of this paper are: i) to review finance literature used in simultaneous equations method, ii) to show that both two-stage least squares (2SLS) and three-stage least squares (3SLS) are special cases of generalized method of moments (GMM) estimator in estimating simultaneous equations and iii) to investigate the interrelationship among investment, financing, and dividend decisions. We review studies that apply the simultaneous equation estimation on capital structure, corporate investment, payout decisions, ownership structure, corporate governance, stock return, firm performance and/or other corporate issues. Detailed descriptions about the concept of 2SLS, 3SLS, and GMM estimation are introduced. We also investigate the interrelationship among investment, financing and dividend decisions using 2SLS, 3SLS, and GMM methods based on the U.S. listed firm annual data between 1965 and 2012. Our results are consistent with Lambrecht and Myers's (2012) theory that dividend and investment decisions are jointly determined. In addition, these three corporate decisions are co-determined and the interaction among them should be taken into account in a simultaneous equation framework.

Keywords 2SLS • 3SLS • GMM • Investment decision • Financing decision •Dividend decision

JEL Classification C18 • C30 • C36 • G10 • G30

1 Introduction

Simultaneous equations models have been widely adopted to mitigate econometric problem in finance literature. It is suggested that the relation, particularly the interaction, among corporate decisions, firm characteristics, and firm performance should be contemporaneously determined. For example, Anderson and Reeb (2003) investigate the relation between founding-family ownership and firm performance by considering the reversed causality issue. Gong et al. (2008) decipher the cause-consequence relationship between repurchase and earnings management activities in system equations. Harford et al. (2014) consider the interdependence of a firm's cash holdings and the maturity of its debt. Therefore, to understand the application of simultaneous equations models, we survey the methodologies and review papers that use these methods. We also illustrate how to implement the estimation of simultaneous equations with a test on corporate investment, leverage, and payout.

The utilization of ordinary least squares (OLS) estimation on simultaneous equations yields biased and inconsistent estimates since the assumption of uncorrelation between the regressors and the disturbance terms is violated in empirical data. The instrumental variable (IV) methods are commonly used to deal with this endogeneity problem, and both two-stage least squares (2SLS) and three-stage least squares (3SLS) estimations belong to IV class estimators.[1] The generalized method of moments (GMM) estimator proposed by Hansen (1982) further generalizes Sargan's (1958, 1959) linear and nonlinear IV estimators based on optimal weighting matrix for the moment conditions. In contrast to traditional IV class estimators, the GMM estimator uses a weighting matrix taking account of temporal

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[1] Wang (2015) reviews instrumental variables approach to correct for endogeneity in finance.

dependence, heteroskedasticity or autocorrelation. In this paper, we give a detailed description about the concept of GMM estimation and also show that both 2SLS and 3SLS estimators are special cases of GMM estimator in estimating a simultaneous equations model.

The applications of simultaneous equations models in finance research are abundant. Some papers study the interrelationship among a firm's capital structure, investment, and payout policy (e.g., Grabowski and Mueller 1972; Higgins 1972; McCabe 1979; Petersen and Benesh 1983; Switzer 1984; Gugler 2003; MacKay and Phillips 2005; Chava and Roberts 2008; Aggarwal and Kyaw 2010; Harford et al. 2014), given the fact that these decisions are simultaneously determined. For example, an increase in debt financing may enhance the funds available to outlays for investment; meanwhile the increase in investment may change the supply-side debt capacity. Firms may adjust their major policies by taking into account the interdependencies among them. In addition, the interrelationship between board composition (or ownership) and firm performance is often investigated in simultaneous equations (e.g. Loderer and Martin 1997; Bhagat and Black 2002; Demsetz and Villalonga 2001; Prevost et al. 2002; Anderson and Reeb 2003). On one hand, insider (manager or director) holdings affect the insider's incentive to work and accordingly positively influence firm performance upon the agency theory; however, firm performance, which is usually proxied by Tobin's Q, also affects whether or not the insider is willing to sell their shares, leading to changes in the ownership structure. In addition to the above-mentioned studies, many other issues of research also apply the simultaneous equations model in their papers because firm decisions, characteristics, and performance may be jointly determined.[2]

[2] For example, capital structure and firm performance (Berger and Bonaccorsi di Patti 2006), financial

In an attempt to illustrate the application of simultaneous equations models, we also examine the interrelationship among a firm's investment, financing and dividend decisions using the 2SLS, 3SLS, and GMM estimations. We collect U.S. listed dividend-paying firms from 1965 to 2012.[3] Our results are consistent with Lambrecht and Myers's (2012) theory that dividend and investment decisions are jointly determined. Moreover, we find that firms with higher investment changes have higher debt financing changes and vice versa. The impact of changes of dividend on changes of debt financing is significantly negative, showing that firms need less debt financing when they are capable of paying more dividend. This finding is consistent with the economic intuition that the firms with a higher dividend payout usually have greater earnings (e.g., Lintner 1956; Skinner 2008) and thus have less incentive to issue debt financing. In addition, the increases in debt financing seem to enhance the funds available to outlays for dividend payout, implying that there is a wealth transfer effect between bondholders and shareholders.

Our research offers two contributions to the literature. First, this paper reviews applications of simultaneous equations models in the financial research and their econometric estimation methods. The endogeneity problem in empirical studies is extensively noted and the appropriate estimation methods should be adopted. Second, we employ 2SLS, 3SLS, and GMM estimations in examining the interrelationship among a firm's investment, dividend payout and debt financing policies. We find these major decisions of firms correlate to each other and should be considered simultaneously.

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policies and ownership (Jensen et al. 1992; Setia-Atmaja et al. 2009), agency problem and firm performance (Agrawal and Knoeber 1996), corporate governance and liquidity (Chen et al. 2007), repurchase and firm performance (Gong et al. 2008), governance in banking industry (Aggarwal and Jacques 2001; Chen et al. 2006), and capital asset pricing models (Simkowitz and Logue 1973; Lee 1976) are the issues of research applying simultaneous equations model in the papers.

[3] Smirlock and Marshall (1983) and Fama and French (2002) also only consider the firms paying dividend.

The paper proceeds as follows. Section 2 presents the literature reviews about the application of simultaneous equations models in finance research. Section 3 discusses the econometric methodologies applied in estimating simultaneous equations model. Section 4 illustrates the application of simultaneous equations to investigate the interaction among investment, financing and dividend decisions. Conclusions are presented in Section 5.

2 Literature review

Simultaneous equations models are intensively applied in studies considering the interrelationship among a firm's major policies. Higgins (1972), Fama (1974), and Morgan and Saint-Pierre (1978) investigate the relationship between investment decision and dividend decision. Grabowski and Mueller (1972) examine the interrelationship among investment, dividend and research and development (R&D). Fama and French (2002) consider the interaction between dividend and financing decisions. Dhrymes and Kurz (1967), McDonald et al. (1975), McCabe (1979), Peterson and Benesh (1983), and Switzer (1984) argue that the investment decision is related to financing decision and dividend decision. Chava and Roberts (2008) show how financing impacts corporate investment via debt covenants. Harford et al. (2014) consider the interdependence of a firm's cash holdings and the maturity of its debt by using a simultaneous equation framework and performing a 2SLS estimation.

The interrelationship between board composition (or ownership) and firm performance is often investigated in simultaneous equations. Agrawal and Knoeber (1996) use seven mechanisms to control agency problems between managers and shareholders.[4] By using 2SLS procedure, Agrawal and Knoeber (1996) find the

[4] These control mechanisms include insider shareholdings, institutional shareholdings, blockholders'

interdependence among these mechanisms and suggest the regression on any single mechanism for firm performance is misleading. Loderer and Martin (1997) examine the executive ownership and firm performance, and find that better performance leads to larger stockholdings of a manager, but not vice versa. Demsetz and Villalonga (2001) suggest that the ownership structure should be modeled as an endogenous variable and should be considered separately for the fractions of shares owned by outside shareholders and management. They run 2SLS regression to mitigate the endogeneity and find no statistically significant relation between ownership structure and firm performance. Anderson and Reeb (2003) also apply 2SLS on the relation between founding-family ownership and firm performance; however, they find family firms perform better than nonfamily firms. In addition to 2SLS, a 3SLS approach is also adopted in this issue. Prevost et al. (2002) set up a simultaneous equations model to control potential endogeneity between board composition and firm performance by using a 3SLS system approach methodology. They find evidence that board composition and firm performance jointly determine and influence each other in a positive manner for the sample of New Zealand firms. Bhagat and Black (2002) also use a 3SLS approach to investigate the similar issue for large American firms. However, they find that low-profitability firms increase the independence of their boards of directors, and firms with more independent boards do not perform better than other firms.

The simultaneous equations model is also used to examine the interaction between financial policies and firm ownership. Jensen et al. (1992) examine the determinants of insider ownership, debt, and dividend policies within a system of equations and apply 3SLS estimation. They find that high insider ownership firms

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shareholdings, use of outsiders on the board of directors, debt financing, the labor market, and the market for corporate control.

choose lower levels of both debt and dividends. By using Austrian data, Gugler (2003) investigates the interrelation among dividends, R&D, and capital investment, and compare the dividend payout policy of different ownership and control structure of firms. He finds the evidence that the investment, R&D , and dividends are jointly determined and thereby estimate the simultaneous equations system by 3SLS. By comparing family-controlled firms, Gugler (2003) finds that state-controlled firms smooth dividends, have large payout ratios, and are most reluctant to cut dividends. Setia-Atmaja et al. (2009) examine the interrelationship among dividends, debt, and boards of directors of family controlled firms in the Australian capital market. By using 3SLS for a system of four equations they show that family controlled firms employ higher dividend payout ratios, higher debt levels, and lower levels of board independence than non-family firms.

The simultaneous equations model is applied in the capital structure literature. Berger and Bonaccorsi di Patti (2006) ague that an agency costs hypothesis predicts that leverage affects firm performance, yet firm performance also affects the choice of capital structure. To address this problem of reverse causality between firm performance and capital structure, they use 2SLS to estimate the simultaneous equations model. They also estimate by 3SLS and do not change the main findings that higher leverage is associated with higher profit efficiency. Aggarwal and Kyaw (2010) examine the impact of multinationality on capital structure and dividend policy using a simultaneous equations model. By recognizing the interdependence between capital structure and dividend payout policy and using 2SLS, they find that compared to domestic companies, multinational companies have significantly lower debt ratios and pay higher dividends. MacKay and Phillips (2005) estimate a system of simultaneous equations using GMM and find that financial structure, technology, and risk are jointly determined within industries.

In addition to the above-mentioned papers, simultaneous equations model is also applied in other issues of finance studies. Simkowitz and Logue (1973) propose a simultaneous equation capital asset pricing model (CAPM) to offer a robust test for the interdependent assumption of the Sharp model. But the effect of multicollinearity in their 2SLS estimation was challenged by Lee (1976). Instead of 2SLS, Lee (1976) shows that the modified 2SLS is more appropriate in estimation of Simkowitz and Logue's (1973) model. Aggarwal and Jacques (2001) estimate a 3SLS model to examine the simultaneous impact of prompt corrective action (PCA) on both bank capital and credit risk. They show that PCA has a significant impact both in terms of raising capital ratios and reducing credit risk for banks. Chen et al. (2006) employ a two-equation model and estimate by 2SLS to examine the relationship between executives' incentive compensation and firm risk for the banking industry. Gong et al. (2008) investigate the earnings management problem of share repurchase. They consider the possible interaction between post-repurchase abnormal accruals and the percentage of share outstanding repurchased using 3SLS. Chen et al. (2007) adopt simultaneous equations system using both 3SLS and GMM to control the possible simultaneity in the determination of a bid-ask spread and a firm's disclosure policy. They find that firms with poor information transparency and disclosure practices tend to have higher cost of equity liquidity.

3 GMM Methodology

Suppose that a set of observations on a variable y is drawn independently from probability distribution depends on an unknown vector of parameters $\boldsymbol{\beta}$ of interest. One general approach for estimating parameters $\boldsymbol{\beta}$ is based on maximum likelihood

(ML) estimation. The intuition behind ML estimation is to specify a probability distribution for it, and then find an estimate $\hat{\boldsymbol{\beta}}$ in which the data would be most likely to have been observed. The drawback with maximum likelihood methods is that we have to specify a full probability distribution for the data. Here, we introduce an alternative approach for parameter estimation known as generalized method of moments (GMM). The GMM estimation was formalized by Hansen (1982), and has since become one of the most widely used methods of estimation in economics and finance. Hansen won his Nobel Prize in 2013 in economics for deriving the GMM estimation. In contrast to ML estimation, the GMM estimation only requires the specification of certain moment conditions rather than the form of likelihood function.

The idea behind GMM estimation is to choose a parameter estimate so as to make the sample moment conditions as close as possible to the population moment of zero according to the measure of Euclidean distance. The GMM estimation proposed a weighting matrix reflecting the importance given to matching each of the moments. Alternative weighting matrix is associated with alternative estimator. Many standard estimators, including ordinary least squares (OLS), method of moments (MM), ML, instrumental variable (IV), two-stage least squares (2SLS), and three-stage least squares (3SLS) can be seen as special cases of GMM estimators. For example, when the number of moment conditions and unknown parameters are the same, solving the quadratic criterion yields the GMM estimator, which is the same as the method of moment (MM) estimator that sets the sample moment condition exactly equal to zero. The weighting matrix does not matter in this case. In particular, in models for which there are more moment conditions than model parameters, GMM estimation provides a straightforward way to test the specification of the proposed model. This is an important feature that is unique to GMM estimation.

Recently, the endogeneity concern has received much attention in empirical corporate finance research. There are at least three generally recognized sources of endogeneity: omitted explanatory variables, simultaneity bias, and errors in variables. Whenever there is endogeneity, the application of ordinary least squares (OLS) estimation yields biased and inconsistent estimates. In literature, the instrumental variable (IV) methods are commonly used to deal with this endogeneity problem. The basic motivation for the instrumental variable method was to deal with equations that exhibited both simultaneity and measurement errors in exogenous variables. The idea behind IV estimation is to select suitable instruments that are orthogonal to the disturbance while sufficiently correlated with the regressors. The IV estimator makes the linear combinations of sample orthogonality conditions close to zeros. Sargan (1958, 1959) established a fully developed theory of IV estimation. The GMM estimator proposed by Hansen (1982) is also based on orthogonality conditions and provides an alternative solution. Hansen's (1982) GMM estimator generalized Sargan's (1958, 1959) linear and nonlinear IV estimators based on optimal weighting matrix for the moment conditions. In contrast to traditional IV class estimators such as 2SLS and 3SLS estimators, the GMM estimator uses a weighting matrix takes into account temporal dependence, heteroskedasticity or autocorrelation.

3.1 Application of GMM estimation in the linear regression model

Consider the following linear regression model:

$$y_t = \mathbf{x}_t\boldsymbol{\beta} + \varepsilon_t, \quad t = 1, \ldots, T \tag{1}$$

where y is the endogenous variable, $\mathbf{x}_t$ is a $1 \times K$ regressor vector which includes constant term, and ε_t is the error term. Here, $\boldsymbol{\beta}$ denotes a $K \times 1$ parameter vector of interest. The critical assumption made for the OLS estimation is that the disturbance ε_t is uncorrelated with the regressors $\mathbf{x}_t$, $E(\mathbf{x}_t'\varepsilon_t) = \mathbf{0}$. The T observations in model (1) can be written in matrix form as

$$\mathbf{Y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\varepsilon} \tag{2}$$

here $\mathbf{Y}$ denotes the $T \times 1$ data vector for the endogenous variable and $\mathbf{X}$ is a $T \times K$ data matrix for all regressors. In this matrix notation, we have the OLS estimator for $\boldsymbol{\beta}$ as follows:

$$\boldsymbol{\beta}_{\mathrm{OLS}} = (\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{Y} \tag{3}$$

If the disturbance term is correlated with at least some components of regressors, we say that the regressors are endogenous. Whenever there is endogeneity, the application of ordinary least squares (OLS) estimation to equation (2) yields biased and inconsistent estimates. The instrumental variable (IV) methods are commonly used to deal with this endogeneity problem. In a typical IV application, the researcher first chooses a set of variables as instruments that are exogenous and applies 2SLS method to estimate the parameter $\boldsymbol{\beta}$. A good instrument should be highly correlated with the endogenous regressors while uncorrelated with the disturbance in the structural equation. The IV estimator for $\boldsymbol{\beta}$ can be regarded as the solution to the following moment conditions of the form

$$E[\mathbf{z}_t'\varepsilon_t] = E[\mathbf{z}_t'(y_t - \mathbf{x}_t'\boldsymbol{\beta})] = \mathbf{0} \tag{4}$$

where $\mathbf{z}_t$ is a $1 \times L$ vector of instrumental variables which are uncorrelated with a disturbance, but correlated with $\mathbf{x}_t$, and the sample moment conditions are

$$\frac{1}{T}\sum_{t=1}^{T}\mathbf{z}_t'(y_t - \mathbf{x}_t\boldsymbol{\beta}) = \mathbf{0} \tag{5}$$

Assume $\mathbf{Z}$ denotes a $T \times L$ instruments matrix. If the system is just identified

($L = K$) and $\mathbf{Z'X}$ is invertible, the system of sample moment conditions in (5) has a unique solution. We have an IV estimator $\boldsymbol{\beta}_{IV}$ as follows:

$$\boldsymbol{\beta}_{\mathrm{IV}} = (\mathbf{Z'X})^{-1}\mathbf{Z'Y} \tag{6}$$

Suppose that the number of instruments exceeds the number of explanatory variables ($L > K$). The system in (5) is over-identified. Then the question arises how to select or combine more than enough moment conditions to get K equations. Here, the 2SLS estimator, which is the most efficient IV estimator out of all possible linear combinations of the valid instruments under homoscedasticity, is employed in this case. The first stage of the 2SLS estimator is regressing each endogenous regressor on all instruments to get its OLS prediction, expressed in matrix notation as $\mathbf{X} = \mathbf{Z}(\mathbf{Z'Z})^{-1}\mathbf{Z'X}$. The second stage is regressing dependent variable on $\mathbf{X}$ to obtain the 2SLS estimator for $\boldsymbol{\beta}$, $\boldsymbol{\beta}_{2\mathrm{SLS}} = (\mathbf{X'X})^{-1}\mathbf{X'Y}$. Substitute $\mathbf{Z}(\mathbf{Z'Z})^{-1}\mathbf{Z'X}$ for $\mathbf{X}$, the 2SLS estimator $\boldsymbol{\beta}_{2\mathrm{SLS}}$ can be written as

$$\boldsymbol{\beta}_{2\mathrm{SLS}} = \left[(\mathbf{X'Z})(\mathbf{Z'Z})^{-1}\mathbf{Z'X}\right]^{-1}(\mathbf{X'Z})(\mathbf{Z'Z})^{-1}\mathbf{Z'Y} \tag{7}$$

Hansen's (1982) GMM estimation provides an alternative approach for parameter estimation in this over-identified model. The idea behind GMM estimation is to choose parameter estimate so as to make the sample moment conditions in (5) as close as possible to the population moment of zero. The GMM estimator is constructed based on the moment conditions (5) minimizes the following quadratic function:

$$\left[\sum_{t=1}^{T}\mathbf{z}_t{}'(y_t - \mathbf{x}_t\boldsymbol{\beta})\right]' \mathbf{W}_T^{-1}\left[\sum_{t=1}^{T}\mathbf{z}_t{}'(y_t - \mathbf{x}_t\boldsymbol{\beta})\right] \tag{8}$$

for some $L \times L$ positive definite weighting matrix $\mathbf{W}_T^{-1}$. If the system is just identified and $\mathbf{Z'X}$ is invertible, we can solve for the parameter vector, which makes the sample moment conditions of zero in (5). In this case, the weighting matrix is irrelevant. The corresponding GMM estimator is just as the IV estimator $\boldsymbol{\beta}_{IV}$ in (6). If the model is over-identified, we cannot set the sample moment conditions in (5) exactly equal to zero. The GMM estimator for $\boldsymbol{\beta}$ can be obtained by minimizing the quadratic function in (8) as follows:

$$\boldsymbol{\beta}_{\text{GMM}} = \left[(\mathbf{X'Z})\mathbf{W}_T^{-1}\mathbf{Z'X}\right]^{-1}(\mathbf{X'Z})\mathbf{W}_T^{-1}\mathbf{Z'Y} \tag{9}$$

Alternative weighting matrices $\mathbf{W}_T$ are associated with alternative estimators. The question in GMM estimation is which $\mathbf{W}_T$ to use in (8). Hansen (1982) shows that the optimal weighting matrix $\mathbf{W}_T$ for the resulting estimator is

$$\mathbf{W}_T = \text{Var}[\mathbf{z}'\varepsilon] \equiv E[\mathbf{zz}'\varepsilon^2] = E_{\mathbf{z}}\left\{\mathbf{zz}'[E(\varepsilon^2 \mid \mathbf{z})]\right\} \tag{10}$$

Under conditional homoscedasticity $E(\varepsilon^2 \mid \mathbf{z}) = \sigma^2$, the optimal weighting matrix in which case is

$$\mathbf{W}_T = \left(\frac{\mathbf{Z'Z}}{T}\right)\sigma^2 \tag{11}$$

Hence, any scalar in $\mathbf{W}_T$ will be canceled in this case yields

$$\boldsymbol{\beta}_{\text{GMM}} = \left[(\mathbf{X'Z})(\mathbf{Z'Z})^{-1}\mathbf{Z'X}\right]^{-1}(\mathbf{X'Z})(\mathbf{Z'Z})^{-1}\mathbf{Z'Y} \tag{12}$$

Thus, the GMM estimator is simply the 2SLS estimator under conditional homoscedasticity. However, if the conditional variance of ε_t given $\mathbf{z}_t$ depends on $\mathbf{z}_t$, the optimal weighting matrix $\mathbf{W}_T$ should be estimated by

$$\mathbf{W}_T = \frac{1}{T}\sum_{t=1}^{T}\mathbf{z}_t'\mathbf{z}_t\hat{\varepsilon}_t^2 = \frac{1}{T}\mathbf{Z'DZ} \tag{13}$$

where $\hat{\varepsilon}_t$ is sample residuals and $\mathbf{D} = \text{diag}(\hat{\varepsilon}_1^2, \ldots, \hat{\varepsilon}_T^2)$. Here, we can apply the two-stage least-squares (2SLS) estimator in equation (7) to obtain the sample residuals by $\hat{\varepsilon}_t = y_t - \mathbf{x}_t \boldsymbol{\beta}_{2SLS}$, then the GMM estimator $\boldsymbol{\beta}_{GMM}$ is

$$\boldsymbol{\beta}_{GMM} = \left[(\mathbf{X}'\mathbf{Z})(\mathbf{Z}'\mathbf{D}\mathbf{Z})^{-1}\mathbf{Z}'\mathbf{X} \right]^{-1} (\mathbf{X}'\mathbf{Z})(\mathbf{Z}'\mathbf{D}\mathbf{Z})^{-1}\mathbf{Z}'\mathbf{Y} \tag{14}$$

Note that the GMM estimator is obtained by two-step procedure under heteroskedasticity. First use the 2SLS estimator as an initial estimator since it is consistent to get the residuals by $\hat{\varepsilon}_t = y_t - \mathbf{x}_t \boldsymbol{\beta}_{2SLS}$. Then substitute $\sum_{t=1}^{T} \mathbf{z}_t{}'\mathbf{z}_t \hat{\varepsilon}_t^2$ into $\mathbf{W}_T$ as the weighting matrix to obtain the GMM estimator. For this reason, the GMM estimator sometimes called a two-stage instrumental variables estimator.

3.2 Application of GMM estimation in the simultaneous equations model

Consider the following linear simultaneous equations model:

$$\begin{aligned} y_{1t} &= \delta_{12} y_{2t} + \delta_{13} y_{3t} + \cdots + \delta_{1J} y_{Jt} + \mathbf{x}_{1t} \boldsymbol{\gamma}_1 + \varepsilon_{1t} \\ y_{2t} &= \delta_{21} y_{1t} + \delta_{23} y_{3t} + \cdots + \delta_{2J} y_{Jt} + \mathbf{x}_{2t} \boldsymbol{\gamma}_2 + \varepsilon_{2t} \\ &\vdots \\ y_{Jt} &= \delta_{J1} y_{1t} + \delta_{J2} y_{2t} + \cdots + \delta_{J(J-1)} y_{(J-1)t} + \mathbf{x}_{Jt} \boldsymbol{\gamma}_J + \varepsilon_{Jt} \end{aligned} \tag{15}$$

Here $t = 1, 2, \ldots, T$. Define that $\mathbf{y}_t = [y_{1t} \quad y_{2t} \quad \cdots \quad y_{Jt}]'$ is an $J \times 1$ vector for endogenous variables, $\mathbf{x}_t = [\mathbf{x}_{1t} \quad \mathbf{x}_{2t} \quad \cdots \quad \mathbf{x}_{Jt}]'$ is a vectors for all exogenous variables in this system includes constant term. $\boldsymbol{\varepsilon}_t = [\varepsilon_{1t} \quad \varepsilon_{2t} \quad \cdots \quad \varepsilon_{Jt}]$ is an $J \times 1$ vector for the disturbances. Here, $\boldsymbol{\delta}$ and $\boldsymbol{\gamma}$ are the parameters matrices of interest defined as

$$\boldsymbol{\delta} = \begin{bmatrix} \delta_{12} & \delta_{13} & \cdots & \delta_{1J} \\ \delta_{21} & \delta_{23} & \cdots & \delta_{2J} \\ \vdots & \vdots & \vdots & \vdots \\ \delta_{J1} & \delta_{J2} & \cdots & \delta_{J(J-1)} \end{bmatrix} = \begin{bmatrix} \boldsymbol{\delta}_1 \\ \boldsymbol{\delta}_2 \\ \vdots \\ \boldsymbol{\delta}_J \end{bmatrix} \text{ and } \boldsymbol{\gamma} = \begin{bmatrix} \boldsymbol{\gamma}_1 \\ \boldsymbol{\gamma}_2 \\ \vdots \\ \boldsymbol{\gamma}_J \end{bmatrix} \tag{16}$$

There are two approaches to estimate the structural parameters $\boldsymbol{\delta}$ and $\boldsymbol{\gamma}$ of the system, one is the single equation estimation and the other is the system estimation. First, we introduce the single equation estimation shown below. We can rewrite the j-th equation in our simultaneous equation model in terms of the full set of T observations:

$$\mathbf{y}_j = \mathbf{Y}_j\boldsymbol{\delta}_j + \mathbf{X}_j\boldsymbol{\gamma}_j + \boldsymbol{\varepsilon}_j = \mathbf{Z}_j\boldsymbol{\beta}_j + \boldsymbol{\varepsilon}_j, \quad j = 1,\ldots,J \tag{17}$$

where $\mathbf{y}_j$ denotes the $T \times 1$ vector of observations for the endogenous variables on left-hand side of j-th equation. $\mathbf{Y}_j$ denotes the $T \times (J-1)$ data matrix for the endogenous variables on right-hand side of this equation. $\mathbf{X}_j$ is a data matrix for all exogenous variables in this equation. Since these jointly determined variables $\mathbf{y}_j$ and $\mathbf{Y}_j$ are determined within the system, they are correlated with the disturbance terms. This correlation usually creates estimation difficulties because the OLS estimator would be biased and inconsistent (e.g. Johnston and DiNardo 1997; Greene 2011).

As discussed above, the application of OLS estimation to equation (17) yields biased and inconsistent estimates because of the correlation of $\mathbf{Z}_j$ and $\boldsymbol{\varepsilon}_j$. The two-stage least squares (2SLS) approach is the most common method used to deal with this endogeneity problem resulting from the correlation of $\mathbf{Z}_j$ and $\boldsymbol{\varepsilon}_j$. The 2SLS estimation uses all the exogenous variables in this system as instruments to obtain the predictions of $\mathbf{Y}_j$. In the first stage, we regress $\mathbf{Y}_j$ on all exogenous variables in the system to receive the predictions of the endogenous variables on right-hand side of this equation, $\hat{\mathbf{Y}}_j$. In the second stage, we regress $\mathbf{y}_j$ on $\hat{\mathbf{Y}}_j$ and $\mathbf{X}_j$ to obtain the estimator of $\boldsymbol{\beta}_j$ in equation (17). Thus, the 2SLS estimator for $\boldsymbol{\beta}_j$ in Equation (17) is,

$$\boldsymbol{\beta}_{j,2SLS} = \left[(\mathbf{Z}_j^{'}\mathbf{X})\left(\mathbf{X}^{'}\mathbf{X}\right)^{-1}\mathbf{X}^{'}\mathbf{Z}_j \right]^{-1} (\mathbf{Z}_j^{'}\mathbf{X})\left(\mathbf{X}^{'}\mathbf{X}\right)^{-1}\mathbf{X}^{'}\mathbf{y}_j \tag{18}$$

where $\mathbf{X} = [\mathbf{X}_1 \ \ \mathbf{X}_2 \ \ \cdots \ \ \mathbf{X}_J \ ]$ is a matrix for all exogenous variables in this system.

The GMM estimation provides an alternative approach to deal with this simultaneity bias problem. As for the GMM estimator with instruments $\mathbf{X}$, the moment conditions in the equation (17) is,

$$E_t\left(\mathbf{x}_t^{'}\varepsilon_{jt}\right) = E_t\left[\mathbf{x}_t^{'}(y_{jt} - \mathbf{Z}_{jt}\boldsymbol{\beta}_j)\right] = \mathbf{0} \tag{19}$$

We can apply the 2SLS estimator in equation (18) with instruments $\mathbf{X}$ to estimate $\boldsymbol{\beta}_j$ and obtain the sample residuals $\hat{\boldsymbol{\varepsilon}}_j = \mathbf{y}_j - \mathbf{Z}_j\hat{\boldsymbol{\beta}}_{j,2SLS}$. Then, compute the weight matrix $\mathbf{W}_j$ for GMM estimator based on those residuals as follows:

$$\mathbf{W}_j = \left[\frac{1}{T^2}\left(\sum_{t=1}^{T}\mathbf{x}_t^{'}\varepsilon_{jt}\varepsilon_{jt}^{'}\mathbf{x}_t\right)\right] \tag{20}$$

The GMM estimator based on the moment conditions (19) minimizes the following quadratic function:

$$\left[\sum_{t=1}^{T}\mathbf{x}_t^{'}(y_{jt} - \mathbf{Z}_{jt}\boldsymbol{\beta}_j)\right]\mathbf{W}_j^{-1}\left[\sum_{t=1}^{T}\mathbf{x}_t^{'}(y_{jt} - \mathbf{Z}_{jt}\boldsymbol{\beta}_j)\right] \tag{21}$$

The GMM estimator that minimizes this quadratic function (21) is obtained as

$$\hat{\boldsymbol{\beta}}_{GMM} = \left[\left(\mathbf{Z}_j^{'}\mathbf{X}\right)\mathbf{W}_j^{-1}\left(\mathbf{X}^{'}\mathbf{Z}_j\right)\right]^{-1}\left[\left(\mathbf{Z}_i^{'}\mathbf{X}\right)\mathbf{W}_j^{-1}\left(\mathbf{X}^{'}\mathbf{y}_j\right)\right] \tag{22}$$

In the homoscedastic and serially independent case, a good estimate of the weight matrix $\mathbf{W}_j$ would be

$$\mathbf{W} = \left[\frac{\sigma^2}{T}\left(\mathbf{X}^{'}\mathbf{X}\right)\right]$$

Given the estimate of σ^2 is obtained, then rearrange terms in equation (22), which yields

$$\hat{\boldsymbol{\beta}}_{GMM} = \left[(\mathbf{Z}_j'\mathbf{X})\left(\mathbf{X}'\mathbf{X}\right)^{-1}\mathbf{X}'\mathbf{Z}_j \right]^{-1} (\mathbf{Z}_j'\mathbf{X})\left(\mathbf{X}'\mathbf{X}\right)^{-1}(\mathbf{X}'\mathbf{y}_j) \tag{24}$$

Thus the 2SLS estimator is a special case of GMM estimator.

As Chen and Lee (2010) pointed out the 2SLS estimation is a limited information method. The 3SLS estimation is a full information method. The 3SLS estimation takes into account the information from a full system of equations. Thus, it is more efficient than the 2SLS estimation. The 3SLS method estimates all structural parameters of this system jointly. This allows the possibility of contemporaneous correlation between the disturbances in different structural equation. We introduce the 3SLS estimation below. We rewrite our full system of equations in equation (18) as

$$\mathbf{Y} = \mathbf{Z}\boldsymbol{\beta} + \boldsymbol{\varepsilon} \tag{25}$$

where $\mathbf{Y}$ is a vector defined as $\left[\mathbf{y}_1 \quad \mathbf{y}_2 \quad \cdots \quad \mathbf{y}_J\right]'$. $\mathbf{Z} = \text{diag}\left[\mathbf{Z}_1 \quad \mathbf{Z}_2 \quad \cdots \quad \mathbf{Z}_J\right]$ is a block diagonal data matrix for all variables on right-hand side of this system with the form $\mathbf{Z}_j = [\mathbf{Y}_j \ \ \mathbf{X}_j]$ as defined in equation (18). $\boldsymbol{\beta}$ is a vector of interest parameters defined as $\left[\boldsymbol{\beta}_1 \quad \boldsymbol{\beta}_2 \quad \cdots \quad \boldsymbol{\beta}_J\right]'$. $\boldsymbol{\varepsilon}$ is a vector of disturbances defined as $\left[\boldsymbol{\varepsilon}_1 \quad \boldsymbol{\varepsilon}_2 \quad \cdots \quad \boldsymbol{\varepsilon}_J\right]'$ with $\text{E}(\boldsymbol{\varepsilon}) = \mathbf{0}$ and $\text{E}(\boldsymbol{\varepsilon}\boldsymbol{\varepsilon}') = \boldsymbol{\Sigma} \otimes \mathbf{I}_T$ where $\otimes$ signifies the Kroneker product. Here, $\boldsymbol{\Sigma}$ is defined as

$$\boldsymbol{\Sigma} = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \cdots & \sigma_{1J} \\ \sigma_{21} & \sigma_{22} & \cdots & \sigma_{2J} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{J1} & \sigma_{J2} & \cdots & \sigma_{JJ} \end{bmatrix} \tag{26}$$

The 3SLS approach is the most common method used to estimate the structural parameters of this system simultaneously. Basically, the 3SLS estimator is a generalized least square (GLS) estimator in the entire system taking account of the covariance matrix in equation (26). The 3SLS estimator is equivalent to using the all exogenous variables as instruments and estimating the entire system using GLS estimation (Intriligator, Bodkin, and Hsiao; 1996). The 3SLS estimation uses all exogenous variables $\mathbf{X}=[\mathbf{X}_1\ \ \mathbf{X}_2\ \ \cdots\ \ \mathbf{X}_J\ ]$ as instruments in each equation of this system, pre-multiplying the model (25) by $\mathbf{X}_I^{'}=\text{diag}[\mathbf{X}^{'}\ \cdots\ \mathbf{X}^{'}]=\mathbf{X}\otimes\mathbf{I}_J$ yields the model

$$\mathbf{X}_I^{'}\mathbf{Y}=\mathbf{X}_I^{'}\mathbf{Z}\boldsymbol{\beta}+\mathbf{X}_I^{'}\mathbf{u} \tag{27}$$

The covariance matrix from (26) is

$$Cov\left(\mathbf{X}_I^{'}\boldsymbol{\varepsilon}\right)=\mathbf{X}_I^{'}Cov\left(\boldsymbol{\varepsilon}\right)\mathbf{X}_I=\mathbf{X}_I^{'}(\boldsymbol{\Sigma}\otimes\mathbf{I}_T)\mathbf{X}_I \tag{28}$$

The GLS estimator of the equation (27) is the 3SLS estimator. Thus the 3SLS estimator is given as follows:

$$\hat{\boldsymbol{\beta}}_{3SLS}=\left\{\mathbf{Z}^{'}\mathbf{X}_I[\mathbf{X}_I^{'}(\boldsymbol{\Sigma}\otimes\mathbf{I}_T)\mathbf{X}_I]^{-1}\mathbf{X}_I^{'}\mathbf{Z}\right\}^{-1}\mathbf{Z}^{'}\mathbf{X}_I[\mathbf{X}_I^{'}(\boldsymbol{\Sigma}\otimes\mathbf{I}_T)\mathbf{X}_I]^{-1}\mathbf{X}_I^{'}\mathbf{Y} \tag{29}$$

In this case, $\boldsymbol{\Sigma}$ is a diagonal matrix, the 3SLS estimator is equivalent to the 2SLS estimator. As discussed above, the GMM estimator with all exogenous variables $\mathbf{X}=[\mathbf{X}_1\ \ \mathbf{X}_2\ \ \cdots\ \ \mathbf{X}_J\ ]$ as instruments, the moment conditions of this system (25) is,

$$\begin{aligned}\mathrm{E}\left(\mathbf{X}_I^{'}\boldsymbol{\varepsilon}\right)&=\mathrm{E}\left[\mathbf{X}_I^{'}(\mathbf{Y}-\mathbf{Z}\boldsymbol{\beta})\right]\\&=\left(\mathrm{E}\left[\mathbf{X}_I^{'}(\mathbf{y}_1-\mathbf{Z}_1\boldsymbol{\beta}_1)\right]\ \mathrm{E}\left[\mathbf{X}_I^{'}(\mathbf{y}_2-\mathbf{Z}_2\boldsymbol{\beta}_2)\right]\ \cdots\mathrm{E}\left[\mathbf{X}_I^{'}(\mathbf{y}_J-\mathbf{Z}_J\boldsymbol{\beta}_J)\right]\right)^{'}=\mathbf{0}\end{aligned} \tag{30}$$

We can apply the 2SLS estimator with instruments $\mathbf{X}$ to estimate $\boldsymbol{\beta}_j$ and obtain the sample residuals $\hat{\boldsymbol{\varepsilon}}_j=\mathbf{y}_j-\mathbf{Z}_j\hat{\boldsymbol{\beta}}_{j,2SLS}$. Then, compute the weight matrix $\mathbf{W}_{jl}$ for GMM estimator based on those residuals as follows:

$$\mathbf{W}_{jl}=\left[\frac{1}{T^2}\left(\sum_{t=1}^{T}\mathbf{x}_{jt}^{'}\varepsilon_{jt}\varepsilon_{lt}^{'}\mathbf{x}_{jt}\right)\right] \tag{31}$$

The system GMM estimator based on the moment conditions (30) minimizes the quadratic function:

$$\begin{bmatrix} \mathbf{X}'\left(\mathbf{y}_1-\mathbf{Z}_1\boldsymbol{\beta}_1\right) \\ \mathbf{X}'\left(\mathbf{y}_2-\mathbf{Z}_2\boldsymbol{\beta}_2\right) \\ \vdots \\ \mathbf{X}'\left(\mathbf{y}_J-\mathbf{Z}_J\boldsymbol{\beta}_J\right) \end{bmatrix}' \begin{bmatrix} \mathbf{W}_{11} & \mathbf{W}_{12} & \cdots & \mathbf{W}_{1J} \\ \mathbf{W}_{21} & \mathbf{W}_{22} & \cdots & \mathbf{W}_{2J} \\ \vdots & \vdots & \ddots & \vdots \\ \mathbf{W}_{J1} & \mathbf{W}_{J2} & \cdots & \mathbf{W}_{JJ} \end{bmatrix}^{-1} \begin{bmatrix} \mathbf{X}'\left(\mathbf{y}_1-\mathbf{Z}_1\boldsymbol{\beta}_1\right) \\ \mathbf{X}'\left(\mathbf{y}_2-\mathbf{Z}_2\boldsymbol{\beta}_2\right) \\ \vdots \\ \mathbf{X}'\left(\mathbf{y}_J-\mathbf{Z}_J\boldsymbol{\beta}_J\right) \end{bmatrix} \tag{32}$$

The GMM estimator that minimizes this quadratic function (32) is obtained as

$$\begin{bmatrix} \hat{\boldsymbol{\beta}}_{1,\mathrm{GMM}} \\ \hat{\boldsymbol{\beta}}_{2,\mathrm{GMM}} \\ \vdots \\ \hat{\boldsymbol{\beta}}_{J,\mathrm{GMM}} \end{bmatrix} = \begin{bmatrix} \mathbf{Z}_1'\mathbf{X}\mathbf{W}_{11}\mathbf{X}'\mathbf{Z}_1 & \cdots & \mathbf{Z}_1'\mathbf{X}\mathbf{W}_{1J}\mathbf{X}'\mathbf{Z}_J \\ \mathbf{Z}_2'\mathbf{X}\mathbf{W}_{21}\mathbf{X}'\mathbf{Z}_1 & \cdots & \mathbf{Z}_2'\mathbf{X}\mathbf{W}_{2J}\mathbf{X}'\mathbf{Z}_J \\ \vdots & \ddots & \vdots \\ \mathbf{Z}_J'\mathbf{X}\mathbf{W}_{J1}\mathbf{X}'\mathbf{Z}_1 & \cdots & \mathbf{Z}_J'\mathbf{X}\mathbf{W}_{JJ}\mathbf{X}'\mathbf{Z}_J \end{bmatrix}^{-1} \begin{bmatrix} \sum_{l=1}^{J}\mathbf{Z}_1'\mathbf{X}\mathbf{W}_{1l}\mathbf{y}_l \\ \sum_{l=1}^{J}\mathbf{Z}_2'\mathbf{X}\mathbf{W}_{2l}\mathbf{y}_l \\ \vdots \\ \sum_{l=1}^{J}\mathbf{Z}_J'\mathbf{X}\mathbf{W}_{Jl}\mathbf{y}_l \end{bmatrix} \tag{33}$$

The 2SLS and 3SLS estimators are the special cases of system GMM estimator. If the $\mathbf{W}_{jj} = \left[\frac{\sigma_{jj}}{T}\left(\sum_{t=1}^{T}\mathbf{x}_t'\mathbf{x}_t\right)\right]$ and $\mathbf{W}_{jl} = 0$ for $j \neq l$, then the system GMM estimator is equivalent to the 2SLS estimator. In the case, $\mathbf{W}_{jl} = \left[\frac{\sigma_{jl}}{T}\left(\sum_{t=1}^{T}\mathbf{x}_t'\mathbf{x}_t\right)\right]$, the system GMM estimator is equivalent to the 3SLS estimator.

4 Application in investment, financing and dividend policy

4.1 Model and data

The investment, dividend, and debt financing are major decisions of a firm. Past studies argue some relations among investment, dividend and debt financing.[5] To control for the possible endogenous problems among these three decisions, we apply

[5] Higgins (1972), Fama (1974), Morgan and Saint-Pierre (1978), Smirlock and Marshall (1983), Lee et al. (2011) and Chen et al. (2013) investigate the relationship between investment decision and dividend decision. Fama and French (2002) consider the interaction between dividend and financing decisions. Dhrymes and Kurz (1967), McDonald et al. (1975), McCabe (1979), Peterson and Benesh (1983), Switzer (1984), and Pruitt and Gitman (1991) argue that the investment decision is related to financing decision and dividend decision. Chava and Roberts (2008) show how financing impacts corporate investment via debt covenants. Lambrecht and Myers (2012) develop a combined theory of payout, debt, and investment.

2SLS, 3SLS, and GMM methods to estimate the simultaneous-equations model that consider the interaction of the three policies.

There are three equations in our simultaneous-equations system; each equation contains the remaining two endogenous variables as explanatory variables along with other exogenous variables. The three endogenous variables are changes in the investment (ΔInv_{it}), dividend (ΔDiv_{it}), and in debt financing ($\Delta Debt_{it}$) of firm *i* from year *t-1* to year *t*. Inv denotes net property, plant, and equipment. Div denotes dividends. Both Inv and Div are measured on a per share basis. $Debt$ refers to book leverage, defined as the ratio of total liabilities to total assets. The other exogenous variables, which are commonly adopted in the literature, contain lag-terms of the tree policies, sales plus change in inventories (Q_{it}), net income before extraordinary items plus depreciation minus preferred dividends (P_{it}), natural logarithm of lagged total assets ($\ln A_{i,t-1}$), and the lag of earnings before interest and taxes divided by total assets ($E_{i,t-1}/A_{i,t-1}$). The structural equations are estimated as follows:

$$\Delta Inv_{it} = \alpha_{1i} + \alpha_{2i}\Delta Div_{it} + \alpha_{3i}\Delta Debt_{it} + \alpha_{4i}Inv_{i,t-1} + \alpha_{5i}Q_{it} + \epsilon_{it} \ , \tag{34}$$

$$\Delta Div_{it} = \beta_{1i} + \beta_{2i}\Delta Inv_{it} + \beta_{3i}\Delta Debt_{it} + \beta_{4i}Div_{i,t-1} + \beta_{5i}P_{it} + \eta_{it} \ , \tag{35}$$

$$\Delta Debt_{it} = \gamma_{1i} + \gamma_{2i}\Delta Inv_{it} + \gamma_{3i}\Delta Div_{it} + \gamma_{4i}Debt_{i,t-1} + \gamma_{5i}\ln A_{i,t-1} + \gamma_{6i}(E_{i,t-1}/A_{i,t-1}) + \xi_{it} \ . \tag{36}$$

Our sample consists of all dividend-paying U.S. firms listed on NYSE, AMEX, OTC, and NASDAQ stock markets from 1965 to 2012. All of our accounting variables are annual and collected from Compustat Annual Industrial Files. Following previous research (e.g., Fama and Fench 2002; Huang and Ritter 2009; Cook and Tang 2010), we exclude financial firms (SIC 6000-6999) and regulated utilities (SIC 4900-4999) from the sample. We also require firms to have positive total assets and a number of common shares outstanding.[6] To increase the testing power in the regression analysis, we also require firms to survive 30 years or longer. These exclusions leave us with complete information for 564 firms.

Table 1 presents summary statistics on the investment, dividend, and debt financing for different time periods. All of these variables are winsorized at the 1st and 99th percentiles to avoid the influence of extreme observations. Compared with different time periods, the investment during the 1980s is the highest. This result may be from the simulating policies (e.g., the reduction of capital gain tax and the reduction of interest rate), which was promoted by U.S. President Ronald Reagan during the 1980s. Dividend payout is more likely to be reduced after the 1990s. Such finding is consistent with Fama and French (2001), Grullon and Michaely (2002), and Brav et al. (2005), indicating that repurchase is more prevalent to adopt than dividend payout in the recent decades. The average book leverage is 0.494 and the book leverage tends to be higher in later years than in earlier years.

[Insert Table 1 about here]

4.2 Empirical results

Table 2 shows 2SLS regression results for simultaneous-equations model. Averages of individual firms' coefficient estimates of the investment, dividend, and debt financing regressions are presented. The results of relations among these three financial decisions could be directly obtained in this method. First, the significantly positive coefficient of $\Delta Debt_{it}$ (in investment decision), and ΔInv_{it} (in debt financing decision) imply that firms with higher investment changes have higher debt financing changesand vice versa. Ross (1977) and Myers and Majluf (1984) suggest

[6] These variables are used to deflate other variables and the results become difficult to interpret when they have non-positive values.

that debt is preferred to equity for managers to signal the optimistic investment opportunity to investors because the firms are expected to have higher future cash flows to repay the debt. Harris and Raviv (1990) argue that debt is a device to solve the asymmetric information for the investors because it helps to monitor managers and force the firm to liquidation. In addition, our finding that increases in debt financing enhance the funds available to outlays for investment is consistent with McCabe (1979), Peterson and Benesh (1983), John and Nachman (1985), and Froot et al. (1993). Thus, our optimal debt ratio may be the result of a trade-off between the value of information (from more debt) and the cost of monitor.

[Insert Table 2 about here]

Second, the significant coefficients of ΔDiv_{it} and ΔInv_{it} imply that dividend outlays influence investment decisions and vice versa. This finding implies that the firms may use dividend payout to signal the growth opportunity and then these firms increase their investment. The firm with higher investment input may experience the higher earnings and thus could increase the dividend payout. Such finding, that dividend payout responds to investment, confirms the model prediction of Lambrecht and Myers (2012). The relationship between dividend payout and investment is also consistent with the signaling cash flow hypothesis of dividend payout in Yoon and Starks (1995).

Third, the changes of dividend on the change of debt financing are significantly negative, showing that the firms need less debt financing when they are capable of paying more dividend. This finding is consistent with the economics intuition that the firms with higher dividend payout usually have greater earnings (e.g., Lintner, 1956; Skinner, 2008) and thus have less incentive to issue debt financing. In addition, the increases in debt financing seem to enhance the funds available to outlays for dividend payout, implying that firms may transfer the wealth from bondholders to shareholders.

In the investment equation, we find the coefficient of lagged investment is significantly negative, which is the speed of adjustment of investment, indicating that firms adjust its investment toward its target level. The output positively and significantly affects the change of investment, which is consistent with Fama (1974).

In the dividend model, the coefficient of lagged dividend is -0.224 significantly negative, implying that firms adjust the firms' dividends to the targeted levels. The coefficient of P_{it} is significantly positive, implying that firms with high net income tend to increase to pay dividends.

In the debt financing equation, the coefficient of lagged leverage is -0.287 significantly negative. The result is consistent with Jalilvand and Harris (1984), Flannery and Rangan (2006), and Huang and Ritter (2009), which implies firms also tend to adjust toward the target leverage levels. The coefficient of $\ln A_{i,t-1}$ is significantly positive, indicating that large firms leverage more than smaller firms. This finding results from large firms that tend to have a greater reputation and less information asymmetry than small firms and thus large firms can finance at a lower cost. The positive relation between size and leverage is consistent with Fama and French (2002), Flannery and Rangan (2006), and Frank and Goyal (2009).

The coefficient of $(E_{i,t-1}/A_{i,t-1})$ is significantly negative. This result implies that more profitable firms have higher internal funds from their earnings and thus have less incentive to obtain the outside funds by debt issuing. The negative relationship between profitability and leverage is consistent with the findings of Long and Malitz (1985), Rajan and Zingales (1995), Fama and French (2002), and Flannery and Rangan (2006).

Table 3 and Table 4 show results of 3SLS and GMM, respectively. Similarly, we present averages of an individual firm's coefficient estimates of the investment, dividend, and debt financing regressions. All the signs and significance of the estimated coefficients are consistent with the results of 2SLS. We present the detailed process of 2SLS, 3SLS, and GMM estimation by taking IBM's annual data during the period 1966-2012, in Appendix A.

[Insert Table 3 about here]

[Insert Table 4 about here]

By comparing the results from these methods, we find all the coefficients of lagged investment, lagged dividend, and lagged debt financing are significantly negative. This result implies that these three policies tend to be adjusted to the optimal levels. All the exogenous variables have a similar impact in the literature. Our empirical results also can be used to test the joint determination theory of investment, financing, and dividend decisions developed by Lambrecht and Myers (2012).

5 Conclusion

In this paper, we investigate the endogeneity problems related to simultaneous equation system, and introduce how 2SLS, 3SLS, and GMM estimation methods deal with endogeneity. We show that both 2SLS and 3SLS are special cases of the GMM estimator in estimating simultaneous equations. In addition to reviewing applications of simultaneous equation on many finance issues, we also use U.S. listed firms from 1965 to 2012 to examine the interrelationship among corporate investment, leverage, and dividend payout policies in a simultaneous-equation system by employing 2SLS, 3SLS, and GMM.

Our results from 2SLS, 3SLS, and GMM are similar. First, we show that dividend outlays influence investment decisions and vice versa. The fact that dividend payout does not cut back to finance capital investment confirms the model prediction of Lambrecht and Myers (2012). Moreover, investment changes have a positive impact on debt financing changes and vice versa. An increase in debt financing enhances the funds available to outlays for investment, and the increase in investment raises willingness of fund supply by the increase in mortgage of capital investment or investment's future profitability, and thus further improve firm's debt capacity. Changes of dividend have a negative impact on the changes of debt financing, showing that firms need less debt financing when they are capable of paying more dividend. This finding is consistent with the economics intuition that the firms with higher dividend payout usually have greater earnings and thus have less incentive to issue debt financing. In addition, the increases in debt financing enhance the funds available to outlays for dividend payout. Accordingly, our findings suggest that these three corporate decisions are jointly determined and the interaction among them should be taken into account in a simultaneous equation framework.

Appendix A Case study of IBM company

The purpose of this appendix is to use IBM's annual data during the period 1966-2012 as an example to investigate the interrelationship among investment, financing, and dividend decisions. The IBM sample of 47 observations reported in terms of sums of squares and cross products is shown in Table 1. Here, the structural equations of this paper are constructed as follows (34), (35), and (36). As discussed above, we can estimate the structural parameters of this system by one equation at a time through 2SLS estimation and single equation GMM estimation. However, these single estimations ignore the information contained in the other equations. The 3SLS estimation and system GMM estimation provide alternatives to estimate all structural parameters of this system jointly. We illustrate the estimation of a simultaneous equations model using 2SLS, 3SLS, and GMM methods in the following.

A.1 Single equation estimation

We can rewrite the j-th equation in our simultaneous equation model in terms of the full set of T observations:

$$\mathbf{y}_j = \mathbf{Y}_j\gamma_j + \mathbf{X}_j\beta_j + \mathbf{u}_j = \mathbf{Z}_j\delta_j + \mathbf{u}_j, \quad j = 1, 2, 3. \tag{38}$$

where $\mathbf{y}_j$ denotes $T \times 1$ vector of observations for the endogenous variables on left-hand side of j-th equation. $\mathbf{Y}_j$ denotes $T \times 2$ data matrix for the endogenous variables on right-hand side of this equation. $\mathbf{X}_j$ is a data matrix for all exogenous variables in this equation. For example, consider the investment equation in our three-equation model, $\mathbf{y}_j$ and $\mathbf{Y}_j$ are data matrices defined as $[\ \Delta\mathbf{Inv}\ ]$ and $[\ \Delta\mathbf{Div}\ \Delta\mathbf{Debt}\ ]$, respectively. $\mathbf{X}_j = [\ \mathbf{1}\ \mathbf{Inv}_{-1}\ \mathbf{Q}\ ]$ is a $T \times 3$ data matrix for the exploratory variables, where $\mathbf{1}$ is the constants term and $\mathbf{Inv}_{-1}$ denotes one-period-lagged data matrix of $\mathbf{Inv}$. $\mathbf{Z}_1 = [\ \mathbf{1}\ \Delta\mathbf{Div}\ \Delta\mathbf{Debt}\ \mathbf{Inv}_{-1}\ \mathbf{Q}\ ]$ is a $T \times 5$ data matrix for all variables on right-hand side of this equation. As discussed above, the 2SLS estimation uses all the exogenous variables in this system as instruments to obtain the predictions of $\mathbf{Y}_j$. Here, the instruments matrix $\mathbf{X} = [\ \mathbf{1}\ \mathbf{Inv}_{-1}\ \mathbf{Q}\ \mathbf{Div}_{-1}\ \mathbf{P}\ \mathbf{Debt}_{-1}\ \ln(\mathbf{A}_{-1})\ (\mathbf{E}/\mathbf{A})_{-1}\ ]$ is a $T \times 8$ matrix for all exogenous variables in this system. Then, the vector of 2SLS estimates is

$$\begin{aligned}\hat{\delta}_{1,2SLS} &= [(\mathbf{Z}_1'\mathbf{X})(\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{Z}_1]^{-1}(\mathbf{Z}_1'\mathbf{X})(\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{y}_1 \\ &= \begin{pmatrix} -2.4541 & 4.5640 & 42.0613 & -0.0900 & 0.0471 \end{pmatrix}'\end{aligned} \tag{39}$$

Here

$$(\mathbf{Z}_1'\mathbf{X})(\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{Z}_1 = \begin{pmatrix} 47.0000 & -2.6068 & 0.5292 & 1450.8413 & 3876.1612 \\ -2.6068 & 104.1431 & -0.4588 & -482.8651 & 402.7128 \\ 0.5292 & -0.4588 & 0.0242 & 21.7584 & 57.6402 \\ 1450.8413 & -482.8651 & 21.7584 & 57669.2721 & 127304.6882 \\ 3876.1612 & 402.7128 & 57.6402 & 127304.6882 & 354485.4669 \end{pmatrix}$$

and

$$(\mathbf{Z}_1'\mathbf{X})(\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{y}_1 = \begin{pmatrix} -52.8683 \\ 524.8281 \\ -1.6147 \\ 4038.9888 \\ -0.2784 \end{pmatrix}$$

The estimated covariance matrix of the 2SLS estimator is

$$\operatorname{cov}\left(\hat{\boldsymbol{\delta}}_{1,2\text{SLS}}\right) = [(\mathbf{Z}_1'\mathbf{X})(\mathbf{X}'\mathbf{X})^{-1}\mathbf{X}'\mathbf{Z}_1]^{-1}\sigma_{11} = \begin{pmatrix} 15.6513 & 2.0432 & 177.3873 & 0.0145 & -0.2 \\ 2.0432 & 0.9978 & 46.3458 & 0.0382 & -0.0 \\ 177.3873 & 46.3458 & 5509.9816 & 1.0725 & -3.2 \\ 0.0145 & 0.0382 & 1.0725 & 0.0053 & -0.0 \\ -0.2075 & -0.0447 & -3.2734 & -0.0023 & 0.0 \end{pmatrix}$$

while the estimate of σ_{11} is obtained by

$$\hat{\sigma}_{11} = \frac{\left(\mathbf{y}_1 - \mathbf{Z}_1\hat{\boldsymbol{\delta}}_{1,2\text{SLS}}\right)'\left(\mathbf{y}_1 - \mathbf{Z}_1\hat{\boldsymbol{\delta}}_{1,2\text{SLS}}\right)}{T-5} = 40.8431.$$

Then, the corresponding estimated standard errors of 2SLS estimates can be obtained by the square root of the diagonal elements of $\operatorname{cov}(\hat{\boldsymbol{\delta}}_{1,2SLS})$ as follows.

$$\text{s.e.}\left(\hat{\boldsymbol{\delta}}_{1,2\text{SLS}}\right) = \begin{pmatrix} 3.9562 & 0.9989 & 74.2293 & 0.0725 & 0.0615 \end{pmatrix}' \tag{40}$$

As for the GMM estimator with instruments $\mathbf{X}$ for the investment equation in our three-equation model, the moment conditions in the Equation (38) is,

$$\mathbb{E}_t(\mathbf{X}_t'u_{1t}) = \mathbb{E}_t[\mathbf{X}_t'(y_{1t} - \mathbf{Z}_{1t}\boldsymbol{\delta}_1)] = \mathbf{0}. \tag{41}$$

The GMM estimator based on the moment conditions (41) minimizes the following quadratic function:

$$Q(\boldsymbol{\delta}_1) = [\sum_{t=1}^{T}(y_{1t} - \mathbf{Z}_{1t}\boldsymbol{\delta}_1)\mathbf{X}_t']\widehat{\mathbf{W}}_1^{-1}[\sum_{t=1}^{T}\mathbf{X}_t'(y_{1t} - \mathbf{Z}_{1t}\boldsymbol{\delta}_1)] \tag{42}$$

Here, the optimal weighting matrix $\widehat{\mathbf{W}}_1$ is the asymptotic variance matrix of sample mean of moment conditions. We can apply the estimates of 2SLS estimation with instruments $\mathbf{X}$ in equation (39) to obtain the sample residuals $\hat{\mathbf{u}}_1 = \mathbf{y}_1 - \mathbf{Z}_1\hat{\boldsymbol{\delta}}_{1,2\text{SLS}}$. The estimated weighting matrix $\widehat{\mathbf{W}}_1$ for GMM estimator based on those residuals can be constructed by Newey-West (1987) estimation is

$$\widehat{\mathbf{W}}_j = \begin{pmatrix} 2.6802 & -0.0096 & 0.0003 & 0.0148 & 0.0012 & 0.0187 & -0.1984 & -2.0510 \\ -0.0096 & 0.0000 & 0.0000 & -0.0001 & 0.0000 & 0.0001 & 0.0007 & 0.0057 \\ 0.0003 & 0.0000 & 0.0000 & -0.0001 & 0.0000 & 0.0009 & -0.0002 & 0.0037 \\ 0.0148 & -0.0001 & -0.0001 & 0.0006 & 0.0001 & -0.0026 & -0.0005 & -0.0255 \\ 0.0012 & 0.0000 & 0.0000 & 0.0001 & 0.0001 & -0.0013 & 0.0001 & -0.0120 \\ 0.0187 & 0.0001 & 0.0009 & -0.0026 & -0.0013 & 0.2465 & -0.0253 & 0.4074 \\ -0.1984 & 0.0007 & -0.0002 & -0.0005 & 0.0001 & -0.0253 & 0.0174 & 0.0955 \\ -2.0510 & 0.0057 & 0.0037 & -0.0255 & -0.0120 & 0.4074 & 0.0955 & 3.6176 \end{pmatrix}$$

Then, the vector of GMM estimates that minimizes this quadratic function (42) through the Broyden-Fletcher-Goldfarb-Shanno (BFGS) algorithm is

$$\hat{\delta}_{1,\text{GMM}} = \begin{pmatrix} -1.1062 & 4.7143 & -1.8814 & 0.0132 & 0.0097 \end{pmatrix}' \tag{43}$$

The corresponding asymptotic variance of the GMM estimator can be obtained by $\mathbf{V}_T = \{\mathbf{D}_1'\widehat{\mathbf{W}}_1^{-1}\mathbf{D}_1\}^{-1}$. Here, $\mathbf{D}_1$ is the transpose of the Jacobian matrix of moment conditions in investment equation evaluated at GMM estimates.

$$\mathbf{D}_1 = \begin{pmatrix} -47.0000 & 2.6068 & -0.5292 & -1450.8414 & -3876.1612 \\ -1450.8413 & 482.8651 & -21.7584 & -57669.2782 & -127304.6842 \\ -3876.1612 & -402.7128 & -57.6402 & -127304.6946 & -354485.4658 \\ -166.5106 & 84.0313 & -2.8771 & -6768.0668 & -14813.9201 \\ -700.9190 & -174.1938 & -6.4491 & -24376.5476 & -62129.2397 \\ -24.8893 & 1.6723 & -0.2712 & -648.2833 & -2030.8573 \\ -498.4315 & 25.2313 & -5.9328 & -14821.2700 & -41185.2342 \\ -7.7955 & 0.3706 & -0.0669 & -262.8514 & -627.8541 \end{pmatrix}$$

and the resulting estimated asymptotic covariance matrix of GMM estimator $\mathbf{V}_{1T}$ is

$$\mathbf{V}_{1T} = \begin{pmatrix} 9.1371 & 1.7792 & 137.3474 & -0.1135 & -0.1053 \\ 1.7792 & 0.6805 & 32.8959 & -0.0027 & -0.0287 \\ 137.3474 & 32.8959 & 3358.5269 & -2.0750 & -1.5714 \\ -0.1135 & -0.0027 & -2.0750 & 0.0046 & 0.0003 \\ -0.1053 & -0.0287 & -1.5714 & 0.0003 & 0.0016 \end{pmatrix}$$

Then, the vector for estimated standard errors of single-equation GMM estimates can be obtained from the square root of diagonal elements of $\mathbf{V}_{1T}$ is

$$\text{s.e.}\left(\hat{\boldsymbol{\delta}}_{1,\text{GMM}}\right) = \begin{pmatrix} 3.0228 & 0.8249 & 57.9528 & 0.0682 & 0.0397 \end{pmatrix}' \tag{44}$$

A.2 System estimation

We can rewrite our full system of equations as

$$\mathbf{Y} = \mathbf{Z}\boldsymbol{\delta} + \mathbf{u} \tag{45}$$

where $\mathbf{Y}$ is a vector defined as $[\ \mathbf{\Delta Inv}\ \ \mathbf{\Delta Div}\ \ \mathbf{\Delta Debt}\ ]'$. $\mathbf{Z} = \text{diag}[\ \mathbf{Z}_1\ \ \mathbf{Z}_2\ \ \mathbf{Z}_3\ ]$ is a block diagonal data matrix for all variables on the right-hand side of this system with the form $\mathbf{Z}_1 = [\ \mathbf{1}\ \mathbf{\Delta Div}\ \mathbf{\Delta Debt}\ \mathbf{Inv}_{-1}\ \mathbf{Q}\ ]$, $\mathbf{Z}_2 = [\ \mathbf{1}\ \mathbf{\Delta Inv}\ \mathbf{\Delta Debt}\ \mathbf{Div}_{-1}\ \mathbf{P}\ ]$, and $\mathbf{Z}_3 = [\ \mathbf{1}\ \mathbf{\Delta Inv}\ \mathbf{\Delta Div}\ \mathbf{Debt}_{-1}\ln(\mathbf{A})_{-1}\ \ (\mathbf{E/A})_{-1}\ ]$. $\boldsymbol{\delta}$ is the vector of parameters of interest. Here, the instruments matrix defined as $\mathbf{X}_I = \text{diag}[\ \mathbf{X}\ \ \mathbf{X}\ \ \mathbf{X}\ ]$ with $\mathbf{X} = [\ \mathbf{1}\ \mathbf{Inv}_{-1}\ \mathbf{Q}\ \mathbf{Div}_{-1}\ \mathbf{P}\ \mathbf{Debt}_{-1}\ \ln(\mathbf{A}_{-1})\ (\mathbf{E/A})_{-1}\ ]$.

The 3SLS estimation involves an instrumental variable approach to produce consistent estimates and generalized least squares (GLS) technique to account for the possibility of contemporaneous correlation between the disturbances in different structural equation. The 3SLS estimation uses all exogenous variables as instruments in each equation of this system. Basically, the first two stages of 3SLS estimation is similar to 2SLS estimation, whereas in the third stage we apply GLS estimation to deal with the contemporaneous correlation across equations. The vector of estimates for each equation obtained by 2SLS estimation is

$$\hat{\boldsymbol{\delta}}_{2\text{SLS}} = \begin{pmatrix} \hat{\boldsymbol{\delta}}_{1,2\text{SLS}} \\ \hat{\boldsymbol{\delta}}_{2,2\text{SLS}} \\ \hat{\boldsymbol{\delta}}_{3,2\text{SLS}} \end{pmatrix} = \begin{pmatrix} [\ -2.4541\ \ 4.5640\ \ 42.0613\ \ -0.0900\ \ 0.0471\ ]' \\ [-0.6152\ \ 0.0991\ \ 12.0646\ \ -0.3697\ \ 0.1237\ ]' \\ [\ -0.1232\ \ 0.0008\ \ -0.0088\ \ -0.1397\ \ 0.0221\ \ -0.1548\ ]' \end{pmatrix} \tag{46}$$

Form the residuals of each equation by $\hat{\mathbf{u}}_j = \mathbf{y}_j - \mathbf{Z}_j\hat{\boldsymbol{\delta}}_{j,2SLS}$, and use these residuals to form the contemporaneous covariance matrix as follows:

$$\widehat{\boldsymbol{\Sigma}} = \begin{pmatrix} \hat{\sigma}_{11} & \hat{\sigma}_{12} & \hat{\sigma}_{13} \\ \hat{\sigma}_{21} & \hat{\sigma}_{22} & \hat{\sigma}_{23} \\ \hat{\sigma}_{31} & \hat{\sigma}_{32} & \hat{\sigma}_{33} \end{pmatrix} = \begin{pmatrix} 36.49811 & -3.30773 & -0.11242 \\ -3.30773 & 0.84160 & -0.00016 \\ -0.11242 & -0.00016 & 0.00116 \end{pmatrix} \tag{47}$$

while the estimate of σ_{ij} is calculated by

$$\hat{\sigma}_{ij} = \frac{\left(\mathbf{y}_i - \mathbf{Z}_i\hat{\boldsymbol{\delta}}_{i,2SLS}\right)'\left(\mathbf{y}_j - \mathbf{Z}_j\hat{\boldsymbol{\delta}}_{j,2SLS}\right)}{T}, \quad \text{for i, j} = 1, 2, 3.$$

Then, apply the GLS estimation to obtain the vector of 3SLS estimates as follows:

$$\hat{\boldsymbol{\delta}}_{3SLS} = \left\{\mathbf{Z}'\mathbf{X}_I[\mathbf{X}_I'(\widehat{\boldsymbol{\Sigma}} \otimes \mathbf{I}_T)\mathbf{X}_I]^{-1}\mathbf{X}_I'\mathbf{Z}\right\}^{-1}\mathbf{Z}'\mathbf{X}_I[\mathbf{X}_I'(\widehat{\boldsymbol{\Sigma}} \otimes \mathbf{I}_T)\mathbf{X}_I]^{-1}\mathbf{X}_I'\mathbf{Y}$$

$$\begin{pmatrix} \hat{\boldsymbol{\delta}}_{1,3SLS} \\ \hat{\boldsymbol{\delta}}_{2,3SLS} \\ \hat{\boldsymbol{\delta}}_{3,3SLS} \end{pmatrix} = \begin{pmatrix} [\,-2.1798 \;\; 5.1858 \;\; 79.0964 \;\; -0.0379 \;\; 0.0197\,]' \\ [\,-0.2861 \;\; 0.1357 \;\; 1.0691 \;\; -0.2040 \;\; 0.0734\,]' \\ [\,-0.0891 \;\; 0.0031 \;\; -0.0204 \;\; -0.1282 \;\; 0.0180 \;\; -0.1234\,]' \end{pmatrix} \tag{48}$$

The estimated standard errors of 3SLS estimates can be obtained by the square root of the diagonal elements from $\left\{\mathbf{Z}'\mathbf{X}_I[\mathbf{X}_I'(\widehat{\boldsymbol{\Sigma}} \otimes \mathbf{I}_T)\mathbf{X}_I]^{-1}\mathbf{X}_I'\mathbf{Z}\right\}^{-1}$ is

$$\begin{pmatrix} \text{s.e.}(\hat{\boldsymbol{\delta}}_{1,3SLS}) \\ \text{s.e.}(\hat{\boldsymbol{\delta}}_{2,3SLS}) \\ \text{s.e.}(\hat{\boldsymbol{\delta}}_{3,3SLS}) \end{pmatrix} = \begin{pmatrix} [\,2.8660 \;\; 0.7857 \;\; 62.5301 \;\; 0.0592 \;\; 0.0421\,]' \\ [\,0.3626 \;\; 0.0194 \;\; 9.1971 \;\; 0.0841 \;\; 0.0311\,]' \\ [\,0.0909 \;\; 0.0013 \;\; 0.0071 \;\; 0.0501 \;\; 0.0095 \;\; 0.0938 \;\; -0.1234\,]' \end{pmatrix} \tag{49}$$

As before, the system GMM estimator with instruments matrix $\mathbf{X}_I$, the moment conditions of this system (45) is

$$\mathbb{E}(\mathbf{X}_I\mathbf{u}) = \Big(\; \mathbb{E}[\mathbf{X}'(\mathbf{y}_1 - \mathbf{Z}_1\boldsymbol{\delta}_1)] \;\; \mathbb{E}[\mathbf{X}'(\mathbf{y}_2 - \mathbf{Z}_2\boldsymbol{\delta}_2)] \;\; \mathbb{E}[\mathbf{X}'(\mathbf{y}_3 - \mathbf{Z}_3\boldsymbol{\delta}_3)] \;\Big)' = \mathbf{0}.. \tag{50}$$

The system GMM estimator based on the moment conditions (54) minimizes the following quadratic function:

$$Q\left[\begin{pmatrix} \boldsymbol{\delta}_1 \\ \boldsymbol{\delta}_2 \\ \boldsymbol{\delta}_3 \end{pmatrix}\right] = \begin{pmatrix} (\mathbf{y}_1 - \mathbf{Z}_1\boldsymbol{\delta}_1)\mathbf{X}' \\ (\mathbf{y}_2 - \mathbf{Z}_2\boldsymbol{\delta}_2)\mathbf{X}' \\ (\mathbf{y}_3 - \mathbf{Z}_3\boldsymbol{\delta}_3)\mathbf{X}' \end{pmatrix}' \begin{pmatrix} \widehat{\mathbf{W}}_{11} & \widehat{\mathbf{W}}_{12} & \widehat{\mathbf{W}}_{13} \\ \widehat{\mathbf{W}}_{21} & \widehat{\mathbf{W}}_{22} & \widehat{\mathbf{W}}_{23} \\ \widehat{\mathbf{W}}_{31} & \widehat{\mathbf{W}}_{32} & \widehat{\mathbf{W}}_{33} \end{pmatrix} \begin{pmatrix} \mathbf{X}'(\mathbf{y}_1 - \mathbf{Z}_1\boldsymbol{\delta}_1) \\ \mathbf{X}'(\mathbf{y}_2 - \mathbf{Z}_2\boldsymbol{\delta}_2) \\ \mathbf{X}'(\mathbf{y}_3 - \mathbf{Z}_3\boldsymbol{\delta}_3) \end{pmatrix} \tag{51}$$

We can apply the estimates of 2SLS estimation with instruments $\mathbf{X}$ in each equation to obtain the sample residuals $\hat{\mathbf{u}}_j = \mathbf{y}_j - \mathbf{Z}_j\hat{\boldsymbol{\delta}}_{j,2SLS}$. The optimal weighting matrix of $\widehat{\mathbf{W}}_{ij}$ can be constructed by using the Newey-West estimation to estimate the variance matrix of sample mean of moment conditions. Then, the corresponding vector of system GMM estimates that minimizes this quadratic function (51) based on BFGS algorithm is

$$\begin{pmatrix} \hat{\boldsymbol{\delta}}_{1,\mathrm{GMM}} \\ \hat{\boldsymbol{\delta}}_{2,\mathrm{GMM}} \\ \hat{\boldsymbol{\delta}}_{3,\mathrm{GMM}} \end{pmatrix} = \begin{pmatrix} [\,-1.0786 \;\; 4.9479 \;\; 37.6671 \;\; -0.0333 \;\; 0.0129\,]' \\ [\,-0.5014 \;\; 0.1185 \;\; 10.9065 \;\; -0.3181 \;\; 0.1028\,]' \\ [\,-0.1235 \;\; 0.0008 \;\; -0.0060 \;\; -0.1364 \;\; 0.0209 \;\; -0.1078\,]' \end{pmatrix} \tag{52}$$

and the corresponding asymptotic variance of GMM estimator can be obtained by $\mathbf{V}_T = \{\mathbf{D}'\widehat{\mathbf{W}}^{-1}\mathbf{D}\}^{-1}$. Here, $\mathbf{D}$ is the transpose of the Jacobian matrix of moment conditions in Equation (50) evaluated at GMM estimates, and $\widehat{\mathbf{W}}$ is the optimal weighting matrix of this system. the vector for the estimated standard errors of system GMM estimates obtained from the square root of diagonal elements of $\mathbf{V}_T$ is

$$\begin{pmatrix} \mathrm{s.e.}(\hat{\boldsymbol{\delta}}_{1,\mathrm{GMM}}) \\ \mathrm{s.e.}(\hat{\boldsymbol{\delta}}_{2,\mathrm{GMM}}) \\ \mathrm{s.e.}(\hat{\boldsymbol{\delta}}_{3,\mathrm{GMM}}) \end{pmatrix} = \begin{pmatrix} [\,2.4437 \;\; 0.8378 \;\; 57.0179 \;\; 0.0648 \;\; 0.0346\,]' \\ [\,0.2703 \;\; 0.0179 \;\; 6.9756 \;\; 0.0772 \;\; 0.0309\,]' \\ [\,0.0837 \;\; 0.0007 \;\; 0.0041 \;\; 0.0429 \;\; 0.0082 \;\; 0.1032\,]' \end{pmatrix} \tag{53}$$

Table A1: The IBM sample of 47 observations reported in terms of sums of squares and cross products.

	1	ΔInv	ΔDiv	ΔDebt	$\mathbf{Inv}_{-1}$	Q	$\mathbf{Div}_{-1}$	P	$\mathbf{Debt}_{-1}$	$\ln(\mathbf{A}_{-1})$	$(\mathbf{E}/\mathbf{A})_{-1}$
1	47.000	-52.868	-2.607	0.529	1450.841	3876.161	166.511	700.919	24.889	498.431	7.796
ΔInv	-52.868	3958.480	574.251	-2.104	-4038.989	-0.278	-440.373	203.749	-29.497	-521.374	-8.932
ΔDiv	-2.607	574.251	143.663	-0.230	-482.865	402.713	-84.031	174.194	-1.672	-25.231	-0.371
ΔDebt	0.529	-2.104	-0.230	0.067	21.758	57.640	2.877	6.449	0.271	5.933	0.067
$\mathbf{Inv}_{-1}$	1450.841	-4038.989	-482.865	21.758	57669.272	127304.688	6768.066	24376.549	648.283	14821.270	262.851
Q	3876.161	-0.278	402.713	57.640	127304.688	354485.467	14813.920	62129.241	2030.857	41185.234	627.854
$\mathbf{Div}_{-1}$	166.511	-440.373	-84.031	2.877	6768.066	14813.920	923.108	2979.217	70.662	1698.273	32.234
P	700.919	203.749	174.194	6.449	24376.549	62129.241	2979.217	13003.440	329.655	7214.574	130.988
$\mathbf{Debt}_{-1}$	24.889	-29.497	-1.672	0.271	648.283	2030.857	70.662	329.655	15.155	272.438	3.626
$\ln(\mathbf{A}_{-1})$	498.431	-521.374	-25.231	5.933	14821.270	41185.234	1698.273	7214.574	272.438	5335.773	80.131
$(\mathbf{E}/\mathbf{A})_{-1}$	7.796	-8.932	-0.371	0.067	262.851	627.854	32.234	130.988	3.626	80.131	1.513

For example, the OLS estimator in the investment equation is $\hat{\alpha} = (\mathbf{Z}_1'\mathbf{Z}_1)^{-1}\mathbf{Z}_1\mathbf{y}_1$, namely $\mathbf{y}_j = \Delta\mathbf{Inv}$ and $\mathbf{Z}_1 = [\,\mathbf{1}\ \Delta\mathbf{Div}\ \Delta\mathbf{Debt}\ \mathbf{Inv}_{-1}\ \mathbf{Q}\,]$.

Hence, the resulting OLS estimates of investment equation are

$$\begin{pmatrix} \hat{\alpha}_1 \\ \hat{\alpha}_2 \\ \hat{\alpha}_3 \\ \hat{\alpha}_4 \\ \hat{\alpha}_5 \end{pmatrix} = \begin{pmatrix} 47.0000 & -2.6068 & 0.5292 & 1450.8413 & 3876.1612 \\ -2.6068 & 143.6629 & -0.2300 & -482.8651 & 402.7128 \\ 0.5292 & -0.2300 & 0.0674 & 21.7584 & 57.6402 \\ 1450.8413 & -482.8651 & 21.7584 & 57669.2721 & 127304.6882 \\ 3876.1612 & 402.7128 & 57.6402 & 127304.6882 & 354485.4669 \end{pmatrix}^{-1} \begin{pmatrix} -52.8683 \\ 574.2510 \\ -2.1041 \\ -4038.9888 \\ -0.2784 \end{pmatrix} = \begin{pmatrix} -5.5650 \\ 3.0264 \\ -27.8209 \\ -0.1492 \\ 0.1155 \end{pmatrix}$$

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Table 1 Summary statistics

		Inv					*Div*					*Debt*				
	N	Mean	Median	Q1	Q3	Standard Deviation	Mean	Median	Q1	Q3	Standard Deviation	Mean	Median	Q1	Q3	Standard Deviation
1965-1969	1,498	16.724	10.389	5.339	20.755	18.064	1.105	0.975	0.528	1.416	0.787	0.412	0.411	0.306	0.514	0.145
1970-1979	4,902	17.763	10.878	5.482	21.673	19.754	0.946	0.786	0.400	1.237	0.776	0.443	0.453	0.341	0.545	0.145
1980-1989	5,481	19.977	12.045	6.319	26.525	20.464	1.063	0.811	0.443	1.426	0.861	0.477	0.489	0.373	0.578	0.151
1990-1999	5,383	16.035	9.804	5.155	19.512	17.680	0.844	0.641	0.390	1.081	0.704	0.531	0.546	0.420	0.649	0.169
2000-2012	5,228	13.695	7.577	4.121	15.980	17.024	0.775	0.611	0.325	1.000	0.677	0.545	0.556	0.432	0.659	0.174
1965-2012	22,492	16.874	10.017	5.155	20.805	18.867	0.921	0.718	0.399	1.199	0.770	0.494	0.501	0.380	0.606	0.166

This table presents the summary statistics where we show the mean, median, first quartile, third quartile, and the standard deviation of each variable from 1965 to 2012. Only firms that survive 30 years or longer are included in the sample. These exclusions leave us with complete information for 564 firms. *N* is the number of firm-year observations. The sample consists of 22,492 firm-year observations from annual Compustat files, excluding financial and regulated firms. *Inv* denotes net property, plant, and equipment. *Div* denotes dividends. Both *Inv* and *Div* are measured on a per share basis. *Debt* refers to book leverage, defined as the ratio of total liabilities to total assets. All variables are winsorized at the 1st and 99th percentiles to avoid the influence of extreme observations.

Table 2 Results of 2SLS

Independent Variables \ Dependent Variables	ΔInv_{it}	ΔDiv_{it}	$\Delta Debt_{it}$
Constant	0.200 (1.77)	0.033 (5.95)	0.081 (10.27)
$Inv_{i,t-1}$	-0.296 (-28.43)		
$Div_{i,t-1}$		-0.224 (-28.35)	
$Debt_{i,t-1}$			-0.287 (-35.06)
ΔInv_{it}		0.046 (19.71)	0.012 (7.52)
ΔDiv_{it}	6.664 (6.51)		-0.096 (-6.80)
$\Delta Debt_{it}$	10.772 (8.35)	0.246 (2.87)	
Q_{it}	0.085 (14.31)		
P_{it}		0.039 (19.93)	
$\ln A_{i,t-1}$			0.011 (8.83)
$E_{i,t-1}/A_{i,t-1}$			-0.101 (-6.39)
Adjusted R-squares	0.53	0.49	0.15

This table presents the 2SLS regression results of a simultaneous equation system model for investment, dividend, and debt financing:

$\Delta Inv_{it} = \alpha_{1i} + \alpha_{2i}\Delta Div_{it} + \alpha_{3i}\Delta Debt_{it} + \alpha_{4i}Inv_{i,t-1} + \alpha_{5i}Q_{it} + \epsilon_{it}$,

$\Delta Div_{it} = \beta_{1i} + \beta_{2i}\Delta Inv_{it} + \beta_{3i}\Delta Debt_{it} + \beta_{4i}Div_{i,t-1} + \beta_{5i}P_{it} + \eta_{it}$,

$\Delta Debt_{it} = \gamma_{1i} + \gamma_{2i}\Delta Inv_{it} + \gamma_{3i}\Delta Div_{it} + \gamma_{4i}Debt_{i,t-1} + \gamma_{5i}\ln A_{i,t-1} + \gamma_{6i}(E_{i,t-1}/A_{i,t-1}) + \xi_{it}$.

The coefficients are shown in averages across the 564 firms. Regressions are based on non-missing observations and winsorization at the 1st and 99th percentiles. The three endogenous variables are ΔInv_{it} , ΔDiv_{it} , and $\Delta Debt_{it}$, which are the change in net plant and equipment, the change in dividends, and the change in book leverage ratio, respectively. The independent variables in the investment regression are lagged investment ($Inv_{i,t-1}$), and sales plus change in inventories (Q_{it}). The independent variables in the dividend regression are lagged dividends ($Div_{i,t-1}$), and net income before extraordinary items plus depreciation minus preferred dividends (P_{it}). All the variables in both of investment and dividend equations are measured on a per share basis. The independent variables in the debt financing regression are lagged book leverage ($Debt_{i,t-1}$), natural logarithm of lagged total assets ($\ln A_{i,t-1}$), and the lag of earnings before interest and taxes divided by total assets ($E_{i,t-1}/A_{i,t-1}$). Numbers in the parentheses are t-statistics.

Table 3 Results of 3SLS

Dependent Variables / Independent Variables	ΔInv_{it}	ΔDiv_{it}	$\Delta Debt_{it}$
Constant	0.086 (0.96)	0.029 (6.41)	0.072 (10.62)
$Inv_{i,t-1}$	-0.235 (-22.60)		
$Div_{i,t-1}$		-0.177 (-23.69)	
$Debt_{i,t-1}$			-0.240 (-29.60)
ΔInv_{it}		0.052 (19.83)	0.013 (8.08)
ΔDiv_{it}	8.050 (5.29)		-0.107 (-5.80)
$\Delta Debt_{it}$	13.232 (8.09)	0.091 (0.85)	
Q_{it}	0.069 (13.37)		
P_{it}		0.029 (17.68)	
$\ln A_{i,t-1}$			0.008 (7.93)
$E_{i,t-1}/A_{i,t-1}$			-0.079 (-6.21)
Adjusted R-squares 0.67			

This table presents the 3SLS regression results of a simultaneous equation system model for investment, dividend, and debt financing:

$\Delta Inv_{it} = \alpha_{1i} + \alpha_{2i}\Delta Div_{it} + \alpha_{3i}\Delta Debt_{it} + \alpha_{4i} Inv_{i,t-1} + \alpha_{5i} Q_{it} + \epsilon_{it}$,

$\Delta Div_{it} = \beta_{1i} + \beta_{2i}\Delta Inv_{it} + \beta_{3i}\Delta Debt_{it} + \beta_{4i} Div_{i,t-1} + \beta_{5i} P_{it} + \eta_{it}$,

$\Delta Debt_{it} = \gamma_{1i} + \gamma_{2i}\Delta Inv_{it} + \gamma_{3i}\Delta Div_{it} + \gamma_{4i} Debt_{i,t-1} + \gamma_{5i}\ln A_{i,t-1} + \gamma_{6i}(E_{i,t-1}/A_{i,t-1}) + \xi_{it}$.

The coefficients are shown in averages across the 564 firms. Regressions are based on non-missing observations and winsorization at the 1st and 99th percentiles. The three endogenous variables are ΔInv_{it} , ΔDiv_{it} , and $\Delta Debt_{it}$, which are the change in net plant and equipment, the change in dividends, and the change in book leverage ratio, respectively. The other variables are the same as in Table 1. Numbers in the parentheses are t-statistics.

Table 4 Results of GMM

Independent Variables \ Dependent Variables	ΔInv_{it}	ΔDiv_{it}	$\Delta Debt_{it}$
Panel A: Regression analyses of investment, dividend and debt financing			
Constant	0.166 (1.78)	0.027 (5.93)	0.075 (10.57)
$Inv_{i,t-1}$	-0.256 (-24.44)		
$Div_{i,t-1}$		-0.186 (-24.81)	
$Debt_{i,t-1}$			-0.256 (-32.57)
ΔInv_{it}		0.050 (19.84)	0.012 (7.62)
ΔDiv_{it}	7.832 (9.55)		-0.101 (-5.94)
$\Delta Debt_{it}$	11.695 (7.82)	0.100 (1.08)	
Q_{it}	0.075 (12.99)		
P_{it}		0.033 (18.84)	
$\ln A_{i,t-1}$			0.009 (8.12)
$E_{i,t-1}/A_{i,t-1}$			-0.087 (-6.15)
Adjusted R-squares	0.38	0.36	-0.23

This table presents the GMM regression results of a simultaneous equation system model for investment, dividend, and debt financing:

$\Delta Inv_{it} = \alpha_{1i} + \alpha_{2i}\Delta Div_{it} + \alpha_{3i}\Delta Debt_{it} + \alpha_{4i}Inv_{i,t-1} + \alpha_{5i}Q_{it} + \epsilon_{it}$,

$\Delta Div_{it} = \beta_{1i} + \beta_{2i}\Delta Inv_{it} + \beta_{3i}\Delta Debt_{it} + \beta_{4i}Div_{i,t-1} + \beta_{5i}P_{it} + \eta_{it}$,

$\Delta Debt_{it} = \gamma_{1i} + \gamma_{2i}\Delta Inv_{it} + \gamma_{3i}\Delta Div_{it} + \gamma_{4i}Debt_{i,t-1} + \gamma_{5i}\ln A_{i,t-1} + \gamma_{6i}(E_{i,t-1}/A_{i,t-1}) + \xi_{it}$.

Panel A shows the coefficients in averages across the 564 firms. Regressions are based on non-missing observations and winsorization at the 1st and 99th percentiles. The three endogenous variables are ΔInv_{it} , ΔDiv_{it} , and $\Delta Debt_{it}$, which are the change in net plant and equipment, the change in dividends, and the change in book leverage ratio, respectively. The other variables are the same as in Table 1. Panel B shows the average standardized coefficients of speed-of-adjustment across the firms, that is, the coefficients of lagged investment, dividend, and debt financing. The standardized coefficient is calculated by multiplying the unstandardized coefficient by the ratio of the standard deviation of the independent variable (i.e. the lagged terms) to the standard deviation of dependent variable. Numbers in the parentheses are t-statistics.

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Board characteristics and firm performance of Vietnamese publicly listed companies

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Abstract

This paper examines the impact of board characteristics including size, composition, and CEO duality, on both accounting and market performance of Vietnamese publicly listed companies for a sample of 293 listed firms on the Ho Chi Minh Stock Exchange (HOSE) during 2012. The result shows that market – based performance is negatively affected by board size is consistent with Yermack (1996) and Eisenberg et al. (1998). It reveals that companies with larger board of directors report poorer market performance. Another interesting finding indicates that Vietnamese market seems not to be concerned about single leadership structure as the mean value of both market and financial performance are not statistically different for single and dual leadership groups. In addition, the relationship between ratio of independent director and the market valuation is positive but not statistically significant. The impact of financial leverage, firm size, and firm age on company efficiency is also confirmed.

1. Introduction

Over the last few decades, corporate governance has been becoming a worldwide mounting concern caused by a series of major events, e.g. Asian currency crisis during 1997 - 1998, collapse of some corporate giants due to fraud in corporate governance such as Enron, Tyco, WorldCom in 2001 - 2002. In addition, corporate governance is one of crucial factors affecting decision of investors according to a survey conducted by McKinsey in 2002. Its result of this survey also showed that good practice of corporate governance will help firms improve access to capital markets and reduce operating costs, thereby creating competitive advantage. This is the reason why corporate governance is now the centre of worldwide public attention, from government, media to investors and shareholders.

Within corporate governance framework, board of directors plays a central role as they are responsible for devising and overseeing company strategies, as well as controlling over management on behalf of the General Assembly of Shareholders (IFC, 2010). Its efficient operation is dependent upon various factors such as board size, structure, diversity of skills, experience and gender of board members. However, results of previous empirical studies on the impact of board characteristics upon firm performance were inconsistent, even contradictory.

To the best of our knowledge, there is no formal study by this time in Vietnam on the impact of board characteristics on the efficiency of company operation published on specialized journals. With the aim of filling this research gap and contributing more empirical evidence of emerging markets, this study tests hypotheses on the relationship between the size of the board, the presence of independent directors, leadership structure and the performance of Vietnamese publicly listed companies measured by both profitability ratio – ROE and market index – Tobin's Q.

2. LITERATURE BACKGROUND AND HYPOTHESES

2.1. *Relationship between board size and firm performance*

Jensen (1993) indicated that a small size will help the board operate more efficiently as increasing group size makes board members become inefficient because problems stemming from cooperation exceed benefits it could bring. In the case of larger board size, all board members will not be at their best to bring benefits to shareholders, then free - rider problem will occur and reduce efficiency of the whole board. In addition, coordination and communication problems arise and cause slower and less – efficient decision making (Lipton and Lorsch, 1992). In fact, the inverse relationship between board size and its efficiency has been empirically verified by Yermack (1996), Eisenberg, Sundgren, and Wells (1998). However, Pfeffer (1972), Zahra and Pearce (1989), and Dalton and Dalton (2005) presented a completely opposite standpoint about the impact of board size on firm performance. They argued that larger board size leads to a wide diversity in experience, skills and expertise which will facilitate the process of making rational strategic decisions, thereby bringing added value to shareholders (Dalton and Dalton, 2005). Moreover, the presence of independent or non –

executive directors in larger board is expected to reduce their dependency upon the CEO and provide better monitoring. Actually, few previous empirical studies demonstrated this positive correlation, e.g. Mak and Li (2001) and Adams and Mehran (2005)'s research. Besides empirical evidences supporting these two foregoing opposing views, some studies could not find any solid evidence to confirm the relationship between board size and the firm performance.

In brief, the majority of empirical studies into board size found that smaller board size would have better economic results. Large board is believed to function inefficiently and consume more operating cost. Planning, collaboration, making decision and arranging board meetings will become more difficult as the size of board increases. Based on the foregoing standpoint, the hypothesis H1 on the relationship between board size and firm performance is proposed:

H1: There is a negative impact of board size on firm performance.

2.2. *Relationship between board composition and firm performance*

Most theoretical studies have supported the viewpoint that an efficient board should have high rate of independent directors (Lorsch and MacIver, 1989; Mizruchi, 1983; Zahra and Pearce, 1989). This perspective stems from the theory of agency problem between shareholders and management. The separation between ownership and control in listed company causes asymmetric information between executives who directly manage all daily activities and gain complete access to all necessary information, and its shareholders who are indeed the owners but suffer a lack of company information. Being driven by self – interest, executives tend to prioritize their self – serving activities which could be harmful to shareholders' welfare (Mizruchi, 1983). Therefore, the monitoring role of independent board members is extremely important because it minimizes the self - interested actions by managers. In addition, skills, knowledge, business and managerial expertise, and objective standpoint that outside independent directors provide will improve quality and objectivity of board decision, thus bring benefits to the company. Some empirical evidences, which were found through studies of Baysinger and Butler (1985), Black, Jang and Kim (2006), and Dahya, Dimitrov and McConnell (2008), advocate the foregoing viewpoint. However, other studies including Daily and Dalton (1992; 1993), Kesner Victor and Lamont (1986), Mak and Kusnadi (2005) could not find any relationship between the number of outside independent directors and efficiency in company operation.

In summary, serving the role of active monitoring and providing objective judgments, independent board members are believed to improve board effectiveness, thus enhance firm value as well as promote welfare of shareholders. Based on the theoretical viewpoint about benefits from the presence of independent board members, this study proposes and tests the second hypothesis as follows:

H2: There is a positive impact of the proportion of independent board members on firm performance.

2.3. *Relationship between leadership structure and firm performance*

The state that CEO and chairman of the board are the same person is objected by scholars who advocate the theory of agency problem because this single leadership structure excessively empowers CEO, reduces board efficiency in oversight and monitoring role, and rises agency cost (Fama and Jensen, 1983; Rechner and Dalton, 1991; Finkelstein and D'Aveni, 1994). Moreover, it will make the information asymmetry existing between shareholders and managers worsen as CEO could abuse his power for self – serving activities and conceal similar actions of the executive board. In addition, it will be extremely difficult for other board members to deliver objective opinions to debate in board room. As a result, this leadership structure would negatively influence the board process of making decision. In contrast, if two roles are separated, there will be a difference in standpoint between chairman and CEO. Debate and constructive criticisms will help both board of directors and executives reach the most rational decision and reconcile interests of all related parties (Hung and Thang, 2012). In fact, the inverse relationship between CEO duality and board effectiveness was evidenced by studies of Rechner and Dalton (1991) and Pi and Timme (1993).

Contrary to agency theory, stewardship theory supports the occurrence of CEO duality. It proposes that managers are stewards of the company and they will work diligently for greatest benefits of the company and its shareholders (Donaldson and Davis, 1994). Having access to all information regarding company daily activities, CEO will help board of directors come to informed strategic decisions, facilitate and hasten the decision – making process (Thanh, 2012). In the case of dual leadership structure, it will take considerable time for the CEO to obtain board approval in order to adjust company strategy, thus leading to inflexibility and letting the company miss many golden opportunities (Hung and Thang, 2012). Furthermore, the fact that CEO duality prevents conflicts between Chairman and the head of management board and improves the understanding between executives and board members, is expected to enhance board efficiency. The positive impact of single leadership structure on company profitability was supported by experimental evidences of Donalson and Davis (1991) and Peng, Zhang and Li (2007). Nevertheless, there are still many research results could not confirm the relationship between CEO duality and financial measures (Berg and Smith, 1978; Daily and Dalton, 1992; Rechner and Dalton, 1989).

Although current Vietnamese law does not include code arguing explicitly against the concurrence of the CEO and Chairman position, relating bylaws tend to be in favor of the separation of these two crucial positions (Hung and Thang, 2012). Based on agency theory, the third hypothesis of this study is proposed as follows:

H3: *There is a negative impact of single leadership structure on firm performance.*

3. RESEARCH METHODS

3.1. *Data description*

This study gathers data of 330 publicly listed companies on Ho Chi Minh Stock Exchange (HOSE) on December 28th 2012. After eliminating firms with missing data and outliers, the final sample consists of 293 listed firms, accounting for 76.48% of the HOSE market capitalization at this point of time.

The main source is corporate governance documents that are publicly available on company website. They include annual report and annual financial statement, the two most important documents. Listing date and closed share price of each listed firm on December 28th 2012 were collected from reliable websites, namely http://www.cophieu68.vn, http://www.cafef.vn, and www.vietstock.vn. Also, disclosure on independent board members, ownership percentage and transaction announcements of major shareholders published on these websites and the official website of Ho Chi Minh Stock Exchange greatly assist in verifying the independence status of board members when annual report could not provide sufficient information.

3.2. *Research model*

Rashid et al (2010) developed a model to verify the relationship between board characteristics and firm performance in Bangladesh. Bangladesh is a country in South Asia and listed as an emerging market, similar to Vietnam (IFC, 2013). Our study will use this model to test the three hypotheses on the impact of board characteristics upon performance of publicly listed companies in Vietnam.

Model 1:

$$\mathrm{Q} = \alpha + \beta_1 \times \mathrm{LnBDSize} + \beta_2 \times \mathrm{BDComp} + \beta_3 \times \mathrm{CEOD} + \beta_4 \times CR$$
$$+\beta_5 \times \mathrm{Debt} + \beta_6 \times \mathrm{LnFirmSize} + \beta_7 \times \mathrm{LnFirmAge} + \varepsilon$$

and Model 2:

$$\mathrm{ROE} = \alpha + \beta_1 \times \mathrm{LnBDSize} + \beta_2 \times \mathrm{BDComp} + \beta_3 \times \mathrm{CEOD} + \beta_4 \times CR$$
$$+\beta_5 \times \mathrm{Debt} + \beta_6 \times \mathrm{LnFirmSize} + \beta_7 \times \mathrm{LnFirmAge} + \varepsilon$$

Where:

- Q is Tobin's Q ratio, proxy for market measure of firm performance. Tobin's Q is defined as ratio of sum of total market value of equity and book value of total debt to book value of total assets. In greater detail, market value of equity is the market capitalization of each company on December 28^{th} 2012.
- ROE is return on equity, represents accounting measure of firm performance, and is calculated as the ratio of profit after tax to book value of equity.
- BDSize represents board size, measured by the number of board members disclosed in annual report. Article 1, Section 2, Circular 121/2012 / TT-BTC has specified the minimum of 3 and the maximum of 11 people per board of directors in Vietnam.
- BDComp represents board structure, defined by the proportion of independent directors. Article 30, Section 2, Circular 121/2012 / TT-BTC has required that at least 1/3 of board members are independent directors. Definition of independent directors used in this study is based on Article 2, Section 3 of the Circular 121/2012 / TT-BTC.

- CEOD represents the status of CEO Duality. This dummy variable equals 1 if there is single leadership structure, and equals 0 if there is dual leadership structure.
- CR represents the percentage of shares owned by major shareholders. As defined in Article 6, Section 9 of the Law on Securities (2006), a major shareholder is who owns, directly or indirectly, 5% or more of the voting shares of the company.
- Debt is a critical control variable, measured by the ratio of book value of total debt to book value of total assets.
- LnFirmSize represents firm size, based on logarithm of company's market capitalization on December 28th 2012.
- LnFirmAge represents firm age, defined by the number of years listing on the Ho Chi Minh Stock Exchange.
- ε is residual term.

Table 1 – Descriptive statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
ROE	293	-.60	.46	.0831	.13135	-.936	.142	3.584	.284
Q	293	.42	3.94	.9044	.30251	4.188	.142	35.118	.284
LnBDSize	293	1.39	2.40	1.7251	.19130	1.077	.142	.533	.284
BDComp	293	.0000	.6000	.078596	.1328229	1.661	.142	2.124	.284
CEOD	293	.0	1.0	.358	.4803	.594	.142	-1.659	.284
CR	293	.0000	.9775	.542144	.2124678	-.341	.142	-.419	.284
Debt	293	.0029	.9613	.515445	.2136460	-.199	.142	-.762	.284
LnFirmSize	293	1.8414	11.2031	5.747210	1.5159287	1.078	.142	1.871	.284
LnFirmAge	293	.0000	2.4849	1.107055	.6552441	-.149	.142	-.798	.284

4. REGRESSION ANALYSIS

Table 2 – One – way ANOVA for CEO Duality variable

ANOVA

Tobin's Q

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.063	1	.063	.686	.408
Within Groups	26.658	291	.092		
Total	26.721	292			

ROE

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.003	1	.003	.170	.681
Within Groups	5.035	291	.017		
Total	5.038	292			

Before running the regression model, we use the analysis of variance (ANOVA) to test whether there is any difference between dual and single leadership groups. The result shows that there is no significant difference in ROE and Tobin'Q between single leadership firm and other. This result reveals that the concern about CEO duality is not an issue at the emerging market in Vietnam. Therefore, hypothesis H3 is rejected as single leadership structure does not have significant impact on both accounting and market performance. As a result, variable CEOD is excluded from our models. After ANOVA test, our models are revised as the following:

Model 1:

$$\mathrm{Q} = \alpha + \beta_1 \times \mathrm{LnBDSize} + \beta_2 \times \mathrm{BDComp} + \beta_3 \times CR + \beta_4 \times \mathrm{Debt} \\ + \beta_5 \times \mathrm{LnFirmSize} + \beta_6 \times \mathrm{LnFirmAge} + \varepsilon$$

and Model 2:

$$\mathrm{ROE} = \alpha + \beta_1 \times \mathrm{LnBDSize} + \beta_2 \times \mathrm{BDComp} + \beta_3 \times CR + \beta_4 \times \mathrm{Debt} \\ + \beta_5 \times \mathrm{LnFirmSize} + \beta_6 \times \mathrm{LnFirmAge} + \varepsilon$$

Adjusted R2 of first model is 0.282, indicating that the model explains 28.2% of the variation in response variable, Q. Similarly, this goodness – of – fit measure of second model says that 21.8% of the variation in ROE is explained by independent variables. The p – value of F test in both models are approximately 0, which confirms their overall significance. Hence, our sample regression model could serve as a good proxy for the population regression models.

The regression results show that board size is negatively related to Tobin's Q ratio at significance level of 5%. This inverse relationship advocates the standpoint in favor of smaller board size. Larger board would lead to inefficient operation due to cooperation and communication problems arising among board members. In addition, firm has to pay more cost to maintain board operation if the number of board members augments. So, an increase in board size would result in a reduction in firm performance represented by market measure. With regards to the second model, the negative relationship between board size and profitability is not statistically significant because Sig value is greater than 10%. One of the most important duties of board is devising strategy and providing direction. As a result, the board usually focuses on long – term goals instead of short – term goals in order to ensure the company sustainable development and long – term interests of shareholders. Therefore, board efficiency could be reflected more accurately in market index of the company than in accounting performance of current fiscal year. This is the reason why board size and ROE do not have any correlation. Briefly, hypothesis H1 is accepted as the inverse relationship between board size and Tobin's Q has been found.

Table 3 – Regression results

	Dependent variables					
	Q			**ROE**		
	Beta	t-value	Sig.	Beta	t-value	Sig.
Constant	.743	5.031	.000	.083	1.236	.217
LnBDSize	-.247	-2.947	.003	-.041	-1.084	.279
BDComp	.015	.127	.899	-.032	-.619	.537
CR	.029	.407	.685	.004	.113	.910
Debt	-.033	-.460	.646	-.188	-5.855	.000
LnFirmSize	.113	10.594	.000	.033	6.714	.000
LnFirmAge	-.059	-2.515	.012	-.017	-1.567	.118
R^2	.296			.234		
Adjusted R^2	.282			.218		
Sig. of F - value	.000			.000		

The effect of board independence on firm performance is ambiguous. In fact, the proportion of independent board members has a positive relationship with company efficiency measured by market index with regression coefficient 0.015. Meanwhile, the correlation between board independence and accounting performance is found to be negative. Nonetheless, these results are not statistically significant due to Sig. values are greater than 10%. Therefore, there is no empirical evidence that increasing level of board independence would lead to improvement of company performance. This finding partly reveals that, as the condition of significance level is not satisfied, the presence of independent directors in Vietnam has not contributed significantly to the company economic value yet. In fact, our sample data in 2012 reveals that in Vietnam, independent directors who strictly satisfy all requirements in Article 2, Section 3 of Circular

121/2012/TT-BTC were very scarce. As a matter of fact, independent members are often chosen from major shareholders, investment funds, strategic partners, family members of executives, or having managerial role at subsidiaries of the listed firm (Hai Li, 2010). As they are only nominally independent, independent directors cannot perform well their oversight and monitoring role and voice objective criticism. Besides, the majority of independent directors in developing countries like Malaysia and Vietnam did not undertake any official corporate governance training (Haniffa and Hudaib, 2006). Consequently, they have not been aware of their important role in corporate governance system, thus not fulfilling their duty. To sum up, findings show that there is no relationship between ratio of independent directors and firm performance, which makes hypothesis H2 rejected.

Our regression results suggest that CR, proxy for concentration ratio of listed firms, has a positive influence on both Tobin's Q and ROE although its coefficients are not statistically significant. Actually, major shareholders have more power and motivation to exercise controlling rights than minor shareholders do. Their active control of management prevents fraud as a result, thereby reducing agency cost in listed firms. Besides, positive relation between firm size and firm performance indicate that larger firms tend to achieve higher profitability and better market results thanks to their financial strength and ability of diversification. In contrast, the negative effect of firm age on market performance is found at significance level of 5%. It indicates that firms getting older encounter difficulties retaining creative people and their innovative ideas. In addition, according to O'Connor & Byrne (2006), mature firms tend to devote more resources to value preservation than to value creation. The lack of innovative strategies of mature firms makes them less attractive to investors who are usually motivated to gain rewards from innovative projects quickly. The relationship between debt ratio and firm performance is significantly negative in the first model. As our sample consists data of the year 2012, when Vietnamese market has not recovered yet from the global financial crisis 2007 – 2009, this result suggests that the more a firm is heavily in debt, the worse its performance is because this mounting debt reveals bad things of its financial health during the post – recession period.

5. CONCLUSION

In conclusion, the inverse relationship between board size and market performance of firm indicates that an increase in number of board members will reduce efficiency of board operation and lower company market value. CEO duality is also demonstrated to not to have any impact on both Tobin's Q and ROE ratio. It reveals the truth that single leadership structure seems not to be a serious concern of investors in Vietnamese market.

have positive impact on Tobin's Q at high significance level. This finding is against agency theory which advocates the separation between CEO and Chairman position, and contributes an empirical evidence supporting stewardship theory.

In addition, insignificant coefficients of ratio of independent directors in both models suggest that independent members of board in Vietnam currently do not have any remarkable contribution to company economic value as their independence status is not reliable and they are still not fully aware of their crucial role in corporate governance system. Besides, the comprehensive definition of an independent director was officially disclosed recently in Circular 121/2012 / TT-BTC which has taken effect since September 17th 2012. As a result, there was hardly any independent directors who could meet all requirements in the year of 2012. Hence, the impact of them on firm performance could not be measured accurately in this study.

To sum up, variables of board characteristics have clearer relationship with market ratio than with accounting measure. In fact, relations between board characteristics and ROE are almost not statistically significant. Thus, good corporate governance practices do not necessarily lead to higher profitability in short – term but numerous non – financial benefits, e.g. reputation, credibility, and investor confidence. These advantages brought by implementing good corporate governance will make listed firms become more attractive to both domestic and international investors and help them facilitate access to worldwide low – cost capital (IFC, 2010) to develop sustainably and bring long – term benefits to shareholders. Because of foregoing reasons, influence of board characteristics on market – based performance is observed clearly.

Notwithstanding several contributions that this study makes to the literature, especially impact of board size on market – based measures, it has a number of limitations which would represent further research opportunities.

Firstly, time – series data should be incorporated into sample of future studies to track the market perception over years. Actually our study only includes only cross – sectional observations for the year 2012, when Vietnam economy has not recovered yet from the global recession. This period of economic hardship has still adversely influenced operating performance and market value of firms. In fact, in our sample, 12.3% companies report negative ROE and 77.1% have Tobin's Q ratio less than 1.

Secondly, extensive investigations including publicly listed companies on the Hanoi Stock Exchange (HNX) would confirm the relationship between board characteristics and firm performance in the entire Vietnam stock market. Also, future research could incorporate data of longer period of time rather than focus on only cross – sectional observations for 2012 as current study does in order to examine the impact of corporate governance variables on mid – term and long – term corporate performance.

Thirdly, future research could include variables measuring quality of board operation, e.g. number of board meetings during a year, attendance ratio of directors, as well as active participation of independent directors in board meetings. The inclusion of these corporate governance variables is expected to ameliorate the goodness – of – fit statistic of the model and enhance our understanding of corporate governance mechanism and its actual effectiveness in publicly listed companies.

Last but not least, other control variables, for example industry and board and executives ownership, should be introduced to the model in order to improve fit measures. Last but no least, board of directors is an endogenous corporate governance factor according to Hermalin and Weisbach (2003) and Bhagat and Black (2000). So, future studies may test the link by using the method of Instrumental Variables (IV) or Simultaneous – Equation Method (SEM) to eliminate biases caused by endogenous variables.

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Marginal Effects of Factors on the Unconditional Distribution of Financial Literacy in Taiwan

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In this paper, the marginal effects of factors on the unconditional distribution of financial literacy in Taiwan is investigated with the unconditional quantile estimation suggested by Firpo, et al (2009). Factors include higher education status, ratios of male/female, married/unmarried, urban/non-urban individuals are considered. Our empirical data is collected from three surveys on 2007, 2009, and 2011 conducted by Financial Supervisory Commission, R.O.C. Totally, there are 3155 individuals randomly selected and surveyed, 1005 on 2007, 919 on 2009, and 1231 on 2011. Applying the factor analysis suggested by van Rooij, et al (2011), the financial literacy is computed from 18 questionnaires about the knowledge of management on cash, savings, credit, and loans. Our empirical results conclude: 1. Incre- ment of the higher education not only increases the obtainment of financial literacy (since the mean becomes larger after the increase of higher education) but also decreases the dispersion of financial literacy distribution. This conclusion provides an evidence to support the policy of higher education expansion. Besides, the unconditional financial literacy distribution be- comes more skew to the left after the increase of higher education. 2. The marginal effects of ratio of male/female on the unconditional literacy distribution are negative and statistically significant at all quantiles except at extreme quantiles. This indicates the access of financial literacy is easier to female individuals relative to the males. The unconditional financial lit- eracy distribution changes from skew to the right to skew to the left after the increase of the ratio of males. 3. The marginal effects of ratio of married individuals on the unconditional literacy distribution are also negative and statistically significant at all quantiles. This indi- cates the access of financial literacy is easier to unmarried individuals relative to the married ones. The unconditional literacy distribution changes from skew to the right to skew to the left after the increase of the ratio of married individuals. 4. The marginal effects of ratio of individuals live at urban area on the unconditional literacy distribution are statistically insignificant negative at all quantiles.

Keywords Financial literacy, Recentered Influence Function, Unconditional Quantile Estimation

JEL Classification: C12, C46.

1 Introduction

Over the last few decades, financial development has introduced sophisticated financial instruments that require advanced skills for proper use. Marcolin and Abraham (2006) points out that financial literacy skills have been crucial for individuals being able to navigate the financial world. Financial literacy defined in Noctor, et al (1992) is as "the ability to make informed judgments and to take effective decisions regarding the use and management of money." More and more literature has emphasized the effects of financial literacy on household wealth accumulation (Behrman, et al (2012)), on retirement preparedness (Lusardi and Mitchell (2007)). van Rooij, et al (2011) finds that financial literacy is positively correlated with the access of financial markets and investment in stocks. At the macroeconomic level, Jappelli (2010) shows that the ability to reap the benefits of new investment opportunities and participate in financial markets depends crucially on economic literacy. Prete (2013) finds that income inequality grows less in countries where economic literacy is higher, and that financial development is negatively correlated to inequality growth. It is clear that both economic and financial literacy have significant positive effects on the financial market development in macro level and wealth accumulation in micro level. On the other hand, Carlin and Robinson (2012) emphasizes the role of financial education to improve the access of financial literacy. The financial education is provided mostly by the higher education system. Consequently, the acceptance of financial literacy should be positively correlated with the expansion of higher education system in mean level. The marginal effect of the change of proportion of higher educated people on the distribution of the access of financial literacy in Taiwan is investigated in Su, Hsiao, and Chen (2015).

In this paper, the marginal effects of factors on the "unconditional" distribution of financial literacy in Taiwan is studied with the unconditional quantile estimation suggested by Firpo, et al (2009). The factors we consider include higher education status, ratios of male/female, married/unmarried, urban/non-urban individuals. Section 2 introduces the unconditional quantile estimations comprehensively. Using a sample data from the survey conducted by the Financial Supervisory Commission, R.O.C. in 2007, 2009, and 2011, section 3 conducts the empirical study. Section 4 makes the conclusions and suggestions.

2 Unconditional Quantile Estimation

Let random variables $(Y,\boldsymbol{X})$ be defined on the sample space Ω as

$$(Y,\boldsymbol{X}):\Omega\to\mathcal{R}\times\mathcal{R}^k,$$

with joint CDF $F_{Y,\boldsymbol{X}}$. The conditional CDF of Y on $\boldsymbol{X}$ is denoted as $F_{Y|\boldsymbol{X}}$, and the marginal CDFs of Y and $\boldsymbol{X}$ are F_Y and $F_{\boldsymbol{X}}$, respectively. The problem under investigated is how the interested statistic changes by the changing of F_Y due to alerting $\boldsymbol{X}$ a little, i.e., from $F_{\boldsymbol{X}}$ to $G_{\boldsymbol{X}}$ where $G_{\boldsymbol{X}}$ is close to $F_{\boldsymbol{X}}$. Given the new distribution $G_{\boldsymbol{X}}$ after the change, the unconditional distribution of Y moves to $G_Y = G_{Y|\boldsymbol{X}}\cdot G_{\boldsymbol{X}}$ where $G_{Y|\boldsymbol{X}}$ is the conditional CDF of Y on $\boldsymbol{X}$. It is clear that the changes from F_Y to G_Y arise from (1) the change from F_X to G_X and (2) the change from $F_{Y|\boldsymbol{X}}$ to $G_{Y|\boldsymbol{X}}$. To be simplified, Firpo, et al (2009) assumes the conditional distribution of Y on $\boldsymbol{X}$ keeps constant. That is $G_{Y|\boldsymbol{X}} = F_{Y|\boldsymbol{X}}$ is assumed and then the counterfactural distribution $G_Y^* = F_{Y|\boldsymbol{X}}\cdot G_{\boldsymbol{X}}$ is the new distribution of Y given $F_{\boldsymbol{X}}$ changes to $G_{\boldsymbol{X}}$ keeping $F_{Y|\boldsymbol{X}}$ constant. Consequently, the effect of little altering $\boldsymbol{X}$ on the interested statistic becomes $T(G_Y^*)-T(F_Y)$ where $T(G_Y^*)$ and $T(F_Y)$ are the interested statistics measured at distributions G_Y^* and F_Y.

Firpo, et al (2009) defines the *Recentered Influence Function* (RIF) as

$$RIF(y;T,F_Y)=T(F_Y)+\int IF(y;T,F_Y)d\triangle_y(y)=T(F_Y)+IF(y;T,F_Y),$$

where $IF(y;T,F_Y)$ denotes the *Influence Function* of the functional $T(F_Y)$ evaluated at y. It is easy to have

$$E[RIF(y;T,F_Y)]=\int RIF(y;T,F_Y)\,dF_Y(y)=\int[T(F_Y)+IF(y;T,F_Y)]dF_Y(y)=T(F_Y).$$

This indicates that any magnitude of interest can be seen as an expectation. Besides, by the fact of $F_Y(y)=\int F_{y|\boldsymbol{X}=\boldsymbol{x}}dF_{\boldsymbol{X}}(\boldsymbol{x})$,

$$T(F_Y)=E\{E[RIF(y;T,F_Y)|\boldsymbol{X}=\boldsymbol{x}]\},$$

the random variables $\boldsymbol{X}$ have been introduced through the law of iterative expectation.

2.1 The Marginal Effects of Altering $\boldsymbol{X}$

Suppose $F_{\boldsymbol{X}}$ changes marginally in the direction of $G_{\boldsymbol{X}}$. Assume $F_{Y|\boldsymbol{X}}$ stays constant and let $\alpha(T)$ be the vector of partial effects on T of moving each coordinate of $\boldsymbol{X}$ separately as a location shift. Then (under some regularity)

$$\alpha(T) = \int \frac{dE[RIF(T, F_Y)|\boldsymbol{X} = \boldsymbol{x}]}{dx} dF_{\boldsymbol{X}}(\boldsymbol{x}).$$

2.2 RIF of Quantiles and Unconditional Partial Effect

Let q_τ be the τth quantile of Y (unconditional), i.e., $T(F_Y) = q_\tau$ and then the influence function is

$$\begin{aligned}
IF(y; T, F_Y) &= \frac{\tau - 1[y \le q_\tau]}{f_Y(q_\tau)}, \\
RIF(y; T, F_Y) &= T(F_Y) + IF(y; T, F_Y) = q_\tau + \frac{\tau - 1[y \le q_\tau]}{f_Y(q_\tau)}.
\end{aligned}$$

The derivations of $IF(y; T, F_Y)$ and $RIF(y; T, F_Y)$ of q_τ can be found in Huber and Ronchett (2009).

As $1[y \le q_\tau] = 1 - 1[y > q_\tau]$ and

$$\begin{aligned}
RIF(y; T, F_Y) &= q_\tau + \frac{\tau - 1[y \le q_\tau]}{f_Y(q_\tau)} \\
&= q_\tau + \frac{(\tau - 1) + 1[y > q_\tau]}{f_Y(q_\tau)} \\
&= \left[q_\tau + \frac{\tau - 1}{f_Y(q_\tau)}\right] + \left[\frac{1}{f_Y(q_\tau)}\right] 1[y > q_\tau] \\
&= c_{2,\tau} + c_{1,\tau} 1[y > q_\tau],
\end{aligned}$$

then

$$\begin{aligned}
E[RIF(T, F_Y)|\boldsymbol{X} = \boldsymbol{x}] &= \int RIF(y; T, F_Y) dF_{Y|\boldsymbol{X}=\boldsymbol{x}}(y) \\
&= \int \{c_{2,\tau} + c_{1,\tau} 1[y > q_\tau]\} dF_{Y|\boldsymbol{X}=\boldsymbol{x}}(y) \\
&= c_{2,\tau} + c_{1,\tau} \int 1[y > q_\tau]\} dF_{Y|\boldsymbol{X}=\boldsymbol{x}}(y) \\
&= c_{2,\tau} + c_{1,\tau} E[1[y > q_\tau]|\boldsymbol{X} = \boldsymbol{x}] \\
&= c_{2,\tau} + c_{1,\tau} P[y > q_\tau|\boldsymbol{X} = \boldsymbol{x}].
\end{aligned}$$

Thus, the unconditional partial effect is

$$\begin{aligned}
\alpha(\tau) &= \int \frac{dE[RIF|\boldsymbol{X} = \boldsymbol{x}]}{d\boldsymbol{x}} dF_{\boldsymbol{X}}(\boldsymbol{x}) \\
&= \int \frac{d\{c_{2,\tau} + c_{1,\tau} P[y > q_\tau|\boldsymbol{X} = \boldsymbol{x}]\}}{d\boldsymbol{x}} dF_{\boldsymbol{X}}(\boldsymbol{x}) \\
&= c_{1,\tau} \int \frac{d\{P[y > q_\tau|\boldsymbol{X} = \boldsymbol{x}]\}}{d\boldsymbol{x}} dF_{\boldsymbol{X}}(\boldsymbol{x}).
\end{aligned}$$

Based on assumptions on the functional form of $P[y > q_\tau | \boldsymbol{X} = \boldsymbol{x}]$, Firpo, et al (2009) suggests the following estimations of $\alpha(\tau)$.

2.3 Estimation: RIF-OLS

If the linear probability model (LPM) is considered as

$$P[y > q_\tau | \boldsymbol{X} = \boldsymbol{x}] = \boldsymbol{x}'\boldsymbol{\gamma}$$

so

$$\frac{d\{P[y > q_\tau | \boldsymbol{X} = \boldsymbol{x}]\}}{d\boldsymbol{x}} = \boldsymbol{\gamma}.$$

And then the unconditional partial effect vector is

$$\alpha(\tau) = c_{1,\tau}\boldsymbol{\gamma}.$$

Given LPM

$$1[y > q_\tau] = \boldsymbol{x}'\boldsymbol{\gamma} + u$$

with $E(u|\boldsymbol{x}) = 0$,

$$\begin{aligned} RIF(y; F_Y) &= c_{2,\tau} + c_{1,\tau}1[y > q_\tau] \\ &= c_{2,\tau} + c_{1,\tau}(\boldsymbol{x}'\boldsymbol{\gamma} + u) \\ &= c_{2,\tau} + \boldsymbol{x}'(c_{1,\tau}\boldsymbol{\gamma}) + c_{1,\tau}u \\ &= c_{2,\tau} + \boldsymbol{x}'\boldsymbol{\gamma}_\tau^* + u^*, \end{aligned}$$

this is the RIF regression for the τth quantile. For having the RIF regression estimatable, q_τ and $f_Y(q_\tau)$ have to be estimated first. q_τ can be estimated as the sample τth quantile, $\hat{q}_\tau$ and $f_Y(q_\tau)$ can be estimated using kernel density smoothing estimator at $\hat{q}_\tau$, $\hat{f}_Y(\hat{q}_\tau)$. Then for each observation $(y_i, \boldsymbol{x}_i)$, compute

$$\widehat{RIF}(y_i; F) = \hat{q}_\tau + \frac{\tau - 1[y_i \leq \hat{q}_\tau]}{\hat{f}_Y(\hat{q}_\tau)}$$

and then regress $\widehat{RIF}(y_i; F)$ on $\boldsymbol{x}_i$ and then obtain $\hat{\boldsymbol{\gamma}}_\tau^*$ which equals to $\hat{\alpha}(\tau)$.

2.4 Estimation: RIF-LOGIT

By specifying a Logit model, given the estimated $\hat{q}_\tau$,

$$P(y_i > \hat{q}_\tau | \boldsymbol{X} = \boldsymbol{x}_i) = \frac{\exp(\boldsymbol{x}_i'\gamma)}{1 + \exp(\boldsymbol{x}_i'\gamma)},$$

the marginal effect of the jth explanatory variable on $P(y_i > \hat{q}_\tau | \boldsymbol{X} = \boldsymbol{x}_i)$

$$\frac{dP(y_i > \hat{q}_\tau | \boldsymbol{X} = \boldsymbol{x}_i)}{dx_{ij}} = \gamma_j \left[\frac{\exp(\boldsymbol{x}_i'\gamma)}{1 + \exp(\boldsymbol{x}_i'\gamma)} \right] \left[1 - \frac{\exp(\boldsymbol{x}_i'\gamma)}{1 + \exp(\boldsymbol{x}_i'\gamma)} \right].$$

Denote $\tilde{\gamma}$ as the MLE of the Logit model. Thus, the expectation

$$\int \frac{d\{P[y > q_\tau | \boldsymbol{X} = \boldsymbol{x}]\}}{d\boldsymbol{x}} dF_{\boldsymbol{X}}(\boldsymbol{x})$$

could be approximated by by the sample mean of the estimated marginal effects

$$\frac{1}{n} \sum_{i=1}^{n} \tilde{\gamma}_j \left[\frac{\exp(\boldsymbol{x}_i'\tilde{\gamma})}{1 + \exp(\boldsymbol{x}_i'\tilde{\gamma})} \right] \left[1 - \frac{\exp(\boldsymbol{x}_i'\tilde{\gamma})}{1 + \exp(\boldsymbol{x}_i'\tilde{\gamma})} \right]$$

Then, the j-th element in $\boldsymbol{\alpha}(\tau)$ can be estimated by

$$\tilde{\alpha}_j(\tau) = \frac{1}{\hat{f}_Y(\hat{q}_\tau)} \left\{ \frac{1}{n} \sum_{i=1}^{n} \tilde{\gamma}_j \left[\frac{\exp(\boldsymbol{x}_i'\tilde{\gamma})}{1 + \exp(\boldsymbol{x}_i'\tilde{\gamma})} \right] \left[1 - \frac{\exp(\boldsymbol{x}_i'\tilde{\gamma})}{1 + \exp(\boldsymbol{x}_i'\tilde{\gamma})} \right] \right\}$$

This method is called the RIF-LOGIT estimation.

3 Empirical Data

Our empirical data is obtained from three surveys on 2007, 2009, and 2011 conducted by Financial Supervisory Commission, R.O.C. Totally, there are 6860 individuals were surveyed, 2133 on 2007, 2071 on 2009, and 2656 on 2011. Using the method of factor analysis suggested by van Rooij, et al (2011), the financial literacy is measured from 18 questionnaires about the knowledge of management on cash, savings, credit, and loans.

The explanatory variables considered in this paper are:

1. highedu: dummy variable, 1 for individual having degree from college, university, or graduate and 0 otherwise;

2. sex: dummy variable, 1 for male and 0 for female;

3. marriage: dummy variable, 1 for married and 0 otherwise;

4. pincome: 1 for annual personal income from NT$ 370 thousands to NT$ 680 thousands , 2 for NT$ 680 thousands to NT$ 1240 thousands, and 3 for above NT$ 1240 thousands;

5. fincome: 1 for annual family income from NT$ 660 thousands to NT$ 1230 thousands , 2 for NT$ 1230 thousands to NT$ 2150 thousands, and 3 for above NT$ 2150 thousands;

6. Dfulltime: dummy variable, 1 for having full-time job and 0 otherwise;

7. Darea: dummy variable, 1 for living in urban area and 0 otherwise;

The summary statistics of empirical data are shown in Table 1. As shown in Table 1, the ratio of male individuals is 0.448 and the ratio of individuals having higher education (defined as receiving degree from college, university, or graduate) is 0.461. The proportion of married individuals under survey is 0.644. The sample average of "pincome" is 0.686 which indicates that the average personal income is below NT$ 370 thousands. Meanwhile, the sample average of "fincome" is 0.853 which indicates that the average family income is below NT$ 660 thousands. The ratio of individuals who have full-time jobs is 0.640 and the ratio of individuals living in urban area is 0.723.

Table 1. Summary Statistics

	literacy	highedu	age	sex	marriage	pincome	fincome	fulltime	area
Min.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Q_1	1.957	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000
Mean	2.792	0.461	2.048	0.448	0.644	0.686	0.853	0.640	0.723
Median	2.860	0.000	2.000	0.000	1.000	1.000	1.000	1.000	1.000
Q_3	3.629	1.000	3.000	1.000	1.000	1.000	1.000	1.000	1.000
Max.	4.552	1.000	4.000	1.000	1.000	3.000	3.000	1.000	1.000
Variance	1.178	0.248	1.621	0.247	0.229	0.628	0.674	0.230	0.200
Stdev	1.085	0.498	1.273	0.497	0.478	0.792	0.821	0.479	0.447
Skewness	-0.335	0.153	-0.012	0.208	-0.601	0.891	0.759	-0.585	-0.997
Kurtosis	-0.624	-1.976	-1.043	-1.956	-1.638	-0.025	0.058	-1.657	-1.005

3.1 Empirical UQE Estimation

The regression model considered in this paper is

$$\begin{aligned}\text{literacy} &= \beta_1 + \beta_2\text{highedu} + \beta_3\text{age} + \beta_4\text{sex} + \beta_5\text{pincome} \\ &\quad + \beta_7\text{marriage} + \beta_7\text{fincome} + \beta_8\text{Dfulltime} + \beta_9\text{Darea} + error.\end{aligned}$$

For comparisons, the mean regression estimated by OLS, the conditional quantile regressions and unconditional quantile regressions at quantiles 0.1, 0.5 , and 0.9 are considered. The estimated results are presented in Table 2. Robust standard errors for OLS and bootstrapped standard errors (2000 replications) for CQR (conditional quantile), RIFOLS (RIF-OLS estimation), and RIFLOG (RIF-LOGIT estimation) are provided in parentheses. These estimations are conducted with R3.0.2. The package "ks" is used to estimate the density function and package "boot" is to do the bootstrapping for estimating the variance-covariance matrix of coefficients. The R codes and empirical data are available from authors upon request.

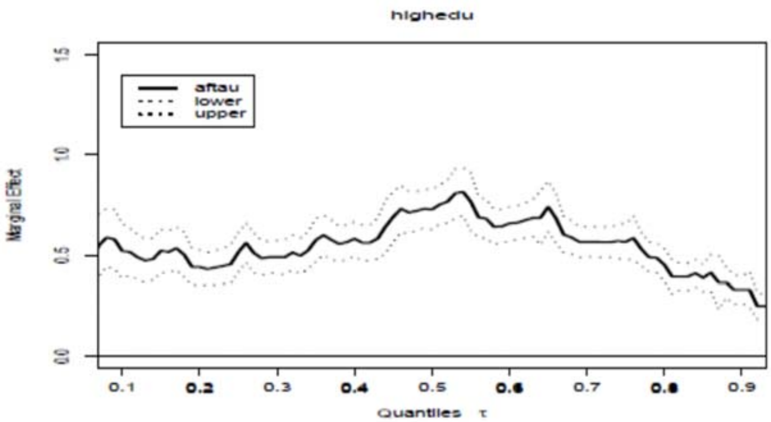
Table 2. Estimated Results from OLS, CQR, and UQR Regressions

		$\tau = 0.1$			$\tau = 0.5$			$\tau = 0.9$		
	OLS	CRQ	RIFOLS	RIFLOG	CRQ	RIFOLS	RIFLOG	CRQ	RIFOLS	RIFLOG
Intercept	2.359	0.770	0.552	0.664	2.477	2.502	-0.340	3.748	3.965	-0.876
	(56.35)	(12.92)	(6.39)	(8.48)	(35.81)	(38.01)	(-5.22)	(82.71)	(114.32)	(-12.27)
highedu	0.546	0.469	0.467	0.521	0.736	0.768	0.728	0.372	0.306	0.331
	(20.51)	(11.60)	(10.07)	(8.02)	(16.33)	(16.98)	(14.45)	(14.86)	(12.33)	(9.17)
Dage	0.082	0.090	0.150	0.102	0.098	0.101	0.102	0.041	0.007	0.009
	(7.609)	(5.51)	(6.36)	(5.23)	(5.31)	(5.98)	(5.73)	(3.02)	(1.02)	(0.92)
sex	-0.140	-0.125	-0.097	-0.119	-0.179	-0.241	-0.241	-0.030	-0.007	-0.005
	(-5.61)	(-3.41)	(-2.05)	(-2.51)	(-4.55)	(-5.86)	(-5.56)	(-1.25)	(-0.32)	(-0.24)
marriage	-0.196	-0.106	-0.247	-0.183	-0.249	-0.291	-0.290	-0.141	-0.097	-0.097
	(-7.05)	(-2.41)	(-4.75)	(-3.31)	(-5.47)	(-6.33)	(-6.12)	(-5.31)	(-3.85)	(-3.91)
pincome	0.121	0.151	0.137	0.249	0.130	0.142	0.142	0.059	0.074	0.061
	(5.86)	(4.43)	(3.81)	(4.72)	(4.12)	(4.08)	(4.02)	(2.84)	(3.80)	(3.66)
fincome	0.095	0.086	0.079	0.091	0.093	0.101	0.102	0.111	0.084	0.072
	(5.24)	(3.34)	(2.41)	(2.51)	(3.03)	(3.47)	(3.49)	(6.52)	(4.81)	(4.63)
Dfulltime	0.076	0.332	0.463	0.345	-0.049	-0.068	-0.068	0.001	-0.070	-0.057
	(2.50)	(6.79)	(7.80)	(5.82)	(-1.10)	(-1.37)	(-1.39)	(0.04)	(-2.74)	(-2.02)
Darea	-0.017	-0.029	-0.009	-0.019	-0.052	-0.079	-0.079	0.032	0.045	0.053
	(-0.653)	(-0.70)	(-0.17)	(-0.37)	(-1.26)	(-1.78)	(-1.73)	(1.23)	(1.92)	(1.97)

3.2 Marginal Effect of Higher Education

From Table 2, the OLS estimated coefficient of "highedu" is 0.546 and significant from zero which indicates the increment of the proportion of high-educated individuals has significant positive impact on the conditional mean of financial literacy obtainment. At quantiles 0.1, 0.5, and 0.9, the CQR estimated coefficients of "highedu" are 0.469, 0.736, and 0.372 and are statistically significant. The impact of "highedu" on the conditional quantile is getting large at high quantiles which demonstrates that increase the proportion of high-educated population increase the dispersion of conditional distribution of obtainment of financial literacy. For the

Figure 1: Marginal Effects of Higher Education

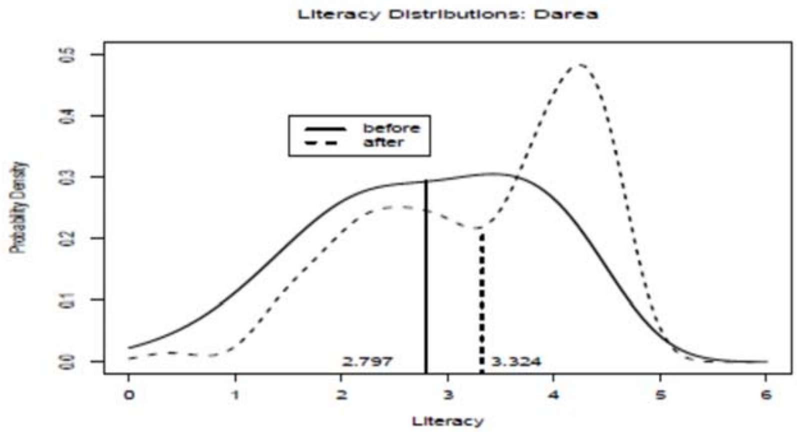


RIF-OLS (RIF-LOG), the estimated coefficients of "highedu" at quantiles 0.1, 0.5, and 0.9 are 0.467 (0.521), 0.768 (0.728), and 0.306 (0.331). These results indicate that the proportion of high-education population always has positive effect on the quantiles of financial literacy distribution.

To study the marginal effects of higher education on the unconditional distribution of financial literacy comprehensively, we estimate the sample quantiles of the financial literacy, $\hat{q}_\tau$, and the marginal effects using RIFLOG, $\tilde{\alpha}_\tau$, for $\tau = 0.01, 0.02, \ldots, 0.98, 0.99$. The estimated $\tilde{\alpha}_\tau$ for 99 τs (represented as line "aftau") and their 95 % confidence intervals (represented as lines "upper" and "lower") are plotted in Figure 1. It is clear that all 99 $\tilde{\alpha}_\tau$s are significant from zero at 5 % of Type I error. It is also found that $\tilde{\alpha}_\tau$s are decreasing from $\tau = 0.01$ to 0.2 and turn to be increasing at increasing rate from $\tau = 0.2$ to 0.53. But from $\tau = 0.53$ to 0.99, $\tilde{\alpha}_\tau$s are decreasing at increasing rate which is larger the increasing rate from $\tau = 0.2$ to 0.53. And then, we find that the marginal effects, $\tilde{\alpha}_\tau$s, at high τs are smaller relative to the ones with small τs.

Denote $\tilde{\alpha}_\tau(\textit{higher education})$ as the estimated marginal effect of higher education. Using the kernel smoothing density estimator, the density function of "before" (before change) is estimated using $\hat{q}_\tau$ and the one of "after" (after change) is estimated using $\hat{q}_\tau + \tilde{\alpha}_\tau(\textit{higher education})$. The "after" density function describes the new unconditional distribution of financial literacy

Figure 2: "before" and "after" Change of Higher Education



after an unit change of higher education. The estimated density functions are represented as in Figure 2.

As shown in Figure 2, the mean of the estimated "after" density function is 3.324 which significantly larger than 2.797, the mean of estimated "before"density function. This indicates that an increment of higher education moves the unconditional distribution of financial literacy to the right. In other words, an increment of higher education moves all quantiles of financial literacy to the right. However, the lower quantiles are moved to the right more than the higher quantiles are. Besides, the dispersion of estimated "after" distribution becomes smaller than the "before" one. In addition, it is interesting to find the "after" uncondition distribution of financial literacy becomes bimodal and the density at right mode is much higher than the one at left mode. This result implies that increment of higher education not only increases the level of financial literacy but also decreases the dispersion of literacy. Finally, the skewness of the unconditional literacy distribution becomes larger from "before" change to "after" change. The distribution becomes more skew to the left "after" the change.

To a summary, the estimated impacts of higher education on the unconditional distribution of financial literacy are concluded as following:

1. Increment of the status of higher education will have statistically significant positive marginal effects on conditional and unconditional distributions of financial literacy, i.e., move conditional and unconditional distributions to the right.

2. The increase of higher education reduces the dispersion more for the unconditional distribution than for the conditional distribution.

3. Increment of higher education will make the unconditional literacy distribution more skew to the left.

These conclusions imply that increase the higher education not only increases the obtainment of financial literacy (more significant at quantiles smaller that 0.53) but also decrease the dispersion of financial literacy distribution. Therefore, the extension of higher education in Taiwan is supported by our findings.

3.3 Marginal Effect of Sex

From Table 2, the OLS estimated coefficient of "sex" is -0.14 and significant from zero which indicates the increment of the proportion of male individuals has significant negative impact on the conditional mean of financial literacy obtainment. At quantiles 0.1, 0.5, the CQR estimated coefficients of "sex" are -0.125, -0.179 and are statistically significant. However, the CQR estimated coefficients of "sex" at quantile 0.9 is -0.030 which is statistically insignificant. Similar results are found for the estimations from RIF-OLS and RIF-LOG. For the RIF-OLS (RIF-LOG), the estimated coefficients of "sex" at quantiles 0.1, 0.5, and 0.9 are -0.097 (-0.119), -0.241 (-0.241), and -0.007 (-0.005). These estimations are statistically significant at quantiles 0.1 and 0.5, but insignificant at 0.9. Since all estimated coefficients are negative, the obtainment of financial literacy is easier to female relative to male individuals.

From Figure 3, it is clear to know the negative marginal effect of "sex" is getting large for quantiles from 0.01 to 0.5 and then getting smaller for quantiles larger than median. The marginal effects are statistically significant at most of quantiles except at the extreme small (less than 0.1) and large (larger than 0.85) quantiles. Besides, the marginal effects display almost symmetric pattern at median. This symmetric marginal effects make the skewness of unconditional literacy distribution changed. As shown in Figure 4, the original unconditional literacy distribution denoted as solid line and symbolled with "before" is skew to the left. However, the unconditional literacy distribution after change which is denoted as dotted line

Figure 3: Marginal Effects of Sex

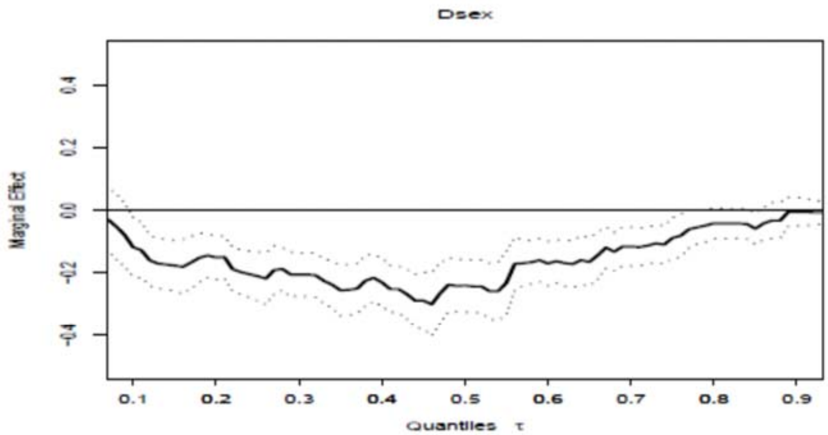
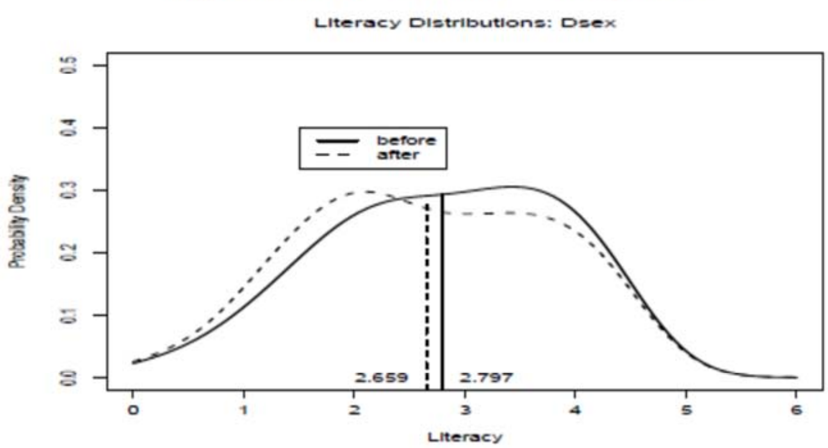


Figure 4: "before" and "after" Change of Sex



and symbolled with "after" becomes skew to the right. Finally, the mean of unconditional literacy distribution changes from 2.797 to 2.659 after the change. As to the dispersion of literacy distribution, there is no significant difference between "before" and "after" change.

To a summary, for the factor "sex", we find that

1. The marginal effects of "sex" are negative and statistically significant for all quantiles except at extreme small and large quantiles.
2. The access of financial literacy is easier to female individuals relative to males.
3. The mean of unconditional literacy distribution "after" change is smaller than the one "before" change.
4. The unconditional literacy distribution is skew to the right "before" change and then is skew to the left "after" change.

3.4 Marginal Effect of Marriage

The OLS estimated coefficient of "marriage" is -0.196 and significant from zero which indicates the increment of the proportion of married individuals has significant negative impact on the conditional mean of financial literacy obtainment. At quantiles 0.1, 0.5, and 0.9, the CQR estimated coefficients of "marriage" are -0.106, -0.249, and -0.141 and are all statistically significant. For the RIF-OLS (RIF-LOG), the estimated coefficients of "marriage" at quantiles 0.1, 0.5, and 0.9 are -0.247 (-0.183), -0.291 (-0.290), and -0.097 (-0.097) and are also all statistically significant from zero. These results indicate that married individual are easier to access financial literacy than the ones without marriage.

As shown in Figure 5, the negative impact of "marriage" on the conditional quantile is getting smaller for quantiles from 0.01 to 0.25 and is getting larger for quantiles from 0.25 to 0.5. For quantiles larger than 0.5, the negative marginal effects becomes smaller and smaller. For all quantiles from 0.01 to 0.99, the marginal effects are statistically significant. Since the marginal effects are all negative, the mean of the unconditional literacy distribution becomes smaller. As shown in Figure 6, the mean of the unconditional literacy distribution

Figure 5: Marginal Effects of Marriage

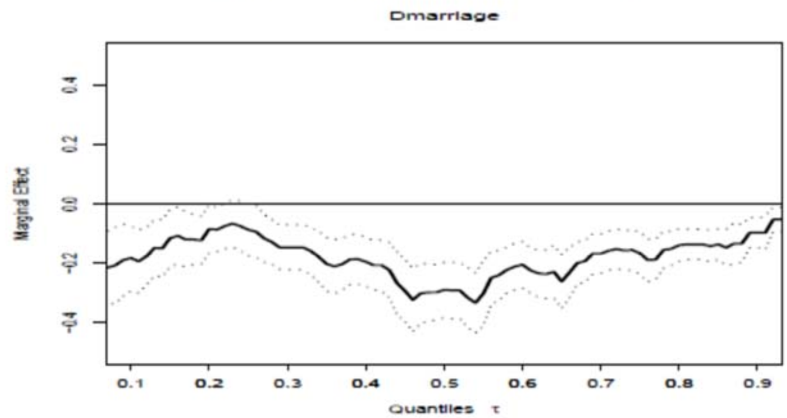
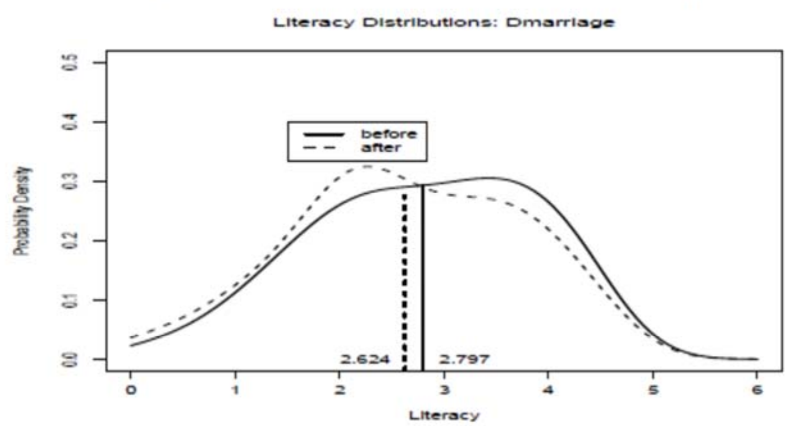


Figure 6: "before" and "after" Change of Marriage



"before" change is 2.797 and is 2.624 "after" the change. Besides, the unconditional literacy distribution "before" the change is skew to the left and then becomes skew to the right "after" the change.

To a summary, for the factor "marriage", the estimated results are similar to the ones of "sex". We find that

1. The marginal effects of "marriage" are negative and statistically significant for all quantiles.

2. The access of financial literacy is easier for unmarried individuals relative to the married ones.

3. The mean of unconditional literacy distribution "after" change is smaller than the one "before" change.

4. The unconditional literacy distribution is skew to the right "before" change and then is skew to the left "after" change.

3.5 Marginal Effect of Area

From Table 2, the OLS estimated coefficient of "Darea" is -0.017 and not significant from zero which indicates the increment of the proportion of individuals living at urban area has significant positive impact on the conditional mean of financial literacy obtainment. At quantiles 0.1, 0.5, and 0.9, the CQR estimated coefficients of "Darea" are -0.029, -0.052, and 0.032 and are statistically insignificant. For the RIF-OLS (RIF-LOG), the estimated coefficients of "Darea" at quantiles 0.1, 0.5, and 0.9 are -0.009 (-0.019), -0.079 (-0.079), and 0.045 (0.053) and all of them are statistically insignificant. These results indicate that the proportion of urban population always has insignificant effect on the quantiles of unconditional financial literacy distribution. That is, the unconditional distribution of financial literacy is not different for individuals live at urban area or countryside. This result might be attributed to the well established internet and communication infrastructure in Taiwan.

As shown in Figure 7, it is obvious that the marginal effects of "Darea" on the unconditional literacy distribution are statistically insignificant for all quantiles considered. Since

Figure 7: Marginal Effects of Area

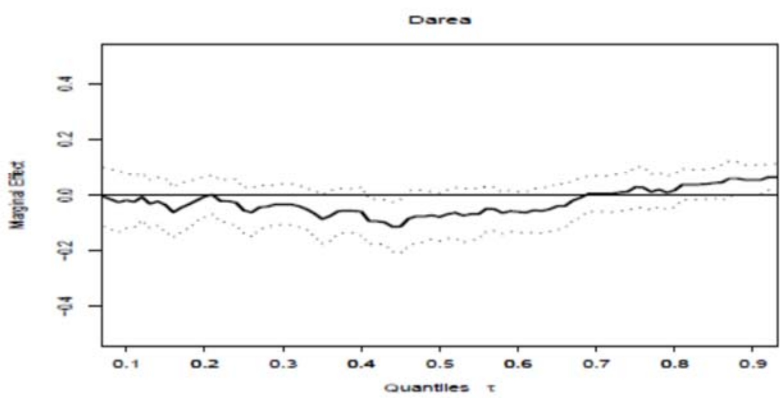
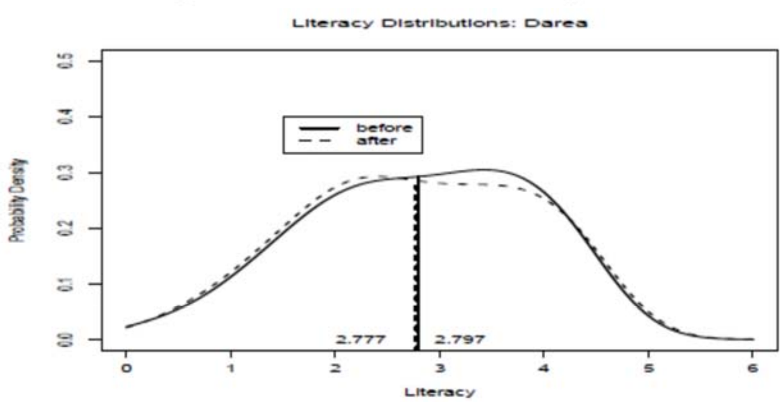


Figure 8: "before" and "after" Change of Area



the marginal effects are insignificant, the mean and skewness of the unconditional literacy distribution change a little from "before" to "after", as shown in Figure 8. The mean changes from 2.797 to 2.777.

4 Conclusions and Suggestions

This paper investigates the marginal effects of higher education status, ratios of male/female, married/unmarried, urban/non-urban individuals on the conditional and unconditional distributions of financial literacy. Using the surveyed samples from Financial Supervisory Commission, R.O.C. on 2007, 2009, and 2011, the quantile regression of Koenker and Bassett (1978) and the unconditional quantile estimation of Firpo, et al. (2009) are used to study the conditional and unconditional distribution of financial literacy, respectively.

Our empirical results conclude: 1. Increment of the higher education not only increases the obtainment of financial literacy (since the mean becomes larger after the increase of higher education) but also decreases the dispersion of financial literacy distribution. This conclusion provides an evidence to support the policy of higher education expansion. Besides, the unconditional financial literacy distribution becomes more skew to the left after the increase of higher education. 2. The marginal effects of ratio of male/female on the unconditional literacy distribution are negative and statistically significant at all quantiles except at extreme quantiles. This indicates the access of financial literacy is easier to female individuals relative to the males. The unconditional financial literacy distribution changes from skew to the right to skew to the left after the increase of the ratio of males. 3. The marginal effects of ratio of married individuals on the unconditional literacy distribution are also negative and statistically significant at all quantiles. This indicates the access of financial literacy is easier to unmarried individuals relative to the married ones. The unconditional literacy distribution changes from skew to the right to skew to the left after the increase of the ratio of married individuals. 4. The marginal effects of ratio of individuals live at urban area on the unconditional literacy distribution are statistically insignificant negative at all quantiles.

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The Impacts of Asymmetric Information and Short Sales on the Illiquidity Risk Premium in the Stock Option Market

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The illiquidity risk premium hypothesis implies the existence of a positive relationship between illiquidity in the option markets and option returns. Based upon numerous studies within the extant literature examining the roles of informed traders in the option markets, we explore the ways in which asymmetric information and short sales can affect the illiquidity risk premium hypothesis. Our findings reveal that the illiquidity risk premium is higher for the options of those firms with higher information asymmetry, as well as those firms with higher short sales demand or supply. These results are found to be particularly robust for short-term and/or OTM contracts.

Keywords: Information asymmetry; Short sales; Short-sales constraints; Informed traders; Option illiquidity premium.

JEL Classification: G14.

1. Introduction

Numerous studies have explored the relationship between illiquidity and expected returns within the stock, bond, and foreign exchange markets and generally identified the existence of a positive relationship between illiquidity and expected returns. There is also a growing body of evidence on the existence of illiquidity premiums in derivatives markets. However, unlike stocks, bonds, or currencies, derivatives are traded with a zero net supply; thus the relationship between illiquidity and expected returns may depend on whether liquidity providers are net long or net short stock options.

In a derivatives market, a negative net demand by the end users in the stock should be economically equivalent to the positive net supply. However, traditional option pricing models didn't consider the role of financial intermediaries and thus the impact of supply and demand on option prices.[1] Garleanu, Pedersen, and Poteshman (2009) provided a demand-based option theory and indicated that market makers who suffer from higher unhedgeable risks will move the price up (down) when the net demand is positive (negative), whilst Lakonishok, Lee, Pearson, and Poteshman (2007) documented a negative net demand for stock options. Bongaerts et al. (2011) demonstrated that when investors with short positions in zero net supply assets are taken into consideration, the illiquidity premium could actually be zero, positive or negative; indeed, Deuskar et al. (2011) and Bongaerts et al. (2011) respectively found negative illiquidity premiums in the credit default swap market and the interest rate derivative market, whilst Christoffersen, Goyenko, Jaconbs and Karoui (2014) found a positive relationship in the stock option market. Such inconsistencies within the derivatives markets motivate us to further investigate the factors potentially affecting the illiquidity risk premium in the stock option market.

As compared to trading in the underlying assets, option trading involves lower transaction costs and provides higher leverage; thus, informed traders may choose to trade in options in order to take advantage of their private information. As suggested by Easley, O'Hara and

[1] Classical references include Black and Scholes (1973), Hull and White (1987), and Heston (1993).

Srinivas (1998), in order to earn profits, informed traders with private information are more likely to trade in the option markets when the option liquidity level is satisfactory and information asymmetry in the stock market is high. Of particular significance is the fact that options can be used as a device for circumventing the short-sale constraints in the stock market.

Many of the prior related studies, such as Manaster and Rendleman (1982) and Sheikh and Ronn (1994), indicate that information is reflected in the option markets prior to being reflected in the underlying stock markets, whilst Diamond and Verrecchia (1987) suggested that informed traders with unfavorable information on the underlying stocks will prefer to trade in the option markets. Furthermore, following the demonstration by Vayanos and Wang (2012) of the ways in which information asymmetry and imperfect competition affect liquidity and asset prices, we posit that the involvement of informed traders may well play an important role in the determination of the illiquidity risk premium in the option markets.

Whilst a number of studies have undertaken theoretical explorations of the ways in which the existence of informed trading may affect the general risk premium, such studies have reported quite mixed findings. For example, although both Leland (1992) and Wang (1993) suggested that the existence of informed traders causes information asymmetry and thus lowers the cost of capital for a firm, a number of other studies have subsequently concluded that information asymmetry actually increases such capital costs.

From their examination of the differences in the composition of public and private information, Easley and O'Hara (2004) noted that uninformed traders would tend to demand a greater risk premium when trading with informed traders, since they recognize the existence of an informational disadvantage, and hence, will tend to hold fewer assets. This will ultimately drive down the prices of those securities with high levels of private information (or information asymmetry), thereby leading to an increase in the cost of capital for these firms.

These empirical findings suggest that private information induces a new form of systematic risk, and that in equilibrium investors require compensation for taking such risk. Thus, it seems natural to question whether the involvement of informed traders changes the positive association between option illiquidity and expected option returns; indeed, several related studies have documented the influence of information asymmetry on the future dynamics of asset prices, with particular focus on the links between information asymmetry and subsequent stock returns.

For example, Pan and Poteshman (2006) found that stocks with low put-call ratios outperformed stocks with high put-call ratios, with the predictability of stock returns being higher for those stocks with high concentrations of informed traders. Furthermore, using volatility spreads to predict stock returns based upon various types of informational circumstances, Atilgan (2014) found that the predictability of stock returns was stronger during major information events. Thus, our initial objective in the present study is to examine whether the level of information asymmetry plays an important role in the determination of the illiquidity risk premium across firms in the option markets.

In addition to the level of information asymmetry, both short sales demand and supply are also found to have impacts on trading by informed traders. On the demand side, it was noted by Figlewski and Webb (1993) that the level of short interest ratio in the underlying stock can significantly affect the option prices of the stock; thus, they argued that short selling was undertaken primarily by market professionals who are also be likely to be informed traders. On the supply side, several studies have demonstrated that short-sales constraints in the stock market affect trading activities in the option market, with Hu (2014), for example, recently noting that option trading is often considered to be an effective method of mitigating short-sales constraints, and thus, conveying more information for those firms with greater short-sales constraints. Our second objective is therefore to examine whether the demand and supply levels of short sales have impacts on the illiquidity risk premium across firms in the option markets.

Our empirical analysis involves the use of the 'information asymmetry index' (ASY-INDEX) and the 'probability of informed trading' (PIN) to measure information asymmetry and the levels of short interest ratio and institutional ownership in a stock to respectively measure the demand and supply for short sales. Our findings based upon US listed stocks and options are summarized as follows.

Firstly, we present evidence to show that the level of information asymmetry has significant impacts on the option illiquidity risk premium across different firms, particularly in the case of call options. The positive relationship that exists between option illiquidity and expected option returns is found to be increased in those cases where there is a higher concentration of informed traders, a finding which is consistent with that of Easley and O'Hara (2004).

Secondly, we find that an increase in short sales strengthens the positive relationship between option illiquidity and expected option returns for call options, whilst higher short interest ratio weakens the negative relationship for put options. Whilst uninformed traders will demand greater compensation when holding more call options (Easley and O'Hara, 2004), when there is higher short interest ratio, the dissemination of information on prices will reduce the uncertainty in the put prices thereby reducing the illiquidity premium (Wang, 1993).

Finally, we find that higher short-sales costs (low institutional ownership) tend to strengthen the positive relationship between option illiquidity and expected option returns for put options; the reason for this is that put options contain more information when there are greater short-sales constraints on the stocks.

In summary, we provide evidence to show that information asymmetry and the demand and supply of short sales are important factors in the determination of the option illiquidity risk premium across firms; this is consistent with the argument put forward by Easley and O'Hara

(2004) that uninformed traders will demand a greater risk premium when trading with informed traders. Our empirical results are also found to be particularly robust for short-term OTM options, which is consistent with the general belief that informed traders tend to prefer to use those contracts with higher leverage, better liquidity or lower transaction costs in order to take advantage of their private information.

In addition to confirming the findings of Christoffersen et al. (2014), we contribute to the extant literature by introducing the influences of informed traders on the determination of option prices. We also demonstrate that information asymmetry and the demand and supply of short sales are important factors influencing the illiquidity risk premium across different firms.

The remainder of this paper is organized as follows. Section 2 provides details of our hypothesis development, followed in Section 3 by a description of the data and empirical measures used in our study. The empirical methodology adopted for our analysis is described in Section 4, with Section 5 subsequently presenting and discussing the empirical results. Finally, the conclusions drawn from this study are presented in Section 6.

2. HYPOTHESIS DEVELOPMENT

Using the component firms of the S&P 500 index, Christoffersen et al. (2014) examined the ways in which option illiquidity affected expected option returns and identified a positive relationship between these two factors, which is consistent with the risk premium hypothesis proposed by Amihud (2002). However, in contrast to spot assets with a positive net supply, given that derivatives are zero net supply assets, certain factors may play important roles in determining the risk premium.

It has been noted in many of the prior studies, such as Manaster and Rendleman (1982) and Sheikh and Ronn (1994), that information is reflected in the option market more rapidly than in the corresponding stock market, thereby leading to the suggestion that the option market is the preferred venue for informed traders to realize their private information. Easley, O'Hara and Srinivas (1998) set up a market microstructure model to demonstrate that informed traders preferred to trade in the option markets when option liquidity was high; Easley and O'Hara (2004) subsequently noted that uninformed investors will tend to demand a higher risk premium when they are faced with informed traders in the market.

From their analysis of the ways in which information asymmetry and imperfect competition affect liquidity and asset prices, Vayanos and Wang (2012) found a positive relationship with expected returns under information asymmetry when the illiquidity was measured using Kyle's lambda. In other words, the involvement of informed traders may well vary across different firms, with uninformed traders requiring a higher risk premium when there are more informed traders in the market in order to compensate for their informational disadvantage, thereby leading to a higher level of information asymmetry.

Based upon the findings and theorems of the related studies referred to above, we argue that the level of information asymmetry may influence the relationship between option illiquidity and expected option returns. We expect to find an increasingly positive relationship between option illiquidity and expected option returns with the level of information asymmetry. Accordingly, we propose the first of our hypotheses, as follows:

Hypothesis 1: The relationship between option illiquidity and expected option returns will be more positive for firms with higher information asymmetry.

Figlewski and Webb (1993) demonstrated that the significantly higher average level of short interest ratio with 'optionable' stocks (those stocks selected as the underlying asset of an option) provides support for the argument that option trading facilitates short selling. They also found that short interest ratio in the underlying stock could significantly affect option prices and went on to suggest that short sales were primarily undertaken by market professionals.

Diamond and Verrecchia (1987) had earlier indicated that speculative short sellers were more likely to trade in the option markets (with a particular focus on trading in put options) essentially because, on the one hand, such trading could reduce their short sales costs, whilst on the other hand, it could increase their leverage. These studies therefore seem to jointly suggest that the level of short interest is positively related to the amount of informed trading, since short selling is widely regarded as being carried out primarily by market professionals.

Given that informed traders prefer to trade in the option market when they have access to private (especially negative) information, the level of short interest ratio should be positively related to the level of information asymmetry. As suggested by Easley and O'Hara (2004), uninformed traders demand a greater risk premium when trading with informed traders because compensation is required for their losses. Thus, if uninformed traders hold more call options of those stocks with higher short interest ratio, they naturally assume greater risk as a direct result of their informational disadvantage. Accordingly, investors holding more call options of those stocks with higher short interest ratio may require a greater risk premium. This leads to the development of our second hypothesis, as follows:

Hypothesis 2: The relationship between option illiquidity and expected option returns will be more positive for firms with higher short interest ratio, particularly in the case of call options.

In addition to the demand side of short sales explored by the studies referred to above, the stock market supply side (short-sale constraints or short-sales costs) can also affect trading activities in the option markets. Informed traders with negative information could trade in the option market as an alternative to short selling, particularly in those cases where the difficulty of engaging in short selling in the stock market is high; that is to say, if there are higher levels of short-sales constraints in the stock market, informed traders with negative information are more likely to trade in the option market.

Some of the prior studies using institutional ownership as a proxy for the market supply of short interest have identified the existence of a negative relationship between the level of institutional ownership and the difficulties involved in engaging in short selling (see D'Avolio, 2002; Asquith, Pathak and Ritter, 2005). Hu (2014) also found that the informational benefit of option trading was higher for stocks with greater short-sales constraints.

Given that informed traders have incentive to buy put options to realize their private negative information for firms with higher short-sales costs, uninformed traders buying put options may assume greater levels of risk. We therefore consider shorting supply to construct our third hypothesis, as follows:

Hypothesis 3: The relationship between option illiquidity and expected option returns will be more positive for firms with lower institutional ownership (higher short-sales costs), particularly in the case of put options.

3. DATA

The primary dataset adopted for this study includes stock option quotes and the illiquidity measures of both stocks and options, with the measures of both information asymmetry and the demand and supply of short sales also being utilized in our empirical analysis. The sample period adopted for this study runs from January 1996 to December 2007.

3.1. *Stock Option Quotes and Computation of Option Returns*

The stock options data were collected from Option Metrics, with the dataset including daily closing bid and ask quotes, implied volatility levels and the deltas of all stock options listed in the US exchanges. As regards time to maturity, short-term options are defined as those with maturity periods ranging from 20 and 70 days, whilst long-term options are those with maturity periods ranging from 71 and 180 days.

Following Bollen and Whaley (2004) and Driessen, Maenhout and Vilkov (2009), we also adopt the option delta for our classification of moneyness in the present study. The call (put) deltas for OTM options range from 0.125 to 0.375 (–0.375 to –0.125), whilst those for ATM options range from 0.375 to 0.625(–0.625 to –0.375) and those for ITM options range from 0.625 to 0.875 (–0.875 to –0.625).

Those option contracts which meet the following criteria are excluded from our sample in order to deal with concerns regarding liquidity or reliability: (i) prices violate the no-arbitrage conditions; (ii) ask price $\leq$ bid price; (iii) open interest is equal to 0; (iv) price details are incomplete; (v) price < \$3 and bid-ask spread < \$0.05 or price $\geq$ \$3 and bid-ask spread < \$0.10.

Following Frazzini and Pedersen (2012) and Christoffersen et al. (2014), we compute the daily delta-hedged returns of options as:

$$\tilde{R}^{O}_{t+1,n} = R^{O}_{t+1,n} - R^{S}_{t+1} S_t \frac{\Delta_{t,n}}{O_{t,n}} \qquad (1)$$

where $R^{O}_{t+1,n}$ is the daily raw return of option n and $\Delta_{t,n} = \frac{\partial O_{t,n}}{\partial S_t}$ is computed based upon the Cox, Ross and Rubinstein (1979) binomial tree model allowing for early exercise, given that all stock options are American style options. S_t is the price of the underlying stock at time t and R^{S}_{t+1} is the stock return computed from S_t and S_{t+1}. All of the details on stock prices are obtained from CRSP.

Following Coval and Shumway (2001), we use the bid-ask midpoints to compute the raw option return ($R^{O}_{t+1,n}$) as the equally-weighted average of the daily returns of all available options in each moneyness and maturity category. In other words, the return of a particular category of a firm from t to $t+1$ is defined as:

$$R^{O}_{t+1} = \frac{1}{N} \sum_{n=1}^{N} \frac{O_{t+1}(K_n, T_n - 1) - O_t(K_n, T_n)}{O_t(K_n, T_n)} \qquad (2)$$

The corresponding delta-hedged return is then computed as:

$$\tilde{R}^{O}_{t+1} = \frac{1}{N} \sum_{n=1}^{N} \frac{O_{t+1}(K_n, T_n - 1) - O_t(K_n, T_n)}{O_t(K_n, T_n)} - R^{S}_{t+1} S_t \frac{1}{N} \sum_{n=1}^{N} \frac{\Delta_t(K_n, T_n)}{O_t(K_n, T_n)} \quad (3)$$

where N is the number of available contracts in each category at time t with quotes at time $t+1$; and $O_t(K_n, T_n)$ is the mid-point quote of an option with strike price K_n and maturity T_n.[2]

The summary statistics of the option returns across various maturity-moneyness categories for call and put options are reported in Table 1. We first of all compute the descriptive statistics for each firm and then take the cross-sectional averages of these statistics, as a result of which we find that the returns of put options are generally higher than those of call options. Returns on short-term options are more volatile than returns on long-term options, especially for OTM

[2] We use the adjustment factor provided by Option Metrics for splits and other distribution events.

contracts.

Variables	Mean	Std. Dev.	Skewness	Kurtosis	Avg. No. of Firms
Panel A: Calls					
a. Short-term Options					
ATM	−0.0075	0.1044	0.5729	7.5609	808
ITM	−0.0027	0.0477	0.5633	6.5945	909
OTM	−0.0210	0.3622	0.2263	9.5186	1,014
b. Long-term Options					
ATM	−0.0012	0.0829	0.7483	12.5576	1,489
ITM	−0.0006	0.0358	0.5203	11.0742	1,467
OTM	−0.0061	0.2726	0.3082	14.0850	1,389
Panel B: Puts					
a. Short-term Options					
ATM	−0.0016	0.0732	0.8400	7.5096	672
ITM	0.0000	0.0473	0.6171	4.2878	660
OTM	−0.0020	0.1757	0.9605	13.7534	937
b. Long-term Options					
ATM	0.0014	0.0507	1.0738	11.7113	1,260
ITM	0.0008	0.0337	0.6331	5.9273	970
OTM	0.0038	0.1006	1.5214	23.0853	1,484

3.2. *Stock and Option Illiquidity Measures*

Using the data obtained from the high-frequency intraday 'trade and quote' (TAQ) database, stock illiquidity is calculated in this study as the effective spread.[3] The effective spread is defined as:

$$IL_k^S = 2\,|ln(P_k) - ln(M_k)| \qquad (4)$$

where P_k is the price of the k^{th} trade; and M_k is the midpoint of the best bid and offer prices at the time of the k^{th} trade.

The dollar-volume weighted average of all IL_k^S computed over all trades during the day defines the daily effective spread of the stock, IL^S, as follows:

[3] The same illiquidity measure has also been adopted in many of the prior related studies, including Hasbrouck and Seppi (2001), Huberman and Halka (2001), Chordia, Roll and Subrahmanyam (2000; 2001) and Chordia, Sarkar and Subrahmanyam (2005).

$$IL^S = \frac{\sum_k DolVol_k IL_k^S}{\sum_k DolVol_k} \tag{5}$$

where DolVolk refers to the dollar-volume computed as the product of the stock price and the trading volume.
Similar to Cao and Wei (2010), we adopt the relative quoted bid-ask spread as the measure of option illiquidity, which is computed from the end-of-day quoted bid and ask prices provided by Ivy DB Option Metrics. For each contract, we compute the daily relative quoted spread as:

$$IL_{t,n}^O = \frac{OA_t(K_n,T_n) - OB_t(K_n,T_n)}{O_t(K_n,T_n)} \tag{6}$$

where $O_t(K_n, T_n)$, $OA_t(K_n, T_n)$ and $OB_t(K_n, T_n)$ are the respective end of day closing mid-point, ask and bid quotes for an option with strike price K_n and maturity T_n. It should be noted that $O_t(K_n, T_n) = (OA_t(K_n, T_n) + OB_t(K_n, T_n))/2$.

$$IL_t^O = \frac{1}{N}\sum_{n=1}^{N} IL_{t,n}^O \tag{7}$$

where N is the number of available contracts within the category at time t.

The summary statistics of the relative bid-ask spread illiquidity measures for all firms are presented in Table 2. According to the option illiquidity (IL^O), we find that short-term contracts are more illiquid than long-term contracts for both call and put options, with OTM contacts exhibiting the highest overall illiquidity.

Variables	Mean	Min.	Max.	Std. Dev.
Panel A: Calls				
a. IL^O for Short-term Options				
ATM	0.2471	0.0755	0.7696	0.1250
ITM	0.1370	0.0503	0.4475	0.0637
OTM	0.6642	0.1627	1.6375	0.3378
b. IL^O for Long-term Options				
ATM	0.1859	0.0524	0.6923	0.0957
ITM	0.1138	0.0402	0.5203	0.0742
OTM	0.4851	0.1064	1.4078	0.2640
c. IL^S for Stocks	0.0270	0.0014	0.6263	0.0352
Panel B: Puts				
a. IL^O for Short-term Options				

ATM	0.2035	0.0724	0.6309	0.1016
ITM	0.1215	0.0521	0.3617	0.0535
OTM	0.5128	0.1436	1.4295	0.2712
b. IL^{O} for Long-term Options				
ATM	0.1426	0.0499	0.5261	0.0706
ITM	0.0950	0.0394	0.3292	0.0444
OTM	0.3184	0.0882	1.0741	0.1727

3.3 Information Asymmetry Measures

Two measures of information asymmetry are adopted in this study. Firstly, following Drobetz et al. (2010), we create an information asymmetry index with the exclusion of those firms with a fiscal year not ending with the corresponding calendar year. Secondly, we follow several of the prior related studies on informed trading to use the 'probability of informed trading' (PIN) to measure information asymmetry.[4]

Various measures of information asymmetry have been introduced within the prior empirical studies; for example, Vermaelen (1981) identified the tendency for a reduction in information asymmetry with firm size, whilst Smith and Watts (1992) discovered an increase in information asymmetry with growth opportunities. Krishnaswami and Subramaniam (1999) indicated that information asymmetry was reduced in line with the number of analysts tracing the firm, and went on to suggest the use of analyst forecast errors as an effective measure for information asymmetry. Finally, Aboody and Lev (2000) also found an increase in information asymmetry with R&D expenditure.

For our first measure of information asymmetry in the present study, we follow the method of Drobetz et al. (2010) to construct an information asymmetry index (ASY-INDEX) based upon the various dimensions of the concepts described above. These dimensions include analyst forecast errors,[5] firm size, R&D expenditure, Tobin's Q and the number of analysts

[4] See Easley et al. (1998) and Easley, Kiefer and O'Hara (1997; 2002).

[5] We use the following measure of analyst forecast errors: $ERRORF = ln(1 + |EPS_{Forcast} - EPS_{Actual}|/|Median\ EPS|)$, where $EPS_{Forecast}$ is the earnings per share forecast, which is the average of all forecasts for a firm provided by all analysts in November and December of the previous year. The difference between actual and forecasted earnings per share is scaled by the median earnings per share forecast.

tracing the firm.[6] The accounting data, which is obtained from Compustat, includes R&D expenditure and total assets. Details on the analyst forecasts and the number of tracking analysts are collected from I/B/E/S.

For our compilation of the index, we first of all calculate the annual quintile ranking of a firm over all firms for each dimension of information asymmetry, with a higher score indicating a higher level of information asymmetry; for instance, a firm will be assigned a score of 5 (1) if it belongs in the smallest (largest) 20 per cent of all firms in a given year. We then sum the ranks for all five dimensions of information asymmetry, with the largest (smallest) value of the ASY-INDEX for firms with the highest (lowest) level of information asymmetry being 25 (5). The PIN is used as the second measure of information asymmetry in our analysis, with the quarterly PIN estimates for the period from January 1996 to December 2006 having been obtained from Stephen Brown.

3.4 Short Sales Measures

One stream of the extant literature on short sales suggests that high short interest ratios (shares sold short over shares outstanding) predicts low future returns,[7] whilst an alternative stream indicates that short sales are dependent upon the institutional ownership of the stock.[8]

[6] Elton, Gruber and Gultekin (1984) noted that most of the forecast error in the last month of the fiscal year could be explained by erroneous estimation of firm-specific factors. Diamond and Verrecchia (1991) and Ozkan and Ozkan (2004) further indicated that large firms may be faced with less information asymmetry essentially because they are more mature and have more transparent disclosure policies; thus, they tend to receive more attention from the market. From their analysis of insider trading gains in firms with high and low R&D expenditure, Aboody and Lev (2000) found that the insider gains in R&D firms were larger than those in firms with no R&D, and provided evidence to show that R&D was related to information asymmetry. Following the indication by Smith and Watts (1992) that information asymmetry was more serious for firms with significant growth opportunities, McLaughlin, Safieddine and Vasudevan (1998) used investment opportunities as a proxy for information asymmetry. In the present study, we use Tobin's Q, defined as the book value of assets minus the book value of equity plus the market value of equity divided by the book value of assets, to measure growth opportunities. Chang, Dasgupta and Hillary (2006) suggested that the greater the analyst cover of a firm, the higher the information released to the public, and hence, the more limited the level of information asymmetry; the number of analysts can therefore also be used to proxy for information asymmetry. Brennan and Subrahmanyam (1995) argued that higher analyst coverage could reduce the adverse selection costs, as measured by the inverse of market depth.

[7] Examples include Figlewski (1981), Figlewski and Webb (1993), Senchack and Starks (1993), Asquith and Meulbroek (1995) and Desai et al. (2002).

[8] See D'Avolio (2002), Asquith et al. (2005) and Hu (2014).

We also follow Asquith et al. (2005) to consider both short sales demand and supply so as to define the level of stocks to short sales. We follow Figlewski and Webb (1993) to use the short interest ratio as a proxy for short sales demand and as suggested by D'Avolio (2002) and Asquith et al. (2005), we take institutional ownership as the proxy for the market supply of short interest, since it has a negative correlation with the difficulties involved in short selling.

The data on short interest are obtained from Compustat on the fifteenth day of the month (or the nearest trading day if the fifteenth day is not a trading day), whilst the institutional ownership data are obtained from 13-F filings. The descriptive statistics on the information asymmetry measures, comprising of the means, medians, standard deviations and 10%, 50% and 90% percentiles, are reported in Table 3.

Variables	P_{10}	P_{50}	P_{90}	Mean	Std. Dev.
ASY-Index	11.0000	15.0000	18.0000	14.7072	2.9757
PIN	0.0785	0.1391	0.2265	0.1483	0.0732
SI	0.0005	0.0117	0.0821	0.0347	0.1761
OP	0.0828	0.2636	0.6944	0.3419	0.3219

4. METHODOLOGY

Christoffersen et al. (2014) identified a positive relationship between option illiquidity and expected option returns, attributing this result to the option illiquidity premium. However, given that derivatives are zero net supply assets, they are more complicated than assets with positive net supplies; therefore, for our examination of the ways in which information asymmetry and short sales affect the positive relationship identified by Christoffersen et al. (2014), we modify the regressionmodel adopted in their study to consider the effect of information asymmetry in order to test Hypothesis 1, as follows:

$$\tilde{R}_{i,t}^{O} = a_{0,t} + \beta_{1,t}\tilde{R}_{i,t-1}^{O} + \beta_{2,t}IL_{i,t-1}^{\mathrm{O}} + \beta_{3t}IL_{i,t-1}^{\mathrm{S}} + \beta_{4,t}IL_{i,t-1}^{\mathrm{O}}$$

$$\times Dummy_{Asy.Info.} + \beta_{5,t}IL_{i,t-1}^{\mathrm{S}} \times Dummy_{Asy.Info.} + \beta_{6,t}Dummy_{Asy.Info.} \quad (8)$$
$$+ \beta_{7,t}\sigma_{i,t-1} + \beta_{8,t}ln(size_{i,t-1}) + \beta_{9,t}b_{i,t-1} + \beta_{10,t}lev_{i,t-1} + \varepsilon_{i,t}$$

where $\tilde{R}_{i,t}^{O}$ are the delta-hedge option returns; $IL_{i,t}^{O}$ refers to the option illiquidity and $IL_{i,t}^{S}$ denotes the stock illiquidity; $Dummy_{Asy.Info.}$ is a dummy variable which takes the value of 1 if the ASY-INDEX for stock i is ranked in the top 20 per cent; otherwise 0; and $\sigma_{i,t}$ denotes the historical volatility estimated using the daily stock returns from the GARCH(1,1) model.

As suggested by Duan and Wei (2009), $b_{i,t}$ is the square root of the R^2 from running the daily OLS regressions of the excess stock returns on the four factors proposed by Fama and French (1993) and Carhart (1997), with a one-year rolling window. Furthermore, we follow both Dennis and Mayhew (2002) and Duan and Wei (2009) to control for size and leverage; $size_{i,t}$ is the natural logarithm of the market capitalization of the firm; and $lev_{i,t}$ is defined as the sum of long-term debt and the par value of the preferred stock, divided by the sum of long-term debt, the par value of the preferred stock and the market value of equity.

We expect to find that if the illiquidity premium hypothesis holds, then β_2 will be positive, and if investors require a higher risk premium for the options of stocks with higher levels of information asymmetry, then β_4 will be significantly positive. Based upon the replication argument proposed by Leland (1985) and Boyle and Vorst (1992), we also expect to find that β_3 will be positive.[9]

When using the PIN as an alternative proxy for information asymmetry, the terms with $Dummy_{Asy.Info.}$ are not included in the regression model; instead, we first of all group the firms based on their quarterly PIN levels into the three categories of low (<30%), mid (30-70%) and high (>70%), and then run the cross-sectional regression model without the dummy term for the returns of options across various moneyness-maturity categories in order to examine the significance of the mean of the β_2 coefficients for each category.

As regards the short sales demand side, we follow Figlewski and Webb (1993) to use the relative short interest (that is, the number of shares sold short divided by the total outstanding shares of the firm) as the measure of the annual average short interest ratio. For the supply side,

[9] An option can be replicated by trading the underlying asset and a risk free bond in a frictionless and complete-market model; however, this is not the case, given the existence of liquidity risk. Market makers have net long positions in the equity option markets, and hence, need to create a synthetic short option using the underlying stock. This will lead to a reduction in the price that market makers receive from shorting the synthetic option with the illiquidity of the stock market, thereby reducing the option price.

we follow Asquith et al. (2005) and Hu (2014) to consider institutional ownership as the proxy for short-sales constraints (short-sales costs) and then rewrite the regression models, as shown below, to respectively test Hypotheses 2 and 3:

$$\tilde{R}^{O}_{i,t} = a_{0,t} + \beta_{1,t}\tilde{R}^{O}_{i,t-1} + \beta_{2,t}IL^{O}_{i,t-1} + \beta_{3t}IL^{S}_{i,t-1} + \beta_{4,t}IL^{O}_{i,t-1} \times Dummy_{RSI} + \beta_{5,t}IL^{S}_{i,t-1} \times Dummy_{RSI} + \beta_{6,t}Dummy_{RSI} + \beta_{7,t}\sigma_{i,t-1} + \beta_{8,t}ln(size_{i,t-1}) + \beta_{9,t}b_{i,t-1} + \beta_{10,t}lev_{i,t-1} + \varepsilon_{i,t} \qquad (9)$$

and

$$\tilde{R}^{O}_{i,t} = a_{0,t} + \beta_{1,t}\tilde{R}^{O}_{i,t-1} + \beta_{2,t}IL^{O}_{i,t-1} + \beta_{3t}IL^{S}_{i,t-1} + \beta_{4,t}IL^{O}_{i,t-1} \times Dummy_{op} + \beta_{5,t}IL^{S}_{i,t-1} \times Dummy_{op} + \beta_{6,t}Dummy_{op} + \beta_{7,t}\sigma_{i,t-1} + \beta_{8,t}ln(size_{i,t-1}) + \beta_{9,t}b_{i,t-1} + \beta_{10,t}lev_{i,t-1} + \varepsilon_{i,t} \qquad (10)$$

where the $Dummy_{RSI.}$ variable takes the value of 1 if the relative short interest for stock *i* is ranked in the top 20 per cent; otherwise 0; and the $Dummy_{op.}$ variable takes the value of 1 if the institutional ownership for stock *i* is ranked in the bottom 20 per cent; otherwise 0. Similarly, if Hypothesis 2 (3) holds, then we would expect to find that β_4 will be significantly positive, particularly for call (put) options

5. EMPIRICAL RESULTS

5.1 Preliminary Results

Prior to using our regression models to formally test for the impacts of information asymmetry and short sales on the illiquidity risk premium, we provide some preliminary evidence on the existence of the illiquidity risk premium in the option markets. We short the stocks according to their previous-day illiquidity measures and form three groups of firms in the categories of low (<30%), mid (30-70%) and high (>70%) illiquidity for each day. We then calculate the delta hedge returns of options for each group of firms across various moneyness-maturity categories. The average option returns for all categories are reported in Table 4.

Variables	Lagged Option Illiquidity ($IL^{O}_{i,t-1}$)	*t*-value

	High	Mid	Low	H–L	
Panel A: Calls					
a. Short-term Options					
High (>70%)					
ATM	0.0021	–0.0092	–0.0116	0.0137	28.77***
ITM	–0.0021	–0.0014	–0.0022	0.0001	0.54
OTM	0.0226	–0.0187	–0.0320	0.0546	41.58***
Med (30%-70%)					
ATM	–0.0126	–0.0134	–0.0145	0.0019	5.72***
ITM	–0.0025	–0.0031	–0.0033	0.0008	6.07***
OTM	–0.0372	–0.0425	–0.0478	0.0106	7.96***
Low (<30%)					
ATM	–0.0157	–0.0180	–0.0199	0.0042	11.05***
ITM	–0.0038	–0.0041	–0.0048	0.0010	9.17***
OTM	–0.0510	–0.0584	–0.0634	0.0124	7.23***
b. Long-term Options					
High (>70%)					
ATM	0.0066	–0.0010	–0.0027	0.0093	33.91***
ITM	0.0003	0.0000	–0.0007	0.0010	7.39***
OTM	0.0221	–0.0016	–0.0098	0.0319	39.05***
Med (30%-70%)					
ATM	–0.0032	–0.0047	–0.0055	0.0023	11.85***
ITM	–0.0008	–0.0010	–0.0014	0.0005	7.40***
OTM	–0.0130	–0.0173	–0.0206	0.0076	9.14***
Low (<30%)					
ATM	–0.0064	–0.0073	–0.0080	0.0015	6.94***
ITM	–0.0015	–0.0017	–0.0022	0.0006	9.56***
OTM	–0.0224	–0.0254	–0.0256	0.0032	3.12***
Variables	Lagged Option Illiquidity ($IL^{O}_{i,t-1}$)				t-stat.
	High	Mid	Low	H–L	
Panel B: Puts					
a. Short-term Options					
High (>70%)					
ATM	0.0005	–0.0033	–0.0040	0.0044	11.81***
ITM	0.0011	0.0012	0.0006	0.0005	2.60***
OTM	0.0154	–0.0081	–0.0114	0.0268	32.76***
Med (30%-70%)					
ATM	–0.0043	–0.0047	–0.0053	0.0009	3.78***
ITM	0.0004	0.0000	–0.0002	0.0006	2.97***
OTM	–0.0120	–0.0132	–0.0151	0.0031	5.76***
Low (<30%)					

ATM	−0.0058	−0.0062	−0.0060	0.0002	0.57
ITM	−0.0008	−0.0008	−0.0009	0.0001	0.37
OTM	−0.0153	−0.0159	−0.0163	0.0011	2.25**
b. Long-term Options					
High (>70%)					
ATM	0.0030	0.0016	0.0013	0.0017	9.24***
ITM	0.0012	0.0012	0.0010	0.0002	1.59
OTM	0.0119	0.0032	0.0013	0.0107	27.45***
Med (30%-70%)					
ATM	0.0006	0.0002	0.0001	0.0006	4.53***
ITM	0.0009	0.0007	0.0009	0.0000	0.30
OTM	0.0004	−0.0001	−0.0009	0.0013	5.78***
Low (<30%)					
ATM	−0.0001	−0.0003	−0.0003	0.0002	1.51
ITM	0.0007	0.0007	0.0003	0.0004	2.61***
OTM	−0.0013	−0.0020	−0.0020	0.0007	3.45***

Regardless of which moneyness or maturity is considered, the average return for the high-illiquidity group is always found to be higher than that for the low- illiquidity group, with almost all of the differences being significant at the 1% level. In other words, the average option returns are positively associated with the option illiquidity levels; this is in line with the findings of Christoffersen et al. (2014) and confirms the existence of the illiquidity risk premium in the option markets

5.2 Results on Information Asymmetry

In order to test Hypothesis 1, we first of all run the cross-sectional regression model specified in Equation (8) for each day and then take the time-series averages of the regression coefficients. We report the results based upon the information asymmetry index (ASY-INDEX) in Table 5, with Newey and West (1987) adjusted t-statistics. As shown in Panel A, the overall results on call options are found to be consistent across all moneyness and maturity groups.

Variables	ATM		ITM		OTM	
	Coeff.	*t*-stat.	Coeff.	*t*-stat.	Coeff.	*t*-stat.
Panel A: Calls						
a. Short-term Options						

Variables	ATM Coeff.	ATM t-stat.	ITM Coeff.	ITM t-stat.	OTM Coeff.	OTM t-stat.
α_0	0.0108	2.80***	0.0005	0.37	0.1242	6.94***
β_1	–0.2007	–45.66***	–0.2755	–71.59***	–0.0778	–21.76***
β_2	0.0204	7.86***	0.0054	2.38**	0.0246	10.32***
β_3	0.9671	6.60***	0.2449	4.49***	2.0181	4.28***
β_4	0.0276	6.76***	0.0058	1.59	0.0274	7.86***
β_5	–0.4091	–2.49**	–0.1441	–2.22**	–1.3020	–2.62***
β_6	–0.0063	–6.65***	–0.0005	–1.33	–0.0210	–6.24***
Adj-R^2	0.1033		0.1258		0.0822	
b. Long-term Options						
α_0	0.0040	1.57	–0.0012	–1.53	0.0411	3.75***
β_1	–0.1479	–47.00***	–0.3017	–90.44***	–0.0527	–14.78***
β_2	0.0225	9.98***	0.0073	4.32**	0.0187	9.69***
β_3	0.3933	5.75***	0.1454	5.41***	0.3513	1.53
β_4	0.0219	6.32***	0.0061	2.29**	0.0204	7.02***
β_5	–0.0408	–0.50	–0.0706	–1.98**	–0.2999	–1.22
β_6	–0.0039	–5.79***	–0.0007	–3.00***	–0.0085	–4.35***
Adj-R^2	0.0832		0.1339		0.0782	

Variables	ATM		ITM		OTM	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
Panel B: Puts						
a. Short-term Options						
α_0	–0.0094	–3.42***	–0.0105	–4.64***	0.0006	0.12
β_1	–0.1842	–42.81***	–0.1214	–31.66***	–0.1412	–43.67***
β_2	0.0146	6.21***	0.0241	7.25***	0.0246	12.45***
β_3	0.4900	4.77***	–0.0761	–1.11	0.9449	3.72***
β_4	–0.0014	–0.36	–0.0070	–1.56	0.0131	4.37***
β_5	0.0207	0.17	–0.0094	–0.12	–0.6252	–2.29**
β_6	–0.0011	–1.53	0.0003	0.45	–0.0019	–1.48
Adj-R^2	0.1025		0.0981		0.0670	
b. Long-term Options						
α_0	–0.0049	–2.79***	–0.0056	–3.94***	–0.0134	–5.89***
β_1	–0.1445	–39.95***	–0.1105	–28.05***	–0.1404	–42.28***
β_2	0.0146	7.15***	0.0135	5.19***	0.0223	16.49***
β_3	0.2098	4.17***	–0.0290	–0.79	0.2521	2.47**
β_4	–0.0024	–0.80	–0.0069	–1.82*	0.0064	3.07***
β_5	0.0252	0.44	0.0055	0.14	–0.0959	–0.89
β_6	–0.0005	–1.19	0.0001	0.15	–0.0011	–1.72*
Adj-R^2	0.0900		0.0927		0.0596	

The positive significance of β2 is in line with the illiquidity risk premium hypothesis, which is again consistent with the findings of Christoffersen et al. (2014). The positive β3 provides support for the option replication argument proposed by Leland (1985) and Boyle and Vorst (1992), although it is found to be insignificant for long-term OTM call options. The β4 coefficient is found to positively significant at the 5% level for all groups, with the one exception of short-term ITM call options, thereby confirming Hypothesis 1. In other words, our regression results on call options strongly indicate that the higher the level of information asymmetry, the higher the illiquidity risk premium.

Furthermore, the information asymmetry effect is found to be particularly strong for short-term call options, essentially because β2 + β4 is higher for short-term contracts than long-term contracts. This finding could be attributable to the fact that informed traders are more likely to trade in short-term contracts, as opposed to long-term contracts, so that they can take advantage of certain aspects of the former, such as higher leverage and liquidity.

By contrast, as shown in Panel B, the results from put options are less convincing since the β4 coefficient is found to be positively significant only for OTM options, which could be attributable to uninformed investors tending to view put options as insurance against existing long positions on the underlying asset, whilst also choosing not to speculate on negative news. Although the effect of information asymmetry is less robust for put options, full support is still provided for the illiquidity risk premium hypothesis since all of the β2 coefficients are found to be positively significant at the 1% level.

Our finding that the effect of the impact is particularly pronounced for OTM contracts, which are not dependent on call/put or short-/long-term contracts, is of some importance, since this finding suggests that informed traders prefer to trade in OTM options in order to take advantage of their private information, and thus, uninformed traders require a higher risk premium when trading in this group of contracts to compensate for the risk that they face due to their informational disadvantage.

The empirical results obtained from PIN, the alternative proxy for information asymmetry, are shown in Table 6. Since the PIN dataset is obtained with quarterly frequency, we run the cross-sectional regression model specified in Equation (8) without the information asymmetry dummy variable for each day on the returns of options across various moneyness-maturity categories for the three groups of firms grouped by their PIN levels. The means of the β2 coefficients and their t-statistics are reported in Table 6.

Variables	*Low-PIN*		*Mid-PIN*		*High-PIN*	
	Coeff.	*t*-stat.	Coeff.	*t*-stat.	Coeff.	*t*-stat.
Panel A: Calls						
a. Short-term Options						
ATM	0.0163	4.44***	0.0313	13.32***	0.0412	17.71***
ITM	0.0121	4.57***	0.0109	5.48***	0.0094	4.13***
OTM	0.0046	1.08	0.0366	16.81***	0.0470	30.88***
b. Long-term Options						
ATM	0.0261	7.39***	0.0351	15.09***	0.0434	18.30***
ITM	0.0149	7.17***	0.0145	9.65***	0.0123	5.85***
OTM	0.0079	2.10**	0.0259	13.51***	0.0353	23.78***
Panel B: Puts						
a. Short-term Options						
ATM	0.0167	4.95***	0.0173	8.42***	0.0187	8.02***
ITM	0.0408	8.46***	0.0240	7.77***	0.0173	5.81***
OTM	0.0102	4.32***	0.0270	17.61***	0.0370	22.19***
b. Long-term Options						
ATM	0.0164	5.97***	0.0187	10.54***	0.0179	10.40***
ITM	0.0196	5.25***	0.0123	5.09***	0.0036	1.25
OTM	0.0210	11.37***	0.0246	20.38***	0.0278	19.39***

The results based upon the PIN levels are generally consistent with those based upon the ASY-INDEX, with strong support being provided for the illiquidity risk premium hypothesis since virtually all of the β2 coefficients are found to be positively significant at the 1% level. Furthermore, the β2 coefficients of the higher PIN groups are found to be larger than those of the lower PIN groups for the majority of the moneyness-maturity categories, a finding which is particularly robust for OTM (call and put) contracts.

In summary, both the ASY-INDEX and PIN results indicate that uninformed traders require a higher illiquidity risk premium for the options of firms with higher levels of information asymmetry, thereby confirming Hypothesis 1.

5.3 Results on Demand and Supply of Short Sales

Following Asquith et al. (2005), we consider the demand-side and supply-side measures of short sales in order to investigate their overall impact on the illiquidity risk premium hypothesis when informed traders are in possession of negative private information. The results from the demand-side measure for short interest ratio are shown in Table 7.

Variables	ATM		ITM		OTM	
	Coeff.	*t*-stat.	Coeff.	*t*-stat.	Coeff.	*t*-stat.
Panel A: Calls						
a. Short-term Options						
α_0	0.0016	0.41	0.0004	0.23	0.1053	5.93***
β_1	–0.2000	–50.26***	–0.2700	–67.76***	–0.0725	–18.99***
β_2	0.0223	5.47***	0.0015	0.39	0.0264	7.71***
β_3	1.3483	7.82***	0.1684	2.39**	1.5192	3.19***
β_4	0.0127	2.57**	0.0065	1.38	0.0018	2.62***
β_5	–0.5971	–3.16***	0.0407	0.47	0.3434	0.59
β_6	–0.0031	–3.16***	–0.0009	–1.91*	–0.0141	–3.77***
Adj-R^2	0.1120		0.1284		0.0780	
b. Long-term Options						
α_0	–0.0015	–0.58	–0.0030	–3.13***	0.0329	2.87***
β_1	–0.1493	–44.29***	–0.3004	–86.73***	–0.0460	–11.94***
β_2	0.0229	8.34***	0.0073	2.62***	0.0229	9.91***
β_3	0.4051	5.57***	0.1604	4.05***	0.2538	1.30
β_4	0.0138	3.47***	0.0061	1.94*	0.0081	2.24***
β_5	–0.0192	–0.21	–0.0583	–1.35	0.0922	0.32
β_6	–0.0021	–2.93***	–0.0002	–0.84	–0.0035	–1.47***
Adj-R^2	0.0875		0.1383		0.0757	

Variables	ATM		ITM		OTM	
	Coeff.	*t*-stat.	Coeff.	*t*-stat.	Coeff.	*t*-stat.
Panel B: Puts						
a. Short-term Options						
α_0	–0.0143	–4.29***	–0.0155	–5.75***	0.0141	2.31**

β_1	–0.1780	–39.12***	–0.1230	–29.43***	–0.1426	–39.62***
β_2	0.0237	5.15***	0.0293	5.08***	0.0219	7.66***
β_3	0.7176	4.50***	–0.1663	–1.44	0.1687	0.52
β_4	–0.0132	–2.57**	–0.0091	–1.28	0.0069	1.93*
β_5	–0.2036	–1.14	0.0065	0.05	0.6243	1.78*
β_6	0.0008	0.97	0.0026	3.07***	–0.0050	–3.18***
Adj-R^2	0.1102		0.0984		0.0702	
b. Long-term Options						
α_0	–0.0097	–4.89***	–0.0063	–3.98***	–0.0181	–6.37***
β_1	–0.1409	–36.77***	–0.1066	–25.80***	–0.1359	–36.75***
β_2	0.0219	7.67***	0.0171	4.22***	0.0273	13.02***
β_3	0.2797	5.16***	–0.0569	–1.16	0.1161	1.04
β_4	–0.0020	–0.52	–0.0041	–0.79	–0.0016	–0.62
β_5	–0.1368	–2.20**	–0.0035	–0.06	0.0851	0.69
β_6	0.0009	1.56	0.0011	2.12**	0.0013	1.86*
Adj-R^2	0.0953		0.0953		0.0668	

For call options, with the exception of ITM contracts, we find that the illiquidity risk premium is higher when there is higher short selling of stocks, essentially because all of the $\beta 4$ coefficients are found to be positively significant at the 5% level; however, there is no clear pattern for put options. In summary, the effect of the demand of short sales on the illiquidity risk premium is particularly high for OTM call options, with these findings being largely consistent with Hypothesis 2, as well as the ASY-INDEX and PIN results.

A higher level of short interest ratio indicates a bearish prospect for the firm. Given unfavorable information on the underlying stocks, informed traders will not only short sell the stocks, but also buy put options, since trading in the latter attracts lower transaction costs, whilst providing higher leverage. Under such circumstances, uninformed traders buying more call options will require a higher risk premium as they are more likely to lose out to informed traders who may trade more put options, an argument which is consistent with that of Easley and O'Hara (2004).

Conversely, the short interest ratio level signals the release of negative information, which lowers the uncertainty of trading in put options. Consequently, investors trading in put options will not demand a higher illiquidity risk premium when the level of short interest ratio in the underlying stock is higher. For most of the moneyness- maturity categories, we even find a negative β4 coefficient, which is consistent with the argument of Wang (1993), that the illiquidity risk premium for put options will be lower when there is greater short interest ratio in the underlying stock.

The results on the impact of the supply-side measure (short-sales constraints or short-sales costs) on the illiquidity risk premium are shown in Table 8. Although there are no significant findings for call options, for put options, almost all of the β4 coefficients are found to be positive, with significance at the 1% level, for OTM contracts. In contrast to our earlier findings using other measures, the findings on short-sales constraints suggest that uninformed investors trading in put options will tend to demand a higher illiquidity risk premium for those stocks with higher short-sales constraints.

Variables	ATM		ITM		OTM	
	Coeff.	*t*-stat.	Coeff.	*t*-stat.	Coeff.	*t*-stat.
Panel A: Calls						
a. Short-term Options						
α_0	0.0097	2.58***	0.0003	0.21	0.1097	6.78***
β_1	−0.2006	−49.81***	−0.2765	−62.07***	−0.0782	−20.18***
β_2	0.0295	10.85***	0.0116	4.07***	0.0384	18.21***
β_3	0.5841	6.32***	0.0840	1.88*	0.9700	3.40***
β_4	−0.0014	−0.35	−0.0029	−0.75	−0.0047	−1.32
β_5	0.1574	1.09	0.0284	0.41	0.3477	0.73
β_6	−0.0001	−0.06	0.0001	0.15	−0.0022	−0.82
Adj-R^2	0.1049		0.1279		0.0866	
b. Long-term Options						
α_0	−0.0001	−0.04	−0.0020	−2.61***	0.0357	3.43***
β_1	−0.1599	−46.03***	−0.3003	−68.75***	−0.0538	−15.53***
β_2	0.0353	13.83***	0.0142	5.92***	0.0297	15.43***
β_3	0.2714	5.81***	0.0514	2.24**	0.2887	2.12**
β_4	0.0022	0.66	−0.0021	−0.71	−0.0016	−0.58
β_5	0.1729	2.49**	0.0560	1.53	−0.0020	−0.01
β_6	−0.0009	−1.65*	−0.0002	−0.72	−0.0017	−1.07
Adj-R^2	0.0894		0.1399		0.0778	

The option market can be used as a device for circumventing short-sales constraints in the stock market. For those stocks with greater short-sales constraints, informed traders will inevitably choose to trade in put options when they are in possession of private negative information. Therefore, uninformed traders buying put options on those stocks with high short-sales constraints will require a higher illiquidity risk premium since the risk arising from their informational disadvantage is higher. Although uninformed traders may realize that the put option market is a channel for informed traders to take advantage of their private negative information, they do not know when they will choose to do so; however, this is not the case for call options. These findings are generally consistent with Hypothesis 3.

In summary, we provide evidence to show that for both call and put options, information asymmetry and short sales have significant impacts on the illiquidity premium. Our findings reveal that information asymmetry and short interest (short-sale costs) are positively associated with the option illiquidity risk premium, particularly for call (put) options. Furthermore, these results are found to be especially robust for short-term or OTM option contracts, a finding which is consistent with the common belief that informed traders are more likely to trade in these contracts in order to realize their private information.

6. CONCLUSIONS

Based on the extant literature on the roles of informed traders in the option markets, we extend the work of Christoffersen et al. (2014) to examine the ways in which information asymmetry and short sales affect the option illiquidity risk premium. In addition to using the two measures of information asymmetry (ASY-INDEX and PIN), we also use the demand-side and supply-side measures of short sales (short interest and short-sales constraints) in order to examine their impacts on the relationship between option returns and option illiquidity.

Our findings reveal that both information asymmetry and short sales have significantly positive impacts on the option illiquidity risk premium, with our empirical results being found to be particularly robust for short-term contracts. These findings are also consistent with the argument put forward by Easley and O'Hara (2004) that uninformed traders will demand a greater risk premium when trading with informed traders.

In addition to confirming the findings of Christoffersen et al. (2014), we also contribute to the extant literature by introducing the influences of informed traders on the determination of option prices and documenting that information asymmetry and the demand and supply of short sales are important factors influencing the illiquidity risk premium across different firms.

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The role of service encounter interaction behavior in activating customer participation and co-creating value in the health care service

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This research aims to explore the role of service encounters and customers' participation in the interaction process to co-create value, leading to customer satisfaction. A model was developed which was tested in the health care context. Based on the data of 320 paired patient-physician cases, the analysis revealed that physician's interactions are critical customer-oriented behaviors which directly affect customer value. More importantly, it plays a key role in activating the customer participation to a service creation. From the customer view, although actively participating in a service requires more resources, it is worthy because it creates much more value-in-use.

Keywords: Value co-creation, customer participation, provider interaction behavior, health care service, Vietnam.

1. Introduction

In the recent years, the participation of customers in a service has received increasing attention from marketing academia as well as practitioners. Several studies have attempted to provide insights into the nature of customer participation, its mechanism, antecedents as well as consequences (Alam, 2011; Jo Bitner, Faranda, Hubbert, & Zeithaml, 1997; Lovelock & Young, 1979; Ordanini & Parasuraman, 2010; Ramaswamy & Gouillart, 2010; Tanev et al., 2011). Terms such as co-producer (Wikström, 1996), “partial” employee (Larsson & Bowen, 1989), value co-creator (Vargo & Lusch, 2004) have been suggested in the marketing literature to highlight the participative role of customer in a service.

The service dominant logic (Vargo & Lusch, 2004) and service logic (Grönroos, 2008) advocate that in the process of need-fulfillment, customers are the co-creator of value for themselves and the service provider is not a supplier of value but a facilitator of the customer’s value creation process. Service scholars indicate further that customers and service firm co-create value through resource integration and interaction (Gummesson & Mele, 2010; Vargo, Maglio, & Akaka, 2008). Despite this important notion, few studies have clearly analyzed the specific roles of service provider and the customer in the value co-creation process (Grönroos & Voima, 2013). Particularly, research to provide insights into the interaction behaviors of customers and a service firm (i.e., the service encounters) to create customer value is scant. Moreover, as individual customer has different level of resources and willingness to participate actively in the service process, it is important to understand how a service encounter can help to mobilize customers to participate in the service process.

In this context, the primary purpose of this research is to investigate how interaction behaviors of service encounters activate customer participation behaviors, and how both of which together create value for customers, leading to their satisfaction.

This research problem is specifically imperative in the health care context, where customers (or patients) are no longer considered as passive recipients of medical treatment, but actually play a more active role in improving the effectiveness of therapeutic activities (McColl-Kennedy, Vargo, Dagger, Sweeney, & van Kasteren, 2012). In this regards, Bodenheimer, Wagner, and Grumbach (2002) suggest to consider patient - professional partnership as the new paradigm of chronic disease management. In this partnership, physicians (doctors) are experts about diseases and patients are experts in their own lives and conditions. Thus, the collaboration process between a patient (customer) and a physician (service encounter) would be critical for the successful outcomes for customers (Yi & Gong, 2013).

The rest of this paper is organized as follows. The next section will present the theoretical background of key concepts, which is followed by the development for proposed hypotheses. Research design will then be reported which is featured by a dyadic approach to data collection. Data analysis, result discussions and implications are made up the final sections of the paper.

2. Theoretical background

2.1. *Customer participation behaviors to co-create value*

In a broad sense, value co-creation is described as a process in which efforts are combined among of firms, employees, customers, stockholders, government agencies, and other entities related to any given exchange, but is always determined by the beneficiary (e.g., customer) (Vargo et al., 2008). In this process, customers and the service firm hold crucial roles; and interaction between them is the key to value co-creation (Grönroos & Voima, 2012). In the interaction, the firm engages in the customer's value creation process as a value facilitator, and customer becomes a collaborator with service provider as a co-producer (Grönroos, 2008).

From the behavioral view, Yi and Gong (2013) describe customer co-creation behaviors as a construct made up of two components: participation behaviors and citizenship behaviors. Participation behaviors are an integral component of the production of a service. On the other hand, citizenship behaviors are customer activities related to the service, but out of the service process. These citizenship behaviors are not compulsory for the service creation, thus are beyond the scope of this current study.

Customer participation behaviors occur during the direct interaction with service encounter and are necessary to attain a proper performance in the service co-creation process. This concept has evolved from the interference of customer in service production (Levitt, 1972) to the engagement of customer in value creation (Grönroos & Ravald, 2011; Lusch & Vargo, 2006). Several studies have stressed that customer participation behavior can only occur in an interaction in the joint sphere of the service (Chan, Yim, & Lam, 2010; Grönroos, 2008; Yi, Nataraajan, & Gong, 2011). Specifically, Yi and Gong (2013) identify four dimensions of customer participation behaviors which represent the value co-creation process: (1) Information seeking – customers actively look for information about how to perform their tasks, what they are expected to do, and how they are expected to perform those tasks, in order to understand the nature of service and their roles in the value co-creation process; (2) Information sharing – customers share relevant information and expectation to help firms understand their particular needs and expectations; (3) Responsible behavior – customers recognize their duty and take responsibility to coordinate and ensure successful cooperation; and (4) Personal interaction – interpersonal relations between customers and employees, which are manifested by social aspects such as courtesy, friendliness, and respect.

2.2. *Service providers' interaction behaviors*

In an effort to bring the service dominant logic perspective into practice, Karpen, Bove, Lukas, and Zyphur (2014) introduce a framework of a firm's interaction capabilities to co-create value with customers. These interaction capabilities are then reflected by six corresponding manifestations as behaviors to facilitate the value co-creation process with customers. They include (1) Individuated interaction – behavior aiming to understand individual customers' unique contexts, their preferences and expected outcomes; (2) Relational interaction – behavior to improve social and emotional connections with customers in the service process; (3) Ethical interaction – behavior to reflect a fair manner towards customers in the service context; (4) Empowered interaction – behavior to empower customers to utilize their skills to shape the nature and content of exchange in the service process; (5) Developmental interaction – behavior to assist customers in developing their knowledge, competence, and skills; and (6) Concerted interaction – behavior to facilitate, coordinate and integrate customers in the service process. These six behaviors also reflect the resource integration mechanism of the service firm in the value co-creation process. Karpen et al. (2014) suggest that implementing these behaviors is an important strategy to drive customer-related participative performances, leading to perceived value, satisfaction, trust, repurchase intention, and positive word-of-mouth.

2.3. *Customer perceived value*

Perceived value, which is often understood as the overall assessment of the trade-off associated with customers’ experiences based on the perceptions of what is received and what is given (Zeithaml, 1988), can be considered as one of the main reasons for customers’ engagement with an organization. It is very important for firm to understand how to deal with and manage customer interactions in the value co-creation process, otherwise it may make customers perceive less value and lead to unexpected outcome (Sinnya, 2014).

Sweeney and Soutar (2001) introduce four dimensions to explain customers’ perceived value, including emotional, social, functional value (quality/ performance), and price dimensions. In the health care service context, the functional value and emotional value are most important to patients’ perception of service value since health care is regarded as 'high credence' services due to the need for high level of trust in health care professionals and its impacts on the quality of life (Venkatesh & Balaji, 2012). Therefore, the functional and emotional value (the utility generated from expected service’s performance and from feeling or affective mood through the service) will play the key roles in measuring perceived value in this study.

3. Proposed hypotheses

3.1. *Provider interaction behavior, customer participation and perceived value*

Interaction behaviors of service provider are important to activate customer participation and ensure the success of value co-creation. When using a service, each customer has a certain degree of resources such as knowledge and skills that can contribute to the service process (Grönroos, 2008). However, to activate these customer resources, the service firm needs to have certain behaviors to encourage customers to contribute their knowledge and skills and interact as a co-creator of value (Prahalad & Ramaswamy, 2000). As value is created in usage, interaction can make the value creation process of customers accessible by service providers and can provide them with an opportunity to influence customer’s experiences in the joint sphere and take part in the customer’s value creation process as a co-creator (Grönroos & Voima, 2013). Therefore, the service provider behavior to interact with customer and enhance collaboration are expected to have positive impact on the extent of customer participation.

In the health care service, behaviors to foster two-way communication or to open dialogue between physician and patient is also important to provide patients with the needed social or emotional support, making them feel at ease and psychologically comfortable during treatment and keep them engaging in value co-creation. As patients often possess little knowledge of their illness and therefore feel stressed and emotional (Berry & Bendapudi, 2007), the more pleasant and positive the social environment is, the more likely patients would be to collaborate in the treatment process (Lengnick-Hall, Claycomb, & Inks, 2000). Moreover, as physician attempts to share all relevant and non-misleading information during discussion or is willing to clarify any potential risks associated with certain types of treatment, confidence can also be built, potentially leading to active participation.

Physician's interaction behavior with patient in an individual basis is also critical to foster participation. Different patients, even with the same medical condition, may have completely different circumstances or context. If physicians are capable of approaching each patient individually and having a more thorough understanding of their idiosyncratic conditions (such as medical condition, their unique circumstance, preference for particular treatment options, and expected outcome of treatment), they can offer solutions that better fit each individual patient's expectation, which in turn will enhance the collaboration and facilitate value co-creation.

Furthermore, patient would be more willing to comply with the treatment options that they have jointly developed with the physician (Prahalad & Ramaswamy, 2004). If physicians are open to patients' suggestions and constantly provide feedback for preferred treatment option, patients would be more willing to get involved in the treatment process, and value co-creation would be facilitated and enhanced.

In combination, as physicians can interact with patients in an individual, relational, and ethical manner, patients would be more willing to take an active participation role in value co-creation and the value perceived by patients would also be increased. It is therefore, hypothesized that:

H1: Physician interaction behaviors have a positive impact on patient participation.

H2: Physician interaction behaviors have a positive impact on patients' perceived value.

3.2. *Customer participation and perceived customer value*

Kellogg, Youngdahl, and Bowen (1997) suggest that treating customer participation as a variable of their own value equation can create more implications for both researchers and managers. Within the health care context, patient participation in the treatment process can be demonstrated through various types of behavior.

First, patients may seek information to clarify service requirements and to understand the nature of service and their roles in the value co-creation process, helping them become more integrated into this process (Kelley, Donnelly, & Skinner, 1990; Kellogg et al., 1997; Yi & Gong, 2013). With adequate information, patients would feel more confident, uncertainty would be reduced, and they would be ready to cooperate with physicians, enhancing value co-creation.

Second, they may also express opinions, state preferences, and explore options (Cegala, Street Jr, & Clinch, 2007). By providing physicians with proper information and honestly answer all treatment-related questions, patients could help physicians make accurate diagnosis, understand their particular needs and successfully perform the duties, enhancing the value perceived by patients.

In addition, patients should cooperate with physicians in the value co-creation process through accepting the guidance and following advice and consultancy (Yi & Gong, 2013). As patients recognize their duties and responsibilities and what are expected of them, they would be more cooperative and the value co-creation would likely be successful, increasing the perceived value.

In short, as patients attempt to participate in the treatment process, their perceived value can be increased. Thus:
H3: Patient participation has a positive impact on patient's perceived value of the health care service.

3.3. *Perceived value and customer satisfaction*

Customer satisfaction is a widely researched construct in the literature which can be understood as the customer's emotional response to the fulfillment of needs, expectations, wishes or desires (Keiningham et al., 2015). It is defined as an affective state as the result of comparing the expected performance and the perceived performance of a service (Oliver, 1980). Customer satisfaction has been showed to have strong impact on positive word-of-mouth and loyalty (Ravald & Grönroos, 1996).
In health care service, patient satisfactions are regarded as common evaluation in achieving quality service and the goal of chronic treatment (Aliman & Mohamad, 2013; Anderson & Zimmerman, 1993; Porter, 2010) because it is related to patients' acceptance to treatment continuation, relationship with physician, patient adherence and subsequent desired outcomes. Empirical evidence suggests that perceived value is a contributing factor to satisfaction (Yang & Peterson, 2004); and that service providers can spend their effort on improving value perceived by customers to increase customer satisfaction. Vega-Vazquez, Ángeles Revilla-Camacho, and J. Cossío-Silva (2013) also prove a positive relationship between value co-creation and customer satisfaction. The patients' participation in making decision together with health care professionals could improve their disease status, reduce stress, and therefore increase their perceived value and satisfaction. Therefore, it is hypothesized that:

H4: Patients' perceived value has a positive impact on their satisfaction.

3.4. *Research model*

Figure 1 depicts the proposed research model. In this model, the interaction behaviors of a service provider, the participation behaviors of customer and customer's perceived value are all operationalized as second-order reflective constructs. Within the health care context, physician interaction behaviors are reflected by individuated interaction, relational interaction and concerted interaction. Patient's participation behaviors are reflected by information seeking, information sharing and responsible behavior, while perceived value includes functional and emotional value.

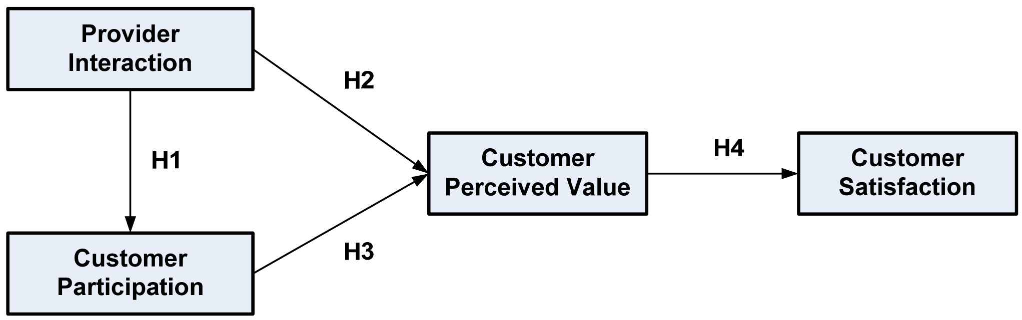

Figure 1: The proposed research model

4. Method

Quantitative data were collected via face-to-face interviews with a structured questionnaire at outpatient departments of 59 public and private hospitals in HCM City based on convenient sampling method. At each interview site, the dyadic technique was applied which matched one patient and the corresponding physician into a paired case. For each paired case, the physician was first interviewed about his/her interaction behaviors, and then he/she was asked to recommend one chronic patient for a following interview about participation behavior, perceived value and satisfaction level.

The scale measuring physician interaction behaviors was based on Karpen, Bove, and Lukas (2011) and consisted of 11 items reflecting three dimensions (individuated interaction, relational interaction, and concerted interaction). Patient participation behaviors were measured by 10 items reflecting three dimensions (information seeking, information sharing, and responsible behavior) and were adapted from Yi and Gong (2013). Patient perceived value and satisfaction were measured by 4 and 5 items, respectively, which were adopted from Sweeney and Soutar (2001) and Aliman and Mohamad (2013). All items were measured in 5-point Likert scale.

5. Results

5.1. Sample characteristics

A total of 320 pairs of response (i.e., 320 cases) were collected and qualified for use in the data analysis. The sample characteristics are presented in Table 1.

Table 1 – Sample characteristics

Hospital type:	
Public	65%
Private	35%
Chronic disease:	
Cardiology	12%
Hypertension	13%
Diabetic	10%
Asthma + COPD	20%
Rheumatology, Hepatitis	9%

	Combined disease			20%
	Others			15%
Frequency of visit:				
	First time			11%
	Two times per month			44%
	Once per month			33%
	Once per 2 months			12%
Gender:				
		Physician		
		Male		Female
Patient	Male	24%		19%
	Female	29%		28%
Age group:				
		Physician		
		25-35	36-45	46 & above
Patient	35 and below	4%	5%	6%
	36-45	7%	8 %	5%
	46-55	5%	11%	6%
	56 and above	11%	21%	11%

5.2. Validity and reliability of measures

Exploratory factor analysis (EFA) and Cronbach alpha were first employed for preliminary assessment of dimensionality, reliability and construct validity. Then, the qualified items were submitted to confirmatory factor analysis (CFA) to examine the full measurement model. The test for normality showed that 24 remaining items have kurtosis values range from -1.036 to 1.630 and skewness values range from -0.883 to 0.183 which indicate a slight deviation from normal distribution (Kline, 2011). Therefore, maximum likelihood (ML) was an appropriate estimation method (Fabrigar, Wegener, MacCallum, & Strahan, 1999).

The CFA of the full measurement model resulted in satisfactory fit indices: Chi-square = 265.01; dF = 173; GFI = 0.931; CFI = 0.970; TLI = 0.960; RMSEA = 0.041. The HOETLER index of 247 was above the threshold value of 200, indicating that the sample size was large enough for this analysis (Byrne, 2001). These results showed an acceptable fit between the measurement model and the data collected. Factor loadings of items ranged from 0.50 to 0.86 and composite reliabilities were from 0.57 to 0.87. Correlation coefficients between pairs of constructs ranged from 0.26 to 0.84, which were below 1.00 (at p = 0.05). Thus, the measurement scales for each first-order concepts were satisfactory in terms of reliability, convergent validity and discriminant validity.

5.3. Structural model estimation and hypothesis testing

Given the satisfactory fit of the measurement model, the proposed hypotheses were then tested using structural equation modeling. In order to reduce the complexity of the model which comprises many second-order reflective constructs, item parceling technique (Bagozzi & Heatherton, 1994) was applied. Accordingly, 11 composite indicators were created from 22 original indicators, with kurtosis values ranging from -0.917 to 1.570 and skewness values ranging from -1.003 to 0.044. Maximum likelihood method is still appropriate for estimation.

The estimation of the proposed structural model using Maximum Likelihood method resulted in a good fit: Chi square = 66.977; dF = 40; CFI = 0.980; GFI = 0.964; TLI = 0.972; RMSEA = 0.046. Loadings of items on their respective latent constructs ranged from 0.50 to 0.86

Based on the standardized path coefficients (Table 2), we found that all four hypotheses were supported. As predicted, physician interaction behaviors have a strong and positive impact on patient participation behaviors ($\beta = 0.62$; $p < 0.01$) as well as value perceived by patient ($\beta = 0.32$; $p < 0.01$); patient interaction behaviors are strongly and positively associated with their perceived value ($\beta = 0.57$; $p < 0.01$); and patient perceived value has a strong and positive impact on their satisfaction ($\beta = 0.89$; $p < 0.01$).

The results also showed that the proportion of the variance in patient's perceived value explained by patient participation and physician interaction behaviors was considerably high at 65% and patient perceived value explained 78% variance of patient satisfaction.

The hypotheses testing results are summarized in Table 2, along with the standardized parameter estimates.

Table 2. Standardized estimates

	Hypothesis	Standardized Coefficients	Sig.	Result
H1 (+)	Physician Interaction → Patient Participation	0.62	***	Supported
H2 (+)	Physician Interaction → Perceived Value	0.30	***	Supported
H3 (+)	Patient Participation → Perceived Value	0.57	***	Supported
H4 (+)	Perceived Value → Patient Satisfaction	0.89	***	Supported

6. Discussions

Literature advocates that customer and service provider co-create value (Grönroos, 2008); and that the value is co-created through resource integration and interaction (Gummesson & Mele, 2010). In this specific study in the context of health care service, the results provide more concrete empirical evidence on the roles and mechanism in which the two sides, i.e., service encounters and customers interact directly within the joint sphere to co-create value for customers.

Firstly, co-creation of value requires that services are not solely produced by the firm and customers are not passive recipients of value. It reflects the reality that customers must participate in the service creation process (Vargo & Lusch, 2004). In the health care context, the participation or involvement of customers is compulsory. Previous studies have shown that patient participation behaviors taken in the forms of information sharing and information seeking are key to patient-physician relationship and patient satisfaction (Epstein & Street, 2011; Holman & Lorig, 2004; Yi & Gong, 2013). However, participating in a service process also means that customers must spend more of their own resources in addition to the amount of money they pay. In the customer view, whether there is an additional value in the trade-off between the spending additional resources and receiving a more customized and/or better quality service. With the empirical result indicating the positive effect of customer participation on customer perceived value in health care context, the current study provides an empirical evidence to consolidate the notion that the more actively a patient participate the better service value he or she would receive. In other words, this study is in strong support of the view on customer as co-creator or co-producer of value in the foundational premises of service dominant logic suggested by Vargo and Lusch (2004) and Grönroos (2008).

Secondly, the participation of service customers in a service must be inquired in the context of its interaction with service provider (Gummesson & Mele, 2010). The current study extends our understanding on this interaction by specifying the role of the two sides. Particularly, it is founded that there is a significant positive effect of interaction behaviors of the service provider (i.e., service encounters) on customer participation. That is, the extent of customers' participation is depended on how the service provider interacts with them in the role of an initiator. Given the notion that both sides are co-creators of value, this result indicates that service encounters actually keep the initiative role in activating the service customers to participate. This role of service provider is very important in service contexts where customer participation is a required part of the value co-creation procedure but customers are reluctant or not confident to participate, such as health care, education, consulting or other professional services (Lengnick-Hall et al., 2000).

The third issue relates to capability of service encounters in directly creating value for customer through their interaction behaviors. In this case of health care service, physician interaction behaviors are positively associated with patient perceived value. Interaction activities undertaken by physicians may include detailed discussion with patient about treatment plan, explanation about how the patient can best assist the healing process, or any additional information sources the patient may find useful, which in turn will translate into more informed decisions. In addition, as physician attempts to address each patient individually, spend time listening to their concerns and demonstrate sympathy and care, patient can feel emotionally supported. Thus, confidence can be built and patient can make better and more informed choices regarding their treatment procedure. All of these potential outcomes will definitely enhance customer perception of service value in both process and outcome forms.

From the practical view, some managerial implications can be drawn from the results of this study. In Vietnam, one of the most challenging barriers for patient participation in the treatment process stem from inadequate information and knowledge on the patient side. Additionally, the lack of commitment, interpersonal and communication skills on the physician side may potentially lead to therapeutic failure. It would be more difficult to enhance patient participation in public hospitals since physicians may not have sufficient time to spend on consulting individual patient due to the heavy workload (Krueger et al., 2001). Therefore, measures to improve the physician's interpersonal and communication skills can increase collaboration and interaction between physicians and patients, which will then enhance patient satisfaction and lead to positive effect on treatment adherence and outcomes.

7. Conclusion

In aggregation, the current study contributes to extend our knowledge about the twofold roles of interaction behaviors of service encounters in the context of heath care. Interaction behaviors are primarily a reflection of the customer-oriented behavior (COB), a critical success factor in any high-contact service (Mechinda & Patterson, 2011). Moreover, it also plays crucial role in activating the participation of customers to contribute their resources for a better service production, leading to higher value perception and customer satisfaction. From the customer view, although actively participating in a health care service requires more resources, it is worthy to do so because it creates much greater value-in-use for them.

From the methodological view, a feature of this study is the dyadic approach to data collection. While many prevailing quantitative studies employed survey data collected from single informants, the current study relied on paired-case approach to data collection for a better reflection the nature of two-side interaction. More importantly, it is considered one among the most effective ways to minimize the common method bias in the survey data which leads to systematic errors (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003).

There are a number of limitations of this study, which suggest areas for further research. From the general theoretical view on the provider – customer interaction to co-create value, this research confined within one service industry context (i.e. health care). Given the diverse nature of services, further research is suggested to examine the roles of interaction in services with different features in terms of level of contact (high vs. low), knowledge distance between customer and provider (high vs. low), target of service acts (object vs. human), relation base (membership vs. contract-based). Another issue that is worthy to explore relates to the changing roles in the interaction between service encounters and customers in different stages of the service value co-creation, which are out of the direct interactive joint sphere of the process.

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□ □ □ □ □ □ Using path analysis to examine the mediation effects of agency costs and risk-taking in the relationship between ownership structure and firm performance

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Abstract

Purpose **–** Given the knowledge gap in the mediated effects of ownership structure on

firm performance, the purpose of this paper is to test whether agency costs and corporate risk-taking mediate the relationship between equity ownership structure and firm performance.

Methodology **–** The causal-steps approach is adopted to model the relationship from past ownership structure via current agency costs and current risk-taking to current firm performance. The generalized method of moments (GMM) and panels corrected standard errors (PCSEs) estimations are used with a sample of 475 observations on listed firms on the Vietnamese stock markets over a five-year period (2008-2012).

Findings **–** The results suggest that agency costs mediate the positive effect of past government ownership and past insider ownership on current firm performance, while risk- taking mediates the negative effect of past foreign ownership on current firm performance.

Implications/Originality **–** This new evidence enhance our understanding of how ownership structure affects firm performance. Government ownership and insider ownership, but not foreign ownership, can mitigate agency problems in listed firms in transitional and emerging countries.

Keywords Ownership structure, firm performance, agency costs, risk-taking, mediation, Vietnam

1. Introduction

Performance of a firm can be influenced by its ownership structure due to several reasons: i) owners have different power, incentives and ability to monitor managers due to the difference in their identities, concentration and resource endowments; and ii) owners have varying goals for their involvement in firms, resulting in different effects on firm performance (Douma, George & Kabir 2006). However, ownership-performance issue is not only involved with such a question of why ownership structure affects firm performance but also how, or via which channels, the former affects the latter. Since most prior literature on this issue has ignored mediation approach, the mechanisms by which the effects of ownership structure are transmitted to firm performance are not adequately understood.

In practice, ownership structure-firm performance relationship has a long tradition of research, at least since Berle et al. (1932) with emphasis on manager ownership-firm performance; but the issue remains controversial until recently, in particular for other dimensions and/or forms of equity ownership such as ownership concentration, government ownership or foreign ownership. For instance, while many authors such as Megginson, Nash and Randenborgh (2012) or Djankov and Murrell (2002) argue that government ownership is inefficient and negative for firm performance, some other authors such as Tian and Estrin (2008) or Vaaler and Schrage (2009) claim that government ownership at a certain levels helps improve firm performance.

Moreover, most prior studies on the association between ownership structure and firm performance have adopted the direct approach (i.e. ownership structure directly affect firm performance). It can be argued that this approach may lead to spurious results because the indirect links may exist in reality and they can divert the effect of ownership structure. Consequently, the estimated coefficients obtained from this approach merely indicate the total effect of the former on the latter, while the other types of effects such as indirect and direct effect are not identified.

Consistent with Le and Buck (2011), this research firstly argues that ownership structure does not itself 'cause' firm performance, and agency cost is a 'missing link' in this relationship. Agency theory suggests that the relation between firm performance and ownership structure is closely associated with agency costs because different forms of ownership may have different levels of agency costs. In turn, agency costs can adversely affect firm performance (Brown, Beekes & Verhoeven 2011). The out-of-equilibrium model of relation between corporate governance and firm performance also suggests that corporate governance has a causal effect on firm performance indirectly through its impacts on the agency conflict of the firm, which is embodied with the incentives and monitoring of the management (Tan 2009).

In addition, agency theory also suggests the link between equity owners and risk- taking. Accordingly, shareholders have different risk preferences; for example, managers are commonly regarded as risk-averse shareholders since their human capital invested in the firm is not diversified (Himmelberg, Hubbard & Palia 1999). It can be argued that these differences can influence risk-taking behaviours of the firm. In addition, it is well documented in corporate risk management theory that risks are closely associated with firm performance. 'High risk-high return' is a well-known hypothesis in this connection. As a result, another issue of concern is whether there is a continual connection of ownership structure-corporate risk taking-firm performance; that is, whether corporate risk-taking transmits the impact of ownership structure to firm performance. However, the understanding of a mediation mechanism among these three variables is quite limited in the literature. It is thus argued in this paper that corporate risk-taking is another 'missing link' between ownership structure and firm performance.

Taken together, this paper is aimed at answering the following research questions:

1) Is the relationship between ownership structure and firm performance mediated by agency costs and risk-taking?

2) Do agency costs contribute as much as risk-taking to explaining the effect of ownership structure on firm performance?

The focus of this study is on the relationship between three ownership identities (government ownership, insider ownership and foreign ownership), two mediator variables (agency costs and corporate risk-taking), and financial firm performance (return on assets or Tobin's Q). A two-mediator model is established to examine the related paths among these variables. All ownership variables are lagged by one year to formulate potential causal effects between ownership structure and firm performance.

In terms of research context, this study examines the issue from the context of the stock markets in the developing and transitional economy of Vietnam for several reasons: 1) no prior research has been undertaken on the mediated relationship between ownership structure and performance of the Vietnamese listed firms; 2) this country has unique characteristics in terms of newly developed stock markets, risk-seeking attitudes of shareholders and transitional economy.

Using causal-steps approach (Baron & Kenny 1986), I find evidence of the mediation effect of agency costs and risk-taking. Specifically, agency costs fully mediate the positive effect of past government ownership and past insider ownership on firm performance, while

risk-taking mediates the negative effect of foreign ownership on market performance only. The finding for government ownership is consistent with Le and Buck (2011) and it challenges prior studies on developed markets which postulate a negative impact of government shareholding. The finding for insider ownership supports the 'alignment of interest effect' hypothesis. The result for foreign ownership suggests that foreign shareholders are risk-adverse investors in the Vietnamese stock markets. Additionally, the risk-seeking behaviours of government and insider shareholders do not lead to higher firm performance.

This study contributes to the literature in several aspects. First, this is the first study that adopts mediation approach to examine the relationship between multiple forms of ownership structure and firm performance. Second, this study contributes to the application of agency theory in a mediation context. Third, this research extends Le and Buck (2011) in terms of developing two-mediator model to explain the relationship. Forth, this research provides useful implications for the privatization process in developing countries because it explores the effect of both public and private forms of equity ownership on listed companies' performance. Last, this first study is the first that examines the inter-relationship between equity ownership structure, agency costs, risk-taking and firm performance of the Vietnamese listed companies.

This paper has some limitations. First, the findings may be generalized to listed firms only because the sample does not contain the firms outside stock markets. Second, causal- steps approach suffers from a few limitations, including the lack of the specific indirect effects and standard errors of mediated effects. Third, the reverse causal effect of firm performance on ownership structure is not yet considered in this research. A more proper understanding of the mediated relationship could be obtained if the feedback effect of firm performance is accounted for.

Section 2 of this paper presents a review of related literature on the issue. Section 3 discuses theoretical foundation of research. Section 4 describes data sample. Section 5 introduces empirical models, estimation methods and variable measurement. Section 6 reports the main results of the study. Section 6 discusses empirical results and concludes the paper.

2. Review of related literature

As aforementioned, almost all prior studies only examine the total effect of ownership structure on firm performance due to direct approach to the issue. This section reviews related literature on the total effects between three types of equity ownership (government ownership, insider ownership and foreign ownership) and firm performance, and agency costs and risk-taking where they are relevant.

Government ownership-firm performance

An overwhelming viewpoint is that government ownership is normally associated with inefficiency and bureaucracy, i.e. negative relationship between government ownership and firm performance (Djankov & Murrell 2002; Netter & Megginson 2001; Thomsen & Pedersen 2000). However, there is a considerable amount of empirical evidence that runs counter to such position. Many authors claim that government ownership can contribute to improving firm performance, conditionally among a certain group of listed companies or subject to country-specific contexts. For example, in China's stock market, Tian and Estrin (2008) report that government ownership is positively related to firm performance when the government ownership reaches a certain high level or more than 25%; LI, Sun and Zou (2009) find that the negative effect of government ownership on firm performance is 'only among the more profitable firms'. Vaaler and Schrage (2009) state that government ownership is also able to positively contribute to firm performance if government holds no more than 50% ownership in a low policy stability country, and no more than 25% of ownership in a low-to-mid policy stability country.

Insider ownership-firm performance

There are basically three main streams of literature regarding the relationship between managerial/insider ownership and firm performance. The first is termed 'alignment of interest effect' (Jensen & Meckling 1976). Berle et al. (1932) argue that the separation of ownership from control will reduce manager's incentives to pursuit the goal of corporate profit maximization. As a result of the conflict of interest between managers and shareholders, or between majority and minority shareholders (Clacher, Hillier & McColgan 2010), if the interests are aligned between managers and shareholder, the higher proportion of managerial ownership can support an improved firm performance level. This proposition is supported by empirical evidence such as Bhagat, Bolton and Romano (2010) and Mehran (1995) who also claim that managerial equity ownership and firm performance is positively associated.

In contrast, the second stream postulates 'entrenchment effect' so that as the proportion of equity owned by managers increases, they will have less incentives to pursuit the target of corporate profit maximization. In other words, managerial ownership and firm performance is negatively related. According to Shleifer and Vishny (2008), managers will get involved in non-maximizing behaviours when they hold up to a certain level of a firm's ownership.

The third stream of literature in this regard argues a non-linear relationship between managerial ownership and firm performance. The overall effect of managerial ownership on firm performance may depend on the relative strengths of two above-mentioned forces: alignment of interest effect and entrenchment effect; accordingly, managerial ownership at a certain range of managerial ownership is positive for firm performance if the alignment effect is dominant and vice versa over some other ranges if the entrenchment effect dominates (Morck, Shleifer & Vishny 1988; Thomsen & Pedersen 2000).

Foreign ownership-firm performance

Studies on the effect of foreign ownership also provide mixed results. On the one hand, a large body of literature find a significant positive effect of foreign ownership on firm performance, whereby it can bring about an increase in firm value (Dwivedi & Jain 2005; Sabur, Omar Al & Wares 2012; Sarkar & Sarkar 2000). On the other hand, foreign ownership is found to be significantly negatively associated with firm performance (Sulong & Nor 2008).

Ownership structure-agency costs-firm performance

In terms of a potential mediation role of agency costs in ownership-performance relation, some authors such as Thomsen and Pedersen (2000) show that ownership structure may affect agency costs and consequently a firm's financial performance and investment opportunities. Denis (2010) and Jensen and Meckling (1976) also indicate that concentrated ownership may reduce agency costs because large shareholders have more incentive and ability to influence managers, thus increasing firm value when there is the concentration of cash flow rights.

Many studies have been undertaken to examine the impact of agency costs in a range of finance-related choices such as ‘capital structure, maturity structure, dividend policy, and executive compensation’(Ang, Cole & Lin 2000, p. 81). However, few studies have sought the intervening role of agency costs in equity ownership-performance relationship; while most others merely investigate separately the association either between ownership structure and agency costs, or between agency costs and firm performance. For example, Ang, Cole and Lin (2000) argue that agency costs are closely associated with the agency conflict between shareholders and managers within a firm. They eventually find that agency costs are inversely related to managerial ownership in the U.S. market. In the context of a developing country, Sabur, Omar Al and Wares (2012) argue that there exists a high agency problem and

that agency conflict lies with shareholdings by sponsors, government, institutions, and foreigners as indicated by the negative effects of such identities on firm performance.

The most relevant literature on the mediated effect of ownership structure on firm performance is Le and Buck (2011). Using causal-steps approach, Le and Buck (2011) find that agency costs mediate the positive impact of government ownership on firm performance measured by return on assets and return on equity, and there is no direct effect of government ownership on firm performance in the Chinese stock market. However, the investigation of the authors is merely confined to government ownership; and all variables are measured contemporaneously, leading to weak inference for potential causal effects of government ownership on firm performance.

In general, it can be argued that the literature on the mediated relationship is between ownership structure and firm performance is rather limited. Apart from Le and Buck (2011), mediation analysis approach has not been applied to identify the mediating effect of agency costs associated with other forms of ownership such as insider ownership and foreign ownership.

Ownership structure-risk-taking-firm performance

Like the case of agency costs, most previous studies do not treat risk-taking as a mediating variable in the association between equity ownership and firm performance. It is quite common in the literature that only individual directions of effects are tested, either between ownership and risk-taking or between risk-taking and firm performance.

John, Litov and Yeung (2008) investigate the association between investor protection and risk-taking, and then between risk-taking and country-wide performance (productivity and GDP growth). The authors argue that insider or manager ownership is among a number of factors that influence risk-taking. In particular, in countries with low investor protection, managers are often dominant insiders and they may prefer to avoid risk-taking to protect their expected private benefits. This is a useful implication for follow-up studies that use data from developing countries where investor protection is poor. However, due to the objectives of research, John, Litov and Yeung (2008) do not attempt to examine the intervening role of risk-taking in the association between insider ownership and performance.

In the context of Korean market, Kim (2011) to examines the association between foreign ownership and risk-taking in investment of firm, and the relation between risk-taking and firm growth. Controlling for endogeneity by 2SLS regressions, Kim (2012) reports that foreign ownership is found to be positively related to risk-taking in firms with greater opportunities for investment, and risk-taking in turn improves firm growth. However, since this study uses cross-sectional data, a limitation of Kim (2012) is the lack of discussion about the changes of foreign ownership and risk-taking over time, which is important when the time effect is available. Besides, risk-taking as a connecting point between foreign ownership and firm growth is not considered in this study.

Using a panel data sample of the Turkish market, Guner and Kursat (2002) investigate the effect of ownership structure on firm performance and risk-taking, respectively. Applying ordinary least squares (OLS) regression for panel data, the authors report significant links between ownership structure and firm performance, and between ownership structure and risk-taking. Firms with highly concentrated ownership and government-owned firms are found more easily to take risk. Like previous studies, a potential connected link from ownership structure-risk taking-firm performance is not examined in this study

3. Potential mediating role of agency costs and risk-taking in ownership-performance relationship

Agency theory defines agency relationship as a contract between the principles and the agent, under which the latter is delegated with authority to perform some service on the former's behalf (Jensen & Meckling 1976). Two agency problems are concerned in the agency relationship: 1) the conflict in the goals of the principle and the agent, and 2) the risk sharing between the principle and the agent when there is difference in their risk preferences (Dias & Mroczkowski 2012). Therefore, it can be argued that the conflict of interests and risk preference are the two core factors that can explain the relationship between equity ownership and firm performance.

In terms of the conflict of interests, it is widely known from the agency theory that 'the agent will not always act in the best interest of the principal', and 'it is impossible for the principal or the agent at zero cost to ensure that the agent will make optimal decisions from the principal's viewpoint'(Jensen & Meckling 1976, p. 5). Hence, it is documented in agency models that the misalignment of interests between managers and shareholders causes costly actions undertaken by managers (Bhagat & Jefferis 2002). Intuitively, agency costs are incurred by firm due to the divergence in the interests of managers and shareholders. Regardless of the existence of agency costs, shareholders are still willing to provide a considerable amount of their capital to corporations run by managers; it is thus popular that equity ownership structure is widely held (Jensen & Meckling 1976). As a result, each type of ownership structure may be related to a certain level of agency costs.

Additionally, ownership structure can influence agency problems in the sense that it can be used as a mechanism to control such problems (Agrawal & Knoeber 1996). For instance, an increase in the level of insider ownership is regarded as one of effective corporate governance mechanisms to mitigate the agency conflicts in such a way that they are consistent with shareholders' interest and if a contract between the firm and managers cannot make it possible (Bhagat, Bolton & Romano 2010). The formation of a board of directors is also a solution to the agency problems (Hermalin & Weisbach 2003).

Ownership structure may have effect on agency costs and consequently firm performance and investment opportunities (Thomsen & Pedersen 2000). In this connection, the out-of-equilibrium model, which is based on "inefficient hypothesis", holds that since corporate governance structure is not optimal, any adjustment on corporate governance will result in direct effect on agency conflict, which in turn affects firm performance (Hermalin & Weisbach 2003; Tan 2009). Thus, it is assumed in this model that there is an indirect link between corporate governance mechanisms and firm performance through agency costs.

With regards to risk preference aspect, agency theory also suggests that the degree of corporate risk-taking is influenced by the risk preference of equity owners. Individual shareholders may have different risk attitudes, which indicate the link between ownership structure and risk-taking. Specifically, the risk preference of a shareholder may be categorized into one of the following three types: risk aversion, risk neutrality and risk seeking (McGuigan, Moyer & Harris 2005; Merna & Al-Thani 2008).

Most prior literature on corporate risk-taking in agency context focuses on the behaviour of inside managers (Kim 2011) and often regards managers as risk-averse shareholders. Unlike outside shareholders who tend to take higher risks to the extent that they can diversify, insiders may ignore risky projects because the human capital of managers invested in the firm is not diversifiable. The greater corporate resources the insiders expect to divert, the more the insiders will avoid taking risky investments to protect their private benefits (Himmelberg, Hubbard & Palia 1999).

Overall, it can be argued that agency theory can explain the indirect link between ownership structure- agency costs - firm performance, as well as the direct link between ownership structure and risk-taking, but it does not suggest the direct link between risk-taking
and firm performance. Corporate risk management theory can complement this limitation of agency theory. The focus of corporate risk management is on the risk-return trade-off (Gordon, Loeb & Tseng 2009); and a conventional assumption in finance theories is that 'higher risk' implies 'higher potential return' (Drever, Stanton & McGowan 2007). Corporate

risk management has become another area of corporate governance. Taking care of risk- taking in entrepreneurism is crucial to ensure that directors are accountable for the firm. Hence, an issue of common concern is how to make a balance between regulation and control on the one hand and the opened room for risk-taking and innovation necessary for economic growth on the other hand (Farrar 2008). Therefore, risk-taking can be viewed as another intervening factor that transmits the effect of ownership structure on firm performance.

4. Data Sample

4.1. Data sources

Financial data of listed firms are obtained from audited annual financial statements,
which are sourced from DataStream. Stock price data are retrieved from the database of stock exchanges which are available on the websites of Hanoi Stock Exchange and Hochiminh Stock Exchange1. Ownership data are hand-collected from company annual reports, which are also downloadable from the websites mentioned above. Since all such data are publicly disclosed as required by the Securities Law, an advantage of this collection is that every single item in the data sample can be cross-checked for accuracy from different sources on the markets, including database of securities companies and listed companies themselves.

4.2. Sample collection and data cleansing procedures

Data in this thesis started with a population of 288 firms, which is the number of all
listed companies on Vietnam's stock markets in 2008, including both Hanoi Stock Exchange and Ho Chi Minh Stock Exchange. The period from 2008 to 2012 is selected due to three following reasons: (i) the year of 2008 was one year after the Securities Law of 2007 in Vietnam came into effect, which is believed to enhance the quality of mandatory information disclosure due to strict legal enforcement; (ii) Data from 2008 of Vietnam's listed companies and stock market were provided in international data terminals such a DataStream; and (iii) Almost all financial reporting standards applicable on Vietnam's stock markets, which are based on the International Financial Reporting Standards (IFRS), were completed and adopted since 2008.

The listed companies must have full 5 years of continuous listing in the period from 2008 to 2012 to enable the efficient use of lagged values of variables. Following previous studies, financial companies were excluded due to the incompatibility or differences in financial statements as compared to non-financial companies. To maintain the quality of data, companies with incomplete data, i.e. lacking annual reports or financial statements of one or more fiscal years, were removed. Finally, a balanced panel data sample is obtained with 475 observations in total (95 firms and 5 years).

In order to mitigate the effect of potential outliers, the most common procedure is to winsorize variables (Leone, Minutti-Meza & Wasley 2014). In comparison with other procedures of data accommodation such as trimming or piecewise linear regression, winsorizing is unaffected by sample size and it helps a regression model fit the data well while having a low level of prediction error (Kennedy, Lakonishok & Shaw 1992). Although there is no generally-accepted guideline for an appropriate fraction of observations to be winsored, a low percent winsorization may miss out many outliers. The percentage of gross errors can be a few in average-quality data and quite realistic at 10% in fairly low-quality data (Hampel 1986). In this thesis, following Miller, Xu and Mehrotra (2014), a 5% winsorization level is selected. While these authors apply the 5% winsorization to dependent variables only, this thesis winsorizes both dependent (outcome) and independent (predictor) variables; i.e. except control variables. This is because winsorizing predictor variables but not dependent variables can lead to biased coefficients (Leone, Minutti-Meza & Wasley 2014). In addition, similar to Chen, W, Liu and Ryan (2008), the lower tails of government ownership and foreign ownership are not winsorized because they are bounded by zero and contain some zero observations (i.e. firms without shareholding of government ownership and foreign ownership).

5. Mediation model and variables

5.1. Recursive model and causal-steps approach

The literature on mediation mechanism suggests that it is unlikely for the effect of a variable to be mediated by only a single mediator variable in most situations (Preacher & Hayes 2008). In the meantime, it is suggested in agency theory and risk management theory that agency costs and risk-taking can be considered as two main mediators of the effect of ownership structure on firm performance as already mentioned. Hence, this research develops a two-mediator model where the direction of effects flow from past equity ownership via current agency costs and current risk-taking to current firm performance. It is plausible to specify ownership structure at past period and firm performance at current period to formulate potential causal effects in ownership-performance relationship. If variables are measured at the same time, there may be not enough time for independent variable to affect mediator variable or mediator variable to affect outcome variable (Gollob and Reichardt 1991, cited in MacKinnon 2012); and more accurate conclusions about mediation can be obtained by considering the temporal order of change over time (MacKinnon 2012).

Following MacKinnon (2012), a two-mediator recursive model is specified with four equations below:

Firm Performance = $i1 + cL$.Ownership Structure $+Z1 + \varepsilon 1$ (1)

Agency Cost = $i2 + a1L$.Ownership Structure $+ Z2 + \varepsilon 2$ (2)

Risk-Taking = $i3 + a2L$.Ownership Structure $+ Z3 + \varepsilon 3$ (3)

Firm Performance = $i4 + b1$Agency Costs $+ b2$Risk-Taking$+ c'L$.Ownership Structure $+Z4 + \varepsilon 4$ (4)

where a1 and a2 are the parameter relating one-year lagged ownership structure (L.Ownership Structure) to the first mediator (agency costs) and to the second mediator (risk-taking), respectively. b1 represents the effect of the agency costs on firm performance adjusted for ownership structure and risk-taking. b2 represents the effect of risk-taking on firm performance adjusted for ownership structure and agency costs. c and c' are the total effect and direct effect of one-year lagged ownership structure on firm performance, respectively. L.Ownership Structure consists of lagged government ownership, lagged insider ownership and lagged foreign ownership. Firm Performance is either ROA or Tobin's Q. Z1, Z2 Z3 and Z4 are vectors of control variables that influence dependent variables. ε1, ε2, ε3 and ε4 are error terms that contain random disturbance and unobserved heterogeneity. i1, i2, i3 and i4 are intercepts.

In this model, agency costs, risk-taking and firm performance are not endogenous covariates since only Equation 4 depends on Equation 2 and Equation 3. Thus, each equation in this system can be individually estimated by a different regression method under the causal-steps approach proposed by Baron and Kenny (1986). According to Preacher and Hayes (2008) and MacKinnon (2012), the causal-steps approach can be used in multiple- mediator context, and the main concern under such approach will be the significance of the paths defining specific indirect effects (a and b parameters in the above model). As summarized by Preacher and Hayes (2008) and MacKinnon

(2012), the Baron and Kenny (1986) causal-step approach can be applied to confirm mediating effect if the following conditions are met:

1) The relationship between predictor variables (ownership structure) and outcome variables (firm performance) is significant (Equation 1 above).
2) The relationship between predictor variables (ownership structure) and mediator variables (agency costs and risk-taking) is significant (Equation 2 and Equation 3 above).
3) The effect of mediator variables (agency costs and risk-taking) on outcome variables (firm performance) controlling for predictor variables (ownership structure) is significant (Equation 4 above).
4) The effect of predictor variables (ownership structure) on outcome variables (firm performance) decreases substantially when both predictor variables and mediator variables are simultaneously regressed.

Following the conditions above, each equation in the recursive model will be regressed in order, starting from Equation 1; hence there will be four steps of regression. Under the 4th condition, partial mediating effect is established if the effect of predictor variables is decreased but still significant; and full mediating effect occur when this effect is no longer significant.

5.2. Predictor variables

Lagged government ownership (L.GOV)

This proxy is measured as the one-year lagged of the proportion of shares owned by government agencies or SOEs over the total common shares of a firm. In fact, the ratios of government ownership can be obtained straightforwardly without any calculation because they are clearly stated in the annual reports of the Vietnamese listed firms.

In Chinese context, Le and Buck (2011) find that the effect of government ownership on firm performance is positively mediated by agency costs. Since Vietnam shares similar characteristics with China in terms of the dominant role of government ownership in the economy, it is plausible to expect that the relationship between L.GOV and firm performance is positively mediated by agency costs; that is, the higher percentage of L.GOV is followed by the lower level of agency costs, and lower agency costs are associated with an improved firm performance level. Besides, for political reasons and power, government shareholders may have strong incentives for preserving and increasing the value of the state capital in listed firms. Hence, they would tend to seek for potential returns by supporting risky investment projects. Because the ‘high risk-high return’ assumption is expected to hold in this research, the risk-seeking preference of government shareholders would be related to an increase in firm performance. Therefore, it is also expected that the relationship between L.GOV and firm performance is positively mediated by risk-taking; that is, L.GOV is positively associated with risk-taking, and higher risk-taking is associated with higher firm performance.

Lagged insider ownership (L.INSIDER)

In the seminal work of Jensen and Meckling (1976), inside equity is defined as the equity ownership by the manager. Following Davidson and Singh (2003) and Tan (2009), L.INSIDER in this thesis is defined as the one-year lagged proportion of common equity owned by the members of the board of directors, including managers, to the total common equity.

Since this proxy consists of shares held by both managers and directors, it is assumed that the interests of both directors and managers are homogeneous, which is suitable to reflect the problem of little separation of ownership and control in the context of a developing country like Vietnam. This is also suitable to the traditional focus of economics and finance literature on the agency problems solved or created by the board of directors (Adams, Hermalin & Weisbach 2010). In order to obtain the accurate private amount of shares owned by insiders, government shares nominally owned by directors are excluded from this ratio.

Based on the ‘alignment of interest’ hypothesis, it is expected that the relationship between L.INSIDER and firm performance is positively mediated by agency costs. That is, the higher percentage of L.INSIDER is followed by the lower level of agency costs, and lower agency costs are associated with higher firm performance. Contrary to conventional assumption of a risk-adverse attitude of insider/managers, in addition, insider ownership is expected to positively related to risk-taking in the context of Vietnam’s stock market. There was a common trend in the period of study that listed firms did engage actively in trading stocks for short-term profits such as dividend and capital gains. In addition, they established an array of subsidiaries for the main purpose of expanding business areas and hence hold a part or majority of common shares of the newly-established ones. It can be argued that such financial investments indeed reflect risk-taking behaviours of insider shareholders of the firms. Together with ‘higher risk, higher return’ assumption, therefore, the effect of L.INSIDER on firm performance is expected to be positively mediated by risk-taking; that is, L.INSIDER is positively associated with risk-taking, and higher risk-taking is associated with higher firm performance.

Lagged foreign ownership (L.FOREIGN)

L.FOREIGN is measured by the one-year lagged fraction of common equity held by foreign investors to the total common equity of a listed firm. It should be noted that the maximum value of foreign ownership is 49% in this research because this is the highest level of foreign ownership in the Vietnamese listed firms according to applicable laws in Vietnam.

Since foreign ownership is not controlling and restricted at 49% in Vietnam’s stock market, there is good reason to suspect that foreign investors in this market have short-term views of investment and want to avoid risky projects. Thus, it is expected that the relationship between L.FOREIGN and firm performance is negatively mediated by risk-taking; that is, L.FOREIGN is negatively associated with risk-taking, and lower risk-taking is associated with a decrease in firm performance. Simultaneously, foreign ownership can be a mechanism to mitigate agency problems due to the monitoring role of foreign investors. It is thus expected that the relationship between L.FOREIGN and firm performance is positively mediated by agency costs; that is, the higher percentage of L.FOREIGN is followed by the lower level of agency costs, and lower agency costs are associated with higher firm performance.

5.3. Mediator variables

Agency costs (AC)

Following Davidson and Singh (2003), this research employs asset utilization ratio as the primary measure of agency costs. The higher value of utilization ratio, the lower level of agency costs is implied since it measures the ability of managers to deploy asset efficiently, and hence an improvement in firm performance is expected.

Risk-taking (RT)

This reseach adopts the common measure of risk that is based on historical stock prices (market-based measure of risk). Following Minton, Taillard and Williamson (2014) and

Huang and Wang (2014), RT is defined as the standard deviation of the marked-adjusted daily stock returns. Specifically, the natural logarithm of variance of daily stock returns is applied to calculate returns; these values are then adjusted to eliminate market-driven risk factor by taking the difference between daily stock returns and the daily returns on stock market index. By subtracting the market-related risk component, this measure can better reflect firm-specific risk-taking behaviours. The higher value of standard deviation indicates higher risk-taking level and vice versa. As aforementioned, RT is expected to be positively associated with firm performance.

5.4. Outcome variables

In the literature, return on assets (ROA) and Tobin's Q (Q) are among the most commonly-used measures of firm performance where the former is accounting-based performance and the latter is stock market-based performance. ROA is a measure of backward-looking perspective because it reflects firm performance accomplished in the past, while Q can provide a forward-looking perspective of what the firm will perform in the future (Demsetz & Villalonga 2001; Hu & Izumida 2008). This paper also employs these two measures to proxy firm performance.

ROA

ROA is defined as the ratio of earnings before tax (EBT) over total assets of the firm. It should be noted that net profit is not used because it was the preferential policy during the initial stage of stock market development in Vietnam that newly-listed companies would be offered 100% exemption from corporate income tax for the first year of listing, plus 50% exemption over the next two years. As the year of listing is different among the listed companies in data sample, therefore, net profit will vary across firms. Hence, the use of EBT is employed to facilitate cross-sectional comparisons.

Q

Q is defined as the simplified Tobin's Q (Hu & Izumida 2008; Tian & Estrin 2008), which is calculated as which is calculated as ratio of the market value of common equity and preferred stock plus the book value of liabilities to the book value of total assets. The numerator of Q can be regarded as the value of the firm, and the dominator represents the replacement value of assets (Himmelberg, Hubbard & Palia 1999). As preferred stocks are rarely issued in Vietnam during the period of study, the value of preferred stocks in numerator are not present in the calculation of Q.

5.5. Control variables

The literature on the issue suggests that the following control variables can be employed in this paper.

1. Financial leverage (LEV): This ratio is calculated as total liabilities divided by total assets of a firm. As an important firm-specific characteristic, LEV is used to grasp the influence of financial leverage on agency costs, risk-taking and firm performance.
2. Firm size (SIZE): This variable is defined as the natural logarithm of total assets. There may be significant differences between large firms and small ones. SIZE is used to capture the influence of firm size on agency costs and firm performance.
3. Firm age (AGE): This variable is defined as the difference between the observed year and the initial year of listing on national stock exchanges. Hence, it shows for how many years a firm has been traded on stock exchanges. AGE is employed to account for the influence it may have on agency costs.

4. Firm growth (GROWTH): This proxy is calculated as the percentage of change in annual sales divided by one-year lagged sales (Hu & Izumida 2008). GROWTH is employed to account for the effect of firm growth on risk-taking.
5. Financial investment (FIN): This variable is defined as the sum of short-term and long-term financial investment scaled by total assets. Short-term financial investment include marketable securities, and other financial assets which are available for sale within one fiscal year; while long-term financial investment consists of capital investments in long-term projects such as equity holdings in unconsolidated companies. FIN is an important control variable in the context of Vietnam's stock market where it is believed that financial investment reflects risk-taking preference of listed firms.
6. Lagged firm performance (L.FP): This variable is defined as the one-year lagged value firm performance. L.FP is used as control variable in firm performance equations under the assumption that the current-year firm performance is influenced by the last-year firm performance.
7. Big-4 audit company (BIG4AUDIT): This is a dummy variable to control for the influence of audit quality offered by Big-4 international audit companies on risk-taking and firm performance. BIG4AUDIT takes a value of 1 if the firm's financial statements are audited by one of Big-4 international audit affiliates, and zero otherwise.

Table 1: Summary of variables

Denotation	Definition
Predictor variables	
L.GOV	The one-year lagged government ownership. It is the one-year lagged value of the ratio of shares owned by government over total common shares.
L.INSIDER	The one-year lagged insider ownership. It is the one-year lagged value of the ratio of shares owned by the board of directors over total common shares.
L.FOREIGN	The one-year lagged foreign ownership. It is the one-year lagged value of the ratio of shares owned by foreign investors over total common shares.
Mediator variables	
AC	Asset utilization ratio. It is calculated as annual sales divided by total assets.
RT	Corporate risk-taking. It is calculated as the standard deviation of market-adjusted stock returns, where stock returns are the natural logarithms of variance of daily closing prices of stocks.
Outcome variables	
ROA	Return on Assets. It is a proxy of accounting-based firm performance and calculated as earnings before tax (EBT) over total assets.
Q	A proxy of market-based firm performance. It is calculated as market value of equity and book value of liabilities over book value of assets.
Control variables	
LEV	Financial leverage. It is calculated as ratio of total liabilities over total assets. [1,2,3,4]
SIZE	Firm size. It is calculated as the natural logarithm of the book value of total assets. [1,2,4]
AGE	Years of listing on stock markets. It is calculated as the difference in the observed year and listed year of a firm. [2]
GROWTH	Firm growth. It is calculated as the percentage change in annual sales to one-year lagged sales. [3]
FIN	Financial investment. It is calculated as the ratio of total financial investment over total assets.[3]
L.FP	One-year lagged firm performance. It is the one-year lagged value of the ROA or Q. [1,4]
BIG4AUDIT	A dummy variable. It is equal to 1 if a firm's financial statements are audited by one of the Big-4 audit affiliates, and 0 otherwise. [1,4]

Note: [1,2,3,4] indicates control variables are used in Equation 1, 2, 3 and 4 respectively

5.6. Description of variables

Table 2 shows the summary of statistics of all main variables except dummy ones. Both current-year and one-year lagged ownership variables are presented. Government ownership (GOV) ranges from zero to 55.54% with the standard deviation of about 21.93% around the mean 28.92%. It can be seen that the standard deviation and average value of GOV are the largest in comparison with those of other ownership variables. The high values of government ownership suggest that the distribution of government variable is quite dispersed and that government is major shareholder in many firms.

Similarly, there is a large difference between the minimum and maximum level of insider ownership (INSIDER) at 0.1% and and 47.73%, respectively. The very small proportion of INSIDER at the lower end is applicable to some listed SOEs where the proportion of government ownership is large. Since only the private shareholding of these members are calculated as INSIDER, as defined earlier, the above-mentioned low ratio is justifiable.

The range of foreign ownership (FOREIGN) is from zero to 36.6%. This is because foreign investors do not invest in a number of Vietnam's listed companies; while they are not owning more than the restricted threshold of 49% of equity in the others. The mean and standard deviation of foreign ownership are smaller in comparison with government ownership and insider ownership, which are 8.999% and 11.07%, respectively.

The summary statistics of lagged ownership variables are almost similar to the original ones. The only exception is that the number of observations is less by 95 due to the lagging process of these variables.

Table 2: Summary statistics

Variable	Obs	Mean	Std.Dev.	Min	Max
GOV (%)	475	28.92	21.93	0	55.54
L.GOV (%)	380	29.09	21.88	0	55.54
INSIDER (%)	475	11.66	13.53	0.100	47.73
L.INSIDER (%)	380	11.73	13.64	0.100	47.73
FOREIGN (%)	475	8.999	11.07	0	36.60
L.FOREIGN (%)	380	8.982	11.10	0	36.60
AC	475	1.175	0.771	0.208	3.055
RT	475	2.983	0.767	1.874	4.523
ROA (%)	475	8.621	7.460	-1.734	25.86
L.ROA (%)	380	9.125	7.278	-1.734	25.86
Q	475	1.040	0.369	0.613	2.131
L.Q	380	1.073	0.376	0.613	2.131
LEV (%)	475	49.77	22.45	3.901	92.44
AGE (year)	475	3.411	1.924	0	10
SIZE	475	20.05	1.382	16.67	24.75
GROWTH (%)	475	20.89	58.45	-86.30	725.5
FIN (%)	475	11.84	15.25	0	91.87

There is a large difference in extreme values of agency cost variable (AC), which varies between 0.208 and 3.055. The standar deviation of AC is 0.771 around the mean of 1.175.

The variable of risk-taking (RISK) ranges from 1.874 to 4.523. The mean value of risk- taking at 2.983 is higher than that of agency costs, but the standard deviation of risk-taking is slightly smaller than that of AC, at 0.767.

In terms of firm performance variables, the standard deviation, the minimum and maxium value of ROA are 7.46%, minus 1.734% and 25.86%, respectively. The nagative value of ROA shows that some listed companies suffered from loss during the period of study. However, ROA is averaged at 8.621 %, suggesting that most of the listed companies in this sample are profitable. The lowest and highest value of Q is 0.613 and 2.131, indicating that the market value of some firms is smaller than their assets. On average, however, the mean value of Q is more than 1 times, at 1.040, and the standard deviation of Q of 0.369. Statistics for lagged ROA and lagged Q are almost similar to those of Q.

6. Results

6.1 Total effect of ownership structure on firm performance

The first step of causal-steps approach for the recursive model in this study is to estimate the total effects of ownership structure on firm performance in Equation 1. Since the GMM estimation is applied to this equation as mentioned earlier, a primary task is to classify endogenous, predetermined and exogenous variables.

Treatment of variables

All explanatory variables of interests, consisting of lagged government ownership, lagged insider ownership and lagged foreign ownership, are treated as endogenous assuming that they are correlated with the unobserved fixed effects of the firm. The Durbin-Wu-

Hausman test of endogeneity of these variables confirms this treatment (DWH statistic=32.69, p<0.01).

Besides, it is plausible to argue that financial leverage, firm size and lagged firm performance are not strictly exogenous since they can be affected by prior shocks or changes in firm-specific characteristics; for instance, firm performance is potentially pre-determined because firm value has persistence (Hu & Izumida 2008). Hence, financial leverage, firm size and lagged firm performance are treated as predetermined variables in dynamic GMM regression of Equation 1.

According to Roodman (2009), one assumption for the use of system GMM regression is that there is no correlation across individuals (firms) in the idiosyncratic disturbances; and the inclusion of time dummies can make this assumption more likely to hold. Therefore, year dummy variables are added to Equation 1. In addition, industry dummies are added to account for the industry-specific effects in GMM estimation (Tan 2009). As dummy variables, Big-4 audit, time dummies and industries dummies are treated as exogenous in Equation 1.

Empirical results

The GMM regression of Equation 1 for the determinants of accounting firm performance (ROA) and market firm performance (Q) are presented in the table below.

Table 3. Total effects of ownership structure on firm performance

	ROA	**Q**
L.GOV	0.135	-0.001
	(0.063)**	(0.003)
L.INSIDER	0.258	0.007
	(0.109)**	(0.004)*
L.FOREIGN	0.147	0.001
	(0.113)	(0.004)
LEV	-0.285	-0.001
	(0.058)***	(0.002)
SIZE	1.732	0.014
	(1.699)	(0.044)
BIG4AUDIT	-2.273	0.061
	(2.487)	(0.083)
L.ROA	0.425	
	(0.112)***	
L.Q		0.233
		(0.090)**
_cons	-30.046	0.372
	(45.450)	(1.130)
Observations	380	380
Number of instruments	50	68
Number of groups	95	95
AR(1)	-2.59	-1.97
[P-value]	(0.010)	(0.048)
AR(2)	-1.92	-1.37
[P-value]	(0.055)	(0.171)
Hansen test	22.48	63.35
[P-value]	(0.662)	(0.029)
Difference-in-Hansen test	18.28	14.88
[P-value]	(0.371)	(0.604)
F-statistics	7.51	18.10

Notes: *This table reports the results of dynamic system GMM regressions of both measures of firm performance in Equation 1. It examines how ROA and Q are affected by ownership structure and other control variables. Endogenous variables are lagged government ownership, lagged insider ownership, and lagged foreign ownership. Predetermined variables are financial leverage, firm age and lagged firm performance. Exogenous variables are Big4audit, time dummies and industry dummies. When ROA is regressed, in the transformed equation, the lags 2 of endogenous variables, and lags 1 of predetermined variables, are used as instruments. In the level equation, the first lags of differenced endogenous variables and the contemporaneous differenced predetermined variables are used as instruments. When Q is regressed, in the transformed equation, the lags 1 to lags 2 of endogenous variables, and the contemporaneous lags to lags 1 of predetermined variables are used as instruments. In the level equation, the lags 2 of the differenced endogenous variables and the first lags of differenced predetermined variables are used as instruments. The parameters are estimated using two-step procedures for dynamic system GMM. The robust standard errors using the Windmeijer correction for small-sample are included in parentheses. Estimators of year and industry dummies are excluded from the table for brevity.*

In ROA regression, the total effects of both lagged government ownership and lagged insider ownership are found to be significantly positive at the 5% level, where the degree of influence of latter on current-year ROA is stronger than that of the former. The coefficient of lagged foreign ownership is also positive, but it is not significant.

Among control variables of ROA, higher financial leverage is significantly associated with lower accounting firm performance at the 1% level. Firm size does not have any influence on current-year ROA. There is no significant difference between firms audited by Big-4 audit affiliates and the other firms. Lastly, the effect of lagged ROA is positive and significant at the 1% level.

In Q regression, it is found that lagged insider ownership has significant total effect on market firm performance at the 10% level. Lagged Q has significantly positive effect on current Q at the 1% level. The impacts of all other variables on Q are weak and insignificant.

Therefore, the ownership variables of interests in the next steps of regression will be lagged government ownership and lagged insider ownership because it is found that both of them have significant total effect on ROA and the latter has significant total effect on Q. The *first condition* for a mediating effect is met for lagged government ownership and lagged insider ownership in relationship with ROA, and for lagged insider ownership in relationship with Q.

6.2 Direct effect of ownership structure on agency costs

The second step for testing mediating effects in this paper is to regress agency costs on ownership structure and other controlling variables in Equation 2 to investigate whether the relationship between ownership structure on agency costs are significant.

Diagnostic tests

The multicollinearity test shows that the problem of collinearity among explanatory variables in this equation is not present since all the variance inflation factors (VIF) are less than 10 and the mean VIF value is 5.47. The Wooldridge test for serial correlation indicates that the first-order autocorrelation is existent in this equation because null hypothesis is rejected ($F = 29.334$, $p < 0.01$). In addition, the likelihood-ratio test for panel data shows that there is heteroscedasticity in error terms (the LR chi square value is 451.03, $p<0.01$).

The test for firm fixed-effect show that there is unobserved firm fixed effect in Equation 2 (F = 42.31, p < 0.01). The Hausman test also indicates that a fixed-effects model can be used (chi-square statistic=17.75, p<0.01). Thus, the Pesaran's (2004) CD test for cross-sectional dependence problem in fixed-effects model is conducted. The CD test indicates that there is the problem of cross-sectional dependence in Equation 2. The average absolute value of correlation among residuals is quite high at 0.563, corresponding to a strong rejection of the null hypothesis of no cross-sectional dependence. This result is further confirmed by the Frees's test.

To account for first-order autocorrelation, heteroskedasticity and cross-sectional dependence problems in Equation 2, Prais-Winsten regression with panel corrected standard errors (PCSE) is employed. Under this method, the standard errors based on large-T asymptotics assumption performs well in small panels, which are robust to heteroscedasticity, contemporaneously cross-sectional correlation and autocorrelation of type AR(1) (Hoechle 2007). Furthermore, it is assumed that the AR(1) parameters are specific to panels, i.e. autocorrelation structure is different across individual firms. Year dummies are included to account for common shocks influencing agency costs; and industry dummies are added to control for industry-specific effects.

Empirical results

The empirical results for the effects of ownership structure on utilization measure of agency costs are presented in the table below. To compare for robustness, the results of PCSE estimation with common AR(1) structure are also reported.

Table 4. Direct effects of ownership structure on agency costs (utilization ratio)

	Prais-Winsten regression (common AR1)	**Prais-Winsten regression** (firm-specific AR1)
	(1)	(2)
L.GOV	0.005	0.005
	(0.001)***	(0.001)***
L.INSIDER	0.005	0.006
	(0.003)*	(0.002)***
L.FOREIGN	0.006	0.007
	(0.004)	(0.005)
LEV	0.004	0.004
	(0.003)	(0.002)*
SIZE	-0.180	-0.189
	(0.019)***	(0.031)***
AGE	0.031	0.031
	(0.020)	(0.011)***
_cons	6.032	6.089
	(0.291)***	(0.505)***
R^2	0.47	0.84
Observations	380	308

Notes: *This table reports the results of Equation 2 for agency costs (asset utilization ratio). It examines how agency costs are affected by ownership structure and other control variables.*

Prais-Winsten estimators with common AR1 and firm-specific AR1 are presented in column 1 and column 2, respectively. Corrected robust standard errors are reported in parentheses. Estimators of year and industry dummies are excluded from the table for brevity.

The above table shows that two regression methods produce fairly similar results. As already noted, the ultimate results of Equation 2 are based on the standard errors under the assumption of firm-specific autocorrelation structure (in column 2), which is supported by higher R-squared.

Lagged government ownership and lagged insider ownership are consistently found to be significantly positively related to utilization measure of agency costs at the 1 percent level. The effect of lagged foreign ownership is not significant at all. Financial leverage and firm age are estimated to have significantly positive effect on agency costs at the 10 percent and 1 percent level respectively, whereas firm size has significantly negative association with agency costs at the 1 percent level.

At this step of regression, it is found that the direct path between lagged government ownership and agency costs are significant and robust. Lagged insider ownership has similar effect. An increase in the proportion of government and insider shareholdings in this year is followed by a higher asset utilization ratio or lower agency costs in the next year. Hence, the second condition of mediation is satisfied for the link between the above two ownership structure and the first mediator variable (agency costs).

6.3. Direct effect of ownership structure on risk-taking

The third step of testing mediation mechanism in the recursive model in this study is

the regression of risk-taking on ownership structure and other control variables in Equation 3.

Diagnostic tests

The test for multicollinearity is first conducted. The result shows that the problem of collinearity among explanatory variables in Equation 3 is not present since all the variance inflation factors (VIF) are less than 10 and the mean VIF value is 5.26. Like Equation 2, serial correlation test is conducted. The result indicates that the first-order autocorrelation is not present in Equation 3 (F statistic = 0.394, $p > 0.5$). The likelihood-ratio test for hetoroskedasticity rejects the null hypothesis that the error terms are homoskedastic (LR chi square value is 148.41, $p < 0.1$).

The test for fixed-effect shows that there is unobserved firm fixed effect (F-statistic = 3.55, $p < 0.01$). The Hausman test also indicates that a fixed-effects model is preferred (chi-square statistic = 21.72, $p<0.01$). Hence, the Pesaran's (2004) CD test for cross-sectional dependence in fixed-effect model is performed for Equation 3. Like Equation 2, the result shows that there is the problem of cross-sectional dependence in Equation 3. The null hypothesis of no cross sectional dependence is strongly rejected at 1% significance level; and the average absolute value of correlation among residuals is high at 0.500. However, the Frees' test does not confirms this result since the Frees' statistic is smaller than the critical value at $\alpha = 0.10$. Even though, since the average absolute value of the off-diagonal elements in CD test is very high (0.5), there is evidence suggesting that the cross-sectional dependence is potential in Equation 3.

As a result, it can be said that Equation 3 is involved with unobserved firm fixed effect, heteroskedasticity and probably cross-sectional dependence; and hence PCSE approach is used with OLS regression instead of Prais-Winsten regression due to the absence of autocorrelation. Year and industry dummies are included to account for common shocks and industry-specific effects respectively. Since the cross-sectional dependence problem is not quite certain in Equation 3, two types of standard errors under PCSE method will be reported to make a comparison: 1) standard errors robust to heteroscedasticiy only, and (2) standard errors robust to both heteroscedasticiy and cross-sectional dependence. The ultimate results are based on the latter.

Empirical results

Empirical results for Equation 3 for the direct effect of lagged ownership structure on risk-taking are presented in the table below.

Table 5. Direct effect of ownership structure on risk-taking

	OLS regression (het.only)	**OLS regression**
	(1)	(2)
L.GOV	0.003	0.003
	(0.002)	(0.002)
L.INSIDER	0.006	0.006
	(0.003)*	(0.003)*
L.FOREIGN	-0.007	-0.007
	(0.004)*	(0.004)*
LEV	0.002	0.002
	(0.002)	(0.001)***
BIG4AUDIT	-0.425	-0.425
	(0.097)***	(0.101)***
GROWTH	0.001	0.001
	(0.001)	(0.001)
FIN	-0.000	-0.000
	(0.002)	(0.002)
_cons	2.847	2.847
	(0.139)***	(0.167)***

R^2	0.31	0.31
Observations	380	380

Notes: This table reports the results of Equation 3 for corporate risk-taking (market-adjusted risk). It examines how risk-taking is affected by ownership structure and other control variables. Linear regression with heteroskedastic panels corrected standard errors and linear regression with correlated panels corrected standard errors are reported in column 1 and column 2 respectively. Corrected robust standard errors are reported in parentheses. Estimators of year and industry dummies are excluded from the table for brevity.

The estimators in column 1 and column 2 are almost identical. It demonstrates that the cross-sectional dependence problem is not serious in Equation 3. As argued earlier, the ultimate results are based on column 3 where both hetorescedasticiy and cross-sectional dependence problems are controlled.

Lagged government ownership is statistically not significant related to risk-taking. By contrast, both lagged insider ownership and lagged foreign ownership are found to have significant relation with risk-taking at the 10 percent level; where the effect of the former is positive and that of the latter is negative.

The higher level of financial leverage is estimated to be related to the higher level of risk-taking, which is significant at the 1 percent level. The coefficient on Big-4 auditing is negative, suggesting that firms audited by Big-4 auditing affiliates have lower risk than the others. Lastly, it is found that corporate risk-taking is not affected by a change in firm growth and financial investment.

At the third step of regression, the path between lagged government ownership and risk-taking is not significant. However, the path between the other variable of interest, lagged insider ownership, and risk-taking is established. Although it appears that the total effect of lagged foreign ownership does not exist to be mediated as found in Equation 1, there is evidence that lagged foreign ownership is significantly related to risk-taking. Hence, the second condition for risk-taking to be a mediator in the links between lagged insider ownership, and perhaps lagged foreign ownership, and firm performance is met.

6.4. *Direct effect of ownership structure on firm performance controlling for agency costs and risk-taking*

The final step of causal-steps regression for recursive model is the estimation of

Equation 4, which is revised from Equation 1 to include the effects of agency costs and risk- taking. This equation is needed to estimate the direct effects of ownership structure on firm performance when mediator variables are controlled, as well as the direct effect of mediator variables on firm performance.

In Equation 4, the explanatory variables of interests are ownership structure variables, agency costs and risk-taking. Consistent with Equation 1, ownership structure variables are treated as endogenous ones; and predetermined variables include financial leverage, firm size and lagged firm performance. Big4-audit dummy, year and industry dummies are treated as exogenous variables. Two newly-added variables, agency costs and risk-taking, are also treated as predetermined variables in Equation 4 because in this research, current agency costs and current risk-taking are conceptualized as being affected by past ownership structure.

The empirical results of Equation 4 are presented in column 2 of the table below. To make a convenient comparison, the previous results of Equation 1 are added in the column 1 of this table.

Table 6. Direct effect of ownership structure on firm performance before and after adjusting for agency costs and risk-taking

	ROA		**Q**	
	(1)	(2)	(1)	(2)
AC		4.887		0.110
		(1.993)**		(0.063)*
RT		0.291		0.073
		(0.557)		(0.022)***
L.GOV	**0.135**	**0.056**	-0.001	-0.003
	(0.063)**	**(0.051)**	(0.003)	(0.003)
L.INSIDER	**0.258**	**0.222**	**0.007**	**0.001**
	(0.109)**	**(0.092)****	**(0.004)***	**(0.005)**
L.FOREIGN	0.147	0.023	0.001	-0.003
	(0.113)	(0.083)	(0.004)	(0.004)
LEV	-0.285	-0.226	-0.001	-0.002
	(0.058)***	(0.038)***	(0.002)	(0.002)
SIZE	1.732	1.358	0.014	0.060
	(1.699)	(0.954)	(0.044)	(0.042)
BIG4AUDIT	-2.273	-1.261	0.061	0.094
	(2.487)	(1.548)	(0.083)	(0.061)
L.ROA	0.425	0.334		
	(0.112)***	(0.106)***		
L.Q			0.233	0.251
			(0.090)**	(0.068)***
_cons	-30.046	-20.757	0.372	-0.050
	(45.450)	(24.869)	(1.130)	(0.898)
Observations	380	380	380	380
Number of instruments	50	64	68	88
Number of groups	95	95	95	95
AR(1)	-2.59	-2.81	-1.97	-2.41

[P-value]	(0.010)	(0.005)	(0.048)	(0.016)
AR(2)	-1.92	-1.82	-1.37	-1.07
[P-value]	(0.055)	(0.069)	(0.171)	(0.287)
Hansen test	22.48	26.98	63.35	75.45
[P-value]	(0.662)	(0.909)	(0.029)	(0.117)
Difference-in-Hansen test	18.28	17.49	14.88	24.36
[P-value]	(0.371)	(0.863)	(0.604)	(0.499)
F-statistics	7.51	22.84	18.10	18.86
[P-value]	(0.000)	(0.000)	(0.000)	(0.000)
Time effects	Included	Included	Included	Included
Industry effects	Included	Included	Included	Included

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Notes: *This table reports the results of dynamic system GMM regressions of firm performance in Equation 4 after controlling for the effects of agency costs and risk-taking (column 2). It examines how firm performance is directly affected by ownership structure, agency costs, risk-taking, and other control variables. The results of Equation 1 are also re- represented in column 1 to compare with Equation 4. Endogenous variables are lagged government ownership, lagged insider ownership, and lagged foreign ownership. Predetermined variables are agency costs, risk-taking, financial leverage, firm size and lagged firm performance. Exogenous variables are Big4audit, time dummies and industry dummies. When ROA is regressed, in the transformed equation, the lags 2 of endogenous variables and lags 1 of predetermined variables are used as instruments. In the level equation, the first lags of differenced endogenous variables and the contemporaneous differenced predetermined variables are used as instruments. When Q is regressed, in the transformed equation, the lags 1 to lags 2 of endogenous variables, and the contemporaneous lags to lags 1 of predetermined variables are used as instruments. In the level equation, the lags 2 of the differenced endogenous variables and the first lags of differenced predetermined variables are used as instruments. The parameters are estimated using two-step procedures for dynamic system GMM. The robust standard errors using the Windmeijer correction for small-sample are included in parentheses.*

In regression with ROA, agency costs are found to have a significantly positive relation with ROA at the 5% level: an increase by 1 in asset utilization ratio is associated with nearly 0.049% increase in ROA of the same year. Hence, the third condition for potential mediation effect of agency costs is met. However, the third condition for risk-taking is not met, suggesting that risk-taking does not meditate the effect of ownership structure on ROA.

As stated earlier, the fourth condition for the mediated effect is that the direct effects of predictor variables on the outcome variables are reduced or no longer significant when mediator variables are controlled for. The results in column 2 of ROA regression show that when agency costs and risk-taking are added to Equation 4, the direct positive effects of lagged government ownership becomes insignificant while that of lagged insider ownership is still significant but smaller. Taken together, there is evidence that agency costs fully mediate the effect of lagged government ownership on firm performance while partially mediate the effect of lagged insider ownership on firm performance.

In regression with Q, it is found that both mediator variables have quite strongly and significantly positive association with Q. An increase by 1 in utilization ratio and risk-taking is associated with an increase of 0.1 and 0.7 in Q, respectively. The direct effect of lagged insider ownership on Q found in Equation 1 becomes quite weak and insignificant when agency costs and risk-taking are added. This is evidence of a full mediating effect of agency costs on lagged insider ownership-firm performance relationship; meanwhile, risk-taking may mediate the effect of lagged foreign ownership on Q.

The explaining powers of all other controlling variables are not changed in both columns. Accordingly, accounting firm performance ROA is negatively affected by financial leverage and positively by lagged ROA; and Q is positively affected by lagged Q.

In short, it can be concluded that there is a full agency costs-mediated relationship between lagged government ownership and ROA, partial agency costs-mediated relationship between lagged insider ownership and ROA, full agency costs-mediated relationship between lagged insider ownership and Q, and potential risk taking-mediated relationship between lagged foreign ownership and Q.

6.5. ***Robustness tests***

Several additional regressions are conducted to check for robustness of the coefficients

of all variables of interest as the followings:

1) Using another measure of accounting firm performance, that is return on equity (ROE), and re-testing Equation 1 and Equation 4. The results show that the total effects of lagged government ownership and lagged insider ownership remain significantly positive to ROE; and the direct effects of agency costs and risk-taking on firm performance are similar to those obtained with ROA.

2) Using another measure of agency costs and re-testing Equation 2 and Equation 4.

Following Chen, X and Yur-Austin (2007), adjusted short-term debt ratio (AC2) is employed as an alternative proxy of agency costs, which is calculated as the market value of equity divided by book value of equity and multiplied by short-term debt ratio. It indicates the likelihood of engaging in underinvestment, ‘which is a situation where a firm foregoes positive net present value projects’. A high value of AC2 means a low likelihood of underinvestment; hence this ratio is expected to have similar signs as asset utilization ratio. The results of Equation 2 using AC2 shows that lagged government ownership and lagged insider ownership are significantly associated with AC2, which are the same as those obtained with utilization ratio. When Equation 4 is re-tested using AC2, consistent results are obtained: AC2 is significantly positively related to ROA and Q.

3) Removing insignificant control variables and re-testing Equation 3. As reported Table 5, firm growth and financial investment do not significantly explain risk- taking; hence they are dropped from Equation 3. The re-testing results do not change in terms of the significantly positive and negative effect of lagged insider ownership and lagged firm performance on risk-taking, respectively.

In short, the above additional tests indicate that the effects among variables of interest, namely ownership structure, agency costs, risk-taking and firm performance are robust.

7. Discussion and Conclusions

As for the potential mediating role of agency costs, it is well established that agency

costs emerge as a consequence of the agency conflicts within firms, and a certain structure of ownership can be utilized to reduce the agency problems (Agrawal & Knoeber 1996; Jensen & Meckling 1976). Hence, prior studies on the issues suggests that there are robust links between equity ownership and agency costs, and in turn, agency costs is related to firm performance (Ang, Cole & Lin 2000; Davidson & Singh 2003).

As expected, the results in this study suggest that agency costs fully mediate the positive effect of lagged government ownership on ROA, partially and fully mediate the positive effect of lagged insider ownership on ROA and Tobin's Q respectively. The empirical evidence is consistent with Le and Buck (2011) in terms of a positive contribution of government ownership via agency costs to improving performance of listed firms. Thus, a universally negative view of government ownership is challenged.

The results for insider ownership support the 'alignment of interest effect' (Jensen & Meckling 1976; Morck, Shleifer & Vishny 1988; Shleifer & Vishny 2008). In particular, the positive effects of previous-year insider ownership on current-year ROA occur via both indirect and direct channel. In the context of transitional and merging countries like Vietnam, therefore, government ownership and insider ownership can be employed as corporate governance mechanisms to mitigate the agency conflicts within listed firms and hence to enhance firm performance.

In terms of the second channel, corporate risk-taking, this research does not find evidence of the link between government ownership and risk-taking. However, the evidence for insider ownership and risk-taking is as expected and opposite to the assumption of 'risk-averse preference' of insider ownership (Himmelberg, Hubbard & Palia 1999). Specifically, insider shareholders in Vietnamese stock markets tend to prefer and take risks. The 'higher risk-higher return' assumption (Drever, Stanton & McGowan 2007;

Gordon, Loeb & Tseng 2009) is not supported for the relation between risk-taking and ROA, but it is confirmed for the relation between risk-taking and Q.

Foreign shareholders are found to be risk-adverse investors. The tendency to avoid risks of foreign investors may be due to their short-term view of investment in frontier stock markets, particularly when they do not have controlling stakes in the firm. Since the higher level of risk-taking in this year is estimated to be followed by an increase in Tobin's Q in next year, therefore, it is likely that risk-taking mediates the negative effect of foreign ownership on market performance of listed firms. It should be noted that this mediating effect of risk-taking is not certain because the total effect of foreign ownership on firm performance is not significant to be mediated as reported at step 1 of regression (Equation 1). At least, it can be said there are signs of the negative impact of foreign ownership in Vietnam's stock market and this is consistent with the evidence found in Phung and Le (2013), suggesting that foreign investors do not contribute to improving firm performance due to ownership restriction.

To conclude, while prior literature almost ignores the indirect channels in ownership structure-firm performance relationship, this paper provides evidence to confirm that agency cost and risk-taking are two 'missing links' in this association, and the mediation effect of agency costs is stronger than that of risk-taking. By adopting mediation approach, this paper sheds lights on the mechanisms by which government ownership, insider ownership and foreign ownership can affect firm performance. Hence, it is recommended that the intervening role of agency costs and risk-taking in equity ownership-firm performance relation be accounted for in further research on the issue. Research on Vietnam's stock markets can also benefit from the estimated influence of control variables employed in this paper.

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A NEW PARADIGM INHUMAN RESOURCE MANAGEMENT PRACTICES IN VIETNAM

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Abstract
The study explores the scales of human resource management (HRM) practices in the context of Vietnam. The study investigates the relationships between HRM practices and business performance. Data were collected from 388 companies, using a questionnaire survey. The research showed that HRM practices in Vietnam can be measured through 7 dimensions with tested construct validity. Except four traditional functions of HRM such as recruitment-selection, training-development, performance appraisal, and compensation, HRM practices in Vietnamese context involve three more advanced functions: leading change, motivation and talent management. This result implies that HRM practices in Vietnam are following the world trend in HRM practices. It indicates that HRM practices in Vietnam are beyond traditional functions of HR department and closer to the change agent role and hand-in-hand with line managers in talent management. Another finding is about the important role of HRM practices the firm's business performance. Particularly, HRM practices can explain 43% of variation in business performance.

Keywords HRM practices, business performance, Vietnam.

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Influence of Managerial Power and Types of Corporate Governance on Trade Credit Use

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Abstract
The high ranking manager in a corporation is the major financial decision-maker; therefore the attitude of this manager toward the corporation's debtors influences the amount of the firm's trade credit. This research investigates the influence of the high ranking manager's power and the use firm's trade credit (i.e., accounts payable and accounts receivable).The sample is collected from the listed companies in Taiwan Stock Exchange OTC market between 2005 and 2011. Managers' power is divided into four categories and four types of governance to analyze the managerial index. The research results show that different high ranking managers' power has a different effect on corporations' final trade credit. Managers' power indirectly affects the rights of stockowners and increases turnover and profit through trade credit. This shows that the attitude of the high ranking manager affects trade credit decisions, as well as cost control and debtor relationship maintenance.

Keywords *trade credit, managers' power, governance type.*

I. Introduction

Company bonds and bank loans have always been the main financing channels for domestically- listed and OTC companies. However, apart from these channels, companies delay paying creditors based on the previous trade credit. This is known as trade credit, and since trade credit is often accompanied by early payment deduction benefit, it has a dramatic influence on the company's profit. Especially in recent years, with enhanced economic prosperity, many domestic corporations are finding it more difficult to obtain financing, which leads to many good credit companies providing and using trade credit to lower their sales cost and delay payment. Poor credit or poorly-operated corporations that find it more difficult to borrow from the bank can use trade credit to increase their cash flow and even maintain a continued partnership with suppliers.

The supply of trade credit is short-term credit suppliers provide to purchasers. In other words, the goods are delivered to the purchaser first and the supplier agrees that the purchaser can make payment later. With the development of the economy, corporations emphasize self-credit, so that the trust between them increases. Trade credit has gradually been accepted and used in order to more actively trade and maintain a good relationship, since it lowers the financing costs of corporations compared to a bank loan. Elliehausen and Wolken (1993) explain that trade credit accounts for 20% of non-financial corporation debt and 35% of total assets; moreover, Rajan and Zingales (1995) point out that trade credit is 17.8% of the total assets of American companies. Furthermore, Kohler et al. (2000) also mention that, in British companies, trade credit reaches as high as 55% of the sales amount. According to the above authors, there is a certain relationship between trade credit and the operational performance of companies.

An extension of trade credit acts as a financing tool (Ferris, 1981). Smaller and newer companies in the market are unlikely to obtain a loan from the bank, and the ratio of trade credit rises at this point. Further research shows that the demanding party views trade credit as being a financing tool with zero interest and discounts if the payment is settled within the given period. This has more advantages than bank financing. In the perfectly competitive market theory, a company can have lower interest rates if it mortgages its goods to the financial organization; however, in actual trading, the company tends to use trade credit because it can obtain more information about competitors with lower supervising costs. A company can understand the operation of its clients from the number and time the order was placed with the information asymmetry theory. Therefore, it knows which clients need to be followed up. This information would be relatively expensive if it had to be acquired from a financial organization.

Pringle (1974) maintains that a company uses trade credit like a flow reserve, which has a preventative function. Trade credit can turn future uncertain purchasing income into a predictable future cash flow; therefore, when having a flexible future cash flow, a company can make better use of the excess capital. Profit maximization companies have a better chance than unstable companies of obtaining funds from financial organizations (Schwartz, 1974). Therefore, for this reason, companies with better conditions and profits are more willing to provide trade credit as a financing tool for smaller and newer companies. In this way, the pressure of finding financing resources of many small companies and factories is resolved and this increases the overall social productivity and efficiency.

Apart from performance and salary contracts, power also affects the decision-making of the Chief Executive (CEO) in terms of corporate financing and trade credit when developing important strategies such as investment and financing. Liu & Jiraporn (2010) believe that, in a risk aversion hypothesis and reputation hypothesis, in order to consider their own reputations, managers tended to make decisions in favor of debtors and stockholders when facing financial risk that cannot be predicted and dispersed. However, in a self-interest hypothesis and lack of opinion diversification hypothesis, more powerful managers will pursue their self-interest and sacrifice that of stockholders and debtors; or in the absence of an open major decision-making process, managers would take a decision that might further harm the interests of debtors or make a wrong decision. Therefore, managers with different levels of power will have different effects on the value of their corporations.

In addition, the operational models of corporations are different in eastern and western countries. In western countries, companies adopt a professional management operation, while in eastern countries; most companies are run by one family or a few families. In the research of Astrachan and Shanker (2003), when appointing a CEO, Asian family businesses are more likely to inherit the position than in western countries. Moreover, the CEO has a more central decision-making power in Asian corporations than in western ones, and the company structure tends to be more centralized. This means that Asian corporations tend to appoint an heir or CEO from the family, and he holds a certain power, which means that many important decisions are made for his convenience. In view of this, the research has an empirical platform that is different from western culture in order to understand the power of a CEO and categorize the type of governance to observe the influence of corporate performance and value. Leuz, Nanda & Wysocki (2003) also propose that, when power is centered in the hands of high ranking staff or stockholders, they have the material influencing power and can manipulate the accuracy of the earnings and financial statements so that the debtors do not know the actual cash flow information and bear a higher risk of bankruptcy.

Moreover, the relationship between high ranking managers and corporation performance is supported by previous literature. For example, previous literature explains that the factors that influence corporate performance are company characteristics, industry characteristics, and market characteristics (Faulkender, 2005); however, the development, decision-making and strategic execution are decided by managers. Therefore, the behavior and decisions made by corporate managers is one of the main factors of the final results and performance. Bebchuk, Cohen & Ferrell (2009) propose that the more centralized power high ranking managers have in terms of decision-making, the more influence they have on company performance, which causes a decrease in the corporation's value. Since the corporation's value decides the weighted average fortune variable of the stockholders and debtors, the power of the CEO also affects their rights.

In recent years, listed and OTC companies that are bound by government regulations and investment acts, have placed more value on protecting the interests of stockholders. However, with more information, it is easy to reflect the company's current situation in the stock or bond markets. Therefore, if the CEO controls the sales cost, turnover, sales amount, or trade credit, he can exploit the interests of the debtors and stockholders by transferring their assets to himself. This illustrates how the power of the CEO influences a corporation's trade credit and affects the operation and profits without stockholders being aware.

When making financing and trade credit decisions, the strength of the power influencing the interests of the debtors can be divided into a risk aversion hypothesis and reputation hypothesis, which favors their interests, and a self-interest hypothesis and lack of opinion diversification hypothesis, which contravenes their interests. According to Liu & Jiraporn (2010), the decision-making of a high ranking manager with greater power indicates a lack of diversified opinion hypothesis so that the debt capital cost of the company would be higher. In contrast, if a high ranking manager has weaker power, he tends to maintain the interests of the debtors and stockholders under the influence of risk aversion or market reputation when using trade credit to avoid the likelihood of bankruptcy.

The power index of the manager, namely, structural power, ownership power, expert power, or prestigious power, should be structured to understand the influence of the power of the CEO in domestic corporations in terms of corporation trade credit. As mentioned in the previous paragraphs, this is the obvious difference between the operation of western and Asian corporations, and the type of corporate governance will be discussed later in the paper. Therefore, the objectives of this research are as follows:

I. To determine the influence of the power of the CEO on corporate trade credit.

II. To determine the influence of the type of corporate governance on corporate trade credit.

II. Research method

The purpose of the research is to discuss the influence of high ranking managers on the supply and demand of corporate trade credit. The aim is to understand whether investors' decision of the power structure of the high ranking manager and the supply and demand of trade credit reflects the corporation's market value. In order to achieve this aim and make a contribution, a high ranking manager power index is established, together with the theory and empirical base of trade credit and the category of corporate governance by discussing them from the perspective of the literature and analyzing them with the appropriate statistical variables and methods as empirical evidence of the conclusion and suggestions. The process, methods, and steps of the empirical research are described below.

1. The measurement of trade credit parameters

Accounts receivable (AR) and accounts payable (AP) are used as the supply and demand of trade credit, which mainly occurs during the trading process. Therefore, the amount of the trade credit provided is influenced by the turnover.

(I) Sales (S) is the control variable of trade credit supply. In contrast, sales cost (C) is the control variable in a trade credit demand model. A change in operation will cause a change in sales (ΔS) and sales cost (ΔC). In terms of the trade credit supply, if the sales change more, it means that the sale of products increases so that the accounts receivable increases. Therefore, a change in sales is positively related to accounts receivable; in contrast, when discussing trade credit demand, a change in sales cost should positively relate to accounts payable.

(II) Company scale (lnA): The logarithm of the total assets of the company is taken to measure its scale. From the financing point of view, big companies are more capable of providing more TC; on the other hand, the quality confirmation theory suggests that smaller companies need more TC than big companies to ensure product quality. However, in terms of the willingness of TC providers, big companies tend to have a better reputation and when they have more assets; a good reputation will bring more investment opportunities. Therefore, if a small company has a greater demand for TC but has yet to establish a reputation; it is unlikely to have this investment opportunity.

(III) Inventory (I): Inventory and accounts receivable are current assets in accounting, and the two are substitutable from a financial perspective. If a company has high inventory, it must lower the supply of TC. From another angle, the inventory is the company' s asset. Therefore, when the inventory is high, it will be used as collateral for the TC supplier. At this point, a company with a high inventory should increase its demand for TC. In summary, a high inventory company will increase its TC demand and decrease its TC supply. In other words, inventory and accounts receivable are negatively related and positively related to accounts payable.

(IV) Retained earnings (RE): When a company has more retained earnings, it has more assets. This means it has more ability to provide more TC. The TC provider will also consider the internal funds of the TC demander. Therefore, a company with more retained earnings is more likely to be provided with TC. In short, retained earnings have a positive effect on the supply and demand of TC.

2. The measurement of managers' power index

The structural power index of high ranking managers is established by the definition of Liu & Jiraporn (2010). This research defines a high ranking manager as the General Manager of a corporation. If a corporation has no General Manager, it is the CEO and Chief Operating Officer in that order. If none of these exist, it is defined as the person in the highest decision-making position. The managers' power indices are shown below.

(1) CEO Ownership (CO): This means the share of the high ranking management team's total issuing shares (percentage).

(2) CEO Expertise (CE): This is the previous position taken by the General Manager. If he participates in the high management team, including this one, the score is one. If he has no managerial position, the score is at least one.

(3) CEO Reputation (CR): This means whether or not the General Manager has any other managerial position or a seat on the Board. Each position adds one point. If he has no other position, the score is zero.

(4) CEO Pay Slice (CPS): This is the salary of the General Manager in the high management team. The salary announced in the annual report of each company prevails, excluding other income.

3. Governance category

In this paper, the governance category is divided as the following four types:

(1) Family (F): At least two family members have a position on the Board or have reached the standard of manager (manager and above) as revealed in the annual report. Second-tier relatives are generally the standard in the annual report. The Director of the Board and General Manager are family members with more than 50% of the seats on the Board. A family corporation often has relative or absolute share advantages; the seats on the Board are an absolute advantage. This research divides corporate governance as shown below.

(2) Association (A): Run by different families. This type of corporation has more dispersed stock rights. No single group has the absolute advantage; therefore, most decisions must have the consent of stockholders and the Board is formed of more than 2 groups.

(3) Government (G): In 1989, the Executive Yuan established a Privatization of state businesses promotion team" to release shares and sell assets to lower the position of the government. Although the government owns less than 50% shares, it has substantial controlling power of the Board and the appointment of personnel.

(4) Manager (M): This mainly applies to the electronic industry which hires managers with a professional background and capability as members of the Board. They even participate in the operation or occupy important positions to create profits for the company.

4. Multiple regression model analysis

The purpose of the research is to discuss whether or not the power of managers and the type of governance of a company have different influences on the usage of TC. According to research by Choi and Kim (2005), accounts receivable (AR) is used as the dependent variable in the TC supply model and accounts payable (AP) as the dependent variable in the TC demand model. In the process of TC, the amount of TC is closely related to the company's scale and annual trading figures. Therefore, sales are taken as the operational variable in the TC supply model and cost of sales is the operational variable in the TC demand model.

This research basically emphasizes the influence of TC on the power index of high ranking managers; therefore, the independent variables are selected in accordance with Long (1993), Petersen and Rajan (1977), Choi and Kim (2005). Capturing the explanatory variable in TC should satisfy the influential variables mentioned in the TC theory. Therefore, defined from the previously mentioned TC, the operational variable is the changing amount of sales, the changing amount of cost of sales, the inventory, and retained earnings to explain the TC situation. The regression model of TC demand is defined as:

$$\boldsymbol{AP_i} = \alpha_0 + \alpha \ \ln \boldsymbol{A} + \alpha_2 \Delta \boldsymbol{C_i} + \alpha_3 \boldsymbol{I_i} + \alpha_4 \boldsymbol{RE_i} + \varepsilon_i \qquad (1)$$

The regression model of TC supply:

$$\boldsymbol{AR_i} = \alpha_0 + \alpha \ \ln \boldsymbol{A} + \alpha_2 \Delta \boldsymbol{S_i} + \alpha_3 \boldsymbol{I_i} + \alpha_4 \boldsymbol{RE_i} + \varepsilon_i \qquad (2)$$

In other articles that discuss TC, which mainly define it as short term financing or cash flow, quarterly information was used as the basis for analysis. This is because quarterly data was sufficient to assess the usage of the TC of the corporation in each phase. However, current research focuses on the influence of high ranking managers on TC; therefore, annual information was used in order to more precisely observe the power of the manager to influence TC for all manager indices and the same time standard of TC. Thus, the related variables in TC research are acquired from annual data in the annual report, and in this way, the managers' power index is combined. Therefore, unlike the sales income and cost of sales, which are one quarter late, our model is one year late. The manager model for TC demand is:

$$AP_i = \alpha_0 + \alpha \ \ln A + \alpha_2 \Delta C_i + \alpha_3 I_i + \alpha_4 RE_i + \alpha_5 CO_i + \alpha_6 CE_i + \alpha_7 CR_i + \alpha_8 CPS_i + \varepsilon_i \qquad (3)$$

The manager model for TC supply is:

$$AR_i = \alpha_0 + \alpha \ \ln A + \alpha_2 \Delta S_i + \alpha_3 I_i + \alpha_4 RE_i + \alpha_5 CO_i + \alpha_6 CE_i + \alpha_7 CR_i + \alpha_8 CPS_i + \varepsilon_i \qquad (4)$$

Finally, the governance type of Asian companies is different from that of western countries. Besides discussing the manager indices, the method of forming high ranking managers is further investigated to discuss TC from another aspect. The establishment of a corporate governance model still uses the important variables for TC, namely, the changing amount of the sales, the changing amount of cost of sales, the inventory, and retained earnings. Then, the corporation governance type is divided into four different categories, namely, association, government, manager, and family. These four categories have three dummy variables and then the two types with the lowest proportion are set as control groups for cross-reference. Thus, there will be two other models. The type of corporate governance in the TC supply model is:

$$AR_i = \alpha_0 + \alpha_1 \ln A + \alpha_2 \Delta S_i + \alpha_3 I_i + \alpha_4 RE_i + \alpha_5 CO_i + \alpha_6 CE_i + \alpha_7 CR_i + \alpha_8 CPS_i + \alpha_8 DJ + \varepsilon_i, J = 1,2,3 \qquad (5)$$

The type of corporate governance in the TC demand model is:

$$AP_i = \alpha_0 + \alpha_1 \ln A + \alpha_2 \Delta C_i + \alpha_3 I_i + \alpha_4 RE_i + \alpha_5 CO_i + \alpha_6 CE_i + \alpha_7 CR_i + \alpha_8 CPS_i + \alpha_8 DJ + \varepsilon_i, J = 1,2,3 \qquad (6)$$

III. Empirical results and analysis

1. Descriptive statistics

The study selected domestic listed and OTC companies from 2005 to 2011, excluding financial businesses, insurance, logistics, and travel industries that mainly collect cash, to study their supply and demand of TC. There are 7466 effective samples.

CO, CE, CE, and CPS are the highest ranking management power indices, and the variable establishment was mentioned in the previous section. It is worth noting that the prestigious power in the high ranking management power indices is in accordance with the position or service on the Board, supervising Board, consultant, and director of other companies. Therefore, the power value of high rank managers of different corporations greatly differs from that announced on the financial statement and further makes the standard deviation higher than other management variables.

Finally, the descriptive statistical analysis of accounts receivable and accounts payable, lnA, △S, △C, RE, and I are shown in the table as the supply and demand of corporation TC, the change in sales, the change in the cost of sales, the current retained earnings, and the inventory respectively. The four dummy variables are the corporate governance types. It is worth noting that the average value of family governance in Taiwanese corporations is 0.62, which means that more than 60% of them are governed by family members.

2. Multiple regression analysis

This research seeks to determine the influence of prominent high ranking managers on TC. This is consistent with previous literature (Finkelstein, 1992; Bebchuk et al., 2009), which points out that the proportion of the total salary of high ranking managers in the operational team explains the effect of structural power on the corporation's performance. However, the negative relationship between the salary of high ranking managers and the supply of TC means that when high ranking managers have more salary power, this will cause a decrease of corporate TC whether from the supply or demand perspective. Finally, the TC position will be less. It has a positive relationship with prestigious power and expert power, which means that when high ranking managers have more power in these two aspects, corporate TC increases. This shows that the prestigious and expert power of high ranking managers positively help TC. The ownership power of professional managers shows no prominent results.

Hill and Wayne (2012) point out in their article that the increment of corporate TC supply helps to increase the reward of corporate debtors. This means that accounts receivable and the reward of debtors have a positive relationship. When high ranking managers have more shares, they have more power in the final pay-off and surplus distribution. In the TC supply model, it is found that, when high ranking managers possess company shares, TC is relatively positive but not prominent. This means that, when company shares increase, high ranking managers have an effect on TC, but in the agency theory, this is an agency issue. The main cause of the agency issue is the final distribution rights of self-interest and the company receiving a surplus, leading to less prominent TC usage. In the previous agency theory, if a high ranking manager makes decisions to harm the interests of clients and favor his own interests in an effective market, he must not have a good position at the next stage. Therefore, in the reputation index, it was found that, when a high ranking manager has a higher reputation, he can make a TC supply which favors the debtors or clients so that he can have a better managerial position in the future. According to the reputation hypothesis, when a manager builds a certain credit relationship with outsiders or banks and corporations, he will be careful not to harm the interests of investors and debtors.

The salary index of high ranking managers shows that there is a prominent negative relationship, whether in the supply or demand of TC. When establishing the salary index, it means that the higher the high ranking manager's salary is in the team, the more powerful his decision-making. In the lack of opinion diversification hypothesis, a group decision helps the diversification and diversity of the corporation; however, when the decision-making power is more centralized, more wrong decisions are possible, which will further harm the investment value of the corporation's debtors and clients. Further investigation found that, in the agency theory, if a corporation attracts funds from outside investors by issuing equities, the agency of the corporation may harm the interests of the stockholders by increasing self-interest. This theory is different from the TC situation of the manager in the model.

Having discussed the power indices of high ranking managers, the management indices are retained in the following models. These are substituted with the dummy variables of the types of corporate governance for a regression test. It was found from two control groups that the manager type was the one that most used TC; the association type and family type had no prominent advantages or disadvantages, and the government type was the one that least favored TC. The results are prominently related to the above hypothesis. In terms of the association type, more people in the decision-making team have less centralized issues, which mean that they tend not to make the wrong decisions. This is because some people may have more shares in the team, while others may have none; as a result, the decision-making is more neutral. This means that whether in the supply or demand of TC, the decision will not only not harm the debtors and stockholders, but also not overly erode the assets of the clients for self-interest. In government-type corporations, the proportion possessed by the government is higher. Therefore, the position of the high ranking manager is politically-related. Therefore, this position may be stabilized as it is supported by political power. Therefore, high ranking managers in government tend to harm the clients for self-interest. There is no prominent willingness to use TC supply and demand. In manager-type corporations, the manager must make a prominent performance to be able to extend the term. This is consistent with the reputation hypothesis that states that, in order to have a better relationship with outsiders and better public credit, the TC supply and demand is increased in corporate operations for maximized interest. Finally, in family types of governance, one certain family or specific members of the family hold absolute majority shares so that outsiders cannot enter the managerial level. It is found from the agency theory that agency issues occur if the agent is the internal shareholder with a high proportion of the stock. This is because if the family manager holds too many shares, he will make a better TC financing decision. However, if the profit of the shares of a family manager is insufficient to cover his consumption, he may make a TC decision that impairs the corporation.

IV. Conclusion

With the rapid development of the prosperity cycle, banks are more cautious when financing corporations; therefore, the difficulty in obtaining a loan to fund operations causes incremental trade credit. The main point of the research is the influence of the CEO on corporate trade credit. Ownership, education and expertise are the points considered. Types of corporate governance are divided into government, association, manager, and family.

The usage of corporate trade credit is found to be different under different CEO power indices. In the model of CEO and trade credit demand and supply, based on a lack of opinion diversification hypothesis, it was found that, if the salary slice of CEOs is higher than that of the salary of the decision-making group, they are not favor of using trade credit. This is because, if their decision-making power is stronger, CEOs are not inclined to consider the fortune of debtors or commissioners, but themselves. An article by Hill and Wayne (2012) mentioned that incremental trade credit helps to reward the debtors, and this coincides with this index. However, the index shows no prominent results with the ownership of the CEOs. This is because the agency problem cannot be eliminated in the agency theory when the agent processes the funds or shares. Past reputation and the expertise of the CEO have a prominent positive influence on trade credit. In the reputation hypothesis and agency theory, CEOs do not harm the clients in order to have a better position. Therefore, when making a credit decision, they tend to favor the debtors. The category of corporate governance fits the agency issue in the agency theory. CEOs in government and family-type corporations do not compete in the management market; therefore, they tend to choose a decision in trade credit that is adverse to that of the debtors. CEOs in managerial corporations consider the position of the next manager or expertise of the managers and choose a trade credit decision favoring the clients. The management team in an association corporation consists of family and managerial characteristics. Therefore, there may be differences in the final decision of trade credit if it unknown whether the decision favors the debtors or not.

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Table 1 Parameter descriptive statistics

	Minimum	Maximum	Mean	Standard Deviation
CO (CEO Ownership, CO)	0	0.337	0.0185	0.028
CR (CEO Reputation, CR)	0	72	3.73	5.488
CE (CEO Expertise)	1	12	1.83	1.161
CPS (CEO Pay Slice)	0	1	0.425	0.244
G (Government)	0	1	0.02	0.126
A (Association)	0	1	0.11	0.316
M (Manager)	0	1	0.25	0.435
F (Family)	0	1	0.62	0.486
AR (Accounts Receivable)	0	476.049	2.706	13.127
AP (Accounts Payable)	0	548.494	2.279	13.656
ΔC (Changing Costs)	-35.911	980.374	1.403	20.161
ΔS (Changing Sales)	-36.96	1038.022	1.517	21.821
Ln A (Company Scale)	10.387	21.272	15.328	1.428
I (Inventory)	0	126.489	1.324	50.705
RE (Retained Earnings)	-129.16	325.5	1.454	10.156

Table 2 Influence of managerial power on TC supply and demand

$$AP_i = \alpha_0 + \alpha_1 \ln A + \alpha_2 \Delta C_i + \alpha_3 I_i + \alpha_4 RE_i + \alpha_5 CO_i + \alpha_6 CE_i + \alpha_7 \mathrm{CR}_i + \alpha_8 \mathrm{CPS}_i + \varepsilon_i$$

$$AR_i = \alpha_0 + \alpha_1 \ln A + \alpha_2 \Delta S_i + \alpha_3 I_i + \alpha_4 RE_i + \alpha_5 CO_i + \alpha_6 CE_i + \alpha_7 \mathrm{CR}_i + \alpha_8 \mathrm{CPS}_i + \varepsilon_i$$

Independent Variables	Expectation Symbols	AP	Expectation Symbols	AR
CO	?	28.755 (.840)	?	4.061 (.133)
CE	+	2.175*** (2.609)	+	1.889** (2.540)
CR	+	2.309*** (12.994)	+	2.323*** (14.645)
CPS	−	-21.458*** (-5.392)	−	-20.674*** (-5.821)
lnA	+	.659*** (8.981)	+	.279*** (3.378)
ΔC	+	.226*** (38.864)		
ΔS			+	.173*** (35.908)
I	+	.839*** (31.843)	+	.854*** (36.727)
RE	+	.373*** (28.713)	+	.436*** (37.014)
$\overline{R^2}$		0.688		0.635

1. ( ) T value

2. "***" prominent standard is 0.01， "**" prominent standard is 0.05， "*" prominent standard is 0.

Table 3 Influence of association governance type management on TC supply and demand

$$AP_i = \alpha_0 + \alpha_1 \ln A + \alpha_2 \Delta C_i + \alpha_3 I_i + \alpha_4 RE_i + \alpha_5 CO_i + \alpha_6 CE_i + \alpha_7 \mathrm{CR}_i + \alpha_8 \mathrm{CPS}_i + \alpha_9 \mathrm{F}_i + \alpha_{10} \mathrm{M}_i + \alpha_{11} \mathrm{G}_i + \varepsilon_i$$

$$AR_i = \alpha_0 + \alpha_1 \ln A + \alpha_2 \Delta S_i + \alpha_3 I_i + \alpha_4 RE_i + \alpha_5 CO_i + \alpha_6 CE_i + \alpha_7 \mathrm{CR}_i + \alpha_8 \mathrm{CPS}_i + \alpha_9 \mathrm{F}_i + \alpha_{10} \mathrm{M}_i + \alpha_{11} \mathrm{G}_i + \varepsilon_i$$

Independent Variables	Expectation Symbols	AP	Expectation Symbols	AR
F	−	-.318 (-1.031)	−	-.217 (-.791)
M	+	1.561 (4.501)	+	1.251*** (4.060)
G	?	-5.079*** (-6.287)	?	-5.233*** (-7.292)
CO	?	-1.786 (-.498)	?	.879 (.276)
CE	+	.172** (2.057)	+	.175** (2.355)
CR	+	.207*** (11.257)	+	.184*** (11.271)
CPS	−	-1.549*** (-3.793)	−	-1.099*** (-3.031)
lnA	+	.345*** (4.179)	+	.724*** (9.881)
ΔC	+	.226*** (39.133)		
ΔS			+	.175*** (36.693)
I	+	.818*** (29.826)	+	.794*** (32.960)
RE	+	.361*** (27.828)	+	.419*** (35.848)
$\overline{R^2}$		0.640		.693

1. ( ) T value

2. "***" prominent standard is 0.01， "**" prominent standard is 0.05， "*" prominent standard is 0.

Table 4 Influence of managerial governance type of management on TC supply and demand

$$AP_i = \alpha_0 + \alpha_1 \ln A + \alpha_2 \Delta C_i + \alpha_3 I_i + \alpha_4 RE_i + \alpha_5 CO_i + \alpha_6 CE_i + \alpha_7 \mathrm{CR}_i + \alpha_8 \mathrm{CPS}_i + \alpha_9 \mathrm{F}_i + \alpha_{10} \mathrm{A}_i + \alpha_{11} \mathrm{G}_i + \varepsilon_i$$

$$AR_i = \alpha_0 + \alpha_1 \ln A + \alpha_2 \Delta S_i + \alpha_3 I_i + \alpha_4 RE_i + \alpha_5 CO_i + \alpha_6 CE_i + \alpha_7 \mathrm{CR}_i + \alpha_8 \mathrm{CPS}_i + \alpha_9 \mathrm{F}_i + \alpha_{10} \mathrm{A}_i + \alpha_{11} \mathrm{G}_i + \varepsilon_i$$

Independent Variables	Expectation Symbols	AP	Expectation Symbols	AR
F	−	-1.879*** (-8.000)	−	-1.468*** (-7.034)
G	?	-6.640*** (-8.517)	?	-1.251*** (-4.060)
A	?	-1.561*** (-4.501)	?	-6.484*** (-9.362)
CO	?	-1.786 (-.498)	?	.879 (.276)
CE	+	.172** (2.057)	+	.175** (2.355)
CR	+	.207*** (11.257)	+	.184*** (11.271)
CPS	−	-1.549*** (-3.793)	−	-1.099*** (-3.031)
lnA	+	.345*** (4.179)	+	.724*** (9.881)
ΔC	+	.226*** (39.133)		
ΔS			+	.175*** (36.693)
I	+	.818*** (29.826)	+	.794*** (32.960)
RE	+	.361*** (27.828)	+	.419*** (35.848)
$\overline{R^2}$		0.640		0.693

1. ( ) T value

2. "***" prominent standard is 0.01， "**" prominent standard is 0.05， "*" prominent standard is 0.

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Stock Price Dynamic When Growth Options are Converted into Assets in Place: Evidence from Private Placements in Taiwan

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Abstract

Many believe that increased investment in capital expenditure is what causes the long-run underperformance of initial public offerings (IPOs) and seasoned equity offerings (SEOs). We argue that such underperformance is caused by the agency costs of managerial discretion on free cash flow, rather than capital expenditure per se. The results of an empirical examination of a sample of 418 private placements by firms on the Taiwan stock markets confirm our hypothesis. We show that the increase in issuers of placements in capital expenditures is associated with better long-run performance, whereas issuers without any investment in capital expenditures have non-positive or significantly negative abnormal returns.

Keywords: *Private placements; Capital expenditures; Long-run performance.*

JEL Codes: G14, G30, G32

1. Introduction

In the last decade, private placements have become an important alternative to public offerings for public firms to raise equity capital. According to the Sagient Research PlacementTracker database, there were 14,079 private investment in public equity (PIPEs) transactions by U.S. public firms in the period 2001-2010, with total proceeds of US$ 421 billion. In comparison, the number of seasoned equity offerings (SEOs) in the corresponding period was 4,065, with a total new capital of US$700 billion.[1]

Existing studies show that SEOs have, on average, a negative announcement return and poor long-run performance.[2] In contrast, private placements tend to have a positive return around the announcement day and non-negative long-run performance.[3] Although the new issue puzzles relating to public offerings and private placements are well documented, few studies have addressed the topic with respect to the difference in the long-run performance of SEOs and private placements. In this paper, we shed light on the role of capital expenditure on post-issue performance, highlighting the relationship between capital expenditure and the long-run performance of private placements.

In a perfect capital market, the value of a firm should be unrelated to the amount of its investment in capital expenditures. However, Loughran and Ritter (1997) and Fu (2010) find that SEO firms tend to increase their capital expenditures rapidly after equity issuance. They conclude that there is a negative relationship between capital expenditures

[1] The statistics on SEOs are from Thomson Financial Securities Data Company's (SDC) new issue database.

[2] Studies that discuss the announcement return and long-run performance of SEOs include Loughran and Ritter (1995, 1997); Spiess and Affleck-Graves (1995); Corwin (2003); Walker and Yost (2008); and Fu (2010).

[3] Studies on private placements include Hertzel, Lemmon, Linck, and Rees (2002); Krishnamurthy, Spindt, Subramaniam, and Woidtke (2005); Wu, Wang, and Yao (2005); Barclay, Holderness, and Sheehan (2007); Wruck and Wu (2009); and Shiu and Wei (2013).

and long-run performance. More recently, Li, Livdan and Zhang (2009) propose the rational overinvestment hypothesis, and argue that managers of IPO and SEO firms have various incentives to grow their firm beyond its optimal size. Because the marginal rate of return on capital is decreasing, increased investment leads to lower marginal rates of return and results in post-issue underperformance. To test the overinvestment hypothesis, Lyandres, Sun, and Zhang (2008) construct an overinvestment risk factor by going long on low-investment stocks and short on high-investment stocks, and show that the overinvestment risk factor successfully explains the long-run underperformance of new issues. They conclude that managers of SEO firms invest too much in capital expenditure or R&D because of the low cost of capital and high agency cost of managerial discretion.

Unlike firms conducting SEOs, which are subject to the agency costs of free cash flow, with such costs increasing as new equity is issued,[4] issuers of private placements are often poorly managed and financially distressed, and cannot access public markets to raise the needed capital (Chen, Dai, and Schatzberg, 2010). In addition, their capital costs are higher than those of their industrial peers are. Thus, the agency costs of managerial discretion are less important for issuers of private placements. Moreover, capital expenditure can significantly increase the firm's placement value because it can bring new business, resulting in a turnaround for the issuer. Consequently, we hypothesize that a positive relationship exists between capital expenditures and the post-issue performance of private placements, in contrast to SEOs.

A pre-issue price run-up reflects a valuable growth opportunity or an overvaluation. Because firms in financial distress are often unable to access public markets, they may

[4] McLean (2011) finds that the propensity to save issuance proceeds as cash has increased significantly over the past three decades. Although some of the issuances are motivated by precautionary savings, the issuances of new shares by health firms also result in managerial discretion over the free cash flow.

resort to target investors through private placements. We posit that firms with financial constraints have various incentives to raise equity capital. If the issuing firms have valuable growth opportunities and specific plans for the proceeds, they would state "investment" as their primary use of capital. In the process of gradually converting growth options into assets in place, these firms may use the proceeds primarily to invest in capital expenditures or R&D. We hypothesize that because of valuable investment opportunities and lower managerial discretion, issuers of private placements with greater capital expenditure tend to have better long-run performance than their industry peers.

On the other hand, if the issuing firms desire to relieve financial constraints, they may state "recapitalization" as their goal and use the proceeds to repay debts or increase their investment in working capital. In cases where managers do not have specific plans and merely take advantage of overvaluation to issue private equity, they tend to state their intended use of proceeds as "general corporate purposes".[5] These two types of issuers tend to spend their proceeds on other accounts, rather than invest in capital expenditure. The impact on the issuer's firm value is twofold. The positive effect is that an issuance of new shares provides substantial cash infusion, which could lower the discount rate of financially distressed firms (Fama and French, 1992). The negative effect is that because the post-issue assets in place are less risky than the pre-issue growth options, the post-issue return will decline (Carlson, Fisher, and Giammarino, 2006). In considering both effects on the firm's value, we hypothesize that issuers of private placements without an investment in capital expenditure will have no excess or negative long-run abnormal returns.

[5] Since the regulation requires disclosure of the intended use of the proceeds, and the competent authority will audit the ultimate use of such proceeds, these regulations force managers of issuing firms to state truthfully their intended use of the proceeds.

To empirically examine our hypothesis, we investigate a sample of 418 placements made on the Taiwanese stock markets between January 2002 and December 2010. The competent authority in Taiwan requires the issuers of private placements to disclose detailed information, including the intended use of the capital raised and the names of target investors. We use the information provided by the firms in complying with this disclosure requirement to classify placements into three categories: investment, recapitalization, and general purpose. We then examine the announcement returns and post-issue stock performance for the three categories. The empirical results support our predictions.

Three main findings emerge from our analysis. First, the ultimate use of proceeds in the years following the placements is generally consistent with the intended use of capital stated in the announcement. That is, issuers in the *investment* category actually increase investment in capital expenditures in the years following the issuance, while issuers in the other two categories do not. This is probably a result of the likelihood of post-audit regulation by the competent authority. It also validates our classification.[6]

Second, the motivation for placement issuance varies depending on category. We follow the methodologies proposed by Rhodes-Kropf, Robinson, and Viswanathan (2005) and Hertzel and Li (2010) to decompose the pre-issue market-to-book ratios into misevaluation and growth opportunity components. Placements in the *investment* category are associated with higher growth opportunities. Thus, firms making such placements increase investment in capital expenditure to take advantage of valuable growth options in the hope of achieving a turnaround. In contrast, placements in the

[6] In a related study, Brown and Floros (2012) find that issuers use funds from PIPEs in cash reserve and R&D rather than capital expenditures. This finding is similar to our sample of placements in the *recapitalization* category and contrasts with placements in the *investment* category.

general purpose category are more likely to be motivated by overvaluation. Managers of issuers in this category do not have specific plans.

Third, post-issue performance varies greatly among these three categories. Placements in the *investment* category have a significantly positive abnormal return over the two- and three-year period following the issuance. In contrast, placements in the *recapitalization* category do not have excess long-term returns. Worse still, placements in the *general purpose* category underperform in relation to their industrial peers. The outperformance of placements in the *investment* category over those in the *general purpose* category is still robust in both insider and non-insider groups. Overall, the empirical findings presented support our hypothesis that investment in capital expenditures significantly increases the firm value of private placements.

Our empirical results complement the debate on the overinvestment of equity issuance. Although several studies, as discussed earlier, document that overinvestment of IPO or SEO firms is the driving force behind long-run underperformance, recent studies suggest a different view. Hertzel and Li (2010) argue that firms with greater growth opportunities tend to invest more in capital expenditures and R&D after issuance but firms with greater mispricing tend to decrease long-term debt or increase cash holdings. Their findings show that the latter, not the former, experience lower post-issue performance. In a study closely related to ours, Autore, Bray, and Peterson (2009) examine the relationship between the intended use of proceeds in SEOs and their subsequent long-run performance. They find that issuers that state *recapitalization* or *general purpose* as their objective experience poor performance, but issuers that state *investment* as their objective do not underperform. The authors do not check whether the ultimate use of proceeds is consistent with the stated purpose. Their sample is also contaminated by the agency costs of managerial discretion. However, their results are qualitatively similar to ours.[7] Both of the findings in this paper and those in Autore et al. (2009) provide strong evidence against the overinvestment hypothesis. Our findings suggest that the adverse effect of overinvestment on firm value is not from investment per se, but rather from the agency cost of managerial discretion on the proceeds from SEOs.[8]

This study also contributes to the existing literature on private placements. In examining the market reaction and long-run performance, Krishnamurthy et al. (2005), Barclay, Holderness, and Sheehan (2007), Wruck and Wu (2009), and Shiu and Wei (2013) have confirmed the role of insiders on performance. In addition to the status of target investors, our findings confirm that the intended use of proceeds from placements is also an important determinant of long-run performance. Investing proceeds in capital expenditures significantly increases the firm value of private placements.

The remainder of this paper is organized as follows. Section 2 introduces private placements in Taiwan. Section 3 describes the data used in this study. The main empirical results and findings are presented in Section 4. A robust check of these results and findings is undertaken in Section 5. Finally, the conclusions drawn from this study are presented and summarized in Section 6.

2. Private placements in Taiwan

Prior to 2002, public offerings were the only choice for public firms in Taiwan to sell their primary shares through seasoned equity offerings. Since some firms with poor

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[7] Although the general findings in Autore et al. (2009) are similar to ours, the report of no abnormal performance on *investment* purpose is worth noting. They examine 880 SEOs in U.S. during the period 1997-2003. Most of the issuers are health public firms.

[8] Li (2011) finds that the positive R&D-return relationship exists only among financially constrained firms. Similarly, we find that the capital expenditures positively predict returns only among issuers of private placements, which are often financially constrained.

operating performance or illiquid stocks were financially constrained during the Asian financial crisis in 1997 and the dotcom crash in 2000-2001, they were unable to access public markets to raise external capital. To solve the problem, the Securities and Exchange Act was amended in January 2002 to allow public firms in Taiwan to choose between public offerings or private placements in conducting SEOs. Because of their flexibility and cost saving, private placements gained market shares soon after the amendment Act and become an important capital-raising source for Taiwanese public firms from 2005 onwards. For example, in 2006 there were 65 private placements by all public firms in the Taiwan stock markets, raising total equity capital of NT$ 84 billion, compared to 70 public seasoned offerings raising a total of NT$ 108 billion. By 2008, when the global financial crisis affected the capital markets, the number of private placements increased to 66 (raising NT$ 34 billion in equity capital) but the number of public offerings decreased to 17 (raising NT$ 14 billion in equity capital).

An issuance of primary shares, whether through public offerings or private placements, cannot be made without shareholder approval, which ultimately requires a two-thirds majority of all votes at a shareholders' meeting. When a firm chooses a public offering, it is obligated to register the issue with the competent authority prior to the sale. Immediately after receiving approval from the authority, the underwriters and the issuing firms can then prepare for the sale of their primary shares to the public. In contrast, when a firm conducts a private placement, it is not required to register with the competent authority in advance.

Prior to the issuance of a private placement, the issuing firm should place the capital-raising proposal on the voting agenda at the shareholders' meeting. In addition, the firm has to disclose the planned amount of capital to be issued, as well as the intended use of the proceeds. Once approval is obtained, the issuing firm contacts the private investors. Securities are generally sold to maximum of 35 knowledgeable investors, including banks, insurance companies, pension funds, incorporated entities, the firm's directors and managers, and other retail investors and institutions approved by the competent authority. When the placement deal is closed, the issuing firm publishes an announcement about the transaction in the "Material Information" bulletin in the Market Observation Post System (MOPS). Those investors acquiring the securities of the private placements are subject to restrictions on the resale for a period of three years.

3. Data

3.1 Sample

To construct the sample for this study, we search the Material Information in the MOPS for private placements announced in the Taiwan stock markets between January 2002 and December 2010. The dataset lists detailed features of each deal, including the announcement date, the intended use of proceeds, the offer price, the total number of shares sold in the placement, the number of investors, the names of the investors, the number of shares purchased by each investor, and the relationship between the issuer and the investors. This produces a total sample of 532 issues. We exclude placements by financial firms, resulting in the elimination of 21 observations.[9]

We then obtain the financial variables from the Taiwan Economic Journal (TEJ) Finance database, the daily price from the TEJ Equity database, and the names of the board directors and the ownership data from the TEJ Company database. Due to the unavailability of these financial variables, stock prices, and ownership data, two

[9] The elimination of financial firms results in smaller firms size and proceeds for our sample issuers, compared to earlier studies using a similar dataset (e.g., Shiu and Wei (2013)).

additional observations are excluded. Furthermore, 58 firms make two or more issuances between two consecutive shareholder meetings; hence, an additional 91 observations are excluded from our analysis.[10] This process leaves us with a final sample of 418 private placements, which is used in most of our empirical analyses.

Table 1 displays the distribution of our sample. Panel A presents the frequency distribution of the sample firms by year. There are only four placements in the first year, accounting for 1% of the total sample. The number of placements increases over time until 2007, and then slightly declines with the financial crisis in 2008.

<Table 1 is inserted about here>

Panel B of Table 1 presents the frequency distribution of the sample firms by industry. Among the 418 sample firms, electronic firms made up 242 of the placements accounting for 58 percent of the total sample. This distribution is generally consistent with the industry structure, with information technology and related firms dominating Taiwan's stock markets.

3.2 Characteristics of the issuing firms

In this section we present descriptive statistics on several firm characteristic variables for our sample of private placements. All variables are the annual or the year-end figures in the preceding year of issue. We define these variables in the following discussion.

Our proxies for firm size are total book assets and market capitalization. The proxy for operating performance is the return on assets, which is calculated as the earnings before interest and taxes (EBIT) divided by total book assets. The proxy for internal cash

[10] If a firm announces multiple issues in the period between two consecutive shareholder meetings, these multiple issues are regarded as tranches of a private placement. Therefore, we aggregate the proceeds from the multiple issues as the proceeds of a single placement.

flow is the cash flow ratio, which is measured as earnings before interest, taxes, depreciation, and amortization (EBITDA) divided by total book assets. Our proxies for liquidity are cash ratio and NWC ratio, which are calculated as the ratio of cash and cash equivalents to total book assets, and the ratio of non-cash net working capital to total book assets, respectively. We compute the total debt ratio as a proxy for financial leverage. We calculate investment in capital expenditures (CAPEX ratio) and research and development expense (R&D ratio) relative to total book assets. We also calculate the controlling ownership as a proxy for the extent of corporate control. Finally, we compute the market-to book ratio, where both the market and book values are measured at the end of the preceding year,[11] as a proxy for investment opportunities and/or mispricing, which we discuss later.

We report the mean and median values of firm characteristic for our sample firms in Table 2. For purpose of comparison, we also report values for the issuing firm's industry peers, which are calculated using all non-placement-issuing firms in the same industry during the same period. We test differences across the private placements and non-issuing sample using the t-statistic (in mean) and non-parametric Wilcoxon rank-sum test (in median).

<Table 2 is inserted about here>

Table 2 highlights that private placements are likely to be made by poorly managed firms that tend to be financially constrained. For the placements sample, the mean cash flow ratio is -7.7% with a median of -1.4%, suggesting the internal source of cash flow is a deficit. In sharp contrast to issuing firms, the typical industry peer has a mean cash flow

[11] We also compute the market-to-book ratio for each deal using market information prior to the announcement day (the market value is measured 10 days prior to the announcement, and the book value is measured at the end of the year preceding the announcement). The results are qualitatively unchanged.

of 9.5% with a median of 10.1%. The difference in the cash flow ratio between issuing and non-issuing firms is statistically and economically significant. Issuing firms also have lower returns on assets than do their benchmark firms. In addition, firms in our sample tend to use more debt, maintain less liquidity, and be more R&D intensive than their industry peers. Interestingly, the issuers of placements have higher mean values of capital expenditures and market-to-book ratios but lower median values than their industry peers, indicating that the distributions of these two variables are rightly skewed.

3.3 Characteristics of the deals

Table 3 presents summary statistics for private placement deals in our sample, showing that the mean gross proceeds are NT$ 490 million, with a median of NT$ 161 million (approximately US$ 14.9 million and US$ 4.9 million respectively).[12] The mean number of new shares issued, as a percentage of the total shares outstanding after the issue, is 24.9% with a median of 18.1%. When compared to other studies, the proceeds and the fraction of shares sold in our private placements sample are slightly larger than U.S. placements. For example, Wruck and Wu (2009) report that the mean (median) gross proceeds are $15.3 million ($3.0 million) and the mean (median) fraction of shares sold is 11.39% (7.24%) in their sample.

<Table 3 is inserted about here>

We calculate the beta and idiosyncratic risk, respectively, as a proxy for a firm's systemic risk and specific risk. The beta is derived from the market model (of daily returns) in the 230-day period beginning 240 days prior to the announcement, while the idiosyncratic risk is calculated as the standard deviation of the residuals from the market

[12] The exchange rate during our sample period is in the range of NT$ 35.11 (February 2002) to NT$ 30.01 (March 2008) per US$ 1. For simplicity, we use the exchange rate of NT$ 33 per US$ 1.

model. As indicated in Table 3, the mean market-to-book ratio is 2.03 with a median of 1.24. The mean (median) beta is 0.65 (0.69) and the mean (median) idiosyncratic risk is 3.72% (3.36%).

On average, the private placements are sold at a discount of 23.5% (measured relative to the market price ten days after the announcement) or 18.1% (one day prior to the announcement). The average discount in our sample is similar to the discount of 18.70% reported in Barclay et al. (2007) and the 19.44% reported in Krishnamurthy et al. (2005). However, it is much higher than the 11.33% (measured by the share price ten days after the announcement) or the 6.79% (one day prior to the announcement) discount reported in Wruck and Wu (2009).

3.4 Classification by stated use of funds

In this section, we introduce our method for classifying our sample of 418 placements into three categories based on the stated use of proceeds posted in the "Material Information" bulletin. We also provide descriptive statistics on firm and deal characteristics for the three categories.

In their announcement of private placements, if issuers indicate that they intend to use the proceeds for investments in R&Ds or capital expenditures, acquisitions, or business expansions, these placements are classified in the "investment" category (120 placements or 29% of our sample). If issuers state that they intend to use the proceeds to repay outstanding debt or bank loans, or to increase working capital, these deals are placed in the "recapitalization" category (229 placements or 55% of our sample). If the issuing firms state that proceeds of placements have multiple purposes and at least two purposes are in the "recapitalization" and "investment" categories, or if the announcements do not specifically identify the intended use of the proceeds,[13] then these placements are classified in the "general purpose" category (69 placements or 17% of our sample). The summary statistics on firm and deal characteristics for the three categories are presented in Table 4.

<Table 4 is inserted about here>

Table 4 shows that, although poor operating performance and financial constraints are universal across all three categories, issuing firms that state "recapitalization" and firms that state "general purpose" have a poorer return on assets, higher leverage, larger relative offer size, and lower net working capital ratio than firms that state "investment". Firms that state "general purpose" are larger and have higher discounts on private shares than firms in the other two categories.

4. Empirical results

4.1 The ultimate use of the proceeds

We classify all sample firms into three categories based on their intended use of funds. It is interesting to note how the issuing firms actually use their funds raised in the private placements of equity. In this section, we investigate the ultimate use of capital for the three categories.

To address the issue, we follow the methodology proposed by Kim and Weisbach (2008), who study how firms use the capital raised in the initial public offerings (IPOs) and seasoned equity offerings (SEOs) in subsequent years. For our sample of 418 private placements, we examine the cumulative changes in cash holdings (Δ Cash), non-cash net working capital (Δ *NWC*), capital expenditures (Σ *CAPX*), R&D (Σ *R&D*), and

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[13] In such a case, the intended use of the proceeds is recorded as "general corporate purpose".

reductions in long-term debt (Σ *LTD reduction*) in the subsequent four years following the issuance. For each of five measures of possible use of the funds raised in the placements, we estimate:

$$Y = \beta_1 \cdot \ln[(\text{proceeds}/TA_0)+1] + \beta_2 \cdot \ln[(\text{other sources}/TA_0)+1] + \beta_3 \cdot \ln[TA_0] + Year + Industry + \varepsilon \quad (1)$$

where $Y = \ln[((V_t - V_0)/TA_0)+1]$ if the measure is one of "real accounts" (*Cash*, *NWC*) or $Y = \ln\left[\left(\sum_{i=1}^{t} V_i / TA_0\right)+1\right]$ if the measure is one of "nominal accounts" (*CAPEX*, *R&Ds*, and *LTD reduction*), and t=1, 2, 3, 4 years after the placements.

In the regression, β_1 measures the cumulative impact of funds raised in placements on their use in the following years, after controlling for other sources of capital inflows and the initial base of total assets. We also consider the year and industry fixed effects in our model specification. In Table 5, we only report the estimate of β_1 for the sake of brevity.

As shown in the table, the β_1 for the *investment* sample in the regressions of increase investment in capital expenditures ($\Sigma CAPX$) is significantly positive at the 1% level. Further, we find that issuers initially keep large amounts of proceeds in cash and net working capital in the year immediately after the issuance of private placements, and then substantially increase investment in capital expenditures over the next three years. Nevertheless, issuers in this category do not increase their R&D expense.[14]

[14] In Taiwan, the Statute for Upgrading Industries (SUI) provides an incentive for business investment in research and development by providing a credit against corporate tax liability for qualified company research expenses. In practice, however, firms in our sample do not have incentives to claim their R&D expenses for two reasons even if they actually spent on research and development activities. First, there is uncertainty regarding the criteria governing the entitlement to deduct R&D expenses. This point is made in the article by PwC: http://www.pwc.tw/en/challenges/taxation/indissue0260.jhtml. Second, our sample firms tend to have substantial accumulated losses and receive little value from the investment credits.

the β_1 for the *recapitalization* sample in the regressions of cumulative changes in cash holdings (Δ Cash) and non-cash net working capital (ΔNWC) is significantly positive at the 1% level. However, none of the coefficients on reductions in long-term debt (Σ*LTD reduction*) is significantly different from zero, indicating that issuers in the *recapitalization* category pile up funds in cash and net working capital rather than repay long-term debt. This finding is consistent with the view of Erel, Jang, and Weisbach (2015), who argue that firms being financially constrained tend to hold more cash on their balance sheet. Moreover, the coefficients in the regressions of capital expenditure and R&Ds are positive, with some being significantly different from zero, showing that firms in this category also slightly increase investments in real activities.

<Table 5 is inserted about here>

Finally, for the *general purpose* sample, the long-term debt temporarily declines in the year after issuance and reverts to its original level later. Firms in this category do not use funds in specific accounts except that they keep a moderate proportion of proceeds in the accounts of cash and net working capital. It reflects the fact that *general purpose* issuers do not have specific plans.

Overall, the results in Table 5 show that the ultimate use of proceeds in each category is consistent with the stated use of funds. This could be attributed to the regulatory requirement for post-audits of the proceeds. It also justifies the classification of our placements sample into *investment*, *recapitalization*, and *general purpose* categories.

4.2 Investment opportunities and mispricing

The summary statistics reported in Table 2 show that the issuers in our sample have a higher mean ratio of pre-issue market-to-book than their industry peers. High market-to-book ratios may be viewed as a sign of overvaluation, or as a sign of valuable investment opportunities (Rhodes-Kropf et al., 2005). In examining the motivation of equity issuance, Hertzel and Li (2010) decompose market-to-book ratios into two components: misevaluation and growth opportunities. They find that issuing firms are both overvalued and have greater growth opportunities relative to non-issuing firms.

We follow the methodologies proposed by Rhodes-Kropf et al. (2005), and Hertzel and Li (2010) to decompose the pre-issue market-to-book ratios of our private placements. The market-to-book ratio can be expressed as follows:

$$\frac{M}{B} \equiv \frac{M}{V} \times \frac{V}{B} \tag{2}$$

where M is the market equity, B is the book equity, and V is the fundamental value of equity. Taking the logarithms of both sides (represented by lower case letters), the equation can be written as follows:

$$m - b \equiv (m - v) + (v - b) \tag{3}$$

In equation (3), the decomposition of market-to-book ratio relies on an estimate of fundamental value, v. For each observation, Rhodes-Kropf et al. (2005) further decompose the market-to-book ratio for firm i at time t into three components as follows:

$$m_{it} - b_{it} = \left[m_{it} - v(\theta_{it};\alpha_{jt})\right] + \left[v(\theta_{it};\alpha_{jt}) - v(\theta_{it};\alpha_{j})\right] + \left[v(\theta_{it};\alpha_{j}) - b_{it}\right] \tag{4}$$

where valuation measure v is defined as a function of θ_{it} (the specific accounting information for firm i at time t) and α (a vector of accounting multiples for firm i in industry j). Specifically, α_{jt} is the vector of industry j accounting multiples at the time t, and α_j is the vector of industry j long-run multiples.

The first part on the right-hand side of equation (4), $m_{it} - v(\theta_{it};\alpha_{jt})$ represents the difference between the market value and fundamental value of equity where fundamental value is conditioned on the firm-specific accounting data, θ_{it}, and the contemporaneous industry *j* accounting multiples. Rhodes-Kropf et al. (2005) argue that this difference can capture the extent to which the firm is misvalued relative to its contemporaneous industry peers, referred to as firm-specific errors (FSE). The second component $v(\theta_{it};\alpha_{jt}) - v(\theta_{it};\alpha_j)$, which is referred to as time-series sector error (TSSE), is the difference between the full time series valuation and the industry specific valuation. This component captures the extent of misvaluation specific to the industry. The final component, $v(\theta_{it};\alpha_j) - b_{it}$, referred to as long-run value-to-book (LRVTB), measures the difference between firm value and book value where firm value is conditioned on the vector of long-run industry *j* accounting multiples.

To estimate $v(\theta_{it};\alpha_{jt})$ and $v(\theta_{it};\alpha_j)$ we use the third model proposed by Rhodes-Kropf et al. (2005) that includes book value of equity (*b*), net income (*NI*), and market leverage ratio (*LEV*) as the θ_{it} (this approach is also used in Hertzel and Li (2010)). Market equity is estimated as a simple linear model of the accounting variables as follows:

$$m_{it} = \alpha_{0jt} + \alpha_{1jt} b_{it} + \alpha_{2jt} \ln(NI)^{+}_{it} + \alpha_{3jt} I_{<0} \ln(NI)^{+}_{it} + \alpha_{4jt} LEV_{it} + \varepsilon_{it} \qquad (5)$$

where $(NI)^{+}$ is the absolute value of net income, $I_{<0}$ is an indicator variable when net income is negative, and *LEV* is computed as:

$$LEV = 1 - \frac{\text{Market equity}}{\text{Market equity} + \text{Book assets - Deferred taxes - Book equity}} \qquad (6)$$

We regress equation (5) annually for each of the 11 industries for the years from

1995 to 2009, to yield the estimates of their accounting multiples (i.e., $\hat{\alpha}_{0jt}$, $\hat{\alpha}_{1jt}$, $\hat{\alpha}_{2jt}$, $\hat{\alpha}_{3jt}$, and $\hat{\alpha}_{4jt}$).[15] The first component of equation (4) (FSE) for each firm is the residual of the equation (5). To calculate the second and third components, we have to estimate the long-run industry multiples. For each industry, we average all multiples over the available years prior to the issuance of the private placement.[16] The accounting variables (b_{it}, NI_{it}, LEV_{it}) with the estimates of long-run industry multiples ($\overline{\alpha}_{0jt}$, $\overline{\alpha}_{1jt}$, $\overline{\alpha}_{2jt}$, $\overline{\alpha}_{3jt}$, and $\overline{\alpha}_{4jt}$) are fitted into the equation (5) to compute the estimate of $v(\theta_{it};\alpha_j)$.

Table 6 presents the mean and median of the three components of the market-to-book ratios for the three categories. The table shows that the mean (median) FSE for the *general purpose* sample is 0.206 (0.262), and is significantly higher than 0.084 (0.031) in the *recapitalization* category and 0.048 (0.100) in the *investment* category. On the other hand, firms in the *investment* category have significantly higher pre-issue LRVTB ratios than do firms in the other two categories. The mean (median) LRVTB in the *investment* category is 0.479 (0.471), which is twice 0.192 (0.169) in the *recapitalization* category and 0.198 (0.184) in the *general purpose* category.

<Table 6 is inserted about here>

The findings in Table 6 show that firms in the *investment* category have high pre-issue LRVTB ratios, and are more likely to have valuable investment opportunities.

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[15] The results are quantitatively similar to those reported in Rhodes-Kropf et al. (2005) and Hertzel and Li (2010). The time series average of coefficients and then averaged across 11 industries is 0.960 (with a standard error of 0.169) for α_0, 0.836 (se=0.024) for α_1, 0.213 (se=0.035) for α_2, -0.032 (se=0.007) for α_3, and is -1.020 (se=0.394) for α_4. The average adjusted R^2 is 0.915.

[16] We also compute the long-run industry multiples using full time series of values, which is used in Rhodes-Kropf et al. (2005), to estimate the TSSE and LRVTB components. The results are qualitatively unchanged. However, as discussed in Hertzel and Li (2010), this methodology suffers the problem of forward-looking information that is not available to investors at the time placements are issued.

They issue new shares to private investors to raise funds for investment in capital expenditures. In contrast, firms in the *general purpose* category have high pre-issue FES ratios, suggesting that the issuance of equity is more likely to be motivated by overvaluation.

4.3 Market reactions

Previous studies show that the market reaction to firms conducting SEOs is negative around the announcement day (e.g., Corwin, 2003; Walker and Yost, 2008). The information asymmetry, which is the assumption of analytical framework of the pecking-order model by Myers and Majluf (1984), is one of the most successful hypotheses offered to explain the negative market reaction to the equity issuance. Myers and Majluf argue that when a firm announces an issue of risky securities, outside investors believe these risky securities to be overvalued and adjust their valuation of the firm to reflect the new information. However, the pecking order theory are challenged by the phenomenon of a positive market reaction to private placements (e.g., Krishnamurthy et al., 2005; Wu, Wang, and Yao, 2005; Wruck and Wu, 2009; Shiu and Wei, 2013). To explain the positive reaction, some studies extend the Myers and Majluf model. For example, Wu and Wang (2005) asserts that the positive effect of asymmetric information about corporate growth opportunities offsets the adverse selection effect from asymmetric information about the assets in place, thus leading to a positive announcement return.

We use the market model to calculate the announcement period abnormal return. The market model is estimated, in the period from day -120 through day -11, with a regression of the firm's daily stock returns on the market return. We use the cumulative abnormal returns (CARs) in two different windows to capture the stock price reactions to the announcement of the private placements: CAR [-1, 3] (cumulative abnormal returns over the 5-day interval beginning 1 day prior to the announcement, with day 0 being the initial announcement day of the private placement) and CAR [-1, 10]. The announcement period abnormal returns are reported in Table 7.

<Table 7 is inserted about here>

As reported, the mean (median) CAR [-1, 3] for all placements is 3.86 percent (1.84 percent), and the mean (median) CAR [-1, 10] is 7.44 percent (2.73 percent). All of these abnormal return measures are significant. In our sample, the information effect of announcing a placement is stronger than the findings in previous studies. For example, Krishnamurthy et al. (2005) report a mean CAR [-3, 0] of 2.21 percent, and Wruck and Wu (2009) measure a mean CAR [-3, 0] of 2.02 percent. Wu, Wang, and Yao (2005) also document a mean CAR [-1, 1] of 3.51 percent for their sample of private placements in Hong Kong.

In proceeding to examine the abnormal returns in the three categories, we find that the positive market reaction to the announcement of private placements do not materially differ between the three intended use of capital types.

4.4 Long-run stock performance

Earlier studies document that private placements underperform, compared to benchmarks, in the long run. For example, Hertzel, Lemmon, Linck and Rees (2002) report a three-year abnormal return of -45.15 percent, while Krishnamurthy et al. (2005) find an abnormal return of -38.39 percent, and Wruck and Wu (2009) document an abnormal return of -25.27 percent. Here, we are interested in understanding whether different stated intentions for use of capital can be associated with a variation in long-run stock performance.

The medium-term abnormal returns in the [11, 480] period and the long-term abnormal returns in the [11, 720] period are a proxy for the post-issue long-run stock performance.[17] We adopt two approaches to measure such performance. The first approach is the cumulative abnormal returns, where the abnormal return is computed by subtracting the value-weighted return of all firms in the same industry from the return of the issuing firm. The second method is the calendar time abnormal return, which involves regressing the portfolios' daily excess return against the four factors of Fama and French (1993, 1996) and Carhart (1997). For each calendar day in our sample period, we form an equally weighted portfolio of all placements in the post-issue period [11, 480] or [11,720]. We also form the portfolios of placements classified by the stated use of capital type. The four-factor model can be stated as follows:

$$R_{i,t} - RF_t = \alpha + \beta_{RMRF} RMRF + \beta_{SMB} SMB + \beta_{HML} HML + \beta_{PR1YR} PR1YR_t + \varepsilon_{i,t} \quad (7)$$

where $R_{i,t}$ is the return on portfolio i at day t, RF_t is the risk free rate,[18] $RMRF_t$ is the daily excess return on the Taiwan-listed value-weighted market portfolio, SMB_t is the return on the factor-mimicking size portfolio, HML_t is the return on the factor-mimicking book-to-market equity portfolio, and $PR1YR_t$ is the return on the factor-mimicking portfolio for a one-year return momentum. The constant term α is Jensen's alpha and β_{RMRF}, β_{SMB}, β_{HML}, and β_{PR1YR} are the factor loadings of $RMRF$, SMB, HML, and $PR1YR$, respectively.

Table 8 reports the summary statistics for the long-run performance of private placements. Panel A presents CAR results. The first row reports the medium-term and

[17] We use 480 days and 720 days to approximate the two-year and three-year period, respectively, after the placement.

[18] Because there is no actively traded T-bond market in Taiwan, we use the one-month time deposit rate offered by the Bank of Taiwan as a proxy for the risk-free rate.

long-term CARs for the entire sample of placements. In contrast to the previous studies, we find that the average of the long-run abnormal returns for all placements is insignificant. As shown, the mean CAR [11, 480] is -1.97 percent (median of -0.97 percent), while the long-term CAR over the [11, 720] window is also insignificantly different from zero, with a mean of -1.41 percent (median of 2.59 percent). Although the mean and median CARs are close to zero, we find a large number of placements exhibit extremely high or extremely low long-run abnormal returns. For example, in the [11, 720] window, almost a quarter of the placements have CARs in excess of 60 percent, whereas one-sixth of placements suffer losses exceeding 60 percent.

<Table 8 is inserted about here>

The second to fourth rows of Panel A show that the long-run stock performance varies across the different types of placements. We find that the average abnormal returns of placements in the *investment* category are significantly positive (11.11 percent in the period [11,480], and 18.04 percent in the period [11,720]), whereas placements in the *general purpose* category are significantly negative (-26.79 percent and -18.97 percent, respectively). The long-run performance for placements in the *recapitalization* category lies between the other two types and the average abnormal returns are not significantly different from zero (-1.34 percent and -6.31 percent).

We also test the difference in the mean and median abnormal returns between the placements in the *general purpose* category and those in the other two categories. With reference to the CAR [11, 480], the placements that state *investment* as the intended use of capital significantly outperform the placements in the *general purpose* category by 37.90 percent (median of 12.17 percent). The placements in the *recapitalization* category also have a significantly superior performance of 25.45 percent (median of 7.43 percent).

All of the differences are statistically and economically significant. Similarly, in the long-term window [11,720], the *investment* placements also significantly outperform the *general purpose* placements.

Panel B of Table 8 presents the Fama-French and the Carhart four-factor model results based on the daily and implied returns in the [11, 480] and [11, 720] windows, respectively. Slightly different from the results in Panel A, the alpha for the entire sample of placements is 0.029 percent and 0.030 percent. Both results are significantly different from zero. The implied abnormal return over the [11, 480] period is 14.33 percent, while it is 23.63 percent over the [11, 720] period. For the placements classified according to the intended use of capital, the alphas for the *investment* category are all significantly positive, while the ones for the *recapitalization* category are insignificantly positive. In contrast to the *investment* and *recapitalization* categories, the alpha on *general purpose* placements is significantly negative. Similar to the result reported in Panel A, the *investment* placements and *recapitalization* placements significantly outperform the *general purpose* placements in the four-factor model.

Using a multivariate model that controls for other factors such as deal and firm characteristics, we further analyze the influence of the intended use of capital on the post-issue performance of placements. The dependent variable in the first and second equations is the medium-term abnormal return, CAR [11, 480], while the dependent variable in the third and fourth equations is the three-year abnormal return, CAR [11, 720]. The independent variables are as follows: the two intended uses of capital dummies (*Investment dummy* and *Recapitalization dummy*) for the placements (the *general purpose* category has been omitted); the fraction of new shares sold in the placement (*Fraction placed*); the ownership of controlling shareholders prior to issuance (*Controlling* *ownership*); the private placement discount (*Discount_2*), which is calculated as the issuing price relative to the closing price on the day prior to the announcement; the market capitalization of the issuing firm (*Ln_cap*; the logarithm of market cap); *return on assets*; *debt ratio*; *beta*; *idiosyncratic risk*; *prior return*; *announcement return*; and the year dummies. The results for the regression of the long-run stock performance are reported in Table 9.

<Table 9 is inserted about here>

As shown in Table 9, when controlling for other factors, placements in the *investment* and *recapitalization* categories both have better post-issue performance than the placements in the *general purpose* category. Particularly, the coefficient on the *Investment dummy* is 39.92 (t-statistic = 3.68) for the medium-term excess return regression and 36.87 (t-statistic= 3.18) for the long-term ones, indicating that the long-run outperformance of the *investment* placements when compared to the *general purpose* placements is not only statistically significant but also economically significant. These results confirm the earlier findings and are consistent with our argument that placements in the *investment* category are more likely to have valuable opportunities while placements in the *general purpose* category do not.

For the firm and deal characteristic variables, we find that the coefficients for *Ln_cap* are significantly negative, suggesting that smaller firms tend to have better long-run performance following the placements. The coefficients for *Controlling ownership* are significantly positive and the ones for *Discount_2* are significantly negative. These findings indicates that issuers with a higher controlling ownership and is less diluted at issuance have better long-run performance. Interestingly, the coefficients on *Announcement return* are significantly negative, implying a reverse relationship between the market reaction and long-run performance. Recalling that abnormal returns of placements around the announcement day are positive for all three categories, the result on reverse relation indicates that investors do not correctly assess the signal of the intended use of capital when placements are announced.

5. Robustness test

Our empirical findings show that private placements in the *investments* category tend to have greater valuable opportunity and issuers subsequently increase investment in capital expenditures. Most importantly, these placements are associated with a long-run outperformance when compared to their industry peers. In contrast, placements in the *general purpose* category do not have specific investment plans and the issuance of placements is more likely to be motivated by overvaluation. These placements are associated with poor long-run performance. These findings are consistent with the view that the intended use of capital stated in the placements does matter for the post-issue long-run performance.

Our results, however, can also be explained by competing hypotheses. Earlier studies have confirmed the role of insiders in private placements and found that placements sold to insiders tend to have better announcement returns and superior post-issue performance than placements sold to outsiders. Either the managerial incentive hypothesis (Wruck, 1989; Krishnamurthy et al., 2005; Wruck and Wu, 2009; Shiu and Wei, 2013) or the certification hypotheses (Hertzel and Smith, 1993) is offered to explain the phenomenon. If the outperformance (underperformance) of placements in the *investment* (*general purpose*) category is merely a manifestation of managerial incentive or certification, we would observe that placements in the *investment* category concentrate in insider placements while placements in the *general purpose* category involve more non-insider placements. We conduct robustness tests, as explained below, to examine the validity of the competing hypotheses.

To distinguish the participating investors as insiders or non-insiders, we collect the names of the private investors in the deal of placement and the relation of the investors with the issuers. Participating investors are regarded as insiders if they are controlling shareholders, directors, or managers. If an investor is a relative or a family member of the controlling shareholder, this investor is also categorized as a controlling shareholder. In each deal, if the dominant investor is insider (non-insider), then this placement is classified as "insider placement" ("non-insider placement"). Among 418 placements, we classify 200 deals as "insider placements", 208 deals as "non-insider placements", and 10 deals are undetermined.

Panel A of Table 10 reports the cross-tabulation of intended use categories and participating investor categories for 418 placements. Although earlier results show that the outperformance of placements in the *investment* category is in sharp contrast to the underperformance of placements in the *general purpose* category, both categories have more insider placements and less non-insider ones than the placements in the *recapitalization* category. It suggests that our findings are not driven by the managerial incentive or certification hypothesis.

<Table 10 is inserted about here>

Panel B of Table 10 reports the summary statistics of several variables for the insider and non-insider placements. Non-insider placements have higher FSE (the value in median is significantly different from zero) than insider placements. However, the difference in LRVTB between two investor type placements is insignificant. The result suggests that overvaluation and valuable growth opportunity in the pre-issue period is not an important consideration, or perhaps is not discerned, by insiders in deciding in which placements to participate. For the offering price, non-insider placements have a smaller discount than insider placements, implying that self-dealing is not supported in our sample. For the post-issue performance, insider placements have better long-run performance than non-insider placements. The differences in CAR[11, 480] and CAR[11, 720] between these two investor-type placements are highly significant. The result is consistent with the prediction of monitoring or managerial incentive hypotheses.

In cross tabulation, if the outperformance (underperformance) of placements in the *investment* (*general purpose*) category is merely a manifestation of managerial incentive or certification, the difference in the long-run performance between the insider and non-insider placements would be significant and the difference between placements in the *investment* category and those in the *general purpose* category would become insignificant. In cross tabulation, we calculate the medium-term (CAR[11, 480]) and the long-term stock performance (CAR[11,720]) for those placements. The results are shown in Panel C of Table 10.

The results from Panel C of Table 10 indicate that the non-insider placements actually weaken the long-run stock performance of the placements. However, the difference in the performance between the placements in the *investment* category and those in the *general purpose* category are still significant. For example, for the sample of insider placements, the placements in the *investment* category outperform the average placements in the *general purpose* category by 38.20 percent (a median of 18.49 percent) in the long-term. Similarly, for the non-insider placements, the average (median) difference in the CAR[11,720] is 33.50 percent (41.04 percent). All of these differences are economically and statistically significant.

To further control for the investor type and other deal and firm characteristics, we add a new independent variable, the *Insider dummy* (a dummy variable for the insider placements), and repeat the multivariate analysis conducted in Table 9. The new results are reported in Table 11. As shown in the Table, the coefficient on Insider dummy is positive and in regression (2) the one is significantly different from zero, suggesting that the insider placements outperform non-insider placements in the post-issue period. More importantly, all of the coefficients on the *Recapitalization dummy* and the *Investment dummy* are positive and most of them are significant. The regression results are qualitatively similar to the cross tabulation results.

<Table 11 is inserted about here>

The above analyses show that our results are not driven by the monitoring or managerial incentive hypothesis. Rather, the empirical results are more consistent with our hypothesis that when the placements are announced, issuers tend to state an investment in capital expenditure if they have a valuable growth opportunity. We find that placements in the *investment* category ultimately increase their investment in capital expenditure and experience outperformance post issue when compared to their industry peers. On the other hand, if the issuing firms are motivated by overvaluation, they tend to state *general purpose* in their announcements.

6. Conclusions

Over the past few years, private placements have become an important way for public firms to obtain equity capital relatively quickly and inexpensively. The advantage of flexibility and cost-saving in private placements is very appealing for small- and mid-cap public firms.

In this paper, we investigate a sample of 418 placements made on the Taiwanese stock markets between January 2002 and December 2010. These issuers of placements are characterized by poor performance with financial constraints. Since regulation requires disclosure of the intended use of funds raised in private placements, this provides us an opportunity to classify all placements into three categories (recapitalization, investment, and general purpose) and to examine the association of investment and the long-run performance of private placements.

Our empirical results show that managers of issuers ultimately use the funds in the accounts in a manner consistent with the stated purposes in the announcement when issued. This is probably attributable to the post-audit requirements by the competent authority. In the decomposition of pre-issue market-to-book ratios, we document that placements in the *investment* category have higher growth opportunities than those in the other two categories, and placements in the general purpose category are more likely to be motivated by overvaluation. Finally, the post-issue performance varies greatly among these three categories. While placements in the *investment* category have significantly positive long-run abnormal returns, and placements in the *general purpose* category have poor long-run performance, the ones in the *recapitalization* category are reported as having no abnormal returns. Our results are robust after controlling for deal characteristics, firm characteristics, and types of participating investors.

For the outperformance of placements in the *investment* category, we argue that the agency problem of managerial discretion on free cash flow is overcome by the emergence of the growth opportunities. Issuers significantly increase investment in capital expenditure to take advantage of valuable investment opportunities in the hope of making a turnaround. The underperformance of placements in the *general purpose* category indicates that these issuers do not have specific plans for the proceeds. Rather, they only take advantage of the overvaluation to issue new equity, and accumulate funds in less-risky accounts, such as cash, cash equivalents, and net working capital. This results in a lower post-issue return. For placements in the *recapitalization* category, an issuance of new equity provides substantial cash infusion for the issuers. The benefits from relieving financial distress risk can offset the decrease in value when growth options are converted into assets in place, where assets in place are less risky than growth options. This results in placements in the *recapitalization* category that do not have abnormal returns in the long run.

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Table 1 Distribution of Private Placements

The sample comprises 418 private placements made by firms on the Taiwan stock markets from January 2002 to December 2010. Panel A presents the frequency distribution of sample firms by cohort year. Panel B reports the frequency distribution of sample firms by industry.

Panel A: Frequency distribution of sample firms by cohort year

Cohort Year	Number of placements	% of sample
2002	4	1.0
2003	15	3.6
2004	15	3.6
2005	42	10.0
2006	61	14.6
2007	76	18.2
2008	62	14.8
2009	77	18.4
2010	66	15.8
Total	418	100.0

Panel B: Frequency distribution of sample firms by industry

Industry	Number of placements	% of sample
Food	2	0.5
Plastics	4	1.0
Textiles	11	2.6
Electric Machinery	16	3.8
Biotechnology and Medical Care	15	3.6
Iron and Steel	13	3.1
Electronic	242	57.9
Building Materials and Construction	62	14.8
Shipping and Transportation	3	0.7
Trading and Consumers' Goods	14	3.3
Others	36	8.6
Total	418	100.0

Table 2 Descriptive Statistics of Firm Characteristics

This table presents descriptive statistics for the characteristics of the sample firms and their industry peers. The sample comprises 418 private placements made by firms on the Taiwan stock markets between January 2002 and December 2010. All of the variables are the annual or the year-end figures in the preceding year. *Cash flow ratio* is earnings before interest, taxes, depreciation, and amortization (EBITDA) divided by total book assets. *CAPEX ratio* is capital expenditures divided by total book assets. *R&D ratio* is the ratio of research and development expenditures to total book assets. *Return on assets* is the net income divided by total book assets. *Cash ratio* is the ratio of cash and cash equivalents to total book assets. *NWC ratio* is the ratio of non-cash working capital (current assets minus current liabilities minus cash and cash equivalents) to total book assets. *Debt ratio* is the ratio of long-term debt plus short-term debt to total book assets. *Market cap* is the stock price times the number of shares outstanding. *Market-to-book* is defined as the ratio of market cap to book value of equity. *Controlling ownership* is the ownership of the controlling family. The last column reports *p*-values for two-tailed tests of differences in the mean (t-statistics) and median (Wilcoxon z-statistics) between issuing firms and their industry peers.

Variable	Issuing firm	Industry peers	Difference	*p*-Value
Cash flow ratio (%)				
Mean	-7.655	9.521	-17.180	0.000
Median	-1.370	10.080	-11.450	0.000
CAPEX ratio (%)				
Mean	4.204	2.703	1.500	0.000
Median	2.061	3.146	-1.085	0.067
R&D ratio (%)				
Mean	4.592	1.943	2.650	0.000
Median	2.460	2.334	0.127	0.000
Return on assets (%)				
Mean	-14.010	4.509	-18.520	0.000
Median	-6.441	4.543	-10.984	0.000
Cash ratio (%)				
Mean	11.952	11.010	0.941	0.164
Median	8.519	12.286	-3.766	0.000
NWC ratio (%)				
Mean	13.700	26.194	-12.490	0.000
Median	14.211	27.422	-13.211	0.000
Debt ratio (%)				
Mean	54.977	45.342	9.640	0.000
Median	55.866	44.006	11.860	0.000
Total Assets (NT$ million)				
Mean	6,678	2,989	3,689	0.002
Median	1,653	1,960	-307	0.000
Market cap (NT$ million)				
Mean	3,534	2,632	902	0.199
Median	789	2,782	-1,993	0.000
Market-to-book				
Mean	2.043	1.239	0.804	0.008
Median	1.247	1.313	-0.066	0.128
Controlling ownership (%)				
Mean	25.010	29.102	-4.092	0.000
Median	20.640	26.280	-5.640	0.000

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Table 3 Summary Statistics for the Deal of Private Placements

This table presents descriptive statistics for the deal. The sample comprises 418 private placements made by firms on the Taiwan stock markets between January 2002 and December 2010. *Gross proceeds* is the total dollar amount of the placements. *Fraction placed* is the fraction of the offered shares relative to the total shares outstanding after the sale. *Market-to-book* is the market-to-book value, where the market value is measured 10 days prior to the announcement, and the book value is measured at the end of the year preceding the date of announcement. *Beta* is calculated from the market model in the 230-day period beginning 240 days prior to the announcement, and *Idiosyncratic risk* is calculated as the standard deviation of the residuals from the market model. *Discount_1* and *Discount_2* are calculated as the (P1-Po)/P1, where Po is the offering price and P1 is the market price. For *Discount_1* (*Discount_2*), the market price is the share price 10 days after the announcement (1 day prior to the announcement).

	Mean	Std Dev	Median
Gross proceeds (NT$ million)	490	2,142	161
Fraction placed (%)	24.901	18.765	18.083
Market-to-book	2.031	6.126	1.243
Beta	0.654	0.384	0.687
Idiosyncratic risk (%)	3.721	1.186	3.359
Discount_1 (% relative to 10 days after announcements)	23.459	26.312	24.016
Discount_2 (% relative to 1 day prior to announcements)	18.084	25.918	19.940

Table 4 Firm and Deal Characteristics by Intended Use of Funds Categories

This table presents the summary statistics for firm and deal characteristics of private placements classified by the stated intended use of funds. The sample comprises 418 private placements undertaken by firms on the Taiwan stock markets between January 2002 and December 2010. Placements are categorized as recapitalization (*N*=229), investment (*N*=120), and general purpose (*N*=69). For the definition of firm and deal characteristics, please refer to Tables 2 and 3.

	Intended use of funds categories		
	Recapitalization	Investment	General purpose
Number of placements	229	120	69
(%)	54.785	28.708	16.507
Return on assets (%)			
Mean	-17.595	-6.958	-14.375
Median	-9.394	0.349	-4.116
NWC ratio (%)			
Mean	8.027	27.669	8.235
Median	9.659	27.597	6.635
Debt ratio (%)			
Mean	59.811	44.374	57.377
Median	59.921	44.390	59.068
Total Assets (NT$ million)			
Mean	5,683	4,204	14,280
Median	1,661	1,552	2,098
Fraction placed			
Mean	26.660	21.069	25.729
Median	20.183	15.074	17.525
Market-to-book			
Mean	2.066	1.964	2.033
Median	1.121	1.473	1.488
Discount_1 (% relative to 10 days after announcements)			
Mean	23.097	22.291	26.688
Median	24.051	24.591	23.109
Discount_2 (% relative to 1 day prior to announcements)			
Mean	17.143	17.936	21.460
Median	19.918	20.000	20.000

Table 5 Ultimate Use of Private Placements Inflows

The table presents estimates from regressions of changes in accounting in the subsequent years on the private equity proceeds and other sources of funds. The sample comprises 418 private placements undertaken by firms on the Taiwan stock markets between January 2002 and December 2010. Placements are categorized as recapitalization (N=229), investment (N=120), and general purpose (N=69). Proceeds are the total dollar amount of funds raised in the placements. TA_0 is the total book assets in the preceding year (t=0). *Cash* is the cash and cash equivalents. *NWC* is non-cash working capital (current assets minus current liabilities minus cash and cash equivalents). *CAPEX* is capital expenditures, and *LTD reduction* is reduction in long-term debt. The numbers in column t-stat are heteroskedasticity-adjusted t-statistics. Coefficients with statistical significance of 10% or less are highlighted in bold-faces type. The regression model can be stated as follows:

$$Y = \beta_1 \cdot \ln[(\text{proceeds}/TA_0) + 1] + \beta_2 \cdot \ln[(\text{other sources}/TA_0) + 1] + \beta_3 \cdot \ln[TA_0] + Year + Industry + \varepsilon$$

where dependent variable $Y = \ln[((V_t - V_0)/TA_0) + 1]$ for "real accounts" (*Cash*, *NWC*), and

$Y = \ln\left[\left(\sum_{i=1}^{t} V_i / TA_0\right) + 1\right]$ for "nominal accounts" (*CAPEX*, R&Ds, and *LTD reduction*).

Categories	t	Dependent variable: Δ*Cash*		Δ*NWC*		Σ*CAPX*		Σ *R&D*		Σ*LTD reduction*	
		β_1	t-stat.	β_1	t-stat.	β_1	t-stat.	β_1	t-stat.	β_1	t-stat.
Recapitalization	1	**0.518**	**2.81**	**0.499**	**4.76**	**0.134**	**1.83**	0.042	1.62	0.006	0.24
	2	**0.565**	**3.35**	**0.752**	**4.86**	**0.142**	**2.05**	**0.123**	**2.39**	-0.049	-0.64
	3	**0.386**	**3.25**	**0.957**	**4.91**	0.189	1.32	**0.158**	**2.74**	-0.118	-1.44
	4	**0.351**	**2.41**	**1.130**	**5.49**	0.022	0.12	0.102	1.55	-0.126	-1.42
Investment	1	**0.697**	**5.01**	**0.474**	**2.84**	**0.140**	**3.02**	0.020	0.82	-0.010	-0.29
	2	**0.494**	**3.37**	**0.389**	**2.51**	**0.337**	**3.71**	0.053	1.03	-0.025	-0.72
	3	0.084	0.70	**0.292**	**1.86**	**0.525**	**4.29**	0.004	0.07	-0.038	-0.98
	4	**0.304**	**2.28**	0.177	1.03	**0.768**	**4.84**	-0.008	-0.10	-0.038	-0.74
General purpose	1	**0.484**	**2.41**	0.430	1.38	0.030	0.44	0.014	0.58	**-0.080**	**-1.69**
	2	-0.244	-1.08	**0.949**	**3.06**	0.037	0.25	0.033	0.58	0.011	0.13
	3	0.246	0.76	0.216	0.50	0.161	0.99	0.027	0.36	0.060	0.55
	4	**0.610**	**2.11**	0.413	0.71	-0.134	-0.40	0.055	0.58	0.094	0.82

Table 6 Decomposition of Market-to-Book Ratios

This table presents the summary statistics of the market-to-book ratios and the three components for issuers of placements. The sample comprises 418 private placements undertaken by firms on the Taiwan stock markets between January 2002 and December 2010. Placements are categorized as recapitalization (N=229), investment (N=120), and general purpose (N=69). Ln_MB is the logarithm of market-to-book ratio, which is defined as the ratio of market cap to the book value of equity. The three components are firm-specific error (FSE), time-series sector error (TSSE), and long-run value-to-book (LRVTB). *p*-Values are for two-tailed tests of differences in the mean (t-statistics) and median (Wilcoxon z-statistics) between categories. Statistics with p-values of 0.10 or less are highlighted in bold-faced type.

		All issuers	Recapitalization	Investment	General purpose	Diff	*p*-Value	Diff	*p*-Value	Diff	*p*-Value
			(1)	(2)	(3)	(1-2)		(1-3)		(2-3)	
Ln_MB	Mean	0.252	0.165	0.389	0.302	**-0.224**	**(0.010)**	-0.137	(0.200)	0.087	(0.475)
	Median	0.218	0.114	0.387	0.397	**-0.273**	**(0.002)**	-0.283	(0.150)	-0.010	(0.344)
FSE	Mean	0.094	0.084	0.048	0.206	0.036	(0.515)	**-0.122**	**(0.078)**	**-0.158**	**(0.029)**
	Median	0.070	0.031	0.100	0.262	-0.069	(0.744)	**-0.231**	**(0.018)**	**-0.162**	**(0.047)**
TSSE	Mean	-0.117	-0.111	-0.138	-0.102	0.026	(0.442)	-0.010	(0.819)	-0.036	(0.460)
	Median	-0.114	-0.129	-0.115	-0.076	-0.014	(0.695)	-0.052	(0.560)	-0.038	(0.305)
LRVTB	Mean	0.275	0.192	0.479	0.198	**-0.286**	**(0.000)**	-0.005	(0.933)	**0.281**	**(0.000)**
	Median	0.265	0.169	0.471	0.184	**-0.302**	**(0.000)**	-0.015	(0.827)	**0.288**	**(0.000)**

Table 7 Announcement Abnormal Returns

This table presents the mean and median announcement returns, CAR[-1, 3] and CAR[-1, 10]. The sample comprises 418 private placements undertaken by firms on the Taiwan stock markets from January 2002 to December 2010. Placements are categorized as recapitalization (N=229), investment (N=120), and general purpose (N=69). We use the market model to calculate the announcement period abnormal return. The market model is estimated, in the [-120, -11] period, with a regression of the firm's daily stock returns against the market return. The numbers in parentheses are *p*-values.

	CAR[-1, 3] (%)		CAR[-1, 10] (%)	
	Mean	Median	Mean	Median
All placements	3.855	1.842	7.440	2.731
	(0.000)	(0.000)	(0.000)	(0.000)
Recapitalization	4.001	1.934	8.016	4.679
	(0.000)	(0.000)	(0.000)	(0.000)
Investment	2.951	1.981	6.357	1.479
	(0.002)	(0.008)	(0.000)	(0.002)
General purpose	4.945	0.914	7.409	1.938
	(0.001)	(0.017)	(0.002)	(0.023)

Table 8 Long-Run Stock Performance

The sample comprises 418 private placements undertaken by firms on the Taiwan stock markets between January 2002 and December 2010. Long-run stock performance variables are computed over two different periods: medium-term abnormal return is measured in the [11, 480] period and long-term abnormal return in the [11, 720] period. Panel A presents the CARs for all placements and placements categorized as recapitalization (N=229), investment (N=120), and general purpose (N=69). Abnormal returns are computed by subtracting the value-weighted returns of all firms in the same industry from the return of the corresponding issuing firm. We test for the difference between two placement categories using the t-test for the mean, and the Wilcoxon sign rank test for the median. Panel B presents the alphas from daily Fama-French and Carhart four-factor model, and the implied medium-term and long-term abnormal returns. The implied median-term abnormal return is calculated as $(1+alpha)^{470}-1$, and the implied long-term abnormal return as $(1+alpha)^{710}-1$. *p*-Values are for two-tailed tests and are reported in parentheses below the mean or median values. Statistics with *p*-values of 0.10 or less are highlighted in bold-faced type.

Panel A: Cumulative abnormal returns for private placements

	Medium-term abnormal return CAR [11, 480] (%)		Long-term abnormal return CAR [11,720] (%)	
	Mean	Median	Mean	Median
All Placements (N=418)	-1.965 (0.583)	-0.972 (0.566)	-1.409 (0.718)	2.590 (0.913)
Recapitalization (N=229)	-1.339 (0.786)	-1.552 (0.505)	-6.309 (0.242)	-3.044 (0.350)
Investment (N=120)	**11.113** **(0.057)**	**3.189** **(0.081)**	**18.039** **(0.009)**	**12.882** **(0.017)**
General purpose (N=69)	**-26.789** **(0.006)**	**-8.980** **(0.016)**	**-18.971** **(0.043)**	**-23.071** **(0.081)**
Recapitalization *minus* General purpose	**25.450** **(0.015)**	**7.428** **(0.042)**	12.662 (0.252)	20.028 (0.150)
Investment *minus* General purpose	**37.901** **(0.000)**	**12.169** **(0.002)**	**37.010** **(0.001)**	**35.954** **(0.002)**

Panel B: Calendar time portfolio abnormal returns for private placements

	Medium-term abnormal return Alpha [11, 480] (%)		Long-term abnormal return Alpha [11, 720] (%)	
	Daily	Implied	Daily	Implied
All Placements (N=418)	**0.0285** **(0.032)**	14.331	**0.0299** **(0.009)**	23.629
Recapitalization (N=229)	0.0272 (0.132)	13.657	0.0149 (0.348)	11.189
Investment (N=120)	**0.0530** **(0.006)**	28.279	**0.0584** **(0.000)**	51.386
General purpose (N=69)	**-0.0655** **(0.021)**	-26.495	**-0.0453** **(0.064)**	-27.509
Recapitalization *minus* General purpose	**0.0927** **(0.057)**	40.159	**0.0602** **(0.025)**	38.698
Investment *minus* General purpose	**0.1185** **(0.002)**	54.773	**0.1037** **(0.006)**	78.894

Table 9 Determinants of Long-Run Stock Performance

This table presents the regression results of the long-run stock performance for private placements undertaken by firms on the Taiwan stock markets between January 2002 and December 2010. The dependent variable in regression models (1) and (2) is medium-term stock performance, which is measured by CAR [11, 480], and the dependent variable in the models (3) and (4) is long-term stock performance, which is measured by CAR [11, 720]. Abnormal returns are computed by subtracting the value-weighted return of all firms in the same industry from the return of the corresponding issuing firm. *Recapitalization dummy* and *Investment dummy* are indicator variables that are equal to 1 if the placements are categorized as recapitalization or investment purpose, respectively. *Fraction placed* is the fraction of the offered shares relative to total shares outstanding after sale. *Controlling ownership* is the ownership of the controlling family before the placement. *Discount_2* is the private placement discount and is calculated as the $(P_1\text{-Po})/P_1$, where Po is the offering price and P_1 is the share price one day prior to the announcement. *Ln_cap* is the logarithm of the market value of shares outstanding, measured 10 days prior to the announcement. *Return on assets* is the net income divided by the total assets in the preceding year; *Debt ratio* is the book-debt ratio, which is measured as the total debt divided by the total assets at the end of the year preceding the announcement; *Market-to-book* is the market-to-book value, where the market value is measured 10 days prior to the announcement, and the book value is measured at the end of the year preceding the announcement; *Beta* is calculated from the market model in the 230-day period beginning 240 days prior to the announcement; and *Idiosyncratic risk* is calculated as the standard deviation of the residuals from the market model. *Announcement return* is measured by CAR[-1, +10]. *FSE* (firm-specific error) and *LRVB* (long-run value-to-book) are the components of the Ln_MB, which are reported in Table 5. The numbers in parentheses are White (1980) heteroskedasticity-adjusted t-statistics. Coefficients with *p*-values of 0.10 or less are highlighted in bold-faced type.

Table 9 (Contd.)

	Medium-term excess return CAR[11, 480]		Long-term excess return CAR[11, 720]	
	(1)	(2)	(3)	(4)
Intercept	-14.385 (-0.46)	-31.022 (-0.97)	11.981 (0.33)	12.268 (0.33)
Recapitalization dummy	**23.699** **(2.29)**	**22.789** **(2.24)**	8.752 (0.85)	6.697 (0.65)
Investment dummy	**38.049** **(3.49)**	**39.916** **(3.68)**	**34.749** **(3.02)**	**36.871** **(3.18)**
Fraction placed	0.204 (0.85)	0.128 (0.53)	-0.073 (-0.26)	-0.194 (-0.69)
Controlling ownership	**0.600** **(2.58)**	**0.687** **(2.88)**	**0.629** **(2.38)**	**0.743** **(2.82)**
Discount_2	**-0.498** **(-3.43)**	**-0.436** **(-3.12)**	**-0.611** **(-3.58)**	**-0.640** **(-3.81)**
Ln_cap	**-5.764** **(-1.73)**	**-6.918** **(-2.05)**	**-7.861** **(-1.85)**	**-10.657** **(-2.51)**
Return on assets	4.409 (0.24)	7.888 (0.44)	3.597 (0.18)	-1.701 (-0.08)
Debt ratio	-10.295 (-0.58)	-5.485 (-0.30)	-18.424 (-0.98)	-21.293 (-1.11)
Beta	**36.954** **(3.22)**	**40.077** **(3.47)**	**26.422** **(1.98)**	**31.723** **(2.39)**
Idiosyncratic risk	0.511 (0.14)	1.935 (0.52)	5.246 (1.38)	5.313 (1.38)
Announcement return	**-0.426** **(-1.97)**	-0.354 (-1.64)	**-0.500** **(-2.34)**	**-0.450** **(-2.08)**
Year dummies	No	Yes	No	Yes
N	418	418	418	418
Adj-R^2	0.083	0.126	0.094	0.143

Table 10 Contingency Analysis: Intended Use of Proceeds *versus* Investor Type

This table presents the contingency analysis of the placements categorized by the intended use of proceeds and by the dominant investor type. The sample is comprised of 418 private placements made by firms on the Taiwan stock markets between January 2002 and December 2010. Panel A displays the cross tabulation of the intended use of proceeds (Recapitalization, Investment, and General Purpose) and dominant investor type (insider and non-insider) for 418 placements. Panel B reports the summary statistics of the placements classified by dominant investor type. For the definition of variables, please refer to Table 9. Panel C presents the mean and median of the long-run stock performance. We test the difference between two investor type placements using the t-test for the mean and the Wilcoxon sign rank test for the median. p-Values are for two-tailed tests and are reported in parentheses. Statistics with p-values of 0.10 or less are highlighted in bold-faced type.

Panel A: Cross tabulation of the intended use of capital and investor type for 418 placements

	Recapitalization (N=229)	Investment (N=120)	General Purpose (N=69)
Insiders (N=200)	0.502	0.467	0.420
Non-insiders (N=208)	0.467	0.525	0.551
Indistinct (N=10)	0.031	0.008	0.029
Total	1.000	1.000	1.000

Panel B: Summary statistics for placements classified by dominant investor type

Placements sold to	Variables									
	FSE		*LRVB*		*Discount_2*		CAR[11,480]		CAR[11,720]	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Insiders (N=200)	0.053	0.019	0.289	0.281	13.719	19.622	7.298	6.819	8.788	11.129
Non-insiders (N=208)	0.119	0.120	0.262	0.241	22.102	20.601	-10.202	-7.561	-10.622	-4.932
Difference	-0.066	**-0.101**	0.027	0.040	**-8.383**	**-0.980**	**17.500**	**14.380**	**19.410**	**16.061**
(p-value)	(0.175)	**(0.051)**	(0.577)	(0.791)	**(0.001)**	**(0.001)**	**(0.016)**	**(0.021)**	**(0.014)**	**(0.025)**

Table 10 (Contd.)

Panel C: Long-run stock performance of placements

		Recapitalization (1)	Investment (2)	General purpose (3)	Diff: p-value (1)-(3)	Diff: p-value (2)-(3)
				CAR[11,480]		
Insiders	Mean	5.576	22.515	-15.259	20.835 (0.193)	37.775 (0.030)
	Median	6.653	11.966	3.095	3.558 (0.408)	8.871 (0.040)
No-insiders	Mean	-9.129	1.571	-32.741	23.613 (0.100)	34.313 (0.010)
	Median	-7.946	-0.283	-30.321	22.375 (0.137)	30.038 (0.013)
Difference	Mean	14.705	20.944	17.482		
	(p-value)	(0.148)	(0.073)	(0.372)		
	Median	14.600	12.249	33.416		
	(p-value)	(0.130)	(0.044)	(0.176)		
				CAR[11, 720]		
Insiders	Mean	0.424	33.137	-5.062	5.486 (0.755)	38.199 (0.057)
	Median	4.081	27.641	9.148	-5.067 (0.897)	18.492 (0.059)
No-insiders	Mean	-13.926	5.482	-28.017	14.092 (0.333)	33.499 (0.007)
	Median	-5.498	4.179	-36.859	31.361 (0.152)	41.038 (0.004)
Difference	Mean	14.350	27.655	22.955		
	(p-value)	(0.195)	(0.045)	(0.224)		
	Median	9.579	23.462	46.007		
	(p-value)	(0.136)	(0.033)	(0.077)		

Table 11 Robustness Checks: Regression Analysis of Long-Run Stock Performance

The table reports the robustness checks for the regression analysis of long-run stock performance following private placements. The sample comprises 418 private placements made by firms on the Taiwan stock markets between January 2002 and December 2010. *Insider dummy* is an indicator variable that is equal to 1 if the dominant investor in the placement is an insider of the issuing firm. For the definition of other dependent and independent variables, please refer to Table 9. The numbers in parentheses are White (1980) heteroskedasticity-adjusted t-statistics. Coefficients with *p*-values of 0.10 or less are highlighted in bold-faced type.

	Medium-term excess return CAR[11, 480]		Long-term excess return CAR[11, 720]	
	(1)	(2)	(3)	(4)
Intercept	-21.330 (-0.68)	-40.429 (-1.25)	7.419 (0.20)	4.573 (0.12)
Recapitalization dummy	**23.053** **(2.24)**	**21.642** **(2.14)**	8.328 (0.81)	5.759 (0.56)
Investment dummy	**37.665** **(3.49)**	**39.808** **(3.71)**	**34.497** **(3.03)**	**36.782** **(3.20)**
Insider dummy	11.075 (1.42)	**12.952** **(1.70)**	7.276 (0.85)	10.595 (1.28)
Fraction placed	0.266 (1.04)	0.190 (0.76)	-0.033 (-0.11)	-0.143 (-0.49)
Controlling ownership	**0.533** **(2.23)**	**0.618** **(2.53)**	**0.585** **(2.14)**	**0.687** **(2.56)**
Discount_2	**-0.474** **(-3.25)**	**-0.409** **(-2.91)**	**-0.596** **(-3.46)**	**-0.618** **(-3.64)**
Ln_cap	-5.331 (-1.60)	**-6.416** **(-1.81)**	**-7.576** **(-1.77)**	**-10.246** **(-2.41)**
Return on assets	7.002 (0.38)	11.114 (0.60)	5.300 (0.26)	0.938 (0.05)
Debt ratio	-8.626 (-0.49)	-3.665 (-0.20)	-17.328 (-0.91)	-19.805 (-1.02)
Beta	**37.125** **(3.25)**	**40.189** **(3.51)**	**26.535** **(1.99)**	**31.816** **(2.41)**
Idiosyncratic risk	-0.028 (-0.01)	1.390 (0.37)	4.892 (1.21)	4.867 (1.24)
Announcement return	**-0.398** **(-1.82)**	-0.323 (-1.47)	**-0.482** **(-2.22)**	**-0.424** **(-1.94)**
Year dummies	No	Yes	No	Yes
N	418	418	418	418
Adj-R^2	0.086	0.130	0.094	0.145

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RELATIONS AMONG COMPONENTS OF KNOWLEDGE MANAGEMENT ORIENTATION AND MARKET ORIENTATION

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Abstract

Knowledge management orientation and market orientation are the two concepts forming a mechanism for market shaping and response making, hence, creating organizational performance. This mechanism has been empirically tested. However, in view of managerial practices, managers of firms need to know how this mechanism operates in practice. To answer this question, understanding the relations among components of knowledge management orientation and market orientation is demanded. Thus, the objective of this study is to recognize these relations and to propose managerial implications basing on these relations. The study reviewed background theories to establish a set of ten hypotheses on these relations, and tested them with data extracted from enterprises in Hochiminh City with quantitative approach. The results showed that the knowledge receptivity played a driving force role to increase knowledge absorption, sharing, organizational memory. Knowledge receptivity and organizational memory caused strong positive impacts on responsiveness of market orientation. Some managerial implications are proposed basing on these relations.

1. Introduction

Knowledge management and market orientation is the two concepts creating organizational performance.

Knowledge management with the aim of increasing the organizational knowledge for higher competitive advantage is paid more attention. Basing on the resource based view of the firm, the knowledge based theory of the firm has been established (Grant, 1996). According to this theory, the knowledge is at individual person working in the enterprise. And, the role of the manager is to integrate the individual knowledge into the organizational knowledge. The firm enhances the organizational knowledge via the absorption of new knowledge from the environment. To integrate the individual knowledge as well as new knowledge into the existing organizational knowledge, the firm should have some practices to perform such functions as knowledge absorption, sharing, storing. It should also build up knowledge receptivity behaviors in the staff to increase the knowledge absorption and sharing (Wang et al., 2009). From the organizational knowledge, responses to the environment will be select, implement to create enterprise performance. Thus, firms having knowledge management are believed to create higher performance than the ones without knowledge management.

Market orientation is, in view of behavioral perspective, organizational behavior in generating and sharing market intelligence, and making response to the market (Kohli & Jaworski, 1990). Market orientation helps the organization catching quickly changes in the market and customers 'need, then sharing internally the information of change to create response to meet the changes. As such, market orientation generates high organizational performance.

The knowledge management and market orientation are studied separately and forming two fields of research. However, some recent studies have argued that the two concepts are not separated, but, combined to explain more on organizational performance.

In view of sense making theory, the firm should have a mechanism to interpret the data from the environment to shape the environment understanding, from then, to make responses to the environment (Weick et al., 2005). This mechanism is composed of knowledge management orientation as a cognitive system and market orientation as response system. Knowledge management orientation is an inside-out capability and market orientation is an outside-in capability of the firm. This mechanism was tested empirically to generate the organizational performance (Wang et al., 2009). However, in view of managerial practices, components of knowledge management orientation and market orientation are managerial practices. Thus, the understanding of relations among these components is of importance because it helps to improve managerial practices for organizational performance improvement.

As such, the objective of this study is to build up and empirically test a model presenting the relations among these components. Theoretical background for the model building, research method and results are presented in the followings.

2. Theoretical background and hypotheses

Knowledge management orientation (KMO) is the firm's relative propensity to build on its achieved wisdom as well as the propensity to share, assimilate, and be receptive to new wisdom (Wang et al., 2009). It encourages new knowledge absorption from the market, internal knowledge development, knowledge sharing, storing, positive receptivity of the knowledge. The four components of KMO are: Knowledge absorption (KA), knowledge sharing (KS), organizational memory (OM) and knowledge receptivity (KR).

Knowledge absorption (KA) is the firm's capability to recognize the value of external knowledge and assimilate it, share it and apply it to the commercial end (Cohen & Levinthal, 1990). KA increases the organizational knowledge and creates innovations from the improved organizational knowledge (Nonaka, 1994; Nonaka & Toyama, 2003). The organization will look for external new knowledge which can be integrated with the existing organizational knowledge and can solve the problem faced by the organization to absorb (Nickerson & Zenger, 2004; Nonaka & Toyama, 2003). Therefore, KA is directed basing on the knowledge integration and problem solving.

Knowledge sharing (KS) is the firm's ability to transfer knowledge, skills, technology among departments or individuals in the firm (Kim & Lee, 2006; Tsai, 2002). KS distributes knowledge and creates knowledge flows within the firm and individuals. The sharing could be vertically from managers to staff and vice verse or horizontally among the staff. It could be conducted by the organizational regulations or social interactions.

Organizational memory (OM) is an organizational mechanism to capture, store and disseminate knowledge for decision making (Huber, 1991). Explicit knowledge is coded, classified, stored and delivered to the staff with the support of IT system. OM can store tacit knowledge in forms of beliefs, knowledge, frame of reference, models, values and norms, organizational myths, legends, stories, routines, procedures, scripts to name a few (Moorman & Miner, 1997).

Knowledge receptivity (KR) is the openness and the ease of absorption to the ideas inside and outside of the organization. This is the extent to which a firm encourages ideas and judge them on a fair effective basis (Wang et al., 2008).

Market orientation (MO) is the organizational capability to meet the changes of customers' needs and create competitive advantages for the organization. MO could be defined in behavioral approach or cultural approach. In cultural approach, MO is an organizational culture to generate effective behaviors for high values to the customers and organizational performance (Narver & Slater, 1988). In behavioral approach, MO is the organizational behaviors to monitor continuously market to recognize changes in consumers' needs and make response to meet the changes. MO in this approach is composed of three components, namely, intelligence generation (IG), dissemination (ID) and responsiveness to the market (Re) (Kohli & Jaworski, 1990). MO has impacts on innovation, then, on organizational performance (Jaworski & Kohli, 1993).

Relations among the components of KMO:

As the organization has knowledge absorption, the new knowledge will be absorbed and classified, coded to store in organizational memory (Nonaka & Toyama, 2003). The organization selects the knowledge to absorb to solve its business problems in accordance with the need of the staff in the problem solving team. Hence, the absorbed knowledge accelerates the knowledge sharing (Nickerson & Zenger, 2004). Therefore, the two first hypotheses H1 and H2 are:

The knowledge absorption has positive impact on the organizational memory (H1) and the knowledge sharing (H2)

When the staff of the organization have knowledge receptivity, the staff values new knowledge, looks for new knowledge to absorb and adopt the new knowledge for sharing and innovation making. Hence, knowledge receptivity increases the level and speed of knowledge absorption, sharing (Davenport & Prusak, 1998). In addition, when having knowledge receptivity, the staff requires knowledge to act on and they need the knowledge available for sharing. They are also willing to contribute their knowledge to the others and the organization. Then, knowledge receptivity causes the development of organizational memory to store all organizational common knowledge, all knowledge contributed by the staff and make the organizational knowledge available for sharing (Davenport & Prusak, 1998). Hence, the hypotheses are presented as followings:

The knowledge receptivity has positive impact on knowledge absorption (H3), knowledge sharing (H4), organizational memory (H5).

Relations among components of market orientation

The three components of market orientation have relations with each other (Kohli & Jaworski, 1990). When having market orientation, the market intelligence collected from the environment will be encouraged to share internally for common understandings. The more market intelligence collected the more intelligence sharing. When having market intelligence shared, the staff can make more effective response to the market. Hence, two hypotheses are proposed as followings:

Intelligence generation has positive impact on intelligence dissemination (H6) and intelligence dissemination has positive impact on market response (H7)

Relations between KMO and MO components

Market orientation exists on the continuum characterized by the degree to which organizations acquire, disseminate and respond to the market information (Sinkula, 1997). Thus, components of knowledge management orientation and market orientation have some relations.

Organizational memory is a baseline for the operation of the organization. It defines the products, the market, business processes, customer data… As a market oriented organization, the staff looks for market intelligence. They base on their internal knowledge stored in organizational memory to give directions for market intelligence collection (Weick 1995). They compare the new market intelligence with the existing one stored in the organizational memory to recognize changes in the market need. When facing problems, the staff of the organization look back to the organizational memory for the knowledge to solve the problem. If the existing knowledge is not enough to solve the problem, they will look for new knowledge from the environment (Nickerson & Zenger, 2004). Thus, organizational memory functions as a baseline for looking new knowledge from the market. Hence, a hypothesis is presented as following:

H8: Organizational memory has positive impact on intelligence generation

Responses the organization makes to the market depend upon the formulation of the market changes, alternative solutions proposed. In order to do so, the discussions among the related staff are conducted. The related staff should have opened minds and receptivity to receive new perspectives from the others to consider and to contribute their opinions to the final solution (Baker & Sinkula, 1999). As such, another hypothesis is as following:

The knowledge receptivity drives the responsiveness in market orientation (H9).

In the same way, as the organization has knowledge management orientation, the staff have good behaviors in knowledge sharing by contributing their knowledge into the organizational memory for others sharing or working with each other (Nonaka & Noboru, 1998). With the knowledge sharing oriented staff, market intelligence, after collected, will be disseminated internally for discussion and response making. Then, another hypothesis is formulated as

Knowledge sharing has positive impact on intelligence dissemination (H10).

From the above hypotheses, a model presenting the relations among components of knowledge management orientation and market orientation is shown in Figure 1.

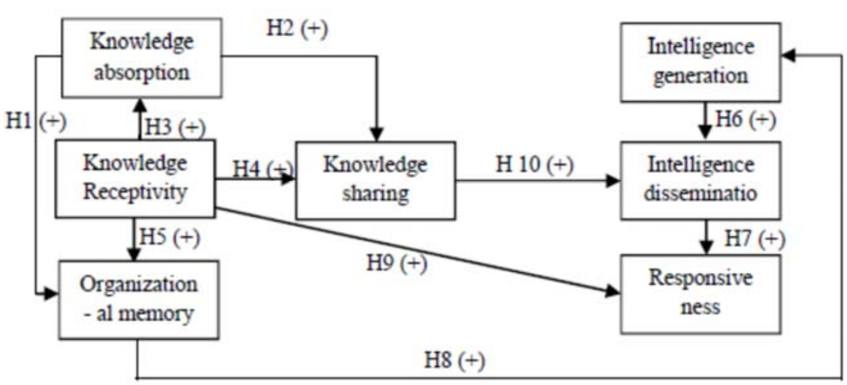

Figure 1: Model of relations among components of KMO and MO

3. Method

3.1. Research method:

Quantitative research method is used in this study. The research process is composed of two steps: First, testing the content, convergent validity, reliability of the measurement scales, then, the structure of the measurement scales with exploratory factor analysis (EFA) and, second, testing the measurement model, structural model with confirmatory factor analysis (CFA) in combination with structural equation modeling. The statistical softwares used to treat data were SPSS 20 and AMOS 5.0

3.2. Data collection

Data were collected from enterprises in Hochiminh City, Vietnam. The sampling procedure was convenient. The tool for data collection was questionnaire sent by post to the firms in accompany with a cover letter presenting the study contents and an empty envelop with stamp on it for the enterprises' reply. The questionnaires were required to be filled out by managers of the enterprises. Telephone calls to the mangers were also conducted to encourage them to fill the questionnaires and to provide the correct information. In all, 2012 questionnaires were sent out to the enterprises and there were 314 fulfilled-out questionnaires got back. Feedback ratio was 15.6%.

3.3. Measures

Components of Knowledge management orientation (KMO)
The measurement scales of KMO components were developed and tested by Wang &et at., (2009). However, due to the differences in the development of market economy between United Kingdom and Vietnam, and to assure of the validity of the concept measurement, the measurement scales of Wang & et al., (2009) were not used directly in this study. Just the list of indicators extracted by Wang &et. al., (2009) from previous studies was used as preliminary indicators of the scales and tested for their content and face validity (Crook et al., 2010; Netemeyer et al., 2003)

To test the face and contents validity of the measurement scales, interviews with seven managers were conducted. They were required to explain their understanding of the indicator descriptions and agreeing on the presence of the indicators in the measurement scales. Any of their adjustments were recorded for scale correction.

After face and content validity assessment, the measurement scale of knowledge absorption was composed of 3 indicators, knowledge sharing with 3 indicators, organizational memory with 4 indicators and knowledge receptivity with 5 indicators.

Components of Market orientation
Components of market orientation scale MARKOR of Kohli & Jaworski (1990) were used in this study. These scales were developed and tested in various contexts by many studies and given valid results. These scales were intelligence generation, intelligence dissemination and responsiveness. In the same way with KMO component scale testing, face and validity test for the components of MARKOR scale were conducted. The final measurement scales were intelligence generation with three indicators, intelligence dissemination with three indicators and responsiveness with four indicators.

All of the indicators in the measurement scales are scored with 5 point Likert scale from the lowest acceptability scored as level 1 to the highest acceptability scored as level 5.

After testing face and contents validity, all of the scales were pre-tested with a small sample of thirty managers in Hochiminh City. The data collected from this small sample were tested with EFA for measurement scale structures and Cronbach's Alpha for their reliabilities. The results of the pretest showed that the interviewees understood the indicator descriptions clearly, the measurement scales were relevant to the concepts, unidimensional. As such, the scales were ready for full scale sample collection.

4. Analysis and results

4.1. Sample descriptive statistics

Data were collected conveniently from list of enterprises in districts and industrial zones in Hochiminh City. There are 314 enterprises of which 42.0% was manufacturing, 21.0% was trading and 24.0% was service and 12.1% trading-service firms filling out the questionnaires. The employee number was varied from less than 10 persons occupying 17.5%, from 11 to 50 persons- 31%, from 51 to 100 persons –19.7%, from 101 to 200 persons – 18.8% and more than 200 persons – 12.8%. All of the enterprises started their operations more than 3 years before the date of data collection.

4.2. Measurement testing

Full scale data collected were treated with EFA for measurement scale structure. The scales' reliabilities were tested with Cronbach's Alpha. Some indicators were deleted from the original measurement scales due to their low factor loadings and/or cross loadings on other scales. Remaining indicators for measurement scales are presented in Appendix 1. After adjusting the measurement scales, they are re-analyzed with EFA and Alpha. Results showed that the scales were acceptable in structure, having unidimensionality, convergence validity (with factor loading of over 0.605), averaged variance extracted of over 59.31%, and reliability with Cronbach's Alpha of over 0.631. Details of the results are presented in Table 1.

These scales were ready for confirmatory factor analysis (CFA) with structural equation modeling. Results of CFA for each measurement scale are presented in Table 1. Most of standardized regression weights were over 0.70 except KA13 and KS 16 at 0.587. Variances extracted were over 0.57, composite reliabilities were higher than 0.68. These showed that each measurement scale was unidimensional, convergent, and assured of internal consistency (Hair et al., 2010). Details of CFA for each scale are presented in Table 1. As such, a measurement model composed of all measurement scales was also built and tested with CFA for their scale structures, convergence, discriminant analysis and their fitness to the data. Criteria for the fitness were χ^2/DF <3, CFI>0,9, TLI >0,9 and RMSEA<0,05 (Kline, 2010).

The results showed that the measurement model was well fitted with the data with $\chi2$ = 1031,711 DF=480, $\chi2$ /DF= 2,149, CFI=0,901, TLI=0,898, RMSEA=0,061. The structure of each measurement scale was unidimensional and convergence (with factor loading of over 0.648). The 95% reliability range of correlation coefficients between any pair of the scales in the measurement model did not cover unit. This was a proof of the discrimination among the measurement scales (Gerbing & Anderson, 1988). The results are shown in Table 2. Thus, the scales were acceptable for the structural model testing.

Table 1: Results of each measurement scale test with exploratory and confirmatory factor analysis

	EFA analysis					CFA Analysis		
	KMO of observed items	Factor loadings	Averaged Variance extracted	Item-to-total coefficients	Cronbach 's Alpha	Standardized regression weight	Variance extracted	Composite reliability
Knowledge absorption (KMO=.627)			62.70%		0.631		57.20%	0.680
KA13	.692	.605		.4738		.587		
KA14	.519	.844		.5233		.814		
KA15	.518	.868		.5753		.842		
Knowledge sharing (KMO=.672)			59.31%		0.721		57.16%	0.696
KS16	.740	.618		.5271		.588		
KS17	.662	.852		.6411		.825		
KS18	.671	.819		.5902		.802		
Organizational memory (KMO=.725)			81.54%		.887		78.92%	.907
KM19	.727	.902		.7780		.898		
KM20	.672	.930		.8314		.915		
KM21	.796	.876		.7321		.852		
Knowledge receptivity (KMO=.713)			71.95%		.803		66.71%	.799
KR23	.705	.853		.6587		.832		
KR24	.710	.850		.6551		.816		
KR25	.726	.841		.6402		.802		
Intelligence generation (KMO=.705)			74.29%		.820		72.37%	.803
IG28	.675	.882		.675		.878		
IG29	.675	.883		.675		.871		
IG30	.792	.820		.792		.801		
Intelligence dissemination (KMO=.698)			74.34%		.826		71.27%	.835
IS31	.670	.877		.7076		.858		
IS32	.801	.808		.6039		.802		
IS33	.645	.899		.7440		.871		
Responsiveness (KMO=0.769)			63.06%		.798		60.83%	.811
IR34	.627	.794		.5761		.782		
IR35	.627	.836		.6444		.815		
IR36	.692	.750		.5633		.741		

From then, a structural model was built and tested with CFA and structural equation modeling. The structural model was well fitted with the data with $\chi2$ = 366.733 DF=17. $\chi2$/DF= 2.157. CFI=.934. TLI=.918. RMSEA=.061. As such, results computed from the structural model were accepted.

Table 2: Discriminant analysis of the measurement scale

			Correlation estimate	Standard errors	95% reliability range		C.R.	P
					Upper level	Lower level		
KA	<-->	IG	.125	.036	.197	.053	3.456	***
KA	<-->	ID	.108	.026	.160	.056	4.109	***
Re	<-->	KA	.198	.039	.276	.120	5.037	***
KS	<-->	IG	.219	.037	.293	.145	5.952	***
KS	<-->	ID	.141	.029	.199	.083	4.840	***
Re	<-->	KS	.268	.040	.348	.188	6.754	***
KR	<-->	IG	.319	.046	.411	.227	6.992	***
KR	<-->	ID	.187	.037	.261	.113	5.083	***
Re	<-->	KR	.357	.048	.453	.261	7.428	***
OM	<-->	IG	.344	.046	.436	.252	7.533	***
OM	<-->	ID	.182	.036	.254	.110	5.107	***
Re	<-->	OM	.303	.044	.391	.215	6.855	***
KA	<-->	KS	.186	.035	.256	.116	5.300	***
KA	<-->	KR	.201	.040	.281	.167	5.029	***
KA	<-->	OM	.247	.042	.331	.163	5.908	***
KS	<-->	KR	.293	.042	.377	.209	6.931	***
KS	<-->	OM	.273	.040	.353	.193	6.810	***
KR	<-->	OM	.424	.052	.528	.320	8.131	***
IG	<-->	ID	.215	.040	.295	.135	5.400	***
Re	<-->	IG	.333	.045	.423	.243	7.420	***
Re	<-->	ID	.229	.042	.313	.145	5.460	***

Hypothesis testing

The regression coefficients computed from the structural model analysis are presented in Table 3 and Figure 2. All of the regression coefficients were significant statistically with C.R>1.96. P<0.05 and positive (Byrne. 2010).

Table 3: Regression coefficient between components of KMO and MO

Components			Regression coefficients		Standard error	C.R.	P
			Unstandardized	Standardized			
KA	→	OM	.261	.217	.076	3.426	***
KA	→	KS	.226	.245	.072	3.132	.002
KR	→	KA	.377	.429	.069	5.432	***
KR	→	KS	.474	.587	.068	6.931	***
KR	→	OM	.708	.669	.077	9.146	***
KR	→	Re	.246	.240	.096	2.563	.002
IG	→	ID	.279	.537	.057	4.864	***
ID	→	Re	1.237	.638	.056	4.827	***
OM	→	IG	.366	.382	.083	4.410	***
KS	→	ID	.102	.157	.041	2.410	***

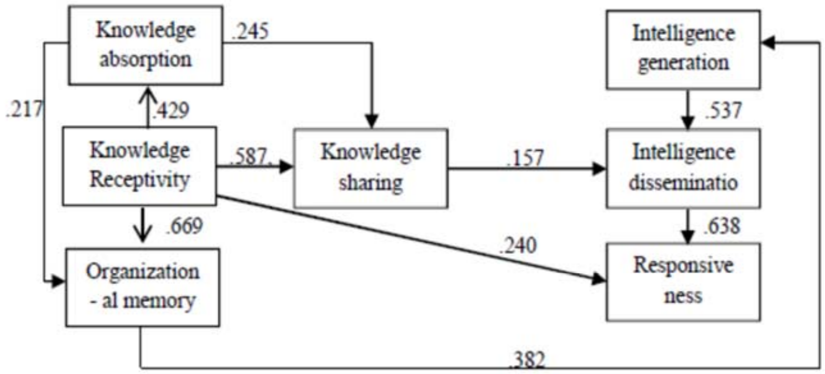

Figure 2: Standardized regression coefficients

These regression coefficients pointed out significant positive relations among these components. Therefore, the ten hypotheses stated above were supported by the data.

5. Discussions

Relations among components of knowledge management orientation (KMO)

Results showed that the four components of KMO have interrelations with each other. Knowledge receptivity played a central role. It had a strongest relation with organizational memory (β=0.669), then, with knowledge sharing (β=0.587), and knowledge absorption (β=0.429). This means that the opened mind and positive behavior to new knowledge are driving force to increase the new knowledge absorption to the organization, sharing existing and new knowledge within the organizational staff. The knowledge receptivity increases the knowledge flow within the organization, hence, increases the knowledge to be stored in the organizational memory.

Knowledge absorption has impacts on organizational memory (β=0.217) and knowledge sharing (β=0.245). Knowledge receptivity impacts organizational memory via direct path and indirect path through knowledge absorption. The path analysis was applied to estimate this integrated impact giving the result of 0.762. In the same way, knowledge receptivity causes impacts on knowledge sharing directly and indirectly via knowledge absorption. This integrated impact is 0.692. This means that the knowledge receptivity explained 76.2% of variance of the organizational memory and 69.2% of variance of knowledge sharing.

Relations among components of market orientation

Results show that intelligence generation has impact on intelligence dissemination (β=0.537) and intelligence dissemination increases responsiveness (β=0.638). These results were in confirmation with some other research (Kohli et al.. 1993)

Relations among components of knowledge management orientation and market orientation

It is very interesting in this study that relations among components of knowledge management orientation and market orientation are recognized.

Knowledge receptivity has positive impact on responsiveness (β=0.240). When having knowledge receptivity, the staff always value, look for knowledge and direct their behavior in sharing knowledge, integrating existing knowledge with new knowledge (Nonaka. 1994; Wang et al.. 2008). Hence, the knowledge is fully distributed within the organization. Innovative opinions are also encouraged to present and judged equally. All brings innovative solutions to the organization, and, a higher probability of having good responses to the market.

The organizational memory accelerates the intelligence generation (β=0.382). The intelligence generation is a directed activity. It bases on the vision, belief of the organization in serving customers and using organizational routines, procedures to look for changes in market, customer demands. The data, information stored in the organizational memory could be analyzed for earlier recognition of customer demand changes and the collection of market data will be conducted for confirmation of this recognition. This is the way the organization shapes the market before making response to the market.

The knowledge sharing drives the intelligence sharing knowledge (β=0.157). The behavior of knowledge sharing will be applied to all kinds of knowledge including market intelligence.

To understand more of the impact of the four components of knowledge management orientation on responsiveness – the action made to the market - path analysis was applied.

The impact of knowledge receptivity to responsiveness is integrated from the direct impact KR→Re and indirect impact KR→ID→Re. Since intelligence dissemination is influenced by knowledge receptivity through two indirect impacts: KR→KS→ID and KR→OM→IG→ID, the total impact of knowledge receptivity to intelligence dissemination was computed and equals 0.246. The indirect impact of knowledge receptivity to responsiveness was 0.157. Hence, the total impact of knowledge receptivity to responsiveness was 0.397. These results show a strong impact of knowledge receptivity to intelligence dissemination and responsiveness.

In the same way, organizational memory influences on responsiveness via the path OM→IG→ID→Re. The path analysis results in this impact strength of 0.131.

The influence of knowledge absorption to responsiveness is integrated from the impacts of KA→OM→Re and KA→KS→ID→Re. The total impact is 0.053. This result shows that the absorption of new knowledge has very limited impact on the responsiveness. Similarly, the impact of knowledge sharing to responsiveness is through KS→ID→Re and equals 0.100.

In all, the knowledge receptivity explained 24.6% variance of intelligence dissemination and 39.7% variance of responsiveness. The organizational memory explained 13.1% , the knowledge sharing explained 10.0% and the knowledge absorption explained only 5.3% variance of responsiveness.

The results show that responses made to the market depend much upon knowledge receptivity, then, on organizational memory, finally, on knowledge sharing. The absorption of new knowledge from the environment has very limited impact on the responses.

These results could be explained by the fact that most Vietnamese enterprises are of small and medium size (SME) and established by entrepreneurs who have internal locus of control, are flexible to change and accept risks of changes for the enterprise development (Nguyen et al.. 2008). They have knowledge receptivity and set up themselve as a symbol of knowledge receptivity for the staff to follow. Hence, they share their knowledge to the staff and set up routines, procedures – a type of organizational memory - to perform the task and encourage the staff to follow. They encourage the staff to present new opinions to do something and put the opinions into the organizational memory for sharing. As such, knowledge receptivity is the main driving force for the other components of knowledge management orientation, particularly, organizational memory and knowledge sharing. The investment of IT system in organizations will be ineffective if there is no staff's knowledge receptivity.

Because of having internal locus of control the entrepreneurs often try to sustain and develop their enterprises with the existing knowledge stored in organizational memory. They do not pay much attention to the new knowledge in the environment to absorb. Hence, organizational memory has more impact on responsiveness than knowledge absorption and knowledge sharing. Due to low level of new knowledge absorption, Vietnamese enterprises have low level of technologies, less innovation as compared with other enterprises in the region (Swierczek & Ha. 2003; World-Bank. 2010)

Managerial implications of the results

The results suggest following managerial implications for the management of the enterprises:

Knowledge receptivity plays a driving force role for knowledge management orientation and responsiveness. The knowledge receptivity should be built in the enterprises to develop knowledge sharing, organizational memory and making response to the market. The knowledge sharing behavior has also impact on responses to the market. Hence. the positive behaviors to receive and share new knowledge are encouraged. The culture of knowledge receptivity and sharing should be set up.

The organizational knowledge should be recorded in organizational memory. The organizational vision, mission should be established and encapsulated in organizational routines, procedures and processes. Knowledge should be classified, coded and recorded in organizational memory. The staff should be encouraged to access the organizational memory for intelligence generation and making responses to the market. In turn, the intelligence collected should also be put into the organizational memory for its development. These will increase the effectiveness of response to the market.

The knowledge absorption, although important in principle, is not focused by the enterprises. It causes shortage of new knowledge in general market, technologies, legal regulations…These shortages make the enterprises have few innovations, low competitiveness. The knowledge absorption should be improved to overcome these weaknesses.

. Conclusion

Knowledge management orientation is a high level concept composed of knowledge absorption, sharing, receptivity and organizational memory. Market orientation is also a high level concept structured from intelligence generation, dissemination and responsiveness. The integration of the two concepts creates a mechanism for market recognition, response making and organizational performance. However, the relations between the components of the two concepts are not recognized. Hence, managerial practices basing on integration of these concepts for organizational performance improvement are not built up. Therefore, this study aimed at recognizing these relations and proposing managerial implications from these relations for organizational performance. The study built up and tested a model of these relations basing on data from enterprises in Hochiminh City with the quantitative approach. The results showed that the components of the two concepts had close relations with each other. Knowledge receptivity was the driving force to increase knowledge absorption, sharing and organizational memory.

Intelligence generation had positive impact on intelligence dissemination, and, in turn, the intelligence dissemination had positive influence on responsiveness. The four components of knowledge management orientation had positive impacts on the components of market orientation, particularly, the responsiveness. Knowledge receptivity explained 39.7%, organizational memory explained 13.1% and knowledge sharing explained 10% variance of responsiveness. Some managerial implications of the results have been proposed.

Since the sampling frame of this study was enterprieses in Hochiminh City, the results are not surely applicable to other provinces in Vietnam where there are differences in economic development and managerial practices. The convenient sampling also impacts on the results. Hence, studies with sampling frame in other provinces and randomly sampling should be replicated to reconfirm these results.

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Appendix 1

Measurement scales in this study

Measurement scale	Indicator name	Indicator description
Knowledge management orientation		
Knowledge absorption	KA13	Enterprise absorbs outside knowledge to perform its activities
	KA14	Enterprise uses IT to look for new information about market and environmental changes
	KA15	The sharing of new knowledge generates new opinions to improve the business
Knowledge sharing	KS16	Enterprise has an IT system and a place for the staff to meet and share knowledge as well as learn with each other.
	KS17	Knowledge is fully shared vertically and horizontally
	KS18	All members share knowledge with other members having the same interest
Organizational memory	KM19	Enterprise has a system to classify and code opinions. knowledge for storage and re-use.
	KM20	Enterprise analyzes systematically projects. works performed to record experiences and best practices.
	KM21	Enterprise maintains very often information system and continuously update information stored in it
Knowledge receptivity	KR23	Organizational culture supports discussions and encourages new opinions.
	KR24	All new opinions are encouraged to present and judged fairly
	KR25	Enterprise values and judges all opinions basing on the opinion contents not on the persons suggesting the opinions.
Market orientation		
Intelligence generation	IG28	Enterprise meets customers at least once a year to look for new products or services that customers need in the future
	IG29	Enterprise recognizes quickly changes in customer need.
	IG30	Enterprise invites customers at least once a year to evaluate its product quality
Intelligence dissemination	IS31	The marketing staff of the enterprise spend time to discuss future need of customers with staff of the other functions.
	IS32	When an important thing happens to a key customer of a business territories. the whole trading unit will be informed of it in very short time.
	IS33	Data on customer satisfaction are shared very often to all level of the trading unit.
Responsiveness	IR34	Enterprise makes quick response to changes in the competitors' prices
	IR35	Enterprise always responses to changes in customers needs.
	IR36	Enterprise reviews periodically its efforts in product development to make sure that the product meeting customers' demands.

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Evaluating Senior and Junior Debts by Considering Default Urgency

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This article proposes a new perspective, the default urgency (DU), to evaluating both senior debts and junior debts. The default urgency describes firm's and claimant's degree of suffering default risk. We value subordinated debts and examine default cost, default probability, and default spread under a consideration of debt' default urgency. We find that senior debts' value is influenced by deep and shallow degrees of default urgency. However, junior debts' premium decreases and default spreads increase as a shallow degree of default urgency appears. Moreover, the default urgency changes full-payable probability, default probability, and bankruptcy probability.

***Key words**: default urgency, subordinated debt, default spread*

JEL classifications: G13, G23, G33.

1. Introduction

A corporate debt, issued by a firm for the purpose of raising funds, provides cash flows for the debt holders. The firm is obliged to redeem promised repayments at face value, along with interests, to the holders of corporate debts, with debt claimants having priority over other equity. A senior debt claimant takes priority over a subordinated debt claimant in the case of a conflict of interest among between claimants. As a firm's value remains low, the senior debt claimant first receives the promised repayment from the issuer, and the junior debt claimant then receives the residuals. If the firm value is low enough, the firm may go bankrupt and end up paying nothing to either debt holders. In other words, given different firm values and priority orders, the both the holders and issuers of corporate debts face different levels of default urgency with respect to the promised repayments.

In this study, we analyze corporate securities under a consideration of the default urgency. If the firm's value of assets is high enough, the firm has enough funds to pay the promised face values to the debt holders on maturity, in which case the claimants and firm can be said to be free from default urgency. Under other conditions, the firm's value of assets makes it possible for the firm to pay the senior debt claimants, but is insufficient to allow it to pay the junior debt claimants. This means there is shallow default urgency for the security claimants. Furthermore, if the firm's value gradually decreases, the firm more urgently pays debt claimants, even then the firm pays nothing to the junior debt claimants. In this type of situation, the firm has deep default urgency. Finally, under conditions where the firm's asset value approaches a very low point, the firm may go bankrupt and may end up not paying anything to either junior or senior debt holders. Therefore, the issue of *how much* the holders of corporate securities receive on maturity depends on a degree of default urgency.

We analyze four aspects from the perspective of default urgency. First, we solve subordinated debts' values. Second, we analyze firm's default cost. third, we also discuss default spreads. Finally, we analyze default probabilities in various degrees of default urgency. The default urgency describes a degree of how firm and claimants suffer from debt's default risk.

Under various degree of default urgency, firm's default costs differ. As a firm stays in a condition of shallow degree of default urgency, the default cost is lower than it is for a firm that stays in a condition of deep degree of default urgency. That is, if the junior debts are defaulted upon and the senior debts are paid by the firm, the default cost is lower. Otherwise, if the senior debts cannot be paid on maturity, the default costs tend to be higher because the firm has larger default urgency. The default costs affect the possibilities of debt holders receiving the promised repayments of corporate debts, and can further change the valuations of senior debts and junior debts.

Another major stream of theoretical analysis in the area of subordinated debts involves analyzing a default risk represented by a default spread (for example, Anderson and Sundaresan 1996, Nivorozhkin 2005a, Zhang et al. 2014). Given various conditions of default urgency for a firm, the degrees of default risk are markedly different for senior and junior debt claimants. For example, the holders of senior debts may have a low default risk as a firm stays in a condition of shallow default urgency, whereas they may have a high default risk if the firm stays in a condition of the deep default urgency. Specifically, we compare the default spreads between senior and junior debts under differential default urgencies to examine the impacts of default urgency on the default spreads of corporate debts. We expect that the spread is greater for a deep degree of default urgency.

We also analyze which conditions of default urgency are more likely to appear. That is, we discuss default probabilities in a shallow degree, a deep degree, a full-payable, or a bankruptcy under default urgencies. For example, in a certain interval, an increase in a firm's value may increase the probability of shallow default, and may decrease the probability of bankruptcy. Specifically, these probabilities may change the valuations of corporate debts, so it is important to analyze both the default probability and the bankruptcy probability in the valuations of corporate debts. In addition, the cost of default affects the intervals of various conditions under a given level of default urgency. For example, a high default cost may increase the bankruptcy stress and decrease the shallow default urgency, in which case the default cost changes the possibilities of default events or bankruptcy events occurring. The study thus solves and analyzes the full-payable probability, shallow default probability, deep default probability, and bankruptcy probability, in terms of a firm's value and the default costs.

A lot of financial literature has analyzed corporate securities, specifically focusing on subordinated debts, in terms of their valuations and designs (see, for example, Black and Cox 1976; Scott 1977; Stulz and Johnson 1985; Diamond 1993; Barclay and Smith 1995; Welch 1997; Chen, Jen, and Choi 1999; Belkhir 2013; and others). Black and Cox (1976) first analyzed subordinated debts using an option pricing theory, and derived a closed-form result for corporate bonds without a consideration of bankruptcy costs and default urgencies. Stulz and Johnson (1985) valued and analyzed the priority of corporate debts and found that the use of secured debt increased the firm values. Considering an asymmetry and financial distress, Welch (1997) explained the debt's claim priority. Diamond (1993) discussed a relation between a seniority and maturity of debt contracts, and found that a short-term debt was senior to a long-term debt. Chen *et al*. (1999) theoretically analyzed a determination of seniority structure of corporate debts and empirically examined a relation between the seniority structure of corporate debts and their characteristics. Numerous studies also argued that a structure of senior debts and junior debts affected its market values.

More recent studies of subordinated debt involve a wide integrated analysis taking account other financial issues (see, Nivorozhkin 2005a,b; Hackbarth and Mauer 2012; Belkhir 2013; Nguyen 2013; Miller et al. 2015; and others). Jointly analyzing the debt priority and optimal capital structures, Hackbarth and Mauer (2012) studied an interaction between financing and investment decisions. Belkhir (2013) examined a market discipline of bank risks to answer a question of whether banks implemented risk management policies that taking account a risk preference of subordinated debt claimants. A relevant study by Nivorozhkin (2005a,b) took account of a bankruptcy cost in the valuations of subordinated debts, and framed in the option pricing theory. They analyzed market disciplines and informational content of subordinated debts incorporating bankruptcy costs, respectively. Miller et al. (2015) employ a spread of subordinated debt as predictors of bank distress, and suggest that the spread is useful tool for warning systems during the financial crisis.

Our article differs from previous studies and contributes to financial literature in followings. Under a variety of default urgency, the bankruptcy or default probabilities and default costs are differential for the holders of corporate debts. Previous studies have not yet examined this practical fact. Specifically, the default costs under a condition of shallow default urgency should differ from those under a condition of deep default urgency. This study first explores the bankruptcy probability, deep and shallow default probabilities, and full-payment probability under different levels of default urgency.

In short, this study attempts to analyze the valuations of senior and junior debts, differential default costs, default spreads, and default and bankruptcy probabilities under different levels of default urgency. First, this study solves a closed-form result for the senior debts and junior debts, and analyzes debt values with respect to firm value and default costs. Second, since the default risks are different in these various conditions of default urgency, this study derives and discusses the default spreads of senior debts and junior debts, to compare these default spreads in terms of firm value and default costs. Third, probabilities of full-payment, shallow default, deep default, and bankruptcy are solved and analyzed under default urgency. Specifically, how the shallow and deep default costs change these probabilities is discussed.

The study is organized in four main sections. The section entitled "Valuations of Corporate Securities under default urgency" describes the theoretical models of the problem and solves closed-form results of security values and default spreads. We also derive the default probabilities and bankruptcy probabilities in this section. The second section, "Numerical Calibration", provides numerical examples for characterizing the debt values, default spreads, and default probabilities under a given level of default urgency. We also elaborate on the economic implications for these results. The third section, "Conclusion" summarizes main findings. Finally, the "Appendix" outlines how the valuations of corporate securities are derived.

2. Valuations of Corporate Securities under Default Urgency

We develop a continuous-time model to solve closed-form results for corporate equity, junior debt, and senior debt, considered under different levels of default urgency. This study also derives the default spreads of junior debt and senior debt, as well as the default probabilities associated with different levels of default urgency, in order to examine *how* the different default costs affect the valuations of corporate debts.

Framing the problem in a continuous-time model, this study makes the same preliminary assumptions as the previous works of Black and Scholes (1973), Merton (1974), Black and Cox (1976), Nivorozhkin (2005a,b). Dynamic process of the underlying firm's value (V) of the corporate securities is assumed to be generated by a geometric Brownian motion (GBM) process framed in a complete probability space (Ω,F,P) with filtration $\{F_t\}$, as follows:

$$dV(t) = \alpha S(t)dt + \sigma SdW \tag{1}$$

Where α and σ denote the instantaneous expected growth and volatility rates of the underlying firm value, respectively, while a stochastic variable W is assumed to follow a Wiener process with a mean value of zero and a standard deviation of one. In addition, a risk-free bond provides interest with a rate (r), in which the borrowing and lending rates are assumed to be equal and constant. Thus, the dynamic process of the risk-free bond price (B) is governed as follows:

$$dB(t) = rB(t)dt \tag{2}$$

The firm's values are shared by one equity-holder and two debt-holders at maturity date ($t = T$), where two debt claims on the firm's value are differentiated by their priorities, but share the same maturity date. The holder of senior debts (S) has first priority and the holder of junior debts (J) has a subordinate priority, while the holder of equity (E) is last in terms of priority.

If a firm does not make the promised repayments of the debts, the direct default costs can cause dead-losses for the firm's value. Specifically, if the firm defaults on making the final repayments (L) to the holders of junior debt but the firm makes the repayments (K) to the holders of senior debt, a shallow default condition arises, and a smaller default cost (c) reduces the firm's value. Furthermore, if the firm defaults on making the promised repayments to the holders of both kinds of debt, a deep default urgency condition arises, and the firm bears the burden of a larger default cost (b). That is, the default costs are different for shallow default conditions and deep default conditions within a framework of different degrees of default urgency. The default cost tends to become larger as the senior debt goes into default, compared to the cost when the junior debt goes into default. However, the default costs are still generally lower than the repayment values of the debts (i.e., $c < b < K, L$).

The amounts of the payoffs the claimants can expect to receive on maturity relating to both the firm's value and the default costs. When a firm's value is greater than the sum of the total debts' face values (K+L), both junior and senior debts can be paid off, and the equity-holder obtains the residual value. If the firm's value does not exceed the sum of the total debts' face values, but exceeds the sum (K+c) of the face value of the senior debt and the shallow default cost, the senior debt claimant can expect to obtain the full amount of the promised repayment and the junior debt claimant expects to obtain the residual value (V-K-c) after the firm pays the repayments (K) to the senior debt claimant and absorbs the dead loss of the default costs (c). In this case, the equity holder gets nothing. Furthermore, if the firm's value does not exceed the sum (K+c) of the face value of the senior debt and the shallow default cost, but exceeds the sum (b+c) of the shallow and the deep default costs, the junior debt claimant expects to receive nothing, while the senior debt claimant obtains the firm's residual value ($V - b - c$). In addition, as the firm's value is lower than the sum (b+c) of the shallow and the deep default costs, the firm's value is disposed to outside claimants (such as accountants, lawyers, staff, or government), and the holders of corporate securities receive nothing.

This study differentiates between four possible financial conditions for the firm, depending on the various degrees of default urgency. In stress condition *I*, on maturity, both senior and junior debts can be fully paid under a condition of sufficient firm value (i.e., K+L< V). In stress condition *II*, the firm cannot make full repayment to the holder of the junior debt, but can make full repayment to the holder of the senior debt, owing to the fact that the firm's value does not exceed the sum of the total debts' face values, but exceeds the sum of the face value of the senior debt and the shallow default cost (i.e., $K + c < V < K + L$). We can say that this represents a condition of shallow default urgency for the firm. In stress condition *III*, the firm stays in a deep default urgency condition, meaning that the junior debt claimant cannot receive any payoff, and the senior debt claimant obtains only a portion of the final promised repayment (i.e., $b + c < V < K + c$). In stress condition *IV*, the firm goes into bankruptcy. The default costs are different under the different degrees of default urgency, as a result of practical facts. We summarize the aforementioned descriptions of the four possible conditions in Table 1.

The values (E, S, and J) of the corporate securities upon maturity depend directly on the level of the firm's value, the promised repayments, and the amounts of the default costs. First, this study determines the equity values under the option pricing theory. The equity holders can receive residual values only if the firm's value is sufficient to make the repayments to the debt claimants on maturity, in which case the firm's financial situation falls under condition *I*. Otherwise, the equity-holders receive nothing under conditions *II*, *III*, and *IV*. The value of the equity on maturity is expressed as follows:

$$E(T) = \max(V(T) - (K + L), 0) \tag{3}$$

It is obvious that the equity value has same formula of a European plain vanilla call option on the firm value, with a strike price of $K+L$. Applying option pricing theory, the closed-form solution for the equity at time t is naturally derived as follows:

$$E(t) = V(t)N(d_1) - (K + L)e^{-r(T-t)}N\left(d_1 - \sigma\sqrt{T-t}\right) \tag{4}$$

where $N(d_i)$ is the cumulative density function of a standard normal distribution with a mean value of zero and a standard deviation of one, and where the cumulative range of probability is from negative infinity to d_i. Here d_1 is calculated as follows:

$$d_1 = \frac{ln\left(\frac{V(t)}{K+L}\right) + \left(r + \frac{1}{2}\sigma^2\right)(T-t)}{\sigma\sqrt{T-t}}$$

Thus, the valuation of corporate equity is the same as that of a European call option on the firm's value, with a strike price equaling the sum of the junior and senior debts' face values. The firm value, promised repayments, time to maturity and related factors can all influence the value of equity securities.

Next, this study values the junior debts, taking into account the levels of default urgency. At maturity date, if the firm's value is larger than the sum (*K*+*L*) of the outstanding debt repayments, which means all of the claimants stay in the full-payable condition, the junior debt claimant obtains full amount of the promised repayments. When the firm value is lower than the sum of the promised repayments (*K*+*L*) but exceeds the value of (*K*+*c*), the holder of junior debt obtains residual values after the firm pays the senior debt claimant and default costs, in which case the firm can be said to be in a condition of shallow default urgency. When the firm's value is lower than the value of (*K*+*c*), the holder of a junior debt will receive nothing. We can briefly summarize these results in mathematical form, as follows:

$$J(T) = \begin{cases} L, & K+L < V(T) \\ V(T) - K - c, & K+c < V(T) < K+L \\ 0, & others \end{cases} \tag{5}$$

Using the same techniques as we use for the valuation of corporate equity, this study solves a closed-form result for the junior debt, which we consider under default urgency, as follows.

$$J(t) = Le^{-r(T-t)}N\left(d_1 - \sigma\sqrt{T-t}\right) + V(t)[N(d_2) - N(d_1)]$$

$$-(K+c)e^{-r(T-t)}\left[N\left(d_2 - \sigma\sqrt{T-t}\right) - N\left(d_1 - \sigma\sqrt{T-t}\right)\right] \tag{6}$$

where

$$d_2 = \frac{ln\left(\frac{V(t)}{K+c}\right) + \left(r + \frac{1}{2}\sigma^2\right)(T-t)}{\sigma\sqrt{T-t}}$$

The valuation of junior debts under default urgency becomes more complicated than that of junior debts without default costs (See, Black and Cox 1976, and Nivorozhkin 2005a,b). In equation (6) the junior debts can be regarded in the same way as a portfolio of three call options on the firm's value with various strike prices. Specifically, the shallow default cost plays a role in the pricing of junior debts, in the case where a condition of shallow default urgency appears.

The possible payoff of the senior debts on maturity is determined as follows. The holders of senior debts can receive the full amount of promised repayments when the firm's value is larger than (K+c), in which case the firm remains under the conditions of fully-payable and shallow default urgency. However, the senior debt claimants can receive part of the promised repayments when the firm's value is between (K+c) and (V-b-c) on maturity, in which case the firm stays in a condition of deep default urgency. Thus, the value of senior debts can be written as follows:

$$S(T) = \begin{cases} K, & K + c < V(T) \\ V(T) - b - c, & b + c < V(T) < K + c \\ 0, & others \end{cases} \tag{7}$$

Using a procedure similar to the pricing of junior debt and equity, the closed-form result for senior debt is as follow:

$$S(t) = Ke^{-r(T-t)}N\left(d_2 - \sigma\sqrt{T-t}\right) + V(t)\left[N(d_3) - N(d_2)\right]$$

$$-(b+c)e^{-r(T-t)}\left[N\left(d_3 - \sigma\sqrt{T-t}\right) - N\left(d_2 - \sigma\sqrt{T-t}\right)\right] \tag{8}$$

where

$$d_3 = \frac{ln\left(\dfrac{V(t)}{b+c}\right) + \left(r + \dfrac{1}{2}\sigma^2\right)(T-t)}{\sigma\sqrt{T-t}}$$

This study derives three formulas of corporate securities under a consideration of different degrees of default urgency. Examining the values (4), (6), and (8), of equity and debts, we find that several parameters affect the valuations of corporate securities. The firm value (V), promised repayments (L and K), risk-free rate (r), time to maturity (T-t), return volatility of firm value (σ), and default costs (b and c) under default urgency can directly change the valuations of corporate securities. Specifically, the shallow default cost (c) can affect the premiums associated with both junior debts and senior debts, while the deep default cost (b) only affects senior debts, because how the junior debt claimants receive final repayments is independent of the level of deep default cost.

To examine the risk premiums of corporate debts under varying levels of default urgency, this study calculates the default spread, that is, the difference in yields between the corporate debts and a risk free bond. Thus, the default spreads of junior debt and senior debt at time t can be expressed as follows:

$$r^J(t)-r(t)=\left(\frac{-1}{T-t}\right)(\ln(N\left(d_1-\sigma\sqrt{T-t}\right)+\frac{V(t)}{L}e^{r(T-t)}[N(d_2)-N(d_1)]$$

$$-\frac{(K+c)}{L}\left[N\left(d_2-\sigma\sqrt{T-t}\right)-N\left(d_1-\sigma\sqrt{T-t}\right)\right]) \tag{9}$$

and

$$r^S(t)-r(t)=\left(\frac{-1}{T-t}\right)(\ln(N\left(d_2-\sigma\sqrt{T-t}\right)+\frac{V(t)}{K}e^{r(T-t)}\left[N(d_3)-N(d_2)\right]$$

$$-\frac{(b+c)}{K}\left[N\left(d_3-\sigma\sqrt{T-t}\right)-N\left(d_2-\sigma\sqrt{T-t}\right)\right]) \tag{10}$$

A high value of the default spread means that holding the asset is more risky, due to its default risk. In equations (9) and (10), the default spreads are influenced by firm value (V), default costs (b and c), and promised repayments (K and L). Because of the complexity of default spread expressions, this study further implements some numerical analyses to examine *how* the aforementioned factors change the default spreads. Specifically, the default spreads of corporate debts are expected to be different for varying levels of default urgency.

Given a level of default urgency, this study further derives the various probabilities for a firm depending on the firm's value with respect to the promised repayments and default costs. Under stress condition *I*, the firm's value is sufficient to pay the full values of all debts, and the debt claimants can be said to be free of default risk. Thus, we can derive a full-payable probability for the debt holders. Under stress conditions *II* and *III*, both shallow default probability and deep default probability are derived. Under condition *IV*, a bankruptcy probability is derived, because the firm does not make any repayment whatsoever to the debt holders. Therefore, the fully-payable probability (P_I), the shallow default probability (P_{II}), the deep default probability (P_{III}), and the bankruptcy probability (P_{IV}) are derived as follows:

$$P_I = \text{Prob}(K + L < V(T)) = N(d_1 - \sigma\sqrt{T-t}) \tag{11}$$

$$P_{II} = \text{Prob}(K + c < V(T) < K + L) = N(d_2 - \sigma\sqrt{T-t}) - N(d_1 - \sigma\sqrt{T-t}) \tag{12}$$

$$P_{III} = \text{Prob}(b + c < V(T) < K + c) = N(d_3 - \sigma\sqrt{T-t}) - N(d_2 - \sigma\sqrt{T-t}) \tag{13}$$

$$P_{IV} = \text{Prob}(V(T) < b + c) = 1 - N(d_3 - \sigma\sqrt{T-t}) \tag{14}$$

The above four probabilities, measuring the likelihood of default under varying levels of default urgency, vary with the firm's value, the default costs, and related factors. This study further discusses the sensitivities of these variables through several numerical examples.

3. Numerical Calibration

To analyze the value characteristics of corporate securities, the default spreads of junior debts and senior debts, and the default probabilities under varying levels of default urgency this investigation conducts a numerical analysis. This study gives a basic setting for the determinants, as follows: the initial firm value ($V(t)$) of \$70 million; the return volatility (σ) of firm values of 20%; the promised repayment amounts (K and L) of senior debt of \$30 million and of junior debt of \$40 million, respectively; the risk free rate (r) of 5%; the shallow default cost (c) of \$10 million; the deep default cost (b) of \$20 million; and the time to maturity (T-t) of 1 year. In this numerical example, the firm has a total promised repayment of $70 million on maturity.

3.1 Value Characteristics of Corporate Securities

The values of corporate securities tend to be higher if the firm value increases. This study displays the values of equity, junior debt, and senior debt, in terms of the firm value and time to maturity, in Panels A, B, and C of Table 2, respectively. We find that the equity value is positively related to the firm's value. The corporate equity can be viewed as a European call option on the firm's value, as per previous discussions by Black and Scholes (1973), Merton (1974), Black and Cox (1976), and others. In Panels B and C, the values of junior debts and senior debts are positive functions of the firm's value. That is, the debt holders tend to be more protected as the firm's value gradually increases. Specifically, as the firm's value approaches a high enough level, the debt values approach the amount of the promised repayments, i.e., the promised repayments of the senior debt and junior debt are $30 million and $40 million, on maturity.

Regarding the time to maturity, due to a time value being embedded in the call options, a long-life equity security is more valuable than a short-life equity security, as shown in Panel A of Table 2. However, the relationship between debt value and time to maturity is ambiguous for junior debts, as shown in Panel B. As the firm value reaches a high enough level (i.e., the junior debt is in-the-money or the firm stays in a condition of a very low default urgency), a short-life junior debt tends to be more valuable. Otherwise, when the firm's value is low (i.e., the junior debt is out-of-the-money or the firm stays in a condition of deep default urgency), a junior debt with a long maturity will have a high premium than a short-life debt, since a long-life debt has more time value. In addition, the value of a short-life senior debt is higher, compared to the value of a long-life senior debt, since the firm's value is high enough for the holders of senior debt in the interval over $K+c$ (= \$40 million).

Figure 1 graphically displays the numerical results discussed above. As previously mentioned, the presentation of the equity value resembles that of a plain vanilla call option with a strike price equal to the sum (i.e., $K+L$ = \$70 million) of the total repayments, as shown in Panel A of Figure 1. Panels B and C show the plots of the values of junior debts and senior debts, respectively, both of which vary with firm value and time to maturity. As the firm's value exceeds the sum of the total repayments, the junior debts reach a maximum in terms of their face value. As the firm's value drops below a threshold of ($K+c$ = \$40 million), the junior debts tend to be valueless. The senior debt also displays a similar presentation, which means the senior debt claimants receive a maximum of the promised payments (i.e., \$30 million) if the firm's value exceeds the strike level of \$40 million (= $K+c$), and the senior debt claimants receive nothing if the firm value is lower than the value of \$30 million (= $b+c$).

Next, this study further explores the impacts of the return volatility of the firm's value on the security values, as shown in Table 3. As the volatility rate is higher, the equity value becomes larger, but the values of both junior debts and senior debts tend to be lower. One rational explanation of this is as follows. A higher volatility rate leads to a wide variation in terms of the future possible results of firm values, and thus an increase of the volatility rate increases the possibility of higher firm values and increases the likelihood of payoffs being made to equity holders. However, the holders of corporate debts cannot receive the aforementioned over benefits from the increasing volatility rates, due to promised repayments remaining constant. In addition, a larger volatility rate also increases the default urgency as the firm's values goes downward, in which case the conditions of shallow-default urgency, deep-default urgency, or bankruptcy occur more frequently. Thus, the values of corporate debts are negatively related with the volatility rate of a firm's value.

Furthermore, this study also analyzes the effects of default costs, as shown in Table 4. We set a range of deep default costs from \$15 million to \$27 million and a range of shallow default costs from \$0 to \$12 million, since the default cost is lower in the condition of shallow default urgency. Panel A of Table 4 shows that the deep default cost (b) does not affect the pricing of junior debt, whereas the shallow default cost (c) has a negative impact on the valuation of junior debt. This is because a high shallow default cost will erode the payoffs of junior debts as the shallow default urgency appears, and because the junior debt has a subordinated priority on the firm's value as the deep default urgency appears. On the other hand, as shown in Panel B, both shallow and deep default costs have negative effects on the valuation of senior debts because an increase in the default cost reduces the payoffs to senior debt claimants. Figure 2 provides a graphical presentation of the relationships between the security values and bankruptcy costs. The main results hold true for the impacts of shallow and deep default costs on the valuations of both junior debts and senior debts.

In terms of the valuations of corporate securities under a consideration of different default urgencies, the shallow default urgency changes the junior debts' and senior debts' premiums, while the deep default urgency only affects the pricing of senior debts. As the results show, the valuation of corporate securities depends on the firm's level in a full-payable condition.

3.2 Default Spreads of Corporate Debts

With a numerical example, this study further analyzes the default spreads of senior debts and junior debts to examine *how* the default risks change in a variety of default urgency conditions. Given the same settings of the parameters, Table 5 shows that the default spreads of junior debts and senior debts gradually decrease along with a firm's value. A high firm value decreases the level of default urgency obviously. Specifically, the junior debts' default spreads are far larger than the senior debts' default spreads. That is, the junior debts have a higher default risk compared to the senior debts, since the junior debts are more likely to be defaulted by the firm, due to their subordinated status in the repayment priority order. In addition, a long-life junior debt has a low default spread, compared to a short-life junior debt, because the long-life junior debt has a higher possibility of receiving the full amount of the promised repayment. On the other hand, a long-life senior debt has a relatively high default spread, compared to a short-life senior debt. The reason is that the default risk is larger for the long-life senior debt, due to the uncertainty of the results regarding the firm's value.

Next, this study discusses *how* the default cost affects the default spread of corporate debts. In Figure 3, the default spreads of corporate debts are higher as the shallow and deep default costs are higher. That is, a high default cost can cause the holding of corporate debts to be risky, since the debt holders expect to receive little in the way of payoffs. In addition, as mentioned in the above discussions, a higher firm value releases the default urgency and thus diminishes the default spread of a corporate debt.

3.3 Probability Analysis

A firm's value, relative to the promised repayments and default costs, determines the level of the firm's default urgency. It is important for the holders of corporate securities to know the full-payable probability, shallow default probability, deep default probability, and full-bankruptcy probability under a given level of default urgency, since these probabilities also influence the pricing of corporate securities. This study further explores these probabilities with respect to firm value, due to the importance of security claimants understanding the probability distributions of defaults (i.e., the likelihood of *whether* they will receive repayment, or not).

In Figures 4-7, this study gives the same settings to the underlying parameters for the purpose of discussing the differential probabilities under given levels of default urgency. First, the default probabilities do not consistently vary with the firm values. Figure 4 displays four probability distributions based on the firm's value. The full-payable probability (P_I) increases with the firm's value, especially in the case of the firm's value exceeding the total promised repayments (K+L). The shallow default probability (P_{II}) shows a peak as the firm's value locates in a range from the value of K+c (= \$40 million) to K+L (=\$ 70 million). Besides, the possibility (P_{III}) of deep default urgency tends to be larger in the interval of (b+c, K+c). The bankruptcy probability (P_{IV}) steadily increases as firm value gradually declines. As a result, as firm value goes downward, the deep default urgency gradually increases as the firm value approaches the level of b+c, and the deep default urgency decreases and the bankruptcy stress increases as the firm value tends to be lower than the level of b+c. That is, if the firm value stays at a very low level, the firm has a high bankruptcy probability on maturity.

Second, the default cost causes different impacts on the default and bankruptcy probabilities. As shown in Figure 5, an increase in the shallow default cost can decrease the shallow default probability (P_{II}) with respect to the firm value. In fact, a higher shallow default cost decreases the probability that the firm value stays in the range (K+c, K+L), i.e., the range of shallow default urgency. The shallow default cost also has a similar impact on the deep default probability (P_{III}), as shown in Figure 6. However, when the firm value is higher, the shallow default cost can increase the deep default probability because the likelihood of the firm's value appearing in the interval (b+c, K+c), i.e., the range of deep default urgency, is higher. That is, the interval of deep default urgency also consistently moves along with the shallow default cost. In addition, as the deep default urgency occurs, the deep default cost has a negative effect on the deep default probability (P_{III}). Actually, a high deep default cost drives the firm to stay in a bankruptcy condition. That is, the firm easily bankrupts if the default cost increases, i.e., the bankruptcy probability (P_{IV}) increases over an interval of (0, b+c) as the default cost (b or c) increases. In this bankruptcy condition, the two debt claimants and the one equity holder receive nothing from the firm.

Third, the default and bankruptcy probability display various paths in different conditions of default urgency. Figure 7 gives a cumulative probability distribution for integrating full-payable, shallow default, deep default, and bankruptcy conditions depending on a variety of default urgencies. With respect to firm value, the sum of these four probabilities equals one, in which P_I, P_{II}, P_{III}, and P_{IV} gradually vary with the firm value. As the firm value is very low, the bankruptcy probability (P_{IV}) tends to be larger, and the other three probabilities tend to be lower. As the firm value gradually increases, the relative proportions of the deep default probability and the shallow default probability also increase, but the former performs a more sensitive change. If the firm value exceeds the level of K+c, the proportion of the deep default probability decreases, and the proportion of the shallow default probability increases, because there is a greater possibility that the promised repayments of senior debts can be made, whereas there is a lesser possibility that the promised repayments of junior debts can be made. Otherwise, if the firm value is high enough, the full-payable probability obviously increases with the firm value, and the bankruptcy probability and deep default probabilities immediately approach zero. That is, the default urgency is eliminated for the firm with a high value.

4. Conclusion

The holders of corporate securities bear different degrees of default urgency that vary with whether firm's values of asset are sufficient to pay claimants. We analyze default costs, default probabilities, and default spreads, under a consideration of default urgency. In actual fact, a firm has a different level of default urgency as it issues corporate debts with a subordinate priority scheme. As shallow level of default urgency appears, there is a high likelihood that the junior debts may be defaulted upon, but the senior debts are still secure in the sense that their holders will likely receive their promised repayments. On the other hand, as a deep degree of default urgency appears, the senior debts may also be defaulted upon. We value senior debts and junior debts under varying levels of default urgency. We also answer the question of *how* the level of default costs changes the debt values and give an analysis of bankruptcy probabilities and default probabilities.

We derive a closed-form result of security values under a consideration of different degrees of default urgency, and finds that the shallow default cost can affect the premiums of both junior debts and senior debts, while the deep default cost only affects senior debts. Second, the junior debts have a higher default risk compared to the senior debts, since the junior debts are more likely to be defaulted on. Specifically, the default spreads of corporate debts are higher as the shallow and deep default costs are higher. Third, the full-payable probability, shallow default probability, deep default probability, and bankruptcy probability vary with a variety of default urgency.

This article identifies default costs, probabilities, spreads, and debt valuation under a consideration of default urgency. Our findings offer new evidence about the valuations of senior and junior debts and provide a new perspective into default risk issues. We show that senior debts' or junior debts' default conditions drive from different conditions of default urgency for the firm and the security claimants.

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Table 1 Security payoffs at the maturity date

Condition	Bankruptcy (IV)	Deep Default (III)	Shallow Default (II)	Full-payable (I)
	$V_T < b+c$	$b+c \le V_T < K+c$	$K+c \le V_T < K+L$	$K+L \le V_T$
Senior Debt	0	$V_T - b - c$	K	K
Junior Debt	0	0	$V_T - K - c$	L
Equity	0	0	0	$V_T - K - L$

Notes: This table describes security payoffs under default urgency at maturity date. V denotes firm value. L and K are the promised repayments to the junior and senior debt claimants, respectively. c and b are a shallow and a deep default cost, respectively, i.e., $c < b < K$ or L.

Table 2 Security values varying with firm value and time to maturity

Panel A: Equity Values (E)

	Firm Value (V)					
Time (T-t)	\$40	\$50	\$60	\$70	\$80	\$90
0.5	0.0001	0.0400	0.8858	4.8221	12.4151	21.8345
1.0	0.0177	0.3925	2.4142	7.3154	14.8287	23.8593
1.5	0.1116	1.0161	3.9318	9.4100	16.9862	25.8497
2.0	0.3096	1.7840	5.3920	11.2887	18.9603	27.7522
2.5	0.6044	2.6284	6.7943	13.0223	20.7967	29.5641
Panel B : Values of Junior Debts (J)						
0.25	2.7559	11.1595	21.6896	31.4540	36.8939	38.6151
0.50	4.2010	12.4985	22.1173	29.9620	34.6677	36.8450
0.75	5.4309	13.5285	22.1090	28.8138	33.0225	35.2683
1.00	6.4910	14.2615	21.9518	27.8490	31.6717	33.8792
1.25	7.3903	14.7760	21.7247	27.0015	30.5051	32.6357
Panel C : Values of Senior Debts (S)						
0.25	18.5850	28.2605	29.2283	29.2588	29.2593	29.2593
0.50	18.0560	26.2431	28.2197	28.5032	28.5338	28.5366
0.75	17.6692	24.7503	27.1150	27.6879	27.8053	27.8274
1.00	17.3345	23.5817	26.0574	26.8417	27.0639	27.1236
1.25	17.0228	22.6149	25.0799	25.9998	26.3168	26.4225

Notes: This table presents values of equities, junior debts, and senior debts varying with firm values and times to maturity. Parameters are set as follows: volatility rate of firm values of $\sigma = 20\%$, face values of senior debts and junior debts of \$30 million and \$40 million, respectively, risk free rate of $r = 5\%$, deep costs of $b =$ \$20 million, and shallow costs of $c =$ \$10 million. Prices are expressed in units of millions.

Table 3 Security values varying with volatility rate and time to maturity

Panel A: Equity Values (E)						
	Volatility Rate (σ)					
Time (T-t)	5%	10%	15%	20%	25%	30%
0.5	2.0733	2.9346	3.8690	4.8221	5.7820	6.7444
1.0	3.6983	4.7635	6.0142	7.3154	8.6352	9.9619
1.5	5.2780	6.4216	7.8715	9.4100	10.9815	12.5654
2.0	6.8286	7.9888	9.5737	11.2887	13.0530	14.8356
2.5	8.3514	9.4936	11.1712	13.0223	14.9400	16.8827
Panel B : Values of Junior Debts (J)						
0.25	36.2752	34.1471	32.7020	31.4540	30.2895	29.1753
0.50	36.1974	33.5953	31.6624	29.9620	28.3872	26.9279
0.75	35.8115	33.0485	30.8099	28.8138	26.9948	25.3555
1.00	35.2665	32.4930	30.0498	27.8490	25.8723	24.1230
1.25	34.6302	31.9277	29.3471	27.0015	24.9166	23.0924
Panel C : Values of Senior Debts (S)						
0.25	29.2593	29.2593	29.2593	29.2588	29.2456	29.1711
0.50	28.5369	28.5369	28.5362	28.5032	28.3094	27.8535
0.75	27.8323	27.8323	27.8245	27.6879	27.2199	26.4086
1.00	27.1451	27.1451	27.1182	26.8417	26.1244	25.0598
1.25	26.4749	26.4747	26.4185	25.9998	25.0828	23.8433

Notes: This table displays values of equities, junior debts, and senior debts varying with volatility risks and times to maturity. Parameters are set as follows: initial firm value V = \$70 million, face values of senior debts and junior debts of \$30 and \$40, respectively, risk free rate of r = 5%, deep costs of b = \$20 million, and shallow costs of c = \$10 million. Prices are expressed in units of millions.

Table 4 Security values varying with default cost

Panel A : Values of Junior Debts (J)

Shallow Default Cost (c)	Deep Default Cost (b)				
	\$15	\$18	\$21	\$24	\$27
0	31.5674	31.5674	31.5674	31.5674	31.5674
3	30.4416	30.4416	30.4416	30.4416	30.4416
6	29.3216	29.3216	29.3216	29.3216	29.3216
9	28.2139	28.2139	28.2139	28.2139	28.2139
12	27.1284	27.1284	27.1284	27.1284	27.1284
Panel B : Values of Senior Debts (S)					
0	27.1348	27.1329	27.1311	27.1294	27.1278
3	27.1126	27.1071	27.1016	27.0963	27.0917
6	27.0608	27.0467	27.0329	27.0198	27.0091
9	26.9563	26.9258	26.8962	26.8689	26.8476
12	26.7704	26.7123	26.6565	26.6067	26.5691

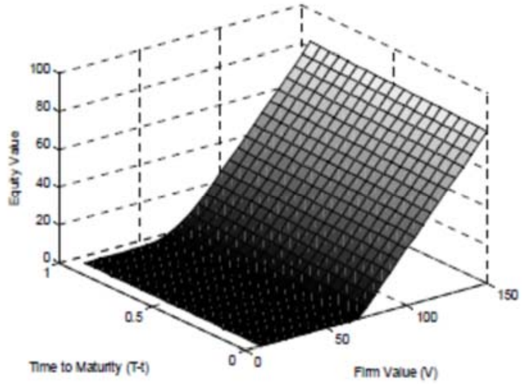
Notes: This table reports values of junior debts and senior debts in Panels A and B, respectively, varying with default costs. Parameters are set as follows: initial firm value V = \$70 million, face values of senior debts and junior debts of \$30 million and \$40 million, respectively, risk free rate of r = 5%, volatility rate of firm values of σ = 20%, and time to maturity of T - t = 2 years. Prices are expressed in units of millions.

Table 5 Default spreads varying with various firm values

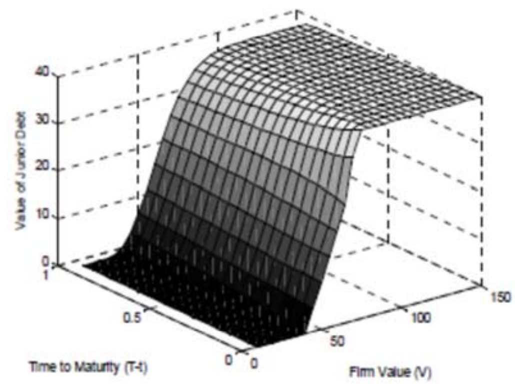
	Firm Value (V)					
Time (T-t)	\$60	\$65	\$70	\$75	\$80	\$85
Panel A : Junior Debts						
1.0	54.25%	36.54%	23.90%	15.15%	9.31%	5.55%
1.5	34.53%	24.30%	16.87%	11.54%	7.78%	5.17%
2.0	25.00%	18.16%	13.10%	9.39%	6.67%	4.71%
2.5	19.42%	14.45%	10.72%	7.93%	5.84%	4.29%
3.0	15.76%	11.95%	9.06%	6.86%	5.19%	3.92%
Panel B : Senior Debts						
1.0	1.12%	0.37%	0.12%	0.04%	0.01%	0.00%
1.5	1.74%	0.79%	0.35%	0.15%	0.06%	0.03%
2.0	2.04%	1.08%	0.56%	0.29%	0.15%	0.08%
2.5	2.17%	1.26%	0.72%	0.42%	0.24%	0.14%
3.0	2.19%	1.35%	0.84%	0.52%	0.32%	0.20%

Notes: This table shows default spreads of junior debts and senior debts in Panels A and B, respectively. Parameters are set as follows: face values of senior debts and junior debts of \$30 million and \$40 million, respectively, risk free rate of r = 5%, volatility rate of firm values of σ = 20%, deep costs of b = \$20 million, and shallow costs of c = \$10 million. Prices are expressed in units of millions.

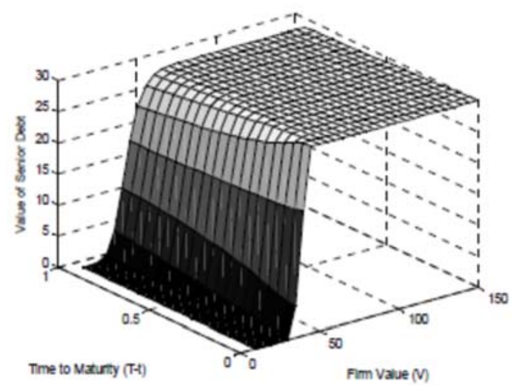
Figure 1 Security values varying with firm value and time to maturity



Panel A: Equity values



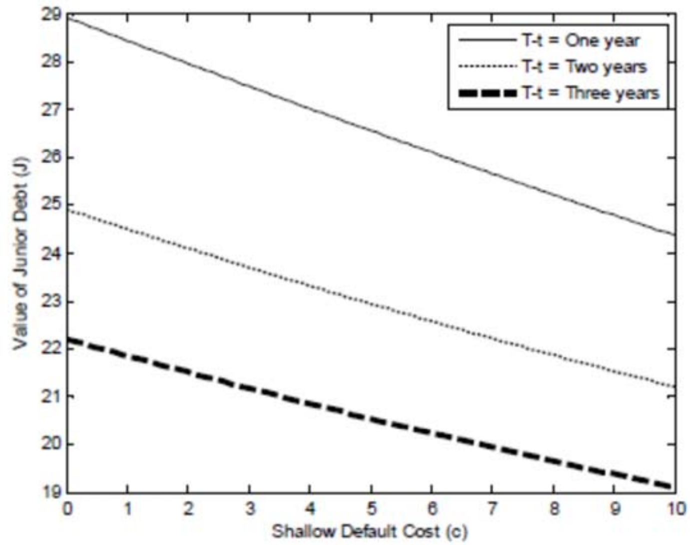
Panel B: Values of junior debt



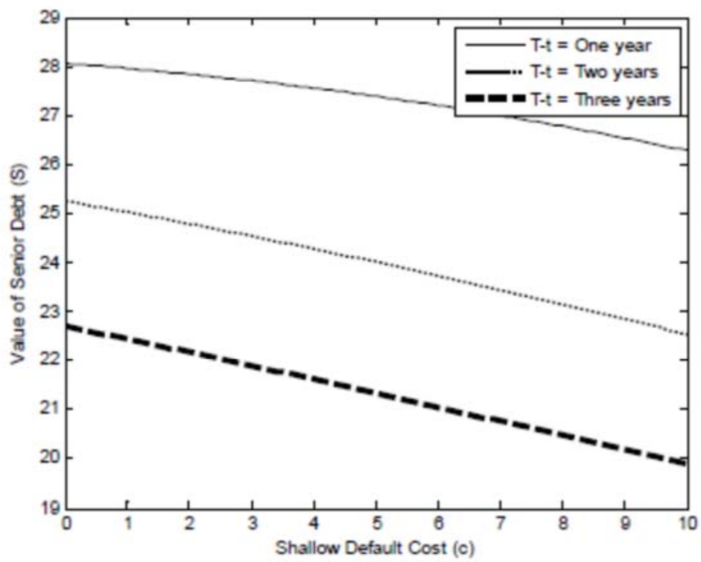
Panel C: Values of senior debt

Notes: This Figure displays values of equities, junior debts, and senior debts varying with various firm values and times to maturity. Parameters are set as follows: volatility rate of firm values of σ =20%, face values of senior debts and junior debts of \$30 million and \$40 million, respectively, risk free rate of r = 5%, deep default costs of b = \$20 million, and shallow default costs of c = \$10 million. Prices are expressed in units of millions.

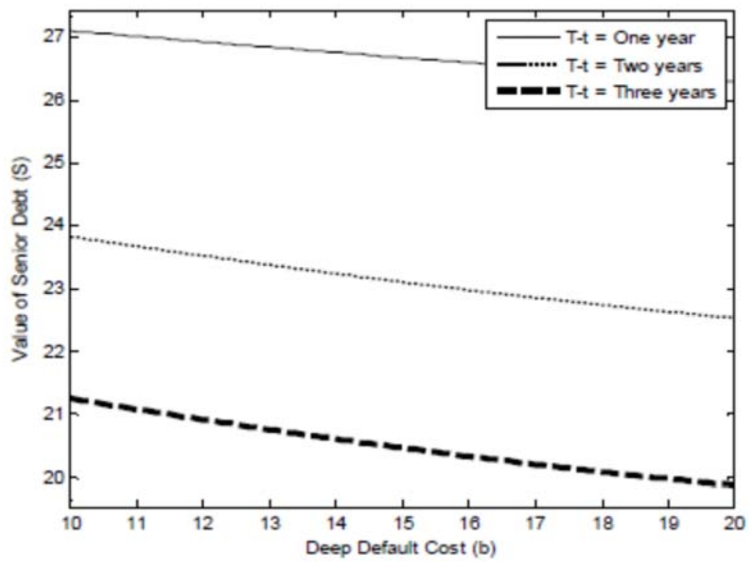
Figure 2 Security values varying with default cost and time to maturity



Panel A: Value variance of junior debt with shallow default costs



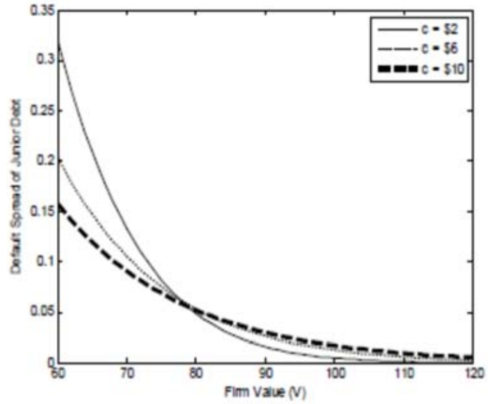
Panel B: Value variance of senior debt with shallow default costs



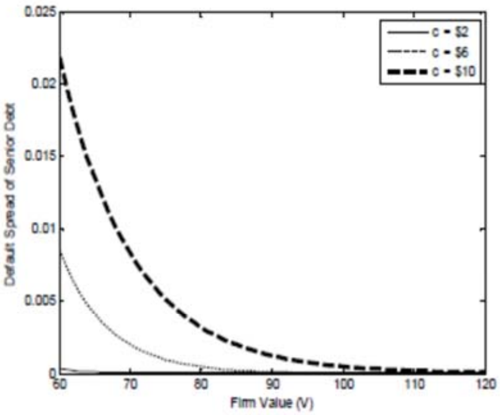
Panel C: Value variance of senior debt with deep default costs

Notes: This Figure presents values of junior debt and senior debts varying with default costs. Parameters are set as follows: initial firm value of V = \$70 million, face values of senior debts and junior debts of \$30 million and \$40 million, respectively, risk free rate of r = 5%, deep default costs of b = \$20 million, shallow default costs of c = \$10 million, and volatility rate of firm values of σ =40%. Prices are expressed in units of millions.

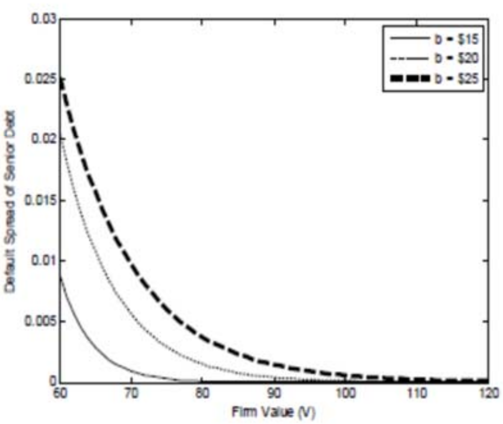
Figure 3 Default spreads varying with default costs



Panel A: default spreads varying of junior debt with shallow default costs



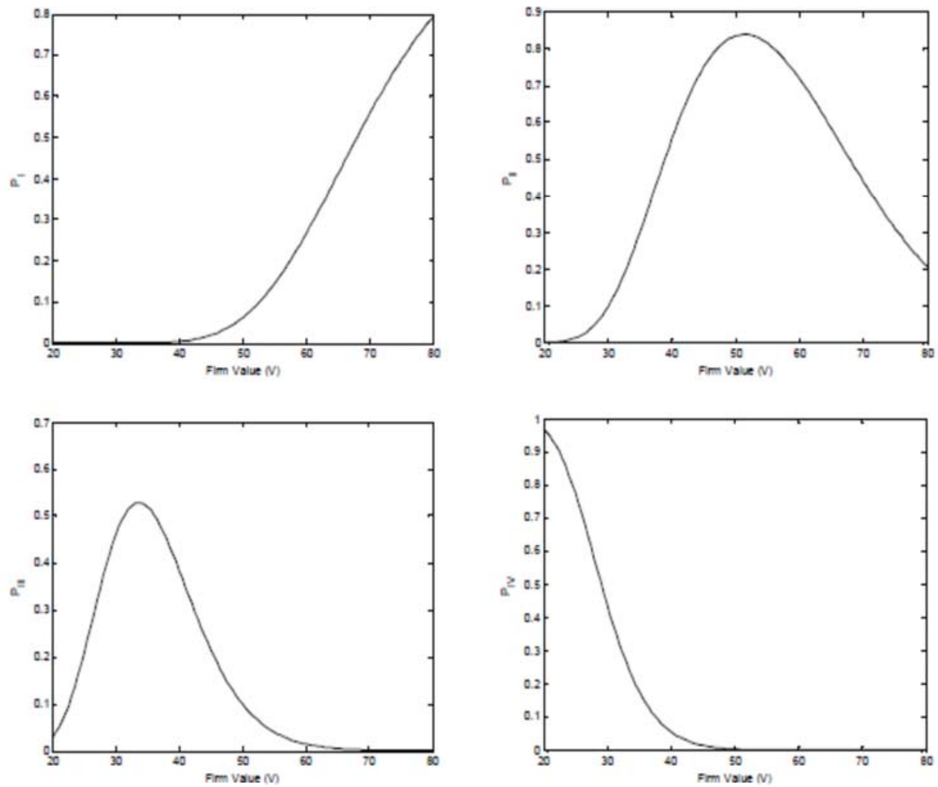
Panel B: default spreads varying of senior debt with shallow default costs



Panel C: default spreads varying of senior debt with deep default costs

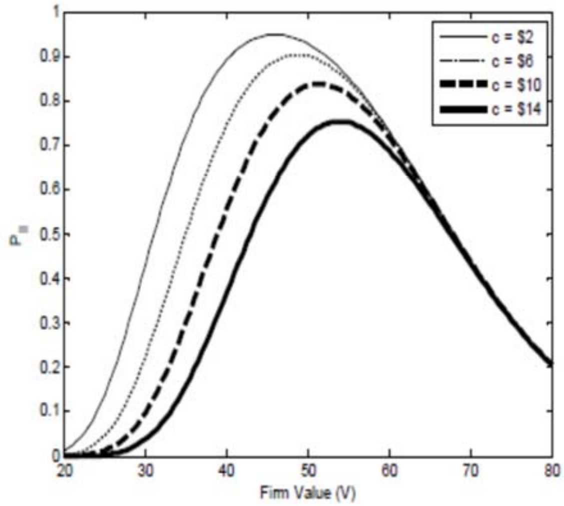
Notes: This Figure shows default spreads of junior debts and senior debts. Parameters are set as follows: face values of senior debts and junior debts of $30 million and $40 million, respectively, risk free rate of r = 5%, volatility rate of firm values of σ =40%, deep default costs of b = $20 million, and shallow default costs of c = $10 million. Prices are expressed in units of millions.

Figure 4 Probability analysis



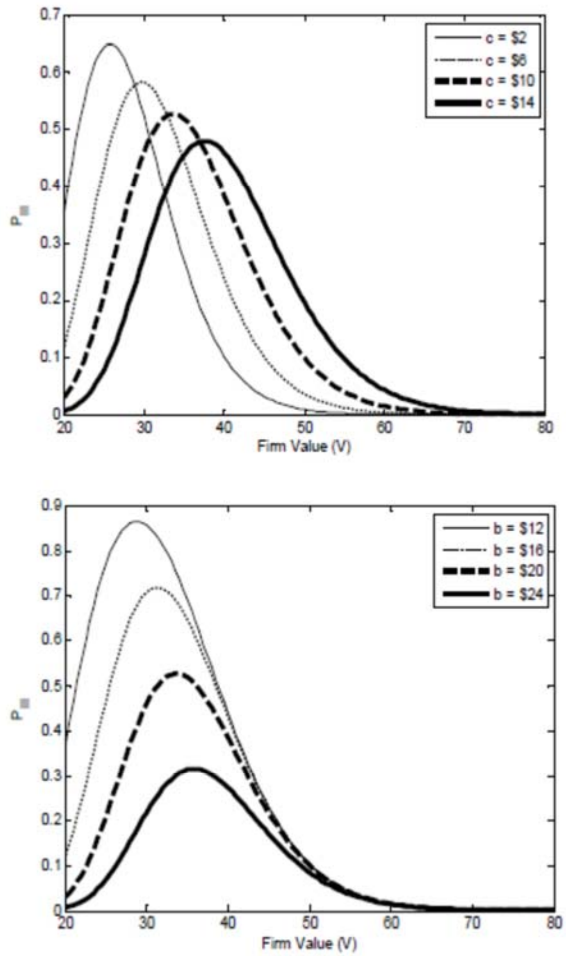
Notes: The Figure shows how full-payable probabilities, shallow default probabilities, deep default probabilities, and bankruptcy probabilities at maturity, vary with firm values. Parameters are set as follows: face values of senior debts and junior debts of \$30 million and \$20 million, respectively, risk free rate of r = 5%, volatility rate of firm values of σ =20%, deep default costs of b = \$20 million, and shallow default costs of c = \$10 million. Prices are expressed in units of millions.

Figure 5 Shallow default probabilities varying with shallow default cost



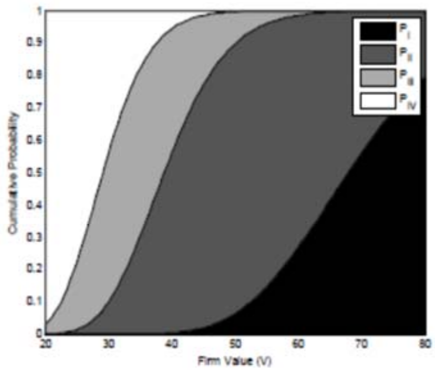
Notes: The Figure shows how shallow default probabilities at maturity vary with firm values, for examining the impacts of shallow default cost. Parameters are set as follows: face values of senior debts and junior debts of $30 million and $40 million, respectively, risk free rate of r = 5%, volatility rate of firm values of σ =20%, and deep default costs of b = $20 million. Prices are expressed in units of millions.

Figure 6 Probability in a deep degree of default urgency



Notes: The Figure shows how deep default probabilities at maturity vary with firm values, for examining the impacts of default costs. Parameters are set as follows: face values of senior debts and junior debts of \$30 million and \$40 million, respectively, risk free rate of r = 5%, volatility rate of firm values of σ =20%, deep default costs of b = \$20 million, and shallow default costs of c = \$10 million. Prices are expressed in units of millions.

Figure 7 Cumulative probabilities under default urgency



Notes: The Figure shows how cumulative full-payable probabilities, shallow default probabilities, deep default probabilities, and bankruptcy probabilities at maturity vary with firm values. Parameters are set as follows: face values of senior debts and junior debts of $30 million and $40 million, respectively, risk free rate of r = 5%, volatility rate of firm values of σ = 20%, deep default costs of b = $20 million, and shallow default costs of c = $10 million. Prices are expressed in units of millions.

Appendix

This appendix presents the result of equations (6) and (8) for the junior debts and senior debts, respectively. Based on option pricing theory, in a risk-neutral probability Q, under the default urgency the price of the junior debt at time t can be written as follows:

$$J(t) = e^{-r(T-t)} E^Q[J(T)]$$

$$= e^{-r(T-t)} E^Q[LI_1] + e^{-r(T-t)} E^Q[(V(T) - K - c)I_2]$$

$$= Le^{-r(T-t)} N\left(d_1 - \sigma\sqrt{T-t}\right) + V(t)[N(d_2) - N(d_1)]$$

$$-(K+c)e^{-r(T-t)}\left[N\left(d_2 - \sigma\sqrt{T-t}\right) - N\left(d_1 - \sigma\sqrt{T-t}\right)\right]$$

where E^Q denotes an expected value conditional on a risk-neutral probability measure Q, and where I_1 and I_2 are indicator functions for full-payable conditions and shallow conditions of default urgency, respectively, and are expressed as follows:

$$I_1 = \begin{cases} 1, & K + L < V_T \\ 0, & others \end{cases}$$

and,

$$I_2 = \begin{cases} 1, & K + c < V_T < K + L \\ 0, & others \end{cases}$$

Similarly, the valuation of the senior debt can be expressed as follows:

$$S(t) = e^{-r(T-t)} E^{Q}\left[S(T)\right]$$

$$= e^{-r(T-t)} E^{Q}\left[KI_0\right] + e^{-r(T-t)} E^{Q}\left[(V(T) - b - c)I_3\right]$$

$$= Ke^{-r(T-t)} N\left(d_2 - \sigma\sqrt{T-t}\right) + V(t)\left[N(d_3) - N(d_2)\right]$$

$$-(b+c)e^{-r(T-t)}\left[N\left(d_3 - \sigma\sqrt{T-t}\right) - N\left(d_2 - \sigma\sqrt{T-t}\right)\right]$$

where I_0 is an indicator function for a condition of default urgency as the firm value exceeds the strike price (K+c), and I_3 is an indicator function for the deep default condition, and they are expressed as follows:

$$I_0 = \begin{cases} 1, & V_T > K + c \\ 0, & others \end{cases}$$

and,

$$I_3 = \begin{cases} 1, & b + c < V_T < K + c \\ 0, & others \end{cases}$$

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AN EXPLORATORY RESEARCH ON KEY ISSUES INFLUENCING THE FORMATION OF INDUSTRY CLUSTERS IN VIETNAM

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Abstract

The development of Industry Clusters (IC) now is a trend concerned to enhance the competitiveness of the industries in the world. The research objective is to review and synthesize current theories of IC development, then to explore key issues influencing the IC formation in Vietnam. A desk research and qualitative method through in-depth interviews with experts have been conducted in this exploratory study. Results find out seven key issues influencing IC development: the necessity of IC development, approaches to IC formation, conditions for development, IC governance structures, difficulties of SMEs participants, supporting policies of the government, and the role of related organizations. The study suggests recommendations for facilitating the development of IC in Vietnam.

Keywords: *Industry clusters, supporting industries, IC structure, SMEs, focal enterprise.*

1. INTRODUCTION

Industry Cluster is a topic of concern in both developed and developing countries because of its enormous impact on the effectiveness of the industry development. The governments and organizations of many countries in the world have developed this concept as a strong model to promote regional and urban economic growth. As a result, a large number of IC was initiated in the 1990s and this trend is increasing.

In Vietnam, the concept of IC has not been popular among enterprises. On the other hand, that the supporting industries (SI) in Vietnam is still underdeveloped is a major obstacle to the IC development. Currently, the majority of Vietnamese enterprises are not eligible to participate in the international supply chain of corporations and large enterprises investing in Vietnam.

Therefore, the objective of this paper is to review and synthesize current theories of industry clusters, then to explore key issues influencing the IC formation in Vietnam.

2. LITERATURE REVIEW AND RESEARCH METHODOLOGY

2.1 Literature review

2.1.1. Concept of industry cluster

Michael Porter is the scholar contributing the most to the development of the concept IC. According to Porter (1990), industrial clusters are groups of interconnected firms, suppliers, related industries, and specialized institutions that arise in particular location. This definition has two core requirements. Firstly, the firms in IC are linked in many ways such as vertical integration (network of supply, production and distribution) and cross-linking (supplemental products and services, etc.). Secondly, it is geographical concentration and linkage of firms. Porter's IC model emphasizes four factors: the limit of geography, the number of industries, interconnection of firm, and competitive advantage. There is a difference between the IC concept of Porter (1990) and industrial cluster of Vietnam (Table 1).

Table 1. Differences between IC of Porter (1990) and Industrial Cluster of Vietnam

Criteria	IC of Porter (1990)	Industrial Cluster of Vietnam
Objectives	– Develop linkages among enterprises in IC. – Enhance enterprises' competitive capabilities – Create workforce, high-quality goods and services	– Attract and relocate enterprises. – Improve infrastructure, promote production and business, and tackle environmental pollution.
Participants	– Suppliers – Manufacturers – Service organizations – Universities and research institutes	– Production and business enterprises – Industrial and handicraft enterprises – Small and medium enterprises (SMEs)
Linkages	– Strong and mutually supportive	– Weak and individually-performing
Scope	– Focus on the geographical concentration of related industries in the supply chain. – IC cannot be limited to a certain geographical boundaries.	– Focus on the geographical concentration of irrelative industries in the supply chain. – Industrial cluster is constrained by geographical boundaries.

(Source: The authors' syntheses)

2.1.2 Necessity of IC development

In the era of globalization and liberalization, the competitive advantages of a nation no longer result from the cheap labor force or abundant resources but from the creativity and improvement abilities. As can be proven in industrialized countries, IC has become an effective tool to strengthen the national and regional economy (Karaev et al., 2007). According to Arif and Sonobe (2012), the formation and development of IC has had crucial effects on the economy: (1) spillover effects of knowledge and technology contribute to sustainable economic development (2) the hierarchy and specialization of labor among enterprises, (3) the labor market easily attracts highly skilled workforce at low labor costs. In addition, firms in IC can get the benefits of collective efficiency such as shares of machinery and equipment, orders, marketing costs, market information, governmental lobby, etc.

On the other hand, industrial parks and industrial zones haven't yet taken advantage of geographical proximity. The linkages among enterprises are weak, and supports from organizations such as education, finance, research and development are not well. Therefore, the formation and development of IC will beneficially connect enterprises and organizations to create a synergy for innovation, operation efficiency and effectiveness, increased competitiveness, and global market involvement. Niu (2010) has pointed out that enterprise benefits greatly from their IC participation. They can improve the supply chain, business strategies, technology, and finance. Moreover, they can increase functions of products, improve product quality, improve customer services, extend longer life cycle of product profitability, stimulate innovation, create new products, open new markets, access to new technologies, and increase productivity.

2.1.3. Approaches to IC development

According Obadic (2013), there are two approaches used to develop IC: "top-down" and "bottom-up".

"Top-down" approach. This approach implies the active role of the government in creating the ICs. The government initiates the IC policies based on the country/region economic policies, directly selects focal enterprises for the development of clusters, and intervenes in many aspects to support IC. Then, the IC policies will be transferred to local community. However, according Obadic (2013), this approach will be less effective since it is not derived from actual situation, not observing the actual dynamics occurring in enterprises and organizations in IC.

"Bottom-up" approach. This approach involves the interaction between enterprises, organizations and a dynamic view of the changing needs of the clusters and the learning process (Borra and Tsagdis, 2008). In the case of the "bottom-up" approach, a motivation to create a cluster policy is from the business sector. The enterprises themselves are in need of improvements in order to enhance their competitive capability, so they actively link and cooperate with one another.

A typical case of "Top-down" approach is Gumi Industrial Park (GIP) (also called Gumi Cluster) - an electronics IC built by the Korean government. The focal firms of Gumi Cluster are LG Electronics and Samsung Electronics. According to Park et al. (2012), the South Korean government initiated the IC establishment. GIP is the IC that the Korean government has built over the years with the aim of developing the Korean electronics industry. In order to catch up with the leading countries in electronics industry, the Korean government has attracted American, Japan and European enterprises to invest in their manufacturing activities in Korea so that domestic enterprises could acquire hands-on learning. This IC strategically cooperates with private research centers and research institutions supported by the government.

As of the "bottom-up" approach, according to Ketels (2003), for a developing country like Thailand, they said that economic development is a multi-leveled collaborative process associated with the government, enterprises, education and research institutes, and supporting organizations. As a result, the government's role for the development of IC is in supporting the development of all ICs through consolidating and establishing the emerging clusters rather than trying to create entirely new clusters, and in developing the public-private partnership.

Two parallel approaches are applied in Europe (Obadic, 2013). For the "top-down" approach, all cluster policies are taken at the supranational level, and consequently form a single national policy. The national government spends a large amount of time on the design and coordination of IC policies, a common framework, and R & D programs while local governments enter the implementation phase. They also apply the "bottom-up" approach by listening to enterprises and local governments who are all virtually better stakeholders at evaluating and meeting each IC's specific needs.

2.1.4 Conditions for IC development

Karaev et al. (2007) suggest that preconditions for the development of IC are: geographical proximity, critical mass of firms, the appropriate business environment, and the trust building among members.

Geographical proximity

Geographical proximity creates competitive advantage for SMEs to collaborate and compete, since a host of linkages among cluster members results in a whole greater than the sum of its parts (Porter, 1998b). Geographical proximity results in enhanced communication and knowledge exchange among cluster members (Karaev et al., 2007). Proximity helps to establish co-operative linkages between companies through enhancing mutual learning and knowledge creation and knowledge can "spill over" between local firms due to the easier (informal) contact between them (Wolter, 2003). Although in the age of internet-based technologies geographical proximity loses importance because of the easier access to information, still some valuable, non-codified, but tacit, knowledge can be exclusively obtained within a cluster (Preissl and Solimene, 2003). Besides, geographical proximity reduces costs for transaction, transportation, insurance, and so on (Karaev et al., 2007).

Business environment

The ICs are affected by business environment, particularly the availability of raw materials and other facilities such as transport (road, rail) and communications, etc. In addition, competitors (local and global), and the cooperation of governmental agencies, enterprises, universities and other related organizations are considered parts of the business environment (Singh et al., 2013). According to Karaev et al. (2007), the appropriate business environment is the basis for the attraction of a large number of SMEs - a precondition for the IC formation. Without such an environment, it can be a major barrier to the implementation of the IC approaches.

Trust building

Ceglie (2003) has pointed out that factors such as trust building and constructive dialogue among cluster actors, exchanging of information, identifying common strategic objectives, agreeing on a joint development strategy and its systematic and coherent implementation are of paramount importance for building an efficient cluster. The trust among members helps them link together more closely. A high trust level also reduces costs for transactions, administrative procedures, and legal disputes. Raising the level of trust among cluster members is a strategic determination in the successful development of clusters. In addition, the presence of a global company or large enterprises in the cluster will facilitate the trust building for the participating enterprises.

2.1.5 Management structure of IC

According to Contreras et al. (2013), the automotive industry IC in Puebla (Mexico) is fully developed with representatives from three participants: upstream, mainstream and downstream. Besides, IC must be supported by other organizations such as related industries and supporting sectors, government, education, institutes for collaboration and associations (Figure 1).

For the case of IC in Indonesia, Tambunan (2009) argues that the economic benefits can only be achieved if IC developed internal and external networks well (Figure 2). Internal networks can be defined as business co-operations or links among enterprises inside the cluster, which can be in various forms, for example marketing, distribution, production, procurement of materials, training for workers, etc. External networks are business and other forms of relation between enterprises inside the cluster and actors outside the cluster such as large enterprises (LEs), suppliers of inputs, providers of business services, and so on (Ceglie and Dinni, 1999).

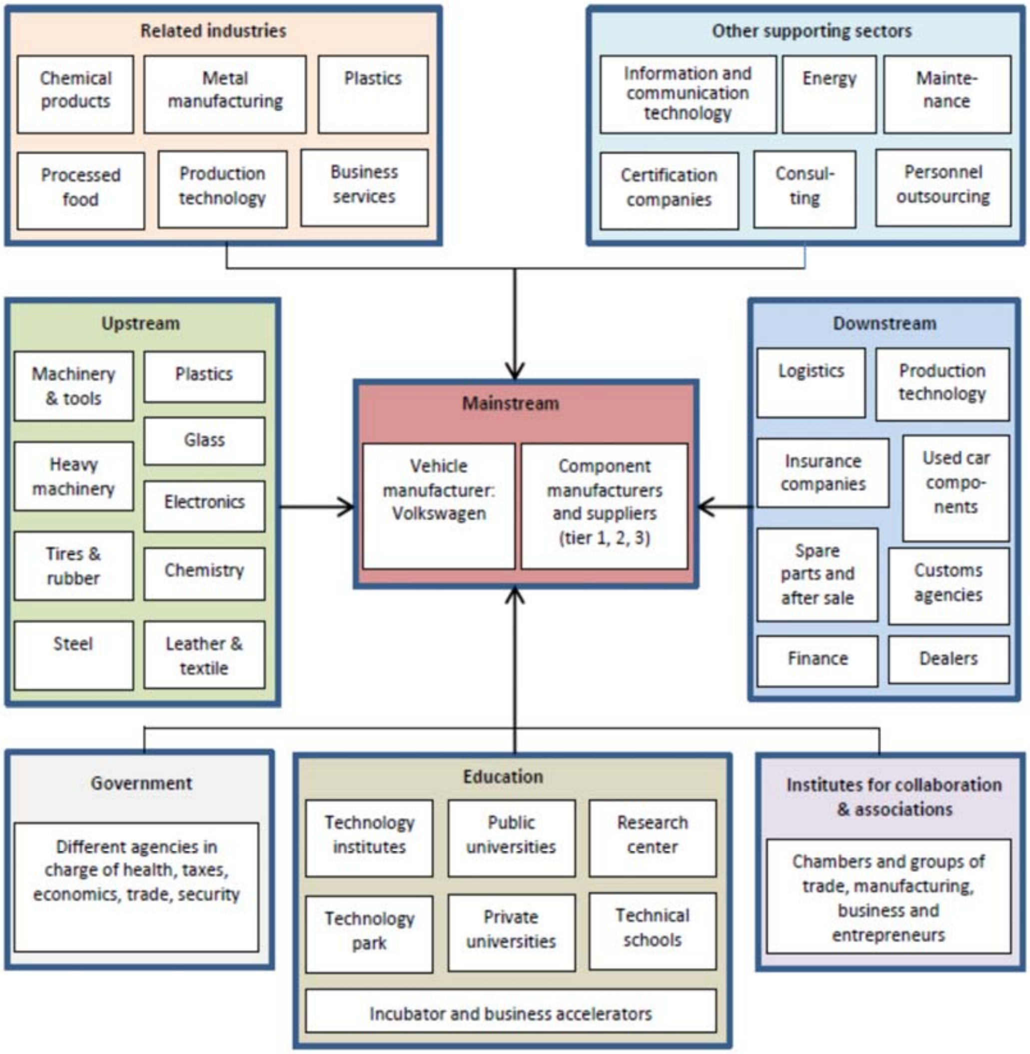

Figure 1. Automobile industry IC model in Mexico's Puebla (Contreras et al, 2013)

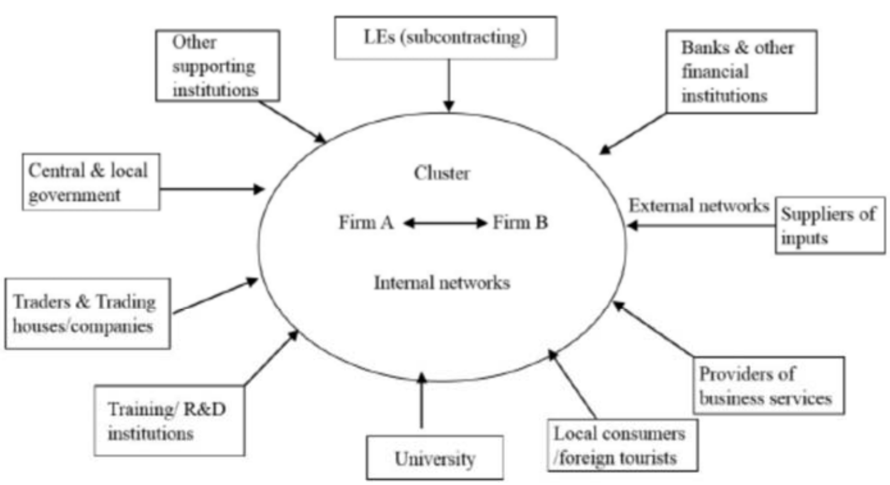

Figure 2. Internal and external networks of a small and medium industry cluster in Indonesia (Tambunan, 2009)

2.1.6. Difficulties of SMEs to participate in the development of IC

Trade liberalization and globalization processes have significantly increased opportunities and challenges for SMEs. SMEs have begun facing two main challenges: first, to transform themselves and increase their individual competitiveness (Fassoula, 2006), and second, due to their limited size to take advantage of synergy effects created by entering into cooperative relations with other SMEs and related partner institutions.

Tambunan (2009) argues that common limitations of SMEs are lack of capital, difficulty in procuring raw materials, lack of market information, difficulty in marketing and distribution, low technological capabilities, high transportation costs, communication problems, cumbersome and costly bureaucratic procedures, and the policies and regulations that generate market distortions.

2.1.7. Government's supporting policy for IC and SI

In developed countries, the governments' IC policies are usually planned at more levels than those of the developing countries, with a transnational and inter-regional way of thinking. Governments often have direct intervention policies for the IC development, whereas similar policies in developing countries are often meant to co-participation and support. According to Obadic (2013), in the EU member countries, the IC development policies have common orientations as follows:

- National or regional authorities focus on fostering innovation and improving knowledge and technology.
- The public and private funds aim to finance major programs for R&D cooperation and commercialization of research applications.
- A focus on developing a business cooperation and networking.
- They stimulate a firm ground promoting exchanges among cluster members, centers of research and education, financial institutions, government organizations and NGOs.

In Thailand, the role of government for IC is concretely expressed through the elements in the diamond pattern (Figure 3).

2.1.8. Roles of related organizations

Roles of universities and research institutes

To succeed, an IC must have a strong education and research. The renowned public and private universities and research centers can offer supports through technology parks, technology business incubators (Contreras et al, 2013).

Role of industry associations

For fast-growing countries, particularly Thailand, Ketels (2003) compared the old and new role of the Industrial Associations with the involvement of IC as shown in Table 2.

The role of banks, venture capital and other financial institutions

According to Liu et al. (2013), the non-governmental chamber of commerce can be a trusted intermediary between banks and enterprises. This organization can reduce the banks' lending risk, and help new business projects improve finance and investment. Family and friends, banks and financial and investing institutions play important roles in providing capital and finance to help enterprises maintain, develop and participate in IC.

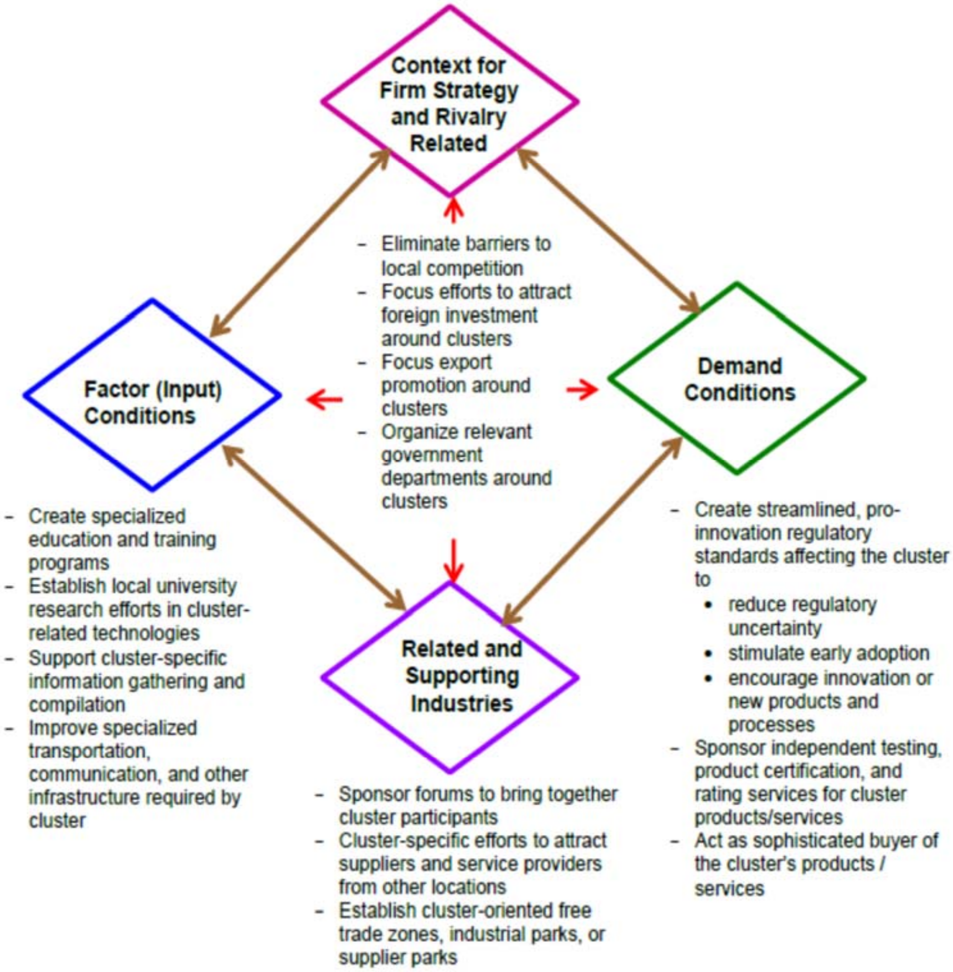

Figure 3. The role of the government in IC development (Ketels, 2003)

Table 2. New roles of industry associations for IC

Traditional Roles	New Roles
- Lobby government (Trade and regulations) - Convene meetings for networking	- Negotiate with government (Trade and regulations) - Information collection and dissemination (E.g. regular benchmarking) - Joint marketing (E.g. trade fairs, missions) - Training (E.g. curriculum for managers, close collaboration with outside educational institutions, sponsoring of targeted scholarships) - Research (E.g. university partnerships, standard setting and testing, specialized research institutes) - Procurement (E.g. joint purchasing programs) - Environmental (E.g. demonstration projects, research sponsorship) ⬇ **Cluster activation and enabling**

(Source: Ketels, 2003)

2.2. Research framework

In reference to experience of the IC development in the world, the research focuses on key issues affecting the IC development in Vietnam: the necessity of IC development, approaches IC development, conditions for IC development, governance structures, the difficulties of SMEs participants, supporting policies of the government, and the role of related organizations.

2.3. Research Methodology

The main method used in this research is desk and qualitative research. This study carries out purposeful sampling because interviewees' characteristics are experts with experiences relating to IC development. The subject aims to develop the IC of automobile industry in the Ho Chi Minh City. Therefore, the experts are selected based on knowledge and long work experience in fields relating to the automobile and supporting industries. There are nine interviewees from automobile manufacturers (focal enterprises), enterprises related to the automobile industry, industrial associations, universities - research institutes, governmental bodies (Department - Board – Sector). The data collected from the in-depth interviews with experts are mainly qualitative (Appendix). Therefore, the study emphasizes on describing and analyzing the meaning of the data.

3. FINDINGS

(a) The necessity of IC development in Vietnam

At present, Vietnam has some IC conceived as:

- At Chu Lai Open Economic Zone, there is a complex of Truong Hai automotive manufacturing and assembly as an IC.
- North Thang Long Industrial Park concentrated 100 percent FDI from Japan. In this Industrial Park (IP), large electromechanical assembly enterprises from Japan such as Canon, Panasonic link with spare parts providers from Japan as well such as Nissei, Santomas, Yasufuku, etc. The Vietnamese enterprises can hardly join in this linkage. North Thang Long IP is considered as a successfully electromechanical IP in Ha Noi. Turnover of this IP is over VND30 trillion and a USD1 billion export per year. With this effectiveness, Hanoi strongly orientates to develop this model.
- In Hung Yen Province, there is a Pho Noi textile IP with export-orientation, international links, or participation in global value chains. This could be a model to replicate.
- In the field of handicrafts, arts and crafts, some trade villages and towns such as Bat Trang bricks, La Phu textile, Dong Ky wood, Dai Bai copper, Da Hoi steel are becoming as an IC.

Through the process of specialization and concentration of similar economic activities, Vietnam's ICs form and develop naturally, not as purposefully intervened by the government and local authorities. Particularly, the successful case like Thăng Long IP with a pioneer CANON is not the original intent of the local government, but largely because of Japanese companies' impacts.

Overall, ICs in Vietnam are at the stage of budding, and none of the clusters reveal the essential nature and meaning of a genuine IC. Instead, these so-called ICs exist mainly because of spontaneous demand of foreign companies in the local region and the inside and outside links that are still rather weak.

Therefore, all the experts (9/9) interviewed believed that the development ICs in Vietnam is now of great importance. According to experts of universities, research institutes and governmental bodies, forming ICs can help local enterprises improve their competitiveness before the wave of globalization and liberalization. At the same time, experts in the SI industry acknowledge that the enterprises expected such ICs to be able to support them in terms of supply and market expansion. The current domestic SMEs, especially supporting industries, have mainly imported raw materials and export products due to the underdeveloped domestic market and low-quality materials from local suppliers.

b) Approaches to develop IC in Vietnam

Most of the experts interviewed (7 out of 9 experts) agreed that we should combine the two approaches to build ICs. According to experts from governmental bodies, both approaches and pay more attention to the "bottom-up" approach should be implemented because most of the Vietnamese enterprises is now SMEs. Based on the need of enterprises and regions, the government develops supporting policies, and environments for linkages among SMEs and. At the same time, large enterprises need to develop linkages in the stages of design, production and consumption.

In addition, the expert from the automobile manufacturers and universities – research institutes recommend that two approaches should be combined to get variety of viewpoints, distinguish responsibilities between the government and enterprises. Thus, each party has own responsibility and better cooperation.

(c) Conditions for developing IC

There is a difference in opinions of experts between enterprises and universities - research institutes about the geographical location. The former highlighted the important role of geographical proximity in reducing costs in the business activities. While the latter argues that geographical proximity is not an important factor for IC, since in the era of information technology, distance is no longer a problem hindering communication among the enterprises. The enterprises become disadvantages in a location boundary. Therefore, the linkages of IC should be opened, and based on the supply chain.

Some experts (3/9) suggest that the business environment is a critical factor. The government need provide a suitable business environment, encourage the development of domestic enterprises, create conditions for infrastructure, implement of preferential policies, offer support services, etc. to help the enterprises participate in the ICs.

Currently, Vietnamese enterprises of SI are very weak. Several experts (4/9) point out that one of the important conditions to build an IC is market demand. An attractive market demand will attract SI enterprises to join in the IC.

(d) Governance structure of IC

Experts suggest that a large company should be chosen to become a focal company of IC. This company leader will connect the SMEs so that they can develop together. Almost experts

(8/9) suggest that focal company should be strong local or foreign company. They also imply that there should be no restriction of location for IC. The location limitation of IC should just make a concentration of businesses in which the government may offer incentives for SMEs and support them in many aspects (R&D, finance, training, logistic services). Customers and suppliers can share with any of those who want participate in supply chains at home and abroad. The building of IC also gives opportunities for new enterprises, and those enterprises that wish to invest more plants can take advantage of the distance to their customers in IC.

(e) Difficulties of SMEs to participate in the development of IC

Vietnamese SI is currently weak in many aspects. The biggest difficulties of Vietnamese SMEs are quality control and technology capability (8/9). The next difficulties are the linkages of enterprises (7/9), and business management (4/9). This is a major barrier to the national industry as well as the development of IC. It leads to SMEs of SI can hardly participate in supply chain of IC now. In addition, they also have to compete with Chinese enterprises whose products and quality are cheaper and stable respectively.

(f) Supporting policies of government for IC and SI

A despite an absence of a policy on the IC development, Vietnamese government has developed many preferential policies on SI (7/9). Unfortunately, these policies exit several inadequate and overlapping things. Thus, they have not come into reality yet to meet the needs of enterprises. According to experts of government bodies, the current financial support of the government is mainly related to the issue of tax reduction for SI enterprises, while the tax is decided by parliament, but not by the government. There is no law concerning such supports at the parliament.

In addition, these experts commented that the role of the government was blurred for FDI enterprises. The FDI enterprises in Vietnam are entitled to preferential investment policies, but the government cannot control how many products of Vietnamese SI enterprises they have to use. This leads to their only link with the "family" enterprise, and the Vietnamese enterprises are unable to participate in their supply chain. In this respect, the government can act as a third party, choosing a number of Vietnamese enterprises that can meet the requirements. The three parties consisting of the government, FDI enterprises, Vietnamese enterprises would sign the supply contract. Then, the government could create favorable conditions for investment, research and development, etc. to support Vietnamese enterprises to meet orders of FDI enterprises. Therefore, it is essential to construct an information channel where the government is the link between domestic and foreign capital enterprises to develop SIs in Vietnam.

(g) Role of related organizations

Universities and research institutions in Vietnam nowadays still carry out mainly functions in research and training, but lack practical applications. Scientific products and human resources from the universities and research institutes have not contributed much to the development of the industries (3/9). Thus, the question is whether the government should have a mechanism to promote this cooperation or not, because the roles of the universities and institutes are extremely important to IC in general and enterprises in particular in terms of improvement, research and development cooperation.

Associations and professional associations have an vital role to IC because of not only the external communication channel between the state agencies with enterprises, but also the role of linking businesses, providing information, supporting enterprises in the same industry, and gathering enterprises. However, at the moment, the association is still on formalism, not efficient for the industries. All experts (9/9), the role of today's associations is generally faint. Most of the leaders of the associations originated from state-owned companies owing a macro view, but not from enterprises. This leads to lack of understanding of businesses' real needs. On the other hand, the associations have not gathered large companies for their voices to represent the voice of the entire sector.

4. CONCLUSION

Based on the synthesis of theories and experiences in developing IC in the world, this study undertook depth interviews with nine experts to explore key issues that influence the development of IC in Vietnam. The results showed that it is extremely necessary to develop IC in Vietnam and "top-down" and "bottom-up" approaches should be combined. Next, the most important condition for the IC development is associated with the market demand and the government's supporting policies. Also, the main difficulties that domestic SMEs are faced with lie on lack of information, technology, and linkages of enterprises. The linkages among universities, research institutes, and associations with enterprises are weak and loose. Finally, there should be a focal enterprise in IC, and there should not exist a limit on location boundary, instead of expanding throughout the supply chain.

This study suggests recommendations aiming at creating favorable conditions for the development of IC in Vietnam. The government should establish sanctions for FDI enterprises so that they can cooperate with local suppliers to develop domestic SIs. Practical implementation guidelines are required following the policies on encouraging or supporting the SIs. The government should also have promotion policies as well as sanctions to increase cooperation between enterprises and universities, research institutes, and associations to facilitate the development of IC. Ho Chi Minh City authorities need to have a direction for choosing appropriately focal enterprise and location of automobile IC and then to build policies encouraging SMEs in automotive supply chain to participate in this cluster.

The limitations of the studies are that the number of experts interviewed is modest and enterprises' readiness to participate in the IC is not investigated. Therefore, this study should continue to undertake surveys on the readiness of businesses in order to establish a solid basis for the formation of IC in Vietnam in general and the automotive IC in Ho Chi Minh City in particular.

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APPENDIX: Summary of experts' main ideas on seven key issues

Key issues	Governmental bodies (Department - Board – Sector - Association)		Universities-Research Institutes			Enterprises				Total
	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7	Expert 8	Expert 9	
Necessity of IC development	Very necessary	Very necessary	Very necessary	Necessary	Necessary	Very necessary	Very necessary	Very necessary	Necessary	9
Approaches to IC	To combine 2 approaches	To combine 2 approaches	To combine 2 approaches	To combine 2 approaches		To combine 2 approaches	To combine 2 approaches	To combine 2 approaches	Indecisive	7
Conditions for IC development		Open geographical location	Open geographical location	Open geographical location	Open geographical location					4
	Closed and open geographical location					Closed and open geographical location				2
							Closed geographical location	Closed geographical location		2
	The business environment is very important.					The business environment is very important.		The business environment is very important.		3
		Market demand is very important.		Market demand is very important.			Market demand is very important.		Market demand is very important.	4
Governance structures	The focal enterprise is a strong Vietnamese one.									1

		The focal enterprise is a strong one, either Vietnamese or foreign.	The focal enterprise is a strong one, either Vietnamese or foreign.	The focal enterprise is a strong one.	The focal enterprise is a strong one.	The focal enterprise is a strong one.	The focal enterprise is a strong one.	The focal enterprise is a strong one, either Vietnamese or foreign.	The focal enterprise is a strong one, either Vietnamese or foreign.	8
Difficulties of SMEs	Corporate Management is weak	Corporate Management is weak	Corporate Management is weak	Corporate Management is weak						4
	Linkage among enterprises is weak	Linkage among enterprises is weak	Linkage among enterprises is weak	Linkage among enterprises is weak			Linkage among enterprises is weak	Linkage among enterprises is weak	Linkage among enterprises is weak	7
	Product quality and technology are weak	Product quality and technology are weak	Product quality and technology are weak		Product quality and technology are weak	Product quality and technology are weak	Product quality and technology are weak	Product quality and technology are weak	Product quality and technology are weak	8
Government's supporting policies	Incoherent, undeveloped IC policies	Incoherent, undeveloped IC policies	Incoherent, undeveloped IC policies	Undeveloped IC policies	Incoherent		Incoherent	Incoherent		7
	Weak supporting industries	Weak supporting industries	Weak supporting industries			Weak supporting industries	Weak supporting industries		Weak supporting industries	6
Roles of stakeholders	Blur	Blur	Blur	Blur	Blur	Blur	Blur	Blur	Blur	9
						The applicability of technological products is low.	The applicability of technological products is low.	The applicability of technological products is low.		3

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Vertical Acquisitions and Supply Chain Performance

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Abstract
We empirically analyze the effects of vertical mergers and acquisitions on the performance of the acquiring firms. Our primary focus is on inventory-related supply chain metrics . Accordingly, we concentrate on sectors where inventories play a significant role; i.e., manufacturing, wholesale and retail industries. By using accounting panel data from Compustat database and the data on vertical acquisitions/acquisitions from SDC Platinum database, we study how the post-acquisition inventory performance compares to that of the pre-acquisition level. We also investigate how ver- tical acquisitions impact other operating performance measures such as gross profit margin, sales efficiency and profitability.

Keywords: *vertical mergers and acquisitions, empirical analysis, inventory management, prof- itability.*

1 Introduction

Vertical merger (or acquisition) occurs when an upstream supplier and a downstream distributor merge (or one acquires the other). There are two types of vertical acquisitions: forward and backward. A forward vertical acquisition occurs when a company combines with one of its downstream distributors or retailers where its products are sold. A well-known example is Disney's acquisition of American Broadcasting Company (ABC) in 1996; Disney is a leading provider of family entertainment while ABC is a broadcasting company with news, cable, and entertainment networks. A backward vertical acquisition is where a company acquires an upstream supplier that produces some of the inputs used in the production of its products. American Technology's acquisition of HST Inc is an example. American Technology is a high-tech producer of branded components while HST is a designer and manufacturer of technologically advanced components for branded consumer products. Recent vertical transactions include Google's purchase of Motorola Mobility, and HP's acquisition of Autonomy, Britain's largest software company.

According to the existing literature, there are two major effects of vertical mergers and acquisitions. One is the cost efficiency and the other is anticompetitive market foreclosure. As on example of cost efficiency that can be gained from vertical mergers, consider the well-known double marginalization in a decentralized supply chain. Double marginalization occurs when both the upstream and downstream firms have monopoly power. The upstream producer of the input will price above marginal cost when it sells the input to the downstream firm, who will then price above marginal cost again when they sell the final product that uses the input. This means the product being market up above the marginal cost twice, which creates two deadweight losses. Vertical mergers eliminates such inefficiency by enabling the upstream firm to directly observe the joint profits. The merged firm can then induce the downstream subsidiary to reveal the correct price by rewarding the downstream subsidiary only when the optimal quantity for the reported price is consistent with the observed joint profits (Perry 1989).

Market foreclosure refers to the effect of vertical mergers on non-merged firms (Salinger 1988). A backward vertical merger can cause market foreclosure, which is the exclusion that results when non-merging downstream firms are foreclosed from the upstream input supply controlled by a vertically integrated firm. The foreclosure of rivals means that remaining suppliers will face less competition. As a result, they may be able to increase their profits by raising their input prices to the non-merging downstream firms, which benefits the vertically integrated firm. Analogous effects occur in a forward vertical merger, where upstream competitors are foreclosed from selling to the downstream division of the integrated firm.

Although many empirical studies have been conducted to examine the existence of these two effects, no research has been done on how vertical mergers affect merged firms' operating as well as inventory related performance. Does the acquiring firm's operating performance improve after a vertical acquisition? How does a vertical acquisition affect the acquiring firm's inventory related performance? These questions are unaddressed in the literature. In this paper, we empirically investigate the impact of vertical mergers on merged firms performance. Our empirical work employs an unbalanced panel of 1175 acquiring firms taken from the Compustat database for the period 1995-2008. By comparing the merging firms absolute performance with their industry benchmarks, we find that i) vertical mergers are generally associated with significant deterioration in operating and inventory related performance during the first year following mergers; ii) merged firms generally take at least two years to recover from the negative effects; iii) within the five years following the vertical merger, merged firms do no exhibit significant competitive advantage over the industry average performance.

The rest of the paper is organized as follows. We review related literature in §2, then propose our hypotheses in §3. The data sources and adopted methodology are discussed in §4. §5 report the detailed results and findings. We provide the concluding discussion and future research directions in §6.

2 Literature Review

In literature, there are many expected benefits from vertical integration, such as cost savings, market foreclosure, information sharing, etc. Although a number of researchers in economics and operations management areas have investigated analytically these effects of vertical integration, less attention has been paid to providing empirical evidence of these benefits. In this section, we shall review the literature on the related areas, including both theoretical and empirical studies.

How vertical mergers affect competition is an important issue in economics. Riordan (2008) reviews the effects of vertical integration around five major theories: single monopoly profit, eliminating markups, restoring monopoly power, raising rivals' costs, and facilitating collusion. Other commonly argued benefits of vertical integration include the reduction of risk (Buzzell 1983, Porter 1985), the integrated firms' ability to innovate and to differentiate (Porter 1985, Perry 1989) increased efficiency in the exchange of information and organizational structures (Porter 1985), and improved market positions of the integrated firm (Perry 1989). Since our interest in this paper does not concern monopoly profit, monopoly power and horizontal collusion, we will focus on the theories and evidence regarding the elimination of markups and the increase in rivals' cost.

Elimination of markups and increase in rivals' cost

Salinger (1988) summarizes three major effects of vertical mergers: i) the merging firm increases its final good output; ii) the unintegrated downstream firms lowers their demand for the intermediate good; iii) the merged firm withdraws from the intermediate good market and the increased concentration causes the intermediate good go up. He shows that which effect dominates depends on market structure and under certain conditions, a vertical merger increase the price for the final products.

More recently, the post-Chicago approach (proposed by Ordover et al. (1990) and Riordan and Salop (1995)) has emerged that has shed new light on the issue of the competitive effects of vertical mergers. This new analysis shows that vertical mergers create vertical integration efficiencies between upstream suppliers and downstream distributors. Potential efficiency benefits include improved coordination in pricing, production, and design that can reduce costs and improve product quality. They also involve more efficient input usage and promotion. Hart et al. (1990) develop a theoretical model showing how vertical integration changes the nature of competition in upstream and downstream markets and identifying conditions under which market foreclosure will be a consequence or a purpose, or both, of such integration. Chen (2001) also shows that vertical mergers will lead to both an efficiency gain and collusive behavior in horizontal competition. Whether the efficiency or the collusive effect dominates depends on the cost of switching suppliers and the degree of product differentiation. A vertical merger can raise downstream rivals' cost if and only if its own cost is reduced through the integration.

Although there are many expected benefits of vertical merger, the existing empirical literature seems to have focused mostly on issues related to transaction costs, foreclosures, and the determinants of vertical integration. The empirical literature on an important aspect of vertical merger, i.e., its effect on operating performance and inventory related supply chain performance, is surprisingly limited. Among the existing studies, McBride (1983) found that vertical integration negatively impacted post-integration prices. Gaudet and Long (1996) utilize a large panel of data to analyzes the effects of three different types of mergers. They show that mergers on average do result in significant increases in profits, but reduce the sales of the merging firms. Bhuyan (2002) finds that vertical mergers negatively impact profits, which may be due to the failure of vertical mergers to create differential advantages, such as cost savings, for the integrated firm. Azzam and Pagoulatos (1999) conclude that there are serious gaps in the vertical integration literature and the limited empirical work that has been done in this area makes generalization difficult to achieve. Therefore, the main purpose of this study is to empirically examine the effect of vertical mergers on the merged firm's performance.

Information sharing

In the supply chain management literature, however, a lot of emphasis has been put on designing an appropriate contract between upstream supplier and downstream retailer to achieve a channel coordination (see Cachon (2003) for a detailed review). Although the coordinated firms still operate independently, the effects of such contracts and vertical integration can be similar[1].

Double marginalization and information asymmetry are two of the major causes of supply chain inefficiency (Tsay et al. 1999, and Ozer and Wei 2006). Without vertical integration or cooperation, these factors can distort firms' incentives such that supply chain members are primarily concerned with optimizing their own objectives, instead of achieving the optimal supply chain performance (Cachon 2003). The classic supply chain management theory suggests that the vertical integration of successive monopolies eliminates double marginalization and results in a lower price of the final good. By this argument, vertical integration both raises profits and benefits consumers (Spengler 1950).

Lee et al. (2000) show that the order information transferred within a vertical supply chain tends to be distorted and can misguide upstream suppliers in their inventory and production decisions. Their analysis suggests that information sharing between supply chain members could provide significant inventory reduction and cost savings to the upstream manufacturer. Yu et al. (2000) also illustrate the benefit of supply chain partnership with vertical partnership. They show that the negative impact of bullwhip effect on a supply chain can be reduced or eliminated because the vertical partnership can help the supply chain members share more information to reduce uncertainties.

Although there are extensive literature in supply chain management area dealing with the supply chain coordination schemes (see Cachon (2003) for a detailed review) and the benefit or information sharing (e.g., Lee et al. (2000), Chen et al. (2000), Lee and Whang (2000), Yao et al. (2007)), to the best of our knowledge, there are few empirical studies on the vertical integration and firm's inventory performance. As the only one related to this issue, Carr and Kaynak (2007) empirically investigate the relationships among communication methods, information sharing within a firm, information sharing between firms, and supplier development support. They find that information

[1]Tan (2001) states that since most of the benefits of forward and backward vertical integration can be obtained by coordinating the logistics operations of independent firms in the supply chain. In this respect, supply chain management is synonymous with integrated logistics systems.

sharing between firms have significant impact on improving buyers product quality and financial performance. However, they did not measure inventory performance such as inventory turnover for supply chain members.

3 Hypothesis Development

In this section, we postulate our hypotheses regarding the impact of vertical acquisitions on operating and inventory performance, drawing on results from extant theoretical and empirical literature. In the interest of space, we focus on the hypotheses related to the performance of the acquiring firms compared to their rivals that have similar size in this context. In total, there are seven hypotheses - three of them dealing with operating performance and the other four dealing with inventory-related supply chain performance measures. We start with the former set.

3.1 Operating performance

A well-developed body of classical economic literature describes the motivations for vertical integrations. One of such motivations is the cost savings (see Spengler (1950), Salinger (1988), and Williamson (1971)). For example, Williamson (1971) suggests that vertical integration may reduce the cost of negotiation between the upstream and downstream firms. Such an effect could also improve the coordination between supply chain players and reduce the effect of double marginalization, so as to improve the profit margin for the vertically integrated firm. On the other hand, according to the vertical foreclosure theory,[2] the foreclosure of rivals from the merged suppliers means that remaining suppliers will face less competition. As a result, they may be able to increase their profits by raising their input prices to the unintegrated downstream firms. Using a Cournot model, Salinger (1988) shows that a vertical merger will reduce the competition in the unintegrated segment of the input market, causing the price of the input to unintegrated firms in the downstream market to rise. He also shows that when no market foreclosure occurs, a vertical mergers causes the price of the final good to decrease.

Since the vertically integrated firms benefit from the cost savings and market foreclosure, their market power increases. Under a typical downward sloping demand curve, the merging firms take

[2]See Krattenmaker and Salop (1986) for a general discussion of potential anticompetitive consequences of vertical mergers.

advantage of their increase in market power by raising price, and both their output and sales will fall. Gugler et al. (2003) show that a vertical merger can increase the degree of vertical contact between the merging firms and their rivals. High vertical contact raises the costs of cutting price in any given market and thus can facilitate more cooperative behavior thereby effectively increasing the merging firm's market power. A vertical merger can also increase market power by raising entry barriers and thus effectively lowering the merging firm's elasticity of demand. Krattenmaker and Salop (1986) point out that by embedding a collusive agreement in a vertical contract that raises input prices, the merged firms can restrain sales to rivals. Salinger (1988) also states that a vertical merger may give an intermediate good producer an incentive to restrict its sales of the intermediate good.

In terms of one of the major motivations of all kinds of M&As - profitability. The market foreclosure theory suggests that the vertical integrated firms may be able to increase their profits by raising their input prices to the unintegrated downstream firms. For example, Ordover et al. (1990) show that these higher prices benefit the vertically integrated firm. If rivals' costs of inputs are increased, they will be forced to reduce their production and raise the prices they charge in the downstream market. This reduction in competition allows the downstream division of the integrated firm to increase its market share and its price. Thus the profits of the vertically integrated firm can rise, even if there are no production efficiency benefits flowing from the vertical integration. D'Aveni and Ravenscraft (1994) also show that vertical integration can increase profits through higher prices by creating barriers to entry, and the integrated firms exhibit higher profitability than non-integrated competitors in the same industry.

Based on the aforementioned theories, we postulate the following hypotheses to examine the effect of vertical mergers on merging firms' operating performance.

Hypothesis 1 *The gross profit margins for merging firms will be positively correlated with vertical mergers.*

Hypothesis 2 *The sales efficiency for merging firms is negatively correlated with vertical mergers.*

Hypothesis 3 *The profitability for merging firms is positively correlated with vertical mergers.*

3.2 Inventory-related performance

As the focus in this paper, we use four different metrics to measure the inventory performance of firms: inventory (INV) which measures the total inventory level of a firms; inventory period (IP) which measures how quickly a firm turns over its inventory; inventory responsiveness (IR), which measures how rapidly a firm adjusts its level of inventory in response to changes in the sales environment; and, gross margin returns on inventory (GMROI), which measures how much a firm earns on every dollar spent on inventory. The last three measures capture different aspects of firm's inventory performance, and hence are complementary in nature. Broadly speaking, IP is a measure of efficiency, GMROI is a productivity/profitability measure, while IR is more related to elasticity.

Inventory and inventory period

In terms of the supply chain inventory management, the major benefits of vertical merger include the information sharing within the integrated firms and the reduction of transaction cost. Lee et al. (2000) point out that sharing sales information can be viewed as a major strategy to counter the bullwhip effect. The bullwhip effect is essentially due to the phenomenon of demand distortion, which creates problems for suppliers, such as grossly inaccurate demand forecasts, low capacity utilization, excessive inventory, and poor customer service. With the integrated supply chain, the merged firms can improve their inventory performance by sharing information and reducing the bullwhip effect, which can lower the total inventory level. Therefore, it is natural to expect the inventory level for the combined firms reduce after vertical mergers.

Hypothesis 4 *The total inventory for merged firms is negatively correlated with vertical mergers.*

On the other hand, D'Aveni and Ravenscraft (1994) shows that vertical integration also results in lower transaction-related costs, but higher production costs. While Lin et al. (2002) find that the more detailed information shared between firms, the lower the total cost, the higher the order fulfillment rate, and the shorter the order cycle time. Combining the effect of vertical mergers on costs and inventory, we postulate the following regarding the merging firms' inventory period.

Hypothesis 5 *The inventory period for merged firms is negatively correlated with vertical mergers.*

Inventory responsiveness

Rumyantsev and Netessine (2007) propose inventory responsiveness metric to link a firm's inventory performance and operating performance. Specifically, they define inventory responsiveness as the difference between the percentage change in inventory level and the percentage change in sales. Hence, if the inventory for a firm is growing at a faster rate than sales, then its inventory responsiveness would be positive, and if it is growing at a slower rate, the value of inventory responsiveness would be negative. Obviously, if they grow at the same rate, then the value would be exactly equal to zero. In essence, inventory responsiveness is a measure of how well the firm adapts its inventory practices in face of changes in demand (sales). Using financial panel data from Compustat, Rumyantsev and Netessine (2007) establish that a faster inventory growth and a faster inventory decline relative to sales are both negatively associated with firm's profitability.

In our context, for vertically merged firms, we expect inventory period to decrease (Hypothesis 5) while gross profit margin to increase (Hypothesis 1). From the definition of these two metrics and coupling with the fact that we expect sales to reduce due to mergers (see Hypothesis 2), inventory should reduce at a faster rate than sales for merging firms, leading to a negative inventory responsiveness. On the basis of above, we postulate:

Hypothesis 6 *Vertical acquisitions result in a negative inventory responsiveness for merged firms.*

Gross margin returns on inventory

Gross margin return on inventory (GMROI) can be used to analyze a firm's ability to turn inventory into cash above the cost of the inventory. This particular metric is calculated as the ratio of the gross margin earned by a firm to its average inventory cost. This is a useful measure as it helps managers to see whether a sufficient amount is being earned compared to the investments in inventory assets. A ratio higher than 1 indicates a positive return on inventory investment, while a ratio below 1 means the firm is selling the product for less than what it costs the firm to acquire it. This ratio can also be expressed as the gross profit margin multiplied by sales-to-inventory ratio. Note that sales-to-inventory ratio is itself related to both the inventory period and gross profit margin.[3] Since we expect gross profit margin to increase (Hypothesis 1) and inventory period to decrease (Hypothesis

[3]Inventory-to-sales ratio is the multiplication of inventory period with COGS-to-sales ratio (i.e., one minus gross profit margin). Sales-to-inventory ratio is the reciprocal of inventory-to-sales ratio.

5), we should observe GMROI for merging firms to increase after mergers. That is:

Hypothesis 7 *The gross margin return on inventory for merged firms is positively correlated with vertical mergers.*

4 Data and Methodology Description

In this section, we discuss the data and methodology we use for establishing the effects of vertical M&As. Our sample is drawn from the population of M&As that took place between January 1, 1997 and December 31, 2006 and is included in the Securities Data Corporation (SDC) Mergers & Acquisitions database. Since we are interested in companies with more inventory related activities, we look for mergers with primary SIC codes in the following ranges: 2000-3999 (manufacturing), 5000-5199 (wholesale trade) and 5200-5999 (retail trade).[4] Moreover, we require all deals in our sample to meet the following criteria: (i) both target and acquirer are U.S. domestic, publicly traded firms, (ii) the announced merger was eventually completed, (iii) the target and acquirer have different primary four-digit SIC code, and (iv) the acquirer did not previously own a majority share of target firm and obtained more than fifty percent of the target's stock through the transaction. The first criteria is to ensure that we have access to their financial data in the Compustat database; the second one is to filter out those merger announcements that did not get approval from authorities; the third one is to exclude other horizontal M&As; and the last requirement is to ensure that transactions have a significant impact on the relationship between two merged firms. Note that throughout this paper we assume the merger date to be the date when the merger was completed (i.e., when there was a change of control of the acquirer to the target) and not when it was announced.[5]

The requirement of target and acquirer having different primary four-digit SIC code does not guarantee the vertical relationship between these two firms. To identify those vertical link between two merged firms, we use the benchmark Make and Use tables obtained from the Bureau of Economic Analysis (BEA) at the U.S. Department of Commerce to create the Input-Output table. The benchmark IO accounts are compiled once every five years and primarily based on the census data

[4] Standard Industry Classification (SIC) is an extensive hierarchical structure of codes developed by the U.S. Department of Commerce to categorize companies based on their industries.

[5] In contrast, most papers in finance (e.g., Shahrur 2005), where the objective is mainly to understand the reaction of the stock market, assume the merger date to be the date when it was announced.

collected by the Bureau of Census. In this paper, we use the 2002 benchmark accounts to define the upstream and downstream industries that experienced horizontal mergers between 1997 and 2006. The Make table is a matrix showing that the commodities (columns) that are produced by each industry (rows) at producers' prices, and the Use table shows the inputs to industry (columns) production and the commodities (rows) that are consumed by industries, consumers and government. The detailed procedure is referred to the appendix of Allayannis and Ihrig (2001). Based on the input-output matrix, we follow the approach by McGuckin et al. (1991) and define a forward (backward) vertical merger that satisfies the input percentage to the target (acquirer) from the acquirer's (target's) industry is more than 5 percent of the total input of the target (acquirer) industry. [6]

For the financial data, we use quarterly financial data for all publicly held U.S. companies with primary SIC codes in the three ranges indicated before (i.e., manufacturing, wholesale and retail sectors) for the 13-year period 1996 - 2008. We obtain this data from Standard & Poor's Compustat database accessed through Wharton Research Data Services (WRDS). We collect them for three years longer than the merger period to ensure that we have at least one (and two) more year data available for the pre- (and post-) merger analysis.

Within the 318 SIC codes covered in our sample, there are 10138 companies whose financial data is available from Compustat, and 1175 acquirers which can be identified from the SDC database.[7] The distribution of vertical M&As covered in our sample is provided in Figure 1. Due to the way Compustat collects data, some of our sample firms have missing value in their accounting data. Therefore, the actual number of usable observations is less than the sample size. For each of the 10138 companies, we collect the quarterly data on the following financial items which are required to calculate the performance metrics of interest to us: asset (data item: ATQ), cost of goods sold (data item: COGSQ), inventories (data item: INVTQ), operating income before depreciation (data item: OIBDPQ), and net sales (data item: SALEQ).

[6]McGuckin et al. (1991) shows that the categorization between a vertical and conglomerate merger are sensitive to this cutoff. And on average, a four-digit SIC code had ten material inputs involving more than 1 percent of total input costs. We use 5 percent cutoff in this paper to filter out the cases where two merged firms are not closely related from a supply chain perspective. D'Aveni and Ravenscraft (1994) define a line of business as vertically integrated when some combination of its forward or backward transfers exceeds 10 percent of its sales or cost of sales.

[7]We use the identifier GVKEY to keep track of each company in Compustat because other firm identifiers such as the company name, CUSIP, or ticker may change over time.

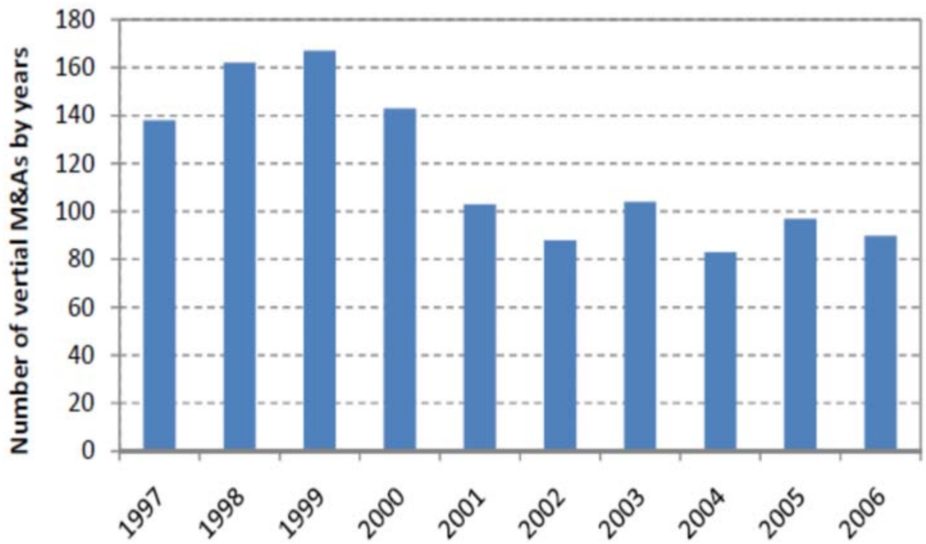

Figure 1: Distribution of 1175 vertical M&As by year

Table 1 provides the basic summary statistics for firms in our sample, based on the last fiscal quarter prior to the effective date of mergers. Several issues need to be discussed in this context. First of all, in contrast to prior research in this area, we include the financial data not only for the merging firms (targets and acquirers) but also for the non-merging ones, because later on we compare the effects of M&As on the performance of the two sets. Second, this table shows that the size of the firms in our sample varies significantly (large standard deviation and range). Moreover, the high kurtosis implies that most of the variance is due to infrequent extreme deviations, and positive skewness means that the mass of the distribution is concentrated on the left and there are relatively few high values.

Based on the above facts, we focus our attention on the change in a firm's performance instead of the level of a firm's performance, and we will mainly use Wilcoxon signed-rank test in our analysis[8]. We will also conduct the t-test and the binomial test to provide robustness checks for the results.

In order to test our hypothesis, we use basic quarterly financial data (e.g., total assets, cost of goods sold, operating income, net sales, and inventory total (INVT)) and compute the performance metrics for each firm i in quarter t as shown in Table 2. We focus our analysis on the four quarters before the merger (quarters -4 to -1) and four years following the merger (quarters 1 to 4). We

[8]Concerning the choice of an expectation model, Barber and Lyon (1996) find that test statistics using the change in a firm's performance relative to an appropriate benchmark consistently yield more powerful test statistics than do those based on the level of a firm's performance relative to the same benchmark. In the choice of statistical test, they find that nonparametric Wilcoxon test statistics are uniformly more powerful than parametric t-statistics, regardless of the operating performance measure employed.

Table 1: Descriptive Statistics for Firms in Our Sample (in million US$)

	Average	Median	St.Dev.	Max	Min	Kurtosis	Skewness
Panel A: Descriptive statistics for 1175 acquiring firms before mergers							
Total Assets	3723.31	334.88	9914.00	111550	1.395	49.96	5.84
Cost of Goods Sold	629.36	53.57	1821.53	22234	0.075	67.42	6.85
Inventory Total	473.63	54.29	1147.91	7791	0.086	17.55	3.95
Operating Income	158.79	6.84	505.21	5212	-255.5	43.45	5.76
Net Sales	997.82	90.67	2421.56	23315	0.038	26.44	4.30
Panel B: Descriptive statistics for 1175 rivals before mergers							
Total Assets	4339.41	913.31	10616.18	120058	0.008	44.27	5.57
Cost of Goods Sold	560.98	124.46	1131.25	10982.7	0.132	26.11	4.30
Inventory Total	435.42	119.64	840.55	6701	0.101	15.73	3.62
Operating Income	216.01	24.18	608.86	4036	-146.2	18.47	4.24
Net Sales	1072.15	211.40	2138.01	13982	0.011	10.95	3.17
Panel C: Descriptive statistics for all 10138 firms in sample							
Total Assets	2584.22	160.04	12105.20	479921	0.001	299.03	14.24
Cost of Goods Sold	422.36	28.11	2372.20	189081	0.001	658.82	20.03
Inventory Total	229.48	22.33	1015.30	40416	0.001	321.10	14.41
Operating Income	95.64	3.57	533.70	25324	-5810.1	383.16	16.02
Net Sales	595.73	45.43	2983.40	195805	0.001	455.62	16.95

exclude quarter 0, the quarter of the merger, from the analysis because in this quarter the two firms are consolidated for financial reporting purposes only from the merger completion date. Consistent with previous studies, we combine the target and acquiring firms' financial data before the merger to obtain the pro forma pre-merger performance of the combined firms. Then, for each sample firm, comparison of the relative change between the pre-merger and post-merger quarterly average performance provides a measure of the percentage change in absolute performance of the merging firms due to the merger. An exception is the inventory responsiveness (IR) metric, which is by definition involves a rate of change (difference between percentage changes in sales and percentage changes in inventory). For this reason, we compute the merger induced changes in IR by subtracting the *average* quarterly change in sales (pre- and post-merger) from the *average* quarterly change in inventory (pre- and post-merger).

We recognize that some of the changes in performance between pre- and post-merger could be due to macroeconomic and/or industry-specific factors. Hence, to rule out the potential industry or economy related effects, in line with previous studies (e.g., Healy et al. 1992 and Barber and Lyon 1996), we use the industry-average performance as a benchmark to evaluate the merging firms'

Table 2: Definitions of Performance Metrics

Operating Performance	Metrics
Gross profit margin	$GPM_{it} = \frac{SALEQ_{it} - COGSQ_{it}}{SALEQ_{it}}$
Sales efficiency: Sales on assets	$SOA_{it} = \frac{SALEQ_{it}}{ATQ_{it}}$
Profitability: Return on assets	$ROA_{it} = \frac{OIBDPQ_{it}}{ATQ_{it}}$
Profitability: Return on sales	$ROS_{it} = \frac{OIBDPQ_{it}}{SALEQ_{it}}$
Inventory Performance	**Metrics**
Total inventory	$INV_{it} = INVTQ_{it}$
Inventory period	$IP_{it} = \frac{INVTQ_{it}}{COGSQ_{it}}$
Inventory responsiveness	$IR_{it} = \frac{INVTQ_{it} - INVTQ_{i,t-1}}{INVTQ_{i,t-1}} - \frac{SALEQ_{it} - SALEQ_{i,t-1}}{SALEQ_{i,t-1}}$
Gross margin return on inventory	$GMROI_{it} = \frac{SALEQ_{it} - COGSQ_{it}}{INVTQ_{it}}$

Note: *ATQ* stands for total asset, *COGSQ* stands for cost of goods sold, *INVTQ* stands for total inventory, *OIBDPQ* stands for operating income before depreciation, and *SALEQ* stands for net sales.

industry-adjusted post-merger performance.[9]

Similarly to pervious studies, such as Hendricks et al. (2007), we denote P_{it} as the average quarterly performance for firm i in year t. The firm i's industry average quarterly performance in year t is PI_{it}. Then ΔAP_{it}, the industry-adjusted percentage change in performance for merging firms i in year t is

$$\Delta AP_{it} = \frac{P_{it} - P_{i,t-1}}{P_{i,t-1}} - \frac{PI_{it} - PI_{i,t-1}}{PI_{i,t-1}}.$$

To illustrate how to compute the adjusted performance, consider the following example: Suppose

[9] To check the robustness of our results, we also used the industry median performance as a benchmark to adjust the merging firm's performance. In that case, the signs of all the changes in the performance metrics of our interest are the same as the results we report, but the level of significance is weaker. We choose to focus on the industry-average adjusted performance because sometimes the industry-median performance happens to be the same as the sample firm's performance, which reduces the significance of the results.

during one year prior to the merger quarter, the average quarterly return-to-assets (ROA) ratio for the pro-forma combined firms is 0.048; and during one year subsequent to the merger quarter, the average quarterly ROA for the merged firm increases to 0.052. Therefore, there is 8.3% increase in ROA during the first year following the merger. For the same time period, we calculate the percentage change in ROA for every non-merging firms in the industry and find that the industry average ROA ratio increases by 4%. In this case, the industry-adjusted percentage change in ROA is 4.3% for the merging firm. [10]

5 Empirical Results

In this section, we report our empirical results. We start by studying the effects of M&As on the absolute performance of the merging firms. Next, we investigate how those effects compare to the effects on the industry average performance. Subsequently, we directly compare the effects on the merging firms to the effects on the performance of the matching rivals. We end this section by discussing whether (and if so, how) our results change if we take into account long-term effects of mergers (two-year post-merger rather than one).

5.1 Effects on the absolute performance

The effects of M&As on the absolute performance of the merging firms is shown under the "+1 Year Absolute" columns in Table 3. From the table we observe that the basic financial measures (e.g., Assets, COGS, Income and Sales) increase significantly after mergers.[11] As regards to operating performance, in general, the gross profit margin of the merging firms decreases significantly (by about 1%) with 54% of the firms showing deterioration. The sales efficiency also decreases significantly (by about 4%) for most of the merging firms. In terms of profitability, it seems that vertical mergers result in lower absolute profitability for the merging firms - both return on assets and return on sales measures decrease significantly (by 10% and 4% respectively).

[10] Note that, similar to Barber and Lyon (1996) and Hendricks and Singhal (2003), throughout this document, we discard extreme values by symmetrically winsorizing the data at the 1% level in each tail while calculating the ratio measures.

[11] Throughout this section, we focus on the median change in performance (as in Healy et al. (1992)) for analyzing the effects of M&As, although we also report the mean change in performance in the summary tables. The reason for this is the fact that the mean is affected by extreme values.

Table 3: Effects of vertical mergers

Merging firms' Performance	Exp. Changes	Obs	+1 Year Absolute mean	median	% neg.	+1 Year Industry-Adjusted mean	median	% neg.
Panel A: Basic Financial Performance								
Perc Chng in assets		1069	0.44	0.20	17.59%	0.29	0.11	35.38%
statistic			16.70***	22.87***	-21.20***	10.61***	11.30***	-9.43***
Perc Chng in cogs		1070	0.33	0.17	22.24%	0.21	0.10	37.56%
statistic			15.46***	19.09***	-18.16***	9.55***	9.76***	-8.03***
Perc Chng in inc		988	0.04	0.11	39.88%	-0.18	0.05	46.73%
statistic			-0.66	4.75***	-6.36***	-2.49**	0.47	-2.03**
Perc Chng in sales		1070	0.30	0.16	20.56%	0.18	0.10	37.56%
statistic			16.33***	19.34***	-19.26***	9.40***	9.05***	-8.03***
Panel B: Operating Performance								
Perc Chng in GPM	+	1069	0.00	-0.01	53.88%	0.00	0.00	50.10%
statistic			0.03	-0.28***	2.54**	-0.14	-1.54	0.06
Perc Chng in SOA	-	1062	-0.04	-0.04	61.58%	-0.05	-0.03	57.12%
statistic			-4.40***	-7.87***	7.55***	-4.36***	-5.16***	4.57***
Perc Chng in ROA	+	984	-0.20	-0.10	63.62%	-0.28	-0.04	52.35%
statistic			-3.97***	-8.15***	8.54***	-4.39***	-3.62***	1.45
Perc Chng in ROS	+	984	-0.43	-0.04	56.91%	-0.34	-0.02	50.99%
statistic			-5.42***	-5.40***	4.34***	-4.32***	-2.91***	0.61
Panel C: Inventory Performance								
Perc Chng in inv	-	1057	0.43	0.21	23.08%	0.31	0.14	36.73%
statistic			15.28***	19.80***	-17.50***	10.75***	11.72***	-8.51***
Perc Chng in INP	-	1055	0.14	0.02	45.78%	0.09	0.03	45.28%
statistic			8.42***	5.60***	-2.74***	4.83***	3.53***	-3.03***
Perc Chng in GMROI	+	1055	0.02	-0.04	56.21%	-0.03	-0.05	53.94%
statistic			1.01	-4.20***	4.03***	-0.97	-3.56***	2.53**
Inventory Respon.	-	1055	0.14	0.03	44.17%	0.13	0.04	44.99%
statistic			6.93***	6.13***	-3.79***	6.28***	5.41***	-3.21***

This table presents the merging firms' absolute and industry-adjusted performance during the period from one year before mergers to one year after mergers. Panel A reports the percentage changes in basic financial performance, Panel B reports the percentage changes in operating performance, and the percentage changes in inventory performance are reported in Panel C. We use t-test for the mean, Wilcoxon sign rank test for the median, and the binomial sign test for the percentage of negativity. The statistics are given in the row denoted "statistic" and the superscripts *, **, and *** indicate that the result is significantly different from zero at 0.10, 0.05 and 0.01 level for two-tailed tests, respectively.

More importantly, there is *no significant positive impact* on the absolute inventory performance due to vertical mergers. For example, mergers result in about 54% of the merging firms turning their inventories slower resulting in a significant 2% increase in the inventory period. This lower turn does not manifest itself in higher productivity returns from inventory investments or more responsive inventory management. Due to the significant increase in inventory (21%) and decrease in GPM, GMROI also reduces significantly. Comparing the growth in merging firms' sales and inventory, the significantly positive IR shows that the increase in inventory outweighs the increase in sales (by 3%). In summary, during the first year after vertical mergers, the merged firms experienced significant deterioration in their absolute operating and inventory related performance. This finding is consistent with the results of an Accenture survey of business executives involved in their companies' mergers or acquisitions that more than 40% of them observed problems in inventory management. (Byrne 2007).

5.2 Effects on the relative performance compared to industry average

The effects on the absolute performance discussed above do not tell the whole story since the macroeconomic factors that might affect the whole industry sector are not taken into account. To deal with this issue, in this section, we investigate the effects on the industry-adjusted performance of merging firms, where we use the effects of M&As on the industry average performance as the benchmark. We refer the readers to §4 for more details about how we calculate the adjusted performance. We proceed with the testing of the seven hypotheses about operating and inventory performances developed in §3 based on adjusted performance. As mentioned before, because of the large disparity among observations, we use the Wilcoxon signed-rank statistics to test our hypotheses and report the t-test statistics and the binomial test statistics to provide robustness checks for the results. Generally speaking, we find that the results of Wilcoxon signed-rank test and binomial test are always in good agreement, while the results of paired t-tests are not always consistent with the other tests because of the presence of extreme values. Before discussing about the effects on operating and inventory performances, we briefly discuss the effects of M&As on the basic financial performance metrics.

Basic financial performance. Under the "+1 Year Industry-adjusted" columns in Table 3, Panel A shows the percentage changes in financial data items - assets, COGS, operating income and sales - for the merging firms. The positive values of Wilcoxon sign rank z-statistic for assets, COGS, and sales indicate that compared to the average level of merging industry, merging firms experience *significantly faster growth in financial performance* after the vertical integration, all significantly different from zero at 1% level. More than 60% of the merged firm experience a significant increase in sales. The only financial performance metric that does not experience a significant change after mergers is the percentage change in operating income before depreciation.

Operating performance. The percentage changes in operating performance metrics are shown in Panel B of Table 3. Looking at the percentage changes in industry-adjusted profit margin, the statistics show that the merging firms' adjusted profit margin is not significantly different from the industry benchmark. This result does not support our first hypothesis that vertical mergers generate market power to the merged firms. However, there are strong indications that *the sales efficiency of the merging firms actually decreases.* Specifically, the industry-adjusted median value of percentage change in Sales on Assets (SOA) metric for merging firms reduces by 13% (significantly different from zero at 1% level). The binomial z-statistics also generate similar results with over 73% of merging firms experiencing a decrease of industry-adjusted SOA within four quarters after the transactions. So, there is strong support for our second hypothesis that the sales efficiency for the merging firms is negatively correlated with M&As. This is because the acquiring firms' post-merger growth in sales does not occur as fast as the growth in total assets (including inventories).

Lastly, we come to the most important operating performance measure - profitability. In the literature, profitability is usually measured by return on assets, i.e., ROA and/or by return on sales, i.e., ROS (Griffin and Mahon 1997; Dehning et al. 2007). Although the industry-adjusted performance looks better than the merging firms' absolute performance, unfortunately, the evidence shows that for both measures, vertical M&As deteriorate the profitability of the merging firms. Specifically, we note that there are negative changes in industry-adjusted ROA and ROS of merging firms (-4% and -2% respectively), which are significant at 1% level. This result is mainly driven by the fact that merged firms failed to achieve a significant improvement in operating income compared to the industry benchmark, although they are still able to increase the absolute operating income.

In summary, our empirical evidence shows that during the first year after vertical mergers, there is no any improvement in merging firms' operating performance, which is characterized by lower sales efficiency and lower profitability.

Inventory performance. The merger effects on industry-adjusted inventory performance is illustrated under the "+1 Year Industry-Adjusted" columns in Panel C of Table 3. In this context, first note that there is a significant increase in the growth of inventory held by merging firms, comparing to the industry benchmark. The median of post-merger inventory for merging firms increased 14% more than the change in the industry average level and around 37% of the merging firms' inventory growth is faster than the industry average level. This suggests that *the merging firms' inventory growth is significantly faster than their industry average level*; however, total inventory is an aggregate measure, which does not take into account the size of the firm. A better measure of inventory efficiency is inventory period (= average inventory / COGS) with a lower value of inventory period representing more efficient firms and vice versa. *From inventory efficiency perspective, merging firms are also worse than the industry average.* Due to the significant increase in industry level, merging firms' inventory periods also become longer after mergers. 55% of the merging firms' post-merger inventory periods performance is worse than the industry benchmark, and the median increase of industry-adjusted inventory period is 3%.

While the above evidence suggests that vertical mergers do not improve inventory efficiency (compared to the industry average), we also need to understand how they affect two other relevant inventory management measures: inventory responsiveness (IR) and gross margin return on inventory (GMROI). In terms of inventory responsiveness, we find that *there is significantly positive impact on the inventory elasticity metric due to M&As*, which means the industry adjusted inventory growth is faster than the industry adjusted sales growth. This fact partly explains the reduction in merging firms' sales efficiency. Moreover, we find that inventory investments are not be providing much returns to the merging firms, compared to the industry average. Rather, the median change in GMROI decreases by 5% for merging firms, with around 54% of them experiencing a significant decline. The underlying reason for this results is that the industry adjusted inventory increases faster than profit margin.

In summary, inventory-related operations for merging firms deteriorate after vertical mergers since their inventory efficiency and inventory productivity reduce. In other words, after vertical mergers, merging firms hold inventory for a longer period, and for each dollar spent on inventory, fewer profit dollars is generated in the first year after mergers than in the year prior to the merger quarter. All of these evidence suggests that vertical mergers do not benefit firms in inventory management at least in a short term.

5.3 Long-term effects of mergers

There are two main reasons to extend our analysis beyond the first year post merger: i) to assess the robustness of the short-term effects of mergers; and ii) to measure the potential bias due to the accounting treatment. In mergers where the purchase accounting method is used to account for the business combination, all the assets of the target firm have to be marked to market before being combined with the acquirer's book assets, and the difference between the purchase price and the revised book value of target firm's equity is recorded as goodwill in the acquirer's book. This accounting treatment might result in increases in the values of target total assets. Thus, results for this year are therefore not comparable across firms or for industry comparisons Healy et al. (1992). To mitigate the effects of such accounting adjustment, it is worthwhile to investigate how our results of the previous section are affected if we consider the long term effects of M&As. Specifically, rather than one year post-merger, in this section we calculate the percentage changes in performance metrics from one year to five years after the transaction. These results are exhibited in Figure 2 for the merging firms for two levels of analysis - unadjusted and industry-average-adjusted.

Based on comparison of the results in this table to those in Figure 2, we can see that, broadly speaking, most of previous performance metrics improves over time, in both absolute and relative measures. In terms of operating performance, merging firms' profit margins gradually improve and catch up with the industry average level. The adjusted changes in sales efficiency and profitability also became insignificant since the second year after mergers. As for the absolute performance, we observe an evident increase in merging firms' sale efficiency since the third year after mergers.

Regarding the inventory related performance measures, the first thing we noticed is that merging firms' inventory growth is significantly slower than the industry average benchmark since the second year after mergers, which implies a potential improvement in the inventory management of vertically integrated firms. The evidence from other performance measure verified such an improvement. The adjusted inventory period (IP) is reduced from the second year and maintains the same level as the industry average level. The adjusted inventory responsiveness (IR) and inventory productivity (GMROI) are also insignificantly different from the industry level since the second year after mergers. The absolute measures even showed some improvement in these measures.

Overall, looking at the long-term changes in merged firms' performance, we find that although mergers deteriorate firms' operating and inventory related performance immediately after the vertical integration, the negative effects diminish over time. Generally speaking, it takes about at least two years for the merged firms to recover from the merger and match the industry average performance. Interestingly, even after five years following vertical mergers, there is still no significant evidence showing that vertical mergers create a competitive advantage over industry average benchmarks.

Figure 2: Long-term effects of vertical mergers

This figure presents the merging firms' absolute and industry-adjusted performance during the period from one year to five years after mergers. Solid bars represent the absolute performance, while striped ones represent the industry-adjusted performance. The pink, yellow, and green color indicate that the result is significantly different from zero at 0.01, 0.05 and 0.10 level for two-tailed tests, respectively.

6 Summary and managerial implications

In this paper, we conduct a cross-industry empirical study of vertical mergers and acquisitions that took place between 1997 and 2006 in manufacturing, wholesale and retail sectors. Our primary focus is on inventory-related supply chain metrics, while we also report to the effects on operating performance and financial performance. The comparison between merging firms' absolute performance and industry average benchmark provides a detailed evidence on the impact of vertical M&As. To investigate the consistency of the effects over time, we extend our analysis up to five years following the transactions.

In general, we find that immediately following the vertical mergers, merging firms' operating and inventory performance deteriorate significantly. Merging firms suffer from a significant reduction in their gross profit margin and sales efficiency. The profitability is also lower than the pre-merger level. Regarding the performance in inventory related measures, the significant buildup in merging firms' inventory levels increases their inventory period while reduces the inventory productivity. The growth in inventory is much faster than the growth in sales. All these evidences suggest that merged firms experience significantly negative effect subsequent to the vertical M&As.

Looking at the long term performance of merging firms, we find that over the five years following the vertical transaction, merging firms continued to recover from the negative consequences of mergers. Generally speaking, it takes at least two years for merged firm to catch up with the industry average performance. However, there is no significant evidence showing that merged firms exhibit superior performance over the industry benchmark, even after considerable time, which suggests that vertical mergers do not provide significant competitive advantages to the merging firms.

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The Asymmetric Contagion Effect from the U.S. Stock Market around the Subprime Mortgage Crisis between 2007 and 2010

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Abstract

This study employed the Enders and Siklos (2001) asymmetric threshold co-integration frameworks, including the M-TAR model and the logistic smooth transition co-integration model to investigate whether the contagion effects had existed in international stock markets by using the changes in the asymmetric long-run equilibrium relationships between the U.S. S&P 500 index and eighteen stock markets in Asia, Europe, and America around the Subprime Mortgage Crisis between 2007 and 2010. The main empirical findings demonstrated that with the application of Engle and Granger (1987) symmetric co-integration test, the Subprime Mortgage Crisis did not reinforce the co-movement trends between the S&P 500 index and these stock markets. However, with the application of the asymmetric co-integration frameworks, there was significantly increase in these co-integration relationships between them after Lehman Brothers filed the bankruptcy on September 15, 2008, and the transition speeds between these two regimes also substantially increased in the logistic smooth transition co-integration model. Both the M-TAR model and the logistic smooth transition co-integration model showed that there existed a contagion effect between them in the aftermath of Lehman Brothers' bankruptcy. Only the China market was not transmitted by the U.S. market during this crisis; there was only an interdependence effect between the U.S. market and China market. Furthermore, the result showed that the event of the Subprime Mortgage Crisis determined the degrees of contagion effects depending on the financial linkage to the U.S. markets, which further demonstrated the differences in the causes and influence between the Subprime Mortgage Crisis and other financial crises in emerging markets.

Keywords: *Threshold Co-integration Model; Logistic Smooth Transition Co-integration Model; Contagion effect; Stock Market; Subprime Mortgage Crisis.*

1. Introduction

In early March 2007, there was a credit crisis in New Century Financial Corp., the second largest mortgage company in the U.S. It ignited the Subprime Mortgage Crisis, which disordered the financial markets in the U.S. and Western Europe (Longstaff, 2010). Fed passed the bailout plan for investment banks and institutions and has poured more than 1000 billion dollars into the financial markets to purchase the non-performing loans to rescue the liquidity of the U.S. financial markets in Quantitative Easing (QE);[1] the European Central Bank (ECB) and the Bank of Japan have also adopted similar policies recently. The Subprime Mortgage Crisis also hit the real output of the U.S. and global economy. Scholars thought the chain reactions incurred by the Subprime Mortgage Crisis have never been seen since the Great Depression.

Past literature about the contagion phenomenon due to financial crises by Lee and Kim (1993), Forbes and Rigobon (2002), Caramazza *et al*. (2004), Dungey *et al*. (2006), Lucey and Voronkova (2008), Gilmore *et al*. (2008), Arouria *et al*. (2009) about the contagion effect or the transmission effect was based on the backgrounds of several financial crises since the late 1980s, including those in the U.S. (1987), Mexico (1994), Thailand (1997), Russian (1998), and Argentina (1999). Recent literature, such as that by Sikka *et al*. (2009), Swan (2009), Longstaff (2010), Claessens *et al*. (2010), Abad *et al*. (2010), Sobreira (2011), Iyer and Peydro (2011), Samarakoon (2011), Afonso *et al*. (2012), Frankel and Saravelos (2012) and Dumontaux and Pop (2013) about the contagion effect was based on the backgrounds of the Subprime Mortgage Crisis and the EMU Sovereign-Debt Crisis.

Although the collapse of the New York stock market in 1987 triggered a global

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[1] The QE was divided into QE I (2008), QE II (2010), QE III (2012) and QE IV (2013) from 2008 to 2014.

stock market crash, the background of the macroeconomic and technological applications was a lot different from that of the current one in terms of globalization and liberalization of the trade environment and the rapid development of capital markets in emerging countries. Freer capital flow among international security markets, electronic trading systems and the linkage of the Internet in stock markets as well as highly developed derivatives have all accelerated the speed of information transmission and increased the links of the international security markets, and these factors have brought about significant differences between the Subprime Mortgage Crisis and the U.S. stock market collapse in 1987. Other financial crises in Mexico, Thailand, Russia and Argentina were only regional crises from emerging markets; therefore, the scope of their influence was only limited to their neighboring countries where the crises occurred, and these crises did not spread globally; apparently, the impact of the Subprime Mortgage Crisis was greater than the above events. The loose financial regulatory systems, high financial deficits and government debts, insufficient foreign exchange, and unstable exchange rates in these emerging countries all contributed to the consequences of the financial crises in these countries.

However, the excessively issued derivatives by banks and the major negligence in the financial regulatory systems in the U.S. and Western European countries caused the Subprime Mortgage Crisis in the U.S. between 2007 and 2010, while nearly no government or research institution had provided early warnings for the imminent Subprime Crisis except very few economists. The recent Subprime Mortgage Crisis, which seems to have had a perceived structural change to the influences of the U.S. stock market, has had a great effect upon the major financial markets of the whole world. Therefore, we used this crisis as the breaking point to investigate the influence of the U.S. stock market on the Asian, European, and American stock markets.

Because past research about the contagion effect due to financial crises mostly emphasized the crises from emerging markets or developing countries, the scope of their influence was limited. The Subprime Mortgage Crisis, which has caused a global financial crisis, was a rare incidence in the past one hundred years; nevertheless, its impact can still be seen at present. How were the relationships between the U.S. stock market and global stock markets affected when an impact of a significant risk event occurred, e.g. the Subprime Mortgage Crisis in the U.S. financial market, due to the stronger links of the international financial markets? Was the impact more significant during the period of "the Subprime Mortgage Crisis" than during the period of "tranquil times"? Was the relatedness changed by the negative impact of the Subprime Mortgage Crisis? This study attempts to clarify the relationship changes between the U.S. stock market and international stock markets during tranquil times and during crisis times. On the one hand, we want to offer our opinions to investors about investing in international security markets; on the other hand, we also hope to provide references to government departments on policy-making for financial oversight, which was the first research motivation of our study.

Past literature about the contagion effect often employed the co-integration method to examine whether a co-integration relationship around a crisis had changed, and whether the contagion effect had existed. Two points will be considered in this study; first, the assumption of "symmetric adjustments" in the traditional co-integration model ignored that the adjustment speeds were different when the stock market was in an upward status or in a downward status. Therefore, to seek a better method to confer the interaction among international stock markets has become the main topic in this article. We employed the Enders and Siklos (2001) asymmetric threshold co-integration test to compare the changes in the asymmetric co-integration relationship between the U.S. stock market and the other stock markets around the Subprime Mortgage Crisis; we wanted to investigate the regime-switching behavior in these co-integration relationships, which was the second research motivation of our study.

However, the Enders and Siklos (2001) threshold co-integration model is not accurately and fully specified when the transition of the transitional variables or threshold variables is a jump transition process. The problems, such as whether the transition of the transitional variables is smooth between two regimes or whether there is heteroscedasticity in the information transmission in international stock markets, are seldom considered in the Enders-Siklos threshold co-integration method.

The second point was to investigate how the asymmetric adjustment and the smooth transition phenomenon influenced the contagion effect. We applied the logistic smooth transition regressive (LSTR) method proposed by Granger and Teräsvirta (1993) and Teräsvirta (1994), which was the expansion of the Enders-Siklos threshold co-integration model, which was the logistic smooth transition co-integration model, to compare the contagion effect from the U.S. stock market to the Asian, European, and American stock markets pre- and during the Subprime Mortgage Crisis.

The correlation analyses of the stock index return and the volatility of the stock index return, Engle and Granger (1987) symmetric co-integration tests, Enders and Siklos (2001) threshold co-integration model, and the logistic smooth transition co-integration model were employed to investigate the contagion or transmission effect from the U.S. stock market to global stock markets in this study. Furthermore, we employed the KSS's exponential smooth transition autoregressive (ESTAR) unit root test by Kapetanios *et al.* (2003) to examine the phenomenon of non-linear stationary in the data of all the stock markets in this study before we investigated the asymmetric transmission effect.

The structure of this article is arranged as follows: Previous literature will be discussed in Section 2, the main methodologies in Section 3, the data and empirical results in Section 4, and the conclusions in Section 5. The flow charts of this dissertation follow the conclusions.

2. Literature Review

World Bank has given contagion three definitions, namely, a broad definition, a restrictive definition, and a very restrictive definition. The broad definition means that contagion is the cross-country transmission of shocks or the general cross-country spillover effects; contagion does not need to be related to crises. The restrictive definition means that contagion is the transmission of shocks to other countries or the cross-country correlation, beyond any fundamental link among the countries and beyond common shocks. This definition is usually referred to as excess co-movement, commonly explained by herding behavior. The very restrictive definition means that contagion occurs when cross-country correlations increase during "crisis times" relative to correlations during "tranquil times".

In academic literature, a crisis contagion theory explained that if there was co-movement or a common trend between different markets, then a shock in one market would transmit to another market. Dornbusch *et al.* (2000) defined contagion as a significant increase in cross market linkages after a shock to an individual country or market, as measured by the degree to which asset prices or financial flows moved together across markets relative to this co-movement in tranquil times. Forbes and Rigobon (2001) divided how the shocks were propagated into two groups of theories: crisis-contingent and non-crisis-contingent theories.

Crisis-contingent theories are those that explain why transmission mechanisms change during a crisis, and therefore, why cross-market linkages increase after a shock. Non-crisis-contingent theories assume that transmission mechanisms are the same during a crisis or at more stable periods, and therefore, cross-market linkages do not increase after a shock. Kaminsky *et al*. (2003) redefined a contagion effect, which was a strong "immediate effect" from a market to other markets after a filed crisis event, by using several previous financial crises as references; they also pointed out that one of the main crisis transmission mechanisms was international trade. We adopted the very restrictive definition by World Bank in this study.

In empirical research, Dornbusch *et al.* (2000) and Forbes and Rigobon (2001, 2002) pointed out that four different approaches had been utilized to measure how shocks were transmitted internationally: cross-market correlation coefficients, ARCH or GARCH frameworks, co-integration techniques, and direct estimation of specific transmission mechanisms by using the Probit model.

Many researchers considered significant increases of correlation or co-movement of the stock markets were the indicators of a contagion effect. King and Wadhwani (1990) and Lee and Kim (1993) used the correlation approach and found that international stock markets had become more interrelated after the U.S. stock market collapse in October 1987. Cha and Oh (2000) showed evidence that the links between the developed markets and the Asian emerging markets began to increase after the 1987 U.S. stock market collapse and the 1997 Asian Financial Crisis. The strengthening co-movement among international stock markets continued for a longer period after the collapse.

Forbes and Rigobon (2002) argued that tests for contagion based on cross-market correlation coefficients were problematic due to the bias introduced by changing volatility in market returns (heteroskedasticity). They showed that correlation coefficients were conditional on market volatility. Under the assumption of no omitted variables or endogeneity, it is possible to adjust this bias. By using this adjustment, there was virtually no increase in unconditional correlation coefficients (i.e., no contagion) during the 1997 Asian Financial Crisis, 1994 Mexican devaluation, and 1987 U.S. stock market collapse. There was a high level of market co-movement, which they called interdependence, in all periods. Caporale *et al.* (2005) modeled the conditional variance by the application of both heteroskedasticity and endogeneity biases and invented a common shock to deal with the omitted variable problem. They found the existence of contagion within the stock markets in Hong Kong, Japan, South Korea, Singapore, Taiwan, and Malaysia during the 1997 Asian Financial Crisis.

Hamao *et al.* (1990) utilized the GARCH model and indicated that the volatility spillovers of the stock indices from New York to Tokyo, London to Tokyo, and New York to London after the 1987 U.S. stock market collapse were observed. Eun and Shim (1989) used the VAR model and found that a substantial amount of multi-lateral interaction existed among the international stock markets. Innovations in the U.S. were rapidly transmitted to other markets in a clearly recognizable fashion, whereas no single foreign market could significantly impact the movement of the U.S. stock market.

Arshanapalli and Doukas (1993) reported that co-integration relationships did not exist in the France, Germany, and the U.K. stock markets and the U.S. Dow Jones index before the 1987 U.S. stock market collapse; however, there were co-integration relationships between them after the U.S. stock market collapse. Sheng and Tu (2000) found that co-integration did not exist in the eleven Asian stock markets and U.S. stock markets before the 1997 Asian Financial Crisis, but it did during the financial crisis, which demonstrated a contagion effect. Bekaert *et al*. (2005) also reported that co-integration relationships did exist among the Asian stock markets during the period of the 1997 Asian Financial Crisis, which demonstrated a contagion effect.

In recent years, many scholars have researched on the Subprime Mortgage Crisis and EMU Sovereign-Debt Crisis. Gorton (2008) was thorough in his work of the derivatives about the subprime mortgage loan, e.g. Mortgage Backed Securities (MBS), Collateralized Debt Obligations, (CDOs) and Credit Default Swap (CDS), as well as their developing processes, issue modes and structures. Longstaff (2010) discussed the contagion effect from the CDOs to the security markets in the U.S. between 2006 and 2008; the ABX index of CDOs was employed to examine whether the contagion effect existed in the mortgage bond market in this study, and it was found that the contagion effect spread first from the lower credit rating CDOs to the higher credit rating CDOs in the CDOs market and then from the CDOs market to the markets of treasury bills and stock. Hui and Chung (2011) discussed the transmission effect from the CDS market to other financial markets in Eurozone during the period of the EMU Sovereign-Debt Crisis, and they found that the information flow in the CDS, futures, and options markets was the main cause which resulted in the spread of the crisis.

If co-integration exists between international stock markets, there will be a common trend. However, the problems of "non-linear" or "asymmetric" characteristics are not considered in the traditional co-integration model. Li and Lam (1995), Koutmos (1998), and Chiang (2001) pointed out that co-integration between stock markets was asymmetric; Wang and Lin (2005), Shen *et al*. (2007), and Chang (2008, 2010) further employed the asymmetric co-integration test for their empirical studies. On the other hand, the threshold co-integration model is not accurately and fully specified when the transition of the threshold variables is a jump transition. The problems of whether the transition of the transitional variables is smooth between two regimes or that there is heteroscedasticity in the information transmission in international stock markets are seldom considered in the threshold co-integration method.

To investigate how the asymmetric adjustment and the smooth transition phenomenon influenced the contagion or transmission effect, we applied the threshold co-integration method and the logistic smooth transition co-integration model to compare the contagion effect from the U.S. stock markets to the Asian, European, and American stock markets pre- and during the Subprime Crisis; therefore, asymmetric adjustments and smooth transition could exist in an upward status (positive impact) or a downward status (negative impact). How did the two phenomena influence contagion effects of the stock markets? Did different correlations, co-movement, interdependence, or contagion effects exist in bull markets or bear markets? These issues were seldom discussed in previous literature; therefore, we decided to explore these problems by the threshold co-integration model and the logistic smooth transition co-integration model.

What is the impact of the U.S. stock market collapse on the global stock markets during the Subprime Mortgage Crisis? Is co-integration strengthened during the financial disaster? The issue of the contagion effect in some countries in Asia, Europe and America, which we have selected for this paper, is carefully examined.

3. Methodologies

3.1 The M-TAR Model

In order to examine the "asymmetric transmission effect" from the U.S. to seven major Asian, seven major European, and four major American stock markets during the period of the Subprime Mortgage Crisis, we employed the Enders and Siklos (2001) M-TAR model of asymmetric threshold co-integration. Conventional tests for the unit root and co-integration, whether proposed by Engle and Granger (1987) or Johansen (1988. 1990, 1994), are misspecified when the adjustment process of the one-period lagged error term is asymmetric. The Enders and Siklos (2001) technique extended the Engle and Granger (1987) framework to test non-linear co-integration (also see Enders and Granger, 1998). In our analysis of the transmission effect from the U.S. stock market to Asian, European and American stock markets around the Subprime Mortgage Crisis, we employed the Enders and Siklos (2001) test for threshold co-integration. First, the long-term equilibrium relationship is as follows.

$$Y_{i,t} = \eta_0 + \eta_1 X_{t^*} + \varepsilon_{i,t} \qquad i = 1, 2 \ldots\ldots\ldots, 18 \tag{1}$$

where $Y_{i,t}$ was the logarithm of the Asian, European and American stock indices for country i on period t and $i = 1, \ldots\ldots, 18$ represents the eighteen countries in our study, respectively. X_{t^*} implies the logarithm of the U.S. stock index, while t^* represents period $t-1$ in the U.S. market, which stands for the U.S. market versus the Asian and European markets, but period t in the U.S. market, which stands for the U.S. market versus the American markets, when the time lag of the trading day had to be considered. (Eun and Shim, 1989; Liu *et al*., 1998). $\varepsilon_{i,t}$ measures the estimated residuals. Enders and Siklos (2001) modified ε_t to allow for two types of asymmetric error corrections based on a co-integrating relationship as depicted in (1).

$$\Delta\varepsilon_t = M_t \rho_1 \varepsilon_{t-1} + (1 - M_t)\rho_2 \varepsilon_{t-1} + \sum_{i=1}^{p-1} \beta_i \Delta\varepsilon_{t-i} + \zeta_t \tag{2}$$

$$M_t = \begin{cases} 1 & \text{if } \Delta\varepsilon_{t-1} \geq r \\ 0 & \text{if } \Delta\varepsilon_{t-1} < r \end{cases} \tag{3}$$

where M_t is the Heaviside indicator function, r denotes the unknown threshold value,[2] and ζ_t is the residual of the white-noise disturbance. (2) and (3) represent

[2] The threshold value is endogenously determined by using the Chan's (1993) grid search method to find the consistent estimate of the threshold. This method arranges the values, $\{\Delta\varepsilon_t\}$, in an

the M-TAR model.[3]

In the M-TAR model, the adjustment is modeled by $\rho_1\varepsilon_{t-1}$ that $M_t = 1$ when the threshold variable, as the lagged different error term ($\Delta\varepsilon_{t-1}$) is above the threshold value r and by $\rho_2\varepsilon_{t-1}$ that $M_t = 0$ when $\Delta\varepsilon_{t-1}$ is below the threshold value. The no co-integration hypothesis ($H_0 : \rho_1 = \rho_2 = 0$) was tested using specifically derived critical values provided by Enders and Siklos (2001). If the null of no co-integration was rejected, the null of symmetric ($H_0 : \rho_1 = \rho_2$) can be tested using a standard F-test.

3.2 The Logistic Smooth Transition Co-integration Model

When we examined the "asymmetric contagion effect" from the U.S. stock market to Asian, European, and American stock markets during the period of the Subprime Mortgage Crisis, we also had to consider the problem of whether the transition process of the threshold variable was a smooth transition between two regimes. Therefore, we applied the Granger and Teräsvirta (1993) and Teräsvirta (1994) logistic smooth transition regression (LSTR) technique to further extend the Enders and Siklos (2001) M-TAR framework, which is called the logistic smooth transition co-integration model. And, the long-term equilibrium relationships between the U.S. stock market and the eighteen stock markets were measured by $\varepsilon_{i,t}$, which was estimated via OLS (1)..

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ascending order and excludes the smallest and largest 15 percent, and the consistent estimate of the threshold is the parameter that yields the smallest residual of sum squares (RSS) over the remaining 70 percent.

[3] Enders and Granger (1998) pointed out the M-TAR model was especially valuable when adjustment was asymmetric such that the series exhibited more "momentum" in one direction than the other.

Next, we employed the foregoing model to test non-linear co-integration or asymmetric co-integration with a logistic smooth transition process between our samples, which is generalized from the Enders-Siklos M-TAR framework as:

$$\Delta\varepsilon_t = \rho_1\varepsilon_{t-1} + (\rho_2\varepsilon_{t-1})q(\Delta\varepsilon_{t-1};\gamma,r) + \sum_{i=1}^{p-1}\beta_i\Delta\varepsilon_{t-i} + \omega_t \tag{4}$$

With

$$q(\Delta\varepsilon_{t-1};\gamma,r) = \left(1+\exp(-\gamma(\Delta\varepsilon_{t-1}-r))\right)^{-1}, \qquad \gamma \ge 0 \tag{5}$$

where $q(\Delta\varepsilon_{t-1};\gamma,r)$ is the logistic smooth transition function, $\Delta\varepsilon_{t-1}$ is the threshold variable or transition variable, r is the threshold value or location parameter and ω_t is the residual of the white-noise disturbance ($\omega_t \sim$ iid (0, σ^2)), and γ is the smooth parameter or slope parameter in $q(\Delta\varepsilon_{t-1};\gamma,r)$, which is employed to measure the transition speed between two difference regimes.

Note that in this case of our study, $\Delta\varepsilon_{t-1}$ is the lagged different error term. Clearly, if $\gamma \approx \infty$, ρ_i in the state dependent (4) changes monotonically with the independent variable $\Delta\varepsilon_{t-1}$ as (5) in (4) is a smooth continuous increasing function of $\Delta\varepsilon_{t-1}$ and takes a value between 0 and 1, depending on the magnitude of $\Delta\varepsilon_{t-1}$. When $\Delta\varepsilon_{t-1} = r$, the value of the transition function ($q(\Delta\varepsilon_{t-1};\gamma,r)$) equals to 0.5, and the current regime is half way between the two extreme upper and lower regimes. When $\Delta\varepsilon_{t-1}$ is large and positive ($\Delta\varepsilon_{t-1} > r$), the value of the transition function equals to 1, $\Delta\varepsilon_t$ is effectively generated by the linear model

$\Delta\varepsilon_t = (\rho_1 + \rho_2)\varepsilon_{t-1} + \sum_{i=1}^{p-1}\beta_i \Delta\varepsilon_{t-i} + \omega_t$, while when $\Delta\varepsilon_{t-1}$ is large and negative ($\Delta\varepsilon_{t-1} < r$), the value of the transition function $q(\Delta\varepsilon_{t-1};\gamma,r)$ approaches 0, $\Delta\varepsilon_t$ is virtually generated by $\Delta\varepsilon_t = \rho_1\varepsilon_{t-1} + \sum_{i=1}^{p-1}\beta_i \Delta\varepsilon_{t-i} + \omega_t$. The intermediate value of $\Delta\varepsilon_{t-1}$ provides a mixture of the two extreme regimes. Note that the M-TAR model manifests a special case since when smoothness parameter γ approaches infinity in (5), $q(\Delta\varepsilon_{t-1};\gamma,r)$ becomes a Heaviside indicator function with $q(\Delta\varepsilon_{t-1};\gamma,r)$ = 1 for all values of $\Delta\varepsilon_{t-1}$ greater than r and $q(\Delta\varepsilon_{t-1};\gamma,r)$ = 0 otherwise, and (4) becomes the M-TAR model. And, if $\gamma \approx 0$, the value of the transition function equals to 0.5 regardless of whether $\Delta\varepsilon_{t-1} - r$ is positive, negative, or 0.

In the logistic smooth transition Enders-Siklos co-integration framework (4 and 5), we can still employ the Enders and Siklos (2001) co-integration test to examine the co-integration relationship; therefore, the no co-integration hypothesis ($H_0 : \rho_1 = \rho_2 = 0$) was tested using specifically derived critical values provided by Enders and Siklos (2001).

When γ approaches zero, (4) becomes the linear AR(p) model, implying that the AR model is nested in the logistic smooth transition Enders-Siklos co-integration model. Therefore, our first step in specifying the model is to test for linearity against the logistic smooth transition Enders-Siklos co-integration model form. If the null of linearity can not be rejected, we shall conclude that the AR model adequately represents the data generating process. However, if linearity is rejected, we will go on to estimate the highly non-linear logistic smooth transition Enders-Siklos co-integration model form using the non-linear least squares (NLLS) approach. From (4) and (5), it can be seen that testing $H_0 : \gamma = 0$ is a non-standard testing problem, since (4) is identified only under the alternative $H_1 : \gamma \neq 0$. Thus, standard t- and F-testing methods are not appropriate steps to arrive at a model choice. Therefore, this study follows Luukkonen *et al*. (1988) to compute a first- and third-order Taylor series approximation to the $\left(1+\exp(-\gamma(\Delta\varepsilon_{t-1}-r))\right)^{-1}$ under the null of $\gamma = 0$ .in (4)

When a third-order Taylor series approximation is used, the expanded and re-parameterized equation is:

$$\begin{aligned}\Delta\varepsilon_t = \alpha + \beta_1\varepsilon'_{t-1} + \beta_2(\Delta\varepsilon_{t-1}) + \beta_3(\Delta\varepsilon_{t-1})^2 + \beta_4(\Delta\varepsilon_{t-1})^3 \\ + \beta_5\varepsilon'_{t-1}(\Delta\varepsilon_{t-1}) + \beta_6\varepsilon'_{t-1}(\Delta\varepsilon_{t-1})^2 + \beta_7\varepsilon'_{t-1}(\Delta\varepsilon_{t-1})^3 + \omega_t\end{aligned} \tag{6}$$

The possible way to identify the appropriate model, the linear co-integration model, and the logistic smooth transition co-integration model is through a sequence of test parameter values from (6), (Woodward and Marisetty, 2005). Thus, we believe that the linearity test is identical to testing the joint restriction that all non-linear terms are zero in the null hypothesis, which is as follows:

$$H_0 : \beta_i = 0 \qquad i = 2, ...7 \tag{7}$$

In (7), if the H_0 is not rejected, we will select the linear co-integration model. If H_0 is rejected, we will select the logistic smooth transition co-integration model.

4. Data and Empirical Results

4.1 Data Description

This study was conducted by using the U.S., Asian, European, and American stock markets. The Standard & Poor's 500 (S&P 500) index in the U.S., seven major Asian stock markets including Taiwan, Hong Kong, Singapore, Japan, Korea, India, and China, seven major European and four major American stock markets, including the U.K., Germany, France, Netherlands, Belgium, Norway, Sweden, Canada, Mexico, Argentina, and Brazil, were researched in this part of our study, and all observations were taken logarithms.[4] The trade stocks in the S&P 500 index included the top 500 enterprises in NYSE and AMEX.[5] The reason why the S&P 500 index was chosen was because the total market value of the S&P 500 index dominated over 80% of the total value of NYSE. In addition, after taking factors such as liquidity and industrial representation into consideration, we believed that this index could reflect the conditions of the capital markets, the security markets, and the economy of the U.S more validly than the Dow Jones index.

The entire sample period was from September 1, 2005 to March 31, 2010 for a total of 820 daily observations which were obtained for each variable.[6] Trading days and closing days were different in various stock markets; therefore, if one market did not have any transaction on a particular day, we would delete the data in other markets on the same day. We only kept the data of synchronized trading days in all stock markets. Hamao *et al.* (1990) pointed out that discarding the data of non-synchronized trading days would not affect the accuracy of the empirical results.

Since there is still no consensus on the start date for the Subprime Mortgage

[4] The sample of the stock index in China is Shanghai Stock Exchange Composite index (SSE Composite index). Furthermore, there are restricted fluctuation ranges in the stock markets of Taiwan, Korea, and China, which are 7% for Taiwan, 15 % for Korea, and 10% for China, respectively. But there are no such restrictions in the U.S., the U.K., Germany, Hong Kong and Singapore stock markets. In past literature, many scholars questioned whether the restrictions would affect researchers' evaluation results. In our study, there were 17 days on which the TSEC Weighted Index exceeded the 7% limit, 18 days on which the KOSPI Composite Index exceeded the 15% limit, and 11 days on which the SSE Composite Index exceeded the 10% limit in our research period, all of which accounted for less than 3% of the entire samples. Shen and Wang (1998) pointed out that when the samples with restricted ranges were less than 5% of the entire samples, their impact on the evaluation results could be considered insignificant. Furthermore, due to the fact that the restricted fluctuation ranges were aimed at individual stocks, the probability of the stock prices of those individual stocks rose and fell at the same time was very low on a trading day. Since the stock indices were adopted in this study, the influence from the restricted fluctuation ranges to our empirical results would not be significant.

[5] NYSE and AMEX are the abbreviations of the New York Stock Exchange and the American Stock Exchange, respectively.

[6] In order to ensure the robust in the empirical results and avoid bias and non-consistency in the empirical results due to the sample numbers with huge differences around the Subprime Crises and the influence of the interference from the EMU Sovereign-Debt Crisis, the entire sample period was set from September 1, 2005 to March 31, 2010 in our study.

Crisis, it is not easy to determine an exact date. In general, scholars (Gorton, 2008; Sikka *et al*. 2009; Claessens *et al*. 2010; Longstaff, 2010) and the financial industry considered the outburst of the financial crisis of the New Century Financial Corp. as the beginning of the crisis. However, the event of Lehman Brothers' filing for bankruptcy on September 15, 2008 aggravated the Subprime Mortgage Crisis (Swan, 2009; Longstaff, 2010; Sobreira, 2011; Afonso *et al*. 2012; Frankel and Saravelos, 2012; Dumontaux and Pop, 2013). The negative effects of the Subprime Mortgage Crisis on the U.S. and global stock markets were different between the two periods, namely, between 2007 and 2008 and between 2009 and 2010. Longstaff (2010) pointed out that the Subprime Mortgage Crisis could be divided into two sections in the timeline, the first section being earlier 2007, and the reason was that the institutional investors, e.g. Bear Stearns and Merrill Lynch, suffered huge losses due to their investment in subprime debts or derivatives. The second section began at the end of 2008, and the reason was that the global financial system continued to deflate currency due to eliminations of the huge debts about subprime mortgage by institutions, enterprises, and governments. Therefore, in order to assure the consistency in our study, we used the date on which the trading of stocks of New Century Financial Corp. was terminated in NYSE, i.e. March 13, 2007, as the first cutting point, and the data on which Lehman Brothers filed their bankruptcy, i.e. September 15, 2008, as the second cutting point. Thus, the period of "the pre-Subprime Mortgage Crisis" was defined as the period from September 1, 2005 to March 13, 2007, and the first section of the period of "during the Subprime Mortgage Crisis" was defined as the period from March 14, 2007 to September 15, 2008, and the second section of the period of "during the Subprime Mortgage Crisis" was defined as the period from September 16, 2008 to March 31, 2010. We, therefore, compared the estimated results of the different periods. The return of stock price indices, which were the logarithms of after the first difference, was employed in our study. The stock price index return is as follows:

$$\Delta LIP_{i,t} = (\ln IP_{i,t} - \ln IP_{i,t-1}) \times 100$$

Where $LIP_{i,t} = \ln IP_{i,t}$, $IP_{i,t}$ was the 19 stock markets in this study.

Table 1 represents the summary statistics for all the returns in our study, and Figures 1 and 2 show that the time trends of logarithms of the stock indices and the stock index returns in 19 stock markets, respectively. In Figure 1, there were downward trends in 19 stock indices, and in Figure 2, there was substantially increase in the variation of returns in the 19 stock markets during the period between the second half of 2007 and the first half of 2009. The results of the three unit root tests, Augmented Dickey and Fuller (ADF; 1984), Phillips and Perron (PP; 1988) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS; 1992), were summarized in Table 2, which shows that the null hypothesis of non-stationarity can not be rejected for any levels of these series. After the first difference, the null is rejected at the 1% significance level for all the series. Therefore, we concluded that all the variables were the $I(1)$ type series at the 1% significance level. Table 3 represents the results of the KSS's (2003) ESTAR unit root test, which showed that variables of all stock indices in this study were non-linear $I(1)$ series at the 1% significance level.

Because the correlation analysis of volatility of the stock index return was employed to investigate the contagion or transmission effect in this study, we used the ARMA(p,q)-GARCH(1,1) model to fit the conditional variance, i.e. the volatility of return; therefore, we first applied the ARCH-LM test to investigate the heteroscedasticity of the conditional variance in returns. Table 4 represents the results of the ARCH-LM test for the volatility of returns in the period of the pre-Subprime Mortgage Crisis 〈Table 4-(1)〉, the first section (section I) of the period of during the Subprime Mortgage Crisis〈Table 4-(2)〉, and the second section (section II) of the period of during the Subprime Mortgage Crisis〈Table 4-(3)〉for all the returns in our study. In Table 4, when the residuals of the ARMA(p,q) model by the ARCH-LM test were examined, the null hypothesis of no GARCH effect was rejected at the 10% significance level in the three periods. Therefore, the use of GARCH(1,1) modeling to extract the values of the return volatility was appropriate.

Tables 5 and 6 represent the results of the non-conditional correlation coefficients of returns and the volatilities of returns, and the t statistics of them between the U.S. and Asian, European, and American stock markets in the three periods around the Subprime Mortgage Crisis, respectively, and Figure 3 shows the volatility of returns in the 19 stock markets.[7] In Figure 3, there was also substantial increase in the volatilities of returns in the 19 stock markets during the period between the second half of 2007 and the first half of 2009. Especially, it reached the peak during 2008 and 2009, which showed that higher and persistent fluctuations could be observed since the eruption of the Subprime Mortgage Crisis; the phenomenon also demonstrated the negative impact of the Subprime Mortgage Crisis on the stock markets in various countries was very severe. In Tables 5 and 6, the results show that both the correlation coefficients of returns and the volatility of returns increased significantly between the U.S. and most of the Asian, European, and American markets during the Subprime Mortgage Crisis, especially in section II after Lehman Brothers filed the bankruptcy on September 15, 2008, except the China stock market, The results in Table 6 also represented that there were volatility spillovers between the U.S. stock market and the above-mentioned stock markets, and the results in Tables 5 and 6 supported the crisis-contagion theory by Dornbusch *et al.* (2000) and Forbes

[7] Both Tables 5 and 6 in our study, the t statistics of correlation coefficients of returns and the volatility of returns between various periods were calculated by Fisher's Z transformation.

and Rigobon (2001).

4.2 The Empirical Results

In this part, we employed the Engle and Granger (1987) co-integration test to examine the symmetric long-run equilibrium relationships, i.e. co-integration relationships, and the Enders and Siklos (2001) M-TAR model and the logistic smooth transition co-integration model, respectively, to investigate the changes in the asymmetric co-integration relationships between the U.S. S&P 500 index and eighteen stock markets in Asia, Europe, and America around the Subprime Mortgage Crisis between 2007 and 2010.

Table 7 represents the results of the Engle-Granger co-integration relationships between the U.S. and the eighteen stock markets in the three periods around the Subprime Mortgage Crisis. The null hypothesis of no co-integration was also shown in Table 7. In Table 7-(1), the results of the Engle-Granger ADF statistics show that there were co-integration relationships between the S&P 500 index and the U.K. and Germany stock markets at the 5 % significance level in the period of the pre-Subprime Mortgage Crisis. In Table 7-(2), the results show that there was a co-integration relationship between the U.S. stock market and Mexico stock market at the 5% significance level in the section I of the period of during the Subprime Mortgage Crisis. In Table 7-(3), the results show that there was only a co-integration relationship between the U.S. stock market and Germany stock market at the 1% significance level in section II of the period of during the Subprime Mortgage Crisis. The results in Table 7 show that there was only significant increase in the co-integration relationship between the S&P 500 index and Germany DAX index around the Subprime Mortgage Crisis; this result was not consistent with the results of the correlation analyses of returns and the volatility of returns in Tables 5 and 6, and it did not support the crisis-contagion theory by Dornbusch *et al.* (2000) and Forbes and Rigobon (2001).

Enders and Granger (1998) and Enders and Siklos (2001) proposed two models for the threshold co-integration test, namely, the TAR model and the M-TAR model. This study adopted the M-TAR model. Enders and Granger (1998) believed that when asymmetrical adjustments occurred in the data series, the determination of the Heaviside indicator function might also be decided by the first difference value of error correction term on period $t-1$ ($\Delta\varepsilon_{t-1}$). Boucher (2007) indicated that the speed of convergence of parameter estimation by using the M-TAR model would be faster than that of the TAR model. Table 8 represents the results of our estimation of the threshold co-integration relationships between the U.S. stock market and the eighteen stock markets in the three periods around the Subprime Mortgage Crisis. The null hypothesis of no co-integration (F_C) and symmetric adjustment (F_A) was also shown in Table 8. In Table 8-(1), both F_C and F_A demonstrated the relationships of asymmetric co-integration between the U.S. stock market and the India, France, Norway, Canada, and Mexico stock markets in the period of pre-Subprime Mortgage Crisis. In Table 8-(2), the F_C statistics rejected the null hypothesis at the 1% significant level, and the F_A statistics rejected the null at the 10% level in section I of during the Subprime Mortgage Crisis except the China stock market. Both F_C and F_A demonstrated the asymmetric co-integration relationships between the U.S. stock market and most of the eighteen stock markets in section I of during the Subprime Mortgage Crisis except the China stock market. In

Table 8-(3), both F_C and F_A demonstrated the asymmetric co-integration relationships between the U.S. market, and most of the all stock markets except the China stock market in section II of the period of during the Subprime Crisis.

Finally, we investigated how the asymmetric adjustment and the smooth transition phenomenon influenced the transmission or contagion effect by applying the logistic smooth transition co-integration model to compare the transmission or contagion effect from the U.S. stock market to the eighteen stock markets in the three periods of pre- and during the Subprime Mortgage Crisis.

Table 9 represents the results of the Enders-Siklos M-TAR co-integration test in logistic smooth transition framework and linearity test for the co-integration relationships between the U.S. stock market and the eighteen stock markets in the three periods around the Subprime Mortgage Crisis. The null hypothesis of no co-integration ($F_C : \rho_1 = \rho_2 = 0$) and linearity model ($F_L : \beta_2 = ... = \beta_7 = 0$) were shown in Table 9. In Table 9-(1), both F_C and F_L demonstrated the relationships of logistic smooth transition co-integration between the U.S. stock market and the Hong Kong, India, Germany, France, Canada, and Mexico stock markets in the period of pre- Subprime Mortgage Crisis. In Table 9-(2), both F_C and F_L demonstrated the logistic smooth transition co-integration relationships between the U.S. stock market and most of the all stock markets in section I of during the Subprime Mortgage Crisis except the China stock market. In Table 9-(3), both F_C and F_L demonstrated the logistic smooth transition co-integration relationships between the U.S. market and most of the all stock markets in our study except the China stock market in section II of during the Subprime Mortgage Crisis.

By further comparing the F_C statistics in Table 8 and Table 9, we found that the co-integration relationships had significantly increased after the shock of the Subprime Mortgage Crisis between the U.S. market and most of the Asian, European, and American stock markets except the China and Brazil stock markets from Tables 8, and except the China stock market from Tables 9. Both Table 8 and Table 9, the results showed that there were "contagion" or "transmission" effects between the U.S. market and most of the Asian, European, and American stock markets after the Subprime Mortgage Crisis, especially in section II of the Subprime Crisis which after Lehman Brothers filed the bankruptcy on September 15, 2008. However, there was only an "interdependence effect" between the U.S. market and the China and Brazil stock markets from Table 8, and between the U.S. market and the China stock market from Table 9. Forbes and Rigobon (2001) defined the contagion of the international stock markets as a significant increase in cross market linkages or co-movement between one market and others after a shock or during a crisis, and our results supported the "contagion effect" between the U.S. stock market and some of the stock markets in the surveyed countries in our study.

By further comparing the F_A statistics in Tables 8-(1), 8-(2) and 8-(3), we found that the asymmetry in the co-integration relationships had also significantly increased after the crisis between the U.S. stock market and most of the eighteen stock markets except the China stock market. The result showed that the Subprime Mortgage Crisis induced quick transmission of massive negative information among many stock markets. These lead to higher risk aversion for international investors.

From the results of F_L statistics in Table 9, we also found similar results in Table 8, which the co-integration relationships were asymmetric or non-linear, and the order of the ranks of the stock market co-integration relationship between the above-mentioned stock markets and the U.S. stock market were similar to that in

Table 8. Moreover, by further comparing the F_L statistics and the smooth parameter (γ) in Tables 9-(1), 9-(2) and 9-(3), we found that the transition speed of co-integration relationships between the difference regimes had also conspicuously increased after the crisis between the U.S. stock market and most of the Asian, European, and American stock markets except the China stock market. The result showed that the Subprime Mortgage Crisis induced quick transmission of massive negative information among many stock markets. These also led to higher risk aversion for international investors.

According to the empirical results in Tables 8 and 9, the order of the ranks of the stock market co-integration relationship between the above-mentioned stock markets and the U.S. stock market is as follows: the countries in Europe (the order of the ranks: France, the U.K, Germany, Belgium, Netherlands, Norway, and Sweden), the countries in America (the order of the ranks: Canada, Mexico, Argentina, and Brazil), and the countries in Asia (the order of the ranks: Singapore, Japan, Hong Kong, Korea, Taiwan, India, and China).

This can be explained with the fact that the financial markets in European countries are relatively advanced markets and have had more linkage with the U.S. financial and security markets, whereas the financial markets in Latin America and Asian countries are emerging markets and have less linkage with the U.S. financial markets.

The contagion effects on European markets were stronger than those on Latin American and Asian markets. In the past, most of the financial crises originated from the countries, which were considered to be emerging markets with a lot of foreign debt, weak financial institutions, and unsound financial supervisory systems. The neighboring countries were apt to be influenced because of their close geographical locations to the origin of a financial crisis. However, the Subprime Mortgage Crisis was due to the huge losses of credit derivatives in the U.S. financial and securities market. It originated from the most advanced country and no one expected this could happen. Surprisingly, the most severely influenced markets were not the neighboring Latin American and Asian markets. Therefore, the extent of financial linkage with the U.S. market might be the explanatory factor of strength of the contagion effect. Because many financial institutions and investors held a lot of subprime mortgage securities in the countries in Western Europe, it was reasonable that the contagion effects were more significant in the European markets than in the Latin American and Asian markets. In short, the origin and impact of the Subprime Mortgage Crisis were different from those of the financial crises in emerging markets.

5. Conclusions

The crisis contagion theory states that exogenous shocks are transmitted to many countries through transmission mechanisms. This effect leads to co-movement of stock markets. Dornbusch *et al.* (2000) and Forbes and Rigobon (2001) pointed out that contagion effects existed when negative impacts occurred during the crisis.

Co-integration relationships between stock markets represent market co-movement or common trends, and the co-integration analysis is widely used to investigate whether or not the long-term equilibrium relationship between stock markets is changed when a financial crisis happens. If the equilibrium relationship changes, the contagion effect occurs. However, the traditional symmetric co-integration analysis ignores the characteristics of asymmetric adjustment in stock markets (Li and Lam, 1995; Koutmos, 1998; Sarantis, 2001; Chiang, 2001). Therefore, we employed the Enders and Siklos (2001) threshold co-integration framework, including the M-TAR model and the logistic smooth transition regressive

(LSTR) method proposed by Granger and Teräsvirta (1993) and Teräsvirta (1994), which was the expansion of the M-TAR model, which allowed asymmetric adjustments and smooth transitions, when analyzing stock market relationships. We tested the asymmetric long-term equilibrium relationship between the U.S. stock market and eighteen stock markets in Asia, Europe, and America around the Subprime Mortgage Crisis.

In this study, we anticipated contagion effects among international stock markets would lead to co-integration between the U.S. and Asian, European, and American stock markets. However, the results of the Engle and Granger (1987) co-integration test did not indicate co-integration relationships between the U.S. and these stock markets. These results were not consistent with the correlation analyses of returns and the volatility of returns, for the correlation coefficients of returns and the volatilities of returns both increased. In addition, these results were different from previous empirical studies, and our assumption could not be verified by traditional co-integration methods. Furthermore, the test results of the Enders-Siklos threshold co-integration model and the logistic smooth transition co-integration model did indicate that co-integration relationship increased. Therefore, the models of threshold co-integration and logistic smooth transition co-integration are the better methods to analyze dynamic stock market relationships.

There are several major findings in this study. First of all, the empirical results supported previous research. We found that the Enders-Siklos threshold co-integration relationships between the U.S. S&P 500 index and most of the stock markets in Asia, Europe, and America increased significantly except the China market and Brazil market, and, the logistic smooth transition co-integration relationships between the U.S. stock market and most of the all stock markets in our study increased significantly except the China market, especially after Lehman Brothers filed for bankruptcy, however, in both models ,the co-integration relationship did not exist between the U.S. market and China market around the Subprime Mortgage Crisis.

The information demonstrated that the Subprime Mortgage Crisis in the U.S. had a contagion effect on international stock markets. When the adjustments of asymmetric and logistic smooth transition in stock markets were compared, the influence of good news and bad news in the U.S. market was significantly enhanced during the crisis (threshold co-integration and logistic smooth transition co-integration). Furthermore, the smooth parameter also significantly increased after the shock of the crisis, the results of which showed evidence that the heteroscedasticity of information transmission in international stock markets increased significantly during the period of the Subprime Mortgage Crisis. It was more likely that the transmission of massive negative information resulted in higher risk aversion for international investors.

The second finding differed from previous literature. Previous works on financial crises revealed that most crises originated from emerging markets. (Aggarwal *et al.*, 1999; Collins and Biekpe, 2003; Dungey *et al.*, 2006) The neighboring countries were easily affected because of their close geographical locations to the origin of the financial crisis: nevertheless, the Subprime Mortgage Crisis was not from an emerging market. In addition, the contagion effect of the stock markets in European countries was more significant than that in Asian and Latin American countries. It was contrary to our assumption that Asian and Latin American countries would be affected more severely. The possible explanation was that the degree of financial linkage with the U.S. market contributed to the strength of the contagion effect. Since the relatively advanced stock markets in Europe were globalized and deregulated markets, they were affected notably. While the stock markets in Asia and Latin America were less globalized and less deregulated, they were affected moderately. Unlike a financial crisis of an emerging market, the Subprime Mortgage Crisis caused quite different contagion effects which were explored in this research.

Finally, the Subprime Mortgage Crisis had weakened international portfolio diversification; therefore, international investors could not diversify their risks by investing in the Asian, European and American stock markets during the crisis. It is likely that if a world financial center is in trouble, global investors will be unavoidably influenced.

Table 1. Summary Statistics for Returns on Stock Indices

	Mean	Max.	Min	Std. Dev	Skewness	Kurtosis	Jarque-Bera	L-B Q(24)
U.S.	-0.0045	10.4083	-13.7989	1.7092	-0.6733**	13.6173***	4357.31***	73.149***
Taiwan	0.0283	16.0768	-9.1898	1.8024	0.4257**	13.2410***	4017.33***	43.607***
Hong Kong	0.0365	16.8007	-15.9720	2.2514	0.0050	13.4282***	4136.90***	34.389*
Singapore	0.0249	21.4742	-10.6280	1.8084	1.5055***	28.5928***	25261.7***	31.964
Japan	-0.0140	9.9854	-12.7154	1.9494	-0.9887**	10.1358***	2085.81***	32.053
Korea	0.0457	13.8635	-11.1720	1.8903	-0.4628**	10.8207***	2359.34***	53.594***
India	0.0873	15.9900	-19.2130	2.3151	-0.5207**	12.1862***	3251.48***	44.603***
China	0.1053	9.3262	-14.1681	2.3567	-0.3227**	6.1742***	399.15***	48.930***
U.K.	0.0092	11.1112	-9.2646	1.3873	0.1857*	14.5732***	7279.23***	71.019***
Germany	0.0252	13.4627	-7.7391	1.5257	0.4548*	13.9090***	6505.90***	20.413
France	0.0030	13.3048	-9.4715	1.5371	0.3892*	14.1886***	6829.32***	57.757***
Netherlands	0.0158	16.0768	-12.1069	1.7540	0.0620	14.3925***	6203.59***	38.601**
Belgium	0.0419	16.8007	-15.9720	2.0367	0.0039	15.9388***	8000.90***	36.144*
Norway	0.0328	21.4742	-10.6280	1.6376	1.5990***	33.8138***	45866.5***	36.793**
Sweden	-0.0046	9.9854	-12.7154	1.8093	-1.1369***	11.666***	3836.37***	31.608
Canada	0.0627	13.8635	-13.1533	1.8610	-0.7190**	11.8343***	3828.69***	42.743**
Mexico	0.0907	11.1115	-7.2661	1,6241	0.2686*	7.8147***	1274.24***	39.299**
Argentina	0.0464	10.4316	-12.9516	2.1197	-0.6569**	7.7990***	1344.07***	42.436**
Brazil	0.0759	15.4728	-12.0961	2.1761	0.0666	8.0790***	1401.51***	47.175***

Notes: 1. The periods and sample sizes for the entire period were between 2005/9/1 and 2010/3/31 with a total of 820 daily observations.

2. *, ** and *** denote significance at 10%, 5% and 1% significance levels, respectively.

3. Jarque-Bera is the statistic of the normal test.

4. L-B Q is the statistics of Ljung-Box Q.

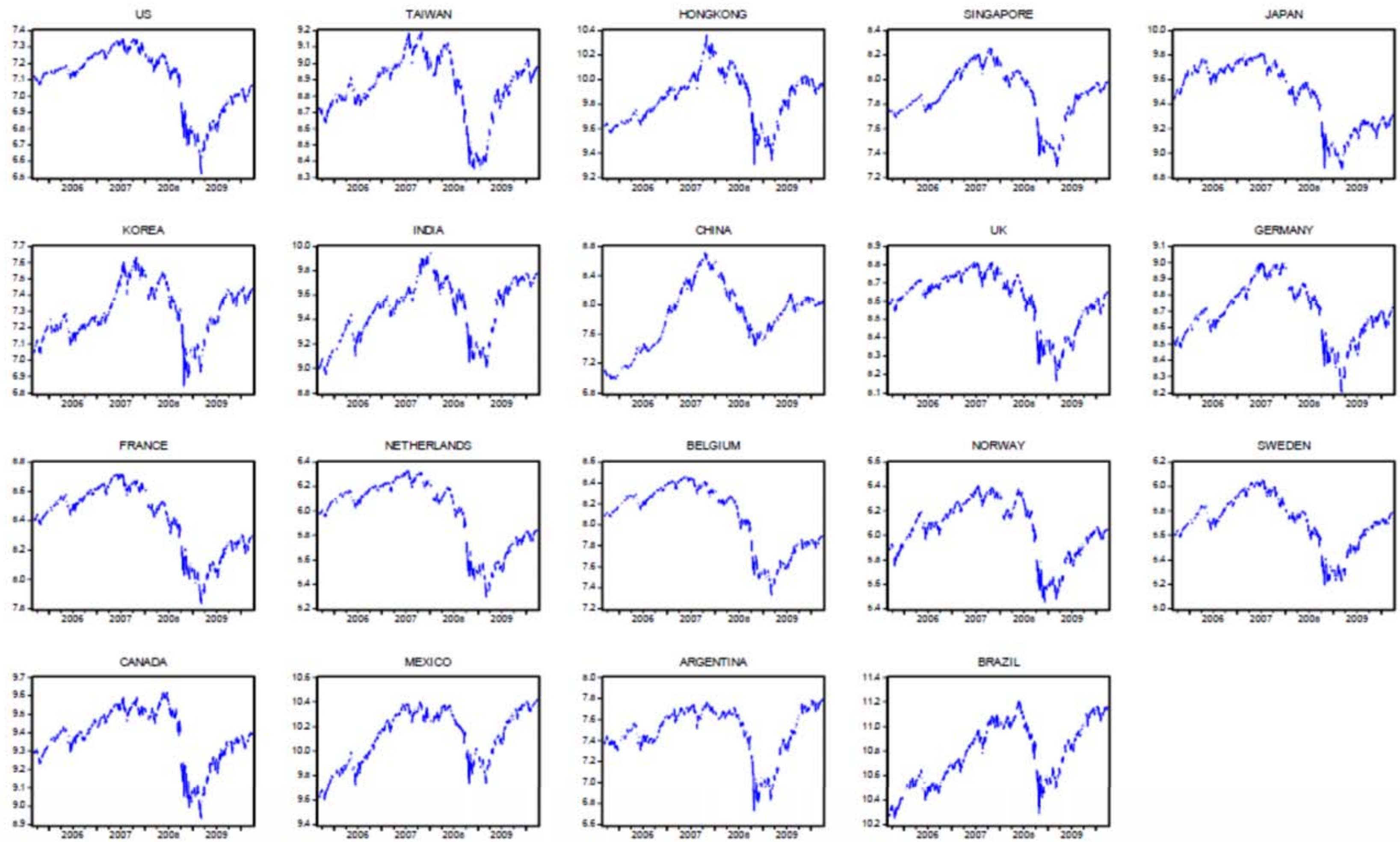

Figure 1. Logarithms of the Stock Indices in 19 Stock Markets

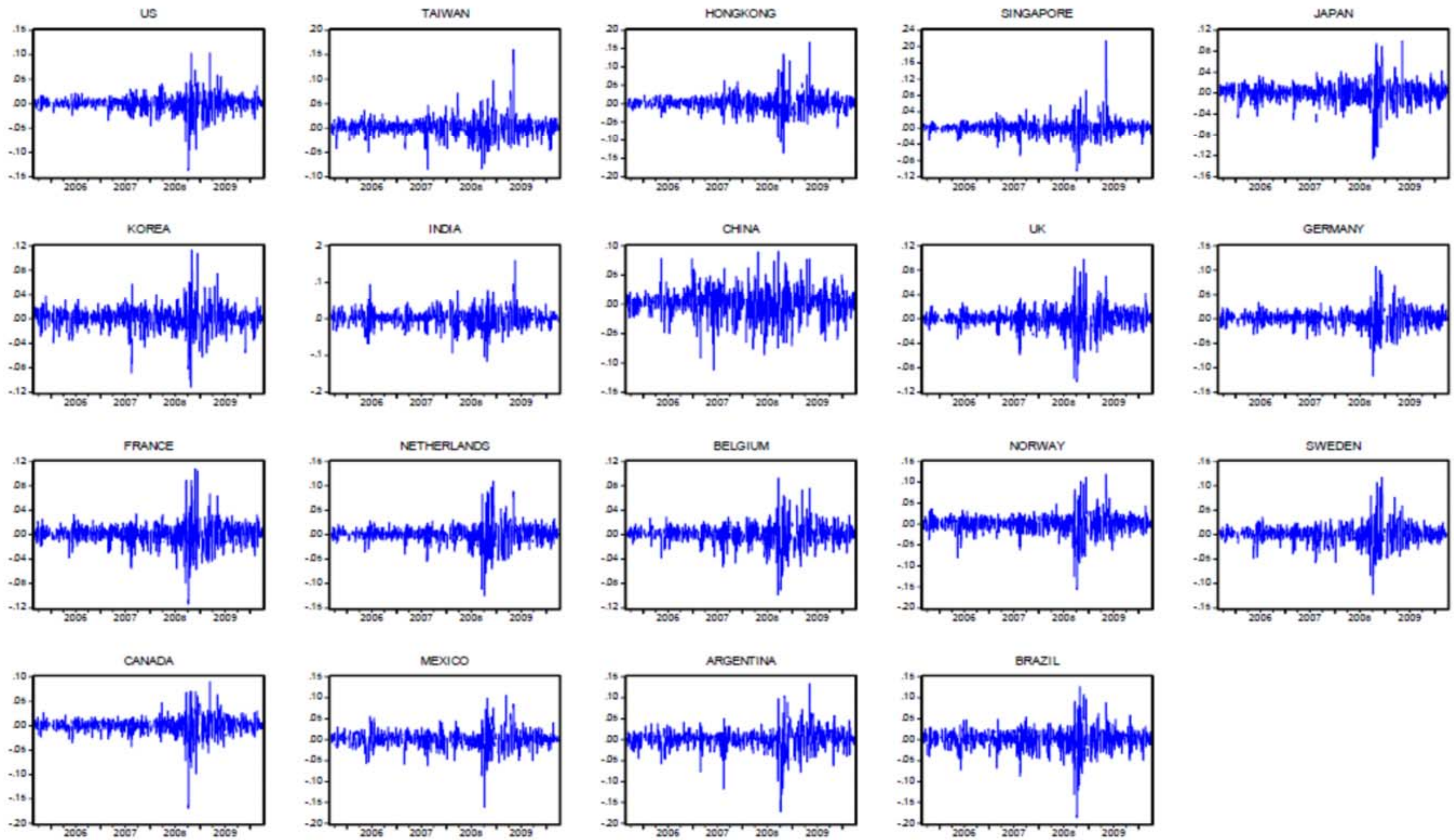

Figure 2. The Stock Index Returns in 19 Stock Markets

Table 2. Results of Various Unit Root Tests

	Level			First difference		
	ADF	PP	KPSS	ADF	PP	KPSS
U.S.	-1.1812(3)	-1.2127	1.7583***	-13.7257(2)***	-32.5813***	0.1594
Taiwan	-1.3266(6)	-1.4461	0.4959**	-14.5142(5)***	-29.8737***	0.1527
Hong Kong	-1.6629(7)	-1.7022	0.5871**	-14.9672(7)***	-31.4268***	0.1099
Singapore	-1.3096(5)	-1.3245	0.5428**	-13.8640(5)***	-30.4380***	0.1839
Japan	-0.9724(6)	-1.0233	2.6169***	-15.1311(6)***	-30.3007***	0.1957
Korea	-1.9824(2)	-2.0741	0.5224**	-14.4282(3)***	-30.3740***	0.1094
India	-1.8744(4)	-1.9701	1.0284***	-14.4474(3)***	-29.3137***	0.1403
China	-1.6501(5)	-1.6350	1.3575***	-13.9793(4)***	-30.8417***	0.2271
U.K.	-1.3481(7)	-1.4995	5.1729***	-22.7124(5)***	-52.4000***	0.1343
Germany	-1.5277(7)	-1.5267	5.2263***	-22.0575(5)***	-49.5223***	0.1280
France	-1.8329(7)	-1.8410	3.4085***	-23.1064(5)***	-50.3363***	0.2699
Netherlands	-1.6714(3)	-1.4532	1.9514***	-19.9581(4)***	-51.3899***	0.1872
Belgium	-1.3159(6)	-1.3993	0.8952***	-21.8217(3)***	-47.7452***	0.1531
Norway	-1.7631(5)	-1.7851	3.3362***	-18.5278(5)***	-46.6613***	0.2157
Sweden	-1.8719(7)	-1.8451	2.8405***	-20.7629(3)***	-49.7341***	0.1908
Canada	-1.8636(6)	-1.9858	5.7133***	-21.9466(5)***	-52.9389***	0.1855
Mexico	-0.6503(6)	-0.5449	3.7719***	-20.7821(5)***	-45.7524***	0.1315
Argentina	-1.1011(8)	-0.9241	4.3167***	-22.8725(3)***	-46.7779***	0.2014
Brazil	-1.0374(9)	-0.8825	3.5478***	-21.2697(5)***	-48.7403***	0.0809

Notes: 1. *** denote significance at the 1% significance levels, respectively; the numbers in the parentheses are the appropriate lag-lengths selected by minimizing AIC.

2. The critical values for the 10%, 5% and 1% significance levels of ADF, PP and KPSS are (-2.567948, -2.863659, -3.435402), (-2.567944, -2.863651, -3.435385) and (0.3470, 0.4630, 0.7390).

3. The null hypothesis of ADF and PP are non-stationary (unit root); the null hypothesis of KPSS is stationary (non unit root).

Table 3. Results of the Non-linear Unit Root Test – the KSS Test

	t Statistics on $\hat{\delta}$	
	Level	First difference
U.S.	-1.1821(2)	-19.1415(2)***
Taiwan	-1.9176(2)	-17.7385(1)***
Hong Kong	-1.6476(1)	-16.3436(1)***
Singapore	-1.5127(0)	-17.9684(0)***
Japan	-1.5814(0)	-17.5631(0)***
Korea	-1.4762(2)	-19.5173(2)***
India	-1.1437(3)	-18.3522(3)***
China	-0.8431(3)	-16.8273(3)***
U.K.	-1.4900(2)	-17.2011(2)***
Germany	-1.4576(0)	-17.2963(0)***
France	-1.1373(1)	-17.5471(2)***
Netherlands	-1.2311(2)	-15.7514(2)***
Belgium	-1.8651(1)	-18.8013(3)***
Norway	-1.7531(0)	-16.2847(1)***
Sweden	-0.8152(0)	-17.5714(0)***
Canada	-1.5864(1)	-18.7681(2)***
Mexico	-1.7207(0)	-18.4324(2)***
Argentina	-1.6473(1)	-16.6389(2)***
Brazil	-0.9944(1)	-19.7016(0)***

Notes: 1. The numbers in the parentheses are the appropriate lag-lengths selected by minimize AIC.

2. The simulated critical values for different Ks were tabulated in Kapetanios *et al.* (2003).

3. *** denotes significance at the 1% significance level.

Table 4. ARMA(p,q)-GARCH(1,1) Modeling and Results of the ARCH-LM Test for the Volatility of Returns

$$r_t = a_0 + \sum_{i=1}^{p} b_i r_{t-i} + \sum_{j=1}^{q} c_j e_{t-j} + e_t \ , \ h_t = \alpha_0 + \alpha_1 e_{t-1}^2 + \alpha_2 h_{t-1}$$

	(1) Pre-subprime mortgage crisis (2005, 9, 1～2007, 3, 13)		(2) Section I of during the Subprime Mortgage Crisis (2007, 3, 14～2008, 9, 15)		(3) Section II of during the Subprime Mortgage Crisis (2008, 9, 16～2010, 3, 31)	
	F-statistics	TR^2	F-statistics	TR^2	F-statistics	TR^2
U.S.	1.7596*	15.4834*	19.3220***	18.9208***	11.1640***	74.6849***
Taiwan	2.6657*	5.3161*	11.1829***	10.8070***	8.3137***	54.5757***
Hong Kong	6.2530**	6.1539**	3.6867***	17.6105***	23.1107***	22.5285***
Singapore	1.9380**	19.1814**	29.7435***	26.9151***	9.4135***	54.0432***
Japan	4.2436**	8.3138**	23.8288***	23.2087***	14.9459***	27.1751***
Korea	4.8330**	4.7817**	10.3015***	10.1979***	8.7011***	31.3094***
India	2.6043*	5.1947*	3.5610*	3.5400*	3.8199***	28.2441***
China	2.8908*	5.7211*	5.2161**	5.1956**	3.4400***	28.6664***
U.K.	8.0266***	15.2942***	14.4526***	14.2356***	8.6698***	38.0119***
Germany	6.0803***	17.3006***	8.3551***	16.4342***	5.8428***	40.8763***
France	3.5117*	3.4917*	14.2297***	14.0199***	7.3379***	49.3724***
Netherlands	4.2571***	12.3576***	8.2519***	8.1893***	8.7495***	38.3111***
Belgium	3.6978**	7.2740**	12.4527***	12.2954***	13.9602***	25.5531***
Norway	8.2889***	8.2255***	11.5116***	21.3943***	7.0003***	42.4148***
Sweden	7.8473***	7.7916***	14.1340***	25.7901***	4.2107***	30.7953***
Canada	2.0276*	9.9792*	16.4551***	16.1691***	9.5419***	54.6276***
Mexico	4.0515**	7.9488**	7.1202***	20.9151***	5.4192***	42.4853***
Argentina	2.8115*	2.8029*	11.4771***	11.3455***	12.1767***	79.4066***
Brazil	5.4940**	5.4222**	13.3052***	13.1236***	11.0915***	38.6655***

Notes: 1. The volatility of returns is measured by the conditional variance of returns from the ARMA(p,q)-GARCH(1,1) model, the lag-lengths of the ARMA(p,q) model selected by minimizing AIC.

2. *, ** and *** denote significance at 10%, 5% and 1% significance levels, respectively; the numbers in the parentheses are the p-value.

Table 5. Results of non-Conditional Correlation Coefficient of Returns

	Correlation Coefficient of Returns			Test of Correlation Coefficient of Returns		
	(1) Pre-subprime mortgage crisis	(2) The section I of during the Subprime Mortgage Crisis	(3) The section II of during the Subprime Mortgage Crisis	(4) Pre-subprime mortgage crisis and section I	(5) section I and section II	(6) Pre-subprime mortgage crisis and section II
Taiwan	0.2345	0.2857	0.3354	0.9142	0.9041	1.8067*
Hong Kong	0.2076	0.3749	0.4880	3.0532***	2.2893***	5.3037***
Singapore	0.1813	0.3878	0.4711	3.7594***	1.6806*	5.3922***
Japan	0.1931	0.2988	0.3486	1.8748*	0.9144	2.7654***
Korea	0.2133	0.3409	0.4182	2.3048***	1.4854	3.7609***
India	0.2013	0.3511	0.4932	2.7064***	2.8522***	5.5242***
China	0.0724	0.0857	0.0927	0.2228	0.1159	0.3359
U.K.	0.4326	0.4847	0.6893	1.0988	5.2172***	6.3020***
Germany	0.4739	0.5193	0.6564	1.0035	3.4684***	4.4591***
France	0.4592	0.4932	0.6207	0.7320	3.0540***	3.7768***
Netherlands	0.3081	0.4314	0.6389	2.3828***	4.8424***	7.1949***
Belgium	0.4008	0.4601	0.6401	1.2122	4.2871***	5.4839***
Norway	0.3310	0.4217	0.6392	1.7610*	5.0455***	6.7841***
Sweden	0.3232	0.4145	0.6392	1.7611*	5.1889***	6.9277***
Canada	0.3605	0.5145	0.6989	3.1850***	4.8690***	8.0135***
Mexico	0.4162	0.5485	0.8128	2.8817***	8.5279***	11.3730***
Argentina	0.3748	0.4812	0.6959	2.1728***	5.5007***	7.6458***
Brazil	0.4058	0.5301	0.7981	2.6581***	8.2663***	10.8907***

Notes: *, ** and *** denote significance at the 10%, 5% and 1% significance levels, respectively.

Table 6. Results of Correlation Coefficient of Volatility of Returns

	Correlation Coefficient of Volatility of Returns			Test of Correlation Coefficient of Volatility of Returns		
	(1) Pre-subprime mortgage crisis	(2) Section I of during the Subprime Mortgage Crisis	(3) Section II of during the Subprime Mortgage Crisis	(4) Pre-subprime mortgage crisis and section I	(5) section I and section II	(6) Pre-subprime mortgage crisis and section II
Taiwan	0.4283	0.6114	0.7292	4.2164***	3.5470***	7.7098***
Hong Kong	0.5341	0.8533	0.8833	11.1894***	2.0116**	13.0586***
Singapore	0.3997	0.6963	0.7041	7.2696***	0.2515	7.4287***
Japan	0.3987	0.8706	0.9132	15.2029***	3.4656***	18.4751***
Korea	0.4361	0.8632	0.9093	13.9531***	3.5772***	17.3529***
India	0.3788	0.5825	0.6209	4.4534***	0.9897	5.3865***
China	0.1154	0.5044	0.3814	7.3110***	-2.5222***	4.6959***
U.K.	0.7385	0.9428	0.9895	13.5725***	14.1225***	27.5224***
Germany	0.7939	0.9118	0.9975	7.5927***	29.6359***	37.1321***
France	0.6146	0.9375	0.9941	16.6552***	19.6277***	36.0711***
Netherlands	0.5275	0.9507	0.9967	20.8430***	22.4071***	42.9851***
Belgium	0.5993	0.9545	0.9985	19.7728***	28.2174***	47.7388***
Norway	0.6585	0.8721	0.9978	9.1808***	33.9132***	42.9772***
Sweden	0.6891	0.9341	0.9981	14.0368***	29.4032***	43.2615***
Canada	0.7651	0.9756	0.9993	19.7826***	29.2745***	48.8056***
Mexico	0.6303	0.9359	0.9955	16.0113***	22.0734***	37.8811***
Argentina	0.7068	0.9080	0.9903	10.5727***	18.8298***	29.2681***
Brazil	0.6747	0.9174	0.9708	12.5330***	8.7689***	21.1425***

Notes: *, ** and *** denote significance at the 10%, 5% and 1% significance levels, respectively.

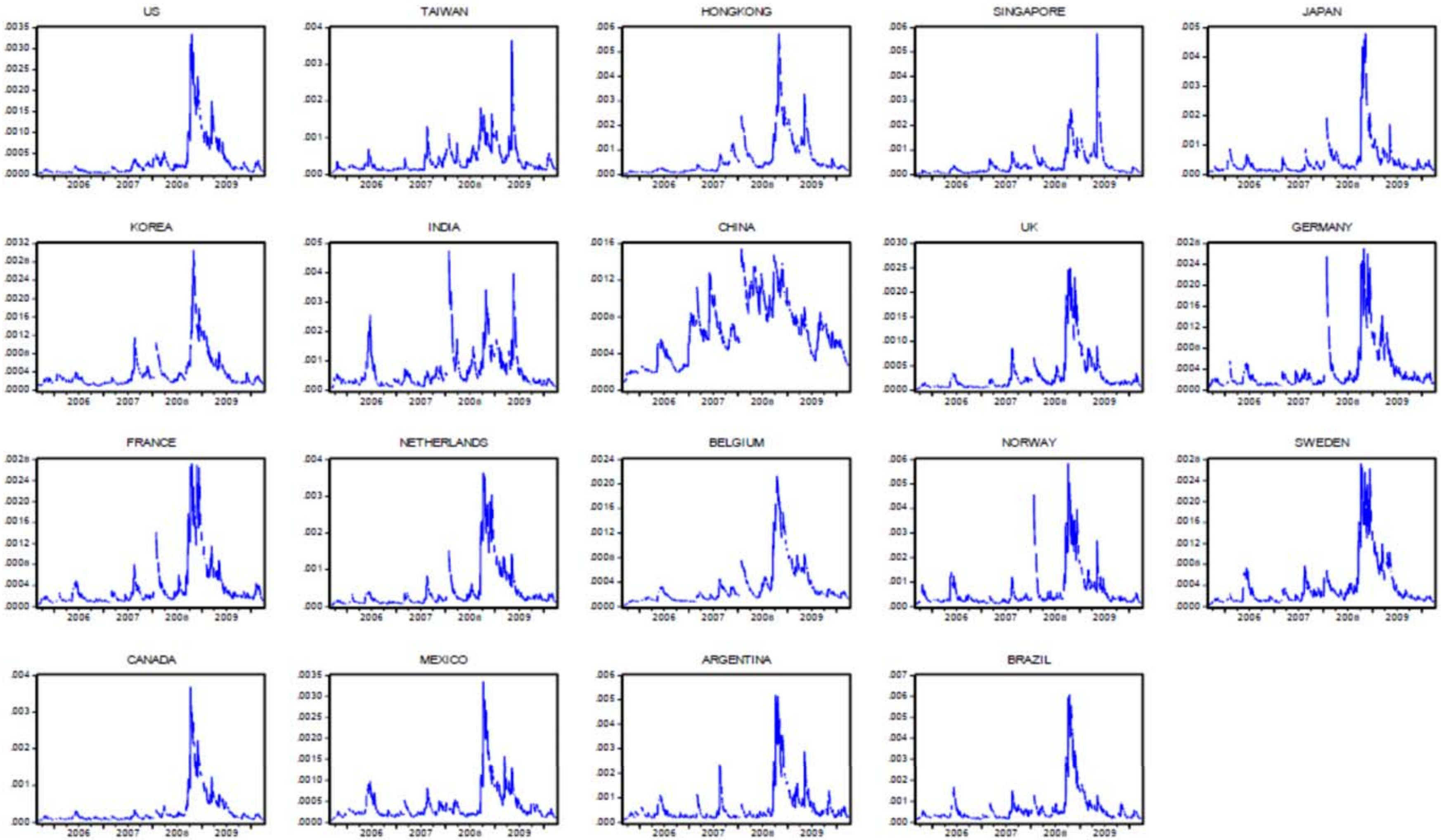

Figure 3. The Volatilities of Returns in 19 Stock Markets

Table 7. Results of the Engle-Granger Test for Co-integration

	(1) Pre-subprime mortgage crisis	(2) Section I of during the Subprime Mortgage Crisis	(3) Section II of during the Subprime Mortgage Crisis
	Engle-Granger ADF Statistic	Engle-Granger ADF Statistic	Engle-Granger ADF Statistic
Taiwan	-1.428	-1.079	-2.548
Hong Kong	-0.632	-1.562	-2.450
Singapore	-1.052	-2.760	-2.747
Japan	-2.098	-2.624	-2.525
Korea	-0.799	-2.372	-2.252
India	-0.281	-1.718	-2.607
China	-0.632	-0.319	-1.852
U.K.	-3.271**	-2.327	-2.968
Germany	-3.339**	-2.626	-4.091***
France	-2.334	-2.363	-2.268
Netherlands	-2.352	-1.272	-3.144*
Belgium	-1.912	-1.187	-1.959
Norway	-2.991	-1.485	-2.575
Sweden	-2.251	-1.562	-2.450
Canada	-1.509	-2.760	-2.747
Mexico	-1.364	-3.684**	-1.670
Argentina	-1.231	-2.857	-1.138
Brazil	-0.300	-2.451	-1.648

Notes: 1. The lag-length of difference Ks selected by minimizing AIC.

2. The critical values of the Engle-Granger ADF Statistics are taken from Engle and Yoo (1987).

3. *, ** and *** denote significance at the 10%, 5% and 1% significance levels, respectively.

able 8. Results of the Enders-Siklos Test for Threshold Co-integration

	(1) Pre-subprime mortgage crisis			(2) Section I of during the Subprime Mortgage Crisis			(3) Section II of during the Subprime Mortgage Crisis					
	F_C	F_A	r	F_C	F_A	r	F_C	F_A	r	Co-integration statistics	Asymmetric statistics	Contagion ? Y/N
aiwan	7.104**	0.880	0.01034	14.366***	6.244**	0.01638	61.386***	8.743***	0.02478	increase	increase	Y
Iong Kong	11.794***	2.287	-0.01305	17.485***	8.121***	-0.00934	87.484***	15.322***	0.02341	increase	increase	Y
ingapore	9.996***	0.331	-0.00573	33.221***	9.317***	0.02491	108.670***	10.134***	0.01819	increase	increase	Y
apan	10.533***	1.530	-0.01024	18.805***	7.203***	-0.01094	97.516***	11.614***	0.01653	increase	increase	Y
orea	6.969**	1.039	-0.00396	13.865***	5.565**	0.01594	72.900***	9.351***	0.01420	increase	increase	Y
ndia	5.659*	3.808*	0.01407	10.352***	6.829**	0.01926	62.255***	8.315***	0.03239	increase	increase	Y
hina	3.193	1.668	0.01986	3.076	1.970	0.02013	1.631	0.580	0.01639	decrease	decrease	N
.K.	53.354***	1.030	0.00663	109.455***	15.836***	0.00730	159.484***	19.940***	-0.00831	increase	increase	Y
ermany	54.435***	1.977	0.00933	97.956***	10.368***	0.01478	128.737***	16.167***	0.00587	increase	increase	Y
rance	60.601***	4.142**	-0.00564	146.796***	11.408***	0.01457	187.742***	17.432***	-0.00765	increase	increase	Y
etherlands	29.888***	1.446	-0.00934	63.892***	6.833**	-0.01072	78.398***	8.631***	-0.00986	increase	increase	Y
elgium	28.869***	0.754	-0.01182	68.388***	5.980**	-0.01295	92.824***	11.633***	-0.02004	increase	increase	Y
orway	16.519***	2.736*	-0.00937	29.864***	4.063*	0.01072	61.036***	7.260***	-0.01991	increase	increase	Y
weden	13.018***	1.473	0.01745	47.290***	4.967**	-0.00849	50.079***	8.980***	-0.00579	increase	increase	Y
anada	21.661***	2.782*	0.02396	41.642***	5.599**	-0.01632	57.413***	6.263***	-0.02024	increase	increase	Y
Iexico	18.068***	4.171**	0.01666	48.140***	4.891*	-0.01380	50.140***	9.307***	-0.01528	increase	increase	Y
rgentina	17.449***	1.641	0.01989	39.472***	7.481**	0.01973	77.752***	4.822**	-0.01108	increase	increase	Y
razil	52.893***	1.707	0.02623	43.137***	3.122*	0.02025	35.593***	7.728***	-0.02053	decrease	increase	N

otes: 1. The lag-length of difference Ks selected by minimizing AIC; r is the estimated threshold value.

2. F_C and F_A denote the F-statistics for the null hypothesis of no co-integration and symmetric adjustment. Critical values of the co-integration test are taken from Enders and Siklos (2001).

3. *, ** and *** denote significance at the 10%, 5% and 1% significance levels, respectively.

Table 9. Results of the Logistic Smooth Transition Co-integration Test

	(1) Pre-subprime mortgage crisis				(2) Section I of during the Subprime Mortgage Crisis				(3) Section II of during the Subprime Mortgage Crisis						
	F_C	F_L	r	γ	F_C	F_L	r	γ	F_C	F_L	r	γ	Co-integration	Non-liner	Contagion ?
Taiwan	6.183**	0.880	0.011	1.56	11.611***	7.321**	0.017	7.1	33.354***	6.251***	0.026	43.6	increase	increase	Y
Hong Kong	12.771***	4.287**	-0.013	3.81	13.856***	8.121***	-0.009	15.6	57.861***	11.056***	0.024	75.1	increase	increase	Y
Singapore	8.162***	0.331	-0.006	4.12	27.251***	9.317***	0.028	11.2	76.149***	9.987***	0.019	65.2	increase	increase	Y
Japan	9.887***	1.530	-0.011	3.76	15.805***	7.203***	-0.011	9.7	62.451***	9.842***	0.017	63.7	increase	increase	Y
Korea	7.002**	1.039	-0.004	1.87	11.865***	5.565**	0.015	11.4	43.112***	7.261***	0.014	54.4	increase	increase	Y
India	5.514*	3.808*	0.014	1.69	10.352***	6.829**	0.019	9.1	30.142***	7.362***	0.032	50.1	increase	increase	Y
China	3.157	2.347	0.021	0.69	3.014	3.241	0.021	4.9	1.647	2.287	0.016	3.7	decrease	decrease	N
U.K.	47.851***	1.030	0.007	3.61	51.351***	15.836***	0.007	9.5	111.871***	15.987***	-0.008	68.1	increase	increase	Y
Germany	51.124***	4.102**	0.009	5.11	59.874***	10.368***	0.016	10.1	98.215***	14.328***	0.007	77.1	increase	increase	Y
France	57.162***	4.142**	-0.006	8.45	78.268***	11.408***	0.017	15.2	146.214***	14.772***	-0.008	74.3	increase	increase	Y
Netherlands	26.742***	1.446	-0.011	3.25	41.221***	6.833**	-0.010	8.7	65.214***	12.146***	-0.010	53.2	increase	increase	Y
Belgium	19.142***	0.754	-0.012	3.33	46.228***	5.980**	-0.013	7.2	91.251***	13.547**	-0.020	66.5	increase	increase	Y
Norway	12.782***	2.736	-0.009	1.67	32.221***	4.063*	0.011	5.3	45.322***	6.251***	-0.019	39.1	increase	increase	Y
Sweden	11.248***	1.473	0.017	1.19	36.211***	4.967**	-0.008	6.1	34.512***	7.278***	-0.006	42.3	increase	increase	Y
Canada	17.548***	3.782*	0.024	2.11	33.236***	5.599**	-0.016	5.9	46.781***	6.311***	-0.020	51.2	increase	increase	Y
Mexico	16.587***	4.171**	0.017	3.14	31.311***	4.891*	-0.014	7.2	41.232***	8.541***	-0.015	50.8	increase	increase	Y
Argentina	12.619***	1.641	0.018	2.56	28.114***	7.481**	0.019	8.3	33.156***	4.239**	-0.011	48.2	increase	increase	Y
Brazil	19.211***	1.707	0.026	2.17	28.146***	3.122*	0.022	7.4	30.181***	6.598***	-0.020	46.2	increase	increase	Y

Notes: 1. The lag-length of difference Ks selected by minimizing AIC; r is the estimated threshold value and γ expressed as the speed of transition.

2. F_C and F_L denote the F-statistics for the null hypothesis of no co-integration and linearity model. Critical values of the co-integration test are taken from Enders and Siklos (2001).

3. *, ** and *** denote significance at the 10%, 5% and 1% significance levels, respectively.

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Using Equity, Index and Commodity Options to Obtain Forward-Looking Betas and Conditional-CAPM Expected Crude-Oil Spot Prices

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Abstract

This paper presents a parsimonious and theoretically-sound basis for extracting forward-looking measures of both equity and commodity betas, and the risk-premium on crude-oil futures contracts.

Defining forward-looking betas as perturbations of historical estimates, we use the market prices of equity, index and commodity options under a single-factor market model to estimate the appropriate forward-looking perturbation to apply to the historical beta. This permits us to compute forward-looking term structures of equity and commodity betas.

In the commodity arena, we use both one- and two-factor models to obtain estimates of a forward-looking measure of the correlation between crude-oil and the S&P 500. Combining these with forward-looking (i.e., implied) volatilities on commodities and stock-market indices, we utilize these forward-looking betas and correlations to provide an ex-ante estimate of the expected future crude-oil spot price through the use of an equity ex-ante risk premium and the conditional CAPM.

Keywords: *Implied volatilities, implied correlations and implied market betas; Expected spot price of oil.*

1 Introduction

The search for forward-looking indicators is a natural one in finance, as one of the primary roles of the discipline is to utilize market information to discern participants' views and expectations. This paper attempts to apply that principle to two distinct issues in financial economics:

1. The analysis of implied volatility, implied correlation and implied betas, and their impact on investment analysis and practice. Equity implied volatility dates back to Latané and Rendleman (1976).[1] Implied correlations have been more challenging, typically requiring the simultaneous pricing of individual *and* (relatively illiquid) spread options so as to permit isolation of the two vols and the implied correlation using the Margrabe (1978) formula.

   Implied equity betas are even more recent, and with several requiring alternative modifications on the "hybrid"-model use of option and historical data. Thus, French, Groth and Kolari (1983) use option-implied volatility with historical correlations. Siegel (1995) uses a hypothetical Margrabe-style exchange option to price "implicit betas." Assuming the skewnewss of the idiosyncratic shock is zero, Chang, Christoffersen, Jacobs and Vainberg (2012) use option-implied volatility and skewness measures from out-of-the-money equity and index options to derive forward-looking betas. In turn, Buss and Vilkov (2012) use forward-looking information from option prices to estimate option-implied correlations, construct option-implied predictors of factor betas and find a monotonically increasing risk-return relation. Finally, Broadie, Chernov and Johannes (2007) use an affine jump-diffusion model to estimate risk premia using S&P futures options.

   In contrast, our approach is a distinctly different hybrid: We use historical betas as well as historical idiosyncratic variances as inputs in order to obtain the *perturbations* or *adjustment factors* (to these historical measures) implied by observed equity and index option prices. By using at-the-money (ATM)

[1] Some of the earlier literature referred to this volatility with the adjective "implicit."

options, our approach does not require computation of skewness, an issue that can be especially problematic in longer-dated options where the vol skew is known to "flatten out." Moreover, by utilizing the entire term structure of volatilities (for the stock and the S&P), we are able to compute a term structure of betas and idiosyncratic variances out to the most-distant option expiration date. In light of the behavior of idiosyncratic variance during a financial crisis, the term structure of idiosyncratic variances is one way of quantifying the duration of such a crisis.

2. As is well-known, there is significant debate on the question of whether forward prices in energy markets are biased or unbiased predictors of future expected prices. The empirical work dating back to Houthakker (1957), Chang (1985), Fama (1987) and Bessembinder (1992) showed that in financial and *mature* commodity futures markets, risk premia in general satisfy the integrated-market model, which predicts risk premia are proportional to the covariance of the futures return with the return on the pricing kernel which we take to be the market portfolio. In a different approach, Kolos and Ronn (2008) estimate the risk premium by computing the ratio of expected return to standard deviation whilst explicitly accounting for the Samuelson effect (aka the "term structure of volatility") in commodity futures contracts.

   Having obtained a forward-looking measure of beta or correlation, there exists an appealing application to the commodity case, specifically, to that most-liquid commodity market of crude-oil futures. Assume the observability of an *ex-ante* risk-premium on the S&P 500 Index,[2] the implied vol of that index and the implied vol of a crude-oil futures contract. Then under a conditional-CAPM, the only remaining requisite input is the beta (or the correlation) of the oil-futures contract with the S&P 500 Index.

   Analogous to the equity analysis presented above, we first proceed with a one-factor model, which permits us to extract the beta between oil prices and the S&P 500. Under a conditional-CAPM, the S&P-500 beta of crude-oil futures

[2] To obtain such an *ex-ante* estimate, we will utilize the procedure specified in Doran, Ronn and Goldberg (2009) and described more fully below.

contract, in conjunction with the implied vols on the stock index and the crude-oil futures contract, provides an estimate of the forward-looking risk premium on oil.

As will be demonstrated empirically below, the practical contribution of this section is to permit investors to distinguish clearly between *demand*-side and *supply*-side shocks to the expected price of oil. A demand-side shock is defined as one arising from a change in the economy's demand for oil products, usually associated with either growth or recessionary conditions; the attendant correlation between oil prices and the S&P is positive. In contrast, supply-side shocks are attributable to constraints on oil supplies reaching consumer markets, due to either hurricanes in the Gulf of Mexico, geopolitical crises in the Middle East or spiking oil prices outpacing economic growth; in this case the correlation between oil prices and the S&P 500 is negative.

A negative correlation will be shown to imply an upward-bias of the futures price relative to its expected-spot price (under the physical measure) counterpart.[3] The approach proffered here thus provides a quantitative measure for this risk premium. Moreover, the procedure detailed below provides a *forward-looking* correlation, and as such is superior to the historical correlation, between crude-oil futures and the S&P.

The paper now proceeds as follows. Considering the format of standard equity options, Section 2 demonstrates the empirical methodology by presenting the one-factor model for standard equity options, its corresponding econometric specification and empirical results. Section 3 extends the one-factor model to its commodity

[3] With the advent of a perceived supply-side crisis, the lay press typically includes numerous references to an oil-price surcharge. For example,

> "The possibility that there might be a disruption in oil supply at some time in 2012 as Iran retaliates has, I think, permanently embedded a \$10 to \$20 premium in the price of oil,"

according to the chief global economist at the Economic Outlook Group cited in the 12/28/11 issue of the *New York Times*.

To be fair, such references are typically made with respect to *spot prices*, but the theory suggests they be reflected in the prices of futures contracts.

analogue, producing the critical betas and correlations between oil markets and the S&P 500 pricing kernel. As a robustness check to the one-factor model, Section 4 extends to the *two*-factor analogue, focusing specifically on equity options and the implied correlations between crude-oil and the stock market. Finally, Section 5 uses the resulting forward-looking measures of the correlation between the one-year oil futures contract and the S&P 500 Index to obtain a forward-looking measure of the expected spot price of oil. Section 6 concludes.

2 Using Equity Options to Obtain Forward-Looking Equity Betas

2.1 The Continuous-Time Theoretical Model

The theoretical, continuous-time model requires the specification of the stochastic processes for the market portfolio, stochastic volatility and the individual-stocks' returns:

$$\frac{dM_t}{M_t} = \mu_m\, dt + \sqrt{V_{mt}}\, dz_{mt} \tag{1}$$

$$dV_{it} = k_i\left(\psi_i - V_{it}\right) dt + \xi_i \sqrt{V_{it}}\, dz_{it} \tag{2}$$

for $i = m, S$, where $\sqrt{V_{mt}}$ is the stochastic volatility of the market portfolio and $\sqrt{V_{St}}$ is the stochastic volatility of stock S.

Accordingly, the conditional-CAPM version of the asset in continuous time is:

$$\begin{aligned} \frac{dS_t}{S_t} &= r\, dt + \beta_t\left(\frac{dM_t}{M_t} - r\, dt\right) + \sqrt{V_{St}}\, dz_{St} \\ &= \left[r + \beta_t\left(\mu_m - r\right)\right] dt + \beta_t\sqrt{V_{mt}}\, dz_{mt} + \sqrt{V_{St}}\, dz_{St} \end{aligned} \tag{3}$$

and $dz_{mt}\, dz_{St} = 0$.

The variance of the market portfolio is V_{mt}, and the total variance of the return on the generic stock is:

$$\mathrm{Var}\left(\frac{dS_t}{S_t}\right) = \beta_t^2 V_{mt} + V_{St}$$

where $\beta_t^2 V_{mt}$ is systematic variance proportional to β_t, and V_{St} is the idiosyncratic variance.

To permit the stock's beta to change over time, we specify the process for the correlation coefficient ρ_{Smt} :

$$d\rho_{Smt} = \alpha_\rho \left(\varphi_\rho - \rho_{Smt}\right) dt + \sigma_\rho \, dz_{\rho t} \tag{4}$$

When we explicitly consider n stocks $j = 1, 2, \ldots, n$, we take appropriate care in subscripting the processes:

$$\begin{aligned} dV_{Stj} &= k_S \left(\psi_{Sj} - V_{Stj}\right) dt + \xi_S \sqrt{V_{Stj}} \, dz_{St} \\ d\rho_{Smtj} &= \alpha_\rho \left(\varphi_{\rho j} - \rho_{Smtj}\right) dt + \sigma_\rho \, dz_{\rho t} \end{aligned} \tag{5}$$

Note the modeling of the two equations in (5): In order to capture the greatest possible number of degrees of freedom in the empirical tests, ψ_{Sj}, $\varphi_{\rho j}$ and the initial values V_{Stj}, ρ_{Smtj} will be stock-specific, while all the other parameters will be the same across stocks.

Finally, when we apply the *risk neutral measure*, it is possible to retrieve the following risk premia:

Risk Premium	Associated with	Wiener shock affecting the
θ_m	dz_{mt}	Market portfolio
θ_{vm}	dz_{vmt}	Stochastic volatility of the market portfolio
θ_{vS}	dz_{vSt}	Stochastic volatility of the generic stock
θ_S	dz_{St}	Individual stock
θ_ρ	$dz_{\rho t}$	Correlation between the stock and the market portfolio

For example, $\theta_m \equiv \left(\mu_m - r\right) / \sqrt{V_{mt}}$.

2.2 Initial Discrete-Time Econometric Tests — Equity Options

Consider the one-factor market-model equation,

$$R_i = a_i + \beta_{i,\,\mathrm{SPX}} R_{\mathrm{SPX}} + e_i \tag{6}$$

where we assume $\mathrm{Corr}(R_{\mathrm{SPX}}, e_i) = 0$. Applying the variance operator to (6) yields

$$\Sigma_i^2 = \beta_{i,\,\mathrm{SPX}}^2 \sigma_m^2 + \sigma_i^2, \tag{7}$$

where

$\Sigma_i^2 \equiv \mathrm{Var}(R_i)$, the variance of the return on stock i

$\sigma_m^2 \equiv \mathrm{Var}(R_{\mathrm{SPX}})$, the variance of the return on the S&P 500 market index

$\sigma_i^2 \equiv \mathrm{Var}(e_i)$, the idiosyncratic variance

Eq. (7) applies to *historical* $\left\{\widehat{\Sigma}_i,\, \widehat{\beta}_{i,\mathrm{SPX}},\, \widehat{\sigma}_i\right\}$ data with $\widehat{\beta}_{i,\mathrm{SPX}} \equiv \mathrm{Cov}\left(R_i, R_{\mathrm{SPX}}\right)/\mathrm{Var}\left(R_{\mathrm{SPX}}\right)$ over some specified time interval.[4] From eq. (7), it is trivial to solve for the historical idiosyncratic risk $\widehat{\sigma}_i$:

$$\widehat{\sigma}_i^2 = \widehat{\Sigma}_i^2 - \widehat{\beta}_{i,\mathrm{SPX}}^2 \sigma_m^2. \tag{8}$$

Relationship (7) also holds *prospectively,* that is, to implied vols $\{\Sigma_i,\, \sigma_i\}$ extracted from option prices on the individual equities i and the market portfolio $m \equiv$ SPX. Now consider a specification that explicitly models the relationship between historical estimates $\left\{\widehat{\beta}_{i,\mathrm{SPX}},\, \widehat{\sigma}_i\right\}$ and forward-looking ones $\{\beta_{i,\mathrm{SPX}},\, \sigma_i\}$. In theory, the difference between historical and *ex-ante* statistics arises from two sources:

1. The information set. The historical returns, variances and covariances are due to a specific realization of uncertainty. That information set is (part of) investors' perceptions of the future, but investors may and presumably do consider other sources of information in forming expectations of the future.

2. A risk premium, aka the "market price of volatility risk." Technically, implied vols are risk-neutral expectations of future realized vols, but as is well-known, there can be a non-zero market price of volatility risk that separates the statistical from the risk-neutral expectations. While the literature is not unanimous, most researchers have found risk-neutral implied vols exceed their statistical-expectations counterparts: See Jackwerth and Rubinstein (1996), Pan (2002), Bakshi and Kapadia (2003a, 2003b), Low and Zhang (2005), Doran and Ronn (2008) and Bollerslev, Gibson and Zhou (2011). Since both the LHS and RHS of eq. (7) pertain to risk-neutral expectations, the forward-looking betas we obtain here are risk-neutral. Whether such betas are upward-

[4] Throughout this paper, variables with a "carat" $\widehat{}$ denote historical estimates.

or downward-biased predictors of forward-looking *statistical* (not risk-neutral) betas is beyond the scope of this research.

The econometric model we posit is one which utilizes *Cross-Sectional Daily Tests with a Term Structure of Betas:* In this test we employ a cross-sectional analysis at a given point in time, taking into explicit consideration the entire term structure of betas. Since equity implied vols are provided on a daily basis out to 18 mos. maturities, we can fill in the missing observations by assuming forward vols are constant between observable expiration dates.[5] Then, for each stock i and maturity m at date t, we use the relationships

$$\begin{cases} \Sigma_{imt}^2 &= \beta_{i,m,t}^2 \sigma_{\mathrm{SPX},m,t}^2 + \sigma_{i,m,t}^2 \\ \beta_{i,m} &= \widehat{\beta}_{i,\mathrm{SPX}} + \alpha_{i,1c} + \alpha_{i,1l}(m-1) + \alpha_{i,1q}(m-1)^2 \\ \sigma_{i,m} &= \widehat{\sigma}_i + \alpha_{i,4c} + \alpha_{i,4l}(m-1) + \alpha_{i,4q}(m-1)^2 \end{cases} \tag{9}$$

In this case, for each stock i on date t we have $m-6 = 12$ d.f. Although we naturally retain the i-dependence of the historical estimates $\left\{\widehat{\beta}_{i,\mathrm{SPX}}, \widehat{\sigma}_i\right\}$, to increase the number of degrees of freedom, we make the simplifying assumptions the estimated coefficients $\{\alpha_{i,1c}, \alpha_{i,1l}, \alpha_{i,1q}, \alpha_{i,4c}, \alpha_{i,4l}, \alpha_{i,4q}\}$ are all *i-independent:* This increases the number of degrees of freedom by the number of stocks $N = 8$ to $12N = 96$.

2.3 Empirical Results — Equity Options

The empirical results reported here cover the period Jan. 3, 2008 – July 31, 2012. $N = 8$ stocks are utilized. They are the stocks included in Bloomberg's BUSOILP Index: Anadarko Petroleum Corp., Apache Corp., ConocoPhillips Co., Chevron

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[5] Using the principle variance is additive across maturities — since S&P returns are uncorrelated across time — for both individual stocks and market index, the algorithm is the following:

For the very first maturity's σ_1, we simply set that equal to the observable σ_2. For the next two maturities, $m = 4$, 5, we solve for σ_4 and σ_5 using the observable σ_3 and σ_6 :

$$(4/12)\sigma_4^2 = (3/12)\,\sigma_3^2 + \left[\sigma_6^2\,(6/12) - \sigma_3^2\,(3/12)\right]/3.$$

We repeat this for successive maturities out to 24 mos. for the S&P and 18 mos. for the individual stocks, whose actively-traded options do not extend to 24 mos.

Corp., Hess Corp., Occidental Petroleum Corp., Marathon Oil Corp. and Exxon-Mobil Corp.[6] We need specify the empirical proxies for the three sets of historical variables $\left\{\widehat{\Sigma}_{it},\, \widehat{\beta}_{i,\mathrm{SPX},t},\, \widehat{\sigma}_{it}\right\}$ as well as the nine ATM implied vols on the S&P 500 and the individual stocks i, $\{\sigma_{mt},\, \Sigma_{it}\}$:

1. The historical estimates $\left\{\widehat{\Sigma}_{it},\, \widehat{\beta}_{i,\mathrm{SPX},t},\, \widehat{\sigma}_{it}\right\}$ on each stock i are obtained from one-year rolling regressions of eq. (6) culminating on date t.
2. The nine ATM implied vols $\{\sigma_{mt},\, \Sigma_{it}\}$ are obtained from ATM options on the S&P 500 Index and the eight individual BUSOILP stocks as observed on date t.

Test #1 — Cross-Sectional Daily Tests (9):

We report the tests of these equations (9) by presenting time-series plots of

[6] The Anadarko Petroleum Corp., a member of the BUSOILP eight, owned a 25% interest in Deepwater Horizon, the oil rig operated by BP PLC in the Gulf of Mexico. As a consequence of the catastrophic sinking of that oil rig on April 20, 2010 Anadarko stock underperformed the BUSOILP index by as much as 35% by June 30, 2010, and remains some 20 percentage points below as of Aug. 2013. Moreover, its 60-day-moving window correlation with BUSOILP declined from 0.84 in April to a low 0.445 on 5/18/2010, before recovering to 0.779 on 9/2/2010.

Figure 1's α_{1l} and Figure 2's α_{4c}.[7] Finally, Figure 3 reports the simple-average historical and implied equity betas for the eight BUSOILP stocks.

[7] The available data permits alternative interesting aggregation of the data and resulting empirical tests. For example, consider:

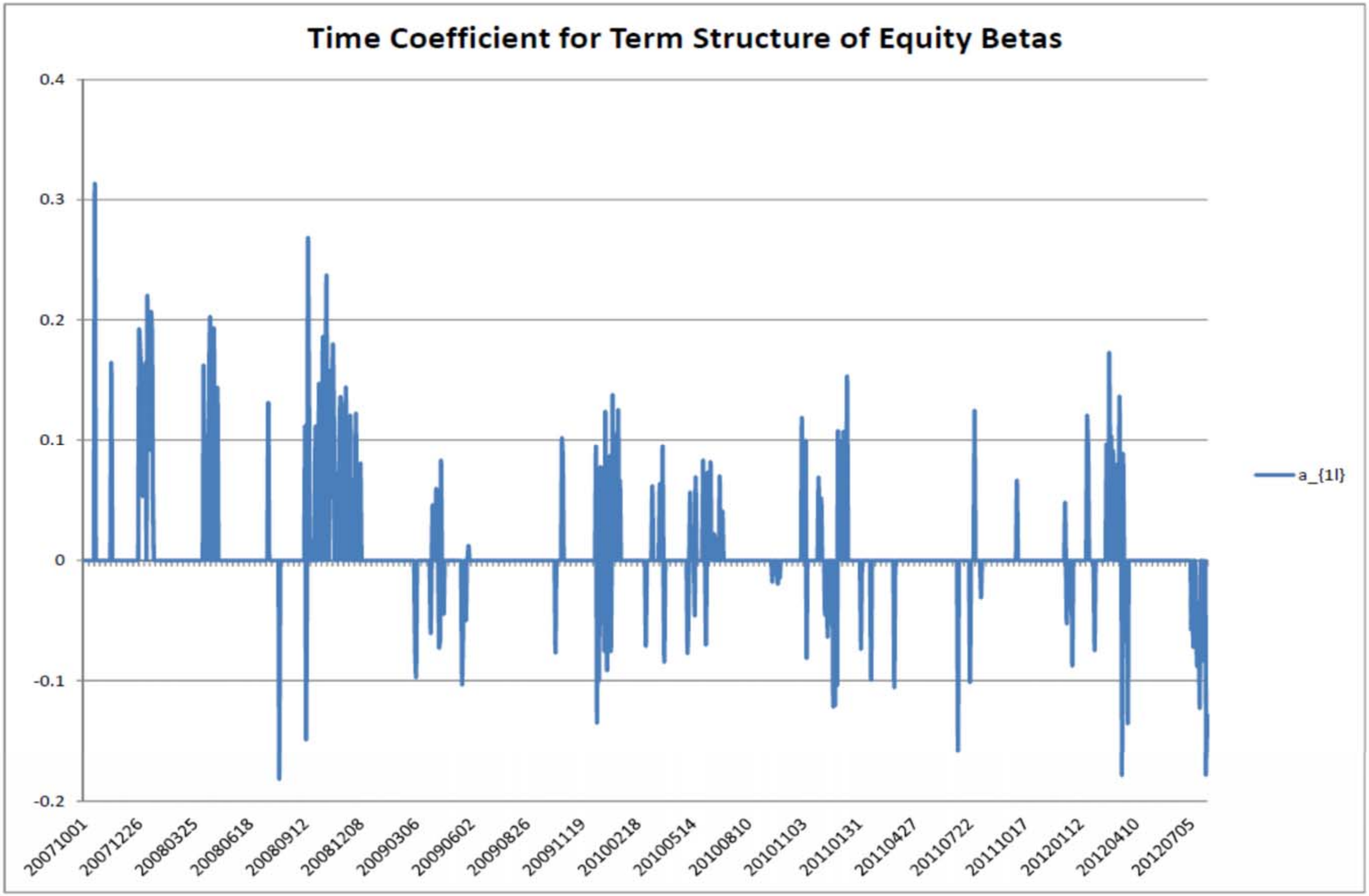
1. A Time-Series Test: Assuming data on N stocks and their associated ATM options, we now formulate a model that aggregates information and specifies a constant stock-specific correction over an entire sample period:

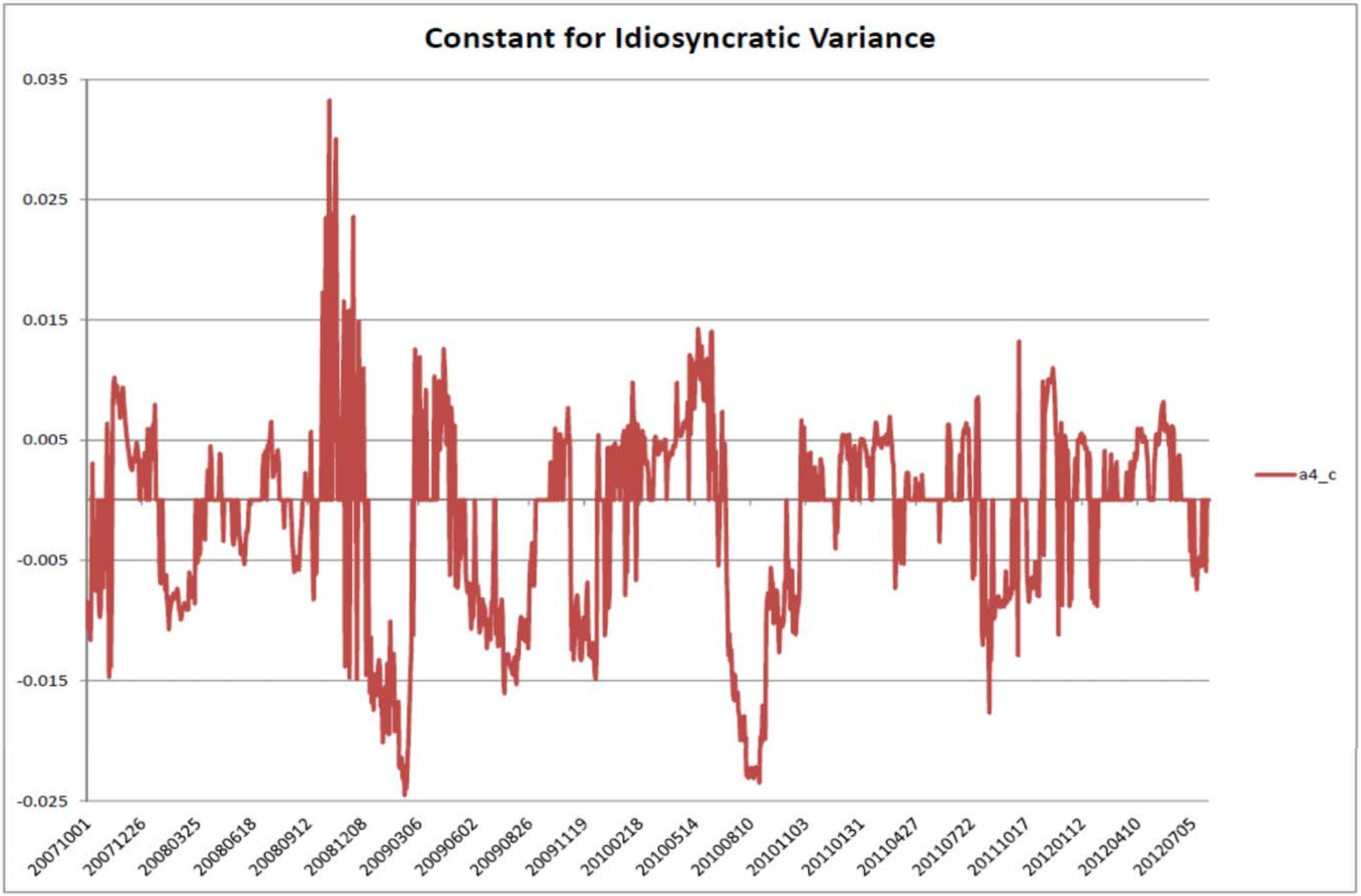
$$\min_{\{a_{1i},\, a_{2i}\}} \quad \sum_{t=1}^{T}\sum_{i=1}^{N}\left(\Sigma_{it}^2 - \widehat{\beta}_{i,\text{SPX},t}^2 a_{1i}^2\sigma_{mt}^2 - \widehat{\sigma}_{it}^2 a_{2i}^2\right)^2.$$

   In words, we seek to solve for the date-t specific correction factors $\{a_{1i},\, a_{2i}\}$ which would satisfy eq. (7). In this test, while the correction factors are stock-specific, they are constant for each stock across the time period being considered.

2. A Constrained Time-Series Test: The third test is a special case of Test 2. In an effort to achieve parsimony with respect to the number of estimated parameters, we constrain the correction factors $\{a_{1i},\, a_{2i}\}$ to be i-independent, $\{a_1,\, a_2\}$:

$$\min_{\{a_1,\, a_2\}} \quad \sum_{t=1}^{T}\sum_{i=1}^{N}\left(\Sigma_{it}^2 - \widehat{\beta}_{i,\text{SPX},t}^2 a_1^2\sigma_{mt}^2 - \widehat{\sigma}_{it}^2 a_2^2\right)^2.$$


Time Coefficient for Term Structure of Equity Betas
0.4
0.3
0.2
0.1
0
-0.1
-0.2
20071001
20071226
20080325
20080618
20080912
20081208
20090306
20090602
20090826
20091119
20100218
20100514
20100810
20101103
20110131
20110427
20110722
20111017
20120112
20120410
20120705
a_{1l}


Constant for Idiosyncratic Variance
0.035
0.025
0.015
0.005
-0.005
-0.015
-0.025
20071001
20071226
20080325
20080618
20080912
20081208
20090306
20090602
20090826
20091119
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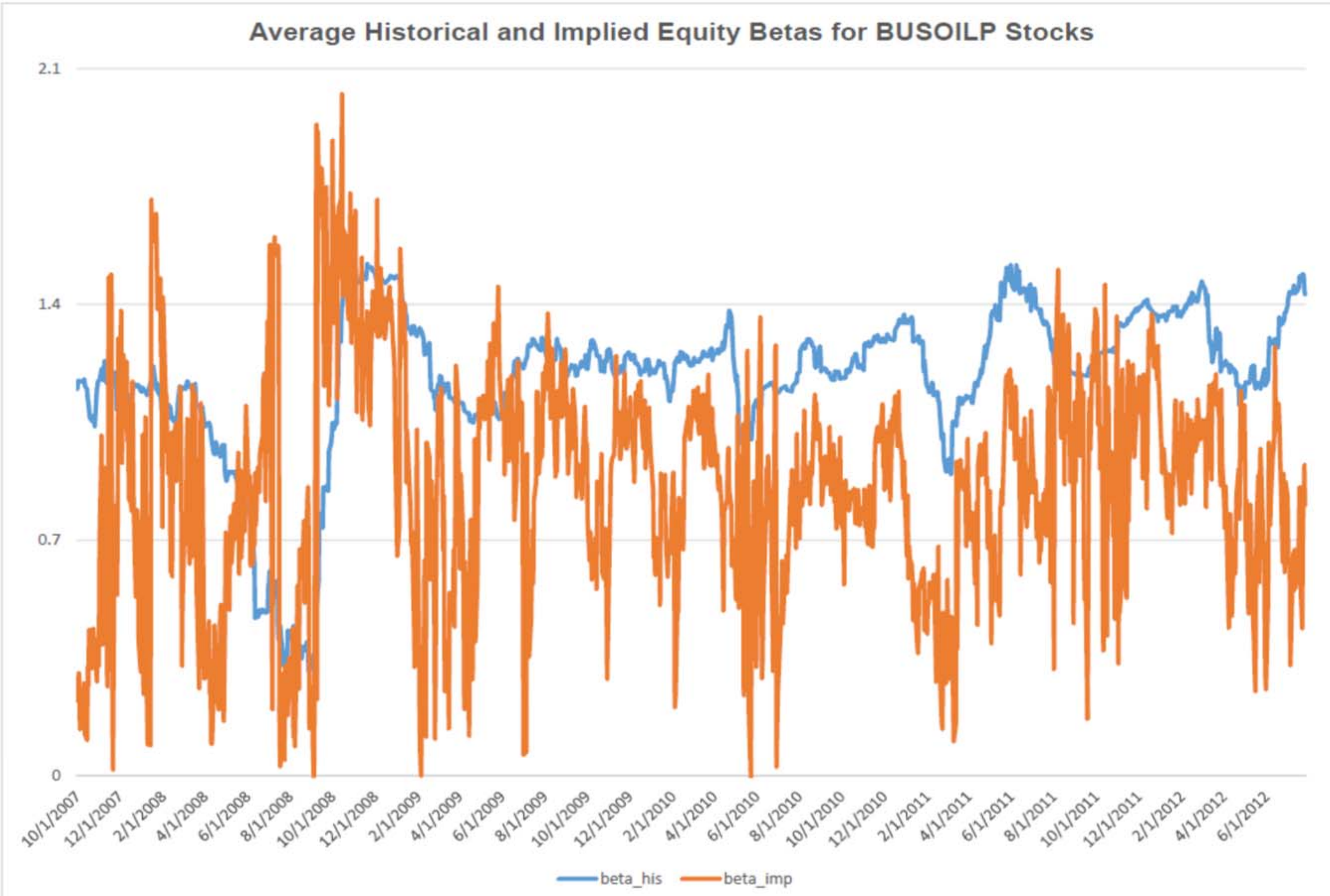
20120410
20120705
a4_c


Average Historical and Implied Equity Betas for BUSOILP Stocks
2.1
1.4
0.7
0
10/1/2007
12/1/2007
2/1/2008
4/1/2008
6/1/2008
8/1/2008
10/1/2008
12/1/2008
2/1/2009
4/1/2009
6/1/2009
8/1/2009
10/1/2009
12/1/2009
2/1/2010
4/1/2010
6/1/2010
8/1/2010
10/1/2010
12/1/2010
2/1/2011
4/1/2011
6/1/2011
8/1/2011
10/1/2011
12/1/2011
2/1/2012
4/1/2012
6/1/2012
beta_his
beta_imp

From Fig. 1, we note the relative sparse incidence of a significantly non-zero value to α_{1l} : Thus, there does not appear to be a frequently-occurring non-flat *term structure of* equity betas. In turn, Fig. 2 appears to indicate the forward-looking idiosyncratic vol reflects market conditions: When large market moves diminish idiosyncratic volatilities (relative to market-related moves), the market forecasts a *reversion* to more-normal conditions thereafter.

Fig. 3, in turn, demonstrates the average value for the high-beta oil equities (BUSOILP simple-average $\widehat{\beta}$ over this period: 1.18) is generally *lower than* its historical counterpart. The average difference over this period is -0.322, with a std. error of 0.011.

Finally, it is instructive to compare and contrast the oil-company equity betas reported here with those obtained by Chang, Christoffersen, Jacobs and Vainberg (CCJV) (2012) and Buss and Vilkov (2012). CCJV generally report far-lower betas (0.33 to 0.80), but that may well be due to the earlier 1996 – 2004 time period covered in their sample: As is well-known, crude-oil exhibited a far-lower correlation prior to the Great Recession. Whether the heightened correlation exhibited more recently is due to the disparate perspectives of "financialization of the energy industry" or to "integrated capital markets" remains an issue to be resolved. Buss and Vilkov (2012), in turn, report a marginally higher implied beta relative to the historical beta. One of the findings of the current paper is that the relationship between historical and implied is quite sensitive to the time period being analyzed — specifically, whether we are in "crisis" or calm mode.

3 Using *Commodity* Options to Obtain Forward-Looking *Commodity* Betas

We now apply the one-factor model directly to crude-oil futures contracts. Specifically, for varying maturities T apply a market-model to returns on crude-oil futures contracts,

$$r_T = a_T + \beta_T R_{\text{SPX}} + e_T \tag{10}$$

$$\Sigma_T^2 = \beta_T^2 \sigma_{mT}^2 + \sigma_T^2 \tag{11}$$

where

$\Sigma_T^2 \equiv \mathrm{Var}(r_T)$, the variance of the return on crude-oil futures contract of maturity T

$\beta_T \equiv \mathrm{Cov}\,(R_T,\, R_{\mathrm{SPX}})/\ \mathrm{Var}\,(R_{\mathrm{SPX}})$, market beta of oil futures contract of maturity T

$\sigma_{mT}^2 \equiv \mathrm{Var}\big(R_{\mathrm{SPX},T}\big)$, the variance of the return on the S&P 500 market index to expiration date T

$\sigma_{iT}^2 \equiv \mathrm{Var}(e_{iT})$, the idiosyncratic variance

As before, the hybrid portion of the model links the historical estimates $\{\hat{\beta}_i,\, \hat{\sigma}_i\}$ to their forward-looking analogues $\{\beta_i,\, \sigma_i\}$ via either multiplicative (12) or additive (13) *quadratic* corrections: Pooling all maturities $T \leq 2$, at any date t,

$$\begin{cases} \beta_{Tt} &= \hat{\beta}_{1t}\left[1 + a_{1ct} + a_{1lt}\,(T-1) + a_{1qt}\,(T-1)^2\right] \\ \sigma_{Tt} &= \hat{\sigma}_{1t}\left[1 + a_{2ct} + a_{2lt}\,(T-1) + a_{2qt}\,(T-1)^2\right] \end{cases} \tag{12}$$

$$\begin{cases} \beta_{Tt} &= \hat{\beta}_{1t} + \alpha_{1ct} + \alpha_{1lt}\,(T-1) + \alpha_{1qt}\,(T-1)^2 \\ \sigma_{Tt} &= \hat{\sigma}_{1t} + \alpha_{2ct} + \alpha_{2lt}\,(T-1) + \alpha_{2qt}\,(T-1)^2 \end{cases} \tag{13}$$

Test #2 — Cross-Sectional Daily Tests (13):

The results are reported in Figs. 4 and 5:

1. Fig. 4 reports the linear adjustment, α_{1lt}, for the futures contracts. Note the non-zero values of the adjustment at the high-volatility period of the Great Recession and during the Arab Spring of 2011, and their smoothened value.[8]

2. Regarding the betas of the prompt-month contract on the S&P 500 Index, these report the historical betas, the resulting additive-quadratic adjusted betas, and their smoothened analogue. The key point is that the hybrid adjusted

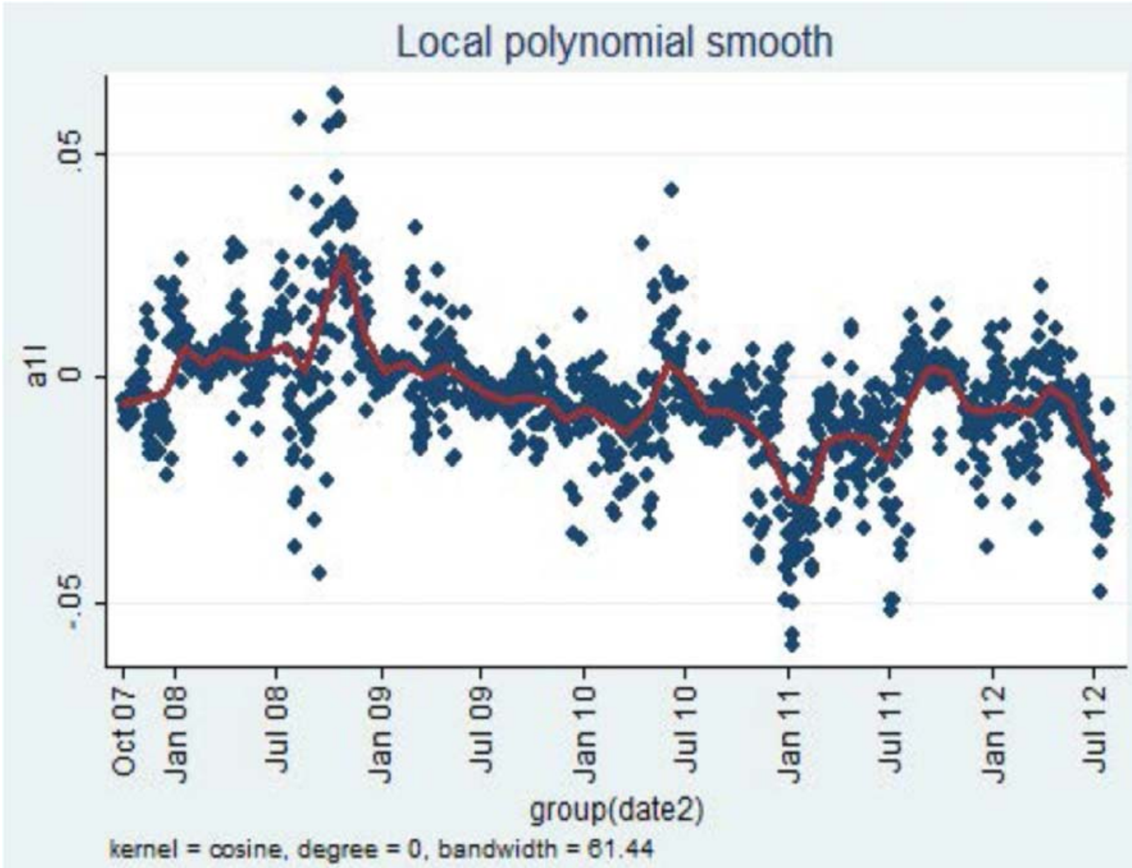
[8] See Gutierrez, Linhart and Pitblado (2003) for the smoothing algorithm.

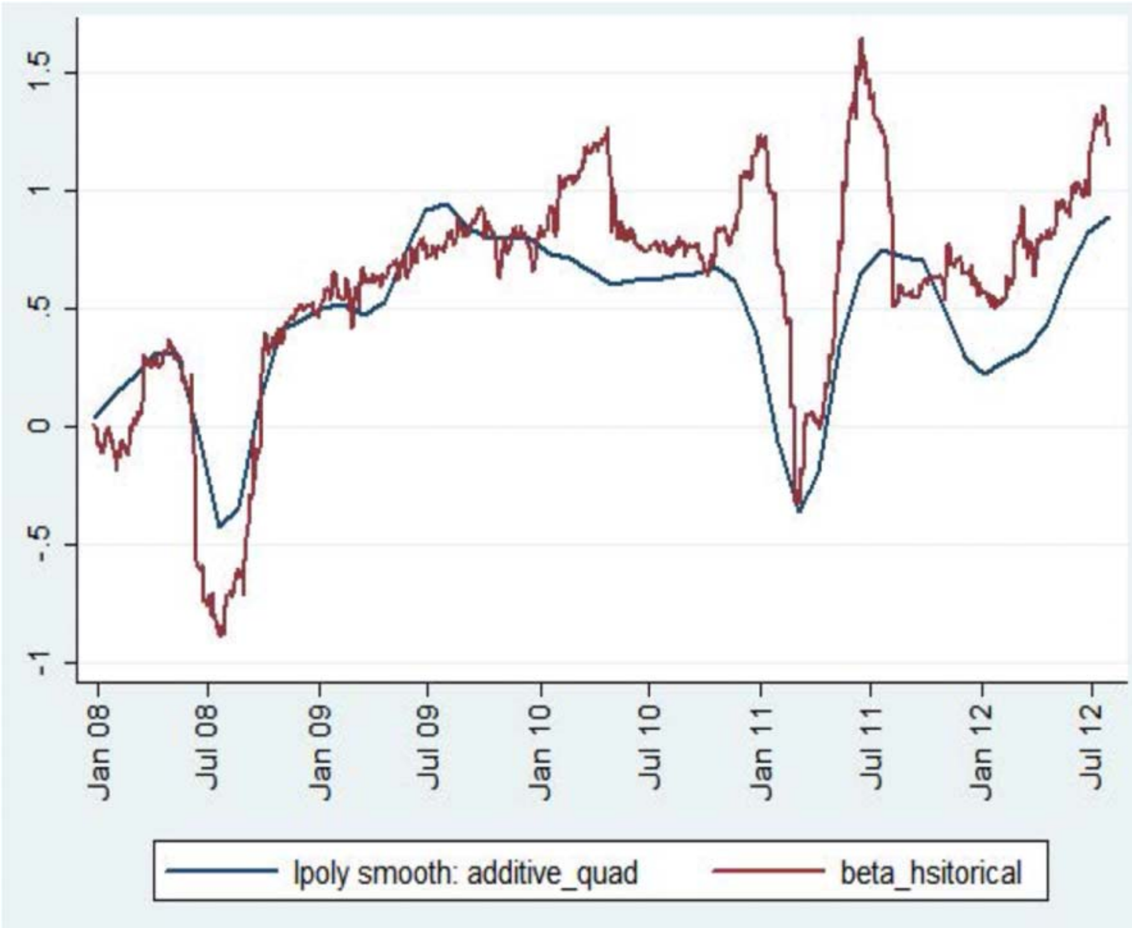
betas anticipate some of the important changes which occurred in the past two crises — the crash of 2008 and the "Arab Spring" events of 2011 — when there were sharp changes in the sign of these betas.[9]

[9] Recognizing that Implied Betas are also functions, in part, of *Historicals,* the regression test uses betas for the period 05/21/2008 to 04/05/2010 (with subsequent data used to compute subsequently-realized betas):

$$\begin{array}{c}\text{Subsequently-Realized}\\ \text{Historical Betas}\end{array} = \text{const.} + a\begin{pmatrix}\text{Historical}\\ \text{Betas}\end{pmatrix} + b\begin{pmatrix}\text{Implied}\\ \text{Betas}\end{pmatrix}.$$

In the empirical results for maturities out to 24 mos., the coefficient $\hat{b}$ was statistically significant for 14 of those 24 maturities: 1 – 6, 9 – 10, 15 – 16, 18, 21, 22 and 24.


Local polynomial smooth
a1l
.05
0
-.05
Oct 07
Jan 08
Jul 08
Jan 09
Jul 09
Jan 10
Jul 10
Jan 11
Jul 11
Jan 12
Jul 12
group(date2)
kernel = cosine, degree = 0, bandwidth = 61.44


1.5
1
.5
0
-.5
-1
Jan 08
Jul 08
Jan 09
Jul 09
Jan 10
Jul 10
Jan 11
Jul 11
Jan 12
Jul 12
lpoly smooth: additive_quad
beta_hsitorical

4 Using Equity Options to Obtain Forward-Looking $\mathrm{Corr}(R_{\mathrm{CL}}, R_{\mathrm{SPX}})$

4.1 The Two-Factor Model

Consider the rate of return R_i on the equity of an oil company and relate that return to two underlying assets, the stock market return R_{SPX} and the 1-yr. crude-oil futures contract R_{CL}, and an uncorrelated idiosyncratic noise term e_i :[10]

$$R_i = a_i + \beta_{i,\mathrm{SPX}} R_{\mathrm{SPX}} + \beta_{i,\mathrm{CL}} R_{\mathrm{CL}} + e_i. \tag{14}$$

Three comments regarding eq. (14) are in order:

1. Eq. (14) is not an *asset pricing* formulation. That is, we make no assumptions regarding the magnitude of a_i; our interest here is purely in the vols and correlation.

2. If we sought to understand the rates of return on oil stocks, we could debate at length the optimal *maturity* of the oil futures we should be utilizing. Presumably, this would have something to do with the company-specific rate of extraction from current and prospective oil fields. Our point here is different: We *fix* the maturity at the one-year mark, and leave all other uncorrelated effects to reside in e_i.

3. As is well-known, these oil companies also have exposure to natgas, which product they frequently extract in the same or different fields. Once again, since we are interested in crude-oil/S&P correlation and vols, by construction we leave all other uncorrelated effects to e_i.

Applying the variance operator to (14) yields

$$\Sigma_i^2 = \beta_{i,\mathrm{SPX}}^2 \sigma_m^2 + 2\beta_{i,\mathrm{SPX}} \beta_{i,\mathrm{CL}} \rho_{m,\mathrm{CL}} \sigma_m \sigma_{\mathrm{CL}} + \beta_{i,\mathrm{CL}}^2 \sigma_{\mathrm{CL}}^2 + \sigma_i^2, \tag{15}$$

---

[10] That is,

$$\begin{aligned} \mathrm{Corr}\,(R_{\mathrm{SPX}}, e_i) &= 0 \\ \mathrm{Corr}\,(R_{\mathrm{CL}}, e_i) &= 0 \end{aligned}$$

The regression formulation we utilize to extract historical parameter values does satisfy a special case of this condition, $\mathrm{Corr}\,(\beta_{i,\mathrm{SPX}} R_{\mathrm{SPX}} + \beta_{i,\mathrm{CL}} R_{\mathrm{CL}}, e_i) = 0$.

where

$$\Sigma_i^2 = \mathrm{Var}(R_i)$$
$$\sigma_m^2 = \mathrm{Var}(R_{\mathrm{SPX}})$$
$$\sigma_{\mathrm{CL}}^2 = \mathrm{Var}(R_{\mathrm{CL}})$$
$$\rho_{m,\mathrm{CL}} = \mathrm{Corr}(R_{\mathrm{SPX}},\, R_{\mathrm{CL}})$$
$$\sigma_i^2 = \mathrm{Var}(e_i)$$

4.2 Specification of the Econometric Tests for the Two-Factor Model

By analogy to the one-factor model, the additive and multiplicative corrections for the two-factor model are:[11]

$$\begin{cases} \beta_{i,\mathrm{SPX}} &= \hat{\beta}_{i,\mathrm{SPX}} + \alpha_{1c} + \alpha_{1l}\,(T-12) \\ \beta_{i,\mathrm{CL}} &= \hat{\beta}_{i,\mathrm{CL}} + \alpha_{2c} + \alpha_{2l}\,(T-12) \\ \rho_{m,\mathrm{CL}} &= \hat{\rho}_{1,\mathrm{CL}} + \alpha_{3c} + \alpha_{3l}\,(T-12) \\ \sigma_i &= \hat{\sigma}_i + \alpha_{4c} + \alpha_{4l}\,(T-12) \end{cases} \tag{16}$$

Since the correlation $\rho_{m,\mathrm{CL}}$ is not stock i-specific, it does not require a modification of the historical correlation $\hat{\rho}_{m,\mathrm{CL}}$, but can be simply computed as one of the outputs of the optimization routine (17) defined below. However, in practical implementation it was found useful to nevertheless model that as in (16) above in order to obtain more-convergent solutions.

Cross-Sectional Daily Tests of (16): Assuming data on N stocks and M maturities and their associated ATM options, in this set of tests, we formulate the additive-model (16) each day t in the sample period:[12]

[11] A natural modeling case to examine is the *affine*, which would combine additive and multiplicative as special cases. Although we did experiment with such a model, the results experienced greater convergence difficulties, as well as rendering their interpretation more problematic.

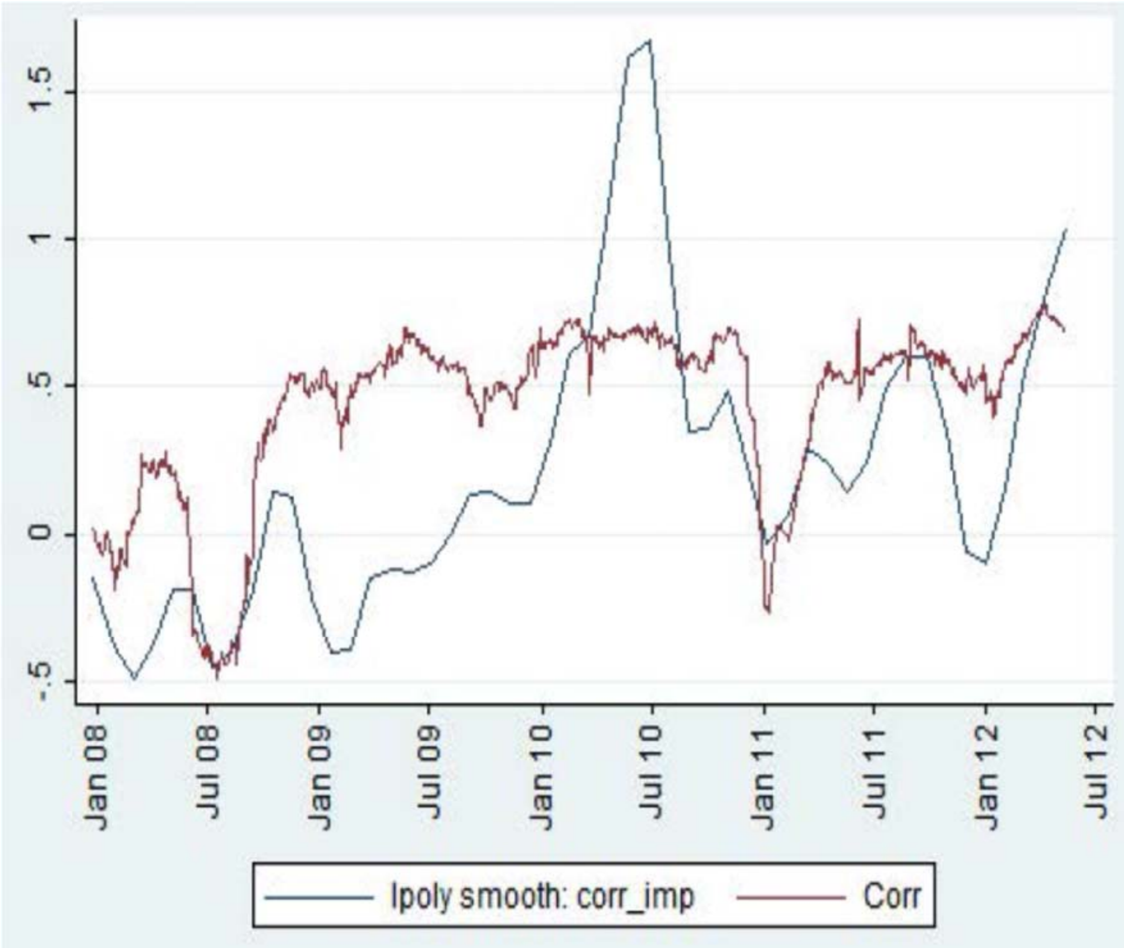
[12] The formulation of the three additive models is again analogous to their multiplicative counterparts.

$$\min_{\{\boldsymbol{\alpha}\}} \sum_{i=1}^{N} \sum_{m=1}^{M} \Big(\Sigma_i^2 - \Big[\widehat{\beta}_{i,\mathrm{SPX}} + \alpha_{1c} + \alpha_{1l}\,(M-12)\Big]^2 \sigma_m^2$$
$$+2\,\Big[\widehat{\beta}_{i,\mathrm{SPX}} + \alpha_{1c} + \alpha_{1l}\,(M-12)\Big]\Big[\widehat{\beta}_{i,\mathrm{CL}} + \alpha_{2c} + \alpha_{2l}\,(M-12)\Big]\big[\widehat{\rho}_{1,\mathrm{CL}} + \alpha_{3c} + \alpha_{3l}\,(M-12)\big]\cdot$$
$$+\,\widehat{\beta}_{i,\mathrm{CL}}^2 a_{2t}^2 \sigma_{\mathrm{CL}}^2 + \widehat{\sigma}_i^2 a_{4t}^2\Big)^2$$
$$\boldsymbol{\alpha} \equiv \{\alpha_{1ct},\, \alpha_{1lt},\, \alpha_{2ct},\, \alpha_{2lt},\, \alpha_{3ct},\, \alpha_{3lt},\, \alpha_{4ct},\, \alpha_{4lt}\}$$

4.3 Empirical Results

Test #3 — Cross-Sectional Daily Tests (17):

Figure 5 below presents the time-series of historical and implied correlations over the period 1/3/2008 – 7/31/2012. While exceeding unity is statistically impossible, such does occur in *point estimates* elsewhere in commodity finance: One example may be found in the implied correlation inferred from applying the Margrabe (1978) formula to *spread options* using implieds for the two sides of the spread. While broadly consistent with the results obtained for the single-factor case (13), there is an abundance of "noise" in the results reported here.


1.5
1
.5
0
-.5
Jan 08
Jul 08
Jan 09
Jul 09
Jan 10
Jul 10
Jan 11
Jul 11
Jan 12
Jul 12
lpoly smooth: corr_imp
Corr

5 Computing Expected Crude-Oil Spot Price Based on Implied Corr(CL, SPX)

To understand the previous two figures in historical perspective, recall in the first half of 2008, oil price surged to all-time highs, peaking at \$145.54 on July 3rd. These oil-price increases contrasted with developed economies' initial slide into recession, resulting in a negative correlation between oil prices and the S&P 500 proxy for world economic activity. This confluence is more acutely reflected in the forward-looking correlations, which are more negative than their historical analogues. As previously presented in Table 1, the ability to observe the sign of the correlation coefficient, and in particular one that is forward-looking, permits us to understand whether a prevailing shock to oil prices is supply- or demand-side in nature.

Moreover, per the analytics below, that sign will also dictate whether the prevailing futures contract is an upward- or downward-biased predictor of expected crude-oil spot prices. These implications of a forward-looking negative correlation(CL, SPX) flow from an application of the CAPM: Since $\beta_{\text{CL, SPX}}$ is proportional to $\rho_{\text{CL, SPX}}$, $\text{sign}(\rho_{\text{CL, SPX}})$ will determine whether the futures contract price is a downward- or upward-biased estimate of the expected spot price of crude one year out. To see this, assume the CAPM obtains for commodities — i.e., that the CAPM is the correct pricing model as crude-oil futures prices trade in fully-integrated capital markets. In that case, we have[13]

$$
\begin{aligned}
\mu_{\text{CL},t} &= \beta_{\text{CL}}\left(\mu_{Mt} - r_t\right), \qquad (18)\\
&= \frac{\text{Cov}\left(R_{\text{CL}},\, R_M\right)}{\text{Var}\left(R_m\right)}\left(\mu_{Mt} - r_t\right)\\
&= \frac{\rho_{\text{CL},t}\sigma_{\text{CL},t}}{\sigma_{Mt}}\left(\mu_{Mt} - r_t\right) \equiv \rho_{\text{CL},t}\sigma_{\text{CL},t}\,\lambda_t \qquad (19)
\end{aligned}
$$

where

$\mu_{\text{CL},t}$ = the expected rate of change on the one-year crude-oil futures contract at date t

[13] Note that in (19) we abstain from subtracting the riskfree rate on the LHS since, for costless-to-enter futures contract, the return in a risk-neutral world is 0 (not the riskfree rate of interest).

β_{CL} = the beta for the one-year crude-oil futures contract. Formally, $\beta_{\text{CL}} = \text{Cov}(R_{\text{CL}}, R_M)/\text{Var}(R_m)$

$\rho_{\text{CL},t}$ = the current *ex-ante* correlation between $F_{\text{CL},t}$ and the Market portfolio

$\sigma_{\text{CL},t}$ = Implied vol on the one-year crude-oil futures contract

λ_t = Current date-t stock market Sharpe Ratio $\equiv \dfrac{\mu_{Mt} - r_t}{\sigma_{Mt}}$

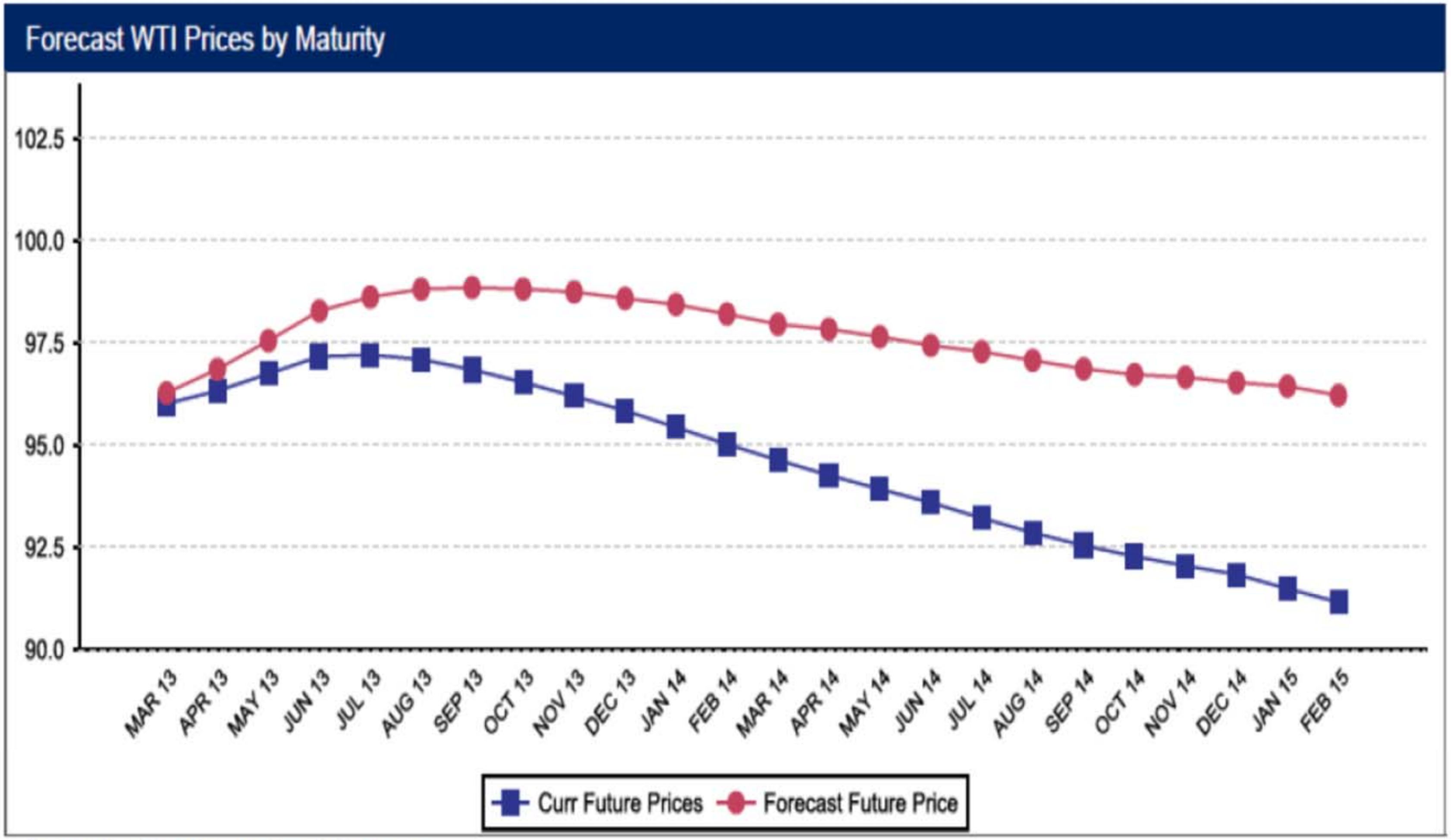
A forward-looking date-t Sharpe Ratio may be obtained using the methodology in Doran, Ronn and Goldberg (2009). The authors obtain a Sharpe Ratio λ_t given by the expression $\lambda_t \equiv 0.46 - 0.162\,\dfrac{\text{S\&P }500_t}{\text{S\&P }500_{t-5,t-6}}$. The reader is referred to the article for details regarding the estimation of the two values 0.46 and $-.162$. The ratio $\text{S\&P }500_t/\text{ S\&P }500_{t-5,t-6}$ is defined as the current value of the S&P divided by its average value over an annual period centered 5.5 yrs. ago.

We can now compute the one-year $[t,\ t+1]$ expected rate of return on the futures contract to its date-$t+1$ maturity. Recalling the terminal value of the WTI futures contract is by definition the spot price of crude, we compute the expected rate of change on the futures contract from date t to its spot price at $t+1$:

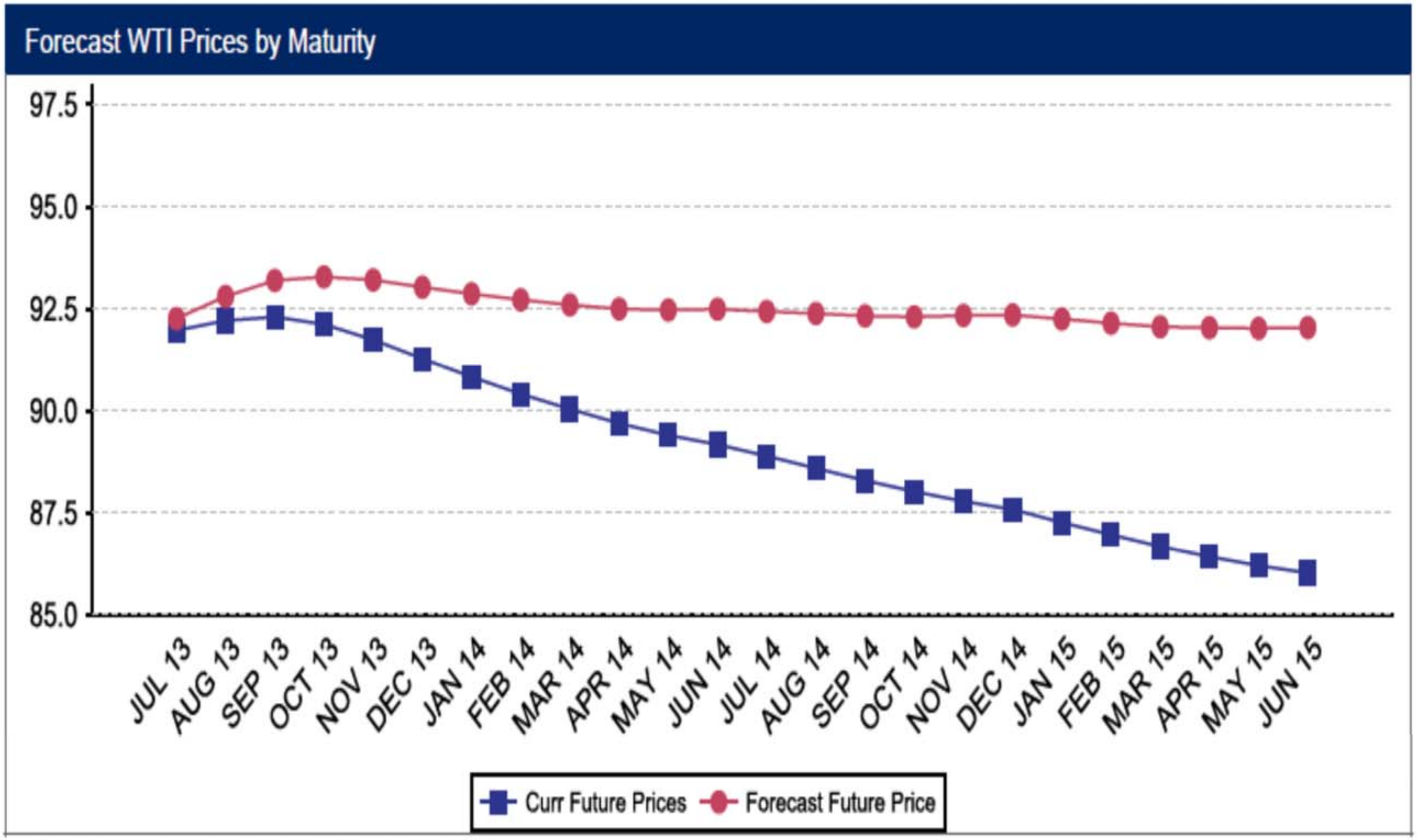
$$
\begin{aligned}
E\left(F_{\text{CL},T}\right) &\equiv F_{\text{CL},t}\exp\left\{\mu_{\text{CL},T}T\right\} \\
&= F_{\text{CL},t}\exp\left\{\frac{\rho_{\text{CL},t}\sigma_{\text{CL},t}}{\sigma_{Mt}}\left(\mu_{Mt}-r_t\right)T\right\} \\
&\equiv F_{\text{CL},t}\exp\left\{\rho_{\text{CL},t}\sigma_{\text{CL},t}\lambda_t T\right\} \\
\Longrightarrow\ \frac{1}{T}\ln\left[\frac{E\left(F_{\text{CL},T}\right)}{F_{\text{CL},t}}\right] &= \rho_{\text{CL},t}\sigma_{\text{CL},t}\lambda_t \\
\begin{array}{c}\text{Annualized Expected}\\ \text{Futures Price Change}\end{array} &\equiv \text{Corr}\left(R_{\text{CL}},\ R_M\right)\begin{pmatrix}\text{Current Futures}\\ \text{Implied Vol}\end{pmatrix}\begin{pmatrix}\text{Current Stock Market}\\ \text{Sharpe Ratio}\end{pmatrix}
\end{aligned}
\tag{20}
$$

For a one-year-ahead expected price, $T = t+1-t = 1$. In (20), the RHS contains three elements, all of which lend themselves to forward-looking measures. $\sigma_{\text{CL},t}$ is observable through the market price of its corresponding option, and as noted the literature provides alternative estimates of the prospective Sharpe Ratio λ_t. The third is $\mathrm{Corr}\left(R_{\mathrm{CL}}, R_M\right)$, the implied correlation between crude-oil futures and the S&P 500.

Using a 60-day moving-window historical correlation of crude-oil futures with the S&P in the conditional-CAPM approach described above, Figs. 6 and 7 depict the entire term structure of expected spot prices at two distinct points in time. The result of substantial interest here is this: Even though both term structures of futures prices are in *backwardation*, the term structure of expected spot prices is virtually flat.



Source: Bloomberg, Guzman Financial Engineers



Source: Bloomberg, Guzman Financial Engineers

6 Conclusions

The paper has documented the potential for using options on equities, commodities and a market index to infer forward-looking statistics of relevance to portfolio managers and analysts in capital budgeting:

1. Applying a single-factor model to equity, commodity and index options, we were able to use historical data parsimoniously to obtain reasonable and intuitively-appealing forward-looking equity betas.

2. Using a two-factor extension to include the return on a crude-oil futures contract, we computed a forward-looking correlation between oil and the S&P, and proceeded to obtain an expected futures price of oil using the CAPM. The empirical results were intuitively appealing in reflecting current conditions in the oil and equity markets.

3. We applied these statistical concepts to inferring a conditional-CAPM forecast of crude-oil spot prices.

The work here admits of extensions in several interesting directions. With respect to the equity analysis considered in Section 2,

1. Add additional stocks, so as to permit credible and accurate measurement of the slope and intercept coefficients

2. Confirm whether, on average, and especially during times of crises, the implied systematic variance ratio $(\beta_{im}\sigma_m/\Sigma_i)^2$ exceeds its historical counterpart $\left(\widehat{\beta}_{im}\widehat{\sigma}_m/\widehat{\Sigma}_i\right)^2$

With respect to the oil futures contracts considered in Section 3, the key extension deferred to next paper is whether the oil-price predictor here outperforms two alternative predictors of crude-oil spot prices are:

1. Practitioner's use of the crude-oil *spot price* as a predictor of future spot prices

2. The futures price as an unbiased predictor of future spot prices

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Substitution and Complementary Effects on Margin Trading of Underlying Stocks after the Introduction of Taiwan Single Stock Futures

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Abstract

This paper investigates how the introduction of single stock futures impacts on the margin trading of the underlying stocks. This study selects twenty stocks, which are listed on the Taiwan Stock Exchange and had top twenty transaction volume futures contracts in the derivatives market during our sample period, to examine the substitution and complementary effects on credit transactions of the underlying stock during the sample period from 13 May 2009 to 4 September 2013. We also employ different company characteristics variables, which are market capitalization, PE ratio, price to book ratio and stock turnover ratio of the underlying companies, to evaluate if there are any significant substitution and complementary effects on margin trading under the firm characteristics. The empirical results indicate that the complementary effect and the substitution effect exist at the same time and various firm characteristics do lead to different degree of substitution or complementary effects on margin trading after SSFs list.

Keywords: *single stock futures, margin trading, substitution effect, complementary effect.*

1. Introduction

Single Stock Futures (SSFs) are futures contracts on individual shares (stocks) between two parties to buy or sell the underlying shares of a particular listed company at a pre-determined price on a pre-determined date. SSFs were first introduced in Australia, Hungary, Holland, Sweden and Hong Kong in the mid-1990s. Taiwan's financial regulator allowed futures trading in individual stocks listed on the Taiwan stock exchange in 2010. While most studies on SSFs have examined the impact on the underlying share prices and volatility, there has been little work on their potential impact on margin trading in the spot market. The main contribution of futures market stems from a reduction in costs that permit transactions and price discovery to occur more efficiently. In this paper we will analyze how the introduction of SSFs impacts on the margin trading. Although both the SSFs and margin trading have the same underlying shares, but they belong to different markets. Stock futures may stimulate margin trading by improving stock price discovery and increase the efficiency of the spot market. Thus, introduction of SSFs is expected to lead to a complement or substitute for margin trading.

Many researchers are interested in the link between the derivatives and their underlying assets. Miller (1977) points out that derivative (more specifically put options) might remove short-sale constraints. Chau, F. et al. (2008) indicate that the introduction of cheaply traded derivatives may allow for leveraged positions that destabilize speculation. Danielsen et al. (2009) find that short selling in the underlying securities declines, after futures are introduced. In the spot market, informed traders transfer to the futures market for less information asymmetry and less transaction costs, indicating the presence of substitution effect on credit transaction. Many empirical studies examine the influence of futures trading on the volatility of underlying spot market. Previous investigations from Weller and Yano (1987) and Detemple and Jorion (1990) support the conclusion that the introduction of derivatives can reduce volatility of the underlying stocks. Lee and Tong (1998) state that stock market trading volume increase but the volatility of the underlying stocks does not increase after the introduction of stock futures. Dennis and Sim (1999) examine a small number of shares to find the relationship between futures trading and spot market volatility. McKenzie et al. (2001) find a general reduction in systematic risk on individual stocks after the introduction of individual share futures. Lien and Yang (2003) find that the availability of the futures contracts attenuate the expiration effects on price volatility and trading volume of individual stocks in Australia. The introduction of stock futures in the American market was also the focus of a study done by Ang and Cheng (2005b). Xie and Huang (2014) investigate the impact of index futures trading on the volatility of the spot market in China and find the launch of index futures does not decrease the volatility of the spot market.

Several articles have examined the effect of the futures trading on the quality and efficiency of the spot market. Ang and Cheng (2005a) find SSFs trading increases market efficiency. Shastri et al. (2008) indicate that in the United States option listings improve the market quality of the underlying stocks.

Hopefully our work can contribute to the literature in the following ways. First, there have been few studies examining substitution and complementary effects of SSFs on margin trading. Second, margin-purchase and margin-sale are separately investigated. Third, the complementary effect and the substitution effect might exist at the same time. Fourth, various firm characteristics do lead to different degree of substitution or complementary effects on margin trading after SSFs list.

2. Theory and Hypotheses

2.1 Substitution effect of stock futures on margin trading

Although SSFs and margin trading have the same underlying asset, but belong to different market. Low-cost SSFs contracts and their relative less access restriction may cause informed investors to shift their activities away from the underlying share and towards the futures market. Thus, introduction of single-stock futures is expected to lead to a substitute and competing market for margin-purchase and short-sale.

Chau, et al. (2008) study the introduction of the Universal Stock Futures (USF) and find the level of feedback trading is low in both the pre-futures and post-futures periods for USF and control stocks. Danielsen, et al. (2009) examine how the introduction of single-stock futures impacts short-sale market and find that short selling in the underlying securities declines, after futures are introduced. Gygax, et al.(2009) point out that the average proportional spreads decrease significantly after SSFs introduction. The average daily trading volume in the NYSE stock spot market is reduced by 389,000 shares. This pattern means a migration of liquidity trading to the SSFs market. Empirical microstructure also said that the contract easier emptying and lower transaction costs to attract informed traders migrate from the spot market to the futures market. Miller (1977), Phillips (2010) find that options act as an effective substitute to short-sales, significantly contributing to the informational efficiency of the market.

In consideration of low-cost, less access restriction and trading strategies diversity of SSFs, our first hypothesis can be stated as follows:

Hypothesis 1: The SSFs contracts serve as a substitute for margin-purchase and short-sale in the underlying stock market.

2.2 Complementary effect of stock futures on margin trading

Many studies indicate that futures market serve as an important medium for price discovery. Lien and Yang (2003) show that that the availability of the futures contracts reduces the expiration effects on price volatility and trading volume of underlying stocks. Cao, et al. (2005) point out that the options market plays an important role in information revelation, whereas during normal market times, the stock market is the primary place of price discovery. Chau, et al. (2008) investigate the impact of the introduction of Universal Stock Futures on underlying market and find that the level of feedback trading is low in both the pre-futures and post-futures periods for USF and control stocks, with the pre-futures period exhibiting marginally more feedback trading. Shastri et al. (2008) indicate that there are increases in trading volume, trading frequency and transaction size for the underlying stocks after option listings. It means option listings improve the market quality of the underlying stocks. Kumar and Tse (2009) analyze SSFs in the Indian market to understand their contribution in price leadership. They find that trades in the stock market contribute more to price discovery than trades in the SSF market, while quotes in the SSF market are more price innovative than quotes in the stock market. Martins, et al. (2012) study Indian SSFs and conclude that a significant relationship exists between the trading volumes of the underlying stocks and the single stock futures on them. Siddiqi, et al. (2012) indicate that the impact of SSFs on trading volume, the number of trades, and the trading value for most the underlying stocks is positively and significantly. They conclude that liquidity of the underlying stocks has increased with the introduction of the SSF in the Pakistan's market.

Based on the above, SSFs trading can help to improve the quality and efficiency of the spot market, and thus increase the trading volume and liquidity for the underlying securities. These features lead to the following hypothesis

.

Hypothesis 2: The introduction of SSFs will increase the efficiency and trading volume of the underlying stock market.

Hypothesis 3: The SSFs contracts serve as a complement for margin trading.

2.3 Substitution and complementary effects on margin trading under firm characteristics

Previous studies have found that stock returns are associated with various firm characteristics. Fama and French (1992, 1993, 1996) bring together beta, size, leverage, book-to-market and EP in a cross-section study. They find that firm size and book-to-market ratio explain most of the variations in US stock returns. Daniel and Titman (1997) find that it is characteristics rather than factor loadings that determine expected returns. Datar, et al. (1998) liquidity plays a significant role in explaining the cross-sectional variation in stock returns even after controlling for the firm characteristics like firm-size, book-to-market ratio and the firm beta. Jarjir (2005) argues that only the size premium is significant and help explaining returns in cross-sectional regressions. In time-series regressions, the three factors (SMB, HML and leverage), with the market portfolio, do have an affect on stock returns in France.

In studying SSFs that have explanatory power for margin trading, one should consider their underlying firm characteristics that have been found to be significant by researchers. These issues lead to the following hypothesis.

Hypothesis 4: Various firm characteristics lead to different degree of substitution or complementary effects on margin trading after SSFs list.

3. Research Methods

3.1 Data

SSFs were introduced on Taiwan Futures Exchange in Taiwan. 252 SSFs listed on Taiwan Futures Exchange are analyzed. We examine SSFs listing events from 13 May 2009 to 4 September 2013. SSFs and margin trading data are obtained from the Taiwan Economic Journal (TEJ), Taiwan Futures Exchange (TAIFEX), Taiwan Stock Exchange (TWSE) and Market Observation Post System (MOPS). In order to avoid dilution of overall research results, we choose only the top 20 daily transaction volume of SSFs as our research focus.

The research variables we use in this paper are defined as follows:

1. Stock Trading Volume (STVol): spot market trading volume of underlying shares (1000-share lot)
2. Margin Trading Volume (MTVol): MTLV+MTSV (1000-share lot)
3. Non-Margin Trading Volume (NMTVol): STVol – MTVol (1000-share lot)
4. Margin-purchase Volume (MTLV) (1000-share lot)
5. Margin-sale Volume (MTSV) (1000-share lot)
6. Dummy variables (D), 0 for pre-introduction of SSFs and 1 for post-introduction of SSFs

Control variables of relevant transaction data are defined as follows:

1. TWSE shares daily trading volume (Volume)
2. TAIEX daily closing value (Price)
3. TAIEX daily high-low range (HMLP)

Firm Characteristics variables of underlying shares:

1. Market value (MV) (in millions NT$)
2. Price-to-Earnings Ratio (PE)
3. Price-to-Book Ratio (PB)
4. Stock Turnover Ratio (TR)

Table 1 displays the summary statistics of the main variables we use in our regressions. The average value of the underlying stock futures is 266,118.5 million. This means that most of the analyzed companies are large-sized. The average Price-to-Earnings Ratio (39.19) is higher than Price-to-Book Ratio (1.87). It implies a steady growth of underlying companies. The stock turnover ratio averaged 0.67 percent and indicated better liquidity.

Table 1 Summary statistics

Variable	Minimum	Maximum	Mean	Std. Dev	Observations
STVol	341	267289	28756.97	26440.49	7200
MTVol	0	93781	9590.95	10797.61	7200
NMTVol	-237	201327	19166.02	18318.52	7200
MTLV	0	56944	4413.91	5329.03	7200
MTSV	0	15643	440.19	895.91	7200
MV	12916	1683543	266118.5	392316.26	7200
PE	0	2550	39.186	177.90	7200
PB	0.35	14.27	1.8721	1.98	7200
TR	0.0281	12.7046	0.668279	0.91	7200

Note: STVol is spot market trading volume of underlying shares; MTVol is margin trading volume; NMTVol is difference between STVol and MTVol; MTLV is Margin-purchase Volume; MTSV is Margin-sale Volume; MV: outstanding shares (stocks) ×Closing price (in million NT$); PE is Price-to-Earnings Ratio; PB is Price-to-Book Ratio; TR is Stock Turnover Ratio (Volume / Shares × 100 (%)).

3.2 Empirical model

3.2.1 The synergistic effect on underlying spot market and credit transactions

This paper investigates first the impact of the introduction of SSFs on the underlying spot market and margin trading. With 180 pre- and post-initial listing of SSFs transaction data, we use event-study methods to examine the synergistic effect. We mainly study the research paper of Gygax et al. (2009) and Madhavan et al. (2005) and use the following regression models.

$$Y_t(STVol_t, MTVol_t, NMTVol_t, MTLV_t, MTSV_t) = a_0 + a_1 D + a_2 Volume_t + a_3 Price_t + a_4 HMLP_t + \mathcal{E}_t \qquad (1)$$

Where t indicates day t; $\mathrm{STVol_t}$ is stock trading volume; $\mathrm{MTVol_t}$ is margin trading volume; $\mathrm{NMTVol_t}$ is non-margin trading volume; $\mathrm{MTLV_t}$ is margin-purchase volume; $\mathrm{MTSV_t}$ is margin-sale; D is the SSFs introduction timing dummy variable; $\mathrm{Volume_t}$is TWSE shares daily trading volume; $\mathrm{Price_t}$ is TAIEX daily closing value; $\mathrm{HMLP_t}$ is TAIEX daily high-low range.

3.2.2 The substitution and complementary effects on margin trading

We use the following regression models to examine the substitution and complementary effects of SSFs introduction on margin trading. In order to explore the implicit implication of a complementary effect in the substitution effect we add an interaction term of $D \times NMTVol_t$.

$$\mathrm{Y}_t(MTLV_t, MTSV_t) = a_0 + a_1 D + a_2 D \times NMTVol_t + a_3 Volume_t + a_4 Price_t + a_5 \mathrm{HMLP}_t + \mathcal{E}_t \qquad (2)$$

Where t indicates day t; $\mathrm{STVol_t}$ is stock trading volume; $\mathrm{MTVol_t}$ is margin trading volume; $\mathrm{NMTVol_t}$ is non-margin trading volume; $\mathrm{MTLV_t}$ is margin-purchase volume; $\mathrm{MTSV_t}$ is margin-sale; D is the SSFs introduction timing dummy variable; NMTVolt is the difference between stock trading volume and margin trading volume; $\mathrm{Volume_t}$ is TWSE shares daily trading volume; $\mathrm{Price_t}$ is TAIEX daily closing value; $\mathrm{HMLP_t}$ is TAIEX daily high-low range.

3.2.3 Substitution and complementary effects on credit transactions under firm characteristics

It can be the situation to reduce the credit transactions for investors that the higher the risk of the underlying stock, the higher the relative risk of its credit transactions. From the above point of view, we can further investigate whether the firm risk of the underlying stock influences the substitution and complementary effects on credit transactions. From the literature discussed previously, we use the market value (MV), stock turnover ratio (TR), Price-to-Earnings Ratio (PE) and Price-to-Book

Ratio (PB) of the company to be the proxy variables for company risk.

$$Y_t(MTLV_t,MTSV_t) = a_0+a_1D+a_2D\times NMTVol_t+a_3D\times FC_t+a_4D\times NMTVol_t\times FC_t+a_5Volume_t+a_6Price_t+a_7HMLP_t+\varepsilon_t \quad (3)$$

Where t indicates day t; $STVol_t$ is stock trading volume; $MTVol_t$ is margin trading volume; $NMTVol_t$ is non-margin trading volume; $MTLV_t$ is margin-purchase volume; $MTSV_t$ is margin-sale; D is the SSFs introduction timing dummy variable; NMTVolt is the difference between stock trading volume and margin trading volume; FC_t is firm characteristics variables which include MV, PE, PB and TR; $Volume_t$ is TWSE shares daily trading volume; $Price_t$ is TAIEX daily closing value; $HMLP_t$ is TAIEX daily high-low range.

4. Empirical results and analysis

4.1 t test

Table 2 shows the independent t-tests of average trading volume comparisons for the pre-introduction and post-introduction periods. As a result, for all the STVol, MTVol, NMTVol and MTLV of the underlying stocks are significantly lower after the introduction of SSFs. This indicates a possible substitution effect of stock futures on spot market and margin trading

.

Table 2 independent sample t test before and after the two stock futures market

Variable	Pre mean	Post mean	Difference	t value
STVol	30998.45	26515.48	-4482.97	7.22***
MTVol	10837.26	8344.63	-2492.63	9.86***
NMTVol	20161.2	18170.85	-1990.35	4.62***
MTLV	5002.94	3824.87	-1178.07	9.44***
MTSV	444.26	436.11	-8.15	0.39

Note: Paired t tests for 180 days pre/post-introduction of SSFs. STVol is spot market trading volume of underlying shares; MTVol is margin purchases volume and short sales volume; NMTVol is difference between STVol and MTVol; MTLV is Margin Trading-Long Volume; MTSV is Margin Trading-Short Volume, *, ** and *** denote significant at 10%, 5% and 1% respectively.

4.2 Synergistic effect on underlying stock market and margin trading

In Table 3 we examine the first model for synergistic effect on underlying stock market and margin trading. The results indicate clearly all variables STVol, MTVol, NMTVol, MTLV and MTSV increased significantly after the introduction of SSFs when other factors of Volume, Price and HMLP under control. We accept the second hypothesis that introduction of SSFs will increase the efficiency and trading volume of the underlying stock market and margin trading. It is puzzling that the results are contrary to independent t test in table 2. The contradiction holds as long as the relationship between substitution effect and complementary effect are not clarified. The complementary effect and the substitution effect might exist at the same time, but in different degree. A more empirical precise study in the following sections is necessary to explain these phenomena.

Table 3 Synergistic effect on underlying spot market and credit transactions

Variable	STVol	MTVol	NMTVol	MTLV	MTSV
Constant	90979.88 (23.36)***	29274.51 (18.24)***	61705.37 (22.33)***	13480.5 (16.9)***	1419.29 (9.79)***
D	5135.59 (8.34)***	1296.36 (5.11)***	3839.23 (8.79)***	638.66 (5.06)***	76.75 (3.35)***
Volume	0.01 (31.51)***	0.004 (31.82)***	0.006 (25.93)***	0.002 (31.07)***	0.0001 (5.69)***
Price	-13.49 (-27.22)***	-4.71 (-23.05)***	-8.78 (-24.99)***	-2.21 (-21.8)***	-0.17 (-9.32)***
HMLP	-19.65 (-3.04)***	-12.19 (-4.58)***	-7.46 (-1.63)	-6.74 (-5.09)***	0.35 (1.47)
Adj. R^2	0.19	0.17	0.15	0.16	0.02
F stat	411.71	371.99	309.25	343.09	34.42

Note: Paired t tests for 180 days pre/post-introduction of SSFs. STVol is spot market trading volume of underlying shares; MTVol is margin purchases volume and short sales volume; NMTVol is difference between STVol and MTVol; MTLV is Margin Trading-Long Volume; MTSV is Margin Trading-Short Volume; D *is* the SSFs introduction timing dummy variable; Volume is day market trading volume; Price is day market closing price; HMLP is daily high-low range, *, ** and *** denote significant at 10%, 5% and 1% respectively.

4.3 Substitution and complementary effects on margin trading

A significant reduction in the amount of margin trading after the introduction of SSFs means a greater complementary effect. In contrast, a significant increase in the amount of margin trading after the introduction of SSFs means a greater substitution effect. The results in table 3 indicate that introduction of SSFs will increase the efficiency and trading volume of the underlying stock market and margin trading. These results are different with the findings in table 2. The great power relationship between substitution effect and complementary effect is still not clarified. Therefore, in order to clarify the relationship between substitution effect and complementary effect, we add an interaction term of the timing dummy variable (D) with Non-Margin Trading Volume (NMTVol) in the regression model.

As shown in table 4, the significance of dummy variables indicates a substitution effect on margin trading after the introduction of SSFs. The results are consistent with our first substitution hypothesis between margin trading and SSFs. On the other hand, the interaction term (D* NMTVol) in both regressions is significant positive. It indicates the presence of a complementary effect under control of the substitution effect. This evidence is consistent with the third hypothesis that The SSFs contracts serve as a complement for margin trading.

Table 4 substitution effect and complementary effect on trading margin

Variable	MTLV	MTSV
Constant	13466.7	1417.47
	(17.82)***	(10.05)***
D	-2056.48	-278.02
	(-13.51)***	(-9.79)***
D×NMTVol	0.14	0.02
	(28.59)***	(20.17)***
Volume	0.002	0.00003
	(28.34)***	(2.89)***
Price	-2.08	-0.15
	(-21.56)***	(-8.58)***
HMLP	-5.49	0.52
	(-4.38)***	(2.21)***
Adj. R^2	0.25	0.071
F stat	469.06	110.46

Note: MTLV is Margin Trading-Long Volume; MTSV is Margin Trading-Short Volume; D *is* the SSFs introduction timing dummy variable; NMTVol is difference between STVol and MTVol ; Volume is day market trading volume; Price is day market closing price; HMLP is daily high-low range, *, ** and *** denote significant at 10%, 5% and 1% respectively.

4.4 Substitution and complementary effects on margin trading under firm characteristics

Previous studies found that the firm characteristics can capture the variation in stock returns. The substitution effect comes from the incentive provided for investors to shift their activities away from the margin trading and towards SSFs. The speculative incentive depends on the magnitude of investment risk. Cautious investors are likely to be comfortable with investments that have lower risk. Firm characteristics are proxy for risk factors in the stock market. Our research aims to link effect of SSFs to firm characteristics.

In this paper, we evaluate if there are any significant substitution and complementary effects on margin trading under the firm characteristics. Four firm characteristics variables were selected based on previous literature namely company size, price-to-earnings ratio, price-to-book ratio and stock turnover ratio. We add the interaction terms of D*NMTVol, D*FC and D*FC*NMTVol in the regression model. The empirical results are shown in Table 5. Panel A shows substitution and complementary effects on margin trading under consideration of market value. A significantly negative coefficient for dummy variable by MTLV and MTSV implies a substitution effect between margin trading and SSFs. The coefficient on the interaction term D*NMTVoL is positive by MTLV and MTSV, telling us the presence of a complementary effect on margin trading. The coefficient on the interaction term D*MV is negative by MTLV, indicating that a substitution effect on margin-purchase exists for the underlying firms with higher market value. A possible reason is that a larger firm is likely to be perceived as a lower risk. This leads to more leveraged transactions like SSFs. There is no significant effect on margin-sale. The last interaction term D*FC*NMTVol is negative by margin-purchase and margin-sale. It indicates a negative relationship between firm size and complementary effect. The possible reason for this result is because stocks of large-sized firms originally tend to be more liquid than small-sized firms. The complementary effect on margin trading increases less for large-sized firms than for small-sized firms.

Panel B shows substitution and complementary effects on margin trading under consideration of price-to-earnings ratio. A significantly negative coefficient for dummy variable by MTLV and MTSV implies a substitution effect between margin trading and SSFs. The coefficient on the interaction term D*NMTVoL is positive by MTLV and MTSV, telling us the presence of a complementary effect on margin trading. The coefficient on the interaction term D*PE is positive by MTLV and MTSV, indicating that a less substitution effect on both margin-purchase and margin-sale exists for the underlying firms with higher price-to-earnings ratio. A possible reason is that investing in a company with high PE ratio is risky. This leads to less leveraged transactions like SSFs. The last interaction term D*FC*NMTVol is positive by margin-purchase and margin-sale. It indicates a positive relationship between PE and complementary effect. The possible reason for this result is because stocks with higher PE tend to be less liquid than small-sized firms. This leads to better price discovery. The complementary effects on margin trading increase more for high PE firms than for lower PE firms.

Panel C shows substitution and complementary effects on margin trading under consideration of price-to-book ratio. A significantly negative coefficient for dummy variable by MTLV and MTSV implies a substitution effect between margin trading and SSFs. The coefficient on the interaction term D*NMTVoL is positive by MTLV and MTSV, telling us the presence of a complementary effect on margin trading. The coefficient on the interaction term D*PE is positive by MTLV and MTSV, indicating that a less substitution effect on both margin-purchase and margin-sale exists for the underlying firms with higher price-to-book ratio. A possible reason is that investing in a company with a high PB ratio is risky. This leads to less leveraged transactions like SSFs. The last interaction term D*FC*NMTVol is negative by margin-purchase and positive by margin-sale. It indicates a negative relationship between PB and complementary effect by margin-purchase. The possible reason for this result is because stocks with higher PB can be overpriced. This leads to less margin-purchase transactions. The complementary effect on margin-purchase increases less for high PB firms than for lower PB firms. On the other hand, higher PB leads to more margin-sale transactions. The complementary effect on margin-sale increases more for high PB firms than for low PB firms.

Panel D shows substitution and complementary effects on margin trading under consideration of stock turnover ratio. A significantly negative coefficient for dummy variable by MTLV and MTSV implies a substitution effect between margin trading and SSFs. The coefficient on the interaction term D*NMTVoL is positive by MTLV and MTSV, telling us the presence of a complementary effect on margin trading. The coefficient on the interaction term D*TR is positive by MTLV and MTSV, indicating that a less substitution effect on both margin-purchase and margin-sale exists for the underlying firms with higher stock turnover ratio. A possible reason is that investing in a company with high TR is risky. This leads to less leveraged transactions like SSFs. The last interaction term D*FC*NMTVol is negative by margin-sale. It indicates a negative relationship between TR and complementary effect by margin-sale. The possible reason for this result is because higher TR is associated with information asymmetry. This leads to less margin-sale transactions. The complementary effect on margin-sale increases less for high TR firms than for lower TR firms.

In summary, the above empirical results are generally consistent with our fourth hypothesis. Various firm characteristics do lead to different degree of substitution or complementary effects on margin trading after SSFs list. We find also that a less substitution effect on margin trading is associated with higher risk of the underlying firms. In contrast, a more complementary effect on margin trading is associated with higher risk of the underlying firms.

Table 5 substitution and complementary effects on margin trading under firm characteristics

	Panel A：FC=MV		Panel B：FC=PE	
Variable	MTLV	MTSV	MTLV	MTSV
Constant	13727.37	1454.25	14591.26	1710.01
	(19.01)***	(10.46)***	(19.43)***	(12.33)***
D	-2595.84	-362	-2159.38	-314.83
	(-15.76)***	(-11.42)***	(-14.15)***	(-11.17)***
D×NMTVol	0.22	0.03	0.13	0.02
	(37.24)***	(24.36)***	(26.21)***	(18.09)***
D×FC	-0.001	0.00006	1.25	0.62
	(-1.65)*	(0.84)	(1.79)*	(4.78)***
D×NMTVol×FC	-0.0000001	-0.00000002	0.0001	0.00002

	(-13.52)***	(-9.14)***	(4.62)***	(3.79)***
Volume	0.002	0.00002	0.002	0.00002
	(28.19)***	(2.07)***	(27.78)***	(1.71)*
Price	-2.06	-0.15	-2.2	-0.19
	(-22.45)***	(-8.69)**	(-23.02)***	(-10.53)***
HMLP	-5.14	0.57	-5.07	0.63
	(-4.29)***	(2.47)**	(-4.09)***	(2.76)***
Adj. R^2	0.31	0.10	0.27	0.11
F stat	466.8	113.35	372.93	133.44

	Panel C：FC=PB		Panel D：FC=TR	
Variable	MTLV	MTSV	MTLV	MTSV
Constant	13292.12	1499.13	15350.75	1960.29
	(17.69)***	(10.56)***	(21.84)***	(16.8)***
D	-2729.43	-330.01	-2919.22	-560.66
	(-14.48)***	(-9.27)***	(-17.73)***	(-20.51)***
D×NMTVol	0.24	0.02	0.09	0.006
	(27.21)***	(9.46)***	(16.04)***	(6.64)***
D×FC	326.12	29.2	2427.09	749.04
	(5.44)***	(2.58)***	(15.67)***	(29.13)***
D×NMTVol×FC	-0.06	0.002	0.003	-0.001
	(-13.78)***	(2.11)**	(0.81)	(-1.69)*
Volume	0.002	0.00003	0.002	-0.00001
	(28.79)***	(2.93)***	(27.91)***	(-0.98)
Price	-2.05	-0.16	-2.25	-0.2
	(-21.42)***	(-9.1)***	(-25.19)***	(-13.75)***
HMLP	-5.84	0.47	-4.4	0.82
	(-4.71)***	(2)**	(-3.79)***	(4.25)***
Adj. R^2	0.27	0.07	0.35	0.37
F stat	373.42	83.15	561.32	602.29

Note: FC is Firm Characteristics; MV is Market value; PE is Price-to-Earnings ratio; PB is Price-to-Book ratio; TR is stock turnover ratio; MTLV is Margin Trading-Long Volume; MTSV is Margin Trading-Short Volume; D *is* the SSFs introduction timing dummy variable; NMTVol is difference between STVol and MTVol ; Volume is day market trading volume; Price is day market closing price; HMLP is daily high-low range, *, ** and *** denote significant at 10%, 5% and 1% respectively.

5. Conclusions

To meet the demand of various futures trading strategies and to provide market participants with a convenient way to transact efficiently in the regular market, TAIFEX introduced SSFs in 2010. SSFs have two main advantages compared to margin trading. First, the SSFs premium and commissions are cheaper. Investors can get leverages that are much higher and potentially make much higher profits than margin trading. Second, SSFs provide for numerous trading strategies and can be applied to a variety of portfolio management needs. Even though, margin trading also has advantages over SSFs in lower risk and higher transaction volume. SSFs can be used to replace or compliment margin trading. In this paper we analyze how the introduction of SSFs impacts on the margin trading.

This article has the following several empirical findings: first, the results of independent t-tests indicate that all the STVol, MTVol, NMTVol and MTLV of the underlying stocks are significantly lower after the introduction of SSFs. This indicates a possible substitution effect of stock futures on spot market and margin trading. The results are contrary to the synergistic effect examination of our first model. The contradiction holds as long as the relationship between substitution effect and complementary effect are not clarified. The complementary effect and the substitution effect might exist at the same time, but in different degree. Second, in order to clarify the relationship between substitution effect and complementary effect, we have examined model 2 and found that a complementary effect exists under control of the substitution effect. Third, various firm characteristics do lead to different degree of substitution or complementary effects on margin trading after SSFs list. We find also that a less substitution effect on margin trading is associated with higher risk of the underlying firms. In contrast, a more complementary effect on margin trading is associated with higher risk of the underlying firms.

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Liquidity Risk Premium: A comparative analysis

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During the last decades the investigation of liquidity has attracted the interest of many researchers and practitioners. Liquidity plays a pivotal role in the determination of the risk-return trade-off of securities, comprising several aspects of trading such as transaction cost, trading activity and price impact, leading more often than usual to an ambiguous risk-return foundation, on an asset pricing framework.
This paper empirically investigates the most important liquidity components and aims to conduct a comparative analysis on the liquidity risk premia of securities. Moreover, a causality analysis is implemented that focuses on the interrelationship between the liquidity components and the market dynamics.
According to the empirical findings of the paper the significance of liquidity is model and time specific. Most importantly, the heterogeneity between liquidity components exhibits a strong business cycle effect
Keywords: liquidity risk premium, transaction cost, trading activity, price impact.

JEL Classifications: G11, G12, G14

1. Introduction

The easiness to buy and sell stocks bears no clear cut role on expected stock returns. Theoretical and empirical models adhere to two separate schools, one set out by Amihud and Mendelson (1986) advocating that increased illiquidity commands higher returns and another by Constantinides (1986) claiming that transaction costs do not affect asset pricing. This paper aims to contribute to this discussion by investigating the pricing of stock liquidity's effect. Six established liquidity proxies spanning three categories of liquidity dimensions, namely - transaction costs, trading activity, and price impact are employed.

According to the first component of liquidity, stock return is an increasing and concave function of transaction cost and thus investors require higher returns for holding illiquid assets. Likewise, according to the trading activity component, investors' holding period is positively associated with transaction cost and consequently affects liquidity. Finally, the price impact accounts for the price response to order flow.

A higher tendency for transactions is commonly observed when the liquidity is higher. Based on the assumption that the liquidity states determine the trading timing for investors, Pereira and Zhang (2010) investigated the strategies of maximizing the investors' utility in an equilibrium model. Investors prefer trading on more liquid days; otherwise, higher return is required as compensation for illiquidity, as a result of lower asset prices in the state of low liquidity, which is less favourable for investor. This argument is addressed by Chordia, Roll, and Subrahmanyam (2001) who claim that liquidity effect is self-perpetuating, and in particular, agents tend to abate or even refrain from further trading after noticing a liquidity anomaly, which, in turn intensifies the anomaly by further reducing liquidity in those periods.

Empirical evidence of the relevant literature involves heterogeneity between the liquidity constituents that varies through time. For instance, while Brennan, Chordia, and Subrahmanyam (1998) detect a significant price impact effect on asset prices, Gervais, Kaniel, and Mingelgrin (2001) find that share prices tend to increase (decrease) over the subsequent days due to unanticipated high (low) past volume. They claim that the high trading activity could be the signal of information or attention instead, resulting in high return. Both of the above-mentioned hypotheses are reasonable and in-line with theory, but, none of them would account adequately for the risk-return trade-off. A comprehensive empirical analysis would potentially enlighten the investigation of liquidity effect across its dimensions.

Among the determinants of liquidity special emphasis is given on inventory risk and information (see Brennan and Subrahmanyam (1996)). According to Chordia, Roll and Subrahmanyam (2001) inventory risk affects the incentive to trading and determines the market depth, hence one of the most essential indicators of market liquidity. On the other hand, if informed speculators and liquidity-motivated investors have differential access to private information, then information is not uniformly distributed to all investors. In particular, adjustments on spreads against speculators would potentially diminish trading activity and consequently the liquidity.

Considering the impact of information on transactions, the liquidity provider makes profit from uninformed investor and loses money to informed investor. The uninformed investor is motivated by exogenous demand, while the informed investor is motivated by the private information advantage. The classic adverse selection theory claims that the market maker determines the ask or bid price by observing the market whether the informed trader has arrived. The bid-ask spread increases in the likelihood of an informed trader, in order that the market maker can protect from the loss to the counterpart.

However, the concept of liquidity in financial markets is intrinsically complicated (Amihud, Mendelson, and Pedersen (2005)) and requires the adoption of a comprehensive liquidity metric. Since the liquidity is commonly reflected on the easiness that an asset is traded at low transaction cost with little price impact, the dimensions include trading quantity, trading speed, trading cost and price impact. In this respect, previous measurement considered in literature includes bid-ask spread of Amihud and Mendelson (1986), the turnover ratio of Datar, Naik, and Radcliffe (1998), the dollar trading volume of Brennan, Chordia, and Subrahmanyam (1998), the return to dollar volume ratio of Amihud (2002) and the return to turnover ratio of Florakis, Gregoriou and Kostakis (2011).

We define liquidity as the ability to trade a certain quantity of assets quickly, with minimal price impact and trading cost. A liquid investment is one where the participant can unwind the position easily and quickly, without affecting the asset price. One source of illiquidity is the exogenous transaction cost. Another source is demand pressure and inventory risk (the market maker is exposed to the risk of price change while holding the assets in inventory). Moreover, the private (asymmetric) information also causes the illiquidity. The cost of illiquidity and the exposure to the liquidity risk render the risk-averse investors to require compensation for bearing the cost or risk. Constantinides (1986) defines the liquidity premium as the compensation to investors so that he is indifferent between a perfect liquid asset and an asset with certain liquidity risk.

The objective of this paper is to investigate empirically the liquidity effect on the risk-return trade-off. Our aim is implemented through the investigation of the liquidity premium dynamics on an asset pricing framework. Specifically, our aim is to quantify the liquidity risk premium comparatively with respect to its main dimensions and to investigate further its time dynamics.

Using US data for the period from 1962 to 2011, we conduct a cross-sectional analysis considering the US Business Cycle Expansions and Contractions. We further consider the liquidity measures on a market wide level and analyse their causality with aggregated market characteristics. Our findings suggest that there exist a heterogeneity in terms of the liquidity constituents which is time specific, though during non-tranquil periods illiquidity yields high returns. Moreover, we find bidirectional causal relationships between liquidity and market characteristics according to Gervais, Kaniel, and Mingelgrin (2001).

The paper is organized as follows; section 2 explains the main liquidity measures under investigation while section 3 analyses the data and constructs the liquidity measures. Section 4 presents the research methodology the results of which are presented on section 5. Finally, section 6 concludes the paper.

2. Literature review

The transaction cost component of liquidity refers to the (relative) bid-ask spread. According to this liquidity metric high (relative) bid-ask spread is associated with high illiquidity and long holding period of investments. Consequently, investors would require compensation for securities with high bid-ask spread and this would result in high (expected) returns.

Specifically, Amihud and Mendelson (1986) claim that risk-neutral investors buy assets and sell them later in a premium which represents the trading cost and is absorbed in the transaction prices. Thus, the price discount would be the present value of the transaction costs:

$$E(r^i) = r^f + \mu \frac{C^i}{P^i} \tag{1}$$

where $E(r^i)$ is the expected return of asset i, r^f is the risk-free rate to proxy the perfect liquid asset return, μ is trading intensity (which is related to the reciprocal of holding period) and $\frac{C^i}{P^i}$ is the relative transaction cost. The last term $\mu \frac{C^i}{P^i}$ is per-period percentage transaction cost. Amihud and Mendelson (1986) employ relative spread (dollar bid-ask spread to transaction price) to proxy the relative transaction cost $\frac{C^i}{P^i}$ and found that the expected return is an increasing function of the spread. Glosten and Harris (1988) studied the market microstructure and trading mechanism, where the market maker loses money from informed investors and earn money from uninformed ones. Thus, the higher possibility of trading with informed trader, the higher bid-ask spread should be set by market makers, that is, the liquidity is lower. Specifically, market makers submit the order by observing and learning from the market data to determine whether informed traders are involved in the market. The market marker submits an order to sell at ask price and an order to buy at bid price. However, due to the effect of adverse selection, the bid price is discounted because the selling order constitutes bad news to the uninformed market participants, similarly, a premium is added to the ask price as a result of the good news signal brought by the buy order. The difference between the discounted bid price and the raised ask price is the bid-ask spread. As a result, higher spreads are imposed in order to offset potential losses from informed investors. Moreover, while the bid-ask spread provides a mean for reducing the losses or increasing the profits for the market maker who is dealing with informed and un-informed investors, respectively, in the same time it might advocate to the opposite direction by dampening the trading activity of informed market participants or by eliminating the marginal benefit for market makers. It is obvious then, that the trade-off between these opposite effects that the increments of the bid-ask spreads cause, would consequently lead market makers to formulate optimum choices regarding the premiums and the corresponding discounts that should be imposed in the trading mechanism. Hence, spread is a measure of liquidity, not only to proxy the transaction cost, but also reflect the (the degree of) asymmetric information.

The next important liquidity component is the trading activity. According to this liquidity metric low turnover ratio is associated with long holding periods of investments and high spread. Consequently, investors would require a compensation for securities with low TR and this would result in high (expected) returns. Amihud and Mendelson (1986) argued that less liquid assets are allocated to investors with longer investment horizons. In addition, Atkins and Dyl (1994) found a positive relationship between the average holding horizon and the spread. Since turnover ratio is the reciprocal of average holding period and is related to how quickly a dealer expects to turn around her position, the turnover ratio (trading volume divided by share of outstanding) is also used as one of the liquidity measures. Datar, Naik and Radcliff (1998), Rouwenhorst (1999) and Nguyen, Mishra, Prakash and Ghosh (2007) used turnover ratio to measure liquidity, motivated by the fact that low turnover ratio implies long holding horizon and large spread, thus, lower turnover ratio indicates lower liquidity. Datar, Naik and Radcliff (1998), used data from US stock exchanges and investigated the cross sectional effects of turnover ratio controlling for several firm characteristics and they found that turnover ratio is negatively related to expected asset returns. Similarly, Nguyen et.al (2007) concluded on a negative relationship between turnover ratio and expected returns. However, the findings of Rouwenhorst (1999) are different; using a sample of 20 emerging stock exchanges it was found that the turnover effect is insignificant while its values differ among different clusters of firms with respect to the beta coefficient. Moreover, there are some extended studies on the interaction between turnover ratio and returns' momentum. Conrad, Allaudeen, and Cathy (1994) argued that high-turnover-ratio stocks experience short-term return reversal in the following week, while low-turnover ratio stocks experience return continuations. Lee and Swaminathan (1998) found that the price momentum effect is stronger in high-turnover-ratio stocks than in low-turnover-ratio stocks in intermediate terms. Brown, Crocker, and Foerster (2009) concluded in a positive relationship between the turnover ratio and return for high capitalized stocks (liquid) only. They argued that this finding depends on market conditions (bull or bear) and potentially on the momentum effect. All these exemplified findings are not consistent with the principles of liquidity unless the turnover ratio is positively associated with illiquidity. The latter is implied by Stoll (1978), who applied the turnover ratio metric to proxy the adverse information effect. The intuition is that the private information would lead higher level of trading relative to the outstanding shares. Thus, higher level of turnover ratio indicates the adverse information, which results in the higher spread and higher illiquidity.

Another liquidity measure that accounts for the trading activity is the dollar trading volume which is defined as the product of the total number of shares traded by the average price per share. It was firstly studied by Stoll (1978) and it is supposed to be the most important determinant of the bid-ask spread. The bid-ask spread serves as the proxy of transaction cost, of which three components are inventory cost, order processing cost and adverse selection cost. Stoll (1978) considered the inventory cost or holding cost of stocks as a function of holding period, in turn, the holding period is function of trading volume since it is easy for traders to reverse the position if the asset is being heavily traded. Thus, the spread is negatively related to dollar volume. Moreover, Glosten and Harris (1988) provide the evidence that the adverse selection cost is the significant component of bid-ask spread, as well as trading size (order flow) is inversely related to spread. Furthermore, Brennan and Subrahmanyam (1995) estimate the transitory and permanent components of transaction cost as the illiquidity measures and they claim that the trading volume is a primary determinant of the adverse selection cost of transaction. Dollar volume measures the speed of transaction to unwind the position. In particular, low dollar volume in specific transaction indicates illiquidity, since the position could be difficult to get out of and the trading opportunities are fewer than high dollar volume case; likewise, the high dollar volume implies high liquidity. Higher volume typically results in narrower spreads, less slippage (slippage is the difference between the last trade price and the price realized by the next order), and less volatility, according to Chordia, Roll and Subrahmanyam (2000), who document a strong cross-sectional relationship between dollar volume and various measures of the bid-ask spread and market depth. Numerous researchers work on the dollar volume, served as the proxy of liquidity. Brennan, Chordia, and Subrahmanyam (1998) examine a multi-factor asset pricing model where one of the stock characteristics is liquidity level, measured by dollar volume. In their study, the dependent variable is the excess return (1966-1995) of individual stocks, while the right-hand variables are the stock characteristics, including size, B/M, price, and dollar volume. They find the dollar volume and stock expected return has negative relationship. Chordia, Subrahmanyam and Anshuman (2001) document the significant and negative relationship between the return and the dollar volume, as well as the negative relation between return and second moment of dollar volume (the unconditional realized and the conditional GARCH type volatility the standard deviation of past 36 month dollar volume or conditional volatility calculated by GARCH). The response variables in the empirical tests are stock excess returns and FF risk-adjusted returns, respectively, and produce similar estimation of coefficients. The abovementioned negative relation between returns and dollar volume is considered in a cross-sectional dimension. However, in the time-series dimension, Gervais, Kaniel, and Mingelgrin (2001) find a short-term (1, 10, 20 days) positive relation between stock return and dollar volume exploiting further the short and long term dynamics of liquidity. They claim that higher trading activity attracts more investors causing higher prices due to greater demand in the subsequent days.

The third component of liquidity is the price impact that is “trading without changing the price”. The first proposed measure is the Aminvest ratio which is defined as the ratio of the dollar volume over the absolute return. This ratio is a measure of how much dollar volume is required to move a stock's price up or down by one percentage point. A high ratio means that large amounts of stock can be traded with little effect on prices, thus, the stock is very liquid. Kyle (1985) investigated the price change per unit of the net order flow in stock market and found that he impact increases with the asymmetry information and decreases with uninformed order flow. Amihud (2002) proposed the ratio of absolute return to the dollar volume as an alternative expression of the price impact. In particular, this measure indicates the average daily price change to $1 trading volume for individual stocks, where the extremely liquid stocks should be able to absorb more trading volume without corresponding price movements; likewise, substantial response of price to each transaction implies this stock is less liquid. Thus, this measure proxies the illiquidity of a stock. Florakis, Gregoriou, and Kostakis (2011) argued that the Amihud measure has strong size-bias because of the fact that the higher volume traded in bigger stocks and forcing conclude that the bigger stocks are more illiquid. Moreover, this measure ignores the importance of trading frequency, which is also involved in the determination of the required liquidity premium and potentially dominates the transaction cost dimension. Hence, Florakis et.al (2011) proposed to use the ratio of absolute return to turnover ratio, with regard that the turnover ratio has no bias of size effect.

3. Data and Liquidity measures

The data are collected from CRSP and COMPUSTAT tape. The firms are common securities listed in NYSE-AMEX, providing market data for closing price, closing bid and ask, trading volume, outstanding shares and daily close-to-close returns. In addition accounting data for historical (realized) book value, earnings per share and dividend yield are obtained. The closing bid/ask prices are only available after 1990 in the CRSP data file. The dataset of other variables ranges from Jan., 1962 to Dec., 2011. The risk free rate is proxied by the one-month US T-bill rate. Historical prices for the US Fama-French factors are downloaded from the website French's library .

The data are filtered excluding:

- shares that are traded at Nasdaq
- shares that are not available in either CRSP or COMPUSTAT tape
- the first and last trading month for each firm
- shares that have fewer than two years prices or fewer than 15 trading days in one month
- shares with extreme ask/bid prices (less than $5 or larger than $1000, or the closing bid prices are higher than ask prices)
- shares with negative BM values and those which are in the financial services sector
- shares with extreme dollar market capitalisation, B/M, DY, and EP (less than 0.5% or lager than 99.5% percentile)

Overall, the number of firms in each month varies from 745 to 3154 with an average of 2050. The daily data from CRSP are transformed into monthly security characteristics by averaging or summing, in order to obtain monthly closing bid/ask prices and returns, trading volume, share of outstanding and market capitalization.

Moreover, we define three variables related with the short and long term momentum effects, RET23, RET46, RET712, as the cumulative asset return from the last three to last two months, from last six to four months, from last twelve to seven months, respectively. In addition, fundamental data are drawn from COMPUSTAT on an annual basis and then transformed into monthly. The dividend yield (DY) is measured by the sum of all dividends paid over the previous months, divided by the share price at the end of the second to last month (Price-end). Similarly, we calculate the book-to-market value (B/M) and the earnings-price ratio (EP). The monthly data statistics description corresponds to the pooled time-series averages of the cross-sections as presented in Table 1 of the appendix.

Table 1. Descriptive Statistics of cross section variables

Table 1 **Statistics description of cross section variables**

This table domenstrates the statistics of monthly variables, which are going to be used in the cross-sectional regrssions. The mean, median, standard deviation are obtained by the time-series average of monthly cross-sectional mean, median, standard deviation. The listed variables are observed or calculated from a sample of average 2050 NYSE-AMEX firms from Jan., 1962 to Dec., 2011 recorded in CRSP tape. The control variables are reported in Panel A. RET is the monthly return of assets. CAP is the market capitalizations of firms. PRICE denotes the closing prices at the end of month. B/M is the book-to-market ratio, obtained by the ratio of last year's book value to the market prices at the end of each month. EP is the earning price ratio. DY is the divided yield, which is calculated by the sum of last year's dividend over the prices at the end of each month. Ret 23, Ret46, Ret712 are cumulative returns of over the second through third, forth through sixth, and seventh through twelfith months prior to the present months, respectively. The six variables measure liquidity in Panel B. DVOL denotes sum of daily dollar trading volumes within month for each stock. S is the value of absolute monthly spreads, which are obtained by taking average of the daily absolute spread within each month. RS represents relative spread, namely, the ratio of absolute spread to share closing prices, and the monthly relative spread is the average of daily relative spread. TR is the monthly turnover ratio , calculated by monthly trading volume over number of shares outstanding in each month. R/DVOL denotes the ratio of absolute return to dollar volume, while the monthly R/DVOL is the average daily R/DVOL. R/TR is defined similar to the previous variable, but the absolute return is divided by daily turnover ratio.

Panel A:	Monthly control variables								
	RET	CAP(10^6)	PRICE	B/M	EP	DY	Ret23	Ret46	Ret712
Mean	0.0131	1.4247	27.05	0.7711	0.0801	0.0344	0.0245	0.0365	0.0745
Median	0.0068	0.3331	21.50	0.6039	0.0676	0.0246	0.0181	0.0293	0.0639
Standard deviation	0.0944	3.5107	23.45	0.7790	0.1470	0.0494	0.1297	0.1555	0.2144

Panel B:	monthly liquidity measures					
	DVOL(10^6)	S	RS	TR	R/DVOL(10^-6)	R/TR
Mean	130.05	0.2284	0.0122	68.2268	0.2421	0.0185
Median	25.95	0.1978	0.0101	45.6211	0.1126	0.0136
Std.deviation	251.79	0.1410	0.0078	99.6094	0.3296	0.0165

RET is the monthly return for stocks, CAP stands for the market capitalization, P is the closing prices at the last trading day of each month, B/M is the monthly book-to-market ratio, EP is the earning-price ratio, DY is the dividend yield, Ret23, Ret46, Ret712 are the cumulative monthly returns as defined above.

We construct the monthly liquidity measures based on the daily liquidity measures, removing first the outliers (lower and upper 0.5%) of each daily liquidity measure. In the following formulas i is the asset indicator, t and m stand for the day and month indicators and n is the number of available trading days in each month.

The daily absolute spread is calculated as the difference between bid price and ask price. For a single stock, its monthly spread is calculated by averaging the daily spread over the month:

$$S_{i,m} = \frac{1}{n}\sum_{t=1}^{n}(ask_{i,t} - bid_{i.t}) \quad (2)$$

The daily relative spread is calculated as the ratio of the absolute spread over the price. For a single stock, its monthly spread is calculated by averaging the daily spread over the month:

$$RS_{i,m} = \frac{1}{n}\sum_{t=1}^{n}\frac{ask_{i,t} - bid_{i.t}}{price_{i,t}} \quad (3)$$

The turnover ratio at month m is calculated as the ratio of the number of shares traded in month m over the number of share outstanding:

$$TR_{i,m} = \frac{\sum_{t=1}^{n} trading\_volume_{i,t}}{share\_of\_outs\tan ding_{i,m}} \quad (4)$$

The dollar volume is the sum of the daily dollar volume, over month m:

$$DVOL_{i,m} = \sum_{t=1}^{n} DVOL_{i,t} \quad (5)$$

The return to dollar volume is the ratio of the average absolute return over the dollar volume, over month m:

$$R/DVOL_{i,m} = \frac{1}{n}\sum_{t=1}^{n}\left(\frac{|RET_{i,t}|}{DVOL_{i,t}}\right) \quad (6)$$

The return to turn over ratio over month m is the average daily ratio of absolute return over turnover ratio, over month m, where daily turnover ratio is obtained by the ratio of daily trading volume over the number of shares outstanding:

$$R/TR_{i,m} = \frac{1}{n}\sum_{t=1}^{n}\left(\frac{|RET_{i,t}|}{TR_{i,t}}\right) \quad (7)$$

The monthly liquidity measures descriptive statistics, obtained by the time-series averages of the cross-section data, is displayed in Table 1 Panel B. Furthermore, we also report the time-series average of the monthly cross-sectional contemporaneous correlations coefficient of the above variables (monthly characteristics and liquidity measures) in Table 2.

The past performance indicator is based on the cumulative return of the past information as shown below:

RET23: cumulative market return from (t-66) to (t-44), the prior 3 to 2 months cumulative daily return;

$$RET23_t = \prod_{n=44}^{66}(1 + RET_{t-n}) - 1 \tag{8}$$

RET46: cumulative market return from (t-132) to (t-88), the prior 6 to 4 months cumulative daily return;

$$RET46_t = \prod_{n=88}^{132}(1 + RET_{t-n}) - 1 \tag{9}$$

RET712: cumulative market return from (t-264) to (t-154), the prior 12 to 7 months cumulative daily return;

$$RET712_t = \prod_{n=154}^{264}(1 + RET_{t-n}) - 1 \tag{10}$$

Table 2. Monthly pairwise Correlation between liquidity components and firm characteristics

Table 2 **Monthly Correlation - Pairwise**

This table present time-series of monthly cross-sectional correlations between the firm characteristics using in the pricing model. The listed variables are observed or calculated from a sample of average 2050 NYSE-AMEX firms from Jan., 1962 to Dec., 2011 recorded in CRSP tape. The first six variables measure liquidity. DVOL denotes the logarithm of sum of daily dollar trading volumes within month for each stock. S is the logarithm value of absolute monthly spreads, which are obtained by taking average of the daily absolute spread within each month. RS represents logarithm of relative spread, namely, the ratio of absolute spread to share closing prices, and the monthly relative spread is the average of daily relative spread. TR is the logarithm of monthly turnover ratio , where the monthly turnover ratio is calculated by monthly trading volume over number of shares outstanding in each month. R/DVOL denotes the logarithm of the ratio of absolute return to dollar volume, while the monthly R/DVOL is the average daily R/DVOL. R/TR is defined similar to the previous variable, but the absolute return is divided by daily turnover ratio. RET is the monthly return of assets. CAP is the logarithm of market capitalizations of firms. PRICE denotes the logarithm of closing prices at the end of month. B/M is the logarithm of book-to-market ratio, which is obtained by the ratio of last year's book value to the market prices at the end of each month. DY is the divided yield, which is calculated by the sum of last year's dividend over the prices at the end of each month. Ret 23, Ret46, Ret712 are cumulative returns of over the second through third, forth through sixth, and seventh through twelfith months prior to the present months, respectively. We use * to denote the significance of the coefficients at 1%.

	DVOL	S	RS	TR	R/DVOL	R/TR	RET	CAP	PRICE	B/M	EP	DY	Ret23	Ret46	Ret712
DVOL	1														
S	-0.024	1													
RS	-0.314 *	0.398 *	1												
TR	0.257 *	-0.035	-0.147 *	1											
R/DVOL	-0.180 *	0.131 *	0.449 *	-0.152 *	1										
R/TR	-0.155 *	0.177 *	0.339 *	-0.232 *	0.523 *	1									
RET	0.035	0.013	0.068	0.312 *	0.090	0.089	1								
CAP	0.750 *	-0.007	-0.281 *	-0.019	-0.136 *	-0.059	-0.056	1							
PRICE	0.446 *	0.445 *	-0.329 *	0.052	-0.221 *	-0.077	-0.060	0.400 *	1						
B/M	-0.039	0.245 *	-0.036	0.002	0.028	0.020	-0.019	-0.053	0.222 *	1					
EP	0.030	0.185 *	-0.111 *	-0.002	-0.054	-0.019	-0.046	0.017	0.254 *	0.524 *	1				
DY	-0.046	0.037	-0.026	-0.132 *	-0.040	-0.001	-0.146	0.002	0.090	0.375 *	0.306 *	1			
Ret23	0.010	0.018	0.067	0.240 *	0.038	-0.019	0.214	-0.069	-0.076	-0.025	-0.061	-0.193 *	1		
Ret46	0.006	0.018	0.069	0.248 *	0.044	-0.020	0.233	-0.078	-0.085	-0.032	-0.071	-0.221 *	0.313 *	1	
Ret712	0.005	0.013	0.063	0.274 *	0.050	-0.025	0.251	-0.090	-0.099	-0.034	-0.070	-0.259 *	0.341 *	0.408 *	1

There exist significant correlations between the components of liquidity with an exception on the relationship between spread and trading activity. Within all liquidity components, positive and significant correlations are observed. The trading activity measures are negatively correlated with transaction cost components and positively with price impact constituents. The turnover ratio is positively correlated with monthly cumulative returns, while the share price related measures, such as dollar volume, R/DVOL and relative spread, are correlated with market capitalisation. For the rest of the market-wide variables, prices of shares at the end of month are significantly correlated with market capitalizations, while the three indicators of firm value and firm performance (BM, EP and DY) and past performance are significantly correlated with each other.

We are also interested in the market-wide liquidity measures accompanied with other market-wide variables based on the six liquidity components. Besides the daily return process of the market portfolio other related variables are also used such as the market portfolio volatility and its bullish and bearish components. Moreover, we consider the momentum effect of market portfolio, by recruiting three variables: RET2, 3, RET4, 6 and RET7, 12, which represent the cumulative return from the last three to last two months, from last six to four months and from last twelve to seven months, respectively.

The market-wide variables are computed by aggregating the daily observations of common shares as shown below (i is the securities indicator, N is the number of assets in each trading day t).

The average market-wide spread and relative spread in each trading day are calculated by the following equations:

$$MS_t = \frac{1}{N}\sum_{i=1}^{N}(bid_{i,t} - ask_{i,t}) \tag{11}$$

$$MRS_t = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{bid_{i,t} - ask_{i,t}}{price_{i,t}}\right) \tag{12}$$

The market-wide turnover ratio is the value weighted average of all available shares' TR in each trading day according to the following equation:

$$MTR_t = \sum_{i=1}^{N}\left(\frac{trading\_volume_{i,t}}{number\_of\_shares\_outs\tan ding_{i,t}} * \frac{Cap_{i,t}}{\sum_{i=1}^{N} Cap_{i,t}}\right) \tag{13}$$

The market-wide dollar volume is calculated as the summation of all the available shares' dollar volume in each trading day:

$$MDVOL_t = \sum_{i=1}^{N} DVOL_{i,t} \tag{14}$$

The market-wide return to dollar volume is calculated by the average of all available shares' measure in each trading day:

$$MR/DVOL_t = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{|return|_{i,t}}{Dvol_{i,t}}\right) \tag{15}$$

The market-wide return to turnover ratio is calculated by the average of all available shares' measure in each trading day:

$$MR/TR_t = \frac{1}{N}\sum_{i=1}^{N}(\frac{|return|_{i,t}}{TR_{i,t}}) \tag{16}$$

There are several market-wide variables that are based on the market portfolio, its variance and its bullish and bearish regimes:

The market return is defined as the value weighted daily return according to the following formula:

$$MRET_t = \sum_{i=1}^{N}(RET_{i,t} * \frac{Cap_{i,t}}{\sum_{i=1}^{N} Cap_{i,t}}) \tag{17}$$

The market-wide volatility is defined as the squared market return:

$$VOL_t = MRET_t^2 \tag{18}$$

The bullish/bearish components of the market portfolio are given by the following equations:

$$PRET = \max(0, MRET) \tag{19}$$

$$NRET = \min(0, MRET) \tag{20}$$

Table 3. Descriptive statistics of market-wide cross section characteristics

Table 3	Daily market-wide variable
	This table documents the statistics of market-wide variables on the daily basis.The listed variables are observed or calculated from a sample of average 2050 NYSE-AMEX firms from Jan., 1962 to Dec., 2011 recorded in CRSP tape. Except spread and relative spread are only avaiable after 1990, other variables are available over 1962 to 2011. The market variables are aggregated by all of the avaiable assets in the daily data sample. Panel A demonstrates the market return related vairbales. MRET denotes the market return, which are calculated by the value-weighted daily return of shares. PRET and NRET are decomposed from MRET into the positive and negative strings, namely, positive return process are max (0, MRET), while negative return process are min (0, MRET). VOl is the volatility of market return, calculated by (MRET)^2. Ret23, Ret46, Ret712 are cumulative market returns of over the second through third, forth through sixth, and seventh through twelfth months prior to the present months, respectively. Note, we assume 22 trading days in one month. The variables in Panel B are market-wide liquidity measures process, where MDVOL is market dollar volume, the sum of all available share dollar volume in each trading day. MS is the market spread, calculated by the average of cross-sectional shares spread on daily basis. MRS is the market relative spread, calculated by the average of cross-sectional shares relative spread on daily basis. MTR indicates market turnover ratio, obtained by value-weighted average of assets turnover ratio. MR/DVOL and MR/TR denote the market return to dollar volume and market return to turnover ratio, respectively, and they are derived from daily average of return to dollar volume and return to turnover ratio.

Panel A:	**MRET**	**PRET**	**NRET**	**VOL**	**Ret23**	**Ret46**	**Ret712**
Mean	0.00072	0.00366	-0.00294	0.00010	0.0168	0.0336	0.1359
Median	0.00089	0.00089	-0.00023	0.00002	0.0199	0.0360	0.1369
Std.deviation	0.00986	0.00618	0.00612	0.00044	0.0484	0.0686	0.1436

Panel B:	**MDVOL (10^6)**	**MS**	**MRS**	**MTR**	**MR/DVOL (10^-6)**	**MR/TR**
Mean	16816	0.231	0.012	3.249	0.229	0.018
Median	5185	0.163	0.009	2.318	0.180	0.016
Std.deviation	24090	0.175	0.009	3.200	0.168	0.010

4. Research methodology

We conduct an APT analysis on an asset pricing framework incorporating the liquidity risk premium and a time series causality analysis between the market-wide liquidity measures and several market characteristics.

Moreover, considering the impact of financial conditions on the effect of liquidity on asset returns, we split the whole sample horizon into eight non-overlapping sub-periods according to the most recent announcement of the US Business Cycle Expansions and Contractions from NBER's Business Cycle Dating Committee. The peak month to next peak month is recognized as one Business Cycle. In specific, we have the following sub-periods in our sample: from Jan. 1962 to Dec. 1969, from Jan. 1970 to Nov. 1973, from Dec. 1973 to Jan. 1980, from Feb. 1980 to July 1981, from Aug. 1981 to July 1990, from Aug. 1990 to March 2001, from April 2001 to Dec. 2007, from Jan. 2008 to Dec. 2011.

For the purposes of our analysis we form portfolios on the six liquidity components. In each month m, we rank stocks by liquidity in month m-1 constructing 5 portfolios on the corresponding percentiles, i.e. [0-20], [20-40], [40-60], [60-80] and [80-100]. The monthly equal-weighted portfolio returns are calculated while a long-short trading strategy is formed, according to which a portfolio of undervalued (illiquid) shares is bought and a portfolio of overvalued (liquid) is short-sold. Insights about the statistical significance of the strategy's payoff, is obtained through the t-test:

$$t_{illiquid\text{-}liquid} = \frac{(\overline{r_{illiquid}} - \overline{r_{liquid}})}{\sqrt{\sigma_{illiquid} / T + \sigma_{liquid} / T}} \qquad (21)$$

where $r_{illiquid}$ and r_{liquid} are monthly equal-weighted returns for the illiquid and the liquid portfolios, respectively and T is the number of observations for portfolio returns in the examined period.

Table 4 of the appendix, provides a descriptive analysis of the liquidity portfolios' performance and the long-short trading strategy for the whole period and for the eight sub-periods. Panel A refers to the transaction cost, panel B to the trading activity and finally panel C, to the price impact component.

Please insert Table 4 about here

Furthermore, we adopt Liu's (2006) approach and empirically examine the risk-return trade-off of the trading strategies on liquidity, applying the Fama-MacBeth (1973) cross-sectional model, controlling for several effects on firm fundamentals. The Arbitrage Pricing Theory (APT) specification that we apply in this paper is the following:

$$R_{i,m} - R_{f,m} = c_0 + \sum_{k=1}^{K} \beta_{i,k} f_{k,m} + \sum_{n=1}^{N} c_n Z_{n,i,m} + \varepsilon_{i,m} \qquad (22)$$

where $R_{i,m}$ is the monthly asset return and $R_{f,m}$ is the risk free rate which is proxied by the US one-month T-bill rate. The first term of the model, $\sum_{k=1}^{K} \beta_{i,k} f_{k,m}$, adjusts the return according to the Fama-French factors, i.e. market risk premium, SMB and HML, while the second one, $\sum_{n=1}^{N} c_n Z_{n,i,m} + \varepsilon_{i,m}$, represents the liquidity risk premium and several stylized control variables. Specifically, adjusting the returns according to the Fama-French factors yields to the following re-parameterization of the model:

$$R^{*}{}_{i,m} = c_0 + \sum_{n=1}^{N} c_n Z_{n,i,m} + \omega_{i,m} \quad (23)$$

where $R^{*}{}_{i,m}$ is the risk-adjusted return, i.e. $R^{*}{}_{i,m} = R_{i,m} - R_{f,m} - \sum_{k=1}^{K} \beta_{i,k} f_{k,m}$. The terms of the risk adjusted components, $\beta_{i,k}$, are estimated using a 60 months rolling window[1].

Thus, using two different specifications for the dependent variable (excess return, $R_{i,m} - R_{f,m}$, and risk adjusted return, $R^{*}{}_{i,m}$) we examine empirically the cross sectionality of asset returns and the existence of various liquidity risk premia. The Fama-MacBeth analysis is conducted using two lags in the set of the independent variables (*m-2*). The lag of firm characteristics is adopted in extant literature (e.g. Brennan, Chordia, and Subrahmanyam (1998), Chordia, Subrahmanyam and Anshuman (2001), Pereira and Zhang (2010)) in order to overcome the thin trading effect.

Particularly, the control variables consist of the firm size (CAP), the Book-to-Market ratio (BM), the Dividend Yield (DY), the Earnings-Price ratio (EP), three momentum specifications (RET23, RET46, RET712) and the reciprocal of the monthly prices (1/P). All of these firm characteristics have been used extensively in the literature. Particularly, Lee and Swaminathan's (1998) argued that the turnover liquidity measure may be less than a perfect proxy for liquidity due to its relationship with past performance. Thus, the Jegadeesh and Titman (1993) past performance dynamics are accounted for by the cumulative monthly return, RET23, RET46, RET712. Finally, based on Miller and Scholes (1992), the low priced assets are in financial distress and for that reason we use the share price in our model to control for this effect.

The examination of the multifactor model is implemented through the t-statistic of the Fama-MecBeth (1973) approach:

$$\bar{c}_{i,j} = \frac{1}{M} \sum_{m=1}^{M} \hat{c}_{i,j,m}$$

(24)

$$se(c) = \sigma(c) / \sqrt{M}$$

(25)

$$t_c = \frac{\bar{c}}{se(c)}$$

(26)

[1] For the purposes of the rolling window estimation we require at least 24 in 60 monthly data for each stock. The first rolling estimation is based on 30 monthly observations and is extended to account for 60 observations.

where $\widehat{c}_{i,j,m}$ is the estimated coefficient of the j[th] characteristic of the i[th] asset in month *m*, *σ(c)* is the sample standard deviation of the cross-section regressions estimates and M is the number of observations.

The comparative analysis of the liquidity risk premia is followed by a time series analysis that aims to account for the potential bidirectional relationships between liquidity and market characteristics. We employ a VAR representation of the market-wide liquidity measures and the market characteristics, investigating the potential causality effects between the liquidity components and the market dynamics.

The market-wide liquidity components refer to transaction cost, trading activity and price impact, while the market conditions, refer to the return sign (PRET, NRET), the market volatility (VOL) and the momentum proxies (RET23, RET46, and RET712).

The Dickey-Fuller test would dictate that the return-based variables (MR/DVOL, MR/TR, MRET, VOL, PRET, NRET, RET23, RET46, RET712) are stationary. For the price-based variables (MDVOL, MTR, MS, MRS) we use the first difference: $\Delta x_t = x_t - x_{t-1}$, where x denotes MDVOL, MTR, MS and MRS, respectively. Therefore, we employ these variables in a VAR representation and conduct the Granger Causality test:

$$X_t = \sum_{l=1}^{L} A_i X_{t-l} + u_t \tag{27}$$

where X_t is a matrix consisting of the following thirteen variables, MR/DVOL, MR/TR, MRET, VOL, PRET, NRET, RET23, RET46, RET712, ΔMDVOL, ΔMTR, ΔMS and ΔMRS on a daily basis. In our empirical estimation, we use 20 lags, following the convention of one month (20-22 trading days). The pair of the hypotheses under investigation is:

H_0: one specific variable k does not Granger cause other variables (the 20 coefficients associated with the one specific variable are jointly zero in the VAR estimation equation) and H_1: not H_0

5. Empirical findings

The results of our analysis consist of a descriptive analysis and a model-based one and refer to the three components of liquidity, that is, the transaction cost, the trading activity and the price impact. Consequently, the effect of liquidity on asset returns is investigated via the presence of significant long-short payoffs on liquidity portfolios and through the significance of the liquidity risk premium on an asset pricing framework. The descriptive results of portfolios are presented in Table 4 while the Fama-MacBeth regressions, in Table 5. The Fama-MacBeth analysis with the excess and the abnormal return are similar, and thus for parsimonious reasons, we discuss the results on the excess returns only.

Table 4. Mimicking portfolios on liquidity measures

Table 4 Mean of time-series monthly return of portfolios constructed by liquidity meaures

All the stocks are ranked on the basis of its monthly liquidity measures, in an ascending order. The portfolios are named by their liquidity measures, and the number in the names of portfolios indicates the rank of liquidity measures' quantity. e.g. in the groups of spread (S), P1 indicates the stocks in this portfolio have lowest spread; while in the groups of R/DVOL, the stocks in portfolio of P5 have the highest R/Dvol. The portfolios are monthly rebalanced, on the basis of month (t-1) liquidity measures, and we report the time-series average return of portfolios in month t. The returns of portfolios are calculated by equal-weighted. The data ranges from:1962 to 2011, where the whole sample horizon is divided into 8 sub-periods according to the Business Cylces, Jan 1962 to Dec. 1969, Jan 1970 to Nov 1973, Dec 1973 to Jan 1980, Feb 1980 to July 1981, Aug 1981 to July 1990, Aug 1990 to March 2001, April 2001 to Dec 2007, Jan 2008 to Dec 2011. The last row in each panel reports values for t-tests referring to the null hypothesis of no difference in means between P1 and P5. We use * to denote the significance of the difference at 5%.

Panel A	*liquidity portfolio*	whole horizon	period 1	period 2	period 3	period 4	period 5	period 6	period 7	period 8
	S: P1	0.0692						0.0634	0.0592	0.0972
	S: P2	0.0749						0.0768	0.0636	0.0897
	S: P3	0.0728						0.0746	0.0649	0.0824
	S: P4	0.0715						0.0762	0.0643	0.0740
	S: P5	0.0700						0.0726	0.0652	0.0728
	S P 5-1	0.0008						0.0092 *	0.0060 *	-0.0244 *
	t-stat	0.6080						4.1252	2.8760	-3.5053
	RS: P1	0.0643						0.0648	0.0558	0.0771
	RS: P2	0.0713						0.0683	0.0633	0.0906
	RS: P3	0.0748						0.0723	0.0631	0.0990
	RS: P4	0.0726						0.0765	0.0631	0.0807
	RS: P5	0.0759						0.0826	0.0727	0.0679
	RS: P 5-1	0.0117 *						0.0178 *	0.0169 *	-0.0092
	t-stat	*8.9723*						*7.5938*	*5.8215*	*-1.5363*

Table 4 Mean of time-series monthly return of portfolios constructed by liquidity meaures

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Panel B	*liquidity portfolio*	whole horizon	period 1	period 2	period 3	period 4	period 5	period 6	period 7	period 8
	TR: P 1	0.0586	0.0476	0.0635	0.0671	0.0711	0.0667	0.0599	0.0467	0.0560
	TR: P 2	0.0634	0.0559	0.0733	0.0710	0.0765	0.0694	0.0584	0.0515	0.0715
	TR: P 3	0.0716	0.0659	0.0817	0.0783	0.0827	0.0734	0.0678	0.0606	0.0824
	TR: P 4	0.0812	0.0768	0.0934	0.0874	0.0943	0.0793	0.0788	0.0708	0.0913
	TR: P 5	0.0975	0.0956	0.1075	0.1019	0.1082	0.0877	0.0996	0.0874	0.1138
	TR: P 5-1	0.0389 *	0.0480 *	0.0440 *	0.0348 *	0.0372 *	0.0210 *	0.0396 *	0.0407 *	0.0578 *
	t-stat	25.2141	13.5326	8.6987	5.9824	4.2123	6.2316	15.5095	16.0382	8.0765
	DVOL: P 1	0.0657	0.0574	0.0748	0.0764	0.0766	0.0722	0.0634	0.0545	0.0627
	DVOL: P 2	0.0649	0.0569	0.0731	0.0707	0.0778	0.0693	0.0640	0.0531	0.0705
	DVOL: P 3	0.0665	0.0531	0.0712	0.0717	0.0794	0.0700	0.0661	0.0583	0.0816
	DVOL: P 4	0.0671	0.0529	0.0698	0.0697	0.0766	0.0686	0.0709	0.0618	0.0795
	DVOL: P 5	0.0612	0.0490	0.0551	0.0588	0.0747	0.0615	0.0666	0.0596	0.0769
	DVOL: P 5-1	-0.0045 *	-0.0084 *	-0.0197 *	-0.0176 *	-0.0018	-0.0107 *	0.0032	0.0051 *	0.0142 *
	t-stat	*-3.3516*	*-3.5615*	*-5.1345*	*-3.3686*	*-0.2579*	*-3.4143*	*1.3232*	*2.0742*	*2.4535*

Table 4 **Mean of time-series monthly return of portfolios constructed by liquidity meaures**

All the stocks are ranked on the basis of its monthly liquidity measures, in an ascending order. The portfolios are named by their liquidity measures, and the number in the names of portfolios indicates the rank of liquidity measures' quantity. e.g. in the groups of spread (S), P1 indicates the stocks in this portfolio have lowest spread; while in the groups of R/DVOL, the stocks in portfolio of P5 have the highest R/Dvol. The portfolios are monthly rebalanced, on the basis of month (t-1) liquidity measures, and we report the time-series average return of portfolios in month t. The returns of portfolios are calculated by equal-weighted. The data ranges from:1962 to 2011, where the whole sample horizon is divided into 8 sub-periods according to the Business Cylces, Jan 1962 to Dec. 1969, Jan 1970 to Nov 1973, Dec 1973 to Jan 1980, Feb 1980 to July 1981, Aug 1981 to July 1990, Aug 1990 to March 2001, April 2001 to Dec 2007, Jan 2008 to Dec 2011. The last [illegible]

Panel C

liquidity portfolio	whole horizon	period 1	period 2	period 3	period 4	period 5	period 6	period 7	period 8
R/DVOL: P 1	0.0598	0.0475	0.0537	0.0573	0.0735	0.0604	0.0655	0.0578	0.0750
R/DVOL: P 2	0.0676	0.0536	0.0679	0.0698	0.0791	0.0684	0.0702	0.0639	0.0841
R/DVOL: P 3	0.0708	0.0572	0.0746	0.0741	0.0796	0.0730	0.0727	0.0636	0.0869
R/DVOL: P 4	0.0723	0.0611	0.0795	0.0776	0.0819	0.0747	0.0747	0.0612	0.0824
R/DVOL: P 5	0.0757	0.0645	0.0859	0.0835	0.0829	0.0776	0.0766	0.0682	0.0783
R/DVOL: P 5-1	0.0159 *	0.0170 *	0.0322 *	0.0261 *	0.0094	0.0172 *	0.0111 *	0.0104 *	0.0033
t-stat	11.4378	6.6299	7.0736	4.8806	1.2346	5.2758	4.2856	3.8782	1.5925
R/TR: P 1	0.0775	0.0787	0.0890	0.0846	0.0927	0.0742	0.0725	0.0659	0.0882
R/TR: P 2	0.0759	0.0741	0.0854	0.0822	0.0903	0.0748	0.0715	0.0650	0.0874
R/TR: P 3	0.0740	0.0683	0.0839	0.0803	0.0874	0.0748	0.0714	0.0621	0.0859
R/TR: P 4	0.0724	0.0635	0.0809	0.0789	0.0833	0.0755	0.0724	0.0607	0.0797
R/TR: P 5	0.0731	0.0579	0.0809	0.0803	0.0795	0.0779	0.0775	0.0641	0.0742
R/TR: P 5-1	-0.0045 *	-0.0208 *	-0.0081 *	-0.0042 *	-0.0132 *	0.0037	0.0050 *	-0.0018 *	-0.0140 *
t-stat	*-3.1287*	*-6.6726*	*-1.7126*	*-1.7473*	*-1.7935*	*1.1218*	*2.1935*	*-1.7692*	*-2.3388*

Table 5 **Cross-sctional regression**

This table reports the cross-sectional regressions results. The data use in the cross-section regressions are from a sample of average 2050 NYSE-AMEX common listed firms from Jan., 1962 to Dec., 2011 recorded in CRSP tape. The dependent variables in the row are monthly individual asset excess return. The independent variables (first column) are liquidity measures, CAP, BM, EP, DY, RET23, RET 46, RET712 and 1/P, where CAP is the market capitalizations of firms, BM is the book-to-market ratio, obtained by the ratio of last year's book value to the market prices at the end of each month. EP is the earning-price ratio, calculated by the earnings over the prior year divided by the share prices at the end of each month. DY is the dividend yield, which is calculated by the sum of last year's dividend over the prices at the end of each month. Ret 23, Ret46, Ret712 are cumulative returns of over the second through third, fourth through sixth, and seventh through twelfth months prior to the present months, respectively. 1/P denotes the reciprocal of closing prices at the end of month. Each Panel reports results from one specific liquidity measure: S is the value of absolute monthly spreads, which are obtained by taking average of the daily absolute spread within each month, the results are in Panel A. RS represents relative spread, namely, the ratio of absolute spread to share closing prices, and the monthly relative spread is the average of daily relative spread, the results are in Panel B. DVOL denotes sum of daily dollar trading volumes within month for each stock, the results are in Panel C. TR is the monthly turnover ratio, calculated by monthly trading volume over number of shares outstanding in each month, the results are in Panel D. R/DVOL denotes the ratio of absolute return to dollar volume, while the monthly R/DVOL is the average daily R/DVOL, the results are in Panel E. R/TR is defined similar to the previous variable, but the absolute return is divided by daily turnover ratio, the results are in Panel F. The cross-sectional regression generate monthly coefficients for each independent variable The coefficients reported in the table are obtained by the time-series mean of monthly estimation results. The t-statistics are calculated by the time-series coefficients estimation; the results are displayed on the right hand of the coefficients estimation. All the results are demonstrated in 8 sub-periods (Period 1 to 8) and whole sample horizon (1990-2011 for Panel A and B, 1962-2011 for Panel C,D,E,F). We use * to denote the significance of the coefficients at 5%.

	Period 1		**Period 2**		**Period 3**		**Period 4**		**Period 5**		**Period 6**		**Period 7**		**Period 8**		**whole period**	
Panel A	**Jan 1962 to Dec. 1969,**		**Jan 1970 to Nov 1973**		**Dec 1973 to Jan 1980**		**Feb 1980 to July 1981**		**Aug 1981 to July 1990**		**Aug 1990 to March 2001**		**April 2001 to Dec 2007**		**Jan 2008 to Dec 2011**		**whole period**	
	excess return	**adjusted return**	**excess return**	**adjusted return**	**excess return**	**adjusted return**	**excess return**	**adjusted return**	**excess return**	**adjusted return**	**excess return**	**adjusted return**	**excess return**	**adjusted return**	**excess return**	**adjusted return**	**excess return**	**adjusted return**
S											**0.000 ***	**0.000 ***	**0.002 ***	**0.001 ***	**-0.001**	**-0.008**	**0.000 ***	**0.001 ***
											2.342	1.857	1.909	1.011	-0.648	-0.448	1.940	1.765
CAP											**0.001**	**0.000**	**0.000**	**-0.001**	**-0.001 ***	**-0.001 ***	**0.000**	**0.000**
											1.045	1.055	-0.717	-0.206	-1.616	-1.886	-0.652	-0.536
BM											**0.000**	**0.000**	**0.001 ***	**0.000 ***	**-0.001**	**0.000**	**0.000**	**0.001**
											0.890	0.873	1.601	1.652	-0.858	-0.171	1.343	1.625
EP											**0.001**	**0.001**	**0.008 ***	**0.008 ***	**0.002**	**0.002**	**0.004 ***	**0.001 ***
											0.201	0.195	3.161	2.433	0.754	0.286	2.527	1.882
DY											**-0.003**	**0.010**	**-0.005**	**-0.598**	**0.007**	**0.009**	**-0.002**	**-0.005**
											-0.178	1.841	-0.267	-0.183	0.658	0.648	-0.225	-0.156
RET23											**-0.003**	**-0.009**	**0.009**	**0.006**	**-0.013**	**-0.077**	**-0.001**	**0.000**
											-0.515	0.469	1.187	1.367	-1.002	-1.633	-0.189	-0.714
RET46											**0.014 ***	**0.503 ***	**0.008**	**0.004**	**-0.009**	**-0.003**	**0.007**	**0.003 ***
											3.328	2.816	1.481	1.745	-0.774	-0.237	3.070	2.136
RET712											**0.004**	**0.008**	**0.002**	**0.003**	**-0.006**	**-0.009**	**0.001**	**0.010 ***
											1.363	1.606	0.460	0.874	-0.652	-0.834	0.739	2.277
1/P											**0.003 ***	**0.002 ***	**0.005 ***	**0.008 ***	**0.006 ***	**0.004 ***	**0.004 ***	**0.002 ***
											2.322	2.197	2.824	2.529	1.896	1.921	6.255	4.160

Table 5 **Cross-sctional regression**

This table reports the cross-sectional regressions results. The data use in the cross-section regressions are from a sample of average 2050 NYSE-AMEX common listed firms from Jan., 1962 to Dec., 2011 recorded in CRSP tape. The dependent variables in the row are monthly individual asset excess return. The independent variables (first column) are liquidity measures, CAP, BM, EP, DY, RET23, RET 46, RET712 and 1/P, where CAP is the market capitalizations of firms, BM is the book-to-market ratio, obtained by the ratio of last year's book value to the market prices at the end of each month. EP is the earning-price ratio, calculated by the earnings over the prior year divided by the share prices at the end of each month. DY is the dividend yield, which is calculated by the sum of last year's dividend over the prices at the end of each month. Ret 23, Ret46, Ret712 are cumulative returns of over the second through third, fourth through sixth, and seventh through twelfth months prior to the present months, respectively. 1/P denotes the reciprocal of closing prices at the end of month. Each Panel reports results from one specific liquidity measure: S is the value of absolute monthly spreads, which are obtained by taking average of the daily absolute spread within each month, the results are in Panel A. RS represents relative spread, namely, the ratio of absolute spread to share closing prices, and the monthly relative spread is the average of daily relative spread, the results are in Panel B. DVOL denotes sum of daily dollar trading volumes within month for each stock, the results are in Panel C. TR is the monthly turnover ratio, calculated by monthly trading volume over number of shares outstanding in each month, the results are in Panel D. R/DVOL denotes the ratio of absolute return to dollar volume, while the monthly R/DVOL is the average daily R/DVOL, the results are in Panel E. R/TR is defined similar to the previous variable, but the absolute return is divided by daily turnover ratio, the results are in Panel F. The cross-sectional regression generate monthly coefficients for each independent variable The coefficients reported in the table are obtained by the time-series mean of monthly estimation results. The t-statistics are calculated by the time-series coefficients estimation; the results are displayed on the right hand of the coefficients estimation. All the results are demonstrated in 8 sub-periods (Period 1 to 8) and whole sample horizon (1990-2011 for Panel A and B, 1962-2011 for Panel C,D,E,F). We use * to denote the significance of the coefficients at 5%.

Panel B	Period 1 Jan 1962 to Dec. 1969,		Period 2 Jan 1970 to Nov 1973		Period 3 Dec 1973 to Jan 1980		Period 4 Feb 1980 to July 1981		Period 5 Aug 1981 to July 1990		Period 6 Aug 1990 to March 2001		Period 7 April 2001 to Dec 2007		Period 8 Jan 2008 to Dec 2011		whole period whole period	
	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return
RS											**0.000** *	**0.000** *	**0.001** *	**0.005** *	**0.000**	**-0.001**	**0.000** *	**0.001** *
											1.630	1.783	1.707	1.910	-1.116	-1.038	1.988	1.762
CAP											**0.001**	**0.000**	**0.000**	**0.000**	**-0.002** *	**-0.007** *	**0.000**	**0.000**
											1.061	1.335	-0.709	-0.316	-1.855	-1.839	-0.842	-0.237
BM											**0.000**	**0.000**	**0.001** *	**0.001** *	**-0.001**	**0.000**	**0.000**	**0.000**
											0.818	0.570	1.657	1.803	-0.903	-0.383	1.271	1.470
EP											**0.002**	**0.002**	**0.008** *	**0.002** *	**0.002**	**0.002**	**0.004** *	**0.007** *
											0.397	0.908	3.529	2.212	0.769	0.856	2.893	1.835
DY											**-0.004**	**-0.009**	**-0.004**	**-0.009**	**0.008**	**0.002**	**-0.001**	**-0.004**
											-0.235	-0.700	-0.210	-0.958	0.733	0.897	-0.203	-0.503
RET23											**-0.003**	**-0.003**	**0.009**	**0.007**	**-0.013**	**-0.098** *	**-0.001**	**-0.006**
											-0.492	-0.823	1.179	1.105	-1.025	-1.775	-0.200	-0.174
RET46											**0.015** *	**0.026** *	**0.008**	**0.005**	**-0.009**	**-0.005**	**0.007** *	**0.004** *
											3.338	2.462	1.477	1.690	-0.786	-0.493	3.070	2.317
RET712											**0.004**	**0.005**	**0.001**	**0.002**	**-0.006**	**-0.007**	**0.001**	**0.004**
											1.288	1.426	0.414	0.717	-0.665	-0.686	0.630	0.204
1/P											**0.003** *	**0.009** *	**0.003** *	**0.002** *	**0.007** *	**0.005** *	**0.004** *	**0.009** *
											2.243	2.629	2.238	2.174	2.460	2.661	6.170	4.166

Table 5 **Cross-sctional regression**

This table reports the cross-sectional regressions results. The data use in the cross-section regressions are from a sample of average 2050 NYSE-AMEX common listed firms from Jan., 1962 to Dec., 2011 recorded in CRSP tape. The dependent variables in the row are monthly individual asset excess return. The independent variables (first column) are liquidity measures, CAP, BM, EP, DY, RET23, RET 46, RET712 and 1/P, where CAP is the market capitalizations of firms, BM is the book-to-market ratio, obtained by the ratio of last year's book value to the market prices at the end of each month. EP is the earning-price ratio, calculated by the earnings over the prior year divided by the share prices at the end of each month. DY is the dividend yield, which is calculated by the sum of last year's dividend over the prices at the end of each month. Ret 23, Ret46, Ret712 are cumulative returns of over the second through third, fourth through sixth, and seventh through twelfth months prior to the present months, respectively. 1/P denotes the reciprocal of closing prices at the end of month. Each Panel reports results from one specific liquidity measure: S is the value of absolute monthly spreads, which are obtained by taking average of the daily absolute spread within each month, the results are in Panel A. RS represents relative spread, namely, the ratio of absolute spread to share closing prices, and the monthly relative spread is the average of daily relative spread, the results are in Panel B. DVOL denotes sum of daily dollar trading volumes within month for each stock, the results are in Panel C. TR is the monthly turnover ratio, calculated by monthly trading volume over number of shares outstanding in each month, the results are in Panel D. R/DVOL denotes the ratio of absolute return to dollar volume, while the monthly R/DVOL is the average daily R/DVOL, the results are in Panel E. R/TR is defined similar to the previous variable, but the absolute return is divided by daily turnover ratio, the results are in Panel F. The cross-sectional regression generate monthly coefficients for each independent variable The coefficients reported in the table are obtained by the time-series mean of monthly estimation results. The t-statistics are calculated by the time-series coefficients estimation; the results are displayed on the right hand of the coefficients estimation. All the results are demonstrated in 8 sub-periods (Period 1 to 8) and whole sample horizon (1990-2011 for Panel A and B, 1962-2011 for Panel C,D,E,F). We use * to denote the significance of the coefficients at 5%.

Panel C	Period 1 Jan 1962 to Dec. 1969,		Period 2 Jan 1970 to Nov 1973		Period 3 Dec 1973 to Jan 1980		Period 4 Feb 1980 to July 1981		Period 5 Aug 1981 to July 1990		Period 6 Aug 1990 to March 2001		Period 7 April 2001 to Dec 2007		Period 8 Jan 2008 to Dec 2011		whole period whole period	
	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return
DVOL	**0.001**	**0.000**	**-0.005** *	**-0.002** *	**-0.001**	**-0.009**	**-0.002**	**-0.009**	**-0.002** *	**-0.001** *	**0.000**	**0.000**	**-0.001**	**-0.001**	**0.000**	**0.000**	**-0.001** *	**-0.001** *
	0.439	0.504	-2.891	-1.878	-0.895	-0.170	-0.757	-0.717	-2.373	-2.569	0.360	0.368	-0.631	-0.267	-0.252	-0.252	-2.166	-2.438
CAP	**-0.002**	**-0.004**	**0.005** *	**0.003** *	**0.000**	**0.000**	**0.000**	**0.000**	**0.001**	**0.004**	**0.000**	**0.000**	**0.000**	**-0.002**	**-0.001**	**0.000**	**0.000**	**0.001**
	-1.334	-1.363	2.174	1.776	-0.209	-0.246	0.091	0.019	1.304	1.598	0.242	0.655	-0.270	-0.682	-0.342	-0.309	0.594	0.442
BM	**0.000**	**0.001**	**0.001**	**0.007**	**0.004** *	**0.001** *	**0.001**	**0.000**	**0.001**	**0.003**	**0.000**	**0.000**	**0.001** *	**0.001**	**-0.001**	**0.000**	**0.001** *	**0.001** *
	0.149	0.300	0.767	0.217	3.028	2.910	0.276	0.311	0.867	0.833	0.889	0.809	1.681	1.068	-0.806	-0.738	2.691	2.830
EP	**0.020** *	**0.094** *	**-0.037** *	**-0.093** *	**0.009**	**0.009**	**0.013**	**0.083** *	**0.004**	**0.004**	**0.005**	**0.006** *	**0.008** *	**0.005** *	**0.002**	**0.007**	**0.004**	**0.001**
	1.751	1.854	-1.978	-1.846	1.040	1.098	1.206	1.764	1.035	1.635	1.170	1.850	3.361	1.792	0.772	0.388	1.563	1.351
DY	**-0.080** *	**-0.045** *	**0.047**	**0.090**	**-0.110** *	**-0.081**	**-0.058**	**-0.079**	**-0.002**	**-0.003**	**-0.006**	**-0.001**	**-0.003**	**-0.010**	**0.009**	**0.009**	**-0.024** *	**-0.021** *
	-2.538	-2.275	0.701	0.700	-2.712	-1.616	-1.460	-1.403	-0.133	-0.363	-0.393	-0.377	-0.145	-0.644	0.774	0.552	-2.343	-2.523
RET23	**0.028** *	**0.060** *	**0.013**	**0.064** *	**0.006**	**0.008**	**0.004**	**0.006**	**0.003**	**0.007**	**-0.006**	**-0.007**	**0.011**	**0.016** *	**-0.013**	**-0.040**	**0.005** *	**0.002** *
	3.888	1.661	1.434	1.796	0.991	0.359	0.229	0.312	0.476	0.979	-0.983	-0.700	1.512	1.917	-1.075	-1.409	2.049	2.830
RET46	**0.015** *	**0.003** *	**0.007**	**0.007**	**0.005**	**0.008**	**0.015**	**0.004**	**0.010** *	**0.009** *	**0.014** *	**0.024** *	**0.009** *	**0.001** *	**-0.008**	**-0.003**	**0.009** *	**0.003** *
	2.470	2.079	0.835	0.912	0.699	0.675	1.152	1.164	2.326	2.786	3.319	3.501	1.617	1.757	-0.774	-0.768	4.135	3.961
RET712	**0.011** *	**0.011** *	**0.002**	**0.001**	**0.010** *	**0.021** *	**0.012**	**0.065**	**0.005**	**0.006** *	**0.008** *	**0.005** *	**0.002**	**0.003**	**-0.005**	**-0.004**	**0.006** *	**0.007** *
	3.677	3.300	0.499	0.731	2.677	1.974	0.886	0.046	1.416	1.727	2.361	1.830	0.567	0.695	-0.641	-0.985	3.767	2.445
1/P	**0.001**	**0.004**	**-0.002**	**-0.007**	**0.005** *	**0.005** *	**0.000**	**0.000**	**0.000**	**0.000**	**0.004** *	**0.010** *	**0.003** *	**0.000** *	**0.007** *	**0.009** *	**0.002** *	**0.005** *
	0.731	0.456	-0.763	-0.484	1.994	1.909	0.067	0.856	-0.297	-0.457	2.935	2.367	1.914	1.730	2.500	2.877	3.573	2.362

Table 5 **Cross-sctional regression**

This table reports the cross-sectional regressions results. The data use in the cross-section regressions are from a sample of average 2050 NYSE-AMEX common listed firms from Jan., 1962 to Dec., 2011 recorded in CRSP tape. The dependent variables in the row are monthly individual asset excess return. The independent variables (first column) are liquidity measures, CAP, BM, EP, DY, RET23, RET 46, RET712 and 1/P, where CAP is the market capitalizations of firms, BM is the book-to-market ratio, obtained by the ratio of last year's book value to the market prices at the end of each month. EP is the earning-price ratio, calculated by the earnings over the prior year divided by the share prices at the end of each month. DY is the dividend yield, which is calculated by the sum of last year's dividend over the prices at the end of each month. Ret 23, Ret46, Ret712 are cumulative returns of over the second through third, fourth through sixth, and seventh through twelfth months prior to the present months, respectively. 1/P denotes the reciprocal of closing prices at the end of month. Each Panel reports results from one specific liquidity measure: S is the value of absolute monthly spreads, which are obtained by taking average of the daily absolute spread within each month, the results are in Panel A. RS represents relative spread, namely, the ratio of absolute spread to share closing prices, and the monthly relative spread is the average of daily relative spread, the results are in Panel B. DVOL denotes sum of daily dollar trading volumes within month for each stock, the results are in Panel C. TR is the monthly turnover ratio, calculated by monthly trading volume over number of shares outstanding in each month, the results are in Panel D. R/DVOL denotes the ratio of absolute return to dollar volume, while the monthly R/DVOL is the average daily R/DVOL, the results are in Panel E. R/TR is defined similar to the previous variable, but the absolute return is divided by daily turnover ratio, the results are in Panel F. The cross-sectional regression generate monthly coefficients for each independent variable The coefficients reported in the table are obtained by the time-series mean of monthly estimation results. The t-statistics are calculated by the time-series coefficients estimation; the results are displayed on the right hand of the coefficients estimation. All the results are demonstrated in 8 sub-periods (Period 1 to 8) and whole sample horizon (1990-2011 for Panel A and B, 1962-2011 for Panel C,D,E,F). We use * to denote the significance of the coefficients at 5%.

Panel D	Period 1 Jan 1962 to Dec. 1969,		Period 2 Jan 1970 to Nov 1973		Period 3 Dec 1973 to Jan 1980		Period 4 Feb 1980 to July 1981		Period 5 Aug 1981 to July 1990		Period 6 Aug 1990 to March 2001		Period 7 April 2001 to Dec 2007		Period 8 Jan 2008 to Dec 2011		whole period whole period	
	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return
TR	0.001	0.001	-0.005 *	-0.002 *	-0.001	-0.006	-0.002	-0.003	-0.002 *	-0.003 *	0.000	0.001	-0.001	0.000	-0.001	-0.001	-0.001 *	0.000 *
	0.449	0.805	-2.885	-2.414	-0.906	-0.844	-0.762	-0.273	-2.366	-2.446	0.318	0.138	-0.630	-0.451	-0.325	-0.287	-2.191	-2.669
CAP	-0.001 *	-0.005 *	-0.001	0.000	-0.001 *	-0.004 *	-0.002	-0.003	0.000	-0.001	0.001	0.000	-0.001 *	-0.001 *	-0.001 *	-0.003 *	-0.001 *	0.000 *
	-2.248	-2.128	-0.521	-0.430	-1.900	-1.717	-0.992	-0.280	-0.656	-0.529	0.960	0.191	-1.811	-1.924	-1.638	-1.756	-2.472	-2.760
BM	0.000	0.001	0.001	0.001	0.004 *	0.006 *	0.001	0.001	0.001	0.001	0.000	0.001	0.001 *	0.000 *	-0.001	0.000	0.001 *	0.000 *
	0.150	0.654	0.763	0.736	3.031	2.582	0.273	0.616	0.863	0.480	0.869	0.821	1.666	1.799	-0.863	-0.155	2.669	2.947
EP	0.020 *	0.076 *	-0.037 *	-0.035 *	0.009	0.008	0.013	0.076 *	0.004	0.008	0.005	0.006	0.008 *	0.004 *	0.002	0.000	0.004 *	0.002 *
	1.748	1.771	-1.974	-1.853	1.039	1.031	1.208	1.794	1.041	1.542	1.171	1.481	3.357	1.756	0.781	0.978	1.563	1.901
DY	-0.080 *	-0.077 *	0.048	0.045	-0.110 *	-0.281 *	-0.058	-0.072	-0.002	-0.008	-0.006	-0.008	-0.003	-0.005	0.007	0.003	-0.024 *	-0.090 *
	-2.536	-2.510	0.702	0.328	-2.712	-2.630	-1.454	-1.559	-0.132	-0.688	-0.404	-0.709	-0.147	-0.538	0.658	0.775	-2.360	-2.964
RET23	0.028 *	0.036 *	0.013	0.035 *	0.006	0.008	0.004	0.003	0.003	0.009	-0.006	-0.010	0.011	0.022 *	-0.013	-0.076 *	0.005 *	0.001 *
	3.886	2.227	1.437	1.803	0.988	0.907	0.227	0.342	0.474	0.789	-0.980	-0.746	1.512	1.946	-1.077	-1.901	2.046	2.117
RET46	0.015 *	0.010 *	0.007	0.002	0.005	0.000	0.015	0.049 *	0.010 *	0.068 *	0.014 *	0.079 *	0.009 *	0.008 *	-0.009	-0.007	0.009 *	0.001 *
	2.472	2.879	0.836	0.851	0.694	0.746	1.151	1.720	2.324	2.610	3.334	2.403	1.616	1.659	-0.795	-0.229	4.134	3.254
RET712	0.011 *	0.011 *	0.002	0.006	0.010 *	0.082 *	0.012	0.040	0.005	0.003	0.008 *	0.009 *	0.002	0.007	-0.005	-0.009	0.006 *	0.007 *
	3.686	2.698	0.499	0.247	2.680	2.708	0.885	0.893	1.416	1.514	2.364	2.464	0.582	0.800	-0.615	-0.646	3.788	3.083
1/P	0.001	0.010	-0.002	-0.005	0.005 *	0.009 *	0.000	0.000	0.000	-0.001	0.004 *	0.004 *	0.003 *	0.003 *	0.007 *	0.002 *	0.002 *	0.008 *
	0.732	0.417	-0.765	-0.422	1.992	1.996	0.068	0.013	-0.294	-0.226	2.917	2.398	1.893	1.941	2.472	2.434	3.550	2.340

Table 5 **Cross-sctional regression**

This table reports the cross-sectional regressions results. The data use in the cross-section regressions are from a sample of average 2050 NYSE-AMEX common listed firms from Jan., 1962 to Dec., 2011 recorded in CRSP tape. The dependent variables in the row are monthly individual asset excess return. The independent variables (first column) are liquidity measures, CAP, BM, EP, DY, RET23, RET 46, RET712 and 1/P, where CAP is the market capitalizations of firms, BM is the book-to-market ratio, obtained by the ratio of last year's book value to the market prices at the end of each month. EP is the earning-price ratio, calculated by the earnings over the prior year divided by the share prices at the end of each month. DY is the dividend yield, which is calculated by the sum of last year's dividend over the prices at the end of each month. Ret 23, Ret46, Ret712 are cumulative returns of over the second through third, fourth through sixth, and seventh through twelfth months prior to the present months, respectively. 1/P denotes the reciprocal of closing prices at the end of month. Each Panel reports results from one specific liquidity measure: S is the value of absolute monthly spreads, which are obtained by taking average of the daily absolute spread within each month, the results are in Panel A. RS represents relative spread, namely, the ratio of absolute spread to share closing prices, and the monthly relative spread is the average of daily relative spread, the results are in Panel B. DVOL denotes sum of daily dollar trading volumes within month for each stock, the results are in Panel C. TR is the monthly turnover ratio, calculated by monthly trading volume over number of shares outstanding in each month, the results are in Panel D. R/DVOL denotes the ratio of absolute return to dollar volume, while the monthly R/DVOL is the average daily R/DVOL, the results are in Panel E. R/TR is defined similar to the previous variable, but the absolute return is divided by daily turnover ratio, the results are in Panel F. The cross-sectional regression generate monthly coefficients for each independent variable The coefficients reported in the table are obtained by the time-series mean of monthly estimation results. The t-statistics are calculated by the time-series coefficients estimation; the results are displayed on the right hand of the coefficients estimation. All the results are demonstrated in 8 sub-periods (Period 1 to 8) and whole sample horizon (1990-2011 for Panel A and B, 1962-2011 for Panel C,D,E,F). We use * to denote the significance of the coefficients at 5%.

Panel E	Period 1 Jan 1962 to Dec. 1969,		Period 2 Jan 1970 to Nov 1973		Period 3 Dec 1973 to Jan 1980		Period 4 Feb 1980 to July 1981		Period 5 Aug 1981 to July 1990		Period 6 Aug 1990 to March 2001		Period 7 April 2001 to Dec 2007		Period 8 Jan 2008 to Dec 2011		whole period whole period	
	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return
R/DVOL	0.005 *	0.008 *	0.001	0.000	0.002	0.004	0.001 *	0.005 *	0.000	0.000	0.001	0.000	0.000	0.000	0.001 *	0.001 *	0.000 *	0.001 *
	3.039	2.227	0.754	0.801	1.049	1.020	2.564	2.851	-0.633	-0.735	1.000	1.322	-0.038	-0.022	2.073	2.846	1.701	1.831
CAP	0.005 *	0.008 *	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.000	0.000	-0.001	-0.003	0.000	0.001	0.000	-0.001
	2.840	1.936	-0.285	-0.068	0.108	0.351	1.068	1.385	0.287	0.175	-0.193	-0.194	-0.849	-0.711	0.458	0.686	-0.605	-0.421
BM	0.001	0.000	0.004 *	0.008 *	0.001	0.000	0.000	0.000	0.000	0.000	0.001 *	0.000 *	-0.001	-0.001	0.001 *	0.000 *	0.001 *	0.000 *
	0.642	0.021	3.091	3.475	0.259	0.203	0.775	0.025	0.876	0.879	1.638	1.596	-0.833	-0.801	2.682	2.636	2.366	2.918
EP	-0.049 *	-0.051 *	0.008	0.007	0.012	0.040	0.004	0.002 *	0.005	0.009	0.008 *	0.008 *	0.002	0.004	0.004	0.008	0.006 *	0.006 *
	-2.740	-2.807	0.839	0.787	1.138	1.123	1.067	1.993	1.146	1.682	3.366	3.105	0.700	0.223	1.355	1.418	2.112	2.752
DY	0.144 *	0.204 *	-0.099 *	-0.066 *	-0.054	-0.003	0.001	0.000	-0.007	-0.004	-0.002	-0.008	0.008	0.008	-0.016	-0.024	-0.024 *	-0.082 *
	2.452	2.584		-1.885	-1.179	-1.044	0.034	0.059	-0.401	-0.475	-0.098	-0.025	0.677	0.819	-1.435	-1.220	-2.524	-2.047
RET23	0.011	0.009	0.008	0.007 *	0.001	0.008	0.002	0.008	-0.006	-0.003 *	0.010	0.033	-0.013	-0.012	0.005 *	0.009 *	0.002	0.001
	1.181	1.670	1.270	1.766	0.089	0.047	0.380	0.675	-1.123	-1.764	1.324	1.259	-1.060	-1.652	1.937	1.831	0.823	0.888
RET46	0.006	0.008	0.007	0.005	0.013	0.058	0.011 *	0.073 *	0.014 *	0.033 *	0.009 *	0.008 *	-0.009	-0.002	0.009 *	0.006 *	0.000	-0.001
	0.671	0.969	0.975	0.167	0.970	0.628	2.346	2.501	3.262	1.994	1.542	1.917	-0.817	-0.870	4.072	2.892	-0.150	-0.682
RET712	0.001	0.000	0.010 *	0.001 *	0.011	0.011	0.006	0.003	0.008 *	0.008 *	0.002	0.002	-0.006	-0.004	0.006 *	0.010 *	-0.001	0.000
	0.241	0.595	2.531	1.985	0.774	0.670	1.507	1.801	2.313	2.037	0.478	0.537	-0.662	-0.314	3.616	3.854	-0.746	-0.961
1/P	-0.002	-0.006	0.006 *	0.002 *	0.000	0.000	-0.001	0.000	0.004 *	0.005 *	0.003 *	0.005 *	0.007 *	0.003 *	0.003 *	0.009 *	0.001 *	0.006 *
	-0.599	-0.231	2.075	2.484	0.099	0.071	-0.603	-0.503	2.940	2.031	1.885	1.853	2.423	2.703	3.616	2.415	1.825	1.869

Table 5 **Cross-sctional regression**

This table reports the cross-sectional regressions results. The data use in the cross-section regressions are from a sample of average 2050 NYSE-AMEX common listed firms from Jan., 1962 to Dec., 2011 recorded in CRSP tape. The dependent variables in the row are monthly individual asset excess return. The independent variables (first column) are liquidity measures, CAP, BM, EP, DY, RET23, RET 46, RET712 and 1/P, where CAP is the market capitalizations of firms, BM is the book-to-market ratio, obtained by the ratio of last year's book value to the market prices at the end of each month. EP is the earning-price ratio, calculated by the earnings over the prior year divided by the share prices at the end of each month. DY is the dividend yield, which is calculated by the sum of last year's dividend over the prices at the end of each month. Ret 23, Ret46, Ret712 are cumulative returns of over the second through third, fourth through sixth, and seventh through twelfth months prior to the present months, respectively. 1/P denotes the reciprocal of closing prices at the end of month. Each Panel reports results from one specific liquidity measure: S is the value of absolute monthly spreads, which are obtained by taking average of the daily absolute spread within each month, the results are in Panel A. RS represents relative spread, namely, the ratio of absolute spread to share closing prices, and the monthly relative spread is the average of daily relative spread, the results are in Panel B. DVOL denotes sum of daily dollar trading volumes within month for each stock, the results are in Panel C. TR is the monthly turnover ratio, calculated by monthly trading volume over number of shares outstanding in each month, the results are in Panel D. R/DVOL denotes the ratio of absolute return to dollar volume, while the monthly R/DVOL is the average daily R/DVOL, the results are in Panel E. R/TR is defined similar to the previous variable, but the absolute return is divided by daily turnover ratio, the results are in Panel F. The cross-sectional regression generate monthly coefficients for each independent variable The coefficients reported in the table are obtained by the time-series mean of monthly estimation results. The t-statistics are calculated by the time-series coefficients estimation; the results are displayed on the right hand of the coefficients estimation. All the results are demonstrated in 8 sub-periods (Period 1 to 8) and whole sample horizon (1990-2011 for Panel A and B, 1962-2011 for Panel C,D,E,F). We use * to denote the significance of the coefficients at 5%.

Panel F	Period 1		Period 2		Period 3		Period 4		Period 5		Period 6		Period 7		Period 8		whole period	
	Jan 1962 to Dec. 1969,		Jan 1970 to Nov 1973		Dec 1973 to Jan 1980		Feb 1980 to July 1981		Aug 1981 to July 1990		Aug 1990 to March 2001		April 2001 to Dec 2007		Jan 2008 to Dec 2011		whole period	
	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return	excess return	adjusted return
R/TR	-0.001	-0.001	0.006 *	0.008 *	0.001	0.001	0.002	0.001	0.002 *	0.003 *	-0.001	0.000	0.001	0.001 *	0.000	0.000	0.001 *	0.000 *
	-0.526	-0.298	4.364	3.471	1.225	1.326	0.980	0.530	2.674	2.284	-0.780	-0.635	1.161	1.917	0.070	0.054	2.388	2.967
CAP	-0.001 *	-0.006 *	0.001	0.009	-0.002 *	-0.008 *	-0.002	-0.002	0.000	0.000	0.001	0.001	-0.001 *	-0.001 *	-0.001	0.000	-0.001 *	-0.001 *
	-2.144	-2.734	1.031	1.269	-2.302	-2.388	-1.135	-1.380	-0.230	-0.197	0.882	0.838	-1.687	-1.384	-1.415	-1.361	-2.021	-2.731
BM	0.000	0.000	0.002	0.007	0.004 *	0.007 *	0.004	0.008	0.001	0.000	0.000	0.000	0.001	0.000	-0.001	0.000	0.001 *	0.002 *
	0.121	0.441	1.337	1.405	2.868	2.199	1.566	1.576	1.030	1.086	0.838	0.018	1.582	1.311	-0.649	-0.512	3.098	2.825
EP	0.021 *	0.029 *	-0.057 *	-0.032 *	0.017 *	0.045 *	0.005	0.008	0.007 *	0.009 *	0.008 *	0.006	0.008 *	0.002 *	0.002	0.002	0.006 *	0.002 *
	1.699	1.849	-2.741	-2.803	1.862	1.952	0.412	0.587	1.651	1.129	1.947	1.571	3.542	2.938	0.668	0.750	2.068	2.293
DY	-0.085 *	-0.090 *	0.040	0.065	-0.130 *	-0.069 *	-0.061	-0.099	-0.004	-0.001	-0.008	-0.006	-0.002	-0.010	0.010	0.005	-0.030 *	-0.100 *
	-2.310	-2.141	0.483	0.445	-3.033	-2.001	-1.366	-1.642	-0.214	-0.215	-0.453	-0.966	-0.118	-0.143	0.836	0.823	-2.573	-2.180
RET23	0.024 *	0.095 *	0.026 *	0.069 *	0.008	0.000	0.022	0.025	0.002	0.004	-0.002	-0.007	0.014 *	0.038 *	-0.013	-0.029	0.008 *	0.003 *
	3.214	3.334	3.862	3.870	1.415	1.970	1.347	1.187	0.272	0.757	-0.262	-0.380	1.944	1.773	-1.061	-1.459	2.815	2.148
RET46	0.011 *	0.030 *	0.023 *	0.020 *	0.010	0.007	0.006	0.010	0.010 *	0.100 *	0.015 *	0.077 *	0.011 *	0.072 *	-0.011	-0.100	0.010 *	0.060 *
	1.766	1.839	3.253	2.701	1.461	1.274	0.530	0.212	2.262	2.668	3.693	1.973	2.030	2.340	-0.953	-0.099	4.522	2.550
RET712	0.010 *	0.069 *	0.002	0.009	0.013 *	0.044 *	0.024 *	0.067	0.008 *	0.006 *	0.006 *	0.005 *	0.002	0.007	-0.006	-0.003	0.006 *	0.002 *
	3.139	2.893	0.492	0.813	3.439	2.785	1.789	1.428	2.003	2.822	1.891	1.894	0.644	0.665	-0.743	-0.417	3.930	2.727
1/P	0.001	0.002	-0.003	-0.009	0.002	0.003	0.000	0.001	0.000	0.000	0.004 *	0.008 *	0.003 *	0.099	0.007 *	0.008 *	0.002 *	0.009 *
	0.556	0.855	-1.362	-1.233	1.088	1.625	0.101	0.953	-0.041	-0.050	3.134	3.384	1.641	1.411	2.451	2.224	3.265	2.471

Regarding the transaction cost, there are two liquidity measures. The value of monthly spread is averaged by the daily spreads (the difference between ask prices and bid prices), while the relative spreads are obtained by the ratio of the absolute spreads over prices. Both of the two measures are adopted to present the transaction costs of shares. We first focus on the mimicking portfolios' patterns in Table 4, where excess return increases from portfolio 1 to portfolio 5 for both the S and the RS. However, only the RS could provide a significant pattern. We further explore this through the cross-sectional regressions and we find that both of the measures (S, RS) are priced in the market providing a liquidity risk premium. We also found that the control variables that refer to profitability (EP and DY) along with the prices and the past performance are significant in this model. Turning to the sub-period analysis on Business Cycles, we observe that the results from the mimicking portfolios as well those from the asset pricing model are similar. Furthermore, during the last sub-period the portfolios provide a negative pattern on liquidity which is actually not priced on the asset pricing model, though the Capitalization variable becomes significant at this period.

Regarding the trading activity, we use the turnover ratio and the dollar volume measures. The mimicking portfolio analysis suggest that high values of the turnover ratio and low values of the dollar volume are associated with higher returns a result which is also consistent with the risk premia analysis only for the dollar volume measure. Through our descriptive analysis we find a positive relationship between TR and returns which is in line with Brown, Crocker, and Foerster (2009) (for big size firms) and a negative one regarding the DV consistently with Brennan, Chordia, and Subrahmanyam (1998), and Chordia, Subrahmanyam and Anshuman (2001). Furthermore, the inclusion of the control variables in our analysis (CAP, B/M, EP, 1/P and momentum proxies) seems to play a significant role on this relationship and offsets the positive significant TR effect. Moreover, the CAP variable is more significantly priced along with TR than with DVOL. This might be due to the high correlation between DVOL and CAP which possibly implies a size domination effect. The presence of R46 coefficients is more significant than RET23 and RET712, in both cases. The results obtained for the sub-periods are flat for the TR measure, i.e. we observe a positive effect of the TR on asset returns for all sub-periods. However, the DVOL measure provides negative returns during the analysis (either with the mimicking portfolios or the cross-sectional analysis) with an exemption to the last two sub-periods. Similar results have been found in the literature. Brennan, Chordia, and Subrahmanyam (1998), and Chordia, Subrahmanyam and Anshuman (2001) suggest that assets with high turnover ratio or dollar trading volume are supposed to yield negative premium. In contrast, Brown, Crocker, and Foerster (2009) found a positive association between turnover ratio and asset return in big firms, and suggest that the effect of turnover ratio might be dominated by information and momentum effects. Similar findings have been reported in Pástor and Stambaugh (2003). It should also mentioned that the magnitude of trading activity is higher during the second sub-period (i.e. Jan. 1970 to Nov. 1973), a result which is in line with Brennan, Huh, Subrahmanyam (2012), who claim that the liquidity risk premium is apparent mostly in down-side market conditions.

The price impact dimension of liquidity risk is analysed through the R/DVOL and R/TR measures. The first measure is positively and significantly associated with returns while the second one, negatively. Our findings are consistent with those of Florakis et.al. (2011). The insignificant results of the momentum and size control variables indicate that the R/DVOL dominate the size and the past performance effects. Moreover, the price impact incorporates several structural changes with respect to the Business Cycles. R/DVOL is significantly positive in sub-periods 1, 4 and 8 and in the whole horizon, while the R/TR is positive and significant in period 2 and 5 and in the whole sample horizon. The loadings of price impact in other sub-periods are statistically insignificant. In specific, the positive relationship between R/TR and asset excess return is stronger in period 2, which is in line with the finding of trading activity, i.e. DVOL and TR. The momentum variables (RET 23, RET46, RET712) are insignificant when using the R/DVOL in the whole sample period, in contrast to the R/TR.

By investigation of the market-wide variables we examine the coherence between the liquidity measures as shown in Panel A, of Table 6. We observe that the six market-aggregated liquidity measures are all significantly correlated with each other. The correlation relationship is, in general, consistent with the results of the mimicking portfolios which display the cross-sectional correlation of individual asset monthly liquidity measures. Each pair of liquidity measures which are in the same dimension of liquidity (i.e. transaction cost, trading activity and price impact) are positively correlated with each other. Moreover, the trading activity measures, MDVOL and MTR, are significantly negative correlated with any other measures, while the transaction cost measures, MS and MRS, are significantly positive correlated with price impact measures, MR/DVOL and MR/TR. Besides, the correlation between the three categories of market-wide liquidity measure and the market portfolio return-related variables are also very interesting. Specifically, the correlation coefficient between MDVOL and VOL, PRET, NRET is 0.16, 0.15 and -0.14, respectively; while the correlation coefficient between MTR and VOL, PRET, NRET presume a similar pattern. Thus, the market volatility affect the inventory risk and due to its impact on market liquidity via trading activity. The opposite signs of the coefficients between the trading activity (MDVOL and MTR) and PRET or NRET, provide insights on that the trading could be heavier in either up-market or down-market, an assumption which is also addressed by Pástor and Stambaugh (2003). In addition, the correlation coefficient between the price impact measures (MR/DVOL and MR/TR) and momentum variables (RET23, RET46 and RET712) are also significantly positive. It is suggestive that the past performance has relative high influence on price impact measures. This argument is not in line with the individual liquidity measure case, where TR is significantly correlated with the momentum variables (RET23, RET46 and RET712).

Table 6 **Contemporaneous correlation and Granger causality tests between VAR innovations**

This table reports the contemporaneous correlation and granger causaliy tests results between the listed variables of interest. The market variables are aggregated by the all the avaiable assets in the daily data sample. Except spread and relative spread are only avaiable after 1990, other variables are available over 1962 to 2011. In Panel A, the first six variables are market-wide liquidity measures process, where MDVOL is market dollar volume, the sum of all available share dollar volume in each trading day. MS is the market spread, calculated by the average of cross-sectional shares spread on daily basis. MRS is the market relative spread, calculated by the average of cross-sectional shares relative spread on daily basis. MTR indicates market turnover ratio, obtained by value-weighted average of assets turnover ratio. MR/DVOL and MR/TR denote the market return to dollar volume and market return to turnover ratio, respectively, and they are derived from daily average of return to dollar volume and return to turnover ratio.MRET denotes the market return, which are calculated by the value-weighted daily return of shares. PRET and NRET are decomposed from MRET into the positive and negative strings, namely, positive return process are max (0, MRET), while negative return process are min (0, MRET). VOl is the volatility of market return, calculated by (MRET)^2. Ret23, Ret46, Ret712 are cumulative market returns of over the second through third, forth through sixth, and seventh through twelfith months prior to the present months, respectively. Note, we assume 22 trading days in one month. The matrix in Panel A demonstrates the contemporaneous correaltion between each pair of market variable processes. The pair wise correlation coefficients are in the intersections of the variables in row and in column. In Panel B, the results from Granger Causality tests are reported. Since it requires stationary process in Granger Causality tests, the non-staionary price-related variables, MDVOL, MTR, MS and MRS, are transformed by first difference. diff(xt) = xt - x(t-1). The p-value in matrix indicats the possibility of each variable in row does not granger cause the corresponding variable in column. The p-value lower than 0.1 are indicated by *. Panel C is equivalent to the results in Panel B.The resluts of REJECT to the bull hypothsis is according to the p-values in Panle B.

Panel A: Corrlation

	MDVOL	MS	MRS	MR/DVOL	MR/TR	MTR	VOL	RET	PRET	NRET	RET23	RET46	RET712
MDVOL	1.00												
MS	-0.77 *	1.00											
MRS	-0.79 *	0.98 *	1.00										
MR/DVOL	-0.66 *	0.76 *	0.81 *	1.00									
MR/TR	-0.70 *	0.83 *	0.86 *	0.97 *	1.00								
MTR	0.95 *	-0.66 *	-0.67 *	-0.69 *	-0.72 *	1.00							
VOL	0.16 *	-0.08	-0.07	-0.02	0.01	0.25 *	1.00						
MRET	0.00	0.01	0.01	-0.04	-0.05	0.01	-0.06	1.00					
PRET	0.15 *	-0.07	-0.07	-0.04	-0.02	0.21 *	0.40 *	0.80 *	1.00				
NRET	-0.14 *	0.08	0.08	-0.02	-0.06	-0.20 *	-0.50 *	0.80 *	0.28	1.00			
RET23	0.00	0.06	0.05	-0.12 *	-0.14 *	0.01	-0.04	-0.01	-0.04	0.03	1.00		
RET46	0.02	0.05	0.04	-0.15 *	-0.16 *	0.00	-0.05	0.00	-0.04	0.04	-0.01	1.00	
RET712	0.05	0.12 *	0.09	-0.21 *	-0.20 *	0.02	-0.04	-0.01	-0.04	0.03	-0.07	0.38 *	1.00

Table 6 **Contemporaneous correlation and Granger causality tests between VAR innovations**

This table reports the contemporaneous correlation and granger causaliy tests results between the listed variables of interest. The market variables are aggregated by the all the avaiable assets in the daily data sample. Except spread and relative spread are only avaiable after 1990, other variables are available over 1962 to 2011. In Panel A, the first six variables are market-wide liquidity measures process, where MDVOL is market dollar volume, the sum of all available share dollar volume in each trading day. MS is the market spread, calculated by the average of cross-sectional shares spread on daily basis. MRS is the market relative spread, calculated by the average of cross-sectional shares relative spread on daily basis. MTR indicates market turnover ratio, obtained by value-weighted average of assets turnover ratio. MR/DVOL and MR/TR denote the market return to dollar volume and market return to turnover ratio, respectively, and they are derived from daily average of return to dollar volume and return to turnover ratio.MRET denotes the market return, which are calculated by the value-weighted daily return of shares. PRET and NRET are decomposed from MRET into the positive and negative strings, namely, positive return process are max (0, MRET), while negative return process are min (0, MRET). VOl is the volatility of market return, calculated by (MRET)^2. Ret23, Ret46, Ret712 are cumulative market returns of over the second through third, forth through sixth, and seventh through twelfith months prior to the present months, respectively. Note, we assume 22 trading days in one month. The matrix in Panel A demonstrates the contemporaneous correaltion between each pair of market variable processes. The pair wise correlation coefficients are in the intersections of the variables in row and in column. In Panel B, the results from Granger Causality tests are reported. Since it requires stationary process in Granger Causality tests, the non-staionary price-related variables, MDVOL, MTR, MS and MRS, are transformed by first difference. diff(xt) = xt - x(t-1). The p-value in matrix indicats the possibility of each variable in row does not granger cause the corresponding variable in column. The p-value lower than 0.1 are indicated by *. Panel C is equivalent to the results in Panel B.The resluts of REJECT to the bull hypothsis is according to the p-values in Panle B.

Panel B: P value

	MDVOL	MS	MRS	MTR	MR/DVOL	MR/TR	VOL	RET	PRET	NRET	RET23	RET46	RET712
MDVOL		0.555	0.000 *	0.000 *	1.000	0.884	0.000 *	0.000 *	0.000 *	0.000 *	0.001 *	0.154	0.244
MS	0.616		0.000 *	0.402	0.365	0.191	0.983	0.150	0.262	0.239	0.640	0.904	0.378
MRS	0.659	0.000 *		0.534	0.026 *	0.035 *	0.576	0.021 *	0.005 *	0.351	0.732	0.922	0.327
MTR	0.000 *	0.054 *	0.000 *		0.788	0.077	0.000 *	0.000 *	0.000 *	0.000 *	0.000 *	0.055 *	0.006 *
MR/DVOL	0.000 *	0.022 *	0.000 *	0.000 *		0.000 *	0.000 *	0.000 *	0.000 *	0.000 *	0.180	0.452	0.635
MR/TR	0.000 *	0.000 *	0.000 *	0.000 *	0.000 *		0.000 *	0.000 *	0.000 *	0.000 *	0.046 *	0.164	0.362
VOL	0.000 *	0.000 *	0.000 *	0.000 *	0.007 *	0.000 *		0.000 *	0.000 *	0.000 *	0.015 *	0.007 *	0.405
RET	0.000 *	0.002 *	0.000 *	0.010 *	0.079 *	0.036 *	0.000 *		0.000 *	0.000 *	0.010 *	0.005 *	0.016 *
PRET	0.000 *	0.001 *	0.000 *	0.000 *	0.000 *	0.000 *	0.000 *	0.000 *		0.000 *	0.004 *	0.000 *	0.014 *
NRET	0.000 *	0.003 *	0.000 *	0.000 *	0.011 *	0.010 *	0.000 *	0.000 *	0.000 *		0.007 *	0.056 *	0.476
RET23	0.776	0.443	0.379	0.159	0.000 *	0.000 *	0.000 *	0.000 *	0.000 *	0.000 *		0.236 *	0.000 *
RET46	0.000 *	0.514	0.410	0.000 *	0.599	0.207	0.006 *	0.078	0.009 *	0.122	0.011 *		0.000 *
RET712	0.004 *	0.332	0.757	0.001 *	0.629	0.114	0.053	0.723	0.103	0.263	0.104	0.000 *	

Table 6 **Contemporaneous correlation and Granger causality tests between VAR innovations**

This table reports the contemporaneous correlation and granger causaliy tests results between the listed variables of interest. The market variables are aggregated by the all the avaiable assets in the daily data sample. Except spread and relative spread are only avaiable after 1990, other variables are available over 1962 to 2011. In Panel A, the first six variables are market-wide liquidity measures process, where MDVOL is market dollar volume, the sum of all available share dollar volume in each trading day. MS is the market spread, calculated by the average of cross-sectional shares spread on daily basis. MRS is the market relative spread, calculated by the average of cross-sectional shares relative spread on daily basis. MTR indicates market turnover ratio, obtained by value-weighted average of assets turnover ratio. MR/DVOL and MR/TR denote the market return to dollar volume and market return to turnover ratio, respectively, and they are derived from daily average of return to dollar volume and return to turnover ratio.MRET denotes the market return, which are calculated by the value-weighted daily return of shares. PRET and NRET are decomposed from MRET into the positive and negative strings, namely, positive return process are max (0, MRET), while negative return process are min (0, MRET). VOl is the volatility of market return, calculated by (MRET)^2. Ret23, Ret46, Ret712 are cumulative market returns of over the second through third, forth through sixth, and seventh through twelfith months prior to the present months, respectively. Note, we assume 22 trading days in one month. The matrix in Panel A demonstrates the contemporaneous correaltion between each pair of market variable processes. The pair wise correlation coefficients are in the intersections of the variables in row and in column. In Panel B, the results from Granger Causality tests are reported. Since it requires stationary process in Granger Causality tests, the non-staionary price-related variables, MDVOL, MTR, MS and MRS, are transformed by first difference. diff(xt) = xt - x(t-1). The p-value in matrix indicats the possibility of each variable in row does not granger cause the corresponding variable in column. The p-value lower than 0.1 are indicated by *. Panel C is equivalent to the results in Panel B.The resluts of REJECT to the bull hypothsis is according to the p-values in Panle B.

Panel C: Gausality

	MDVOL	MS	MRS	MTR	MR/DVOL	MR/TR	VOL	RET	PRET	NRET	RET23	RET46	RET712
Ho, MDVOL do not Granger cause				REJECT	REJECT	REJECT	REJECT	REJECT	REJECT	REJECT		REJECT	REJECT
Ho, MS do not Granger cause		REJECT	REJECT	REJECT	REJECT	REJECT	REJECT	REJECT	REJECT	REJECT			
Ho, MRS do not Granger cause	REJECT	REJECT		REJECT	REJECT	REJECT	REJECT	REJECT	REJECT	REJECT			
Ho, MTR do not Granger cause	REJECT				REJECT	REJECT	REJECT	REJECT	REJECT	REJECT		REJECT	REJECT
Ho, MR/DVOL do not Granger cause			REJECT			REJECT	REJECT	REJECT	REJECT	REJECT	REJECT		
Ho, MR/TR do not Granger cause			REJECT		REJECT		REJECT	REJECT	REJECT	REJECT	REJECT		
Ho, VOL do not Granger cause	REJECT			REJECT	REJECT	REJECT		REJECT	REJECT	REJECT	REJECT	REJECT	
Ho, RET do not Granger cause	REJECT		REJECT	REJECT	REJECT	REJECT	REJECT		REJECT	REJECT	REJECT		
Ho, PRET do not Granger cause	REJECT		REJECT	REJECT	REJECT	REJECT	REJECT	REJECT		REJECT	REJECT	REJECT	
Ho, NRET do not Granger cause	REJECT			REJECT	REJECT	REJECT	REJECT	REJECT	REJECT		REJECT		
Ho, RET23 do not Granger cause	REJECT			REJECT		REJECT	REJECT	REJECT	REJECT	REJECT		REJECT	
Ho, RET46 do not Granger cause				REJECT			REJECT	REJECT	REJECT	REJECT			REJECT
Ho, RET712 do not Granger cause				REJECT				REJECT	REJECT		REJECT	REJECT	

The pair-wise Granger-causality tests between the market-wide variables of the VAR are presented in Panel B and C of Table 6. In order to examine the null hypothesis that variable k does not Granger-cause variable q, we test whether the lag coefficients of k are jointly zero when q is the dependent variable in the VAR. MDVOL explains MTR, MR/DVOL, MR/TR while MTR does not have a causal relationship with transaction cost variables. All liquidity measures have a unidirectional causal relationship with trading activity measures. The bidirectional relationships exist within each category of liquidity measures.

Finally, with respect to the market wide characteristics and liquidity measures we find that bidirectional effects exist between liquidity and VOL, PRET or NRET. Specifically, these characteristics are associated with price impact or trading activity measures in a bidirectional relationship, that explain past performance and subsequently the market-wide trading activity.

Figure 1. The Granger causality between three dimensions of liquidity measure at the market level. The arrow represents the causality between measures.

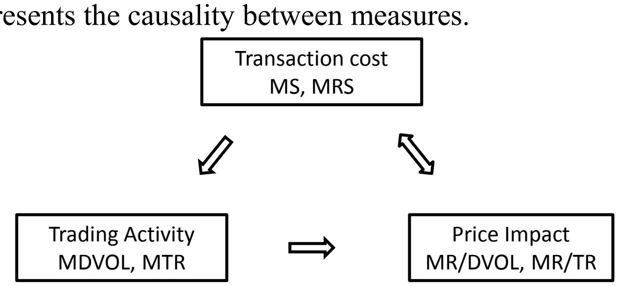
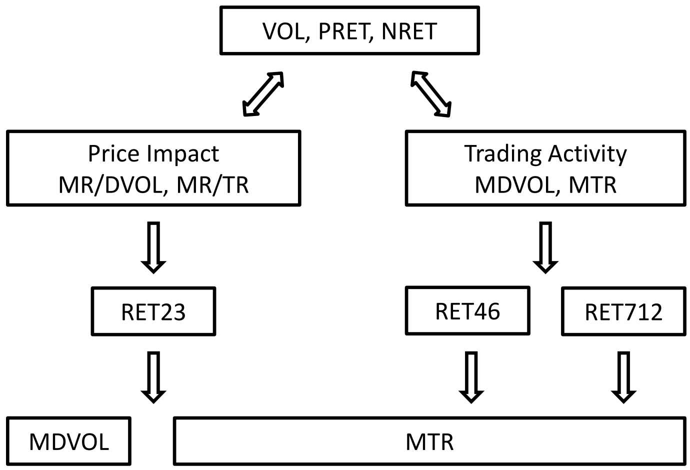


Figure 2. The Granger causality between the market indicators and three dimensions of liquidity measure at the market level. The arrow represents the causality between variables.



Conclusion

Liquidity is commonly reflected on the easiness that an asset is traded at low transaction cost with little price impact and this is quantified by different proxies on trading quantity, trading speed, trading cost and price impact. According to the extant literature the most important components of liquidity are the transaction cost, the trading activity and the price impact.

Our paper focuses on the liquidity measures in a comparative framework. Using data from CRSP over the period 1962 to 2011 we adopt the conventional Fama-MacBeth approach controlling for several factors on firm fundamentals.

The empirical findings of the paper are consistent with the foundations of the constituents of liquidity measures though several structural changes have taken place during the examined time period. The liquidity risk premium is strengthened during downturns of the market conditions. Moreover, there is evidence that the trading activity component of liquidity dominates conventional risk factors such as the size effect. Similar results are obtained with the R/VOL which dominates the size and the momentum effects.

Moreover, we investigate the Granger Causality between three classes of liquidity indicators and the market characteristics. Bidirectional causality exists within the same category of liquidity measures, and between transaction cost and price impact measures, while the three liquidity measures are Granger caused by transaction costs and trading activity. Finally, we found that the market-wide characteristics (VOL, PRET or NRET) affect the trading activity and the price impact liquidity components and subsequently the past performance of asset returns

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Valuation of Quanto Variable Annuities: a Variance Reduction Approach

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Equity-linked insurance products are very appealing to the insurance policy holder. Compared to the traditional annuity product, equity-linked insurance products have the advantage of offering additional return when the linked equities perform well. How- ever, due to their complicated payoff structure, their valuation and risk management are challenges to the insurance company. In this paper, we study valuation methods for quanto variable annuity contract with cliquet options. We propose an efficient Monte Carlo method to price such contract. Numerical examples suggest our approach is quite effective.

Key words and phrases: Monte Carlo method, Variable Annuities, Cliquet Options, Quanto.

JEL Classifications: F31, F37, F47

1 INTRODUCTION

Equity-linked annuity contracts has become very popular in the market. There are two major types of equity-linked annuity contracts: variable annuity (VA) and equity-linked annuity (EIA). The markets of VA and EIA are very large. According to LIMRA International and Advantage Compendiumm, VA and EIA contracts have very high sales volume (Table 1) in United States.

Table 1: VA and EIA sales volume in billion dollars in United States, 2003-2009.

Year	VA	EIA
2003	129.4	14.0
2004	132.9	23.4
2005	137.6	27.3
2006	184.2	25.3
2007	182.2	25.1
2008	154.8	26.7
2009	127.0	30.1

Compared to the traditional annuity product, VA and EIA have the advantage of offering additional return when the linked equities perform well. Although VA and EIA share this commonality, they are different in various aspects:

1. A typical (non-registered) EIA is an insurance company "general account" product. This means that EIA is treated as a liability item on insurance company's balance sheet. On the other hand, VA is a "separate account" product. Except the guarantees embedded in the contract, any gains or losses to the underlying

assets in the VA separate account are reflected directly and immediately in the VA contract owners' accumulation values.

2. Owners of variable annuities are generally allowed to modify their investment allocations periodically, sometimes as often as daily, and VA contract values change according to the performance of the selected investment portfolios. Therefore, VA contracts provide their owners with considerably greater investment flexibility than do EIA contracts. The linked indices in EIA contracts are usually the well known indices such as S&P 500. So, EIA owners basically cannot have direct influence on the values of linked indices.

3. VAs are considered to be securities and must be registered with the Securities and Exchange Commission (SEC). On contrary, EIAs are not required to register with SEC and most EIAs are not registered.

4. At maturity, the guarantees embedded in EIA contracts are usually in-the-money. On the other hand, VA's guarantees are usually out-of-the-money.

Above differences between VAs and EIAs exist in US market. Asia markets for VA and EIA have a different story. For example, equity-linked insurance contracts must be premium protected and must be "separate account" products in Taiwan. Regulator set a very high "capital requirement" standard for insurers for providing guarantees in equity-linked insurance. For this reason, insurers in Taiwan have to transfer their risks associated with these guarantees to a third party. Reinsurance is one way for transferring these risks, but it is usually too expensive for insurers. A more popular way is to package premium-protected structure products as equity-linked insurance contracts. Such premium-protected structure products are designed and sold by investment banks. In order to be a qualified provider for such structure products, the investment bank must maintain a high credit rating. These structure products are classified as variable annuities in Taiwan, because they are separate account products. However, their financial property are more like EIA products in United States. These products have exotic payoff functions and their valuation becomes an important issue for the insurers. In this paper, we focus on one of such structured products. The variable annuity contract under consideration has quanto feature and embedded cliquet options. Such contracts are attractive to the investor because of their protection against downside risk and significant upside potential. We discuss the Monte Carlo valuation approach and then propose efficient algorithms. In particular, we applied variance reduction technique of control variates to improve the performance of Monte Carlo approach.

This paper is organized as follows. In Section 2, we describe the variable annuity contract under consideration. In Section 3, we first describe the stochastic models for the linked index and exchange rate. Then we present the risk neutral valuation formulas under the stochastic models. In Section 4, we devise a few control variates and test their effectiveness via numerical examples. Finally, Section 5 offers some concluding remarks.

2 VARIABLE ANNUITY CONTRACTS WITH CLIQUET OPTIONS

The payoff of the variable annuity contracts under consideration is very similar to simple ratchet EIA contracts with maturity guarantee; see, Hardy (2003) and Hsieh and Chiu (2007) for more information. The VA contracts might also be called cliquet options with global floor Kjaer (2006). However, there is one major difference between the VA contracts considered and simple ratchet EIA contracts: the VA contracts considered are quantos. That is, the linked-index is dominated in a different currency. For example, the contracts pay off in Australian dollar and the linked-index is S&P 500 which is dominated in United States dollar.

The index participation is evaluated annually. Let T be the maturity of a VA contract and $S(t)$ be the linked-index at time $t \leq T$. We set

$$R_t = \frac{S(t)}{S(t-1)}, \quad t = 1, \ldots, T, \tag{1}$$

which are the annual returns of linked-index. The effective annual returns of the VA contract are defined as

$$\tilde{R}_t = 1 + \min(\max(\alpha(R_t - 1), f), c) \tag{2}$$

where f is the annual guarantee rate, c is the annual cap rate, and α is the participation rate in the linked-index.

Treat these effective annual returns as simple returns and sum them arithmetically, then the total return at maturity is

$$R_M = 1 + \sum_{t=1}^{T} (\tilde{R}_t - 1) = 1 - T + \sum_{t=1}^{T} \tilde{R}_t, \tag{3}$$

In addition to annual guarantee rate f, the VA contract also provides guarantee at maturity. This type of guarantee is sometimes called global guarantee. Let the initial investment be P. If the maturity guarantee promises a maturity guarantee rate G, then the payoff of the VA contract is

$$P \cdot \max(R_M, G), \tag{4}$$

3 VALUATION FORMULAS FOR THE VA CONTRACT CONSIDERED

Most of the previous related research in insurance field (Hardy (2004), Lee (2003), Tiong (2000), and Gerber and Shiu (2003)) adopted the Black-Scholes assumptions Black and Scholes (1973) for the linked-index and interest rate. We follow these assumptions. But, since the VA contract is quanto, we need to add exchange rate model.

More specifically, the linked-index $S(t)$ and exchange rate $C(t)$ follow geometric Brownian motions and the interest rate r (local currency) and r_f (foreign currency) are constants.

$$\begin{aligned}
\frac{dS(t)}{S(t)} &= \mu_S dt + \sigma_S dz_1(t), \\
\frac{dC(t)}{C(t)} &= \mu_C dt + \sigma_C[\rho dz_1(t) + \bar{\rho} dz_2(t)], \\
\frac{dB(t)}{B(t)} &= r dt, \\
\frac{dD(t)}{D(t)} &= r_f dt,
\end{aligned} \tag{5}$$

where $z_i(t)$, $i = 1,2$ are independent standard Brownian motions, σ_S is the volatility of the linked index, σ_C is the volatility of the exchange rate, ρ is the correlation coefficient between $\log(S(t))$ and $\log(C(t))$, $\bar{\rho} = \sqrt{1-\rho^2}$ is the orthogonal complement of ρ and $B(t)$ and $D(t)$ denote the local and foreign money market accounts, respectively. We call the models defined in (5) Black-Scholes quanto model Baxter and Rennie (1996). To make the model more concrete, we might assume that the local current currency is Australian dollar and the foreign currency is US dollar. So, there are three tradables in Australian dollar: $B(t)$, $C(t)D(t)$, and $C(t)S(t)$. Based on Girsanov's and martingale representation theorems (see Baxter and Rennie (1996), for example), there exists a unique measure Q such that, under which, both $C(t)D(t)/B(t)$ and $C(t)S(t)/B(t)$ are martingales. And under measure Q, the processes $S(t)$ and $C(t)$ can be written as

$$\begin{aligned}
\frac{dS(t)}{S(t)} &= (r_f - \rho\sigma_S\sigma_C)dt + \sigma_S d\tilde{z}_1(t), \\
\frac{dC(t)}{C(t)} &= (r - r_f)dt + \sigma_C[\rho d\tilde{z}_1(t) + \bar{\rho} d\tilde{z}_2(t)],
\end{aligned} \tag{6}$$

where $\tilde{z}_1$ and $\tilde{z}_2$ are independent standard Brownian motions under measure Q.

If a derivative's payoff depends only on $S(t)$ and/or $C(t)$, then its fair value can be represented as expectation under measure Q Baxter and Rennie (1996). This fair value is actually equal to the initial value of a (dynamic) replicating portfolio. Such valuation approach is usually called risk neutral valuation (see, for example, Harrison and Kreps (1979) and Harrison and Pliska (1981)) and measure Q is called risk neutral measure. Therefore, the fair value of the VA contract defined in Section 2 can be written as

$$V = E_Q[e^{-rT} P \cdot \max(R_M, G)], \tag{7}$$

where $E_Q[\cdot]$ denotes the expectation operator under measure Q.

4 MONTE CARLO APPROACH

It is well known that, under the risk neutral measure Q, $\log(R_t)$ are independent normal random variables with common mean

$$r_f - \rho\sigma_S\sigma_C - \frac{\sigma_S^2}{2}$$

and common variance σ_S^2 Hull (2006). Since R_M is just a function of $R_t, t = 1,\ldots,T$. Equation (7) implies Monte Carlo approach can be used to price the contract. We shall use control variates (see, e.g., Bratley et al. (1983) and Law and Kelton (2000)) to speedup the Monte Carlo method.

From Equation (7), it is easy to see that R_M can be a good control variate. To make R_M a valid control variate, we need to compute $E_Q[R_M]$. To this end, we follow the idea in Hsieh and Chiu (2007).

Using (2) we can get

$$\tilde{R}_t = (1-\alpha) + \alpha \min(\max(f_\alpha, R_t), c_\alpha), \tag{8}$$

where $f_\alpha = 1 + f/\alpha$ and $c_\alpha = 1 + c/\alpha$. Set

$$X_t = \min(\max(f_\alpha, R_t), c_\alpha). \tag{9}$$

Then it is easy to see that X_t's are independent censored lognormal random variables with censored values f_α and c_α.

We use (3) to obtain

$$\begin{aligned} E_Q[R_M] &= E_Q[1 - T + \sum_{t=1}^{T} \tilde{R}_t] \\ &= E_Q[(1-\alpha T) + \alpha T X_1] \\ &= 1 - \alpha T + \alpha T E_Q[X_1] \end{aligned} \tag{10}$$

Therefore, we reduce the task of computing $E_Q[R_M]$ to the task of computing $E_Q[X_1]$.

To compute $E_Q[X_1]$, we first write

$$\begin{aligned} E_Q[X_1] = {} & f_\alpha P(R_1 \le f_\alpha) + E_Q[[R_1; f_\alpha \le R_1 \le c_\alpha] \\ & + c_\alpha P(R_1 \ge c_\alpha). \end{aligned}$$

Then, by representing R_1 as

$$\exp(r_f - \rho\sigma_S\sigma_C - \sigma_S^2/2 + \sigma_S N(0,1))$$

and letting

$$d_1 = \frac{\log f_\alpha - r_f}{\sigma_S} + \frac{2\rho\sigma_C + \sigma_S}{2}, \tag{11}$$

and

$$d_2 = \frac{\log c_\alpha - r_f}{\sigma_S} + \frac{2\rho\sigma_C + \sigma_S}{2}, \tag{12}$$

we obtain

$$\begin{aligned} P(R_1 \le f_\alpha) &= P(N(0,1) \le d_1) = \Phi(d_1), \\ P(R_1 \ge c_\alpha) &= P(N(0,1) \ge d_2) = \Phi(-d_2), \end{aligned}$$

and

$$\begin{aligned} & E[R_1; f_\alpha \leq R_1 \leq c_\alpha] \\ = & \int_{d_1}^{d_2} e^{r_f - \rho\sigma_S\sigma_C - \sigma_S^2/2 + \sigma_S z} \cdot \phi(z) dz \\ = & e^{r_f - \rho\sigma_S\sigma_C}[\Phi(d_2 - \sigma_S) - \Phi(d_1 - \sigma_S)] \end{aligned}$$

where $\phi(\cdot)$ and $\Phi(\cdot)$ are the density function and the cumulative distribution function of standard normal random variable, respectively.

Combining these three terms, we get the explicit formula for $E_Q[X_1]$:

$$\begin{aligned} E_Q[X_1] = & f_\alpha\Phi(d_1) + c_\alpha\Phi(-d_2) \\ & + e^{r_f - \rho\sigma_S\sigma_C}[\Phi(d_2 - \sigma_S) - \Phi(d_1 - \sigma_S)] \end{aligned} \tag{13}$$

With (13) and (10), the following proposition is straightforward.

Proposition 1

$$\begin{aligned} E_Q[R_M] = & 1 - \alpha T \\ & + \alpha T(f_\alpha\Phi(d_1) + c_\alpha\Phi(-d_2)) \\ & + \alpha T e^{r_f - \rho\sigma_S\sigma_C}[\Phi(d_2 - \sigma_S) - \Phi(d_1 - \sigma_S)], \end{aligned}$$

where d_1, d_2 are defined in (11) and (12).

Now, we are ready to test some numerical examples. We begin with a description of the parameters of Black-Scholes quanto model for the VA contracts: the contract maturity $T = 5$, initial investment $P = 100$, floor rate $f = 1\%$, the volatility of the linked-index $\sigma_s = 25\%$, the volatility of the exchange rate $\sigma_C = 10\%$, the correlation coefficient $\rho = -0.1$, local currency interest rates $r = 6\%$, foreign currency interest rates $r_f = 4\%$, and the global guarantee rate $G = 110\%$.

We simulate 1000 independent runs of $(\tilde{R}_1, \cdots, \tilde{R}_T)$. From these 1000 simulated paths, we can easily obtain 1000 independent replications of $e^{-rT}P \cdot \max(R_M, G)$. Based on these independent copies, standard point estimates of $E[e^{-rT}P \cdot \max(R_M, G)]$, and their standard errors are computed and presented in Table 2.

The accuracy of the point estimates in Table 2 are not very satisfactory. We shall apply the variance reduction technique of control variate. In particular, we take advantage of Proposition 1 and select control variate

$$C = R_M - E_Q[R_M], \tag{14}$$

Using the same 1000 replications of $(\tilde{R}_1, \cdots, \tilde{R}_T)$, we can also obtain 1000 independent replications of C. Let λ_1 and λ_2 be any real numbers and set

$$Y(\lambda) = e^{-rT}P \cdot \max(R_M, G) - \lambda C$$

Since $E_Q[C] = 0$, it is easy to see that $E[Y(\lambda)]$ equal to the fair value of the VA contract. Therefore, it provides alternative mean of computing the price. It is well known that

Table 2: Fair value of the VA contract computed by naive Monte carlo method. The upper table contains point estimates and the lower table contains their standard errors.

$\alpha \setminus c$	0.10	0.15	0.20	0.30	0.40
0.6	90.81	95.26	98.34	101.77	103.20
0.8	91.78	97.37	101.60	107.26	110.28
1.0	92.42	98.69	103.86	111.26	116.01
1.2	92.86	99.60	105.43	114.34	120.50
1.4	93.17	100.30	106.56	116.74	124.11
1.6	93.41	100.84	107.45	118.63	127.09
1.8	93.60	101.25	108.17	120.12	129.58
2.0	93.76	101.59	108.77	121.30	131.64
0.6	0.199	0.288	0.361	0.462	0.517
0.8	0.208	0.310	0.395	0.533	0.626
1.0	0.212	0.322	0.418	0.578	0.701
1.2	0.214	0.329	0.433	0.609	0.754
1.4	0.216	0.334	0.443	0.634	0.792
1.6	0.218	0.336	0.450	0.652	0.823
1.8	0.219	0.338	0.455	0.666	0.848
2.0	0.220	0.340	0.457	0.676	0.868

the optimal (variance-minimizing) weight λ^* of the control variate is Cov(Y,C)/Var(C) Bratley et al. (1983). The quantities of Cov(Y,C) and Var(C) are estimated by the sample covariance and variance.

It turns out that control variate $Y(\lambda)$ is quite effective. Table 3 show the results. These results indicate that the accuracy of the estimates has been improved significantly with control variate C.

To further quantify the effectiveness of control variate C, we define variance reduction ratio as follows.

$$\mathrm{VRR} = \frac{\text{Var(naive estimator)}}{\text{Var(estimator with control variate)}} \tag{15}$$

Because most of the computational effort was used to generate the sample paths of $(\tilde{R}_1,\cdots,\tilde{R}_T)$, the additional work needed to compute C is minor. Therefore, it seems reasonable to use VRR as a proxy of computational gain. Table 4 shows that the quantities of variance reduction ratio range from 88 to 2070. This indicates control variate C is very effective in reducing the estimator's variance.

5 CONCLUDING REMARKS

In this paper, we introduced a variable annuity contract in Taiwan market. The variable annuity contract has quanto feature and embedded cliquet options. Such contracts are

Table 3: Fair value of the VA contract computed by Monte carlo method with control variate $C = R_M - E_Q[R_M]$. The upper table contains point estimates and the lower table contains their standard errors.

$\alpha \setminus c$	0.10	0.15	0.20	0.30	0.40
0.6	90.74	95.17	98.22	101.59	102.99
0.8	91.75	97.25	101.47	107.04	110.04
1.0	92.39	98.60	103.69	111.08	115.72
1.2	92.83	99.55	105.27	114.13	120.23
1.4	93.15	100.25	106.46	116.49	123.86
1.6	93.39	100.79	107.37	118.36	126.82
1.8	93.58	101.21	108.10	119.87	129.25
2.0	93.74	101.55	108.69	121.12	131.29
0.6	0.021	0.021	0.022	0.022	0.022
0.8	0.020	0.020	0.021	0.021	0.021
1.0	0.020	0.020	0.020	0.020	0.020
1.2	0.019	0.019	0.020	0.020	0.020
1.4	0.019	0.019	0.019	0.019	0.020
1.6	0.019	0.019	0.019	0.019	0.019
1.8	0.019	0.019	0.019	0.019	0.019
2.0	0.019	0.019	0.019	0.019	0.019

attractive to the investor because of their protection against downside risk and significant upside potential. We proposed a control variate for improving the computation efficiency of valuing such contracts. The numerical results show that the control variate is quite effective. This also suggests that Monte Carlo methods can be a very efficient computational tool for pricing complex insurance products.

Our study also provides computational tools for analyzing the trade-off among various parameters for such contracts. For example, the following information can be obtained from our study:

1. The effect of participation rate α on cost;
2. The effect of ceiling rate c on cost;
3. The effect of floor rate f on cost; and
4. The effect of the global guarantee rate G on cost.

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Table 4: Variance reduction ratio of control variate $C = R_M - E_Q[R_M]$.

$\alpha \setminus c$	0.10	0.15	0.20	0.30	0.40
0.6	87.9	179.4	275.4	435.6	537.2
0.8	104.9	228.3	366.5	647.4	875.2
1.0	116.1	263.3	439.2	818.7	1184.1
1.2	123.2	286.2	490.0	951.3	1432.8
1.4	128.4	301.5	526.1	1059.6	1631.4
1.6	132.4	312.5	553.5	1144.8	1799.3
1.8	135.7	321.1	573.8	1213.4	1946.9
2.0	138.3	328.6	589.2	1268.6	2069.6

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□ □ □ □ □ □ The Effects of Corporate Governance on Idiosyncratic Risk: Evidence from Taiwan Financial Institutions

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We use the data of Taiwanese financial institutions from 2006:Q1 to 2012:Q4 to examine the effects of corporate governance mechanisms on idiosyncratic risk. Our results show that the firms with better corporate governance mechanisms (including more independent board, better transparency) tend to have a lower idiosyncratic risk. However, firms with higher foreign ownership appear to have a higher idiosyncratic risk.

Keywords: dynamic panel regression, corporate governance, idiosyncratic Risk.

1. Introduction

The financial industry is an indicator of national economic development and plays an important role in economic activities. If the financial industry is mismanagement, financial institutions will lose financial intermediation functions, and affects the development of other industries. In addition, if a financial crisis occurs, the crisis would seriously affect the financial order and economic development. Therefore, some series of financial industry problems, like the Iceland financial crisis and the Lehman Brothers bankruptcy, raised the global financial crisis. Thus, in the academic field, find out the mechanisms of avoiding malpractice and reducing risk of financial industry is critical.

Since the opening to establishing private banks in Taiwan in 1991, Taiwan has adopted a series of financial reforms, which have substantially increased the number of financial institutions in Taiwan. Consequently, harsh competition has occurred between financial institutions, and credit quality have deteriorated, bank profits have decreased, and non-performing loan ratios have increased, thereby increasing the risk and damaging the rights of stakeholders. Therefore, how to decrease the risk and avoid financial crisis of Taiwan is an important issue.

BASEL III suggested to strengthened corporate governance to prevent the risk occurring from the financial industry. Besides, previous studies also indicate that corporate governance serve as a type of a mechanism, protect minority shareholders and stakeholders, and enhance the wealth of shareholders. Lin, et al. (2010) specified that through the design of the corporate governance mechanism could reduce the agency problems and decrease idiosyncratic risk. Firms with better corporate governance mechanisms have fewer agency problems. The idiosyncratic risk of the firm and capital costs would be reduced, thereby enhancing corporate performance and shareholder wealth. Hence, if financial institutes establish better corporate governance mechanisms can reduce the risk to improve the financial industry environment and to avoid malpractice of the financial industry.

However, the literatures regarding the effects of corporate governance quality on the risk of financial institutions is lack. Furthermore, after reviewing the literature, numerous studies have focused on exploring the relationship between partial corporate governance mechanisms and firm performance. Few studies have explained the relationship between corporate governance and risk. Thus, to make up the gap in the literatures, this study provides direct empirical evidences of the effects of corporate governance quality on risk. This paper follows Lin et al. (2010) to use idiosyncratic risk as the proxy for the level of risk in financial industry. The idiosyncratic risk represents the risk link with how the financial institutes operate their own business and systems.

In this study, the financial holding industry, banking industry, and securities industry in Taiwan were the research subjects. Empirical evidence was used to analyze the relationship between financial corporate governance mechanisms and idiosyncratic risk. Flannery and Hankins (2013) indicated that dynamic panel data regression has become increasingly vital in the corporate finance field. In addition, if explained variables of lag periods are included in independent variables, dynamic panel data regression must be used to avoid biased parameter estimates. Thus, this paper modified the empirical model by Lin et al. (2010) and used dynamic panel data regression in this study. This study also referred to Arellano and Bond (1991) and conducted generalized method of moments (GMM) regression to estimate the regression parameters. Furthermore, the Sargan test was used to examine the effectiveness of the instrumental variables adopted by the dynamic panel data regression.

This study explored the effects of corporate governance quality on idiosyncratic risk. Corporate governance involves ownership structure, board structure, executive incentive, and information disclosure. The results show that when the high proportion of independent directors and supervisors in the board associated with lower idiosyncratic risk. Moreover, higher information transparency indicates less idiosyncratic risk. The main contribution of this study is the comprehensive investigation on the effects of the corporate governance mechanism on idiosyncratic risk in financial industry.

The literature mainly focuses on exploring the effects of the corporate governance mechanism on operating performance or conceptually explains the influence of parts of the corporate governance mechanism on idiosyncratic risk. These studies have failed to examine the effects of the entire corporate governance mechanism on idiosyncratic risk. Only Lin et al. (2010) used general industry as the research subject and comprehensively focused on the effect of internal and external corporate governance mechanisms on idiosyncratic risk. However, they did not examine the financial industry. Because the financial sector is a franchise industry and is closely related to the public, a firm must possess a strong corporate governance mechanism. We conducted comprehensive analysis to determine how the corporate governance mechanisms influence idiosyncratic risk. This study can serve as a reference for government agencies and financial institutions in promoting corporate governance so that the essence of corporate governance can be implemented to maintain stakeholder interests. Thus, corporate organizations and operations can develop steadily. Section II presents a literature review; Section III introduces data sources, variable definitions, and the research model; Section IV shows the empirical analysis results; and Section V the conclusions

2. Literature Review

2.1. *Financial Institutions and Corporate Governance*

The financial industry is the primary industry in a nation. However, Taiwan’s financial industry lacks industrial competitiveness. Since 1980, to adapt to the globalization and liberalization trends in the global financial markets, the government has gradually relaxed the financial regulatory measures and reduced the regulatory thresholds for establishing banks. The government hope that by enabling fully competition in the financial industry, the industry could improve efficiency and establish fair competition in the financial system.

Because of the special nature of the financial industry, poor operations affect the firm role as funding agencies and the national economic development. Chen (2005) presented characteristics of the financial industry and the necessity of strengthening corporate governance. First, the financial industry is the economic lifeline of a nation. Corporate borrowing, fund collection, and international trade are dependent on the financial sector. If the financial sector possesses poor corporate governance, the funding agency function would be compromised and would affect the economic sector. Major funding in the financial institution is obtained from the public. Specifically, banking funds are primarily obtained from the community. Although banks possess low equity funds, they operate large-scale businesses. With this operation from a high financial leverage, corporate governance must be implemented to safeguard the rights and interests of depositors. Regarding the financial industry, integrity and trust are essential; therefore, the managerial style and ethical standards determine the stability of a bank and bank performance. Taiwan's financial institutions have focused on a personal-network and family-oriented business model in financial institutions, which is a substantial barrier to corporate governance. Taiwan's financial institution requires a stable corporate governance mechanism to reduce the risks and problems in moral issues.

To implement a stable corporate governance system and promote the healthy development of the financial market, the Taiwanese government has made several major revisions to the legal regulations and initiated a series of complementary measures and reform items.

2.1.1. Improving the independency of board

To prevent the board from becoming a formality, the Securities and Futures Commission of Ministry of Finance, beginning in February 22, 2002, implemented an independent director and supervisor system in two stages. During the first stage, initial public offering (IPO) and over the counter (OTC) firms must disclose in their annual report whether the board of directors comply with crucial resolutions made by directors and supervisors and the opinions of both parties. In addition, to apply for becoming a listed or OTC firm, firms must establish at least two independent directors and one independent supervisor. If these firms failed to follow these requirements, they could not be listed. The second stage involved publically promoting these regulations to encourage all the listed and OTC firms to implement these regulations.

2.1.2. Strengthen the information transparency

Financial holding corporations should disclose all net operating income. This included a financial holding corporation's banks, insurance, securities, and investment firms; current regulations do not specifically require that corporations reveal all of their businesses and regions of operation. Consequently, corporate profit sources are vague to the public. Regarding corporate expansion and globalization, financial institutions must revise disclosure items to respond to global trends. Domestic banking businesses focus on lending, but the competent authority has not regulated the disclosure lending structure. Consequently, investors are unable to obtain the lending policies of various banks or subsequently assess potential credit risks.

2.1.3. The Best-Practice Principles of Corporate Governance

To implement a corporate governance system, the Taiwanese government released the Corporate Governance Best-Practice Principles for TSEC/GTSM Listed Companies, which was approved by the Securities and Futures Commission, in October 2002. The content contains provisions regarding protecting shareholder equity, strengthening board responsibilities, exerting the supervisor functions, respecting stakeholder rights and interests, and enhancing information transparency.

2.2. *The Corporate Governance and Risk in Financial Industry*

The majority of the literature explores only the relationship between partial corporate governance mechanisms and risk. Regarding internal corporate governance mechanisms, empirical studies have indicated that strong corporate governance could reduce the capital costs of firms, but they failed to explain the relationship between corporate governance and the idiosyncratic risk of capital cost. Himmelberg et al. (1999) stated that when managers possessed high shareholding ratio idiosyncratic risk was reduced. Regarding the external governance mechanism, Jin and Myers (2006) conducted an empirical study from a national perspective. They found that firms possessing less information transparency exhibited high idiosyncratic risk. However, they did not research the quality of firm-level governance and its effects on idiosyncratic risk. Moreover, Gasper and Messa (2006) used data obtained from CRSP Compustat to analyze the effects of product market competition on idiosyncratic risk. The study showed that highly competitive product markets exhibited increased idiosyncratic risk. Ferreira and Laux (2007) explored the effects of the market for corporate control on idiosyncratic risk. Their results indicated that firms that possessed numerous anti-takeover provisions had low idiosyncratic risk. Unlike previous studies, Lin et al. (2010) examined the effects that comprehensive corporate governance, which involved internal and external mechanisms, has on idiosyncratic risk. The results indicated that when the shareholding ratio by external blockholders, ratio of independent directors and supervisors on boards, and shareholding ratio by managers were high, and when information was obtained in a timely manner, then idiosyncratic risk was reduced. In other words, improved internal corporate governance mechanisms effectively reduce idiosyncratic risk. Legal regulations and product market competitiveness have no substantial effects on idiosyncratic risk, thereby indicating that external corporate governance mechanisms cannot reduce idiosyncratic risk.

Regarding the financial industry, scholars have mostly focused on parts of corporate governance mechanisms and their effects on system risk or corporate governance mechanisms and their influence on partial idiosyncratic risk. Saunders et al. (1990) examined the relationship between bank ownership structure and risk taking. The results indicated that total risk, non-system risk, and the shareholding ratio of operators are significantly positively correlated. In addition, the non-significant relationship between system risk and the shareholding ratio of operators indicated the importance of idiosyncratic risk. Chen (2003) examined factors from 1996 to 2001 (i.e., the period of Taiwanese bank recession) that influenced bank risk-taking behavior. They found that corporate governance mechanisms had a significant effect on bank credit risks and overall risks. Chen et al. (1998) used 302 banks from 1988 to 1993 as their sample. The study indicated that the shareholding ratio of management (including managers and directors) was negatively correlated with the risk proxy variables in two-factor market models.

In other words, when the shareholding ratio of management increased, risk aversion behaviors also increased, thereby supporting the relative risk aversion hypothesis. Cebenoyan et al. (1995) found that when institution investors possessed high shareholding ratios, the risk-taking rate of the bank was reduced, thereby supporting the efficient monitoring hypothesis. However, Li (2002) showed that high shareholding ratios by institution investors increased bank credit risk, market risk, and overall risk. This relationship supported the conflict of interest hypothesis. Kan (2003) indicated that no significant correlation was observed between the shareholding ratio by legal personalities of institutions and the nonperforming loan ratio of a bank.

3. Methodology

3.1. *The Data*

Financial institutions issued by the Taiwan Stock Exchange were recruited as research subjects, including independent banks of the listed and OTC firms, financial holding banks, and securities industry. Research data included the Taiwan stock index, firm stock price, and financial reports. All data were obtained from the Taiwan Economic Journal (TEJ) and Market Observation Post System based on public-issued listed and OTC firms.

Because the insurance industry lacks information disclosure mechanisms, these firms were not included in this study. For the research sample, 33 firms were selected including nine independent banks, 14 financial holding banks, and 10 securities firms. Prior to 2006, TEJ only collected semiannual reports of the financial industry firms and not quarterly reports; therefore, this study began its examination from the first quarter of 2006 to the fourth quarter of 2012; the period was 7 years, overall. The study examined the data of the quarterly reports for each year.

3.2. *The Variable Definitions*

3.2.1. Ownership structure

This study used the shareholding ratio by external blockholders and by institutional legal personalities as the proxy variables for the ownership structure. This study defined the external blockholder ownership (BOR) as the shareholding ratio of blockholders who were not identified as directors and managers. The institutional ownership (IOR) was defined as the sum of the ratio of foreign legal personality ownership from the investment sample firms (FOREIGN), investment trust and consulting ownership (ITCS), and the dealer shareholding ratio (DEALERS). This study predicted that when the external blockholder shareholding ratio and the institutional legal-personality shareholding ratio were high, then the supervising ability of a firm would be high and idiosyncratic risk would be low.

3.2.2. Managerial incentives

This study used managerial ownership ratio (MOR) as the proxy variable of the managerial incentive mechanism. We predicted that when the managerial shareholding ratio was high, the interests of the managers and shareholders would be consistent and idiosyncratic risk would be low.

3.2.3. Board composition

This study defined the independent director and supervisor ratio to the overall director and supervisor seats (INDR) as the number of seats of independent directors and supervisors of the sample firm divided by the total seats of the board of directors and supervisors. This study predicted that a high ratio of independent directors and supervisors to the director and supervisor seats would elicit a highly independent board. Thus, the managerial supervisory capacity would be strong and the idiosyncratic risk low.

3.2.4. Information transparency

This study used information timeliness and disclosure rating as proxy variables of information transparency. This study predicted that when the information transparency is high, the quality of corporate governance is strong and therefore idiosyncratic risk is low.

3.2.4.1. Information timeliness

Timeliness of information (TIMELINESS) was used as the first proxy variable of information transparency (Ashbaugh et al., 2006). The regression equation is established as follow:

$$RET_{i,\tau} = \beta_0 + \beta_1 NIBE_{i,\tau} + \beta_2 LOSS_{i,\tau} + \beta_3 NIBE_{i,\tau} \times LOSS_{i,\tau} + \beta_4 \Delta NIBE_{i,\tau} + \varepsilon_{i,\tau} \quad (1)$$

where $RET_{i,\tau}$ represents the average stock return of firm i in quarter τ; $NIBE_{i,\tau}$ denotes the quarterly net income of firm i in quarter τ divided by the shareholder equity market cap at the beginning of the quarter; $LOSS_{i,\tau}$ represents a dummy variable. When $NIBE_{i,\tau}$ is a negative number, $LOSS_{i,\tau}$ is 1; otherwise, $LOSS_{i,\tau}$ is 0; ($\Delta NIBE_{i,\tau}$) represents the quarterly net income change of firm i in quarter τ divided by the shareholder equity market cap at the beginning of the quarter. Regression analysis on data of quarter τ of all firms is conducted using (1). The regression residual i resulting from the regression analysis is squared and multiplied by -1. The product is information timeliness ($TIMELINESS_{i,\tau}$) of firm i in quarter. When $TIMELINESS$ is high, the data respond to return in a timely manner; therefore, firm information transparency level is high.

3.2.4.2. Disclosure rating

Information disclosure assessment (INF) was used as the second proxy variable representing information transparency. To measure the degree of information disclosure, this study cited the assessment results of the information disclosure and transparence ranking system provided by the Taiwan Securities and Futures Institute. The following paragraphs present the assessment ranks converted into numeral codes for measurements, as shown in Table 1.

Table 1 The rating scale of information transparency

The Rating Scale	Codes
A+	5
A	4
B	3
C	2
C−	1

3.2.5. The measurement of idiosyncratic risk

This study follows the direct decomposition method by Xu and Malkiel (2003) to estimate idiosyncratic risk. In addition, by establishing the market model, we estimated the volatility sequence of idiosyncratic and systemic risks. To solve the heteroscedasticity and heavy-tailed distribution patterns concerns that the sequence of returns possessed, when estimating idiosyncratic risk, we used a GARCH model to modify the direct decomposition method by Xu and Malkiel (2003).

$$r_{i,\tau} = \alpha_i + \beta_i r_{m,t} + \varepsilon_{i,t} \tag{2}$$

$$r_{i,t} = \alpha_i + \beta_i r_{m,t} + \gamma_i r_{mv,t} + \kappa_i r_{b/v,t} + \varepsilon_{i,t} \tag{3}$$

(2) is the market model, where α_i and β_i represent parameters to be estimated; $r_{i,t}$ denotes the excess return of stock i on day t; $r_{m,t}$ depicts the excess return of the market portfolio on day t, and $\varepsilon_{i,t}$ represents the residuals. The equation (3) is three factor model proposed by Fama and French (1993), where r_i, k_i represent parameters to be estimated; $r_{mv,t}$ represent the market size factor, $r_{b/v,t}$ represents the book to market value factor.

In general, (2) and (3) disregards the issue that data in financial asset time series possesses heteroscedasticity, which leads to inefficient estimations of the parameters. Thus, Xu and Malkiel (2003) used rolling methods to estimate the idiosyncratic risk of individual stocks to solve conditional heteroscedasticity. In (2) and (3), the residuals appeared to possess a GARCH-model effect. Because of this effect, the idiosyncratic risk of market factors was estimated.

$$\varepsilon_{i,t} \mid \psi_{t-1} \sim N(0, h_{i,t}^2) \tag{4}$$

$$h_{i,t}^2 = \phi_0 + \phi_1 \varepsilon_{i,t-1}^2 + \phi_2 h_{i,t-1}^2 \tag{5}$$

where ψ_{t-1} represents the total information collection prior to period $t-1$; ϕ_0, ϕ_1, ϕ_2 are parameters that are not negative numbers, and $\phi_0 + \phi_1 < 1$; $h^2_{i,t-1}$ denotes the estimate of idiosyncratic risk of stock i at period t; $\varepsilon^2_{i,t-1}$ represents the residual square of idiosyncratic risk of stock i during period $t-1$; if $h^2_{i,t}$ were calculated using market model; $hF^2_{i,t}$ were calculated using three factor model.

Because relevant financial variables could only be obtained from quarterly data reports, we converted the other research variables into variables representing quarterly data. Daily idiosyncratic risk $h^2_{i,t}$ and $hF^2_{i,t}$ were converted into quarterly idiosyncratic risk by adding all trading days in that quarter. The converted idiosyncratic risks are denoted by $IV_{ij,\tau}$ and $FIV_{ij,\tau}$

.3.2.6. Control variables

This study establishes 8 control variables in the study model. The following control variables were converted into quarterly data. The 8 control variables were firm size ($LNSIZE_{i,\tau}$), market-to-book ratio ($MTB_{i,\tau}$), leverage rate ($LEV_{i,\tau}$), stock turnover ratio ($TURN_{i,\tau}$), capital expenditure ratio ($CE_{i,\tau}$), return on assets ($ROA_{i,\tau}$), non-performing loans ($NPL_{i,\tau}$), and bank of international settlement ratio ($BIS_{i,\tau}$).

3.3. Empirical Model

Because the data in this study were panel data that involved cross-sectional and time-series data of the listed firms in Taiwan's financial industry from 2006:Q1 to 2012:Q4, the data were suitable for constructing a panel-data model for statistics analysis, thereby reducing the collinearity problem. Flannery and Hankins (2013) indicated that when a lagged period of an explained variable was included in the explanatory variables, a dynamic panel data-regression model was used to conduct empirical analysis to avoid deviated parameter estimates. Thus, the dynamic panel data-regression model was established as follows:

$$Y_{i,\tau} = \beta_{oi} + \sum_{k=2}^{K} \beta_k X_{ki,\tau-1} + \varepsilon_{i,\tau},\ i = 1,\ldots,N, \tau = 1,\ldots,T \tag{6}$$

where $Y_{i,\tau}$ represents the idiosyncratic risk ($IV_{i,\tau}$ or $FIV_{ij,\tau}$) of firm i in quarter τ; $X_{ki,\tau}$ denotes the Kth explanatory variable of firm i in quarter τ; $\beta_0, \beta_1, \ldots, \beta_K$ represent the parameters to be estimated; and $\varepsilon_{i,\tau}$ denotes a random error item.

4. Results

4.1. Descriptive Statistics

This study used the Taiwan financial holdings, banks and securities firms from 2006:Q1 to 2012:Q2 as samples. Descriptive statistical analysis was conducted to obtain the mean, standard deviation, median, and quartiles of the various research variables. Table 2 presents the descriptive statistical analysis of the overall sample.

The results presented in Table 2 are the results of the descriptive statistics of all sample variables. First, by observing the blockholder shareholding ratio, the mean shareholding ratio of the external blockholders of the sample firms was established as 4.08% (SD 0.0833). The first quartile and the third quartile were 0, which indicated that the external blockholder shareholding ratio in the sample firms was generally low and the differences were not significant. Regarding the shareholding ratio of institutional legal personalities, foreign ownership possessed the highest shareholding ratio, with a mean of 16.12% and a median of 10.55%. The results indicated that foreign ownership was relatively strong compared with other types of legal-personality ownership.

In addition, the shareholding ratio presented a negative skew, thereby indicating that foreign ownership had a relatively high shareholding ratio in specific firms. The results in the table show that the mean value of the managerial shareholding ratio was 0.25%. The data indicated that in over half of the sampled firms, the managerial shareholding ratio was 0%. If these firms do not have a comprehensive and stable supervising mechanism or transparent information disclosure policy, then these firms have severe agency problems and information asymmetry concerns.

Regarding board composition, the mean value was 12.44 (SD 0.1001), and the sample firms showed only a slight difference, thereby indicating that employing independent directors and supervisors was common in the sample firms. Regarding operating performance, the mean value of the return on assets was 0.53% and the standard deviation was 0.0133, which indicated that the average performance of the financial industry from 2006 to 2012 was relatively poor.

	Average	St. Dev.	Q1	Median	Q3
$IV_{i,\tau}$	1.6953	0.2465	1.5525	1.6855	1.8896
$FIV_{ij,\tau}$	1.7121	0.2634	1.5888	1.7045	1.9108
$BOR_{i,\tau}$	0.0408	0.0833	0.0000	0.0000	0.0000
$IOR_{i,\tau}$	0.1701	0.1488	0.0332	0.1189	0.2793
$FOREIGN_{i,\tau}$	0.1612	0.1521	0.0411	0.1055	0.2753
$ITCS_{i,\tau}$	0.0065	0.0071	0.0005	0.0042	0.0098
$DEALERS_{i,\tau}$	0.0038	0.0099	0.0000	0.0009	0.0031
$INDR_{i,\tau}$	0.1244	0.1001	0.0000	0.1266	0.2000
$MOR_{i,\tau}$	0.0025	0.0040	0.0004	0.0015	0.0048
$TIMELINESS_{i,\tau}$	-0.1421	0.0555	-0.1233	-0.1167	-0.1132
$INF_{i,\tau}$	3.9788	0.8221	4.0000	4.0000	4.0000
$LEV_{i,\tau}$	0.8121	0.1634	0.6905	0.9091	0.9532
$CE_{i,\tau}$	0.0252	0.0233	0.0122	0.0171	0.0320
$MTB_{i,\tau}$	0.0201	0.0048	0.0082	0.0108	0.0129
$ROA_{i,\tau}$	0.0053	0.0133	0.0012	0.0031	0.0080
$LNSIZE_{i,\tau}$	24.2555	1.3434	23.2134	24.1279	25.4434
$TURN_{i,\tau}$	0.0045	0.0049	0.0011	0.0025	0.0050

Note: Q1 and Q3 are represented the firth and third quartile. $IV_{i,\tau}$ is represented the idiosyncratic risks of firm i at quarter τ. $BOR_{i,\tau}$, $IOR_{i,\tau}$, $MOR_{i,\tau}$ are represented the outside block-holder ownership, institutional ownership, managerial ownership of firm i at quarter τ. $INDR_{i,\tau}$ is represented the proportion of independent supervisor/director in the board of firm i at quarter τ. We take $TIMELINESS_{i,\tau}$ for estimating the information timeliness of firm i at quarter τ. $LNSIZE_{i,\tau}$, $MTB_{i,\tau}$, $LEV_{i,\tau}$, $TURN_{i,\tau}$, $CE_{i,\tau}$ and $ROA_{i,\tau}$ are the control variables.

4.2. Correlation Coefficient Analysis

Before a regression model could be established, high degrees of similarities between independent variables must be prevented from influencing the study results. We conducted Pearson correlation coefficient analysis to explore variables related to corporate governance regarding the extent of relationships and the trend of idiosyncratic risk. These variables were as follows: an external block-holder shareholding ratio; shareholding ratio by institutional ownership; shareholding ratio of foreign ownership; shareholding ratio by securities investment trust and consulting representatives; shareholding ratio by dealers; the number of independent directors and supervisors; shareholding ratio by managers; information timeliness; information transparency; and disclosure assessments.

Correlation coefficient analysis indicated that the current idiosyncratic risk and the idiosyncratic risk for the following period were positively correlated. Regarding internal corporate governance variables, the shareholding ratio by institutional leg personalities, shareholding ratio of foreign ownership, shareholding ratio by dealers, and the cost and price differences were all positively correlated with idiosyncratic risk. However, the correlations were not significant. All other variables showed significant correlations with idiosyncratic risk. When the external blockholder shareholding ratio, securities investment trust and consulting representatives, the ratio of independent directors and supervisors, and the shareholding ratio by managers were high, then idiosyncratic risk would also be high. In addition, the two variables related to information transparency (i.e., information timeliness and information disclosure assessment) were negatively correlated with idiosyncratic risk.

		A	B	C	D	E	F	G	H	I	J	K
IV_{t+1}	A	1.00										
IV	B	**0.69**	1.00									
BOR	C	**0.09**	0.07	1.00								
FOREIGN	D	0.00	0.02	**-0.22**	1.00							
ITCS	E	**0.12**	0.06	**-0.14**	**0.39**	1.00						
DEALERS	F	0.05	0.06	0.03	0.02	-0.06	1.00					
IOR	G	0.01	0.02	**-0.22**	**0.99**	**0.43**	**0.08**	1.00				
INDR	H	**0.15**	0.08	**0.21**	**0.14**	0.07	-0.02	**0.14**	1.00			
MOR	I	**0.13**	**0.10**	**-0.18**	**-0.13**	**-0.17**	-0.05	**-0.14**	**-0.12**	1.00		
TIMELINESS	J	**-0.27**	**-0.23**	-0.08	**0.09**	**0.14**	-0.05	**0.09**	-0.01	-0.07	1.00	

INF	K	**-0.19**	**-0.19**	**-0.09**	-0.03	.217**	0.02	-0.01	0.00	**-0.24**	**0.12**	1.00

Note: The definitions of variables are reported in table 2. Bold-faced coefficients are significant at the 1% and 5% level, respectively.

4.3. Empirical Results

The results presented in Table 4 showed that the entire current idiosyncratic risk of the model and the idiosyncratic risk for the following period were positively correlated. These results indicated that the idiosyncratic risk of a firm could change over time. In addition, the effects of partial corporate governance on idiosyncratic risk were significant. One exception was that the shareholding ratio by blockholders was positively but not significantly correlated with idiosyncratic risk. The shareholding ratio by managers and was negatively, but not significantly, correlated with idiosyncratic risk. Reaching more than the 5% level of significance, the other variables, such as the ratio of independent directors and supervisors on the board, information timeliness, and information disclosure assessments, were negatively correlated to idiosyncratic risk. This trend showed that high information transparency levels indicate low idiosyncratic risk in financial institutions. When the ratio of independent directors and supervisors on the board was high, the idiosyncratic risk of the firm is low. These results were consistent with the study predictions. The shareholding ratio by institutional legal personalities and idiosyncratic risk were positively correlated, thereby indicating that when the shareholding ratio by institutional legal personalities was high, the idiosyncratic risk of the financial institution was also high. This result was inconsistent to our predictions.

To comprehensively understand the relationship of the shareholding ratio by institutional legal personalities to idiosyncratic risk, this study defined the shareholding ratio by institutional legal personalities separately as the shareholding ratio of foreign ownership, shareholding ratio by securities investment trust and consulting representatives, and shareholding ratio by dealers.

The results shown in Table 5 indicate that the current idiosyncratic risk and the idiosyncratic risk of the following period were positively correlated, thereby suggesting that idiosyncratic risk change over time. By reaching a level of significance of more than 5%, the ratio of independent directors and supervisors on the board and information transparency were negatively correlated to idiosyncratic risk. This indicated that a high number of independent director and supervisors on the board along with high information transparency lowers the idiosyncratic risk of financial institutions. The shareholding ratio by foreign investors and idiosyncratic risk were positively correlated. This indicated that when the shareholding ratio by foreign investors was high, the idiosyncratic risk was high. Regarding the control variable results, Tables 4 and 5 indicate that at a 5% level of significance, firm size and idiosyncratic risk were negatively correlated. A large-scale firm experiences low idiosyncratic risk. In addition, at a 5% level of significance, leverage ratio and idiosyncratic risk were positively correlated, thereby indicating that when high leverage ratios increase idiosyncratic risk increases.

This study also used idiosyncratic risk that was estimated by the three-factor model to verify the stability. The results shown in Tables 4 and 5 are consistent. Therefore, financial institutions must strengthen corporate governance quality to reduce idiosyncratic risk and protect the rights and interests of all stakeholders.

Previous studies have focused on exploring whether the corporate governance mechanisms in general industry could enhance corporate operating performance and shareholder wealth. These studies have rarely focused on the effects of the quality of corporate governance in the financial industry on idiosyncratic risk. In addition, relevant studies have been limited to the influence of partial corporate governance mechanism on idiosyncratic risk. These studies were not comprehensive investigations on the effect of corporate governance mechanisms in the financial industry on firm idiosyncratic risk. Only Lin et al. (2010) used general industry as the research subject and comprehensively explored the effect of the corporate governance mechanism on idiosyncratic risk.

Due to the financial sector is a franchise industry and is closely related to the public, a financial institution with a strong corporate governance mechanism is essential. This study comprehensively analyzed the factors of corporate governance that influenced the idiosyncratic risk in financial industry. These factors can serve as a reference for competent authorities in governmental sectors and financial institutions that are promoting corporate governance. Thus, the essence of corporate governance can be implemented to maintain stakeholder rights and interests and corporate organizations and operations can develop steadily.

This study was conducted from the corporate governance mechanism perspective for investigating idiosyncratic risk in financial institutions. By using dynamic panel data modeling and by using listed and OTC firms from 2006 to 2012 as the study sample, we explored vital corporate governance mechanisms, such as ownership structure, board composition, managerial incentive systems, and information transparency and their relationship with idiosyncratic risk in financial institutions.

First, the empirical results showed that regarding ownership structure, the institutional ownership was positively correlated to firm idiosyncratic risk. After further analysis, the results showed that the foreign investor shareholding ratio and idiosyncratic risk were positively correlated. The main reason for this result could be that foreign investment in Taiwan's financial institution is primarily short term. Thus, foreign investment did not achieve the effect of an institutional legal personality on monitoring corporate operations. Based on board composition, more independent directors and supervisors on the board are correlated to low idiosyncratic risk. This result indicated that when boards of directors of financial institutions in Taiwan possessed high independence, the firm idiosyncratic risk decreased. Finally, high information transparency in a financial institution was correlated to low idiosyncratic risk. Thus, we recommend that the financial industry increase the board of director independence and information transparency to reduce idiosyncratic risk.

Table 4 The empirical results from dynamic panel data regression: market model

Explanatory variables (expected sign)	Dependent variable $IV_{i,\tau+1}$	
	Model 1	Model 2
Intercept	3.2832 (0.9217)	3.5423 (0.9387)
$IV_{i,\tau}$ (+)	2.3341 (0.0000) ***	2.5454 (0.0000) ***
$BOR_{i,\tau}$ (−)	0.1121 (0.5431)	0.1221 (0.5521)
$IOR_{i,\tau}$ (−)	1.2434 (0.0011) ***	
$FOREIGN_{i,\tau}$		0.9987 (0.0000) ***
$ITCS_{i,\tau}$		-1.2563 (0.7676)
$DEALERS_{i,\tau}$		-0.8876 (0.5521)
$TIMELINESS_{i,\tau}$ (−)	-0.0451 (0.0185) **	-0.0444 (0.0178) **
$INF_{i,\tau}$ (−)	-0.3321 (0.0703) *	-0.3561 (0.0773) *

$INDR_{i,\tau}$ (−)	-0.2122	-0.2139
	(0.0340) **	(0.0355) **
$MOR_{i,\tau}$ (−)	-4.2541	-4.6657
	(0.6676)	(0.6709)
$LNSIZE_{i,\tau}$ (−)	-2.1231	-2.1333
	(0.0000) ***	(0.0000) ***
$MTB_{i,\tau}$ (−)	-3.2122	-3.3455
	(0.5143)	(0.5298)
$LEV_{i,\tau}$ (+)	1.1121	1.1222
	(0.7671)	(0.7688)
$TURN_{i,\tau}$ (+)	0.2212	0.2393
	(0.0796) *	(0.0788) *
$CE_{i,\tau}$ (+)	0.8878	0.8999
	(0.8522)	(0.8437)
$ROA_{i,\tau}$ (−)	0.3122	0.3102
	(0.4771)	(0.4777)
Time dummy variables	Yes	Yes
Industry dummy variables	Yes	Yes
$Ad - R^2$	0.2208	0.2332
$Sargan\ Test$	18.2119	19.4531
	(0.3229)	(0.3131)

Table 5 The empirical results from dynamic panel data regression: three-factors model

Explanatory variables (expected sign)	Dependent variable $FIV_{i,\tau+1}$	
	Model 1	Model 2
Intercept	2.9877	2.9889
	(0.3565)	(0.3566)
$FIV_{i,\tau}$ (+)	3.8901	3.8999
	(0.0000) ***	(0.0000) ***
$BOR_{i,\tau}$ (−)	0.2221	0.2233
	(0.3331)	(0.3333)
$IOR_{i,\tau}$ (−)	1.9871	
	(0.0031) ***	
$FOREIGN_{i,\tau}$		0.9987 ***

		(0.0000)
$ITCS_{i,\tau}$		-1.2563
		(0.7676)
$DEALERS_{i,\tau}$		-0.8876
		(0.5521)
$TIMELINESS_{i,\tau}$ $(-)$	-0.1111	-0.1231
	(0.0085) ***	(0.0088) ***
$INF_{i,\tau}$ $(-)$	-0.5432	-0.5569
	(0.0431) **	(0.0448) **
$INDR_{i,\tau}$ $(-)$	-0.3321	-0.3354
	(0.0255) **	(0.0255) **
$MOR_{i,\tau}$ $(-)$	-3.9908	-3.9967
	(0.4444)	(0.4434)
$LNSIZE_{i,\tau}$ $(-)$	-2.2221	-2.2891
	(0.0000) ***	(0.0000) ***
$MTB_{i,\tau}$ $(-)$	-3.4535	-3.5643
	(0.4989)	(0.5001)
$LEV_{i,\tau}$ $(+)$	1.1321	1.1443
	(0.5998)	(0.5988)
$TURN_{i,\tau}$ $(+)$	0.4509	0.4565
	(0.0888) *	(0.0889) *
$CE_{i,\tau}$ $(+)$	0.8779	0.8760
	(0.7677)	(0.7543)
$ROA_{i,\tau}$ $(-)$	0.4454	0.4631
	(0.3339)	(0.3341)
Time dummy variables	Yes	Yes
Industry dummy variables	Yes	Yes
$Ad-R^2$	0.3001	0.3021
$Sargan\ Test$	18.9978	19.5678
	(0.3209)	(0.3087)

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□ □ □ □ □ □ Building automobile industrial cluster in Vietnam. Which factors are important in achieving successful industrial cluster formation?

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This study aims to identify (1) factors that affect the formation of automobile industrial clusters in the world and (2) factors that lead to the successful formation of automobile industrial clusters in Vietnam. A literature review of industrial cluster and in-depth interviews with experts in the automobile industry in Vietnam are utilized in this study. Especially, three university's representatives, two institutes' representatives, three companies' representatives and one government representative in Vietnam are targeted. The collected data are classified, analyzed, and summarized upon Porter's industrial cluster theory. This study finds that an infrastructure, workforce, universities and research institutes, related and supporting industries, domestic demand, export demand, presence of anchor firms, government supporting policies are important factors in building the automobile industrial cluster in Vietnam. And among those factors, according to the automobile industrial cluster experts, the policies of the government is the most emphasized factor which importantly influence on the formation of automobile industrial cluster in Vietnam. Finally, this study offers new insights to assist policy makers in the process of forming automobile industrial cluster in Vietnam.

Key words : Automobile industry; Industry cluster; Industrial cluster formation; Porter's diamond model; Vietnam

I. INTRODUCTION

Automobile industry always plays an important role in the national economy as well as in the world economy. Automobile industry, however, is very complex and it's composed of many parts and components to assemble into a finished product. Each car usually has more than twenty thousand parts which require good quality and diversity of shapes. Thus, this industry needs a huge capital volume, long-term investment and many related and supporting industries.

For many years, the government of Vietnam has considered automobile industry as one of the most vital sectors contributing to the national economic growth. Vietnam's automobile industry starts late and the development is still very slow. The Vietnamese automobile production industry just stays at the assembling stage (Mai Ha, 2014). After 20-year development, there are many big automobile manufacturers who entered Vietnam through a sole proprietorship or joint-investment, such as Fiat, Ssangyong, GM Daewoo, Toyota, Honda, Isuzu, Ford, Hino, Mercedes-Benz, Mitsubishi... Meanwhile, Vietnam established domestic auto firms, for example, Truong Hai and Xuan Kien. Until now, there are about 18 FDI and 38 domestic businesses making and assembling cars, almost all these firms are small scale. They have a capacity of about 460,000 vehicles a year (Thai News Service, 2013). Most assembly lines are operating under production capacity. According CMRR (2014), there are hundreds of auto part manufacture firms, though, most of them are SMEs featured with low production capacity and low technology. Major parts are simple, e.g. seats, mirrors, glasses, plastics, tires, auto storage batteries. In general, auto parts and components in Vietnam depend on import. The localization rate is now still very low compared with the target. The goal is 40% by 2005, 60% by 2010 for type vehicles (trucks, buses, cars), however, the localization rate has risen from 7 to 10 percent for small car and 35-40 percent for light-duty trucks (Thai News Service, 2013).

Currently, Vietnam's automobile industry is competing with those ASEAN countries (Thailand, Malaysia, Indonesia) as well as those assigned with the ASEAN agreement (China, Korea, Japan). Under commitments to the ASEAN Free Trade Area (AFTA), Vietnam will apply a zero tariff policy to all automobiles imported from ASEAN countries by 2018 (Thai News Service, 2013). This could be a big threat to Vietnam's automobile industry because it is hard to compete with the price and quality of imports. To develop the local automobile industry, one of the solutions offered by the Vietnamese government is to form automobile industrial clusters (Phuong Nhi, 2014). In recent years, many automobile industrial clusters have been formed and operated successfully in the US, China, Thailand, Japan, India, Malaysia... The empirical researches on this issue in many countries around the world have shown the important factors that affect the formation and development of automobile industrial clusters like government, work-force, anchor firms, related and supporting industries, home demand ... However, up to now, there have not been much research and documentation related to the formation and development of automobile industrial cluster in Vietnam. Whether the factors mentioned above have the same to the context of Vietnam's automobile clusters? And which factors should be particularly concerned when building automobile industrial cluster in Vietnam? To find the answers, this study analyzes the strengths and weaknesses of the Vietnam's automobile industry, and combines this information with experts' opinions on the factors that lead to the successful formation of automobile industrial clusters in Vietnam. Accordingly, this study could offer references to policy makers in the strategic preparation for forming and developing the automobile industrial cluster in Vietnam in the future.

This study is organized as follows. After the introduction in section I, section II surveys the literature on cluster according to the theory of Porter and explains the differences between the concept of industrial cluster in Vietnam and in the world. Section III describes the method to collect data. Section IV presents the factors that have influenced the formation of automobile clusters in the world and the results of interviews. Section V discusses the factors that lead to the successful formation of automobile industrial clusters in Vietnam. Finally, section VI summarizes the findings and give some new research directions.

II. INDUSTRIAL CLUSTER CONCEPT

After being come up by Alpred Marshall, the concept of industrial cluster has gradually become a subject of intense research studies and economic analysis in recent years. According to Bekele & Jackson (2005), there are some theoretical perspectives of industrial cluster such as, Marshall (1890)'s classical agglomeration theory; Weber (1929)'s location industry theory; Krugman (1991)'s and Venables (1996)'s new economic geography; Porter (1990)'s competitiveness; Romer (1986)'s dynamic externalities and Lucas (1988)'s dynamic externalities … For many years now, much attention has been paid to the concept of industry cluster. Many latter studies on industry clusters were conducted in different industries around the world and each economist had his own definition of a cluster.

According to Kuchiki (2005), an industrial cluster is a geographic concentration of manufacturing companies, suppliers, service providers, and related institutions in a particular field.

Jie (2010) explained that an industrial cluster is large sums of enterprises and supporting institutes that linked in production or sale are collected in one area and form the strong and sustained competitive advantage.

Porter (1998) stated a very broad definition of the industrial cluster concept which is geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries and associated institutions. The basic configuration of any industrial cluster could be identified and mapped as a diamond model which includes four determinants: factor conditions; demand conditions; related and supporting industries; industry strategy, structure, and rivalry (Porter, 1990). Besides, chance and government are also considered as factors influencing on each determinant of diamond model (Porter, 1990).

Among theoretical approaches mentioned above, the theory of Porter about industry clusters and competitiveness is developed on the basis of the previous industrial cluster schools; developed the Porter's industrial clusters bring a new competitive advantage to related companies and institutions in the same geographic area. Porter advanced the cluster concept as a business strategy to increase competitiveness and productivity. Therefore, Porter's industrial cluster definition (Porter, 1998) is used to underline this study and the factors affecting the formation of automobile industrial cluster in Vietnam are upon Porter (1990)'s diamond model.

In Vietnam, the concept of industrial cluster is mentioned in Decision No. 105/2009/QD-TTg, which is issued on August 18, 2009 by the Prime Minister. This concept, however, is related but not identical to the concept of industrial cluster in the world (See Table 1).

Table 1: Differences between the concept of industrial cluster in Vietnam and in the world

Industrial cluster	In the world	In Vietnam
Nature	Referring to the phenomenon of concentration and links of economic activities. They can be formed spontaneously and are not necessarily in sequence.	Referring to the central location of economic activities. They are often established under the conditions and certain procedures.
Purpose of formation	To develop links between members, To improve the competitiveness of enterprises, To create workforce, goods and services of high quality.	To attract and remove kinds of business investment in production and business, To promote business production and reduce environmental pollution.
Participants	Including various firms and institutions that relate to each other and support the production value chain such as manufacturing, suppliers, universities, trade associations…	Including only production and business establishments, industrial production facilities, handicrafts, small and medium enterprises. Do not have an association with other organizations such as universities, research institutes, trade associations.

Scope	Not restricted in certain geographical range.	Having restricted geographical boundaries, size not exceeding 75 hectares

III. METHODOLOGY

This paper applies the research process of Creswell (2008) to conduct the study, the six steps, including: identifying a research problem, reviewing the literature, specifying a purpose for research, collecting data, analyzing and interpreting the data, reporting and evaluating. The purposes of this study is to identify (1) factors that affect the formation of automobile industrial clusters in the world and (2) factors that lead to the successful formation of automobile industrial clusters in Vietnam. The first purpose is resolved by literature review of published materials. This results are combined with the current status of Vietnam's automobile industry to design questionnaire for in-depth interview. The second purpose is resolved by in-depth interview method with experts in the automobile industry in Vietnam. Experts were asked to assess level of importance of the factors affecting the formation of automobile industry cluster as well as to give their opinion about the factors that lead to the successful formation of automobile industrial clusters in Vietnam. Experts who have knowledge of the Vietnam's automobile industry and at least 5 years working experience in this industry, including three university's representatives, two institutes' representatives, three companies' representatives and one government's representative in Vietnam.

The semi-structured questionnaires are designed to discuss the importance of each factor upon the five-point Likert type, (1: not at all important to 5: very important). There are also some open questions to get more information, ideas and opinions from the experts. The results are based on the convergence of from experts' opinions for each factor.

IV. FINDINGS

The results of factors affecting the formation of automobile industrial cluster in the world based on literature review

In this section, the factors affecting the formation of automobile industrial cluster are summarized according to theory of Porter's diamond model, including factor conditions; related and supporting industries; demand conditions; and industry strategy, structure, and rivalry (See Table 2). Besides, government which influenced on the formation of automobile industrial cluster is included, but the chance factor is unstable and rarely happens, out of this summary.

Table 2: Factors affecting the formation of automobile industrial cluster in the world

Authors	Contreras et al.	Bulic et al.	Zambonsky	Ghazali et al.	Kim	Gupta	Ranawat & Tiwari	Okada & Siddharthan	Kuchiki	Brzica	Sakuramoto	Yamawaki
Year	2013	2012	2012	2011	2011	2010	2009	2007	2007	2007	2004	2002
Developing country	*	*		*	*	*	*	*	*		*	
Factor conditions												
- infrastructure	x	x		x		x	x	x	x	x	x	
- work-force	x	x	x	x	x	x	x	x	x		x	
- technology and R&D							x	x	x			
- geographic location	x										x	
- universities & research institutes	x	x			x	x	x		x	x	x	
- quality of life									x			
Related and supporting industries												
- proximity of auto parts suppliers	x	x	x	x	x	x	x	x	x	x	x	x
- proximity of materials suppliers	x	x		x	x			x		x		x
- proximity of supporting services	x	x		x	x			x				
Demand conditions												
- domestic demand	x	x		x	x	x		x	x	x		
-export demand				x				x				
Industry strategy, structure, and rivalry												
- presence of anchor firms	x		x		x	x			x	x	x	x
- cooperation among auto firms	x									x		
Government												
- government supporting policies	x	x	x	x	x	x	x	x	x	x	x	
- local government supporting policies		x					x	x	x	x		

The results of factors affecting the formation of automobile industrial cluster in Vietnam based on interviews

After conducting in-depth interview with experts in automobile industry, the opinions of interviewees about each factor are collected. The experts' opinions on important level of each factor affecting the successful formation of automobile industrial clusters in Vietnam are summarized in Table 3 and are discussed in the following paragraphs. Consequently, to have an overview of the Vietnam's automobile industry, the strengths and weaknesses of automobile industry in Vietnam are figured out according to Porter's diamond model (see Fig.1).

Table 3: Level of importance for each factor from the results in-depth interviews

	Factors affecting the formation of automobile industrial cluster in Vietnam	**Level of importance**	**Representative**								
			(1st) HCMC University of Technology	(2nd) HCMC University of Technology	(3rd) HCMC University of Technology	Institute of Applied Mechanics and Informatics	HCMC Institute For Economic Research	HCMC Department of Industry and Trade	1st Auto Firm	2nd Auto Firm	3rd Auto Firm
Factor conditions	Work-force	1									
		2									
		3									
		4	x				x				
		5		x	x	x		x	x	x	
	Infrastructure	1									
		2									
		3	x		x						
		4					x	x		x	
		5				x					
	Geographic location	1				x	x				
		2	x				x				
		3				x					
		4			x			x			x
		5							x	x	
	Technology and R&D	1									
		2									
		3			x	x	x	x			x
		4		x						x	
		5									
	Universities & research institutes	1									
		2									
		3			x						
		4	x				x	x			
		5		x		x				x	
	Quality of life	1									
		2									
		3			x		x				
		4	x			x				x	
		5									
Demand conditions	Domestic demand	1									
		2									
		3									
		4	x	x						x	
		5				x	x	x			x
	Export demand	1									
		2									
		3				x		x			
		4	x	x			x		x	x	
		5									
Related and supporting industries	Related and supporting industries	1									
		2									
		3									
		4	x		x		x	x	x		
		5				x				x	x
Industry strategy, structure, and rivalry	Presence of anchor firms	1									
		2									
		3					x				
		4	x		x			x	x		
		5				x				x	x
		1									

		2									
		3									
		4			x		x			x	
		5				x					
Government	Government and local supporting policies	1									
		2									
		3									
		4	x				x				
		5		x	x	x		x	x	x	x
New factor	Business capability	1									
		2									
		3									
		4		x						x	x
		5	x		x	x		x			

Note: "1" - not at all important; "2" - not very important; "3" - somewhat important; "4" - important; "5" - very important

Factor conditions

"Workforce" and "universities & research institutes" are considered as very important factors affecting the formation of automobile industrial cluster in Vietnam.

Workforce: automobile industry requires a huge amount of labor, including entrepreneurs, engineers, skilled workers, managers... No matter how the machinery and equipment are, they still are controlled by man. Labor is the source of creativity to enhance cluster's competitiveness. In the future, cheap labor is no longer the strength to create competitive advantage, so building a quality workforce will ensure the sustainable formation and development of automobile industry in Vietnam.

Universities & research institutes: although there are many experts' opinions commented the role of universities and research institutes in Vietnam for the development of the automobile industry is not prominent and lacks of cooperation, but experts still appreciated the importance of this factor. A solid base of education and research could help to form and develop automobile industrial cluster successfully.

The rest factors like "infrastructure ", "technology and R&D", "geographic location" and "quality of life" have not much important effect.

Demand conditions

"Domestic demand" and "export demand" are assessed as prerequisite factors affecting the formation of automobile industrial clusters. However, experts said that domestic demand should be more focused. Large domestic market will create conditions for auto firms to achieve economies of scale. The output of the products is the problem that auto part manufacture firms are concerned is the output of the products because the domestic market size is still small. Hence, they need to expand exports and to participate in global value chains.

Related and supporting industries

This is an extremely important factor that needs to develop urgently to form Vietnam's automobile industrial clusters. To produce a complete car, an automobile manufacturer cannot do it alone, so it needs suppliers of spare parts, raw materials, counseling services, logistics… The weakness of related and supporting industries has been the great obstacle for the formation and development of automobile industrial cluster in Vietnam.

Industry strategy, structure, and rivalry

"Presence of anchor firms" has a very important effect. Each automobile industrial cluster has at least one anchor firm. These anchor firms is to create motivation for the system development and to create links to promote cooperation development. They also play an important role in attracting other firms to participate in the automobile industrial cluster. "Cooperation among auto firms" also affects the formation of automobile industrial cluster but not too much.

Government

This is the most important factor affecting the formation of automobile industrial cluster in Vietnam according to experts' opinions. Government helps to build strategic directions and creating a favorable business environment. The mechanism of government support is fundamental conditions for the formation and development of automobile industrial clusters. In addition, government policies are the most important factor affecting industrial cluster by promoting and controlling the activities of firms in the industry.

A new factor from experts' opinions

During the interview process, a new factor is mentioned and emphasized by many experts which is "business capability". This factor is to create competitive advantages that affect the formation and development of automobile industrial cluster in Vietnam. This factor also paves the way for the existence of the automobile industrial cluster because it helps to increase cluster's competitiveness. Enterprises themselves have to identify their main vehicles and determine a clear business strategy to ensure sustainable development. Business capability is most evident in ensuring product quality and reducing costs to meet customer needs as well as to compete with foreign enterprises.

Chance

Although "chance" is not been got more attention based on the prior researc, it was still considered when conducting interview upon Porter (1990)'s theory. Through open interview questions, some experts give opinions on the chance of Vietnam's automobile industrial clusters.

This factor is not discussed about the level of importance, but some experts feel pessimistic about Vietnam's automobile industry in the future. They said that the chance of Vietnam's automobile industry was very small because there is not much time left from now to 2018. Just one expert believed that Vietnam's automobile industry could survive under the effect of TPP (Trans-Pacific Partnership). That means many big manufacturers are moving from China to Vietnam.

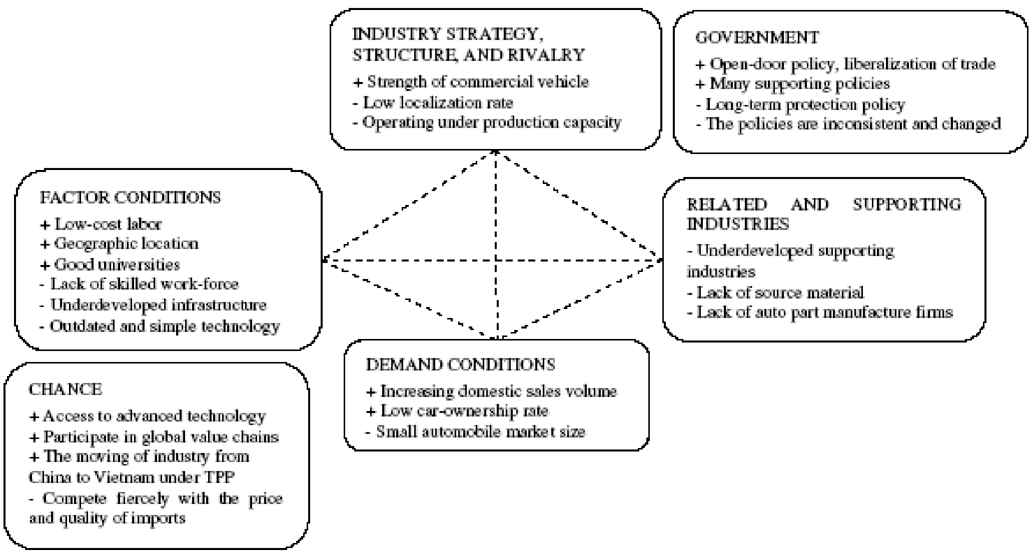

Fig 1: Diamond model for Vietnam's automobile industry (+ marks stand for strengths, while - marks stand for weaknesses)

V. DISCUSSION

In this section, the factors that lead to the successful formation of automobile industrial clusters in Vietnam are summarized based on the results of the literature review, experts' opinions and the specific context of Vietnam's automobile industry are discussed. From the above analysis in section III, there are many similarities between the factors that affecting the formation of automobile industrial cluster in Vietnam and in the world.

Factor "workforce", especially, the trained and good workmanship are considered as the significant factor that have a positive impact on the formation and development of the formation and development of automobile industrial cluster (Yoshida & Nakanishi, 2005; Kuchiki, 2007; Okada & Siddharthan, 2007; Bulic, et.al., 2012…). To develop a good workforce that best meet the needs of Vietnam's automobile industry, universities and vocational schools need more training programs, both theoretically and practically. Each automobile industrial clusters in the world normally has the presence of "universities & research institutes" which is also emphasized as an important factor for the successful formation and development of automobile industrial clusters. In the future, these factors should be more focused to maximize the efficiency of receiving modern automobile technologies, applying research and development (R&D) in automobile industry. In addition, the universities are also home to provide human resources that meet requirements in the sector. It is necessary to link the cooperation between enterprises and educational institutions to grow further. A successful automobile industrial cluster must base on education and science research (Komolavanij et.al, 2009; Contreras et.al, 2013…).

Demand conditions consist of "domestic demand" and "export demand" that are necessary factors for industrial cluster formation (Brzica, 2007; Kuchiki, 2007; Gupta, 2010; Contreras et al, 2013…). The Vietnam's automobile market is much potential with a population of more than 90 million people, but the auto sales volume is very small (over 100,000 units/year). It is essential to have many big automobile manufacturers for attracting more and more investment from auto part manufacture firms. The automobile market in Vietnam should be concerned and extended to motivate the development of automobile industry.

Related and supporting industries which include proximity of auto parts suppliers, materials suppliers and supporting services are mentioned as a very important factor in building an automobile industrial cluster (Yamawaki, 2002; Sakuramoto, 2004; Kuchiki, 2007; Ningyu & Yang, 2011 …). If we would like to have a strong automobile industry in Vietnam, we must develop urgently supporting industries. The development of related and supporting industries is only necessary for the formation and development of the automobile industry but also for the development of other industries.

Factor "presence of anchor firms" effectively influences the industrial cluster formation (Yamawaki, 2002; Kuchiki, 2007; Zamborsky, 2012; Contreras et.al, 2013 …). Vietnam's auto anchor firms should play as the central core of the formation of automobile industrial clusters. These firms help to create a good information network and to promote cooperation among auto firms. The anchor firms' growth will attract the concentration of many auto related and supporting industries.

The study of the experience of the successful formation of automobile industrial cluster in the world showed that government policies played a significant role (Kuchiki, 2007; Okada & Siddharthan, 2007; Ranawat & Tiwari, 2009; Ammarapala et al, 2010; Kim, 2011...). All experts assess that support policies of the government and local authorities have a significant influence on the formation of the automobile industrial cluster in Vietnam. Thus, why "government policies" is the most important factor that affecting the formation of automobile industrial cluster in Vietnam? Experts explained the reasons as below:

- University's representative emphasized that the government should establish a fund to support enterprises and develop appropriate strategies to promote the automobile industry development.
- Another university's representative stated that three main pillars need to cooperate to develop the Vietnam's automobile industry are governments, universities and auto firms. Specifically, government agencies must have appropriate policies and strategies for the development of the automobile industry with a clear purpose. Universities will play a key role in cooperation with enterprises, and application of advanced technology in manufacturing. Auto firms also have the responsibility to support the universities for the training of human resources and funding for research projects.
- An expert comes from Economic Institutes said that government must play a role in supporting policy, however, they should not interfere with industrial cluster's activities deeply. Besides, the government should have a mechanism to explore and resolve the difficulties of enterprises.
- The representative of the department of Industry and Trade said that the most important factor in the automobile industrial cluster formation is government policies. Implementing suitable policies is a good base to create conditions for the development of the automobile industry and to encourage participation of auto part firms as well as large manufacturers in the automobile industrial cluster.
- Companies' representatives highly appreciated the role of government in enacting tax policies to support the development of micro, small and medium-sized enterprises. The government needs to implement favorable policies to attract foreign direct investment and increase the localization rate. Moreover, the government should facilitate and support their business activities because many procedures must take a long time to be completed.

The new factor which is business capability has also affected the industrial cluster formation. Firstly, auto manufacturers must identify their product strategies to avoid falling into the major product changes. According to expert's opinion that Vietnam's automobile firms should focus on manufacturing buses, vans, cars ... Vietnamese enterprises are still weak in many areas such as manufacturing, design, marketing ..., therefore, they now need to improve their competitiveness by investing in technological innovation and productivity as well as taking advantage of training and consultancy services, reducing costs to compete with products imported from foreign countries. In addition, business capability also helps small and medium enterprises to involve in the value chain of the global automobile industry and to have the opportunity to become a supplier for the domestic and foreign manufacturers.

In summary, the successful formation of automobile industrial cluster in Vietnam is a complex task and it requires the participation and cooperation of multiple sectors. The determinant factors of the success of Vietnam's automobile industrial cluster in Vietnam include (1) Factor conditions: "trained and skilled workforce", "universities and research institutes", (2) Demand conditions: "domestic demand", "export demand", (3) Related and supporting industries, (4) "Presence of anchor firms", (5) Government supporting policies, and (6) Business capability. Among those factors, supporting policies of the government is the most significant factor that influence on the formation of the automobile industrial cluster in Vietnam. This result can be used as a reference for policy makers in the process of forming automobile industrial cluster in Vietnam and those factors should be verified when Vietnam is going to build the true automobile industrial clusters in the future.

It would be better to have a specific scale for measuring the level of success of the formation of automobile industrial clusters. On the basis of literature review, there are some criteria used to evaluate and to assess the success level of the formation of automobile industrial cluster, such as: ability to create new product innovation (Deeds et al., 1997, cited in Singh & Shrivastava, 2013); ability to increase specialization, to reduce transaction costs and to enhanced reputation (Eisingerichaet et.al., 2010, cited in Singh & Shrivastava, 2013); and extent to which sales enhanced, to which the quality of goods and processes are improved, to which profit is improved, to which the quality of relationships with customers are improved, to which the quality of relationships with suppliers are improved, and to which the visibility of business is enhanced (Singh & Shrivastava, 2013).

In the context of automobile industrial cluster in Vietnam, it is necessary to conduct further studies to get a deeper understanding of the formation of automobile industrial cluster in Vietnam and have appropriate criteria to evaluate the success level the formation of automobile industrial cluster.

VI. CONCLUSION

This study investigates the factors affecting the formation of automobile industrial cluster in the world and come up with some results about the factors that affect and lead to the successful formation of automobile industrial clusters in Vietnam upon the Porter's industrial cluster theory. Many factors affecting the formation of automobile industrial cluster in Vietnam are found such as, infrastructure, workforce, universities & research institutes, related and supporting industries, presence of anchor firms, government supporting policies… Among those factors, the government policies is considered as the most important factor affecting the successful formation of automobile industrial clusters in Vietnam.

The results of this study could contribute to the knowledge of industrial clusters in Vietnam, especially in the automobile industry. The results could be a reference for policy makers to enact policies to support and to promote the formation of automobile industrial clusters in Vietnam, and improving the competitiveness of the automobile industry in Vietnam. Future studies may continue studying to clarify the unclear and missed factors affecting the formation of automobile industrial clusters like geographic location, chance...; or building scale assessment of the formation which is used in quantitative study to determine the level of importance for each factor that lead to the successful formation of automobile industrial clusters in Vietnam.

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A MIXED-INTEGER LINEAR FORMULATION FOR A CAPACITATED FACILITY LOCATION PROBLEM IN SUPPLY CHAIN NETWORK DESIGN

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In this research, we deal with a multi-item, multi-period capacitated facility location problem where manufacturing plants and distribution centers are decided to open or not at predetermined potential sites. The developed model is formulated as a mixed integer linear programming model (MILP) with the objective minimizing the total cost, including transportation cost, inventory holding cost, and fixed costs for opening facilities. We employ a Lagrangian relaxation algorithm for solving the developed model, the key defference of our algorithm is additional constraint sets added to two sub-problems. For validation testing, some numerical experiments were used for solving, and the solutions obtained from the Lagrangian relaxation algorithm are respectively compared with the solutions obtained by the LINGO solver. With good achievements of this research, our proposed model can be applicability and the proposed approach is advantage for getting the specific solutions..

Keywords: logistic, supply chain, mixed integer linear programming, Lagrangian relaxation, network design.

1. Introduction

In modern business environments, supply chain management has become common practice in all industries and has received growing interest in both academia and industrial practice. The essence of supply chain management and the conceptual framework for evaluating the performance of supply chains have attracted many researchers (e.g., Chan et al., 2003; Stadtler, 2005). Typically, a supply chain network can be considered as an alliance of many members involved, from upstream members (e.g., material suppliers, manufacturers) to downstream members (e.g., distributors, retailers, and end customers). Due to its complex structure, managing a supply chain network is always a challenging task, which combines and integrates all business functions, including inbound logistics, outbound logistics, marketing and sales, customer relationship, etc. In a highly competitive global market nowadays, supply chain management is a key issue in the strategic development of any enterprise (Chan and Qi, 2003).

Among the factors that affect the performance of a supply chain, the physical design of the supply chain plays a very important role. Top managers of many big enterprises increasingly paid attention on the structure of their supply chains as reported and discussed in various case studies presented in a book of Simchi-Levi et al. (2000). In order to help supply chain managers to make decision on supply chain structure, Blackhurst et al. (2005) proposed a decision support modeling methodology for supply chain design, which was integrated also with product and process design decisions. However, regardless of the fact that supply chain design problem is a critical problem, it is still a very challenging problem and not many research works have been conducted to tackle this problem.

Among the initial publications dealing with supply chain design issue is a capacitated facilities location model developed by Geoffrion and Graves (1974). In this research, the authors only focused on distribution function of a supply chain, and the objective of the design problem was to minimize the total cost which consists of transportation cost and fixed cost of opening distribution centers. The problem, which is a multi-item single-period problem, was formulated as a mixed integer linear program, and a Benders decomposition algorithm was also developed for solution purpose. In the same research line, Pirkul and Jayaraman (1998), Mazzola and Neebe (1999) studied multi-item and single-period distribution network design problem, however, they examined the use of Lagrangian relaxation technique for solution purpose. Focusing also on distribution function of supply chain, Melachrinoudis and Min (2007) studied a distribution network redesign problem where an existing distribution center may be closed while some new ones may be opened.

In another research line, Amiri (2006) tackled the single-item single-period supply chain network design problem that involves locating manufacturing plants and distribution centers, and determining the distribution strategy from the plants to the distribution centers and from the distribution centers to the customers, in this research, multiple levels of capacities of warehouses and plants were considered. Eksioglu et al. (2006) examined a single-item multi-period integrated production and distribution planning problem in which inventory is allowed to be carried over during the planning horizon. Later, Lee et al. (2010) proposed two mixed integer linear programs for supply chain network design, their models supports routing decision, this research is necessary for third party losgistics. To the best of our knowledge, the research works that took into consideration all realistic factors of the supply chain network design problem (i.e., multi-item, multi-period, possibility of inventory carrying over) are the ones conducted by Hinojosa et al. (2000, 2008). However, these research works dealt with network redesign problem. Moreover, one of conclusions in the review paper of Melo et al. (2009) said that the most of research structure of SC network is considerably simplified, and few papers attempt the full integration of forward and reserse activitives in SCM. Recently, in an overview work of Arabani and Farahani (2012) considered continuous models with dynamic problems as further trends, but we believe that compflex models with combination of many factors in SC network design are also necessary.

In the research work presented in this paper, we develop a mixed integer linear programming (MILP) model for supply chain network design problem which takes into consideration all the above realistic factors. The developed model will help make decisions on: (1) whether a facility (either a manufacturing plant or a distribution center) should be opened at a potential site among a set of predetermined potential sites; (2) at which period during the planning horizon, a facility is opened if it should be opened; and (3) for each type of product, which distribution centers a manufacturing plant should deliver the product to, and which distribution centers a retailer should place its order from. We then develop a Lagrangian relaxation algorithm for solving this problem. This algorithm is based on relaxing two constraint sets which lead to the decomposition of the MILP model into two sub-problems that can be easily solved to provide an efficient solution to the original problem.

The objective of our MILP model is to minimize the total cost, including transportation cost, inventory holding cost, and fixed costs for opening manufacturing plants and distribution centers. Commonly, the decisions of opening manufacturing plants and distribution centers are strategic or mid-term planning decisions, while the inventory and transportation costs are operational. However, similar to the works of Hinojosa et al. (2000, 2008), our research aims at developing a combined network design and distribution planning model. For distribution planning purpose, we have to decide on which distribution centers a manufacturing plant should deliver the product to, and on which distribution centers a retailer should place its order from. Dealing with this type of problem requires the incorporation of transportation cost as seen in some past research works (e.g., Geoffrion and Graves, 1974; Hinojosa et al., 2000). Related to the incorporation of inventory holding cost in the total cost function, past research works were either consider a single-period model (e.g., Geoffrion and Graves, 1974), or a multi-period model with the assumption that inventory cannot be carried over (due to perishability as in the work of Hinojosa et al., 2000). With the above model settings, exclusion of inventory cost is acceptable. However, in many practical supply networks, it is noted that inventory can be carried over from one period to the next period. Hence, for the proposed model to be more realistic, we also assume that inventory can be carried over during the planning horizon (similar to Hinojosa et al., 2008), and hence, incorporation of inventory cost is needed. It should be noted that in their model, Hinojosa et al. (2008) considered the expansion of an existing network in which new facilities can be opened at predetermined potential sites, while existing facilities can be closed and if an existing facility is closed it will not be reopened. The main difference between our model and the model of Hinojosa et al. (2008) is that we consider the establishment of a new supply network in which new facilities can be opened at predetermined potential sites, and if a new facility is opened, it will not be closed. It is also noted that in our model, a facility can be opened at any period during the planning horizon, not necessarily at the beginning of the planning horizon.

The remaining sections of our paper are organized as follows. In section 2, we derive the mathematical model for the problem. In section 3, we analyze the model developed in section 2 and derive a Lagrangian relaxation version of the original model. Sections 4 and 5 present a solution procedure based on Lagrangian relaxation technique and some numerical experiments. We then conclude the research with some concluding remarks in section 6.

2. Mathematical Model

In this section, the following notations are used:

Indices:

i	index of potential sites for manufacturing plants $i = 1, 2, .., I$
j	index of potential sites for distribution centers $j = 1, 2, .., J$
k	index of products $k = 1, 2, .., K$
r	index of retailers $r = 1, 2, .., R$
t	time index $t = 1, 2, .., T$

Parameters:

T	length of the planning horizon
f_i	fixed cost of opening manufacturing plant i
$f_j^{(1)}$	fixed cost of opening distribution center j
c_{ijk}	transportation cost of shipping a unit of product k from plant i to distribution center j
$c_{jrk}^{(1)}$	transportation cost of shipping a unit of product k from distribution center j to retailer r
p_{ik}	unit production cost of product k at plant i
h_{ik}	unit holding cost of product k at plant i in one period
$h_{jk}^{(1)}$	unit holding cost of product k at distribution center j in one period
$h_{rk}^{(2)}$	unit holding cost of product k at retailer r in one period
d_{rkt}	demand of product k at retailer r in period t
w_{ik}	production capacity associated with product k at plant i
$w_{jk}^{(1)}$	storage capacity associated with product k at distribution center j

Decision variables:

X_{ijkt}	amount of product k shipping from plant i to distribution center j in period t
Y_{jrkt}	amount of product k shipping from distribution center j to retailer r in period t
Z_{it}	a binary variable which indicates whether plant i is operated in period t or not
$Z_{jt}^{(1)}$	a binary variable which indicates whether distribution center j is operated in period t or not
V_{ikt}	amount of product k produced at plant i in period t
Q_{ikt}	amount of product k stored at plant i at the end of period t
$Q_{jkt}^{(1)}$	amount of product k stored at distribution center j at the end of period t
$Q_{rkt}^{(2)}$	amount of product k stored at retailer r at the end of period t

The following assumptions are used for model development:

1) If a plant or distribution center is opened at a certain site, it will not be closed;
2) All cost factors in the model are known in advanced, i.e. the setup costs of plants and distribution centers, the unit production cost, unit transportation cost, and unit inventory holding cost are given;
3) Initial inventory levels at plants, distribution centers, and retailers are zeros;
4) Storage capacity of retailer is large enough to fulfill demand.

The detailed mathematical model is derived as follows:

Objective function:

$$Min\ Z=\sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T}c_{ijk}X_{ijkt}+\sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T}c_{jrk}^{(1)}Y_{jrkt}+\sum_{i=1}^{I}\sum_{t=1}^{T}f_i\left(Z_{it}-Z_{i(t-1)}\right)+\sum_{j=1}^{J}\sum_{t=1}^{T}f_j^{(1)}\left(Z_{jt}^{(1)}-Z_{j(t-1)}^{(1)}\right)$$
$$+\sum_{i=1}^{I}\sum_{k=1}^{K}\sum_{t=1}^{T}p_{ik}V_{ikt}+\sum_{i=1}^{I}\sum_{k=1}^{K}\sum_{t=1}^{T}h_{ik}Q_{ikt}+\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T}h_{jk}^{(1)}Q_{jkt}^{(1)}+\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T}h_{rk}^{(2)}Q_{rkt}^{(2)},\quad (1)$$

Subject to

$$Q_{rk(t-1)}^{(2)}+\sum_{j=1}^{J}Y_{jrkt}\ge d_{rkt}\quad \forall r\in R,\forall k\in K,\forall t\in T,\quad (2)$$

$$V_{ikt}\le w_{ik}Z_{it}\quad \forall i\in I,\forall k\in K,\forall t\in T,\quad (3)$$

$$\sum_{j=1}^{J}X_{ijkt}\le V_{ikt}+Q_{ik(t-1)}\quad \forall i\in I,\forall k\in K,\forall t\in T,\quad (4)$$

$$\sum_{i=1}^{I}X_{ijkt}+Q_{jk(t-1)}^{(1)}\le w_{jk}^{(1)}Z_{jt}^{(1)}\quad \forall j\in J,\forall k\in K,\forall t\in T,\quad (5)$$

$$\sum_{r=1}^{R}Y_{jrkt}\le \sum_{i=1}^{I}X_{ijkt}+Q_{jk(t-1)}^{(1)}\quad \forall j\in J,\forall k\in K,\forall t\in T,\quad (6)$$

$$Q_{rkt}^{(2)} = \sum_{j=1}^{J} Y_{jrkt} + Q_{rk(t-1)}^{(2)} - d_{rkt} \quad \forall r \in R, \forall k \in K, \forall t \in T, \tag{7}$$

$$Q_{ikt} = V_{ikt} + Q_{ik(t-1)} - \sum_{j=1}^{J} X_{ijkt} \quad \forall i \in I, \forall k \in K, \forall t \in T, \tag{8}$$

$$Q_{jkt}^{(1)} = \sum_{i=1}^{I} X_{ijkt} + Q_{jk(t-1)}^{(1)} - \sum_{r=1}^{R} Y_{jrkt} \quad \forall j \in J, \forall k \in K, \forall t \in T, \tag{9}$$

$$Z_{it} \geq Z_{i(t-1)} \quad \forall i \in I, \forall t \in T, \tag{10}$$

$$Z_{jt}^{(1)} \geq Z_{j(t-1)}^{(1)} \quad \forall j \in J, \forall t \in T, \tag{11}$$

$$X_{ijkt}, V_{ikt}, Q_{ikt} \geq 0 \quad \forall i \in I, \forall j \in J, \forall k \in K, \forall t \in T, \tag{12}$$

$$Y_{jrkt}, Q_{jkt}^{(1)}, Q_{rkt}^{(2)} \geq 0 \quad \forall j \in J, \forall r \in R, \forall k \in K, \forall t \in T, \tag{13}$$

$$Z_{it} = 0,1 \quad \forall i \in I, \forall t \in T, \tag{14}$$

$$Z_{jt}^{(1)} = 0,1 \quad \forall j \in J, \forall t \in T, \tag{15}$$

In the above model, the objective function is to minimize the total cost which includes transportation costs from plants to distribution centers; transportation costs from distribution centers to retailers; fixed costs of opening plants; fixed costs of opening distribution centers; production costs; and holding costs at plants, distribution centers, and retailers.

Related to the constraints, constraint set (2) ensures that demands at retailers are always satisfied. Constraint set (3) represents the capacity constraint at manufacturing plant. Constraint set (4) ensures that the amount of product shipped from a plant in each period will not exceed the on-hand inventory. Constraint set (5) ensures that the amount of product stored at a distribution center will not exceed the storage capacity of that distribution center. Constraint set (6) ensures that the amount of product shipped from a distribution center does not exceed the on-hand inventory at that distribution center. Constraint sets (7), (8), and (9) are flow balance constraints. Constraint sets (10) and (11) ensure that when a plant or distribution center is opened, it will not be closed. The other constraints are variable constraints.

As will be shown in the following paragraphs, there exist some redundant constraints in the initial formulation presents above. These redundant constraints will be discarded from the model so that the structure of the model can be simplified in such a way that the Lagrangian relaxation technique can be employed later.

Considering constraint sets (7), (8), and (9) which are the inventory balance equations at retailers, plants and distribution centers, respectively:

$$Q_{rkt}^{(2)} = \sum_{j=1}^{J} Y_{jrkt} + Q_{rk(t-1)}^{(2)} - d_{rkt} \quad \forall r \in R, \forall k \in K, \forall t \in T,$$

$$Q_{ikt} = V_{ikt} + Q_{ik(t-1)} - \sum_{j=1}^{J} X_{ijkt} \quad \forall i \in I, \forall k \in K, \forall t \in T, \quad \text{and}$$

$$Q_{jkt}^{(1)} = \sum_{i=1}^{I} X_{ijkt} + Q_{jk(t-1)}^{(1)} - \sum_{r=1}^{R} Y_{jrkt} \quad \forall j \in J, \forall k \in K, \forall t \in T,$$

The above equations can be rewritten as follows:

$$\sum_{j=1}^{J} Y_{jrkt} + Q_{rk(t-1)}^{(2)} - Q_{rkt}^{(2)} = d_{rkt} \quad \forall r \in R, \forall k \in K, \forall t \in T,$$

$$\sum_{j=1}^{J} X_{ijkt} = V_{ikt} + Q_{ik(t-1)} - Q_{ikt} \quad \forall i \in I, \forall k \in K, \forall t \in T, \text{ and}$$

$$\sum_{r=1}^{R} Y_{jrkt} = \sum_{i=1}^{I} X_{ijkt} + Q_{jk(t-1)}^{(1)} - Q_{jkt}^{(1)} \quad \forall j \in J, \forall k \in K, \forall t \in T,$$

It is noted that $Q_{rkt}^{(2)}, Q_{ikt}, Q_{jkt}^{(1)}$ are non-negative, and hence, it can be derived respectively from the above equations that

$$\sum_{j=1}^{J} Y_{jrkt} + Q_{rk(t-1)}^{(2)} \geq d_{rkt} \quad \forall r \in R, \forall k \in K, \forall t \in T,$$

$$\sum_{j=1}^{J} X_{ijkt} \leq V_{ikt} + Q_{ik(t-1)} \quad \forall i \in I, \forall k \in K, \forall t \in T, \text{ and}$$

$$\sum_{r=1}^{R} Y_{jrkt} \leq \sum_{i=1}^{I} X_{ijkt} + Q_{jk(t-1)}^{(1)} \quad \forall j \in J, \forall k \in K, \forall t \in T,$$

The above expressions are exactly the constraint sets (2), (4), and (6), respectively. Therefore, constraint sets (2), (4), and (6) are redundant constraints, and they can be discarded from the mathematical model. The structure of the revised mathematical model can now allow the Lagrangian relaxation technique to be employed to help find solution for large size problems. This issue will be discussed in details in the next section.

3. A Lagrangian relaxation version of the proposed model

It should be noted that the above-developed model is a mixed-integer linear program, and hence, it usually take time for finding solution, especially when dealing with large size problems. In this research, we will use Lagrangian relaxation technique for solving the problem. For more detailed discussions on the Lagrangian relaxation technique, the readers can refer to Fisher (1981).

Before applying Lagrangian relaxation technique, the model derived in section 2 will be modified as presented below

At first, considering constraint set (9), i.e.,

$$Q_{jkt}^{(1)} = \sum_{i=1}^{I} X_{ijkt} + Q_{jk(t-1)}^{(1)} - \sum_{r=1}^{R} Y_{jrkt} \quad \forall j \in J, \forall k \in K, \forall t \in T,$$

It is noted that $Q_{jk0}^{(1)} = 0$, and hence, constraints in (9) can be rewritten as follows:

$$Q_{jk1}^{(1)} = \sum_{i=1}^{I} X_{ijk1} - \sum_{r=1}^{R} Y_{jrk1}$$

$$Q_{jk2}^{(1)} = Q_{jk1}^{(1)} + \sum_{i=1}^{I} X_{ijk2} - \sum_{r=1}^{R} Y_{jrk2} = \sum_{i=1}^{I} X_{ijk1} - \sum_{r=1}^{R} Y_{jrk1} + \sum_{i=1}^{I} X_{ijk2} - \sum_{r=1}^{R} Y_{jrk2}$$

$$= \sum_{i=1}^{I} \sum_{\tau=1}^{2} X_{ijk\tau} - \sum_{r=1}^{R} \sum_{\tau=1}^{2} Y_{jrk\tau}$$

$$Q_{jk3}^{(1)} = Q_{jk2}^{(1)} + \sum_{i=1}^{I} X_{ijk3} - \sum_{r=1}^{R} Y_{jrk3} = \sum_{i=1}^{I}\sum_{\tau=1}^{3} X_{ijk\tau} - \sum_{r=1}^{R}\sum_{\tau=1}^{3} Y_{jrk\tau}$$

…

or generally,

$$Q_{jkt}^{(1)} = \sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau} - \sum_{r=1}^{R}\sum_{\tau=1}^{t} Y_{jrk\tau} \quad \forall j \in J, \forall k \in K, \forall t \in T, \qquad (16)$$

It is noted that constraint set (16) ensures that at each distribution center j, the inventory level of product k in period t is equal to the cumulative amount of product k received from all manufacturing plants subtracted by the cumulative amount of product k delivered to all retailers from distribution center j.

The expression of $Q_{jkt}^{(1)}$ derived in (16) will be replaced in the expression of the objective function, and hence, constraint set (9) can be discarded from the sets of constraints. In addition, the constraints that $Q_{jkt}^{(1)} \geq 0$ ($\forall j \in J, \forall k \in K, \forall t \in T$) will be replaced by

$$\sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau} - \sum_{r=1}^{R}\sum_{\tau=1}^{t} Y_{jrk\tau} \geq 0 \quad \forall j \in J, \forall k \in K, \forall t \in T \qquad (17)$$

From (16), we also have:

$$\sum_{t=1}^{T} Q_{jkt}^{(1)} = \sum_{t=1}^{T}\left(\sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau} - \sum_{r=1}^{R}\sum_{\tau=1}^{t} Y_{jrk\tau}\right) \quad \forall j \in J, \forall k \in K$$

So,

$$\sum_{t=1}^{1} Q_{jkt}^{(1)} = \sum_{i=1}^{I} X_{ijk1} - \sum_{r=1}^{R} Y_{jrk1}$$

$$\begin{aligned}\sum_{t=1}^{2} Q_{jkt}^{(1)} &= \sum_{t=1}^{2}\left(\sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau} - \sum_{r=1}^{R}\sum_{\tau=1}^{t} Y_{jrk\tau}\right)\\ &= \left(\sum_{i=1}^{I} X_{ijk1} - \sum_{r=1}^{R} Y_{jrk1}\right) + \left(\sum_{i=1}^{I} X_{ijk1} - \sum_{r=1}^{R} Y_{jrk1} + \sum_{i=1}^{I} X_{ijk2} - \sum_{r=1}^{R} Y_{jrk2}\right)\\ &= 2\left(\sum_{i=1}^{I} X_{ijk1} - \sum_{r=1}^{R} Y_{jrk1}\right) + \left(\sum_{i=1}^{I} X_{ijk2} - \sum_{r=1}^{R} Y_{jrk2}\right)\end{aligned}$$

$$\begin{aligned}\sum_{t=1}^{3} Q_{jkt}^{(1)} &= \sum_{t=1}^{3}\left(\sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau} - \sum_{r=1}^{R}\sum_{\tau=1}^{t} Y_{jrk\tau}\right)\\ &= 3\left(\sum_{i=1}^{I} X_{ijk1} - \sum_{r=1}^{R} Y_{jrk1}\right) + 2\left(\sum_{i=1}^{I} X_{ijk2} - \sum_{r=1}^{R} Y_{jrk2}\right) + \left(\sum_{i=1}^{I} X_{ijk3} - \sum_{r=1}^{R} Y_{jrk3}\right)\end{aligned}$$

or generally,

$$\sum_{t=1}^{T} Q_{jkt}^{(1)} = \sum_{t=1}^{T}(T-t+1)\left(\sum_{i=1}^{I} X_{ijkt} - \sum_{r=1}^{R} Y_{jrkt}\right) \quad \forall j \in J, \forall k \in K \qquad (18)$$

Using (18), the cost component related to total inventory holding cost at distribution centers in the total cost function can be rewritten as:

$$\begin{aligned}\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} h_{jk}^{(1)} Q_{jkt}^{(1)} &= \sum_{j=1}^{J}\sum_{k=1}^{K} h_{jk}^{(1)} \sum_{t=1}^{T}(T-t+1)\left(\sum_{i=1}^{I} X_{ijkt} - \sum_{r=1}^{R} Y_{jrkt}\right)\\ &= \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T}(T-t+1)\, h_{jk}^{(1)} X_{ijkt} - \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T}(T-t+1)\, h_{jk}^{(1)} Y_{jrkt}\end{aligned} \qquad (19)$$

It is also noted that constraint set (5) can be rewritten via expression (16) as follows:

$$\sum_{i=1}^{I} X_{ijkt} + Q^{(1)}_{jk(t-1)} - w^{(1)}_{jk} Z^{(1)}_{jt} = \sum_{i=1}^{I} X_{ijkt} - w^{(1)}_{jk} Z^{(1)}_{jt} + \left(\sum_{i=1}^{I} \sum_{\tau=1}^{t-1} X_{ijk\tau} - \sum_{r=1}^{R} \sum_{\tau=1}^{t-1} Y_{jrk\tau} \right) \\ = \sum_{i=1}^{I} \sum_{\tau=1}^{t} X_{ijk\tau} - w^{(1)}_{jk} Z^{(1)}_{jt} - \sum_{r=1}^{R} \sum_{\tau=1}^{t-1} Y_{jrk\tau} \tag{20}$$

So, by introducing Lagrange multipliers $\lambda_{jkt}{}' s$ for the constraints in (5) and $\gamma_{jkt}{}' s$ for the constraints in (17), the objective of the Lagrangian relaxation problem (problem (L)) associated with the original mathematical model can now be derived as

$$Min\ Z_L = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} c_{ijk} X_{ijkt} + \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T} c^{(1)}_{jrk} Y_{jrkt} + \sum_{i=1}^{I}\sum_{t=1}^{T} f_i \left(Z_{it} - Z_{i(t-1)} \right) + \sum_{j=1}^{J}\sum_{t=1}^{T} f^{(1)}_j \left(Z^{(1)}_{jt} - Z^{(1)}_{j(t-1)} \right)$$
$$+ \sum_{i=1}^{I}\sum_{k=1}^{K}\sum_{t=1}^{T} p_{ik} V_{ikt} + \sum_{i=1}^{I}\sum_{k=1}^{K}\sum_{t=1}^{T} h_{ik} Q_{ikt} + \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} (T-t+1) h^{(1)}_{jk} X_{ijkt} - \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T} (T-t+1) h^{(1)}_{jk} Y_{jrkt}$$
$$+ \sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T} h^{(2)}_{rk} Q^{(2)}_{rkt} + \sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} \lambda_{jkt} \left(\sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau} - w^{(1)}_{jk} Z^{(1)}_{jt} - \sum_{r=1}^{R}\sum_{\tau=1}^{t-1} Y_{jrk\tau} \right) + \sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} \gamma_{jkt} \left(\sum_{r=1}^{R}\sum_{\tau=1}^{t} Y_{jrk\tau} - \sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau} \right)$$

or,

$$Min\ Z_L = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} c_{ijk} X_{ijkt} + \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T} c^{(1)}_{jrk} Y_{jrkt} + \sum_{i=1}^{I}\sum_{t=1}^{T} f_i \left(Z_{it} - Z_{i(t-1)} \right) + \sum_{j=1}^{J}\sum_{t=1}^{T} f^{(1)}_j \left(Z^{(1)}_{jt} - Z^{(1)}_{j(t-1)} \right)$$
$$+ \sum_{i=1}^{I}\sum_{k=1}^{K}\sum_{t=1}^{T} p_{ik} V_{ikt} + \sum_{i=1}^{I}\sum_{k=1}^{K}\sum_{t=1}^{T} h_{ik} Q_{ikt} + \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} (T-t+1) h^{(1)}_{jk} X_{ijkt} - \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T} (T-t+1) h^{(1)}_{jk} Y_{jrkt}$$
$$+ \sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T} h^{(2)}_{rk} Q^{(2)}_{rkt} + \sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} \left(\lambda_{jkt} - \gamma_{jkt} \right) \left(\sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau} \right) - \sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} \lambda_{jkt} \left(\sum_{r=1}^{R}\sum_{\tau=1}^{t-1} Y_{jrk\tau} \right) + \sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} \gamma_{jkt} \left(\sum_{r=1}^{R}\sum_{\tau=1}^{t} Y_{jrk\tau} \right)$$
$$- \sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} \lambda_{jkt} w^{(1)}_{jk} Z^{(1)}_{jt}$$

in which,

$$\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} \left(\lambda_{jkt} - \gamma_{jkt} \right) \left(\sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau} \right) = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} \left(\lambda_{jkt} - \gamma_{jkt} \right) \left(\sum_{\tau=1}^{t} X_{ijk\tau} \right) = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} \left(\sum_{\tau=t}^{T} \left(\lambda_{jk\tau} - \gamma_{jk\tau} \right) \right) X_{ijkt}$$

$$\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} \lambda_{jkt} \left(\sum_{r=1}^{R}\sum_{\tau=1}^{t-1} Y_{jrk\tau} \right) - \sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T} \gamma_{jkt} \left(\sum_{r=1}^{R}\sum_{\tau=1}^{t} Y_{jrk\tau} \right) = \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T} \left(\sum_{\tau=t+1}^{T} \lambda_{jk\tau} \right) Y_{jrkt} - \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T} \left(\sum_{\tau=t}^{T} \gamma_{jk\tau} \right) Y_{jrkt}$$
$$= \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T} \left(\sum_{\tau=t+1}^{T} \lambda_{jk\tau} - \sum_{\tau=t}^{T} \gamma_{jk\tau} \right) Y_{jrkt}$$

It can be easily recognized that Problem (L) can be decomposed into two sub-problems (L1) and (L2) as follows:

Sub-problem (L1):

$$Min\ Z_{L1}=\sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T}\left[c_{ijk}+\sum_{\tau=t}^{T}\left(\lambda_{jk\tau}-\gamma_{jk\tau}\right)+\left(T-t+1\right)h_{jk}^{(1)}\right]X_{ijkt} \\ +\sum_{i=1}^{I}\sum_{t=1}^{T}f_i\left(Z_{it}-Z_{i(t-1)}\right)+\sum_{i=1}^{I}\sum_{k=1}^{K}\sum_{t=1}^{T}p_{ik}V_{ikt}+\sum_{i=1}^{I}\sum_{k=1}^{K}\sum_{t=1}^{T}h_{ik}Q_{ikt} \tag{21}$$

Subject to constraint sets (3), (8), (10), (12), and (14).

Sub-problem (L2):

$$Min\ Z(L2)=\sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T}\left[c_{jrk}^{(1)}-\left(\sum_{\tau=t+1}^{T}\lambda_{jk\tau}-\sum_{\tau=t}^{T}\gamma_{jk\tau}\right)-\left(T-t+1\right)h_{jk}^{(1)}\right]Y_{jrkt}-\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T}\lambda_{jkt}w_{jk}^{(1)}Z_{jt}^{(1)} \\ +\sum_{j=1}^{J}\sum_{t=1}^{T}f_j^{(1)}\left(Z_{jt}^{(1)}-Z_{j(t-1)}^{(1)}\right)+\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T}h_{rk}^{(2)}Q_{rkt}^{(2)} \tag{22}$$

Subject to constraint sets (7), (11), (13), and (15).

For fixed values of $\lambda_{jkt}'s$ and $\gamma_{jkt}'s$, it is noted that the value of the objective function of the original model can be determined via the solutions of the two sub-problems (L1) and (L2) as $Z=Z1+Z2$, in which

$$Z1=\sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T}\left[c_{ijk}+\left(T-t+1\right)h_{jk}^{(1)}\right]X_{ijkt}+\sum_{i=1}^{I}\sum_{t=1}^{T}f_i\left(Z_{it}-Z_{i(t-1)}\right)+\sum_{i=1}^{I}\sum_{k=1}^{K}\sum_{t=1}^{T}p_{ik}V_{ikt}+\sum_{i=1}^{I}\sum_{k=1}^{K}\sum_{t=1}^{T}h_{ik}Q_{ikt},$$

$$Z2=\sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T}\left[c_{jrk}^{(1)}-\left(T-t+1\right)h_{jk}^{(1)}\right]Y_{jrkt}+\sum_{j=1}^{J}\sum_{t=1}^{T}f_j^{(1)}\left(Z_{jt}^{(1)}-Z_{j(t-1)}^{(1)}\right)+\sum_{r=1}^{R}\sum_{k=1}^{K}\sum_{t=1}^{T}h_{rk}^{(2)}Q_{rkt}^{(2)}$$

Therefore, the value of the objective function of the original model is determinable if and only if the two sub-problems can give feasible solutions. However, with the current formulations of the two sub-problems, it might happen that the above requirement cannot be ensured. This issue will be discussed and tackled in the next paragraphs.

Considering sub-problem (L1), it can be seen that there exists no constraint that forces binary variables Z_{it} to receive positive values. This will lead to the fact that all $Z_{it}'s$ will be set to zeros when (L1) is solved. All other decision variables will also receive the value of zero, and hence, the objective value is always zero. Therefore, some additional constraint sets should be added to over this trouble as follows:

Additional constraint set 1:

$$\sum_{i=1}^{I}\sum_{\tau=1}^{t}V_{ik\tau}\geq\sum_{r=1}^{R}\sum_{\tau=1}^{t}d_{rk\tau}\quad\forall k\in K,\forall t\in T, \tag{23}$$

This constraint is added to sub-problem (L1) to help ensure that the cumulative production quantity of product k at time period t from all manufacturing plants will exceed the total cumulative demand of retailers.

Additional constraint set 2:

$$\sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{\tau=1}^{t}X_{ijk\tau}\geq\sum_{r=1}^{R}\sum_{\tau=1}^{t}d_{rk\tau}\quad\forall k\in K,\forall t\in T, \tag{24}$$

This constraint is also added to sub-problem (L1) to help ensure that the cumulative shipping quantity of product k at time period t from all manufacturing plants to distribution centers will exceed the total cumulative demand of retailers.

For sub-problem (L2), the same situation occurs, i.e., there is no constraint that forces binary variables $Z_{jt}^{(1)}$ to receive positive values, and hence, all $Z_{jt}^{(1)}{}'s$ will be set to zeros. However, $Y_{jrkt}{}'s$ are not all zeros due to constraints (7). This leads to the situation that some retailers will receive shipments from non-operating distribution centers. Similarity, one additional constraint set must be introduced into sub-problems (L2) as follows:

Additional constraint set 3:

$$\sum_{r=1}^{R} Y_{jrkt} \le w_{jk}^{(1)} Z_{jt}^{(1)} \quad \forall j \in J, \forall k \in K, \forall t \in T, \tag{25}$$

This constraint is added to sub-problem (L2) to help ensure that the amount of product k shipped to all retailers from an operating DC j will not exceed the capacity of DC j. It should be noted that this constraint set can be derived from constraint sets (5) and (6) of the original model. However, due to the fact that constraint set (5) has been relaxed, there is a need to incorporate this constraint into sub-problem (L2).

4. Lagrangian relaxation algorithm

The following Lagrangian relaxation algorithm will be employed for solving purpose

Step 0: Setting initial values

- Set all initial values of Lagrange multipliers to zeros,
- Set initial value of step size multiplier (e.g.,),
- Set the value of - the maximum allowable consecutive iterations with no improvement (e.g.,),
- Set the value of - maximum number of iterations (e.g.,),
- Set initial iteration index ,
- Set initial value of number of iterations with no improvement ,
- Set the value of - the best value of the objective function obtained so far, to infinity.

Step 1: Solving sub-problems

- Find the solution of both sub-problems (L1) and (L2).

Step 2: Determining and updating the current objective value

- Determine the current objective value of the original proposed model , and the current objective value of the Lagrangian relaxation problem ,
- IF THEN {assign , and IF the relaxed constraint sets (5) and (17) are satisfied THEN , goto step 3; ELSE goto step 3} ELSE , goto step 3.

Step 3: Updating the Lagrange multipliers

- IF THEN and ,
- Update the current step size as follows

$$Stepsize_{Iter} = \delta \times \frac{[Z(L) - Z(Best)]}{\sum_{j=1}^{J}\sum_{k=1}^{K}\sum_{t=1}^{T}\left[\left(\sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau} - w_{jk}^{(1)} Z_{jt}^{(1)} - \sum_{r=1}^{R}\sum_{\tau=1}^{t\text{-}1} Y_{jrk\tau}\right)^2 + \left(\sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau} - \sum_{r=1}^{R}\sum_{\tau=1}^{t} Y_{jrk\tau}\right)^2\right]}$$

- Update the Lagrange multipliers

$$(\lambda_{jkt})_{(Iter+1)} = (\lambda_{jkt})_{Iter} + (Stepsize_{Iter})\left(\sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau} - w_{jk}^{(1)} Z_{jt}^{(1)} - \sum_{r=1}^{R}\sum_{\tau=1}^{t\text{-}1} Y_{jrk\tau}\right)$$

$$(\gamma_{jkt})_{(Iter+1)} = (\gamma_{jkt})_{Iter} + (Stepsize_{Iter})\left(\sum_{r=1}^{R}\sum_{\tau=1}^{t} Y_{jrk\tau} - \sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ijk\tau}\right)$$

Step 4*:* Checking stopping condition

- IF $Iter = MaxIter$ THEN stop; ELSE $Iter = Iter + 1$, goto step 1.

5. Numerical experiments

In this section, we conduct numerical experiments to illustrate the applicability of our proposed approach and to compare the performance of our proposed approach with that of commercial Lingo solver. Fifteen test problems with predefined values of I, J, R, K, and T as presented in Table 1 are examined. Among these test problems, it is noted that five problems (S1 to S5) are considered as small size problems, five problems are medium size (M1 to M5), and five problems are large size (B1 to B5).

The input data for each test problem are randomly generated in predefined intervals. For each parameter, the number of data values generated depends upon values of I (number of potential sites for manufacturing plants), J (number of potential sites for distribution centers), R (number of retailers), K (number of product types), and T (length of planning horizon). Data range and the number of generated values for each parameter are summarized in Table 2 below.

Table 1: Test Problems

Problem	I	J	K	R	T
S1	4	3	3	2	3
S2	4	4	4	3	3
S3	5	5	5	5	5
S4	5	6	6	4	5
S5	5	8	8	5	6
M1	8	8	8	8	8
M2	6	10	10	8	8
M3	10	10	10	8	8
M4	10	10	10	10	10
M5	10	15	15	10	10
B1	10	20	20	20	10
B2	10	20	20	25	10
B3	20	20	20	20	10
B4	10	20	20	30	10
B5	40	40	20	20	10

Table 2: Data Ranges for Input Parameters

Parameters	Data Range	Number of generated values
f_i	50,000 to 150,000	I

$f_j^{(1)}$	30,000 to 100,000	J
w_{ik}	1000 to 5000	I*K
$w_{jk}^{(1)}$	1000 to 5000	J*K
p_{ik}	30 to 100	I*K
h_{ik}	1 to 10	I*K
$h_{jk}^{(1)}$	1 to 10	J*K
$h_{rk}^{(2)}$	1 to 10	R*K
c_{ijk}	5 to 20	I*J*K
$c_{jrk}^{(1)}$	5 to 20	J*R*K
d_{rkt}	500 to 2000	R*K*T

Table 3: Value of Total Cost Function with respect to parameter *MaxIter*

Problem	***MaxIter***				
	40	50	60	70	100
S1	2698352	2690700	2690700	2690700	2690700
S2	14038966	14009614	14009614	14009614	14009614
S3	52593508	52557330	52526350	52526350	52526350
S4	51112435	51096247	51071040	51071040	51071040
S5	170718832	170511760	170484970	170484970	170484970
M1	27977765	27813850	27813850	27813850	27813850
M2	36465740	36291680	36289540	36289540	36289540
M3	34332369	34188257	34069325	34069325	34069325
M4	52815222	52741445	52741445	52741445	52741445
M5	81536164	81317516	81215060	81215060	81215060

From the results presented in Table 3, it can be seen that the Lagrangian relaxation algorithm converges very fast when the value of MaxIter increases. For all small and medium size problems considered in our numerical experiment section, there is no change in total costs when MaxIter exceeds 60. However, for reservation purpose, we decide to use MaxIter = 200 in all test problems. It should be noted that even with this overestimated value of MaxIter, our proposed approach still outperform Lingo in terms of computational time for medium and large size problems.

Detailed results about value of total cost function and computational time obtained from Lingo and from the proposed approach are presented in Table 4. In Table 4, column (2) presents the total number of variables and the number of integer variables for each test problem; column (3) presents the number of constraints; columns (4) and (5) present the values of objective function obtained from Lingo and from the proposed approach, respectively; columns (7) and (8) presents computational times of Lingo and of the proposed approach, respectively. It should be noted that the solutions obtained from Lingo in Table 4 (if exists) are global optimums.

From the results presented in Table 4, it can be concluded that our proposed approach is comparable to Lingo in terms of solution quality for small and medium size problems. In addition, our developed approach performs better than Lingo for medium size problems in terms of computational time. For large size problems, our developed approach can help to find good solution in reasonable time while Lingo fails to give optimal solution in many cases.

Table 4: Summary of Numerical Results

Problem	Number of		Best Objective Value	Objective Value	Gap (%)	Comp. Time LINGO (hh:mm:ss)	Comp. time Proposed Method (hh:mm:ss)
	Variables*	Constraints					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
S1	231 (21)	117	2669270	2690700	0.80	00:00:01	00:00:02
S2	456 (24)	197	13899674	14009614	0.79	00:00:01	00:00:03
S3	1800 (50)	665	52011548	52526350	0.99	00:00:02	00:00:03
S4	1815 (55)	605	50846256	51071040	0.44	00:00:03	00:00:04
S5	3978 (78)	1086	169866157	170484970	0.36	00:00:05	00:00:05
M1	10368 (128)	2672	27739772	27813850	0.27	00:00:07	00:00:08
M2	12416 (128)	2800	36166118	36289540	0.34	00:00:12	00:0010
M3	15520 (160)	3340	33944664	34069325	0.37	00:00:13	00:00:10
M4	24200 (200)	5180	52456696	52741445	0.54	00:01:01	00:00:30
M5	42750 (250)	6726	81147884	81215060	0.27	00:01:49	00:01:43
B1	132300 (300)	16270	215279403	216538740	0.58	00:32:44	00:10:54
B2	165300 (300)	20270	N/A	263911580	N/A	N/A	00:28:33
B3	176400 (400)	20360	N/A	246377390	N/A	N/A	00:32:34
B4	198300 (300)	24270	N/A	313326020	N/A	N/A	00:37:42
B5	508800 (800)	36720	N/A	290565420	N/A	N/A	02:40:55

(*: the first value is the total number of variables, the value in parenthesis is the number of integer variables)

6. Conclusions

In this research paper, the main finding is that a mix integer linear programming model to deal with the capacitated facility location problem in supply chain network design, which incorporates also distribution planning decisions, is proposed. The developed model is a multi-item multi-period model which allows manufacturing plants / distribution centers to be opened at any period during the planning horizon. In addition, the model also takes into consideration the possibility for inventory at the end of one period to be carried over to the next period. The other finding is that a Lagrangian relaxation method is successful to help find solution for practical supply chain networks, which are usually large size problems. And special remark of our algorithm is additional constraint sets which are added to two sub-problems, all solutions can not be found without these additional constraint sets. This is the main difference among our algorithm and existing ones that try to drop some constraints to be simplified. Through numerical experiments, we can confirm that the performance of our proposed method is better than that of the commercial Lingo solver, especially for large size problems.

However, it should be noted that the decisions in our model are in place for a long time, and hence, it will be better if the time value of money is incorporated into the model. But, this will make the proposed model to become a very complicated one which is hard to find solution. Regardless of the fact that many similar research works in the past have also been conducted without considering the effect of time value of money, this is clearly a weakness of our proposed model that might limit its applicability in dealing with practical problems. We will try to address this weakness in our future research works.

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□ □ □ □ □ □ The Impacts of Board Characteristics on Performance and Risk-taking: Evidence from the U.S. Banking Industry

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This study examines the impact of board characteristics on bank performance and risk-taking behavior during the financial crisis and non-financial crisis periods, using a sample of 59 U.S. commercial banks and savings banks during 2000 to 2013. The empirical findings indicate that board structure does affect bank performance and their risk-taking behavior at different performing banks. For high-performing banks, CEO duality would decrease bank’s market performance either in crisis or non-crisis period, and it would also decrease market volatility. For low-performing banks, board structure plays more significant effect on bank performance and bank risks than it does on high-performing banks either crisis or non-crisis period. We find that independent board, CEO duality and board size have significantly positive effects on low-performing bank performance, but only CEO duality stays its influence in bank performance during financial financial tsunami of 2008. Moreover, board size, CEO duality and independent board have significantly negative effects on low-performing bank risks and only board size stay its significant influence in bank risks during financial tsunami.

Keywords: Bank Performance, Board structure, Financial Crisis.

1. Introduction

Since the Asian Financial crisis in year of 1997, the issue of corporate governance has been extensively addressed not only in the related research of financial studies but also in the practice of corporate business.

The definition and scope of corporate governance varied with the industries. In general, the board of director plays a key role in the corporate governance. The Sarbanes-Oxley Act (SOX) at year of 2002 mandated strict reforms to improve function of corporate governance for US-listed firms, it emphasizes the independence of auditing committee and board of director to enhance the financial transparency in order to achieve better shareholder's protection. This motivates to examine the impact of board structure on firm performance in this study.

The subprime crisis in 2008 heavily deteriorated bank performance due to high risk loan and high leverage operation, and the financial globalization speeded up the shocks to the other countries. Thus, the risk-taking behavior in banks that is seldom addressed in current literature deserves further investigation, especially in the role of board structure to bank's risk-taking. This study focuses on the influence of board structure in bank performance and risk-taking behavior, and compares the different influences between crisis period of 2008 and non-crisis period.

2. Literature review and hypothesis establishments

Changes of corporate governance at banks during past decades substantially altered the governance of banking organization. Adams and Mehran (2003) has documented the difference of corporate governance, especially in board structure, between US banking holding companies and manufactured firms. How does these changes in corporate governance affect bank performance and risk-taking behavior needs to be further addressed.

2.1 The impact of board structure on bank performance

Adams and Mehran (2003) pointed out that average board size of US BHC (bank holding company) during 1986 to 1999 is 18 directors on the board which is significantly higher than that in manufactured firms of 12 directors. Will larger board size improve bank performance ? Most literature indicated that there existed positive relationship between board size and firm performance (Dalton et al. ,1999; Mak and Li ,2001;Kiel and Nicholson,2003;Dalton and Dalton,2005). Andres and Vallelado (2008), using firm sample of six OECD countries, think larger board size would enhance firm performance due to various background and professional knowledge from larger board; the optimal board size is 19 directors in the board. They also found the inverse U shape relationship between bank performance and board size. Aebi, Sabato and Schmid (2012) also supported the positive relationship between board size and US bank performance during financial crisis.

Based on above, we establish the following hypotheses.

H_{1a} : The board size has positive effect on bank performance.
H_{1b}: The board size has positive effect on bank performance in financial crisis.

2.2 The impact of CEO duality on bank performance

Past literature have proposed that dual role of CEO also serving the president of the board plays certain influence on the firm performance. Fama and Jensen (1983) and Jensen (1993) think that CEO duality would weaken the independent monitoring of the board. However, according to Boyd (1995), CEO duality helps efficient decision making to improve firm performance in financial crisis, thus, the positive relationship between CEO duality and firm performance exists during financial distress period. Thus, we establish the following hypotheses.

H_{2a}: CEO duality has negative effect on bank performance.
H_{2b}: CEO duality has positive effect on bank performance during financial crisis.

2.3 The impact of independent board on bank performance

The function of independent board is to mitigate the potential opportunism of CEO so as to decrease the interest conflicts between managers and shareholders (Crespí-Cladera and Pascual-Fuster, 2013). Lee, Rosenstein and Wyatt(1999) and Byrd and Hickman (1992) also supported the positive relation between independent director and firm performance.

Whether above positive relation between independent director and firm performance exists during financial distress period had been barely documented. Francis et al. (2012) investigated the influence of corporate governance in firm performance. They found that firm performance during crisis period which is measured by accumulated stock return during crisis could be improved by higher ratio of independent director in the board. Based on above, we establish the following hypotheses.

H_{3a} : The board independence has positive effect on bank performance.

H_{3b} : The board independence has positive effect on bank performance during financial crisis.

This research is designed to test the relation between board characteristics and bank performance. Considering the higher risk-taking followed by greater profitability, we examine above hypotheses by measuring bank performance in terms of both bank performance and risk-adjusted bank performance.

2.4 The impact of board size on bank risks

Whether agency problems between management and shareholders with respect to risk-taking behavior may also vary with the bank's board characteristics. Past literature has documented whether bank risk-taking varies with bank's ownership structure (leaven and Levine, 2009; Jensen and Meckling, 1976) and with managerial incentives (Coles, Naveen and Naveen, 2006). Yet, few research has assessed how board structure shapes the risk taking behavior of banks. The way to meet capital requirement is either to reduce risk-taking incentives of banks by restricting banks from engaging in nonlending activities, such as securities and insurance underwriting or to raise bank capital. Some research suggested that loss for bank shareholders from stringent capital requirements might intensify shareholder's risk-taking incentives(Koehn and Santomero, 1980; Buser, Chen, and Kane,1981). We would investigate the role of board characteristics in the agency problems between management and shareholders with respect to bank risk-taking behavior in this study.

Pathan (2009) show the significantly positive relation between strong board and risk-taking behavior, that is, risk control capability is stronger for strong board in terms of smaller board, higher ratio of independent directors. Accordingly, we establish the following hypotheses.

H_{4a} : The board size has negative effect on bank's risk-taking behavior.

H_{4a} : The board size has negative effect on bank's risk-taking behavior during financial crisis.

2.5 The impact of CEO duality on bank risk

Amihud and Lev(1981),Pathan(2009),Castañer and Kavadis (2013) suggested the negative relation between CEO power and bank risk management. CEO power is measured by CEO duality and whether internally hired. The wealth of dual CEO is less likely to be diversified, considering the expected value of debt tax shield and bankrupt costs(Parrino et al., 2005), CEO would choose to be a risk-averter to avoid the wealth loss. Castañer and Kavadis (2013) indicated that dual CEO tends to decrease risk exposure in the way of diversification. However, Ferrero et al. (2012) presents insignificant relation between dual CEO and risk-averse in S&P500 firms during 2008 financial financial tsunami. Even though, we argue that dual CEO would help reduce bank's risks during financial crisis. Accordingly, we establish the following hypotheses.

H_{5a} : The dual CEO has a negative impact on bank risks.

H_{5b} : The dual CEO has a negative impact on bank risks during financial crisis.

2.6 The impact of independent board on bank risks

Fredrickson, Hambrick and Baumrin(1988), Connors(1989), Baysinger and Hoskisson(1990) indicated that independent board could effectively monitor CEO's decision making in the development of firms. Also, Ferrero, Izquierdo and Torres (2012) show that higher ratio of independent directors on the board could restrict over risk-taking during financial financial tsunami of 2008. Accordingly, we establish the following hypotheses.

H_{6a} : The independent board has a negative impact on bank's risk-taking.

H_{6b} : The independent board has a negative impact on bank's risk-taking during financial crisis.

3. Research methodology

3.1 sample description

We examine the impact of board structure on both bank performance and risks by using pooled sample of 59 US commercial banks during 2000 to 2013. The financial information and board structure data are obtained from Bankscope, Execucomp and U.S. Securities. Board information are hand-collected from Exchange Commission website.

3.2 Empirical model

The empirical models are established as follow.

$$\begin{aligned} perform_{it} = {} & \beta_0 + \beta_1 bosize_{it} + \beta_2 indepr_{it} + \beta_3 dual_{it} + \beta_4 lnass_{it} + \beta_5 debt_{it} \\ & + \beta_6 liqratio_{it} + \beta_7 capratio_{it} + \beta_8 yeardum_{it} + \beta_9 intbosz_{it} \\ & + \beta_{10} intdual_{it} + \beta_{11} intyrind_{it} + \varepsilon_{it} \end{aligned}$$

Where i=1,...,N ， t=1,...,T (1)

$$risk_{it} = \beta_0 + \beta_1 bosize_{it} + \beta_2 indepr_{it} + \beta_3 dual_{it} + \beta_4 lnass_{it} + \beta_5 debt_{it} + \beta_6 liqratio_{it} + \beta_7 capratio_{it} + \beta_8 yeardum_{it} + \beta_9 intbosz_{it} + \beta_{10} intdual_{it} + \beta_{11} intyrind_{it} + \varepsilon_{it}$$

Where i=1,...,N ， t=1,...,T (2)

Variable definition:

Dependent variables:

$perform_{it}$ is measured by ROA, ROE and one-year stock return (RET1YE).

$risk_{it}$ is measured by the standard deviation of performance of three-year at t, t-1 and t+1,VOLROA, VOLROE, and VOLRET.

Independent variables:

Board structure is measured by board size (BOSIZE), dual role of CEO (DUAL) and the ratio of independent directors (INDEPR).

(1) BOSIZE：number of directors on the board
(2) DUAL：1 if CEO also serves as the president of the board, otherwise, it is 0
(3) INDEPR： the ratio of independent directors on the board
(4) Yeardum：1 if the sample year is equal to 2008 or 2009, otherwise, it is 0
(5) Intbosz：interaction term of Yeardum and BOSIZE
(6) Intdual：interaction term of Yeardum and DUAL
(7) Intyrind：interaction term of Yeardum and INDEPR

Control variables

(1) CAPRATIO：bank's capital divided by total risky assets
(2) lnass：logarithm of total Assets。
(3) DEBT：total debt divided by total assets
(4) LIQRATIO：total liquidity assets divided by total assets

4. Empirical results

4.1 Descriptive statistics

Table 4.1 show the descriptive statistics of all variables. Panel A is the measure of bank performance with mean ROA of 0.89%, ROE of 8.15% and RET1YE of 8.94%, and the mean ADJROA of 11.04%, ADJROE of 11.55% and ADJRET of 8.94%. Panel B show the bank risks, both ROE and RET1YE have greater volatilities than that in ROA. We also list the performance and risks before, during and after financial financial tsunami year defined as year of 2008 and 2009. In general, we find the performances before and after financial tsunami year are better than that in financial tsunami year; and the risk of financial tsunami year is much higher than that before and after financial crisis. Comparing performance and risks before and after financial tsunami year, we find the performance is generally higher and risks is lower before crisis than those after crisis.

There is around 60% of the sample with CEO duality, and mean board size is 25 showing banks with greater board size. The average ratio of independent directors is 79%.

Table 4.1 Descriptive statistics

Variable name	N	mean	Standard deviation	Min	Max
Panel A：bank performance					
ROA	624	0.8976	1.4002	-6.53	12.15
ROE	623	8.1536	27.9217	-487.57	211.1
RET1YE	732	8.9493	35.9590	-92.686	284.158
ADJROA	571	11.0461	20.0776	-16.2076	204.3819
ADJROE	570	11.5580	33.4513	-10.4876	676.7011
ADJRET	657	0.3406	2.3425	-17.8406	27.9846
Panel B：bank risks					
VOLROA	571	0.4190	0.7017	0.0057	7.7439
VOLROE	571	7.1403	26.7957	0.0141	356.2554
VOLRET	657	26.9435	20.9885	0.0989	205.0164
Bank performance and risks before Financial tsunami (2000 ~ 2007)					
ROA	322	1.2128	0.4681	-0.72	2.71
ROE	322	13.8230	6.0565	-8.99	47.88
RET1YE	400	11.1679	30.7692	-69.706	175.8010
ADJROA	319	14.0278	20.4448	-0.4459	204.3819
ADJROE	319	15.1170	41.9269	-0.4787	676.7011
ADJRET	386	0.7583	2.4595	-13.1925	27.9846
VOLROA	319	0.2669	0.4178	0.0057	3.7264
VOLROE	319	3.4096	5.8457	0.0141	56.2598
VOLRET	386	24.3923	18.1929	0.0989	114.1294
Bank performance and risks during Financial tsunami (2008 ~ 2009)					
ROA	99	-0.1770	1.6007	-5.84	2.79
ROE	99	-4.7112	27.5320	-145.05	27.42
RET1YE	113	-17.9957	33.3229	-92.686	58.826
ADJROA	99	5.4519	20.7668	-16.2076	168.0089
ADJROE	99	2.2402	5.5416	-10.4876	32.7526
ADJRET	110	-1.04359	2.7001	-17.8406	1.5232
VOLROA	99	0.74028	0.8195	0.0057	3.7046
VOLROE	99	11.6363	25.1366	0.4209	218.6847
VOLRET	110	27.5429	19.0037	2.6192	97.0343
Bank performance and risks after Financial tsunami (2010 ~ 2013)					
ROA	203	0.9217	1.9315	-6.53	12.15
ROE	202	5.4212	42.9406	-487.57	211.1

Table 4.1 Descriptive statistics (continued)

RET1YE	219	18.8004	39.3665	-72.833	284.158
ADJROA	153	8.4493	17.7001	-13.4350	183.5973
ADJROE	152	10.1576	20.2244	-2.9807	163.9712
ADJRET	161	0.2850	1.1114	-6.4754	3.0491
VOLROA	153	0.5282	0.9593	0.0057	7.7439
VOLROE	153	12.0094	46.3403	0.0624	356.2554
VOLRET	161	32.6505	26.7383	2.0810	205.0164
Panel C：board characteristics					
BOSIZE	561	12.5918	3.1508	6	25
DUAL	1460	0.6047	0.4890	0	1
INDEPR	466	0.7963	0.1144	0.4	1
Panel D：control variables					
Asset(thousand)	624	85,992,564.23	274,613,984	333,100	2,264,909,000
DEBT	624	0.8952	0.0742	0.064	99.67
LIQRATIO	615	0.0736	0.0913	0.0036	0.6594
CAPRATIO	552	0.141	0.0382	0.013	0.499

Note: ROA is EBIT divided by total assets; ROE is EBIT divided by total equity value; RET1YE is one year stock return; VOLROA is the standard deviation of ROA at year t-1,t, t+1; VOLROE is the standard deviation of ROE at year t-1,t, t+1; VOLRET is the standard deviation of RET1YE at year t-1,t, t+1; DUAL is one if CEO also serving as the president of the board, otherwise, 0; BOSIZE is the total number of directors on the board; INDEPR is the ratio of independent directors to board size; Asset is logarithm of total assets (in thousands dollars); DEBT is total debt divided by total assets; LIQRATIO is total liquid assets divided by total assets; CAPRATIO is total capital divided by total risky assets.

4.2 Empirical results

All regression analyses are results of robust adjusted regressions. In section 4.2.1, Table 4.2 and 4.3 present the results for both bank performance and bank risks respectively. In section 4.2.2, the high and low bank performance empirical results are shown in Table 4.4, 4.5, 4.6 for high-performing banks and in Table 4.7,4.8 and 4.9 for low-performing banks.

4.2.1

From Table 4.2, we find that CEO duality has a significantly positive effect on bank performance in terms of ROA and ROE while they become insignificant after adjusting the risks, implying the risk increasing with higher performance. Board size has a significantly positive effect on adjusted ROA only. The independent board doesn't present any influence in bank performances. Therefore, H_{2a}, H_{2b}, H_{3a}, H_{3b} are not confirmed in this study. Taking a look at the results on financial crisis, we find bank performance does show significantly lower at ROA and ROE during financial tsunami (Yeardum), but, the adjusted performance presents to be insignificant which again might be due to the high volatilities during financial tsunami. As to the effect of board on bank performance during crisis period, we only find board size has significantly negative effect on adjusted stock return, meaning larger board size during crisis period would deteriorate bank adjusted performance. Most hypotheses for crisis period cannot be confirmed. We think the insignificant results might be because the cross out effects between high and low performance. Therefore, we further try to explore the analysis by dividing sample into high and low performance group based on median value of bank performance. Those results are shown in section 4.2.2 later.

Table 4.3 reveals the results of board effect on bank risks. We find significantly positive effect of board size on bank risks in terms of ROA volatility, that is, larger board help mitigate bank risks, confirming $H_{4a.}$ Besides, CEO duality also shows significantly negative influence in stock volatility, confirming $H_{5a.}$ During financial tsunami, there is not any board characteristics shown significant effects on bank risks.

In summary, we cannot find consistently significant results of the board structure on bank performance or banks risks from whole sample. However, we argue that the insignificant results might be because the cross out effects between high and low performance. Thus, we further examine the same issue by using high-performing and low-performing banks sample next in section 4.2.2.

Table 4.2 Regression analysis of bank performance

	Bank performances			risk-adjusted bank performances		
Variables	ROA	ROE	RET1YR	ADJROA	ADJROE	ADJRET
Intercept	1.439	-77.342	70.224	15.682	10.006	-0.934
	(0.2948)	(<.0001)	(0.3565)	(0.3244)	(0.4913)	(0.7699)
Bosize	0.013	0.1374	0.500	0.242 *	0.1876	0.039
	(0.2972)	(0.2827)	(0.4682)	(0.0950)	(0.1520)	(0.1692)
Dual	0.150 **	1.4851 **	2.505	1.261	0.6911	0.223
	(0.0216)	(0.0281)	(0.4921)	(0.1025)	(0.3208)	(0.1483)
Indepr	-0.331	-3.5669	11.698	-1.706	-2.3217	-0.927
	(0.2530)	(0.2330)	(0.4685)	(0.6169)	(0.4508)	(0.1715)
Yeardum	-1.292*	-15.082**	-28.262	-8.436	-8.0466	-0.421
	(0.0502)	(0.0266)	(0.4400)	(0.2483)	(0.2220)	(0.7727)
Intbosz	0.033	0.232	-1.484	0.101	-0.0732	-0.105 *
	(0.2049)	(0.3936)	(0.3108)	(0.7294)	(0.7811)	(0.0718)
Intdual	-0.126	0.185	0.175	0.291	0.8114	-0.083
	(0.3880)	(0.9022)	(0.9828)	(0.8579)	(0.5795)	(0.7983)
Intyrind	0.478	7.368	23.557	2.346	4.7516	1.339
	(0.4531)	(0.2621)	(0.5054)	(0.7406)	(0.4569)	(0.3418)
lnass	-0.048 **	-0.545 **	-0.180	-0.595**	-0.4882**	0.008
	(0.0434)	(0.0275)	(0.8923)	(0.0305)	(0.0491)	(0.8762)
DEBT	0.668	109.555***	-101.793	-2.557	4.3688	0.083
	(0.5977)	(<.0001)	(0.1472)	(0.8616)	(0.7468)	(0.9773)
LIQRATIO	-0.124	-0.1426	12.094	4.014	6.5025 *	0.277
	(0.7193)	(0.9682)	(0.5291)	(0.3173)	(0.0727)	(0.7278)
CAPRATIO	-0.011	-0.052	1.025 *	0.008	-0.0909	0.069***
	(0.2990)	(0.6363)	(0.0809)	(0.9439)	(0.4118)	(0.0043)
N	383	382	382	342	341	340
R-Square	0.1016	0.2097	0.1296	0.0936	0.0999	0.0916

Note: ROA is EBIT divided by total assets; ROE is EBIT divided by total equity value; RET1YE is one year stock return; VOLROA is the standard deviation of ROA at year t-1,t, t+1; VOLROE is the standard deviation of ROE at year t-1,t, t+1; VOLRET is the standard deviation of RET1YE at year t-1,t, t+1; DUAL is one if CEO also serving as the president of the board, otherwise, 0; BOSIZE is the total number of directors on the board; INDEPR is the ratio of independent directors to board size; Asset is logarithm of total assets (in thousands dollars); DEBT is total debt divided by total assets; LIQRATIO is total liquid assets divided by total assets; CAPRATIO is total capital divided by total risky assets; Yeardum is one if sample year is 2008 and 2009, otherwise, 0; Intbosz is the interaction term between Yeardum and BOSIZE; Intdual is the interaction term between Yeardum and dual; Intyrind is the interaction term between Yeardum and INDEPR.

*,**,***represents significance level at 10%,5% and 1%.

Table 4.3 Regression analysis of bank risks

Variables	VOLROA	VOLROE	VOLRET
Intercept	1.947	10.005	10.390
	(0.0004)	(0.0936)	(0.8156)
Bosize	-0.010**	-0.082	-0.534
	(0.0452)	(0.1326)	(0.1850)
Dual	-0.002	0.050	-4.771**
	(0.9225)	(0.8622)	(0.0269)
Indepr	-0.094	-1.280	-11.489
	(0.4207)	(0.3168)	(0.2243)
Yeardum	0.158	0.550	-28.081
	(0.5310)	(0.8407)	(0.1673)
Intbosz	-0.001	-0.009	0.851
	(0.8545)	(0.9325)	(0.2963)
Intdual	0.029	0.233	-7.150
	(0.5959)	(0.7014)	(0.1143)
Intyrind	-0.003	1.509	30.913
	(0.9872)	(0.5701)	(0.1158)
lnass	0.017*	0.119	1.368*
	(0.0681)	(0.2458)	(0.0729)
DEBT	-1.943***	-7.681	0.131
	(0.0001)	(0.1624)	(0.9974)
LIQRATIO	-0.073	-0.758	13.995
	(0.5981)	(0.6142)	(0.2088)
CAPRATIO	-0.006	-0.0647	0.497
	(0.1345)	(0.1571)	(0.1435)
N	342	342	340
R-Square	0.0414	0.0418	0.0668

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

4.2.2 Regression analyses for high-performing and low-performing banks

We further examine the same issue by using median value of bank performance to further separate sample into high-performing and low-performing banks. Table 4.4, 4.5 and 4.6 show the results for sample of high-performing banks, Table 4.7 to 4.9 for sample of low-performing banks. Table 4.4 presents performance results of both basic models and models with interactions between board characteristics and crisis year. Similarly, Table 4.5 gives the results of adjusted performances and Table 4.6 shows the results of bank risks. As shown in Table 4.4 and Table 4.5, we find the CEO duality has significantly negative effects on stock returns at high-performing banks, but, it becomes insignificant after adjusting the risk factor. The interaction term between CEO duality (DUAL) and crisis year (Yeardum) has a significantly negative effect on stock returns, adjusted ROA and adjusted ROE, that is, during financial crisis, high-performing banks with CEO duality would have significantly lower performances than those without CEO duality.

Table 4.7 shows the results of bank risks for high-performing banks. The results indicate that high-performing banks with CEO duality have relatively lower stock volatility than those without CEO duality. During financial tsunami, CEO duality would intensify bank's volatility of ROE; high-performing banks with higher ratio of independent director and larger board have relatively lower bank risks in terms of ROA measure.

In summary of results in high-performing banks, we find the CEO duality does play certain role on bank performance and risks. When bank CEO also serving as the president of the board will reduce bank market performance in favor of H_{2a} and also decrease market volatility in favor of H_{5a}. During crisis period, high-performing banks with CEO duality will reduce bank's accounting performance in terms of ROA and ROE after adjusting risk factor. Besides, higher independent board in terms of independent director ratio and higher board size will also help control bank risks during financial tsunami in favor of in favor of H_{4b} and H_{6b}.

Table 4.7 to 4.9 show the results for sample of low-performing banks. We do find the significant influence of board structure on low-performing bank's performance and risks. Banks with CEO duality have a consistently and significantly positive impact on bank accounting performance in terms of ROA and ROE while this significant effect on performance disappears after considering the risk factor. Although CEO duality does not have significant effects on market performance of stock return, it reduces market volatility of low-performing banks in favor of H_{5a} and also helps improve risk-adjusted bank market performance during crisis period, confirming H_{2b}. Those results indicate that CEO duality helps efficient decision making to improve firm performance in financial crisis, thus, the positive relationship between CEO duality and firm performance exists during financial distress period which result is consistent with findings in Boyd (1995).

Except for CEO duality, board independence is also supported to have a significantly positive effect on low-performing bank's performance and negative effects on bank risks. Table 4.7 shows that bank performance in terms of ROA is improved by the higher ratio of independent directors on the board regardless of ROA or risk-adjusted ROA, confirming H_{3a}. We also find that higher independence of the board helps mitigate the low-performing bank's risks in terms of VOLROA and VOLRET, in favor of H_{6a}. Independent board could mitigate the potential opportunism of CEO though monitoring of independent board, thus, improve bank performance and reduce bank risk-taking behavior. However, above positive relation between independent board and bank performance, hypothesis H_{3b}, is not supported during financial distress period.

Taking a look at the effect of board size on low-performing bank's performance and risks, we find significantly positive relation between board size and market performance in terms of RET1YR and ADJRET (confirming H_{1a}), and significantly negative relation between board size and bank risks in terms of VOLRET and VOLROE, confirming H_{4a}. During financial tsunami, larger board will enhance low-performing bank's risk adjusted accounting performance (ADJROA) in favor of H_{1b}, and also help control market volatility (VOLRET) in favor of H_{4b}.

Overall, we conclude that using the whole sample to test research hypotheses, board structure seems unrelated to bank performance and bank risks in terms of inconsistent results. However, dividing bank performance to high-performing and low-performing banks based on median of performance, we find different results for high- and low-performing banks. For high-performing banks, CEO duality would decrease bank's market performance either in crisis or non-crisis period, and it would also decrease market volatility. For low-performing banks, except for CEO duality, independent board and board size also play significant role in bank performance and bank risks. We find that independent board, CEO duality and board size have positive effects on bank performance, but only CEO duality stays its influence in bank performance during financial tsunami. As to the effect of board structure on bank risks at low-performing banks, we find board size, CEO duality and independent board have negative effects on bank risks and only board size stay its significant influence in bank risks during financial tsunami.

Table 4.4 Regression analyses of bank performance for high-performing banks

Variables	ROA	ROA	ROE	ROE	RET1YR	RET1YR
Intercept	1.08	1.0596	-24.0863	-23.9355	54.4162	57.565
	(0.3392)	(0.3609)	(0.0602)	(0.0678)	(0.4209)	(0.3824)
BOSIZE	-0.0117	-0.0106	-0.0576	-0.0656	0.3949	0.1679
	(0.2323)	(0.2926)	(0.5745)	(0.5471)	(0.4586)	(0.7513)
DUAL	0.0264	0.0153	-0.4942	-0.5798	-5.9564**	-2.655
	(0.6057)	(0.7726)	(0.3536)	(0.3065)	(0.0450)	(0.3825)
Indepr	-0.2816	-0.2885	-2.3209	-2.0963	17.2771	15.4381
	(0.1979)	(0.1955)	(0.2964)	(0.3583)	(0.1853)	(0.2400)
Lnass	0.0085	0.0071	0.2047	0.2185	-0.4156	-0.1552
	(0.6843)	(0.7384)	(0.3077)	(0.2859)	(0.7256)	(0.8933)
DEBT	0.6677	0.7064	42.1349***	41.5417***	-51.8544	-55.6659
	(0.5555)	(0.5409)	(0.0009)	(0.0013)	(0.4204)	(0.3747)
LIQRATIO	-0.2951	-0.2429	4.0224	5.1309*	4.3089	0.2321
	(0.3167)	(0.4365)	(0.1713)	(0.0940)	(0.7813)	(0.9878)
CAPRATIO	-0.0071	-0.0066	-0.0502	-0.0455	0.7119	0.5784
	(0.3440)	(0.3920)	(0.5441)	(0.5918)	(0.1390)	(0.2178)
Yeardum	-0.1284	0.4269	-1.5593*	11.7011	-3.3001	-2.1653
	(0.1766)	(0.7507)	(0.0534)	(0.2564)	(0.4443)	(0.9643)
Intyrind		-0.4655		-14.7805		5.9058
		(0.6873)		(0.1449)		(0.8860)
intdual		0.1528		1.9413		-25.298***
		(0.5376)		(0.3357)		(0.0065)
intbosz		-0.0207		-0.1701		1.0708
		(0.6479)		(0.5680)		(0.5618)
N	171	171	175	175	175	175
R-Square	0.0524	0.0568	0.0941	0.1010	0.0560	0.0897

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

Table 4.5 Regression analyses of adjusted bank performance for high-performing banks

Variables	ADJROA	ADJROA	ADJROE	ADJROE	ADJRET	ADJRET
Intercept	-2.6460	-13.7746	40.5011	42.2435	-5.1875	-4.8902
	(0.9205)	(0.5784)	(0.1099)	(0.1040)	(0.5561)	(0.5790)
BOSIZE	0.3123	0.2028	0.2634	0.2682	0.1097	0.0871
	(0.1714)	(0.3440)	(0.1911)	(0.2123)	(0.1072)	(0.2122)
DUAL	-0.1930	1.0724	-1.3117	-0.6791	0.358	0.6202
	(0.8739)	(0.3508)	(0.2141)	(0.5478)	(0.3577)	(0.1349)
Indepr	-3.1351	-2.8409	-0.7998	-0.3704	-1.127	-1.5424
	(0.5394)	(0.5482)	(0.8547)	(0.9344)	(0.5010)	(0.3771)
Lnass	-0.7321	-0.3786	-0.2923	-0.3327	-0.1006	-0.0727
	(0.1346)	(0.4022)	(0.4598)	(0.4109)	(0.5036)	(0.6298)
DEBT	20.485	25.0067	-31.4221	-33.4183	7.8144	7.5728
	(0.4415)	(0.3116)	(0.2122)	(0.1949)	(0.3496)	(0.3643)
LIQRATIO	16.434**	15.1876**	3.6982	3.4013	4.2406**	3.9556**
	(0.0140)	(0.0182)	(0.5139)	(0.5654)	(0.0329)	(0.0472)
CAPRATIO	0.2195	0.3058*	-0.0647	-0.0701	0.1168*	0.1086*
	(0.2039)	(0.0610)	(0.6881)	(0.6719)	(0.0573)	(0.0769)
Yeardum	-2.7508	43.3228	-2.3441	28.8817	0.7435	0.1565
	(0.1963)	(0.1123)	(0.1284)	(0.1424)	(0.1435)	(0.9783)
Intyrind		-22.3971		-28.7351		1.3238
		(0.3400)		(0.1383)		(0.7886)
Intdual		-18.4253***		-9.3297**		-1.5727
		(0.0003)		(0.0156)		(0.1604)
Intbosz		-0.9981		0.0941		0.0506
		(0.2780)		(0.8687)		(0.8181)
N	154	154	164	164	139	139
R-Square	0.0337	0.1078	0.0291	0.0616	0.0689	0.0813

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

Table 4.6 Regression analyses of banks risks for high-performing banks

Variables	VOLROA	VOLROA	VOLROE	VOLROE	VOLRET	VOLRET
Intercept	0.5588	0.5844	-3.7705	-2.5136	20.2991	20.7022
	(0.2765)	(0.2400)	(0.5672)	(0.6976)	(0.3782)	(0.3747)
BOSIZE	-0.0042	-0.002	-0.0606	-0.046	-0.2296	-0.2631
	(0.3409)	(0.6383)	(0.2478)	(0.3897)	(0.1970)	(0.1544)
DUAL	0.0134	-0.0045	0.3594	0.0624	-2.4638**	-1.8387*
	(0.5693)	(0.8465)	(0.1906)	(0.8245)	(0.0154)	(0.0939)
Indepr	0.0508	0.0482	-0.2084	-0.2031	-3.828	-4.5781
	(0.6076)	(0.6114)	(0.8545)	(0.8561)	(0.3818)	(0.3219)
Lnass	0.0066	0.0040	0.0201	-0.0076	0.5507	0.5767
	(0.4860)	(0.6617)	(0.8451)	(0.9397)	(0.1611)	(0.1486)
DEBT	-0.4833	-0.4820	6.8196	6.0288	-16.372	-16.2631
	(0.3483)	(0.3311)	(0.2980)	(0.3476)	(0.4534)	(0.4616)
LIQRATIO	-0.2922**	-0.2631*	-1.6915	-0.8857	-2.4529	-3.4429
	(0.0240)	(0.0415)	(0.2511)	(0.5477)	(0.6369)	(0.5139)
CAPRATIO	-0.0038	-0.0037	-0.0055	-0.0114	0.0890	0.0725
	(0.2595)	(0.2589)	(0.8960)	(0.7826)	(0.5796)	(0.6551)
Yeardum	0.0937**	2.0484***	1.0765***	3.6343	-1.0797	-7.0993
	(0.0231)	(0.0002)	(0.0073)	(0.4585)	(0.4162)	(0.6413)
Intyrind		-0.9723**		-3.5294		7.0721
		(0.0390)		(0.4646)		(0.5883)
intdual		0.0917		-2.8727***		-3.4412
		(0.3648)		(0.0028)		(0.2458)
intbosz		-0.0888***		-0.131		0.2094
		(<.0001)		(0.3550)		(0.7192)
N	154	154	164	164	139	139
R-Square	0.0292	0.0889	0.0368	0.0724	0.0728	0.0839

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

Table 4.7 Regression analyses of bank performances for low-performing banks

Variables	ROA	ROA	ROE	ROE	RET1YR	RET1YR
Intercept	0.6289	0.6019	-77.8641	-77.3427	39.6335	31.8588
	(0.6700)	(0.6999)	(<.0001)	(<.0001)	(0.5487)	(0.6279)
BOSIZE	0.0173	0.0187	0.1601	0.1374	1.1934*	1.3272**
	(0.1473)	(0.1719)	(0.1837)	(0.2827)	(0.0534)	(0.0496)
DUAL	0.1502***	0.1669**	1.4783**	1.4851**	2.1245	0.8776
	(0.0080)	(0.0168)	(0.0147)	(0.0281)	(0.4474)	(0.7854)
Indepr	0.4441*	0.4623	-2.6902	-3.5669	17.8367	18.8443
	(0.1086)	(0.1755)	(0.3254)	(0.2330)	(0.1701)	(0.1955)
Lnass	-0.0563**	-0.0566**	-0.5335**	-0.5459**	-3.6782***	-4.0273***
	(0.0170)	(0.0230)	(0.0299)	(0.0275)	(0.0015)	(0.0005)
DEBT	0.6656	0.6599	108.711***	109.5555***	-29.6806	-17.4041
	(0.6005)	(0.6180)	(<.0001)	(<.0001)	(0.6204)	(0.7697)
LIQRATIO	0.1543	0.1322	0.0135	-0.1426*	-8.0978	-2.9639
	(0.6576)	(0.7167)	(0.9970)	(0.9682)	(0.6557)	(0.8699)
CAPRATIO	-0.0189	-0.0195	-0.0473	-0.052	0.555	0.5948
	(0.1488)	(0.1565)	(0.6640)	(0.6363)	(0.3160)	(0.2790)
Yeardum	-0.2738***	-0.137	-5.8575***	-15.0822**	-17.8235***	1.0138
	(<.0001)	(0.8066)	(<.0001)	(0.0266)	(<.0001)	(0.9703)
Intyrind		-0.0595		7.3682		-14.5901
		(0.9157)		(0.2621)		(0.5928)
intdual		-0.1009		0.1852		7.6898
		(0.4252)		(0.9022)		(0.2123)
intbosz		-0.0017		0.2323		-0.9221
		(0.9421)		(0.3936)		(0.4111)
N	212	212	382	382	207	207
R-Square	0.0699	0.0709	0.2075	0.2097	0.1579	0.1607

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

Table 4.8 Regression analyses of bank adjusted performances for low-performing banks

Variables	ADJROA	ADJROA	ADJROE	ADJROE	ADJRET	ADJRET
Intercept	10.9347	8.2805	10.1931	10.0062	-0.3628	0.3024
	(0.4172)	(0.5419)	(0.4850)	(0.4913)	(0.9536)	(0.9610)
BOSIZE	-0.0042	-0.1259	0.1837	0.1876	0.1084*	0.083
	(0.9699)	(0.3112)	(0.1377)	(0.1520)	(0.0585)	(0.1850)
DUAL	0.3062	-0.3555	0.9004	0.6911	0.414	0.0937
	(0.5545)	(0.5697)	(0.1471)	(0.3208)	(0.1153)	(0.7579)
Indepr	5.5091**	7.167**	-1.0833	-2.3217	-0.341	-0.1464
	(0.0315)	(0.0218)	(0.6998)	(0.4508)	(0.7814)	(0.9157)
Lnass	-0.3916*	-0.4808**	-0.5137**	-0.4882**	-0.2251**	-0.2618**
	(0.0635)	(0.0240)	(0.0388)	(0.0491)	(0.0362)	(0.0137)
DEBT	-4.866	-0.3383	3.5991	4.3688	0.7365	1.1028
	(0.6768)	(0.9767)	(0.7910)	(0.7468)	(0.8965)	(0.8436)
LIQRATIO	2.3631	2.8394	6.4522*	6.5025*	-0.7411	0.0908
	(0.4653)	(0.3786)	(0.0750)	(0.0727)	(0.6597)	(0.9567)
CAPRATIO	-0.1248	-0.0823	-0.0938	-0.0909	0.0838	0.0811
	(0.3003)	(0.4931)	(0.3985)	(0.4118)	(0.1101)	(0.1172)
Yeardum	-2.2815***	-5.8003	-4.5572***	-8.0466	-1.9097***	-2.5388
	(<.0001)	(0.2197)	(<.0001)	(0.2220)	(<.0001)	(0.3177)
Intyrind		-2.9771		4.7516		-2.1261
		(0.5351)		(0.4569)		(0.4003)
intdual		1.6422		0.8114		1.6261***
		(0.1243)		(0.5795)		(0.0045)
intbosz		0.3855*		-0.0732		0.0827
		(0.0574)		(0.7811)		(0.4267)
N	188	188	341	341	201	201
R-Square	0.0794	0.0959	0.0954	0.0999	0.1563	0.1759

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

Table 4.9 Regression analyses of bank risks for low-performing banks

Variables	VOLROA	VOLROA	VOLROE	VOLROE	VOLRET	VOLRET
Intercept	3.9914	4.1248	10.0593	10.0057	45.9362	49.4149
	(0.0082)	(0.0091)	(0.0878)	(0.0936)	(0.0484)	(0.0316)
BOSIZE	0.004	-0.0018	-0.0841*	-0.082	-0.5003**	-0.7156***
	(0.7469)	(0.9007)	(0.0972)	(0.1326)	(0.0193)	(0.0021)
DUAL	0.0026	0.0360	0.0682	0.0503	-0.9462	-2.1444*
	(0.9644)	(0.6216)	(0.7886)	(0.8622)	(0.3348)	(0.0579)
Indepr	-0.5725**	-0.5257	-1.1346	-1.2805	-10.9897**	-12.1911**
	(0.0462)	(0.1485)	(0.3235)	(0.3168)	(0.0166)	(0.0178)
Lnass	0.0311*	0.028	0.1226	0.1197	0.6238	0.5547
	(0.1886)	(0.2582)	(0.2282)	(0.2458)	(0.1198)	(0.1606)
DEBT	-4.3443***	-4.4318***	-7.9075	-7.6812	-28.4617	-26.2833
	(0.0009)	(0.0010)	(0.1457)	(0.1624)	(0.1779)	(0.2063)
LIQRATIO	-0.0854	-0.1373	-0.7649	-0.7588	5.8581	6.7981
	(0.8138)	(0.7148)	(0.6056)	(0.6142)	(0.3510)	(0.2743)
CAPRATIO	0.0072	0.0087	-0.0652	-0.0647	-0.4341**	-0.4382**
	(0.5962)	(0.5333)	(0.1480)	(0.1571)	(0.0265)	(0.0228)
Yeardum	0.197***	0.0197	1.8462***	0.5508	0.5828	-12.7527
	(0.0004)	(0.9715)	(<.0001)	(0.8407)	(0.5581)	(0.1773)
Intyrind		-0.1485		1.509		3.0181
		(0.7905)		(0.5701)		(0.7482)
intdual		-0.1067		0.2338		3.0285
		(0.3912)		(0.7014)		(0.1549)
intbosz		0.0297		-0.0093		-0.6964*
		(0.2091)		(0.9325)		(0.0721)
N	188	188	342	342	201	201
R-Square	0.0930	0.0930	0.0415	0.0418	0.0488	0.0698

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

5. Conclusion

This study investigates the role of board structure on US bank performance and risks during crisis and non-crisis period by using 59 commercial banks during 2000 to 2013. We find that board structure does affect bank performance and their risk-taking behavior at different performing banks. For high-performing banks, CEO duality would decrease bank's market performance either in crisis or non-crisis period, and it would also decrease market volatility. For low-performing banks, board structure even plays more significant effect on bank performance and bank risks either financial tsunami or non-crisis period than it does on high-performing banks. We find that independent board, CEO duality and board size have significantly positive effects on bank performance, but only CEO duality stays its influence in bank performance during financial tsunami. Moreover, board size, CEO duality and independent board have significantly negative effects on low-performing bank risks and only board size stay its significant influence in bank risks during financial tsunami.

Overall, our results show that board structure presents to play more important role on low-performing banks than on high-performing banks. During financial crisis, CEO duality would deteriorate bank's risk-adjusted performance. These results suggest that corporate governance during crisis period in banking industry still remains room to be improved, especially in board independence. Sound bank governance system definitely helps banks risk management and safely experience through financial crisis.

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OVERVIEW THE RELATIVE EFFECTIVENESS OF EMERGING COUNTRIES POLICY MEASURES DURING AND AFTER FINANCIAL CRISIS

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The objective of this research is to overview the impact of crisis and policy measures taken during the crisis, evaluate the effectiveness of those measures and analyze the exit strategy in Indonesia. To achieve those objectives, this paper will review some policy measures in monetary, fiscal and financial sectors that had been taken to deal with the 2008 global financial crisis using descriptive and statistical analysis. Based on finding, we could conclude that Indonesia had clearly demonstrated the effective and timely response of monetary, fiscal and financial sector policies which helped Indonesia to recover from global economic crisis.

Additionally, the econometric model was used to evaluate the impact of monetary and fiscal policy to economic output using quarterly data from 1990 - 2010. The result shows that monetary and fiscal policies have significant impact to economic output. In the short run the changes in real GDP is significantly affected by changes in real monetary supply in the previous three quarter and real fiscal expenditures. The lesson learned from this research among other are that cooperation and coordination among the policy makers and the timely responses are very important in tackling the crisis; an effective conventional monetary policy in normal times may become less effective in a crisis thus unconventional monetary policy indeed necessary as timely policy response and the improvement for more timely disbursement of government expenditure is important to increase the effectiveness of this policy to stimulate economic output. Moreover, several Indonesian exit strategy and policies to face future challenges are very important to reach the ultimate objective of sustainable economic growth while maintaining macroeconomic stability.

Keywords: monetary policy, fiscal policy, financial sector policy, global financial crisis

JEL Classification: E52, E62, E63

Introduction

The global financial crisis in 2008 had an impact on Indonesian economy as can be explored by assessing Indonesian macroeconomic and financial institution indicators. As a small open economy, Indonesia could not be immune from impact of external shocks. The integration in financial sector has left many countries particularly for open economy to contagion risk. The pressures in the global liquidity had caused a massive short term portfolio capital outflow followed by a decline of Indonesia's financial market performances. In the real sectors, reflecting the input of global slowdown, exports declined and it had an indirect impact on household and private sector's income, leading to a decline in Indonesia's consumption and investment.

All over the globe, at the period the crisis, The Government and The Central Bank implemented policy measure in monetary, fiscal and financial sectors to deal with the global financial crisis. Bank Indonesia had implemented an accommodative monetary policy in order to keep a moderate growth achieve at least by maintaining financial markets liquid which was facilitated by relatively low inflation. The policy rate was brought down in December 2008 with the intention to decrease banks' lending rates. Some unconventional monetary policy measures such as narrowing the interest rate corridor for standing deposit and lending facility had also been taken to address liquidity issues. On the fiscal side, the government provides policy response to keep domestic demand by several fiscal stimulus and trade policies. There were also coordination between Ministry of Finance, Central bank and other institutions in order to maintain financial and macroeconomic stability.

With this background, this paper is aimed to review the policy measures taken during the crisis, evaluating their effectiveness and analyzing the exit strategy to reach the ultimate objective of sustainable economic growth while maintaining macroeconomic stability in Indonesia. In turn this is expected to make a contribution to a comprehensive evaluation of the effectiveness of the policy measures in SEACEN Economies. To handle the broad issues in the paper, two methodologies are adopted: firstly, by descriptive analysis using simple statistics and graphics; and secondly, by econometric model to analyze the relative effectiveness of policy choices. However, it is difficult to analyze the effectiveness of policy choices exclusively during the crisis with an econometric model, since then we have only limited period of data. Therefore, we will analyze relative effectiveness of policies from 1990 – 2010 using Error Correction Model.

The Hyphothesis

There are two arguments between economist about the policy measure to respond the turbulence during the economic crises. The first argument who support the idea that monetary policy is the first line of defense during the turbulance while the second opinion believe that fiscal policy has a more important role particularly when conventional monetary policy measures are not sufficient enought in addresing losses in output due to weakening of economy. As it has stated before, the objective of this paper is to identify and evaluate policy measures during the global financial crisis 2008's so the next sections will explore and review the effectiveness of those policy measures..

The policy choices available during the global financial crisis to maintain economic stability consist of Monetary Policy, Fiscal Policy and Financial Sector Reforms. In examining the relative effectiveness of both monetary and fiscal policies on economic growth, we use the Engle and Granger two step estimating procedure which allows an explicit testing of co-integration and specification of the Error Correction Model (ECM).

The relationship between monetary policy and economic growth was derived from the general theoretical framework formed by Quantity Theory of Money with the following identity:

$$MV = PY \qquad (1)$$

M refers to money stock, V velocity of circulation, P price level and Y income. If V is constant then there is a relationship between changes in the stock of money and changes in the value of national income.

$$M = kPY \qquad (2)$$

The relationship between fiscal policy and economic growth could be explained through the national income identity.

$$Y = C + I + G + (X - M) \qquad (3)$$

Model Specification, Data sources and Limitations

Empirical model in this paper is aimed at testing the relationship of economic growth with monetary policy, fiscal policy and other control variables.

$$Yt = f(MP_t, FP_t, Z_t) \qquad (4)$$

Where Y is a measure of economic activity, MP, a measure of monetary policy, FP measure of fiscal policy and Z is other control variables that may affect economic activity.

In the end, the general form of the Error Correction Model (ECM) specification in this paper is:

$$\Delta Y_t = \sum_{j=1}\sum_{k=0}\beta_{1jk}\Delta X_{jt-k} + \sum_{k=0}\beta_{2k}\Delta Y_{t-k-1} + \lambda ECM_{t-1} + C + e_t \tag{5}$$

Where:

Y = dependent variables (economic output)

X = independent variables, consists of monetary variables, fiscal variables, and other control variables

ECM = residuals from long run relationship between variable

n = number of explanatory variable in the model

p = number of lags used to represent the short run dynamics in the model

There are several variables which could be used as proxies for of economic activity, fiscal policy, monetary policy and control variables as outlined in the table below. We use quarterly data from 1990 Q1 to 2010 Q2. Some of variables were adjusted for seasonality using Census X12 method.

Table 1: List of Variables

Indicator	Variable	Sources	Notes
Growth	GDP Real	IFS, staff estimated	
	GDP Nominal	IFS	
Fiscal	Fiscal Balance	BI	
	Government Revenue	BI	
	Government Expenditure	BI	
	Primary Expenditure		Government Expenditure – Interest Payment
	Primary Balance	BI	
Monetary	M1	IFS	
	M2	IFS	
	Policy Rate	BI	Prior to Q3 2005, we use SBI 1 month as proxy for policy rate
Inflationary Effect	GDP Deflator	IFS, staff estimated	
	CPI	BI	
External Sector	Exchange Rate	IFS	
	Current Account Balance	IFS	
Dummy Recession	1997/1998 Recession	Estimated	Q1 1997 – Q4 1998
	2008/2009 Recession	Estimated	Q4 2008 – Q2 2009

Notes: all variable are in logarithm, except Fiscal balance, primary balance, current account balance (because they contains negative values) and dummy recession (binary 1/0)

The data collection consist of monetary policy, fiscal policy and financial sector reform gathered from the data of Bank Indonesia as an authority of monetary policy and bank supervision and regulation in Indonesia. For the fiscal policy and non bank financial supervision data collected from the Ministry of Finance. The data was colected with data series since January 2008 before the global crisis until 2010.

The Result

To characterize the time series property of the variables, instead of using the Augmented Dickey-Fuller (ADF) tests, it used Phillips Perron (PP) methods. This PP approach is more appropriate than ADF since the data shows a structural break as effect of 1997/1998 crisis. Both of the ADF and PP test indicate that most of the series are non-stationary when the variables are defined in levels, except Fiscal Balance, Primary Balance, Policy Rate and Current Account Balance. But first-differencing the series removes the non-stationary components in all cases and the null hypothesis of non stationary is clearly rejected at the 5% significance level suggesting that all variables are integrated of I(1). Thus, the next step of testing for possible cointegration relationship will be done only with the I(1) variables.

Table 2 Unit Root Test for Variables

Variables	Abbreviation	ADF Test Result					Phillips Perron Test Result				
		Level		1st difference		Level of integration	Level		1st difference		Level of integration
		t-stat	p-values	t-stat	p-values		t-stat	p-values	t-stat	p-values	
Real GDP	RGDP	-2.631	0.268	-2.139	0.032	I(1)	-2.327	0.415	-8.320	0.000	I(1)
Nominal GDP	NGDP	-2.038	0.572	-5.929	0.000	I(1)	-2.117	0.529	-5.491	0.000	I(1)
Real GDP_Adjusted	RGDP_SA	-2.214	0.475	-5.216	0.000	I(1)	-1.921	0.634	-5.159	0.000	I(1)
Nominal GDP_Adjusted	NGDP_SA	-1.913	0.639	-1.957	0.049	I(1)	-1.869	0.661	-2.939	0.004	I(1)
Fiscal Balance	FB	-4.231	0.006	-6.526	0.000	I(0)	-9.025	0.000	-29.488	0.000	I(0)
Government Revenue	GR	5.943	1.000	-17.544	0.000	I(1)	2.972	0.999	-42.299	0.000	I(1)
Government Expenditure	GE	5.327	1.000	-20.666	0.000	I(1)	2.100	0.991	-36.833	0.000	I(1)
Primary Expenditure	PRIM_GE	5.137	1.000	-20.657	0.000	I(1)	1.976	0.988	-42.757	0.000	I(1)
Primary Balance	PB	-5.436	0.000	-6.289	0.000	I(0)	-7.132	0.000	-26.702	0.000	I(0)
Fiscal Balance_Adjusted	FB_SA	-3.074	0.003	-12.525	0.000	I(0)	-8.552	0.000	-20.894	0.000	I(0)
Government Revenue_Adjusted	GR_SA	4.040	1.000	-15.234	0.000	I(1)	3.211	1.000	-15.292	0.000	I(1)
Government Expenditure_Adjusted	GE_SA	3.562	1.000	-10.192	0.000	I(1)	4.154	1.000	-18.761	0.000	I(1)
Primary Expenditure_Adjusted	PRIM_GE_SA	4.400	1.000	-11.337	0.000	I(1)	3.046	0.999	-18.449	0.000	I(1)
Primary Balance_Adjusted	PB_SA	-1.843	0.063	-12.502	0.000	I(0)	-7.297	0.000	-23.681	0.000	I(0)
M1	M1	-2.348	0.404	-1.880	0.058	I(1)	-2.369	0.393	-7.610	0.000	I(1)
M2	M2	-0.933	0.947	-8.250	0.000	I(1)	-0.933	0.947	-8.248	0.000	I(1)
M1_Adjusted	M1_SA	-1.496	0.823	-3.371	0.001	I(1)	-1.641	0.768	-5.250	0.000	I(1)
M2_Adjusted	M2_SA	-0.864	0.955	-6.885	0.000	I(1)	-0.941	0.946	-3.738	0.000	I(1)
Policy Rate	PR	-3.265	0.020	-7.633	0.000	I(0)	-3.000	0.039	-7.646	0.000	I(0)
GDP Deflator	GDPDEFL	-2.125	0.524	-4.443	0.000	I(1)	-1.871	0.661	-4.293	0.000	I(1)
GDP Deflator_Adjusted	GDPDEFL_SA	-2.271	0.444	-3.798	0.000	I(1)	-1.849	0.672	-3.798	0.000	I(1)
CPI	CPI	-2.402	0.376	-3.049	0.003	I(1)	-2.208	0.478	-4.278	0.000	I(1)
Exchange Rate	ER	-1.845	0.673	-5.637	0.000	I(1)	-1.221	0.899	-6.479	0.000	I(1)
Current Account Balance	CAB	-3.021	0.003	-11.764	0.000	I(0)	-3.021	0.003	-16.024	0.000	I(0)
GDP US	USGDP	-0.215	0.992	-2.199	0.028	I(1)	-0.249	0.991	-3.144	0.002	I(1)
GDP Japan	JPGDP	1.014	0.917	-3.321	0.001	I(1)	1.351	0.955	-16.482	0.000	I(1)

Following the Engle and Granger two step-method, in the next step we estimate the long run equilibrium relationship among variables by OLS and test for stationary of the residuals, in the form:

$$y_t = \alpha_0 + \alpha_1 x_t + e_t \tag{6}$$

To identify the unit root in the residuals, it used critical values for the Engle - Granger Cointegration Test provided in Enders (2004). After estimating several alternatives model based on the variables, so the best long run cointegration equations as follow:[1]

[1] RM1_SA defined as real seasonally adjusted M1 which equal to nominal M1/GDP Deflator. RGE_SA defined as real seasonally adjusted government expenditure which equal to nominal government expenditure/GDP Deflator. *value in ( ) shows standard error.* **** significant at $\alpha = 1\%$, ** significant at $\alpha = 5\%$, * significant at $\alpha = 10\%$*. We realize that there might be endogenity relationship between RM1_SA and GDP_SA, but to be

$$\underset{}{RGDP\_SA} = \underset{(0.05)^{***}}{5.13} + \underset{(0.03)^{***}}{0.88\,RM1\_SA} + \underset{(0.25)^{***}}{0.20\,RGE\_SA} \tag{7}$$

$R2 = 0.94$

The critical value of residual unit root test from this equation is -6.61, and given the critical value of Engle - Granger Cointegration Test for 2 variables which is -4.123 for significance at 1%, then variables real GDP, real M1 and real government expenditures are said to be cointegrated.

Next step is to switch to a short run model with an error correction mechanism in the form:

$$\Delta RGDP\_SA_t = \sum_{j=1}\sum_{k=0}\beta_{1jk}\Delta X_{jt-k} + \sum_{k=0}\beta_{2k}\Delta RGDP\_SA_{t-k-1} + \lambda ECM_{t-1} + crisis + C + e_t \quad (8)$$

Where X consists of real M1, real government expenditure and other control variables, meanwhile ECM is residuals from equation (7). To address the impact of crisis, it also used dummy recession variables CR97 and CR08. With general to specific approach to several combinations of cointegrated variables and lags, the best models found as follows:

Table 3: Error Correction Models

Variables	Dependent : Real GDP		
	Coefficient	t-stat	
Real M1(-3)	0.07	2.17	**
Real Gov_Exp	0.03	3.92	***
ECM(-1)	-0.06	-1.91	*
Exchange Rate (-1)	-0.04	-2.95	***
Inflation (-1)	-0.29	-5.63	***
Crisis 97	-0.01	-2.06	**
Constant	0.02	11.36	***
R2	0.66		
DW-Stat	2.00		
SIC	-5.76		

**** significant at $\alpha = 1\%$, ** significant at $\alpha = 5\%$, * significant at $\alpha = 10\%$*

Analysis of results

The empirical results show that Real GDP cointegrated with real M1 and real fiscal expenditure. On the basis of this information, an error correction model was developed which was shown to be well-specified relative to its own information set and capable of parsimoniously representing the data set.

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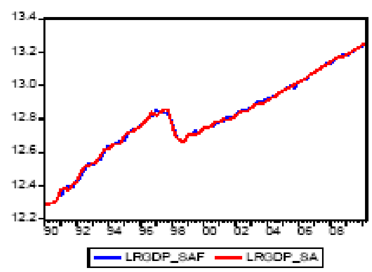
inline with the agreed methodology we assume the one-way relationship between them and use ECM. For robustness, we also use VECM and found the long run relationship between those variables (in appendix).

From the error correction models, it could be concluded that in the short run the changes in real GDP is significantly affected by changes in real fiscal expenditures and real monetary changes. The previous real GDP changes are not significant to affect real GDP changes. The crisis 1997 decrease the real GDP significantly, meanwhile the crisis 2008/2009 effect is not significant. The result also shows a well-defined error correction term, and indicates a feedback of 6% of the previous quarter's disequilibrium from the long run money supply, and fiscal expenditure to economic activity. To evaluate the goodness of the model, I did some in sample forecasting and compared the result with the actual data. The result was quite good as shown in Graph 1. The root mean square error (RMSE) of the forecast was only 0.01.

Graph 1 Evaluation of Model



The lag in the effect of monetary changes relative to fiscal policy as shown in table 4 indicates that the impact of fiscal policy on GDP is relatively faster than monetary policy. This result is in line with the Elmendorf and Furman (2008) which consider that a key potential advantage of fiscal stimulus relative to monetary stimulus was that it could boost economic activity more quickly, and true fiscal stimulus implemented promptly can provide a larger near-term impetus to economic activity than monetary policy.

Table 4 Evaluation of the Effective Fiscal Stimulus Principles

Principles	Explanation	Measure for Indonesia's Fiscal Stimulus	Explanation
Timely	FS should not be enacted prematurely, delayed too long, or consist of tax cuts or spending increases that would take too long to be implemented or to boost output	1 2 3 4 5 Less Effective	Although government immediately giving instruction for FS, but there were problems that delaying the implementation or disbursement of the fund. The government expenditure is mostly disbursed in Q-4 (Graph 26)
Targeted	Tax cuts and spending increases should be directed so	1 2 3 4 5	▪ Although the biggest proportion of the FS is tax

Principles	Explanation	Measure for Indonesia's Fiscal Stimulus	Explanation
	that they provide the greatest benefit to people who are affected most adversely by an economic slowdown	Effective	reduction, but this could stimulate economic output from investment and indirectly would increase employment and wages. Then, these will increase consumption and economic output. ▪ Moreover, the big spending in infrastructure is good because it will boost a sustainable growth in longer term instead of only short term
Temporary	The FS should not increase the budget deficit in the long run	1 2 3 4 5 Quite effective	The source of fund for fiscal stimulus is come from the excess of budget utilization (SILPA) in 2008 and debt. Fund from excess of budget utilization won't affect the next government budget but the usage of debt, in the long term could impact the budget deficit. Additionally, the budget deficit plan in 2010 still relatively high (1.6% GDP) (Table 15)

Note: The 1 – 5 interval scale is based on authors' opinion, which number 1 indicate the policies are ineffective and number 5 indicate the policies are very effective.

Conclusion and Policy Recommendation.

This paper finds that the effect of global financial crises on Indonesian economy caused by sudden stop of capital inflow to emerging market indicate by declining of the economic growth for three quarter during the quarter III 2008 until first semester of 2009. Evidence shows that Indonesia impacted by the global financial crisis resulted from sudden stop capital inflow into emerging market countries and declining global economy growth. Hence, the impact on macroeconomic indicators can be identified by the first and second round effects. The first lesson from the recent crisis is that Indonesia as part of emerging country clearly demonstrated the effectiveness of timely monetary, fiscal and financial sector policy which helping Indonesia to recover from economic crisis. Indonesia and mostly Asian country had experienced the financial crisis during the last ten years. The first Asian crisis episode occurred in 1997 had significant reformation in the financial sector both in policy reform and institutional reform. However, in the second crisis ten years later known as global financial crisis occurred in 2008, the reform, can be categorized as soft reform relatively compare to the first Asian crisis.

The second lesson is that the closer cooperation and coordination among the policy maker is very important in identifying and tackling a global crisis. During the crisis period, some policy measures in monetary, fiscal and financial sectors had been taken to deal with the global financial crisis. On the Central Bank authority, Bank Indonesia had implemented an accommodative monetary policy in order to keep a moderate growth and relative low inflation. The policy rate started to decline on December 2008 with the intention to decrease bank's lending rates. Some unconventional monetary policy had also taken to address liquidity issues. On the fiscal side, the government gives responses to keep domestic demand by several fiscal stimulus and trade policies. There were also coordination between Ministry of Finance, Central bank and other institutions in order to maintain financial market and macroeconomic stability.

The policy measures had been taken during the crisis formulated in a timely manner with the ultimate objective of sustainable economic growth while maintaining macroeconomic stability in Indonesia. Based on error correction models, we could conclude that in the short run the changes in real GDP is significantly affected by changes in fiscal expenditures and inflation. Meanwhile the monetary policy changes and the previous real GDP changes are not significant to affect real GDP changes. Hence, since the conventional monetary policy is not enough during the high degree of uncertainty particularly pressure from external circumstances, thus unconventional monetary policy will enrich the monetary instrument.

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APPENDIX

Table A. 1 Key Indicators Measuring Vulnerability of Economy for External Shocks – 1997/98 and 2008/09 Recession

Indicator	1996		2007	
	US $ Billions	% of GDP	US $ Billions	% of GDP
GDP (Current)	227.37		432.04	-
Exports of Goods and Services	50.19	22%	118.01	27%
Foreign Currency Reserves	17.82	8%	54.74	13%
Imports of Goods and Services	44.24	19%	85.26	20%
Average Monthly Imports	3.69	-	7.10	-
Months of Imports Covered	4.83	-	7.70	-
Balance on Current Account	-7.80	-3%	10.49	2.4%
Total Government Debt			147.51	34.1%
Foreign Debt	110.17	48%	141.18	32.7%
Composition of External Liability				
Short term	22.03	9.7%	27.49	6.4%
Long term	88.14	38.8%	113.69	26.3%
Debt Service Payment (foreign)	2.82	1.24%	2.8	0.7%
Primary Balance	4.55	2.00%	3.3	0.8%
Fiscal Deficit	1.73	0.76%	-5.5	-1.3%

Indicator	1996	2007
Bank Loan to Deposit Ratio (LDR)	109.26	69.22
Non Performing Loan		4.64
Bank Capital Adequacy Ratio	11.82	19.30
ICRG	70.00	70.50
Stock Market Index (last position)	637.43	2,745.83
GDP Growth (yoy)	7.8%	6.3%
S & P Rating		BB -
Inflation	5.12%	5.60%
Output Gap*	149.293	10.852

Note : * calculated by HP Filter Method using annual Real GDP data in Billion Rp

Source : IFS, CEIC, Bank Indonesia and staff estimates

□ □ □ □ □ □ AN EXAMINATION OF THE EFFECTS OF INDIVIDUAL AND ORGANIZATIONAL FACTORS ON PROFESSIONAL ETHICS IN VIETNAM

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By employing and adopting the measures from the studies of Han, Park et al. (2013) and Valentine and Fleischman (2008), the present study aims to examine students' awareness of professional ethics. Students with different majors are the studied subject. Reviewing literature and conducting the empirical survey show some noteworthy points. Firstly, not much can be found on professional ethics in Vietnam, in terms of academic studies and instructions (i.e. codes of conduct) for occupations. Secondly, from students' perspectives, individual ethical standards do not play any role in their awareness of professional ethics. As a consequence, a systematic educational program professional ethics requires a priority significantly.

1. Introduction

Professionals are playing important roles in organizations and in the society, as they are ones who have specialized knowledge and skills which are necessary for organizational and societal development. They are powerful to affect others by such knowledge and skills (Robinson and Dixon 2007). Moreover, with such specialized knowledge and skills, professionals can practice and have a huge control over this knowledge and skills; and benefits the society as well (Brien 1998). In another words, professional ethics can be referred to identifiable, complementary role rights and duties of clients, customers and professional peers (Brinkmann and Henriksen 2008). Therefore, whether society and its members can get benefits from professionals, it depends on the way professionals practice their professional actions (Jamal and Bowie 1995; Brien 1998). In the other words, professional ethics can be seen as individual ethical responsibility from occupational perspective (Beikzad, Abdolapoor et al. 2012)

According to the study of Trevino (1986), personal values (such as personal ethical standards) are considerable factors which have an important influence on the way individuals making ethical decisions. Moreover, professionals perform their professional activities only in the occupational contexts which are promoted by organizations, on the one hand. A socially responsible organization, which has more opportunities to succeed than others do, will create an appropriate environment for ethical decisions of individuals (Han, Park et al. 2013). Professional activities likely impact company's ethical development and CSR practice (Valentine and Fleischman 2008), on the other hand. Moreover, they are also an pivotal element of a company value assets (Hoivik 2002). Thereby, organizational context can be considered as important factor affecting professional ethics.

In this regard, this study aims to examine students' awareness of professional ethics. To address this purpose, the following questions are proposed: (1) how individual and organizational factors impact professional ethics? (2) what are differences in students' perspectives of professional ethics regarding to demographic indicators? And (3) what are managerial implications from the research findings?

2. RESEARCH BACKGROUND

2.1. *Individual factors*

In the light of the literature on professional ethics, ethical decisions are influenced by individual factors (Trevino 1986; Treviño, Weaver et al. 2006). These individual factors are clarified by many studies as personal values, which include knowledge, attitudes, and intention (Douglas, Davidson et al. 2001; Hoivik 2002). In their study, Beikzad, Abdolapoor et al. (2012) reviewed two components of knowledge, including knowledge of society culture and sufficient knowledge of occupation. Personal values are classified by the beliefs that individual have consciously or unconsciously about the world (Rokeach, 1972 cited in Douglas, Davidson et al. 2001). These beliefs are different between individuals. Moreover, Hunt and Vitell (1986, cited in Douglas, Davidson et al. 2001) include personal values as personal experiences. Similarly, Karassavidou and Glaveli (2006) also confirmed that personal values have important impact on attitudes and behaviours which directly affect the way individuals make decisions. Therefore, it can be concluded that personal values is closely connected with professional ethics (Valentine and Fleischman 2008). Therefore, this study, firstly, is to answer the question “What is the relationship between individual factors and PE?”.

2.2. *Organization factors*

In organizational context, personal values are interacted by organizational factors. Furthermore, Longenecker, Moore et al.(2006) also pointed out that ethical framework formed by organization constrains individual ethical behaviors in decision making. It means, individuals’ responses to ethical issues on their profession are framed and determined by the interactions between individual and organizational factors (Han, Park et al. 2013). This point is also confirmed by the study of Douglas, Davidson et al. (2001), even though these factors affect individuals differently. In a study of reviewing professional ethics literature, Treviño, Weaver et al. (2006) categorized factors in organizational context, including: language, rewards/punishment, ethical infrastructure, ethical climate/culture, and leadership. Adapting these organizational factors, many researchers conducted their investigated the impacts of rewards/punishment, peers, and leader on professional ethics.

Punishment and rewards are factors having strong impacts on ethical behavior of an individual (Ball and Trevino 1992). An individual will be strongly impacted in his/her professional behaviors, if he/she observes co-worker punished or rewarded. From such an observation, rules and regulations are accustomed (Ball and Trevino 1992; Han, Park et al. 2013). In particular, none of us want to suffer from any of unethical behavior. Therefore, unethical behaviors in profession will be limited if the management board apply appropriate punishment. Similarly, ethical behaviors are encouraged and reinforced if they are treated in a certain way of rewarding.

From the observation whether (un)ethical behaviors of peers are punished or rewarded, individual are also affected by these behaviors. The more interaction with peers, the stronger impact from them an individual is on (Treviño, Weaver et al. 2006). This point is also confirmed by many research findings (Patterson 2001; Deshpande and Joseph 2009; Elango, Paul et al. 2010; Han, Park et al. 2013; Fu 2014). These studies points out, the way in which an individual respond to in a situation (ethically or not) depends much on the moral approval from a peer. Therefore, individual’s professional ethics are likely to be impacted by ethical behaviours of his or her peers.

One crucial factor in the context of organization affecting professional ethics is manager. This factor is the influential factor impacting others (e.g. rewards/punishments, peer’s ethical behaviors). In fact, from management perspective, managers are figurehead of their organization (Bateman and Scott 2011), and they create the ethical environment through their ethical/unethical behaviors/activities. Managers show their disagreements about unethical behaviors by setting types of punishments; or they can encourage ethical ones by rewarding employees having ethical attitudes. Therefore, employees observe, pay attention, and imitate managers’ ethical behaviours as a model of norms and expectations for appropriate conduct (Mulki, Jaramillo et al. 2009).

2.3. *PE and studies on PE in Vietnam*

Even though research on professional ethics issues is not new, exploring ethical perceptions, understanding, and awareness of Vietnamese employees have been meager to depict a comprehensive overview on this issue. According to the review of literature, the researchers cannot find any studies on professional ethics conducted in Vietnamese context, except a conceptual paper of Trang, Khoa et al. (2014). The paper aims to figure an overview of professional ethics literature. The result shows that there are six dimensions, including laws and rules; personal ethics; knowledge of society culture; professional competence; professional standards/norms; and corporate ethics. Among these six factors, professional competence and corporate ethics can be quantitatively measured. These researchers then investigated students' perceptions of these two factors.

Except Trang, Khoa et al.'s study, which can be considered as an academic view, professional ethics in practice in Vietnam is fragmentary and unguided. Assessing the internet to find instructions on professional ethics, the researchers find some points that need to be concerned. Firstly, there are some professions/sectors having instructions or issued codes of conduct, like lawyers, accountants-auditors, medical professions, stock agencies. The codes of conduct for these occupations are issued by professional associations (like Vietnam Lawyer association, Vietnam Association of Certified Public Accountants); or related ministries (like Ministry of Health). The other professions do not have a clear instruction and the term 'professional ethics' is understood differently in different sectors. Secondly, there are some large corporations (like FPT, Holcim, Vinamilk,Vietcapital, …) issuing codes of conduct for their employees. It means, the professions in these sectors are not shared similar norms/standards in performing occupations and firms/organizations do not pursue and force their workforce in applying these codes. These points might be the reasons leading PE to being a 'hot' issue which is usually mentioned in Vietnam due to many scandals in different sectors.

From the background of PE in literature and in practice in Vietnam, this study employs the method conducted in the study of Han, Park et al.(2013) to examine the influences of individual and organizational factors on PE. Based on the research background, we propose the following hypotheses to explore the relations between organizational factors and PE:

H1: Punishment and an individual's PE have a positive relation.

H2: Rewards and individual's PE have a positive relation.

H3: Perception of peer's ethical behaviors and individual's PE have a positive relation.

H4: Perception of leaders' unethical behaviors and individual's PE have a positive relation.

3. METHODOLOGY

The main purpose of the present study is to empirically examine the level of students' awareness of professional ethics. Therefore, quantitative approach to gather a large number of participants is chosen. The participants involve in a survey using questionnaire to collect data. The study focuses on students as its main sampling because students are potential workforce provided by colleges and universities to practical business. The awareness of students is crucial to reflect their attitudes and behaviors in later occupations.

Data were collected in two steps. The purpose of the first step is to refine the contents and measurement scales before conducting final survey based on convenient sampling. Potential respondents were students in both majors engineering (e.g. civil engineering, chemical engineering, and environmental engineering) and business administration, who are over 20. Two hundred and fifty questionnaires were sent to reach the sample, and 230 questionnaires were returned and only 220 questionnaires were valid.

The questionnaire is adapted from Han, Park et al. (2013) and Valentine and Fleischman (2008). It includes 30 items to measure. For individual and organizational factors, we adopt the measurements and scales from Han, Park et al. (2013). The scale of individual standards of ethical values is with 9 items. There are 4 factors with 16 items in organizational factors, namely: punishment; reward; peers' ethical behaviors; and the ethical integrity of boss. Five items to measure professional ethics are adopted from Valentine and Fleischman (2008). According to Valentine and Fleischman, professional ethics standards are based on the content of similar 'company ethics'; and higher scores indicated a belief that a profession was ethical.

All the items are adjusted to suit the context of the study. Finally, the questionnaire with 6 factors is presented as follow:

Factor 1: Individual standards of ethical values

1. IEV1_I shouldn't harm others psychologically
2. IEV2_For my own interest, I should not harm others
3. IEV3_One shouldn't harm others no matter how small it may be
4. IEV4_Any behavior harming others' dignity and peace shouldn't be allowed
5. IEV5_I shouldn't harm others physically
6. IEV6_I shouldn't pursue my own interest at the expense of others' welfare
7. IEV7_Everybody has different moral standards
8. IEV8_Something that is moral for one may be immoral for another
9. IEV9_Each situation or society requires different ethical standards

Factor 2: Reward for ethical behaviors

1. REB10_My ethical behavior is reflected in my annual performance evaluation
2. REB11_Ethical behavior is recognized and rewarded by our company
3. REB12_Our company gives incentives for ethical behavior

Factor 3: Punishment for unethical behaviors

1. PUB13_If I behave unethically, my annual incentives will be reduced
2. PUB14_If I behave unethically, my annual performance assessment will be negatively affected

Factor 4: Peers' ethical behaviors

1. PEB15_I think my colleagues generally behave ethically
2. PEB16_My colleagues work as ethically as possible
3. PEB17_My colleagues try to abide by the ethical principles of the profession

Factors 5: The ethical integrity of boss

1. EIC18R_My boss tends to intentionally exaggerate my mistakes and convey unfavorable information on me to my direct supervisor
2. EIC19R_My boss may dismiss an employee just because he/she doesn't like the employee
3. EIC20R_My boss intentionally undermines employees' rapport with one another

4. EIC21R_My boss occasionally attempts to intentionally distort what I said
5. EIC22R_My boss may take advantage of my idea
6. EIC23R_My boss hesitates to have employees trained and educated
7. EIC24R_My boss tends to attribute his/her mistakes to me
8. EIC25R_My boss intentionally turns down my requests
9. EIC26R_My boss tends to dwell on my mistakes instead of being forgiving

Factor 6: Professional ethics

1. PE27_I believe that my profession is guided by high ethical standards
2. PE28_My profession reprimands individuals and companies that behave unethically
3. PE29_Individual and organizational ethical standards are supported in my profession
4. PE30_My profession encourages continued ethical development and training
5. PE31_I believe that people in my profession conduct business in an ethical manner

The data is cleaned and processed by using exploratory factor analysis (EFA technique) in SPSS software. Before applying the EFA method, the reliability of the scales has been tested by using Cronbach's alpha criteria, it should be at least 0.6 to be accepted (Nunnanly và Burnstein, 1994). Then, EFA technique is applied with data exploration and variable reduction steps. The EFA process is accepted with the threshold of KMO measure higher than 0.5 and significant at 5%, Eigen values must be larger than 1, Factor loadings of each variable should be at least 0.5, it is no any cross-loading above 0.35 into more than one factors (Hair et al., 2006). Besides, the difference between students' awareness of professional ethics distinguished by demographic variables are considered by ANOVA analysis.

4. DATA ANALYSIS

Input the respondents' information and their choice into the SPSS database that is further used for the related analysis. The characteristics of the sample include gender and majors. In the valid sample, the percentages of male and female students are 59 and 41, respectively. Regarding major categories, 50.5% respondents are studying engineering and 49.5% are in major of business administration.

Most of items are dispersed in the Likert 5 scales with mean is from neutral to agree (See Table 1). That means the student's perceptions on Professional Ethics described by these variables not high. It could be due to the fact that all participants are students, not yet joining labor force; therefore they

Table 1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
IEV1	220	1	5	3.94	.845
IEV2	220	1	5	4.27	.859
IEV3	220	1	5	3.56	.897

IEV4	220	1	5	4.16	.871
IEV5	220	2	5	4.14	.782
IEV6	220	1	5	3.85	.922
IEV7	220	1	5	4.33	.818
IEV8	220	1	5	3.68	1.047
IEV9	220	1	5	3.94	.909
REB10	220	1	5	2.88	.939
REB11	220	1	5	3.40	.899
REB12	220	1	5	3.93	.776
PUB13	220	1	5	3.42	.969
PUB14	220	1	5	3.62	.926
PEB15	220	1	5	3.58	.770
PEB16	220	1	5	3.45	.772
PEB17	220	1	5	3.45	.742
EIC18R	220	1	5	3.46	.913
EIC19R	220	1	5	3.68	1.102
EIC20R	220	1	5	3.72	.989
EIC21R	220	1	5	3.87	.957
EIC22R	220	1	5	3.46	1.140
EIC23R	220	1	5	3.47	.924
EIC24R	220	1	5	3.59	1.032
EIC25R	220	1	5	3.51	.958
EIC26R	220	1	5	3.48	.938
PE27	220	1	5	3.70	.772
PE28	220	1	5	3.46	.923
PE29	220	1	5	3.46	.867
PE30	220	1	5	3.82	.790
PE31	220	1	5	3.50	.819
Valid N (listwise)	220				

Based on the results of the EFA, we classified Individual ethical values into two factors: Idealism (IEV1 to IEV6) and Relativism (IEV7 to IEV9) (see Table 2). Cronbach's alpha for Idealism and Relativism were 0.809 and 0.581, respectively. When excluded item IEV7, Crobach's alpha of this factor increases in 0.601. All remaining items loaded on each factor as the research model and receive the Cronbach's alpha from 0.644 (for REB) to 0.909 (for EIC), satisfy the condition mentioned above. Therefore, all of these indicators will be used in the EFA steps.

Table 2: Factor analysis of Individual Ethical Values

Items	Factor 1 Idealism	Factor 2 Relativism
IEV1	.585	
IEV2	.711	
IEV3	.770	
IEV4	.601	
IEV5	.528	
IEV6	.665	
IEV7		.384
IEV8		.681
IEV9		.637
KMO	0.852	0.600
Bartllett's test (sig)	0.000	0.000
Eigen value	3.081	1.635
Variance explained (%)	51.355	54.507
Cummulative Variance explained (%)	51.355	54.507

Mean	3.9871	3.9803
Standard deviaion	0.618	0.686
Cronbach's alpha	0.809	0.581

As showed at Table 3, both factors Reward for ethical behaviors and Punishment for unethical behaviors group in one component when compared to theory model. Under respondents' opinion, two constructs have closed relation together, cannot separate them, especially in organization. Therefore, this new factor is formed and named company's policy for ethical behavior. Other factors remain their names.

Following EFA analysis, the regression analysis is conducted for new related factors by Enter method. Results of regression showed that VIF<2 and Tolerance was greater than 0.5, that means there was no multi-collinearity (see Table 4).

Table 4: Regression analysis

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	-1,068E-16	.055		.000	1.000		
	The ethical integrity of boss	.136	.058	.146	2.333	.021	.970	1.031
	Company's policy for ethical behaviors	.163	.074	.161	2.202	.029	.706	1.417
	Peers' ethical behaviors	.256	.072	.262	3.561	.000	.702	1.424

a. Dependent Variable: REGR factor score 3 for analysis 3

Results of regression analysis showed that only 3 factors, including: the ethical integrity of the boss, company's policy for ethical behaviours and peers' ethical behaviours, have positive relations with Professional ethics. In the present study, there is no relation between Individual standards of ethical values and Professional ethics. It means that students are not aware of the role of individual in Professional ethics. This might be explained by the reasons that students are not provided/trained Professional ethics in a systematic way. It might lead them to think individual values have no impact on Professional ethics.

Lastly, ANOVA analysis helps to examine the differences in students' awareness of Professional ethics in term of demographic indicators, such as gender and majors with a significance level of 5%. The results showed that there is a significant difference in male and female students. This difference is on two items PE28 and PE30. In both two items, female students have higher score than their counterpart do (See table 5). Similarly, with a significance level of 5%, the results of analysis ANOVA showed no differences in ethics awareness among business administration and engineering students.

Table 5: ANOVA analysis results between male students and its counterpart

		Sum of Squares	df	Mean Square	F	Sig.
PE27	Between Groups	.055	1	.055	.092	.762
	Within Groups	130.540	218	.599		
	Total	130.595	219			
PE28	Between Groups	3.574	1	3.574	4.254	.040
	Within Groups	183.135	218	.840		
	Total	186.709	219			
PE29	Between Groups	.511	1	.511	.679	.411
	Within Groups	164.121	218	.753		
	Total	164.632	219			
PE30	Between Groups	3.439	1	3.439	5.624	.019
	Within Groups	133.289	218	.611		
	Total	136.727	219			
PE31	Between Groups	1.225	1	1.225	1.833	.177
	Within Groups	145.770	218	.669		
	Total	146.995	219			

5. DISCUSSION AND CONCLUSION

The present study is to examine students' awareness of professional ethics by employing and adapting the scales from the studies of Han, Park et al. (2013) and that of Valentine and Fleischman (2008). The analysis has shown that, in students' perspectives, individual ethical values do not have significant impact on their awareness of professional ethics. Meanwhile, 17 variables in organizational factors are divided into 3 factors, namely: policy for ethical behaviors, peers' ethical behaviors, and the ethical integrity of boss.

To analyze the difference in students' perspectives of professional ethics, a comparison is conducted regarding demographic indicators. The result has shown that there is a difference between male and female students' awareness of professional ethics; meanwhile, participants' majors do not make any.

The research findings show some noteworthy points to discuss. As mentioned in the research background, there are not many studies on professional ethics. Therefore, this study can be considered as one of pioneer ones conducted in Vietnam. According to Trang, Khoa et al. (2014), professional ethics is not paid enough attention in university and vocational education. There is no course relating to this topic. This fact helps much in explaining why students do not think individual values having impacts on professional ethics. Moreover, it might be also useful to understand there is no difference between perspectives of students in different majors.

The second point is that, when conducting the survey, students expressed their confusion in understanding the term professional ethics. One of the reasons is that they are not only taught as to professional ethics in their curriculum, but they even cannot find easily what is (are) code(s) of conduct in their professions. This can also support in understanding research in professional ethics is still meager.

The last point needs to be concerned is that there are not common/shared norms/standards in performing occupations in many sectors. Accompanying with no course provided in university/vocational education, this fact has been creating more barriers for professionals in approaching and behaving ethically in their professions.

6. IMPLICATIONS AND LIMITATIONS

One pivotal implication from these research findings is that education sector, especially Ministry of Education and Training and universities, need to supplement a course Professional ethics to University and vocational education programs. On the one hand, a course Professional ethics needs to be added to curriculum to provide students with an overview of knowledge and general understanding of how to behave ethically in performing occupations. On the other hand, all courses in majors need to provide a chapter or a part on Professional ethics to provide student systematic information on code of conduct their occupations. Such doing will help to increase students' awareness of individual values on professional ethics. This implication can be supported by the contribution from the study of Karassavidou and Glaveli (2006).

The research finding points out students do not aware of the impacts of individual ethical values on Professional ethics. From this fact, it is necessary to develop an educational/training objective which can encourage and integrate individual ethical standards into program. This point echoes with the suggestions of Brinkmann and Henriksen (2008). A(n) educational/training program on professional ethics would be the first step for developing shared standards/codes of conduct in occupations.

Like other studies, the present research faces some limitations. Firstly, the approached participants are students in two majors, business administration and engineering, rather than many other ones, like medicine, law, and pedagogue. For this reason, this study cannot represent for awareness of students in general. The further research should extend the sampling to many majors in universities to depict more comprehensive understanding of professional ethics. Secondly, as explained in the study of Valentine and Fleischman (2008), the scale of Professional ethics is borrowed from Corporate ethics. Hence, the measures might be not as exact as its real meaning is for this specific research context. Moreover, the research finding of Trang, Khoa et al. (2014) also points out that there is necessary to undertake a qualitative research to develop the measure for Professional ethics. This point is also suggested in the study of Karassavidou and Glaveli (2006). Further research should focus on developing a scale for professional ethics.

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FINANCIAL MARKET DEVELOPMENT AND CORPORATE CAPITAL STRUCTURE EVIDENCE IN MANUFACTURING SECTOR OF VIETNAM

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The purpose of this paper is to examine the effects of Financial Market Development on capital structure of manufacturing sector in Vietnam.
Keywords: HOSE, Capital structure, Financial market development, Z-score model, Stock market, Credit market, Banking sector.

1. Introduction

Capital structure has a long history since Modigliani and Miller (1958)built the first modern thinking of capital structure. Academics have dedicated much endeavor to understand financing choices of firms. Recent researches try to quantify financing decisions guidance while early studies employed qualitative method. However, the schools of capital structure literature shows extensive researches examining only internal factors influence on capital structure and a little attention on the effect of macroeconomic environment on corporate financing decisions (Hackbarth et al., 2006). It is relatively amazing as intuitively the macroeconomic conditions should have impact on important firm decisions and financing decision is not an exemption. Cognizant of this limitation, this study attempts to contribute to the literature by directly examining the nexus between financial market development in a transitional economy like Vietnam and capital structure decisions among manufacturing firms.

The paper follows the thought that the development of financial market would have large impact on the economy growth and consequently is perceived to have influence onfirms' financing policies. The crucial effects of financial market on the development of economy have been proven by a lot of researches and empirical studies (Bagehot, 1873; Hicks, 1969;Schumpeter, 1911; and Levine, 1997). They proposed that financial development help encourage the industrialization in England, stimulate technological progress and more liquid financial markets do create investment and hence economic growth. From the above argument, it is supposed that financial market development is the key factor affecting financing choices of firms as its function help allocate and channel capital more effectively as well as distribute investment funds and diversify risks, giving more financing sources for firms. Furthermore, it is worth having deep understanding how fast-changing macro-environment especially financial market development influence financing choices of firms under transitional economy such as Vietnam.

The content of this paper comprises five sections. In the section 2, literature related to financing choices of firms is introduced as hypothetical foundation for the whole study. Next, the description about sample as well as key determinants related to financial market development and the steps involved is provided in the Methodology section. The section 4 discusses the results and finally, the conclusion is presented in the last part of this paper.

2. LITERATURE REVIEWS

2.1. *Capital structure theories*

Modigliani and Miller (1958) built the first brick for thought of capital structure literature proposing that firm value does not rely on capital structure under perfect market condition without the effect of tax, inflation and transactional costs. The theory started a long history of debates on capital structure school as many academics doing research in economic field argued that no firm actually works in such a perfect market condition. Consequently, they have put much efforts in determine how capital structure could be used as tool to increase firm value.
Jensen and Meckling (1976) and Jensen (1986) proposed that all firms try to keep the tax benefits from debt always balance with the cost of bankruptcy.Myers (2001) confirmedthat

there is a tax advantage firms can enjoy when they finance by debt and hence, the firm should seek more debt financing opportunities to maximize tax benefit and eventually increase profitability. However, the climbing level of debt is also followed by the insolvency probability. Therefore, capital structure is considered to be the trade-off between tax benefits of debt and insolvency costs.

As regards capital structure of a firm, pecking order theory created by Myers and Majluf (1984) and Myers (1984) is considered as an alternative to trade-off theory and one of the most influential theories about leverage in corporations. This theory isanticipated that the firm enjoy using internal source of fund when available and prefer debt over equity when external financing is required.Myers (1984) explained that it is due to the adverse selection, firms will choose internal instead of external finance

In the agency cost theory proposed by Jensen and Meckling (1976), they said that optimal capital structure will help the firms to reduce the costs associated with the conflicts between the stakeholders. Jensen (1986) also recommended the ability of debt in moderating the conflicts between manager and shareholders. This argument is explained by the fact that debts force the firms to pay out cash for creditors thus reducing the amount of money that managers can use to pursue their own interest.

The information asymmetry theory of capital structure (Ross, 1977) proposed that firm managers have more information about thefuture prospects of the firm than the market. Therefore, the financial decision made by managers provides the market with the information about the firm’s future prospects. Increasing the level of leverage shows that the managers are really confident about the success of the firm in the future thus increasing the firm value by attracting the investments from the market.

Since the very first works of Lintner (1956), Hirshleifer (1958) and the well-known study of Modigliani and Miller (1958), researches and studies day by day have had more and more steps in the perfection of model development on capital structure.

2.2. *Financial Market Development and Capital Structure*

The study carried out by Jong et al. (2007) support the view that macroeconomic factors can have significant impacts on firm leverage in two ways. More specifically, these variables can affect capital structure directly. For instance, the utilization of debt will be improved in a more developed bond market and it is the same case for new stock issuance when the firm decides to finance their business from equity. Furthermore, the indirect effect of macroeconomic factors can influence debt structure through their effect on firm-particular variables. For example, the fact remains that in nations with a better legal system and more developed economy, it is more likely for the firms to take more debt but also the impacts of some firm characteristics on capital structure such as profitability, liquidity, growth opportunity and so on are also strengthened.

The relationship between economic development and debt-equity financing choices has been mentioned by some studies in recent years. They have found that the capital structure decision of a firm not only depends on internal factors but also bears the influence of macroeconomic variables:Total Money Supply (Olorunfemi and Adeleke, 2012); Change In The Interest Rate (Rayan, 2008; Bokpin, 2009; Joseph, Titman and Twite, 2012; Claessens and Klapper, 2002);

Inflation (Bokpin, 2008; Lemma and Negash, 2012; Baltaci and Ayaydin, 2014;Kim and Wu, 1988); Bond Market Development(Sergey, 2009;Agarwal and Mohtadi, 2004; Maksimovic et al., 1995); Stock Market Development (Olorunfemi et al., 2012;Chekanskiy, 2009;Jonget al., 2007; Agarwalet al., 2004; Maksimovic et al., 1995; Bokpin and Isshaq, 2008; Adeyemi, Babatunde and Oboh, 2011); and GDP Growth Rate (Bokpin,2009; Claessens and Klapper,2002; Lemma and Negash, 2012;Baltaci and Ayaydin, 2014; Chekanskiy, 2009; Jong, et al.,2007).

One study worth taking into account is the work of Maksimovic and Demirgiiq-Kunt (1995) exploring the effect of stock market development on the financing choices of firmsin 30 countries for a period of 11 years from 1980 to 1991. It seems to be not enough because the financial market includes more, not only stock market. In this paper, not only the stock market but banking sector development, interest rate and one of the most remarkable event financial crises in 2008 is put into concern. The advantages of this research can be proved by the use of different sources including the macroeconomic factors as well as the internal factors like firm size and firms' financial quality which is calculated by eight separating variables.The impact of financial market development on financing choices of firms is hypothesized as below.

Hypothesis 1:Credit Growth Rate has positive relationship with leverage

Credit is one of the most important sources of fund for the growth of national economy especially developing countries like Vietnam. The growth of credit market is the fundamental requirement for any enterprises to expand production, raise productivity thus encourages the whole economy to develop(Richard Duncan, 2011). He explained that in the period of credit expansion, it is easier for consumers and businesses to borrow and invest. This is the reason for the increase in consumptions and jobs thus improvement in national income and economic growth.In contrast, the decline of credit market associated with bad debt is a sign of an economic depression.The study about bank loan supply, lender choice and corporate capital structure of Mark T. Leary (2005) proposed that the credit market development is one of important factors affecting the corporate capital structure. More specifically, he observed that leverage level of bank-dependent firms increased in the period of expanded bank credit while this level decreased in the period of credit crunch in which investment capital is difficult to obtain. He also postulated that considering credit market movements helps improve the understanding about corporate finance. JianfuShen and Michael Firth and Winnie P.H. Poon (2014) brought out new evidences about the credit supply to the firms' financing choice in China. It is found that the leverage level of large and state-owned firms in China moves with the same direction with the credit supply. With more available credit fund compared to small and private firms, large and stage-owned firms are less likely to use internal funds as well as fund from new stock issuance but rely more on debts. On the contrary, firms having limited access to the bank loans are supposed to depend on the availability of their own earnings and less likely to change their source of fund even when the credit expansion occurs.

Hypothesis 2:Interest Rate has negative relationship with leverage

Evidence reveals that one of the most closely observed variables in the economy all over the world is interest rate. The effects of interest rate spread from the individual choices such as whether to purchase a house or buy securities to the financing decisions of firms such as whether to utilize their funds contributing to the industrial facilities or to put their money into saving account. The fact remains that capital structure of a firm is not entirely free from the influence of interest rate.

A lot of researches studying about the relationship between interest rate and firm leverage choice have been proposed. Goldstein, Ju and Leland (2001) demonstrated that ideal capital structure is affected by the interest rate's changes. They also assert that interest rate is a significant factor contributing to the formation of firms' capital structure. Furthermore, their study show that an optimal level of leverage is the trade-off between tax advantage and insolvency cost associated with debt. Hyde (2007) proposes that interest rate's adjustment will lead to the changes in a firm's financial expense correlated with debt thus affecting the firm's cash flows.However, in the study of Rayan (2008) about financial leverage and firm value shows that there is no significant relationship existing between interest rate and firms' financing choices.

Hypothesis 3: Stock market development has negative relationship with leverage

It is recommended that the development of stock market supports the equity financing over debt financing while the banking development creates more motivations for the firms to finance by debt (Agarwal and Mohtadi, 2004).The stone corner of studying about the relationship between firm capital structure and the development of financial market is conducted by Maksimovic et al. (1995) in 30 countries for a period of 11 years from 1980 to 1991. The results indicated that there existed a significant negative correlation between stock market development and the firm level of leverage ratio. However, when the whole sample was broken down, some findings appeared. More specifically, the further development of developed stock markets causes the equity to substitute debt in financing choice. In contrast, as regards the developing stock markets, large firms engage more in leverage but this market development pattern does not significantly affect the small firms.

Studying about the stock market development and financing choices of firms, another research conducted by Bokpin and Isshaq (2008) about Ghana from 1991 to 2005 proposed some different results. According to their results, stock market development was found not to affect the substitution of equity for debt in financing choice. Furthermore, the study showed that the stock market liquidity is negatively related to the short-term debt ratio.

Hypothesis 4: Banking sector development has positive relationship with leverage

It is proposed by the financial intermediation theory that transaction costs and asymmetric information can be reduced through financial intermediaries as banks. Moreover, banks also create more opportunities for the firms seeking external financing. Evidence reveals that a lot of empirical and theoretical studies have existed studying about the relationship between firms' leverage and banking sector development.

Utilizing panel data from 21 developing countries in 18-year period, SumitAgarwal and Mohtadi (2004) found that stock market development is negatively related to level of leverage while banking sector development increases this variable. Moreover, they also asserted that the development of banking sector and stock market is more significant in the long-run compared to the short-run.

Hypothesis 5: Financial crisis has negative impact on leverage

In recession, a limited amount of funds provided by financial institution would intuitively make firms face more difficulties in achieving financing sources for their business. Evident by the financial crisis occurring in 2008 and 2009 caused a deep downturn in economic activity in the

US and many other nations (Deesomsak, et al., 2004).More specifically, many banks and financial firms went bankrupt when a large number of borrowers refused to repay their debt due to the sharp fall in house price. With the shock in banking and financial sector, a large number of individuals and firms decided to withdraw all of their deposits from the banks leading to a more serious situation. Consequently, banks and financial institutions started to sell out their own assets and limit the new lending which caused a credit crunch in the following period.

From the summary about financial crisis in 2008 and 2009, it is easy to see how this shocking event destroyed the economy in the US and other nations. One of the main purposes of this study is to examine the effect of financial crisis on the capital structure of listed manufacturing firms in Vietnam.

2.3. *Firm specific factors for control variables*

Firm Size

Many studies figured out that firm size has significant relationship with leverage. A study conducted by Deesomsak, et al. (2004) about the determinants of capital structure and the effect of Financial Crisis in 1997 to the Asia Pacific region asserted that larger firm have lower bankruptcy cost as well as stable cash flows and easier access to credit market therefore usually utilize debt to take full advantage of tax shield. In other words, firm size is positively related to leverage. Also studying about the determinants of capital structure, Huang, G. & Song, F.M. (2006) and Dragotă, I.M. &Semenscu, A. (2008) found a positive relationship between capital structure variables and firm size in China and Romani, respectively. They argued that large firms with good reputation and less asymmetric information usually prefer financing by debt over equity. On the other hand, Mazur (2007) discovered a negative relationship between level of leverage and firm size in the Polish companies. As significant impact of firm size on capital structure, this paper employs firm size as control variable.

Firm Financial Quality

Financial quality of a firm is one of the important indicators banks consider to reduce default risk when making lending decision, therefore the financial health of a firm is perceived to have impact on firm capital structure. This is proved by many credit rating agencies have developed their own model to measure the risk of default. Financial quality is supposed to have negative relationship with leverage (Donaldson, 1961).

The stone corner of credit risk measurement model was established by Altman (1968).A study about the relationship between leverage and firm value under the influence of financial quality was conducted by Cheng et al. (2011). The result indicated that the positive impact of leverage on firm value is stronger under the influence of better firm financial quality which is measured by Z-score.The paper uses financial quality model built by Altman (1968) for control variable as following reasons. The first, the model takes into account five financial ratios then provide a distinct score that can give more comprehensive picture of firm financial health than using single financial ratio. The model as following:

$Z = 0.012\ X1 + 0.014\ X2 + 0.033\ X3 + 0.006\ X4 + 0.999\ X5$

X1: Working Capital/Total Assets is a measure of the net liquid assets of the firm. Working capital is the difference between current assets and current liabilities. According to the study of Deesomsak, Paudyal, and Pescetto (2004), liquidity is expected to maintain a negative relationship with level of debt. This result is consistent with the pecking order theory saying that high liquidity often makes firms less willing to engage with debt. Another analysis made by Mazur (2007) also proposed that firms with high liquidity ratios prefer equity for their financing purpose.
X2: Retained Earnings/Total Assets is a measure of profitability. This measure is used as a part of financial quality.
X3: Earnings Before Interest and Taxes/Total Assets is a measure of the true productivity of the firm's assets, abstracting from any tax or leverage factors. It was postulated by Altman (1968) that this ratio is very suitable for the evaluation of firms' financial quality due to their ability to represent the earning power of firms' assets which deciding the existence of any firms.
X4: Market Value of Equity/Book Value of Total Debt
X5: Sales/Total Assets represents the ability of firms' management in using assets to push sales in order to revenue for the companies. This measure also helps firms to evaluate the efficiency of managers in dealing with challenges in the competitive environment.
The second, by using financial quality found by Altman (1968), we can rank all firms from the best to the worst financial quality. Firms have a Z score of greater than 2.99 clearly are regarded as non-bankrupt. Firms having a Z below 1.81 are all bankrupt. Firms having Z score ranging from 1.81 to 2.99 are considered as the "zone of ignorance" or "gray area".

3. METHODOLOGY

3.1. *Data and sample*

Being one of the most important sectors due to its remarkable contribution to country's GDP, manufacturing sector is chosen to target in this study. In manufacturing sectors, all the listed firms in Hochiminh Stock Exchange (HOSE) having available annual data during the period of 2006 to 2013 will be obtained. The companies with gap between years are removed from the dataset in order to get the best efficient observations to analyze. Moreover, the companies with no total debt are also excluded from the sample to ensure the precision of calculation method (the fifth ratio of Z score containing total debt as denominator so the number cannot be zero). Because the number of manufacturing firms listed in HOSE is not the same over time, the data utilized is unbalanced. The sample consisting different number of observations over 8 year-period generates a 492-observation panel data.

3.2. *Model development*

It is postulated by Alfred (2007) that capital structure of a company represents the percentage of debt and equity used to financing their business. Another definition coming from Kennon (2010) defines capital structure as the percentage of money in a business by type including equity capital and debt capital. Each type of these capitals has its own advantages as well as disadvantages. Capital structure is also mentioned by Firer, Ross, Westerfield and Jordan (2004) as the relative amount of debt and equity used to enhance their operation.

As regards the measure of capital structure, there is no universal agreement about this issue. Some researchers prefer a more comprehensive measure of debt which is total debt while some others utilize long-term debt; short-term debt is not widely used (Mazur, 2007). It is reported that the results achieved by using narrow and broad concepts are very similar or even better with the broader concept. Total debt over total asset has proved its efficiency in business research area through numerous studies conducted before by Alonso (2008), Chen (2002), and Chenget al. (2011) since it does not take into account the long-term or short-term behavior of any firms but only their total borrowings during the year. In another aspect, the use of book value of debt seems more reasonable compared to the market value of debt due to the difficulties in obtaining data (Graham and Harvey, 2001). In consistent with the above arguments, the measure of capital structure in this study is the total debt over total assets calculated with book values.

To analyze the impact of Financial Market Development on firms' capital structure, we use leverage model including one dependent variable and five explanatory variables (Credit Growth Rate, Interest Lending Rate, Stock Market Development, Banking Sector Development and Financial Crises) and two control variables (Firm Size and Financial Quality).

$$LEV_{it} = \beta_0 + \beta_1 SIZE_{it} + \beta_2 Z_{it} + \beta_3 CRE_{it} + \beta_4 BANK_t + \beta_5 INT_t + \beta_6 FC_t + \beta_7 STOCK_t + \varepsilon_{it}$$

Where:

LEV: Total debt/Total Assets

β_i: Coefficient for each of the independent variables

SIZE: Firm size

Z: Firms' financial quality

CRE: Credit Growth Rate

INT: Interest Lending Rate

FC: Financial Crisis Dummy Variable

STOCK: Stock Market Size

BANK: Bank Size

Table 1: independent Measurement

Variables	Measurement
LEV	Total debt/Total assets
SIZE	Natutal logarithm of Total assets
Z	Financial quality
CRE	Domestic Credit/GDP
STOCK	Stock market capitalization/GDP
BANK	Total banking assets/GDP
FC	Dummy variable (1 for 2008 and 2009; 0 for the other years)
INT	Interest lending rate

4. RESULTS AND DISCUSSIONS

4.1 Diagnostic test for Multicollinearity

One of the most popular problems in dealing with data in any researches is multicollinearity in which two or more explanatory variables of the model have linear relationships. Multicollinearity can lead to strange results when we want to determine how the exogenous variables independently contribute to the endogenous variable. Therefore, testing multicollinearity among independent variables help the research models avoid biased and unreliable results. The simplest testing strategy for multicolinearity is examining the correlation coefficient among pairs of separate variables. High correlation coefficient of equal to or exceeds 0.8 explains that these variables are highly correlated, causing serious multicolinearity problem. The correlation matrix shows that all the variables in this model can satisfy the multicollinearity testing which contribute to a reliable and unbiased model following (Appendices Table 2)

In addition, to have strong reliability indicating the absence of multicolinearity, variance inflation factor (VIF) is employed to examine the multicolinearity problem between regressors. It was proposed by Besley, Kuh and Welsch (1980) that the tolerance should be greater than 0.2 or at least 0.1, equivalents to VIF ≤ 10. The variance inflation factor (VIF) and the tolerance are both widely used as measures of the degree of multicollinearity. Several rules of thumb – most commonly the rule of 10 – associated with the VIF– are regarded by many practitioners as a sign of severe or serious multicollinearity but this rule has no scientific justification (Uriel,2013). With the mean VIF of 3.27 and no index exceeding 10, the result illustrates that there is nomulticolinearity problem in this dataset (Appendices table 3).

4.2 Fixed and random effects

There are two common assumptions made about the individual specific effect, the random effects assumption and the fixed effects assumption. Every company has its own characteristics (type of management, board of directors, ownership, age, reputation etc.) which may or may not affect the variable variation across entity. Random effects assume that the entity's error terms are random and uncorrelated with the independent variables which allows for time-invariant variables to play a role as explanatory variables. The fixed effect assumption is that the individual specific effect is correlated with the independent variables. From the fixed and random effect testing, the results indicate that there exist both effects in the model (Appendices Table 5).

To determine Random or Fixed effect model is appropriate, Hausman Test that has long been widely used will be conducted. The null hypothesis of Hausman test is that the random effect model is true so the coefficients are equal throughout the population. On the other hand, the alternative hypothesis proposes fixed effect model is more appropriate and reliable in which at least one coefficient distinct from others. The result of Hausman test is presented in Table 6. The Hausman test statistic comparing the random-effects estimators to the fixed effects estimators reports a value of 20.46 with the probability of 0.0043 which is less than 0.05. This implies a rejection of the null hypothesis indicating that fixed effect is appropriate in Model I.In addition, in order to receive the best results without biased and distortion, we have to conduct some tests before running the regression including Autocorrelation and Heteroscedascity.

Test for Heteroscedasticity

```
. xttest3

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (91)  =    2.1e+07
Prob>chi2 =      0.0000
```

Homogeneity of variance of the residuals (constant variance) is one of the main assumptions of OLS regression. If the variances of residuals are not equal across observations, this model suffers heteroscedascity. With the presence of heteroscedascity, the OLS estimates are no longer BLUE which means OLS does not provide the estimate with the smallest variance. It is suggested by Greene (2000, p. 598) that heteroscedasticity within a fixed-effect regression could be detected by implementing the modified Wald test. The result indicates that there is the problem of heteroscedascity in the model.

Test for Autocorrelation

```
. xtserial LEV SIZE Z CRE STOCK BANK FC INT

Wooldridge test for autocorrelation in panel data
H0: no first order autocorrelation
    F(  1,       88) =    186.022
           Prob > F =      0.0000
```

Assumption three of the Classical Linear Regression Model is that the covariance between the error terms over time is zero which means that the errors are uncorrelated with one another. If the errors are not uncorrelated with one another, the autocorrelation problem occurs which may cause distortions to the efficiency of a regression model. Autocorrelation causes the standard errors of the coefficients to be smaller than they actually are and higher R-squared. The test shows that the existence of the autocorrelation problem exists. However, according to Oscar Torres-Reyna (2007) and Maryam Asghari (2013), serial correlation test is applied to panel data with a long period of time (20-30 years) and it is not a problem in a dataset with very few years.

In conclusion, with the existence of heteroscedasticity in prior fixed-effect regression model, it is crucial to have some robustness to this model to limit the biasness created by this friction. For that reason, fixed effect regression with robust option was carried out to provide robust coefficients restraining the distortions in the regression. The table of results is represented below:

LEV	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
SIZE	.1460776	.033641	4.34	0.000	.0792438	.2129114
Z	-.0334077	.0101904	-3.28	0.001	-.0536528	-.0131626
CRE	-.0619959	.0488426	-1.27	0.208	-.1590302	.0350385
STOCK	-.4833173	.1485899	-3.25	0.002	-.7785172	-.1881175
BANK	-.0361956	.0458324	-0.79	0.432	-.1272497	.0548585
FC	-.073942	.0247936	-2.98	0.004	-.1231988	-.0246852
INT	-1.114438	.4071806	-2.74	0.007	-1.923373	-.3055025
_cons	-1.241906	.4397291	-2.82	0.006	-2.115505	-.3683078

(Full table result is presented in Appendices Table 7)

4.3 Credit Growth Rate

Credit is one of the most important sources of fund for the growth of national economy especially developing countries like Vietnam. The growth of credit market is the fundamental requirement for any enterprises to expand production, raise productivity thus encourages the whole economy to develop. However, the result shows that credit growth rate has no statistical significant effect on capital structure of manufacturing sector on HOSE. The fact remains in Vietnam that when the credit market starts to grow, the money is pumped into the other economic sectors instead of manufacturing. More specifically, the fund is mainly distributed into real estate sector or some other services like personal loan due to the rising credit demand of Vietnamese people nowadays. This result is not consistent with the study of Leary (2005) as well as Shen et al. (2014) which considered the credit growth rate as an important factor affecting the corporate capital structure.

4.4 Stock market development

Stock market development is represented by the total stock market capitalization over GDP. This variable enters the regression with a negative size which shows an adverse relationship between stock market development and firm leverage level. The fact remains that a growing stock market creates conditions for the firms to take advantage of equity financing thus reducing the use of debt. The result proving the negative relationship between stock market development and debt ratio has received a lot of support from many researches and studies over time such as the study about financing choices conducted by Bokpin and ZanginaIsshaq (2008) in Ghana as well as the study of SumitAgarwal and Mohtadi (2004) over 11 developing countries. Furthermore, the study carried out by Jong (2007) also pointed out the indirect effect of country-specific factors including Stock market development substituting the financing choices of firms from debt towards equity. In the study of Demirgfic-Kunt and Maksimovic (1995), they also said that banks are really fearful of stock market development since this can lead to the decline in the volume of their business. The regression conducted in this study has shown that the fear of banks has come true when the debt ratio of firms tend to decrease associated with the development of stock market.

4.5 Banking sector development

The purpose of this study is try to prove that financing choice of firms is not only rely on their own characteristics, but also on their surrounding environment such as the growth of the economy, the stock market development as well as the size of banking sector. However, the result points out that there no significant correlation between banking sector and firms financing choices. This result is not consistent with the study of Sumit Agarwal and Mohtadi (2004) who found that banking sector development increases the level of leverage in the long run. The fact remains that regardless of the increase in banks' total assets; the change in total assets of manufacturing companies is a different matter and does not rely on the aforementioned phenomena.

4.5.1Financial Crises

The results for the impact of Financial Crises on Firms' financing choices provide evidence that a relationship does exist. The finding reveals that there is a negative correlation between financial crises and manufacturing firms' level of leverage. This result can be clearly explained by the failures of banks and financial institution activities in the economic depression. To be more detail, the firms found it very hard to finance their operation by debt provided by banks and financial institutions because of their lack of fund due to the huge withdraw by a large number of clients. Almost all countries around the world had to suffer the consequences of financial crises and Vietnam is not an exception.

4.5.1 Interest lending Rate

From the macro point of view, interest rate is an effective tool for the central bank to implement monetary policy thus regulates the relationship between saving, investment, inflation as well as economic growth. In other words, interest rate always has a great influence on the economy. As regard the micro perspective, interest rate plays a very important role affecting personal and corporate decision-making between saving and spending on production, lending or depositing money into the banks. Like many other researches and studies conducted before by Goldstein et al. (2001); Rayan (2008) and Hyde (2007), this variable is proven to have significant relationship with the dependent variable. The result indicates that there exists a negative relationship between interest lending rate and level of debt. As a matter of fact, when the interest rate climbs higher, firms will cut off financing by debt in order to reduce the financial expense as well as increase the overall profit.

4.6 Control variables

4.6.1 Firm size

Size effect is proved to have significant positive relationship with leverage. This result supports the trade-off hypothesis as one of the main reasons is that the stable cash flows of the big companies would help them to reduce the costs of financial distress caused by debt. Moreover, larger companies often have better access to the capital market and prefer to use debt financing over equity. The positive relationship between firm size and level of leverage is pointed out by a lot of prior research about capital structure. Hsiao, Jung-Lieh; Hsu, Ching-Yu; Hsu, Kuang-Hua (2009) argued that large firms with good reputation and less asymmetric information usually prefer financing by debt over equity. Furthermore, a research conducted by Deesomsak, Paudyal, and Pescetto (2004) about the determinants of capital structure and the effect of Financial Crisis in 1997 to the Asia Pacific region asserted that larger firms have lower bankruptcy cost as well as stable cash flows and easier access to credit market, therefore usually utilize debt to take full advantage of tax shield. Dragotă, I.M. and Semenscu (2008) and Huang, G. & Song, F.M. (2006) also discovered a positive relationship between level of leverage and firm size. Last but not least, Information signaling theoryalso supports the use of debt in the business sector.

4.6.2 Financial quality

Including the largest information to calculate, financial quality is one of the most important parts contributing to this paper. The result indicates that in Vietnam, firms with better financial quality would avoid financing by debt to take advantage of retained earnings as the first source of funds following to the pecking order theory or maybe they would issue more equity to penetrate into the growing stock market in Vietnam over years. It is supported by Donaldson (1961) that the more profitable firms tend to borrow less thanks to the internal finance they got from their business. Likewise, in the test conducted by Fama and French (2002), they found that the more profit firms can get the less leverage will they use which is in line with pecking order theory. Furthermore, the significant effect of this variable to firms' financing choices also shows that the Z-score model proposed by Altman (1968) can be applied in the case of Vietnamese Industrial Sector helping the management make better decision about capital structure based on the firms' financial quality.

5. CONCLUSION

In conclusion, there have been a lot of studies and researches about firms' financing choices for a long period of time since the first work of Modigliani and Miller in 1958. However, the consideration about macroeconomic factors' effects on firms' financing choices has just started in recent years and this topic seems to be very new in Vietnam. In recognition of this gap, this paper aim to examine the effects of financial market development on financing choices of firms from manufacturing sector listed in Ho Chi Minh Stock Exchange. This study collect data from 91 manufacturing companies listed in HOSE during the period of 8 years from 2006 to 2013 to catch up with the pace of financial market development including the most shocking event to all countries around the world – Financial Crises in 2008.

Three over five factors reflecting the financial market environment were shown to have considerable impacts on Firms' financing choices including Interest Lending Rate, Stock Market Development, and Financial crises. The remaining factor Banking Sector Development and Credit Growth Rate does not show its significant effect on financing choices of firms. Furthermore, firm specific factors consisting of firm size and financial quality also have significant relationship with firm capital structure.

In general, financing choices of firms from manufacturing sectors seem to be relatively sensitive to shifts in financial market environment over the period of 8 years from 2006 to

2013. Three factors related to the development of financial market within this study have been proven to have significant effects on financing choices of firms. However, there are still some limitations in this paper. At first, the research only investigatesthe impact of financial market development on manufacturing sector in Vietnam. Due to data availability, study period is just from 2006 to 2013 and this is not really convincing for the long term effect measurement. For further research, it is worth examining how financial market development impact on firm financing decisions when ownership structure of firms are put into consider as state – owned companies is the most unique forms of enterprises commonly existing in transitional economy like Vietnam. Furthermore, it is interesting to explore other macroeconomic factors beyond financial market such as inflation or the economy growth rate that may influence firm financing choices.

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APPENDICES

Table 2: Correlation Matrix

	Z	SIZE	INT	CRE	STOCK	BANK	FC
Z	1						
SIZE	-0.06371	1					
INT	-0.01787	0.049432	1				
CRE	0.096836	-0.20514	-0.48235	1			
STOCK	-0.05124	0.124004	-0.75929	0.003588	1		
BANK	-0.08419	0.22612	0.459312	-0.40203	-0.04044	1	
FC	-0.18076	0.27152	0.232032	-0.37657	-0.03762	0.502194	1

Table 3: Multicolinearity Testing

```
. collin CRE SIZE Z STOCK BANK FC INT
(obs=492)

  Collinearity Diagnostics

                        SQRT                    R-
  Variable      VIF     VIF    Tolerance    Squared
----------------------------------------------------
       CRE      2.52    1.59    0.3960      0.6040
      SIZE      1.13    1.06    0.8871      0.1129
         Z      1.04    1.02    0.9619      0.0381
     STOCK      5.80    2.41    0.1724      0.8276
      BANK      2.34    1.53    0.4274      0.5726
        FC      1.59    1.26    0.6304      0.3696
       INT      8.44    2.91    0.1185      0.8815
----------------------------------------------------
  Mean VIF      3.27
```

Table 4: Descriptive Statistics
The table summarized all the measures of variables including Mean, Maximum, Minimum and Standard Deviation.

Table 5: Fixed effects and Random effects Testing

Fixed effects testing

```
. xtreg LEV SIZE Z CRE STOCK BANK FC INT,fe

Fixed-effects (within) regression               Number of obs      =       492
Group variable: company                         Number of groups   =        91

R-sq:  within  = 0.2560                         Obs per group: min =         2
       between = 0.0323                                        avg =       5.4
       overall = 0.0508                                        max =         8

                                                F(7,394)           =     19.37
corr(u_i, Xb)  = -0.5046                        Prob > F           =    0.0000

------------------------------------------------------------------------------
         LEV |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        SIZE |   .1460776   .0180755     8.08   0.000      .110541    .1816142
           Z |  -.0334077   .0089206    -3.75   0.000    -.0509455   -.0158698
         CRE |  -.0619959   .0439273    -1.41   0.159     -.148357    .0243653
       STOCK |  -.4833173   .1387472    -3.48   0.001    -.7560948   -.2105398
        BANK |  -.0361956   .0395759    -0.91   0.361    -.1140019    .0416108
          FC |   -.073942   .0174797    -4.23   0.000    -.1083072   -.0395768
         INT |  -1.114438   .4200991    -2.65   0.008    -1.940354   -.2885216
       _cons |  -1.241906   .2365518    -5.25   0.000    -1.706968   -.7768447
-------------+----------------------------------------------------------------
     sigma_u |  .20244188
     sigma_e |  .07711768
         rho |  .87327605   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F test that all u_i=0:     F(90, 394) =    26.74             Prob > F = 0.0000
```

Random effects testing

```
. xtreg LEV SIZE Z CRE STOCK BANK FC INT,re

Random-effects GLS regression                   Number of obs      =       492
Group variable: company                         Number of groups   =        91

R-sq:  within  = 0.2472                         Obs per group: min =         2
       between = 0.0318                                        avg =       5.4
       overall = 0.0527                                        max =         8

                                                Wald chi2(7)       =    116.01
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000

------------------------------------------------------------------------------
         LEV |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        SIZE |   .0968859   .0135338     7.16   0.000     .0703601    .1234116
           Z |  -.0349523   .0084017    -4.16   0.000    -.0514194   -.0184853
         CRE |  -.1063001   .0432477    -2.46   0.014     -.191064   -.0215363
       STOCK |   -.360157   .1378605    -2.61   0.009    -.6303587   -.0899553
        BANK |  -.0122312   .0396309    -0.31   0.758    -.0899063    .0654439
          FC |  -.0547409   .0171407    -3.19   0.001     -.088336   -.0211458
         INT |  -1.037365   .4262033    -2.43   0.015    -1.872708   -.2020223
       _cons |  -.6366126   .1840567    -3.46   0.001    -.9973571    -.275868
-------------+----------------------------------------------------------------
     sigma_u |  .17222396
     sigma_e |  .07711768
         rho |  .83298423   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Table 6: Hausman test

```
hausman fe re

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |      fe           re          Difference          S.E.
-------------+----------------------------------------------------------------
        SIZE |   .1460776     .0968859        .0491917        .0119817
           Z |  -.0334077    -.0349523        .0015447        .0029979
         CRE |  -.0619959    -.1063001        .0443043        .0076971
       STOCK |  -.4833173     -.360157       -.1231604         .015661
        BANK |  -.0361956    -.0122312       -.0239644               .
          FC |   -.073942    -.0547409       -.0192011        .0034262
         INT |  -1.114438    -1.037365       -.0770725               .
------------------------------------------------------------------------------
                          b = consistent under Ho and Ha; obtained from xtreg
           B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       20.66
                Prob>chi2 =      0.0043
                (V_b-V_B is not positive definite)
```

Table 7: Table Results

```
. xtreg LEV SIZE Z CRE STOCK BANK FC INT, fe robust

Fixed-effects (within) regression               Number of obs      =       492
Group variable: company                         Number of groups   =        91

R-sq:  within  = 0.2560                         Obs per group: min =         2
       between = 0.0323                                        avg =       5.4
       overall = 0.0508                                        max =         8

                                                F(7,90)            =      6.77
corr(u_i, Xb)  = -0.5046                        Prob > F           =    0.0000

                               (Std. Err. adjusted for 91 clusters in company)
------------------------------------------------------------------------------
             |               Robust
         LEV |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        SIZE |   .1460776    .033641     4.34   0.000     .0792438    .2129114
           Z |  -.0334077   .0101904    -3.28   0.001    -.0536528   -.0131626
         CRE |  -.0619959   .0488426    -1.27   0.208    -.1590302    .0350385
       STOCK |  -.4833173   .1485899    -3.25   0.002    -.7785172   -.1881175
        BANK |  -.0361956   .0458324    -0.79   0.432    -.1272497    .0548585
          FC |   -.073942   .0247936    -2.98   0.004    -.1231988   -.0246852
         INT |  -1.114438   .4071806    -2.74   0.007    -1.923373   -.3055025
       _cons |  -1.241906   .4397291    -2.82   0.006    -2.115505   -.3683078
-------------+----------------------------------------------------------------
     sigma_u |  .20244188
     sigma_e |  .07711768
```

Impacts of Foreign Portfolio Flows on Stock Market Returns in Up and Down Trend Evidence from Vietnam

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As capital market liberalization spreads internationally, the influences of foreign portfolio flows on local equity markets are worth being examined. The paper provides a quantitative assessment on the impacts of daily foreign flows on Vietnamese stock market returns (VN-index) in two different up and down trend periods from the end of 2005 to 2011. By combining three widely-used econometric tools which are Vector Autoregressive Models, Granger Causality Tests and Impulse Response Functions, we find several interesting facts. Firstly, almost significant relationships between foreign flows and market returns are very short-term, just in one or two days. Secondly, daily foreign gross purchases and gross sales are demonstrated to have a link with returns and to Granger cause them. On the contrary, foreign net purchases show no relation with market returns. Besides, among three measures of foreign flows, gross sales are demonstrated to have more significant correlation coefficients which spread over three samples (full sample, up and downtrend periods) with market returns. As a result, it could be argued that Vietnamese stock market returns are most sensitive to selling information of foreign investors. Finally, it is shown that market returns response positively (10-day accumulated response) to a random shock to both gross purchases and gross sales even though there are individually negative reactions in some days.
Keywords: Investment, Foreign Portfolio, Stock Market, Vietnam.

1. Introduction

Under waves of capital liberalization spreading globally, it is worth investigating the impact of the foreign portfolio flows on local equity markets. That is even highly justifiable in developing countries such as Vietnam where stock markets are usually small and illiquid, compared with wealthy foreign portfolio flows which account for a noticeable portion in Vietnamese stock market. Actually, there have been many rumors around the possible impacts of foreign flows on Vietnamese stock market returns, which somehow affects investors' psychology and trading strategy. However, not many academic studies about this issue have been conducted yet. It is, therefore, important to examine the relationship between foreign flows and equity market returns in Vietnam. As a result, this study aims to investigate whether foreign portfolio flows affect Vietnamese stock market returns or not and then figure out how they impact on the returns.

Evidences of foreign portfolio flows' impacts on emerging equity markets have been found by a number of researchers. Surprisingly, most of them come up with a fairly similar result which is a positive link between foreign flows and returns. Foot et al. (2001), after conducting a research on 44 different markets, conclude that foreign inflows predict equity returns positively in emerging markets (both short-term and long-term). Furthermore, they figure out that one-basis-point shock of foreign flows causes a 40 basis point increase in returns and the most increases are in the first 30 days or so. Bohn and Tesar (1996) also report the same finding. They use low frequency monthly and quarterly data and find out the positive relationship in emerging markets.

Besides, there have been detailed studies on a particular emerging stock market. Pavabutr (2004) conducts a comprehensive study about the impacts of foreign flows on Thailand stock market before, during and after Asian crisis in 1997, and on 2 different segments (most favorite and least favorite companies by foreign investors). Using a structural VAR to examine the dynamic relation between foreign flows and market returns, he then concludes that there is a strong contemporaneous link (positive) between flows and returns on daily and weekly basis but weakening as time passes (as an aggregate market scale). Clark and Berko (1996) also discover a statistically significant correlation between monthly foreign inflows and market returns in Mexico. They regress Mexican stock returns (Bolsa index) on foreign net purchases and find that "foreign purchases of 1% of market capitalization are associated with a 6 % rise in Bolsa index". On the other hand, Chakraborty (2007) just finds a slight cause running from foreign portfolio flows to market returns when studying foreign indirect investment (FII) flows in India equity market during the period from April 1997 to March 2005. Chakraborty tests a hypothesis that "monthly net FII flows as a proportion of previous month's BSE market capitalization does not Granger-cause monthly BSE National Index return" and only rejects that null hypothesis at 5 % level of significance.

This paper contributes to the literature by yielding a number of new findings on the relation between past foreign flows and aggregate stock market returns in Vietnam. Besides, such discoveries will provide domestic investors with more accurate information of possible impacts of foreigners' trading on market returns, which is helpful for them in making investment decisions.

The rest of the paper is organized as follows. Section 2 describes data and methodology employed. Section 3 presents results and discussion about the impacts of foreign portfolio flows on stock market returns. Results summary and conclusion are offered in section 4.

2. Data Description and Methodology

2.1. *Data*

Raw data consists of market index (VN-index), foreign gross purchases and gross sales of stocks, investment certificates both through dealing and put-through on a daily basis (on Hochiminh Stock Exchange only). The full dataset covers from October 26, 2005 to March 16, 2011. The study period starts from October, 26th, 2005 as this was the time the Decision No. 238/2005/QĐ-TTG of The Prime Minister Phan Van Khai become effective. This policy open more opportunities for foreign investors since it allows foreign investors to hold up to 49% (except banking industry: 30%) of the total listed shares of a firm on Vietnamese stock market compare with before only 30%. The policy started to be effective (effective on Sunday, October 23rd, 2005). The study breaks up such data into two sub-samples: the first is from October 26, 2005 to October 15, 2007 and the second is from October 16, 2007 to March 16, 2011 since the paper aims to explore the impact of foreign flows in different up and down trend period in stock market with relatively balanced observed window. The market index (VN-index) experienced a dramatic uptrend (bull market) during the first period and a downtrend (bear market) in the remaining time, in general. Those data are then processed properly to be employed in the proposed models.

- Daily aggregate gross purchases on day t (in VND billions) = foreign gross purchases (stocks and investment certificates) by dealings on day t + foreign gross purchases (stocks and investment certificates) by put-through on day t
- Daily aggregate gross sales on day t (in VND billions) = foreign gross sales (stocks and investment certificates) by dealings on day t + foreign gross sales (stocks and investment certificates) by put-through on day t
- Daily aggregate net purchases (in VND billions) = Daily aggregate gross purchases - Daily aggregate gross sales
- Daily market return is calculated as follows:

$$R_{mt}(\%) = \frac{VNindex_t - VNindex_{t-1}}{VNindex_{t-1}} * 100\%$$

Where

Rmt: Daily market return on day t

VNindext: VN-index on day t

VNindext-1: VN-index on day t-1

2.2. *Methodology*

The study follows these main steps: dynamic relation with unrestricted Bi-variate Vector Autoregressive Models (VAR), "Granger" causation with Granger Causality Tests, and shock response with generalized Impulse Response Functions (IRF).

The first step is to test variables to see whether they satisfy requirements of Vector Autoregressive Model which is the thesis's main model. VAR requires all its variables to be stationary. Therefore, stationary testing must be conducted first. Two popular unit root tests: Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) are employed to examine whether time series are stationary or not. If all variables are stationary at levels, i.e. I(0), then VAR models are able to be used. If not, i.e. integrated of order d>0: I(d), additional Johansen Co-integration Tests are needed. Co-integration tests are used to determine if there exists a long-run relationship between variables (Gurajati, 2004). If two variables (one is stationary and another is non-stationary at levels) are co-integrated then VAR will be still applicable. However, if two time series are both non-stationary at levels and co-integrated then Vector Error Correction Models (VECM) will be employed instead. In case of no co-integration found, such pairs of variables will not be included in the analysis.

Next, Bi-variate Vector Autoregressive Models (unrestricted versions) are employed to examine the dynamic relation between each of three flows measures (foreign gross purchases, foreign gross sales and foreign net purchases) and market returns on a daily basis. The focus of this study is the link between

past foreign flows and current market returns. While running the models, a caution should be taken in choosing lag-length to which the results are very sensitive. Akaike Information Criteria (AIC) is applied to choose appropriate lag-length. Specifically, the lag-length which has the smallest value of AIC is applied. In VAR models, correlation coefficients are estimated easily (by Ordinary Least Squared method) and such parameters help to explain the relation or correlation between lagged values of foreign flows and local market return. F-statistic (to test the null hypothesis that all coefficients in one equation are jointly equal to zero) is also examined to see whether the model is fit or not. Nevertheless, it should be noted that even in the case F-statistic is greater than F-critical value (null hypothesis is rejected), it does not necessarily mean that there is a relationship between past foreign flows and market returns. The fact that is that in one equation, there are two kinds of coefficients: those of past flows and those of past returns (see estimated VAR models below). Therefore, it can fall to the case that no coefficient of lagged values of foreign flows is significant, which indicates no relation, but at least one coefficient of past returns is statistically significant, which confirms past returns relate to itself. That is the reason why Granger Causality Tests are employed next to clarify the link.

The estimated VAR model for the analysis of foreign flows and market return is as follows:

$$F_t = a + \sum_{j=1}^{k} \beta_j F_{t-j} + \sum_{j=1}^{k} \gamma_j R_{m\,t-j} + u_{1t}$$

$$R_{mt} = a' + \sum_{j=1}^{k} \delta_j F_{t-j} + \sum_{j=1}^{k} \varepsilon_j R_{m\,t-j} + u_{2t}$$

Where

Ft: Aggregate foreign flows (gross purchases, gross sales or net purchases) on day t

Rmt: Daily market returns (VN-index)
a,a': Constant
$\beta,\gamma,\delta,\varepsilon$: Correlation coefficients
k: maximum number of lags
u1t, u2t: Zero-mean white noise disturbances

Thirdly, Granger causality tests are used to figure out the causal relationship (in Granger sense) between variables. Generally speaking, the main purpose of this test is to examine if past foreign flows "Granger" cause market returns by testing the joint hypothesis of equal-to-zero coefficients of lagged foreign flows. VARs' coefficients are argued to be interpreted more deeply by using Granger causality test. X is said to Granger cause Y if X helps in the prediction of Y, or put another way, if the coefficients on the lagged X are statistically significant. It should be noted that the statement X "Granger" causes Y does not imply Y is the result of X. Four possibilities are raised by Gurajati (2004): unidirectional causality from Y to X, unidirectional causality from X to Y, bilateral causality and independence.

Fourthly, Generalized Impulse Response Function will be employed to trace the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables in VAR, that is, to investigate how market returns react to shock to foreign flows. In VAR models, a shock to ith variable does not only affect itself but also is transmitted to all other endogenous variables through the dynamic structure of VAR. There are different types of impulse in which Cholesky and generalized impulses are widely used. Each of them has its own characteristics. Cholesky impulse requires an advanced specification of variables' order and its results are sensitive to that order. On the other hand, generalized impulse has an advantage in that it is independent of the ordering of variables in VAR. Therefore, this thesis employs generalized impulse functions. In addition, IRF will not be carried out for all pairs of variables but just for those which are demonstrated to have causal relationship (from Granger Causality Tests).

Finally, so as to dip further into the relation, the same testing process is carried out for weekly data to see if there is any long-term link (Only important results of weekly data tests are to be presented and compared with daily ones). Weekly data are processed from daily dataset. Weekly variables such as weekly foreign gross purchases, foreign gross sales are computed as the same manner as daily ones but they are sum of five consecutive trading days. The procedure is applied for the full sample and two sub-periods on a weekly basis.

3. Impacts of Foreign Portfolio Flows on Vietnamese Stock Market Returns

3.1. *Dynamic Relation between Foreign Flows and Market Returns*

3.1.1 Foreign Gross Purchases and Market Returns

As can be seen from Table 1, past foreign gross purchases just have significant relation with market returns in the down trend period and full sample, not in the up trend period. No correlation coefficients (of specified lags) are statistically significant from 26/10/2005 to 15/10/2007 when VN-index experienced a dramatic uptrend, even though the joint hypothesis of equal-to-zero coefficients is rejected. Whereas, there is a positive link between past foreign gross purchases (lag 1) and daily market returns from 16/10/2007 to 16/03/2011. Coefficient of foreign gross purchases lag 1 is also positive in full sample but even greater and more significant than in the downward period. That is justifiable since the number of observations in the second period accounts for up to 63.23 % of the full period.

One striking point is that the relationship is very short-term and temporary in those samples (full and bearish period): only between yesterday foreign gross purchases (lag 1) and today return of VN-index. The following lags of foreign gross purchases (e.g. lag 2, 3, 4, etc.) do not have any significant correlation with market returns (except foreign gross purchases lag 8 which is in negative relationship with market returns).

Table 1: Bi-variate VAR of Daily Returns with Daily Foreign Gross Purchases (Partly)

	FULL SAMPLE	**1st PERIOD 26/10/05 – 15/10/07**	**2nd PERIOD 16/10/07- 16/03/11**
	DAILY_RETURN	**DAILY_RETURN**	**DAILY_RETURN**
DAILY_GP (-1)	**0.00139****	0.00178	**0.00116***
t-statistic	[2.48708]	[1.51478]	[1.78458]
DAILY_GP(-2)	-0.00053	0.00029	-0.00092
t-statistic	[-0.92469]	[0.21704]	[-1.40750]
DAILY_GP(-3)	0.00076	0.00103	0.00061
t-statistic	[1.30236]	[0.77473]	[0.92864]
DAILY_GP(-4)	-0.00045	-0.00093	-0.00064
t-statistic	[-0.77511]	[-0.71830]	[-0.98480]
DAILY_GP(-5)	0.00034	0.00001	0.00036
t-statistic	[0.57850]	[0.00746]	[0.55233]
DAILY_GP(-6)	-0.00079	-0.00183	
t-statistic	[-1.35346]	[-1.36435]	
DAILY_GP(-7)	0.00039	-0.00038	
t-statistic	[0.68499]	[-0.33370]	
DAILY_GP(-8)	**-0.00140****		
t-statistic	[-2.54711]		
F statistic	**10.33196**	**4.070658**	**10.96125**
***, **, *** significance at 10%, 5% , 1%**			

3.1.2 Foreign Gross Sales and Market Returns

On the other hand, foreign gross sales seem to have stronger connection with market returns than the gross purchases. Compared to foreign gross purchases, all significant coefficients are higher.

As can be seen in Table 2, there is a positive relation between yesterday foreign gross sales (lag 1) and today market return in both up trend and down trend period and the whole period in which the most significant one is of full sample and the least is that of the second sub-period. However, the correlation is also short-term, mostly in day 1 and day 2.

Table 2: Bi-variate VAR of Daily Returns with Daily Foreign Gross Sales (Partly)

	FULL SAMPLE	1ST PERIOD 26/10/05 - 15/10/07	2ND PERIOD 16/10/07- 16/03/11
	DAILY_RETURN	**DAILY_RETURN**	**DAILY_RETURN**
DAILY_GS(-1)	**0.00231*** **	**0.00385** **	**0.00179***
t-statistic	[3.00492]	[2.55782]	[1.95987]
DAILY_GS(-2)	**-0.00246*** **	-0.00159	**-0.00257*** **
t-statistic	[-3.06241]	[-1.01295]	[-2.71819]
DAILY_GS(-3)	0.00069	-0.00041	0.00133
t-statistic	[0.85130]	[-0.25945]	[1.38471]
DAILY_GS(-4)	-0.00033	-0.00081	0.00003
t-statistic	[-0.41226]	[-0.51310]	[0.02655]
DAILY_GS(-5)	0.00029	0.00157	-0.00007
t-statistic	[0.35382]	[0.99199]	[-0.06920]
DAILY_GS(-6)	-0.00119	**-0.00280***	-0.00053
t-statistic	[-1.54248]	[-1.87784]	[-0.58063]
F-statistic	**13.72128**	**4.59360**	**9.41555**
***, **, *** significance at 10%, 5% and 1%**			

Interestingly, there is a significant reversal (at 1% level of significance) in the relation between lag 2 of foreign gross sales and market returns in the second and full sample, which does not take place in the case of gross purchases. The reversal happens in lag 6 in the first period, however. This may indicate temporary price pressure effect. The price pressure hypothesis states that stock temporary changes in demand influence stock prices but when that change weakens, prices will come back to their previous levels.

3.1.3 Foreign Net Purchases and Market Returns

Table 3 illustrates VAR results of foreign net purchases and market returns which are totally different from what have been shown in the first two measures of foreign flows. No significant relation is found between past foreign net purchases and VN-index returns in all bull and bear period.

Table 3: Bi-variate VAR of Daily Returns with Daily Foreign Net Purchases (Partly)

	FULL SAMPLE	1ST PERIOD 26/10/05 - 15/10/07	2ND PERIOD 16/10/07- 16/03/11
	DAILY_RETURN	DAILY_RETURN	DAILY_RETURN
DAILY_NP(-1)	0.00022	-0.00017	0.00059
t-statistic	[0.38081]	[-0.15922]	[0.82132]
DAILY_NP(-2)	0.00056	0.00138	0.00027
t-statistic	[0.91706]	[1.13605]	[0.37569]
DAILY_NP(-3)	0.00058	0.00092	0.00029
t-statistic	[0.94326]	[0.75071]	[0.39227]
DAILY_NP(-4)	-0.00069	-0.00032	-0.00071
t-statistic	[-1.12279]	[-0.25323]	[-1.00314]
DAILY_NP(-5)	0.00035	-0.00086	
t-statistic	[0.57811]	[-0.70433]	
DAILY_NP(-6)	-0.00066	-0.00048	
t-statistic	[-1.08085]	[-0.39482]	
DAILY_NP(-7)	0.00038	-0.00039	
t-statistic	[0.66372]	[-0.38527]	
F-statistic	**10.80816**	**3.80288**	**13.02938**

***, **, *** significance at 10%, 5% and 1%**

In sum, three measures of foreign flows (foreign gross purchases, gross sales, and net purchases) have different relation with market returns. Only gross purchases and gross sales have positive link with returns but it is just temporary relation, just at lag 1. There is, however, a price reversal at lag 2 of foreign gross sales. In addition, almost correlation coefficients of past weekly foreign flows and weekly returns are insignificant, which strongly confirms the short-term relationship between past foreign flows and market returns. The inconsistency between the paper's findings and those of Foot et al. (2001), Clark and Berko (1996) could be explained partly by the fact that most investors in Vietnamese equity market are individuals who often follow short-term strategy in trading stocks. According to the Vietnam Association of Financial Investors, transactions carried out by individual investors account for up to 85 % of the total daily trading values, which is opposite to common situation in other countries. On the other hand, net purchases (specified lagged values), the real foreign cash inflows, do not associate with market returns. It is also worth noting that among three measures of foreign flows, gross sales are demonstrated to have more significant correlation coefficients which spread over three samples with market returns. As a result, it could be argued that Vietnamese stock market returns are most sensitive to selling information of foreign investors. Besides, two sub-samples give worthy results. It is shown from the tables that foreign flows (especially, gross purchases) correlate stronger with market returns in the second period when the general market went down and then partly recovered (there are more statistically significant coefficients and the F-statistic is also more significant in the second one).

3.2. *Granger Causality between Foreign Flows and Market Returns*

By analyzing correlation coefficients in unrestricted VAR models, the results can just come up with the relation between past foreign flows and market returns (correlation does not necessarily imply causation). In order to investigate the causality, Granger Causality Tests (pair wise versions) are employed for all measures of flows and in three samples. Actually, Granger Causality Tests are one of the helpful techniques to interpret VAR results. They also require users to specify lag-length. Consequently, the same lag-length used in VAR models is applied. Table 4 shows Granger Causality Tests for three types of foreign flows in the full sample. Theoretically, there are four possible results from Granger Tests: unidirectional cause from X to Y, unidirectional cause from Y to X, bilateral cause and independence, however, the causation running from past foreign flows to market returns is the paper's primary focus. Daily foreign gross purchases and gross sales are found to "Granger" cause market return (at 5 % level of significance) while there is not enough evidence for reject the null hypothesis that "Daily Net Purchases does not Granger cause Daily Return" in the full sample. Furthermore, it is found that the causality between foreign gross sales and market returns is unidirectional, that is, only gross sales "Granger" cause returns. Go back to what has been mentioned in the previous part, about price pressure effects. Since it is proven that changes in foreign gross sales are a source for changes in market returns in full sample, the price pressure effect shown by the reversal of VN-index returns in the previous part is confirmed more strongly. The finding is consistent with that of Pavabutr (2004) in Thai Stock Market.

Table 4: Granger Causality Tests of Foreign Gross Purchases, Gross Sales, Net Purchases and Market return (Full Sample-Daily)

Pair wise Granger Causality Tests
Sample: FULL SAMPLE_DAILY

Null Hypothesis:	F-Statistic	Probability
DAILY_GP does not Granger Cause DAILY_RETURN	2.17350	**0.02701**
DAILY_GS does not Granger Cause DAILY_RETURN	2.79847	**0.01041**
DAILY_NP does not Granger Cause DAILY_RETURN	0.70011	0.67205

As a result of Granger Causality Tests in full sample, it can be argued that changes in lagged foreign gross sales and gross purchases help explain changes in current market returns and therefore such flows can be used to help predict market returns in some stages in future.

On the other hand, there is no significant causation between three measures of foreign flows and VN-index returns in the case of two sub-periods (Table 5, 6).

Table 5: Granger Causality Tests of Foreign Gross Purchases, Gross Sales, Net Purchases and Market return (First Period-Daily)

Pairwise Granger Causality Tests
Sample: FIRST PERIOD

Null Hypothesis:	F-Statistic	Probability
DAILY_GP does not Granger Cause DAILY_RETURN	1.16815	0.31957
DAILY_GS does not Granger Cause DAILY_RETURN	1.61253	0.14169
DAILY_NP does not Granger Cause DAILY_RETURN	0.68219	0.68722

Table 6: Granger Causality Tests of Foreign Gross Purchases, Gross Sales, Net Purchases and Market return (First Period-Daily)

Pairwise Granger Causality Tests
Sample: SECOND PERIOD

Null Hypothesis:	F-Statistic	Probability
DAILY_GP does not Granger Cause DAILY_RETURN	1.35390	0.23957
DAILY_GS does not Granger Cause DAILY_RETURN	1.68732	0.12105
DAILY_NP does not Granger Cause DAILY_RETURN	0.47818	0.75179

Like the case of dynamic relation shown by VAR models, NO "Granger" causality running from net purchases to market returns is discovered, which could mean that Vietnamese equity market's returns are affected by foreign gross purchases and gross sales more strongly than the "true" cash inflows: foreign net purchases. That is inconsistent with some previous studies whose measures of foreign flows are net purchases scaled by market capitalization (Pavabutr, 2004, Foot et al., 2001). They all find the relation between net purchases and market returns in their samples.

3.3 Impulse Response Functions: How Does Market Returns Response to Shock to Foreign Flows?

After carrying out Granger Causality Tests and figuring out that foreign gross purchases and foreign gross sales "Granger" cause market returns, Impulse Response Function, another useful technique in VAR analysis, is used to investigate how VN-index returns react to shocks to foreign gross purchases and gross sales individually in the full sample.

Figure 1 shows visual illustration of the response and accumulated response in the whole period.

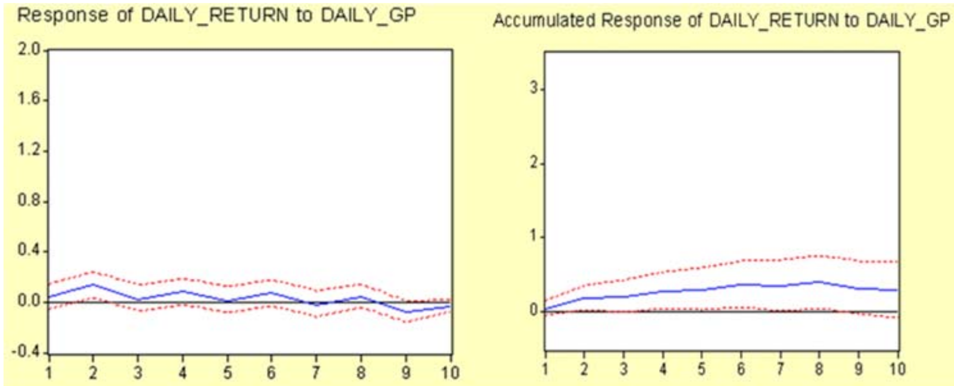

Figure 1: Response and Accumulated Response of Daily Market returns to Shocks in Daily Foreign Gross Purchases (Full Sample)

In general, the reaction of market returns to foreign gross purchases shocks is fluctuated over a 10-day period. Specifically, one standard deviation increase in gross purchases residual makes the current market returns (period 1 in IRF represents for contemporaneous response) go up by 0.043 units or 0.043 %, day 2's market returns will increase by 0.138 % which is the highest, the response of market returns on day 3 is down to 0.023 %, even though it is still positive, and then peaks to 0.08 % on the next day, etc., which indicates that the daily reaction is short-term and unstable. Actually, in VAR result Table 1, the correlation coefficients also experience the same thing but none of them (except lag 1 and 8) are statistically significant. The accumulated effect of the first 6 days is 0.37 %. The reaction is, however, negative on day 7, day 9 and day 10. The accumulated response after 10 days, therefore, is only 0.286 %.

As shown Figure 2 which describes responses of market returns to foreign gross sales shocks, there are some interesting points to be noted.

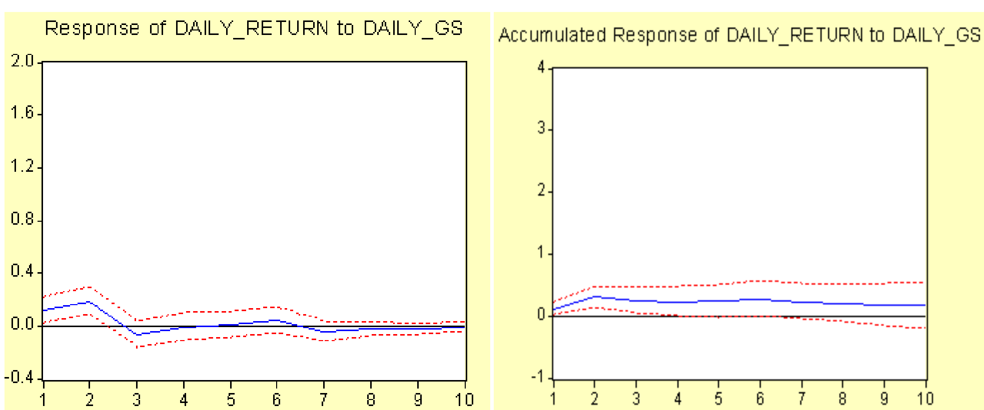

Figure 2: Response and Accumulated Response of Daily Market return to Shocks in Daily Foreign Gross Sales (Full Sample)

First of all, daily market returns react to foreign gross sales more strongly than to gross purchases on day 1 (contemporaneous response): increase by 0.1185 units (or %) compared with only 0.04 units. However, the figure is not as fluctuated as that of gross purchases. There is usually a reversal after 2 days.

In addition, the daily reaction weakens as time passes and not significant from day 4 on, which shows the short-term reaction of market returns. The strongest responses are on day 1 and day 2 with positive reaction at approximately 0.12 % and 0.18 % increase in daily market returns. However, returns on day 3 and 4 react negatively to a rise in foreign gross sales: reduce slightly by 0.066 % and 0.007%. Positive reaction is then found on the next two days and then market returns will go down for a rise in foreign gross sales in the remaining period (day 7 to day 10). The accumulated response after 10 days is 0.166 %, just over half of the accumulated reaction of market return to shock to foreign gross purchases.

4. Conclusion

As demonstrated in the paper, past foreign flows do have specific relationship and impacts on Vietnamese stock market returns. Both past values of daily foreign gross purchases and gross sales are demonstrated to have significant relationship with daily market returns. However, such relation is short-lived, mostly just in 1 or 2 days. Generally speaking, there is a positive link between yesterday foreign gross purchases as well as yesterday foreign gross sales and today market returns (except gross purchases in the first period). Moreover, a strong negative relationship is found between lag 2 of foreign gross sales and market returns in second and whole sample. Surprisingly, past foreign net purchases do not show any connection with stock market returns, demonstrating that Vietnamese equity market returns are affected by gross flows more strongly than by net flows which are the "true" cash inflows of foreign investors. Furthermore, among three measures of foreign flows, gross sales are found to have more significant correlation coefficients which spread over three samples with market returns. As a result, it could be argued that Vietnamese stock market returns are most sensitive to selling information of foreign investors. When it comes to Granger Cause then only gross purchases and gross sales in full sample are found to cause returns. Consequently, those two flows are applied in Impulse Response Functions and the results indicate that market returns response positively (10-day accumulated response) to a random shock to both flows even though there are individually negative reactions in some days.

It is found that both lagged values of daily foreign gross purchases and gross sales have a significant relationship with daily market returns. However, such relationship is short-lived and temporary, mostly just at lag 1 and 2. In addition, when running tests with weekly dataset, almost correlation coefficients of past weekly foreign flows and weekly returns are insignificant. This is inconsistent with those of Foot et al. (2001): "The majority of price increases do not occur over a short period of time, such as a few days. Prices seem to rise subsequent to inflows for a month or two" and Clark and Berko (1996) who find a statistically significant correlation between monthly foreign flows and market return in Mexico. Particularly, there is a POSITIVE link between yesterday foreign gross purchases, yesterday foreign gross sales and today return of VN-index (except gross purchases in the bull market from 26/10/05 to 15/10/07 when the positive connection is proved to be insignificant). On the other hand, there is a significant price reversal

(NEGATIVE) at lag 2 (the day before yesterday) of foreign gross sales which may indicate temporary price pressure effect like in Thai stock Market (Pavabutr, 2004). Surprisingly, no significant relation between past foreign net purchases and market return is discovered , which is not in line with some previous studies whose measures of foreign flows are net purchases scaled by market capitalization (Pavabutr, 2004, Foot et al., 2001). In addition, both past foreign gross purchases and gross sales are found to "Granger" cause market return in the full sample (from 26/10/05 to 16/03/11) and those two flows have a 10-day POSITIVE accumulated impact on return of VN-index.

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AN EMPIRICAL STUDY OF THE INFLATION HEDGING ABILITY OF GOLD FROM THE DEVELOPING COUNTRY: A CASE OF VIETNAM

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This study aims to examine the effectiveness of gold hedging against inflation in long-run in Vietnam over the period of January 1995 to July 2014. By applying a new and innovative technique – threshold co-integration test instead of linear co-integration test – to the relationship between Vietnam's gold price and consumer price index (CPI), the research figures out that gold does provide a complete hedge against inflation in long-run. However, the gold inflation relationship in long term is unstable. The linkage between gold and inflation is found to be non-linear co-integration. The results could benefit both Vietnamese monetary policy makers and investors who hold Gold in their portfolios. Moreover, in order to have a broader view on inflation- hedge of gold across SEA countries, the research also conducts studies on Thailand since the country has quite similar economic backgrounds with Vietnam.

1. Introduction

Investors now become more and more aware of excessive risks due to the unstable market caused by recent financial crises. As a result, they try to look for financial assets which not only can act as profitable investment assets but also are able to preserve themselves from unexpected events. Many popular financial assets such as real estate, government bond, oil, etc. no longer protect fully investors because of the unprecedented crises that the world is facing now. That brings back the interest in Gold, which was a financial asset that received little attention despite its historical role of being a standard of value in many countries' economy. Gold proved itself as a foundation stone of the international monetary system through the popular of the Gold Standard in the 19th century and the Bretton Woods system in the 20th century. Since the Bretton Woods system collapsed in 1971, Gold's role has diminished but still remained an important asset in the reserve holdings of many developed countries and now become an investment asset that attracts a lot of attentions from not only investors and authorities but also from researches. Many in depth studies have been done on the dynamics of gold price. Among them, the researches on the ability to hedge against inflation become the most controversial topic.

Indeed, almost studies on gold price have doing researches mainly on the U.S. During the 20th century, it is shown that there is the economic power shifts from U.S. toward fast growing emerging economies, especially in Asia. Furthermore, in these countries, the traditional mindset of gold as a store of value has existed for decades. Indeed, India, China, Indonesia, Thailand, Vietnam are always in top of gold consumer or producer countries according to World Gold Council. Hence, there is still a need to study this field in Asian countries.

In the case of Vietnam, the role of gold overall monetary policies and in stabilizing the economy is debatable. Vietnamese people consider gold as second currency and a safe haven of wealth for decades. The reasons for this can be explained by the history of Vietnam's economy that has changed from closed to open. In addition, the economic chaos in the 1980s has caused hyperinflation and prevalent distrust of the local currency. As a result, gold, U.S. dollar and other strong currencies have been used parallel to store wealth and conduct major transactions. The series of economic reforms named "DoiMoi", enforced in the second half of the 1980s, the faith of the Vietnam Dong was rebuilt to some extent but the usage of U.S. dollar gold still remains common until today (Siregar & Nguyen, 2013).

In summary, there seems to be a strong belief that gold can provide protection as a hedge or a safe haven against high Inflation. However, to the author's knowledge, hardly any studies has been done on these issues in Asian countries. While inflation has been the focus of many recent works, only one of them have explored the role of gold in hedging against inflation in the country (Le Long, De Ceuster, Annaert, and Amonhaemanon, 2013). On the other hand, this previous research applies the conventional technique which is regression model. Therefore, adopting the innovative technique of co-integration – threshold co-integration approach, this paper aims to examine the relationship between gold price and inflation in Vietnam. Strictly speaking, the research's framework allows for non-linearity, providing a useful measure of the effectiveness of inflation-hedging of gold. Moreover, in order to have a broader view on inflation-hedge of gold across SEA countries, the research also conducts studies on Thailand since the country has quite similar economic backgrounds with Vietnam. Besides, Thailand is also one of the major gold consumer country in the world.

2. Literature Review

In 1930, the theoretical study on the relationship between gold price and inflation was established by Fisher (1930). Fisher's hypothesis, generalized to other investment assets, implies that the expected nominal return on any investment asset expected to be equal to its real return plus the expected inflation rate. Shortly after, Fama and Schwert (1977) had carried out a study to examine the historical return on a numerous assets over the period 1933 to 1971 to explore which asset could have been used to protect investors' wealth against both expected and unexpected inflation. Their results confirmed only residential real estate was a perfect hedge against inflation but their works had inspired and opened a new field of research with plenty of techniques for following researchers.

Literature on the relationship between gold price and inflation has been through three stages of development.

(1) In the early stage, many empirical studies had attempted to justify the value of gold as an inflation-hedging asset through traditional techniques such as regression model, linear co-integration test or error correction models. The study conducted by Chua and Woodward (1982) is the first one testing gold's effectiveness as inflation hedge. By regressing nominal gold returns on both the expected and unexpected inflation, they conclude that gold can effectively hedge against inflation for the U.S., but not for the others. Mahdavi and Zhou (1997) apply co-integration and vector error-correction models (VECM) to the relationship and find no evidence of co-integration between gold price and CPI. Ghosh, Levin, Macmillan, and Wright (2004) take a more intricate technique by including endogenously determined structural breaks into model. The results indicate that there is a co-integrated relationship between gold and inflation for both post war period and since the 1970s. Later, by using the same technique, Levin, Montagnoli, and Wright (2006)expand the previous research to many countries and come to two critical findings. First, there is a stable long-run relationship between the gold price and the price level. Second, in the major gold consuming countries such as Turkey, India, Indonesia, Saudi Arabia, and China, gold acts effectively as a long-term hedge against inflation. In an effort to provide more significant evidence across countries, Tkacz (2007) discovers that gold price contains significant information for future inflation in several countries, especially in those that have adopted formal inflation targets.

(2) After those prior literature on the significant of this relation, it is debatable that conventional co-integration techniques are unable to prove the existence of a stable long-run relationship between gold and inflation since they ignore the noteworthy structural changes associated with the transition of gold from being the basis of the global monetary system to be treated as a commodity. Furthermore, except two major structural changes in gold price since the early 17th consist of the breakdown of Bretton Woods in 1973, oil price shocks in 1973 and 1979/1980, the relationship between consumer prices and gold prices also undergone several serious crises comprise the collapse of Soviet Union in 1991, the burst of the 'dot-com bubble' in 2001 and the recent financial and economic crises started in 2007. For those reasons, the traditional co-integration and VECM methodology seems to be too restrictive. As a result, in the beginning of 20th century, researchers around the world tried to compare and contrast these two techniques in their paper and argued which is the suitable one. Kyrtsou and Labys (2006) use cross-validation of the non-linear co-integration test (bivariate noisy Mackey-Glass Model) with linear co-integration test (VAR) on the U.S inflation and commodity prices. Worthington and Pahlavani (2007) provide evidence in favor of a co-integrating relationship between the price of gold and inflation and help to conclude that a gold investment can serve as an effective inflationary hedge. By applying three tests at the same time

(Johansen co-integration, Single equation error-correction model, Co-integration with structural breaks), Batten, Ciner, and Lucey (2014) show there is no co-integration between gold and inflation if the volatile period of the early 1980s was excluded from the data. Even though their research is not actually examining directly the relation between Gold price and Inflation, they contribute to the argument that linear test cannot provide an adequate result. Generally speaking, these above studies confirmed that ignoring such substantial changes in the relationship between variables could yield to the inability of proving the existence of a stable long-run relationship. Therefore, recent researches have developed a new advance testing method that focus on the possibility of existence of non-linear co-integration between two variables.

(3) The first study that seriously considers the possibility of non-linearity in the inflation hedging relation is provided by Wang, Lee, and Thi (2011). They argue that the existence of transaction costs and the business cycle dependence of the gold demand possibly result in a nonlinear relationship between consumer prices and gold prices. For that reason, they account for nonlinearity based on the threshold co-integration framework. In detail, they analyze the short-run and long-run inflation hedging effectiveness of gold in the USA and Japan for a sample period ranging from January 1971 to January 2010 by conducting two co-integration test: linear test proposed by Engle and Granger (1987)as well as the nonlinear threshold co-integration test suggested byEnders and Siklos (2001). The evidence demonstrate that a gold investment was able to hedge against inflation in the USA, and partially hedged against inflation in Japan. Due to their significant findings and innovative techniques, this research will mainly adopt their procedure to test the relationship in the context of Vietnam and Thailand. In addition, there is one research regarding non-linear co-integration test also need to added into the literature, which is the “Gold as an inflation hedge in a time-varying coefficient framework” of Beckmann and Czudaj (2013). Even though their research does not completely turned into non-linear co-integration test, they already applied the Bi-variation co-integration test and Markov switching vector error correction model (MS-VECM) approach. They conclude that gold is partially able to hedge future inflation in the long-run and this ability is stronger for the USA and the UK compared to Japan and the Euro Area. The advantage of using the non-linear model also is found in describing the dynamic of other connections, for instance, Gold and Dollar (Capie, Mills, & Wood, 2005), Purchasing Power Parity (Heimonen, 2006), Stock Price and Dividends (Esteve & Prats, 2010), Gold and The Yen (Wang & Lee, 2011).

In conclusion, the empirical evidence of the relationship between gold and inflation worldwide is still controversial. Theoretically, most of previous studies supported this relationship. That is, the price of gold tends to move in the same direction and positive correlation with CPI. When inflation occurs, gold will become "safe haven" for investors. However, recent empirical evidence also suggests that this relationship is not clear and sustainable; gold is not completely hedge against inflation. This relation depends very much on place and time the study surveyed. Thus, the questions here are not only on does gold act as an inflation hedge, but also on how well it is. Besides, the previous approaches of authors are varied and different. Recent researches have put efforts on discovering new techniques in attempting to reflect more accurately the nature of this relationship. For that reason, this paper wants to adopt the new testing method of Wang et al. (2011) to present further asymmetric impact on the relationship between CPI and gold prices in long term in Vietnam.

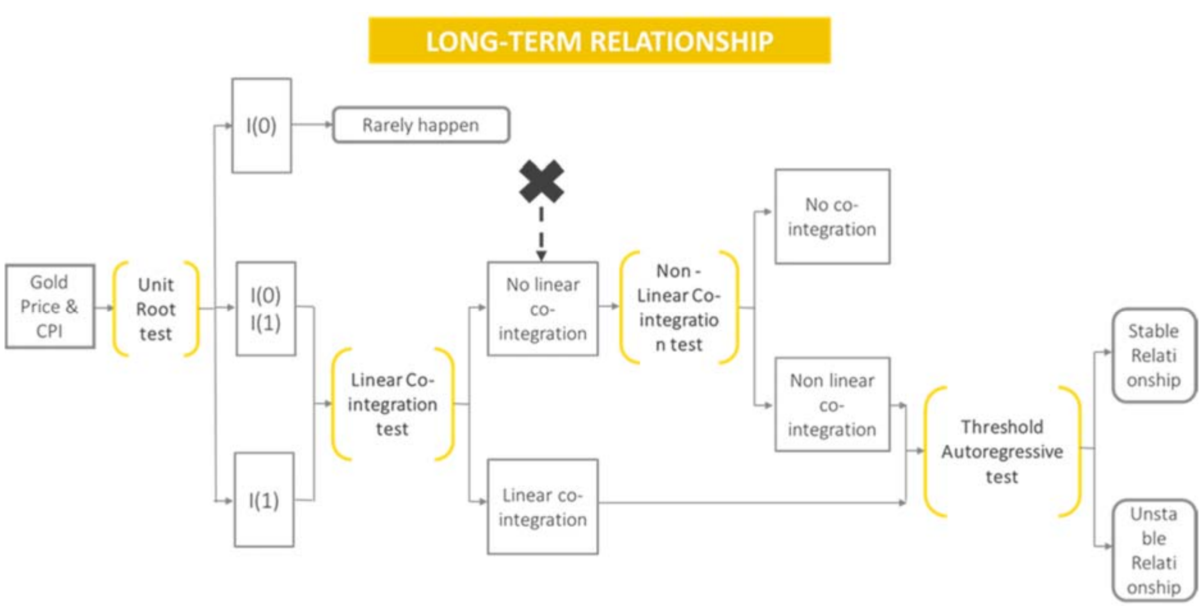
3. Data & Methodology

3.1. *Data collection*

To understand the inflation hedge ability of gold in Vietnam, monthly data of gold price from World Gold Council (per ounce denominated in Vietnam Dong) and CPI from International Monetary Fund (IMF) over the period of January 1995 to July 2014 are used for analysis. The monthly data of Gold Price published in the newest report called World Gold Council Value Research & Statistics Database on 22nd September, 2014 are used. It presented the price of gold per ounce denominated in Vietnamese Dong based on the London PM Fix. The source for CPI is monthly Vietnam CPI from International Financial Statistics of International Monetary Fund (IMF). From the report, the year 2010 was chosen as the index year. The sample period is also from January 1995 to July 2014, which yields 245 observations. Raw data from above sources will be processed appropriately depends on the applied models. First of all, they all will be transformed into natural logarithms.

3.2. *Methodology*

The paper examines long-term relationship between two variables by using both linear and non-linear techniques. The conclusion will be on the ability of gold in hedging against inflation in the long-run. The unit root test is applied first to the log of gold prices and CPIs. When the variables meet the precondition of integrated at the same level, the Engle and Granger linear co-integration test is applied next. Then, to allow for asymmetric adjustment, Enders and Siklos non-linear co-integration test is used to check for stable non-linear relation.



3.2.1 Unit root test:

In applied econometric, most statistical testing method are under assumption of the stationary series.

Because with the properties (means, variances and co-variances) that did not change over time, the data would be easy to predict, and hence, can be modeled and forecasted. On the other hand, the outcomes achieved from the non-stationary series can be spurious since they may indicate a relationship between two variables that does not exist.

As a result, there are a lot of tests which is called unit root test to check whether these variables are stationary or non-stationary. The most common and basic unit root test is the Dickey – Fuller test (Dickey & Fuller, 1979). However, comparing different results from different tests is always a good idea to avoid any bias from the tests and also takes advantages of all kinds of them. Therefore, four testing methods will be applied in this research to identify whether the series is I(1) – integrated in first order – which is most economic data should be or I(0) – stationary. They are Augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1979), Phillips-Perron test (Phillips & Perron, 1988), Dickey Fuller Generalized least squares (GLS) test (Elliott, Rothenberg, & Stock, 1992) and NP-MZ_α(Ng & Perron, 2001).

The tests applied to the natural log of gold price and CPI. The null hypothesis H0 of all tests is having unit root (non-stationary) against the alternatives of stationary series. The equation contains both constant and time trend. The optimal lags are selected according to Akaike information criterion (AIC).

Nevertheless, it is noticed that most economic and business data, particularly financial time series data (such as inflation, macroeconomic indicators, GDP, exchange rate, etc.) are far from stationary, especially in their original units of measurement (Nelson & Plosser, 1982). Therefore, the term "co-integration" was coined to capture the possibility of the existence of long-term relationship between economic series. Two or more variables are considered to be co-integrated when first, all of them have to be integrated in the same order (d), which means it is stationary after differenced "d-times".(Ghosh et al., 2004).

3.2.2 Engle and Granger linear co-integration test

To study the long-run relationship between gold price and CPI, the research uses the concept introduced by Engle and Granger (1987).

According to the research of Wang et al. (2011), the long-run relationship regression between Gold price and CPI is given by:

$$g_t = \theta_0 + \theta_1 p_t + e_t \qquad (1)$$

whereg_t represents for the log of gold price, $p_t$is the price; $\theta_1$is the hedging coefficient that denotes how well gold investment could hedge against inflation or the cross-price elasticity between gold price and CPI and e_t is the error term.

To perform stationary test on the residuals, Engle and Granger used ADF test on following regression with different critical value by MacKinnon (1991):

$$\Delta e_t = p e_{t-1} + \varepsilon_t \qquad (2)$$

whereε_t is the white – noise disturbance.

If the residuals is stationary, there is a linear co-integration between two variables, which means a significant long-run relationship between them. If not, we cannot found any linear co-integration between CPI and Gold Price. However, the standard co-integration framework in equation (2) is misspecified if the adjustment process is asymmetric. For that reason, Enders and Siklos (Enders & Siklos, 2001) proposed the asymmetric (nonlinear) adjustment model to capture the possibility of non-linear co-integration. These tests will be used in this research for the same purpose.

3.2.3 Non-linear co-integration Enders and Siklos test

Due to the drawbacks of linear co-integration test, Enders and Siklos (2001) extended the Engle and Granger (1987) methodology by taking into account asymmetric adjustment. The proposed adjustment models were called the threshold autoregressive (TAR) model and the momentum threshold autoregressive (MTAR) model:

TAR is given by the equation:

$$\Delta e_t = I_t p_1 e_{t-1} + (1 - I_t) p_2 e_{t-1} + \varepsilon_t \qquad (3)$$

Where I_t is the Heaviside indicator such that $I_t = \begin{cases} 1 \ if \ e_{t-1} > \tau \\ 0 \ if \ e_{t-1} \leq \tau \end{cases}$

While MTAR is given by the equation:

$$\Delta e_t = M_t p_1 e_{t-1} + (1 - M_t) p_2 e_{t-1} + \varepsilon_t \qquad (4)$$

$$M_t = \begin{cases} 1 \ if \ \Delta e_{t-1} > \tau \\ 0 \ if \ \Delta e_{t-1} \leq \tau \end{cases}$$

The coefficients p_1 and p_2 represent the different speeds of adjustment for the deviations from the long-run equilibrium. τ is the threshold value, which is unknown and estimated by a search method as proposed by Chan (1993). The TAR model imparts an abrupt non-linear behavior depending on whether the error-correction term is above or below the threshold value, while the MTAR model allows different behavior depending on whether equilibrium deviations are rising or falling. In both models, to test for threshold co-integration, the φ statistic using a non-standard F-statistic is applied first. The null hypothesis of the first test is no co-integration, H_0: $p_1 = p_2 = 0$. The critical value are tabulated in Enders and Siklos (Enders & Siklos, 2001) for both TAR and MTAR specifications. If the null hypothesis is rejected, the next test using a standard F-statisticH_0: $p_1 = p_2$ is implied to check the symmetric or asymmetric adjustment in long-term. Combining both the results of two tests, we will get the final conclusion on the non-linear relationship between gold price and CPI in long-term, which are:

- If the null hypothesis of the first test (no co-integration) is rejected and the null hypothesis of symmetric adjustment of the second test is not rejected, the long-term relationship with symmetric adjustment is recognized. The Engle and Granger model is supported.
- If both null hypothesis is rejected, the threshold co-integration is founded, meaning that the long-term relationship with asymmetric adjustment is recognized. The Threshold Vector Error Correction Model can be applied next to test for short-run.
- If the null hypothesis of the first test is accepted, there is no co-integration between two variables.

4. Empirical results

4.1 Unit Root Test

The results are presented in Table 1. In general, almost all unit root tests reveal that two series are integrated of order one (1). To avoid spurious outcome, the co-integration analysis is conducted next.

Table 1. The result of Unit Root Test[1]

The result of Unit Root Test											
Vietnam	**Level**	**ADF**			**PP**			**DF-GLS**		**NP-MZ**	
		Statistic Value	**p_value**	**Lags**	**Statistic Value**	**p_value**	**Bandwidth**	**Statistic Value**	**Lags**	**Statistic Value**	**Lags**
	LNG	-2.132627	0.5245	2	-2.067319	0.5608	4	-0.825813	2	-1.34529	2
	LNCPI	-1.663489	0.7641	13	-0.994318	0.9417	8	-1.089357	13	-3.1423	13
	First difference										
	ΔLNG	**-11.2255*****	0.0000	1	**-13.5632*****	0.0000	4	**-11.2550*****	1	**-142.83*****	1
	ΔLNCPI	**-3.780174****	0.0193	12	**-9.78560*****	0.0000	5	-1.481512	12	-2.33707	12
Thailand	**Level**	**ADF**			**PP**			**DF-GLS**		**NP-MZ**	
		Statistic Value	**P_Value**	**Lags**	**Statistic Value**	**P_Value**	**Bandwidth**	**Statistic Value**	**Lags**	**Statistic Value**	**Lags**
	LNG	-2.132627	0.5245	2	-2.067319	0.5608	4	-1.675022	2	-5.83283	2
	LNCPI	-3.415507	0.0518	2	-3.097124	0.1094	5	-1.436407	1	-4.48157	1
	First difference										
	ΔLNG	**-11.40989*****	0.0000	1	**-13.51338*****	0.0000	4	**-11.10044*****	1	**-141.663*****	1
	ΔLNCPI	**-10.64494*****	0.0000	0	**-10.68101*****	0.0000	2	**-10.65683*****	0	**-102.846*****	0

4.2 Engle and Granger linear co-integration test

[1] Note: The tests are applied to the natural log of gold price and CPI. The null hypothesis H_0 of all tests is having unit root (non-stationary) against the alternatives of stationary series. The equation contains both constant and time trend. The maximum lag applied is 17 periods as followed the previous research of Wang et al. (2011). The optimal lags are selected according to Akaike Information Criterion (AIC). Four methods include Augmented Dickey-Fuller test (ADF), Phillips-Perron test (PP), Dickey-Fuller – Generalized Least Squares test (DF-GLS), Ng and Perron (NP-MZα)

Table 2. The result of Linear Co-integration Test

Engle–Granger Co-integration test and Co-integration parameters				
Vietnam	**Dependent Variable**	**θ0**	**θ1**	**ADF Test on residuals**
	LNG	**7.896827*****	**1.929461*****	-1.855161
	P-value	0.0000	0.0000	0.6744
	R^2	0.958598		
Thailand	**LNG**	**-5.436157*****	**3.441181*****	-3.043881
	P_value	0.0000	0.0000	0.1227
	R2	0.918231		

The regression equation gives the first look at the relationship between Gold price and Inflation in long-term. θ1 = 1.929461 for Vietnam tells us that when CPI rises 1%, the gold price in Vietnam dong rises 1.929%, showing the complete inflation hedge of gold. In contrast, θ1 = 3.441181 in Thailand tells us that when CPI rises 1%, the gold price in Bath rises 3.44%, showing the complete inflation hedge of gold in both countries. However, both series are non-stationary, which might lead to spurious problem. Thus, to get the most reliable economic relationship between two variables, the co-integration will be employed by testing the stationary of residuals.

The results displayed in table 2 suggest the absence of linear co-integration between Gold price and CPI in Vietnam because we cannot reject the null hypothesis of unit root (p-value = 0.6744). The similar result is explored in Thailand. The insignificant of ADF test on residuals tells us that there is no linear co-integration between Gold price and Inflation in Thailand as well.

4.3 Non-linear co-integration Enders and Siklos test

Table 3. The result of Non-linear Co-integration Test

	Model	N of lags	$H_0: p_1 = 0$	$H_0: p_1 = p_2 = 0$	τ (tau – Threshold value)	$H_0: p_1 = p_2$
			t-Max	Φ		F-equal
Vietnam	TAR	14	-0.914066	6.319635	0.173862	8.382464
	MTAR	14	-0.962327	6.124746	0.032502	8.000346
Thailand	TAR	2	-1.49232	4.424558	0.180446	0.754726
	MTAR	2	**-1.831807****	4.464834	0.035147	0.832524

The results summarized in table 3 uncover the null hypothesis of no co-integration (H_0: p_1= p_2=0) can be rejected at 10% level of significance in TAR model. The study continues to employ the second test for null hypothesis of stable non-linear long run relationship to assess whether the adjustment to the long-run equilibrium is symmetric (H_0: p_1= p_2) or asymmetric (H_1: $p_1 \neq p_2$). The F-value equals 8.382464, significance at 5% level, suggests asymmetric adjustment for Gold price and CPI in long-term in Vietnam

To sum up, in the test of co-movement towards the long-run equilibrium between gold price and CPI, the outcomes suggest non-linear co-integration or asymmetric adjustment between two variables. In the case of Thailand, the results from the similar testing procedure is inconsistent with the results from Vietnam. The non-linear relationship is significantly only in one test t-Max ($H_0 : p_i = 0$) in MTAR model. Consequently, there is no significant evidence of the presence of the non-linear co-integration between gold return and inflation in Thailand.

5. Discussion

As found in the previous section, the results seem to support the assumption that gold should be effective in hedging against inflation. However, a deeper look into the gold price and data of Vietnam during the last ten years will probably request us to be more prudent before jumping into the conclusion that gold's effectiveness in hedging against inflation should be the same in different time-frames: short-term vs. long-term consideration.

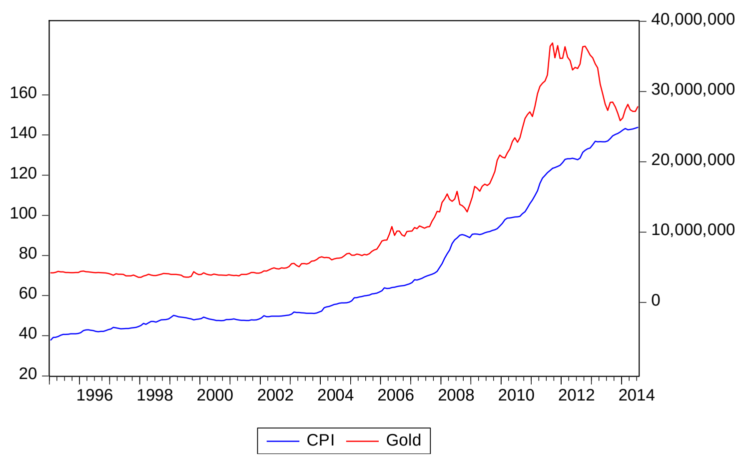


Figure1.The trend of Gold Price and CPI in Vietnam from 1995 – 2014

Figure 1 illustrates that both gold price and CPI are on an upward trend, especially during the 2007 financial crisis, both increase significantly, indicating the possibility of inflation hedging of gold in Vietnam. However, gold price experiences more fluctuation than CPI over the period. While gold price reached to its highest peak at around 36 million VND in September 2011 before decline in 2012 and 2013 due to government's controlling action, CPI kept on increasing steadily. This might affects the hedging ability of gold, especially in short-term.

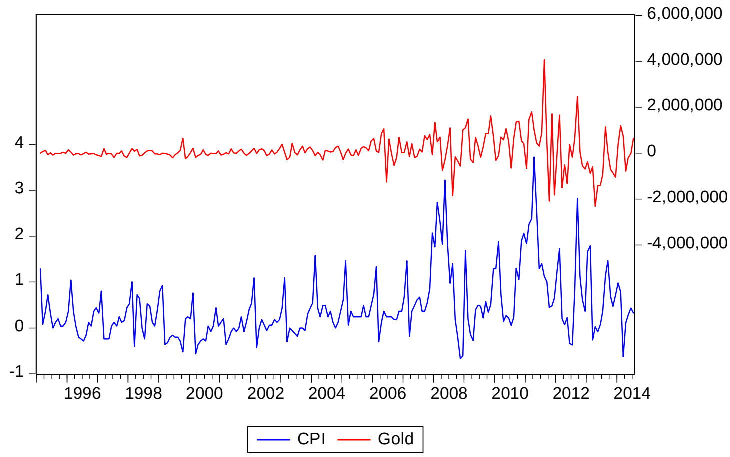


Figure 2: **The volatility of Gold Price and CPI in Vietnam from 1995 – 2014**

Figure 2 shows that there is a wide gap between the movement of CPI and gold price, which implying the possibility of different short-run adjustment between gold price and CPI.

In short, Fig.1 exhibits that the relation between gold price and CPI in Vietnam might exist the long-run trends. Meanwhile, fig.2 illustrates the presence of price rigidity in short-run. Hence, the analysis process should go further by composing two sections to verify separately long-term and short-term relationship.

6. Conclusion

In general, the findings of this research support the argument that gold is an effective tool for hedging inflation in long run from developed countries such as United State or Japan, to developing countries such as Thailand or Vietnam. However, the relationship can vary from country to country and usually be unstable. For instance, the relationship between gold price and inflation in Vietnam is found to be stronger than that in Thailand, implicitly showing the gold investment behaviors in Vietnam is more crucial than that of neighboring country.

This study contributes to the existing literature in a number of ways. Firstly, most previous studies took a developed countries perspective like the U.S or Japan. By investigating the inflation hedge capacity of gold investment for a developing country, where financial market is much less developed and other inflation hedge assets are less available, the study provides valuable international evidence. Additionally, although Ghosh, Levin, Macmillan, and Wright (2004) claimed that holding gold as an inflation hedge is more adequate for investors in developed countries, Vietnam raises a special case study since gold is used publicly and to the same extent as the national currency (VND) for the aims of saving, payment and transactions. In additions, regarding to the reaction of the government and citizens before and during the plunge of economy from 2005 till now, the gold price in Vietnam fluctuates in a unique way, making the complicated but interesting literature for other countries, especially in Asia.

Secondly, gold return – inflation relation reflects the extent to which gold is popular in the economy relative to the fiat money and other investment assets. Thus, the study may partially help Vietnam's authorities in formulating and implementing effective monetary policies and also other macro policies to utilize the capital resource accumulated in gold. Finally, it is expected that the result of this research is to be of interest to investors as well. The findings of the study suggest an up-to-now strategy for investors who are considered to include gold in their portfolio. The evidence of inflation hedge ability of gold allows investors have a better asset portfolio and reduce the loss caused by inflation.

However, this study also has some limitations. Firstly, available monthly data of 19 years does not actually bring enough convincible to the results. This will be an evitable limitation of this research. However, it covers almost the up and down period of Vietnam’s economic. Hence, the empirical results hopefully still have practical meaning. Secondly, the outcome might not reflect fully the fluctuation of Gold Price due to the complexity of the economy. Many economic variables effect on each other while the research focus only on two variables Gold Price and Inflation. For further research, it is worth investigating how efectiveness of gold hedging against inflation changes in short-run as the relationship between Gold price and CPI in Vietnam is not stable, proposing some interesting outcomes when investing the linkage between gold price and inflation in short run. Morever, it is interesting to have more comprehensive comparision the ability of gold in hedging against inflation between developed and developing countries.

Appendix A. Vietnam

Lag length selection:

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1122.005	NA	1.15e-07	-10.30419	-10.24189	-10.27903
1	1157.020	68.73907	8.63e-08	-10.59005	-10.46544*	-10.53971*
2	1160.925	7.594407	8.63e-08	-10.58917	-10.40227	-10.51367
3	1165.264	8.357456	8.61e-08	-10.59229	-10.34308	-10.49162
4	1167.565	4.389251	8.74e-08	-10.57663	-10.26512	-10.45079
5	1168.357	1.496779	9.01e-08	-10.54707	-10.17325	-10.39606
6	1171.240	5.394250	9.10e-08	-10.53677	-10.10066	-10.36060
7	1173.265	3.751750	9.27e-08	-10.51857	-10.02015	-10.31723
8	1174.339	1.969293	9.53e-08	-10.49160	-9.930881	-10.26509
9	1175.022	1.241424	9.83e-08	-10.46104	-9.838014	-10.20936
10	1175.609	1.054858	1.01e-07	-10.42958	-9.744255	-10.15274
11	1180.203	8.171872	1.01e-07	-10.43505	-9.687428	-10.13304
12	1199.061	33.19698	8.80e-08	-10.57199	-9.762065	-10.24482
13	1217.222	31.63499	7.73e-08*	-10.70251*	-9.830277	-10.35016
14	1217.734	0.882471	7.99e-08	-10.67036	-9.735828	-10.29285
15	1218.724	1.687694	8.22e-08	-10.64262	-9.645782	-10.23994
16	1219.560	1.409411	8.47e-08	-10.61345	-9.554315	-10.18561
17	1225.611	10.09480*	8.32e-08	-10.63236	-9.510919	-10.17934

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

The optimal lag for research's model is 13 - significance in first two reliable test.

Threshold value γ estimation

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1122.005	NA	1.15e-07	-10.30419	-10.24189	-10.27903
1	1157.020	68.73907	8.63e-08	-10.59005	-10.46544*	-10.53971*
2	1160.925	7.594407	8.63e-08	-10.58917	-10.40227	-10.51367
3	1165.264	8.357456	8.61e-08	-10.59229	-10.34308	-10.49162
4	1167.565	4.389251	8.74e-08	-10.57663	-10.26512	-10.45079
5	1168.357	1.496779	9.01e-08	-10.54707	-10.17325	-10.39606
6	1171.240	5.394250	9.10e-08	-10.53677	-10.10066	-10.36060
7	1173.265	3.751750	9.27e-08	-10.51857	-10.02015	-10.31723
8	1174.339	1.969293	9.53e-08	-10.49160	-9.930881	-10.26509
9	1175.022	1.241424	9.83e-08	-10.46104	-9.838014	-10.20936
10	1175.609	1.054858	1.01e-07	-10.42958	-9.744255	-10.15274
11	1180.203	8.171872	1.01e-07	-10.43505	-9.687428	-10.13304
12	1199.061	33.19698	8.80e-08	-10.57199	-9.762065	-10.24482
13	1217.222	31.63499	7.73e-08*	-10.70251*	-9.830277	-10.35016
14	1217.734	0.882471	7.99e-08	-10.67036	-9.735828	-10.29285
15	1218.724	1.687694	8.22e-08	-10.64262	-9.645782	-10.23994
16	1219.560	1.409411	8.47e-08	-10.61345	-9.554315	-10.18561
17	1225.611	10.09480*	8.32e-08	-10.63236	-9.510919	-10.17934

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

The estimated threshold value is identified at 0.036096 (Appendix A).

Appendix B. Thailand

Lag length selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	1216.760	NA	4.79e-08	-11.17751	-11.11521	-11.15235
1	1231.660	29.24935	4.34e-08*	-11.27797*	-11.15336*	-11.22763*
2	1235.310	7.099597	4.35e-08	-11.27475	-11.08784	-11.19925
3	1236.579	2.443103	4.46e-08	-11.24957	-11.00036	-11.14890
4	1239.728	6.007777	4.50e-08	-11.24173	-10.93022	-11.11589
5	1239.792	0.120736	4.66e-08	-11.20545	-10.83164	-11.05445
6	1244.957	9.665009	4.61e-08	-11.21620	-10.78008	-11.04002
7	1247.544	4.792332	4.68e-08	-11.20317	-10.70476	-11.00183
8	1254.778	13.26727	4.54e-08	-11.23298	-10.67226	-11.00647
9	1259.293	8.198060	4.52e-08	-11.23772	-10.61470	-10.98605
10	1259.920	1.125897	4.66e-08	-11.20663	-10.52131	-10.92979
11	1265.645	10.18445	4.59e-08	-11.22254	-10.47491	-10.92052
12	1273.431	13.70659*	4.44e-08	-11.25743	-10.44750	-10.93025
13	1274.989	2.713231	4.54e-08	-11.23492	-10.36269	-10.88257
14	1276.821	3.157265	4.63e-08	-11.21494	-10.28040	-10.83742
15	1278.461	2.796324	4.74e-08	-11.19319	-10.19635	-10.79051
16	1279.552	1.840942	4.87e-08	-11.16638	-10.10724	-10.73853
17	1280.432	1.467011	5.02e-08	-11.13762	-10.01618	-10.68460

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

Threshold value γ estimation

Variable	Coefficient	Std. Error
Above Threshold	-1.294080	0.112729
Below Threshold	-0.930445	0.110491
Differenced Residuals(t-1)	0.114920	0.064684
Threshold value (tau):	0.035680	
F-equal:	7.873732	
T-max value:	-8.421005	
F-joint (Phi):	78.134020	

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URBAN DEVELOPMENT THROUGH LAND-BASED INFRASTRUCTURE FINANCING: CASES IN HO CHIMINH CITY

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We identify several varieties of land-based financing for infrastructure projects that would be relevant for Ho Chi Minh City, Vietnam. In our typology we compare several international projects and three cases in Ho Chi Minh City to highlight lessons based on project completion and the financial burden to the city government. We find that the city can apply different models based on several factors such as: its ability to manage land clearance, alignment of incentives between investment partners, and revenue collection related to infrastructure development.

Introduction

Ho Chi Minh City (HCMC), Vietnam is undergoing rapid transformation in its urban design and infrastructure. A large amount of capital is required for urban development in coming years. The city government, however, is facing difficulties in mobilizing capital for such high demand. The irony is that while the city has significant land holdings and with values that have been appreciated strongly thanks to infrastructure improvement for the last two decades, land-based infrastructure financing is still uncommon. This is surprising considering that many other developing cities around the world have used some sort of land-based financing. Internationally, land-based financing techniques have been used most heavily during periods of rapid urban growth and large leaps in the scale of urban development. For example, the massive municipal infrastructure investment in China over last 15 years has been financed in large part by converting land assets into infrastructure.[1] However, land-based financing is often but not always the case. If the investment is poorly designed and generates few benefits then the land value appreciation will fall short of the investment cost.

Basically, there are two categories of land-based financing for infrastructure including: (1) Land acquisition-based financing and (2) non-land acquisition-based financing. In the former, land (areas are usually bigger than the need of infrastructures) will essentially be recalled, then infrastructure will be built on it and the surrounding land will be sold, leased or exploited to cover the investment costs. This strategy based on land price appreciation has its disadvantages. It is captive to real estate market fluctuations, and it is limited by the availability of land. It raises opposition from residents of land to be acquired, making the process of resettlement and compensation very expensive for the government. In the latter model, governments will build infrastructure on land and impose some types of taxes or fees to capture portion of land or property appreciation thanks to infrastructure improvement to cover investment costs. This model can solve land acquisition problems prevalent with the previous model, and it may work for cases extremely difficult in recalling land. However, even non-land acquisition-based financing of infrastructure is can be vulnerable to a hostile legal or political environment. It is not easy to have a right level of tax or fee, and opposition to taxation may be difficult to surmount. Increases in taxes and fees to serve new development usually are not in favor with voters.[2] Moreover, this technique requires a well organized administrative system that includes accurate information on land uses and effective tax collection.[3]

[1] Peterson (2009, p. 23&83)
[2] Altshuler and Gomez-Ibanez (1993, p.3)
[3] Peterson (2009, p.19)

This paper discusses options by using the land-based financing model for HCMC in raising necessary funds and implementing infrastructure development. In the first section, we review the experiences in other countries and highlight several lessons. In the second section, we examine three prominent cases in HCMC including: the Phu My Hung new urban area project, the Thu Thiem Peninsula urban development project, and the Tan Son Nhat – Binh Loi – outer ring road project. Hereafter, we abbreviate these projects as Phu My Hung or the PMH project, the Thu Thiem project and the TSN-BL project, respectively. We apply several questions: "What are key factors that made some cases successful while others not?" and "What are the implications for HCMC (in particular) and other places in applying land-based financing?" The final section will address implications and related issues in applying the land-based financing techniques.

Section 1. Financing Modes from International Experience

In principle, governments have the responsibility in creating infrastructure for public use. In many cases governments simply build infrastructures through their general budget. However, especially in rapid expansion periods when the demand of infrastructure is very high, public money may be not sufficient. Other solutions need to be considered.

One solution, value capture financing, relies on the relationship between increased property values and local improvements in infrastructure. Allowing governments to capture just some of the value of in property appreciation could help pay for infrastructure such as transportation network improvements.[4] For these reasons, land-based infrastructure financing has become a popular model around the world. Even though landowning regimes differ between countries (as well as between municipalities), governments have been able to tap land-based financing techniques to support rapid urban growth. In China and Vietnam, for example, land belongs to the state while in Columbia significant amounts of land are held by private interests. Given these differences, particular strategies have helped jurisdictions raise funds where their general revenues are not sufficient or feasible.

In the land acquisition-based model, the public sector usually takes ownership of land and associated use rights and then sells, leases, or trades some of the land to finance capital projects. The public sector may construct infrastructure improvements itself and thereafter exploit the value of the surrounding improved land, or it may engage private entities to build such projects in exchange for land upfront. In the non-acquisition based model, governments build infrastructure and impose taxes or fees on beneficiaries to cover investment costs. The underlying theory for policies that impose taxes on land improvement is to recapture some of the "unearned increments" in land value that private landholders enjoy from public investment in infrastructure services.[5]In addition to tax and fee, user charges, in many cases, are another suitable financial tool to recover costs for infrastructure services like electricity, telecommunications and water where it is relatively inexpensive to meter use and send bills accordingly. Characteristics of each technique will be discussed more specifically in the following discussion and many of the concepts are heavily borrowed from Peterson (2009).

Land Acquisition Based Financing

Selling land to pay for infrastructure is enticing because of its advantage in raising huge resources in a relatively short period of time. However, a major requirement for the government is that it must take control of land before it can monetize or transfer it to private developers. Moreover, determining the

[4]Walder (2003)
[5] Peterson (2009, p.71)

value of land to be transferred for private developers as well as the allocation of ownership in the joint venture mode is a challenge for this model. We discuss types of the acquisition-based model below.

Transfer land to private developers in exchange for infrastructure

Transferring land to developers, through swaps, sales, or leases has been a common method for infrastructure development. The intercontinental railroad system in the US was mainly built through this model more than a century ago. In exchange for each mile of track laid, the US federal government granted railroad companies 20 square miles of surrounding land.[6] In this case, railroad companies made huge profits from land in addition to operating the railroad systems and the longest and costliest railroad system was built without any financial burden for the US government.

A similar ongoing story in Alexandria, Egypt involves the transfer of 3,360 hectares in 2005 to a private developer by the Alexandria Company for Urban Development in return for the developer's provision of basic infrastructure. The private company will install internal infrastructure and some external infrastructure and as part of the deal, the investment company also will supply the New Urban Communities Authority with housing for low-income households, equal to 7 percent of total development costs. The investment cost of this project was \$1.45 billion, more than 50 times total urban property tax collection and equal about 5 percent of total national government revenue.[7] However, the project has currently run into trouble because the land was directly given to the company by the Ministry of Housing instead of through a competitive bidding process.[8]

In these schemes, transfers to private developers usually involve land that is directly improved by the infrastructure project. The enhancement in nearby property values becomes an important incentive for private investors to provide external infrastructure. This is in addition to the value that comes from internal infrastructure to a development area, which is commonly supplied by private developers. Meanwhile, from the public perspective, the positive benefits for the wider community from improved external infrastructure comprise a major justification for land transfers to private parties.

The main benefit of this model is that governments may receive a large amount of up-front resources for other projects or purposes while necessary infrastructure is still built. Moreover, they does not have to bear the financial burdens and risk as it does in engaging in joint ventures to build the infrastructure or by building infrastructure itself and then sell surrounding improved land.

However, this mode presents a couple caveats especially for developing countries. First, it is not

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[6] Terry Cox (2003)
[7] Peterson (2009, pp.60&104) and World Bank (2006, vol.2, p.60)
[8] https://www.zawya.com/story.cfm/sidZW20100623000134/Court%20Ruling%20Does%20Not%20Cancel%20TMG%27s%20Madinaty%20Deal-Egypt%20Minister

always easy to have competitive and transparent bidding, and it is not easy to decide a reasonable price or volume of land that developers would get in exchange of a certain infrastructure. Second, land clearance may face considerable trouble from either of two situations. If the land clearance process is conducted by the government before land is handed over to private developers, there may be a lack of incentives to implement the process quickly and decisively. Otherwise, if the land clearance process is conducted by the private investor, there may be a lack of experience and expertise in dealing with local citizens and authorities. In the two cases in the US and Egypt mentioned above, the process was workable because the land clearance was simple. Third, public skepticism may haunt such projects when private developers (especially foreign investors) rake in huge profits. Moreover, enforcements for private investors or developers to build committed infrastructure instead of mainly or even merely focusing on exploiting given land is one of critical issues. Some of these problems are illustrated more clearly in the second section with the TSB-BL case of HCMC, Vietnam.

Engage in joint ventures to build the infrastructure

Forming a joint venture to build infrastructure is one way to invite private participation in infrastructure without totally relinquishing ownership of land use rights. This model is popular in many countries. Experiences from China and India are mentioned below.

In China, because all urban land is owned by municipal governments, selling land for value capture in improved properties has been a dominant strategy for infrastructure development. The Chinese government has engaged the private sector to build and to finance infrastructure in exchange for land use rights. In the case of the construction of the six-lane outer ring road around Changsha the Hunan Provincial government used a joint venture -- the Ring Road Corporation-- to build the highway. With the projected cost at $730 million, the government paid nothing out of pocket for the highway, and instead transferred development and land use rights to 3,300 hectares of land to the joint venture.[9]

The developer's revenue from selling leasing rights from this land was enough to cover half of the investment cost for the highway, and the rest was borrowed from the China Development Bank and commercial banks with the informal guarantee of the municipal government through "comfort letters." The underlying implication was that the government would transfer additional land to the Ring Road Corporation in the event that it could not meet its debts. The result was that the highway was built and financed as planned.

Another case of a joint venture to build and operate a new airport is Bangalore International Airport in India. To build a green field airport with $490 million investment cost, the government represented by the Karnataka State Industrial Investment and Development Corporation ventured with domestic

[9]Peterson (2009, p.67)

private partners and a consortium led by Siemens and Unique Zurich. The government contributed 3,850 acres of land, in which 2,000 acres were devoted to the airport, and $87.5 million and in return it received a 26 percent interest of the joint venture. The result was that the airport was built on time and on budget.[10]

In building big infrastructure projects, there are usually two main issues: (1) dealing with local residents in the land clearance process and administrative procedures with local authorities; and (2) financing. The advantage of the joint venture model is that it utilizes the different strengths of public and private parties. Private partners have: the incentive and motivation to manage projects so that they are on time and on budget; the ability to mobilize huge amounts of capital in short periods of time; and access to creative means for resettling residents, sometimes through informal methods. The advantage of public, local partners is their extensive knowledge of and skills in dealing with local politics and administrative issues. This solves the second problem of the first mode mentioned above.

However, similar to the exchange of land for infrastructure above, the joint venture still faces problems of identifying the value of land and the appropriate allocation of shares to partners. Just as in the land transfer mode, public opposition or anger may arise when private partners, especially foreign investors, earn huge profits. In addition, as relatively long-term instruments for land financing, joint ventures face a chronic problem of contract incompleteness.[11] Ambiguity in the contract terms can deter the joint venture mode. Moreover, this mode may be subject to moral hazard in the case that the government guarantees (formally or informally) the borrowing of the joint venture.

Pros and cons of the joint venture model will be illustrated more concretely in the Phu My Hung new urban case that will be described in the second section.

Build infrastructure and sell surrounding improved land

A traditional mode of infrastructure development for urban growth is for the public sector to install needed infrastructure and then to sell serviced land to developers. This is an old procedure used to finance infrastructure investment. Baron Haussmann in 19th century Paris had already used public confiscation of property to build new roads and to sell the resulting higher-valued, improved surrounding land to pay back city debts. However, due to protest of landowners this model was abolished when the courts ruled that excess land acquired by the city for road construction, but not used for actual public works, had to be returned to the original private owners—not at its increased land value after public improvements had been completed, but at its original acquisition price. Around the same time as Haussmann's Paris project, New York City purchased large tracts of land in the path of city expansion and then sold the land at great profit when water mains, sewers, and transportation

[10] Peterson (2009, pp. 69&70)
[11] Milgrom and Robert (1992)

improvements were installed. To finance these activities, both Paris and New York borrowed huge amounts of money and adopted the associated borrowing risks for their municipal governments. As shown in these examples, the build-sell mode has been popular for a long time, and today it is still popular in many countries.[12] Modern implementations can be seen in Egypt and India.

In Egypt, for example, the government legally owns all rural desert land while the private sector owns much of the developed urban land. As cities have grown, the government has installed the infrastructure to support new developments and sold this serviced land to help repay the costs. The New Urban Communities Authority (NUCA), the agency responsible for making these investments, made huge outlays in Egypt's program to expand new cities, spending US$12.7 billion for infrastructure over 435 square km of land. The problem with this strategy, however, is that the government had not been able to recover its costs through land sales after installing the supporting infrastructure. The price for serviced land had been set by an administrative formula that did not reflect market prices. As a result, the NUCA's New Cities program had not reached its growth targets by 2005, partially because infrastructure development had been poorly targeted and concentrated in areas of low demand.[13]

In the Bangalore International Airport case, there were two main components. First, the investment on 3,850 acres of land was undertaken by joint venture to build the new airport. Second, the government also retained 400 acres near the airport site and intended to sell this land at auction, and in the process capture the land value increases from the airport. The proceeds from the land sale were intended to finance a new highway connecting Bangalore with the new airport.

However, the public land-sale component of the project has broken down. Due to resistance and legal challenges from landowners, the government could not proceed with its full plan for land sale. Instead, some land may be given to government agencies for office space development and other facilities may be built to lease to private operators instead of selling the land outright. Moreover, opposition from farmers over the land acquisition process has led the state government to say that it "will return an eighth of an acre of airport land to farmers for each acre of land that was originally acquired."[14]This has ended up as an in-kind betterment tax, details of which will be discussed later.

The land acquisition process for the airport land was fairly smooth because all land belonging to the joint venture had been cleared before the construction and land price went up. In contrast, 400 acres have not been cleared yet due to disputed and bureaucratic land acquisition procedures, and a lack of responsibility and public capital. The lack of clear rules and transparency in land acquisition became

[12]Peterson (2009, pp. 17&18)
[13] World Bank (2006)
[14]Peterson (2009, pp.69-71)

a detriment to public accountability. Landowners became resistant to compensation rates that were backed by compulsory enforcement and untied to market prices.

A variation of the build-sell strategy is possible where municipal governments have high value or "golden land" in urban areas. It is easy to sell such land in order to raise large amounts of funds. For example, in Mumbai, India the Mumbai Metropolitan Redevelopment Authority, for 13 hectares of land "in just two land auctions, in January 2006 and November 2007, [it] was able to generate Rs50.8 billion (approximately US$1.2 billion) from the sale of small land parcels in Bandra-Kurla."[15] Similarly, in four years (2001-2004), HCMC received about $400 million or 15% of the city budget through selling land and building in the city downtown.[16]

The advantage of this technique is its simplicity for the government when it builds infrastructure by itself. It does not have to engage private partners to invest in the land until after construction is completed. Therefore, the process of initial land valuations and structuring agreements may be simpler than other modes. However, it faces other serious problems. First, the public financial burden can be a big issue. Government budgets usually do not have enough funds for such investments. Either formally or informally they must borrow money to finance projects and rely on land value appreciation. This, of course, creates huge risk for municipal budgets. Second, the compensation process can take a long time while land prices continue to rise, causing dispute and unrest by landholders. The political implications for such projects can be huge, making the government reluctant and extremely careful in the land clearance process. Furthermore, the incentives and motivations for public servants to clear land swiftly are limited compared to the joint venture scenario where performance incentives and resources from private investors may expedite land clearance. As we discuss below, this is one of main problems of the Thu Thiem project in HCMC.

Non-land Acquisition Based Financing

In most cases, building infrastructure is a mandate. However, in many cases it is too costly or impossible for governments to take land to finance necessary infrastructure. In these cases governments can still build or manage infrastructure construction through private contractors and raise the required funds through imposing several types of taxes or fees to recover investment costs. Exactions may be in-kind or financial.[17] These models include: betterment levies, sale of development rights, developer exaction and impact fees.

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[15]Peterson (2009, p.91)
[16]Rosengard et al (2006, p.26)
[17]Altshuler and Gomez-Ibanez (1993, p.3)

Betterment levies

A betterment levy captures part of the land-value gain attributable to infrastructure investment by imposing a one-time tax or charge on the land-value gain.[18] The conceptual justification behind the levy is that the appreciation in property value that results from infrastructure development is an unearned increment, at least some of which should be allocated to the provider of the infrastructure. The argument for a betterment levy also rests on the phenomenon that some landholders benefit more than others from improved infrastructure. For example with public transit systems in Washington, DC or Newcastle in the UK properties near transit appreciate faster than properties farther away.[19]

Two types of betterment levies have been applied in Columbia. First, valorización (the particular term for this tax in Columbia) required the government to recover 140% of estimated infrastructure costs through the levy. This also includes 30% added for administrative costs. However, this model failed because it was expensive and difficult to implement and leading to numerous legal disputes over land value gains. Aftermath Columbia's capital, Bogota, has used a special version of valorización with some flexibility. Additional factors have been used to adjust the tax. Different tax rates have been set for industrial and residential use; high-income and medium-income use; relative proximity to infrastructure improvements; and a 5-year repayments period. The result is that 217 public works projects were financed using this method from 1997 to 2007 amounted to US$1 billion.[20]

Bogota's experience has been quite successful against legal challenges because the city does not claim to have a strict formula. Additionally, the tax is spread over the whole city, so public resistance has been minimal. However, the troubles of Poland and Australia in implementing betterment levies also warn of the difficulties that come with this type of taxation. The main problems of administration in assessing the rise in property value and the political conflict that emerges from applying such new taxes were enough to cause Szczecin and Sydney to cancel their betterment levies.[21]

The disadvantage of common betterment levies is that landowners have to pay taxes in cash, moreover. This may get trouble when an economy is in downturn. For example, during the Great Depression of the 1930s, a large number of homeowners in the US were unable to pay their special betterment levies.[22]Payment in-kind can help resolve this issue. Private owners can contribute their land to the public to build infrastructure, receiving back a certain proportion of their land once improvements are completed. The betterment levy in-kind has been common in both developed and developing countries such as the US, Japan, South Korea, Egypt and India.[23]

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[18]Peterson (2009, p.37)
[19]Transport Research Laboratory (1993) and Walmsley and Perrett (1992)
[20]Peterson (2009, p. 61)
[21] Peterson (2009, p. 39)
[22]Altshuler and Gomez-Ibanez (1993, p.8)
[23]Altshuler and Gomez-Ibanez (1993, p.8) and Peterson (2009, p.59)

Sale of development rights

A strategy used in São Paulo, Brazil for financing infrastructure development has been the sale of development rights. São Paulo has been able to sell the right to add floor space beyond normal densities in order to finance public works as approved by law. "Solo criado," as these development rights are referred to, requires developers to pay for additional floor space above the normal limit. There is a pre-determined fee for each unit of floor space added, and moneys that are raised are held in a special fund with investment uses restricted by law.[24]

The Faria Lima Urban Operation was one such campaign to utilize development rights to finance improvements to infrastructure, including streets, drainage, open space, and social housing. Since the project began, reported land values rose from $300/sq m to $7,000/sq m after public investments. Rather than charging a betterment levy on land-value gains, the government sold development rights for 2.25 million sq m of floor space with the 410 ha development area. Over implementation, development rights have been sold for as much as $630 per sq m of allowed floor space. As of 2005, this has raised a total of $190 million from development rights.[25]

One factor needed to be carefully considered is that the base development allowed is not too expensive to service and that the amount charged for increases in development covers the incremental cost of serving that added development.

Developer exactions and impact fees

Impact fees are designed to charge developers the market cost of the infrastructure expansion their development projects will necessitate. This concept has the economically desirable quality of charging users based on the marginal cost of development, or the value of the negative impact on infrastructure as well as externalities that comes with a development project.

Chile is one country that has demonstrated use of impact fees. As in many other countries, municipalities in Chile are not allowed to take on debt. In the 1990s, two municipalities in the Santiago metropolitan region turned to impact fees to finance and to build external road infrastructure for new land developments. As this method was successful for these two municipalities, impact fees were also used to support Chacabuco Province to the north.

Chacabuco needed to add housing for 40,000 new households to be built on agricultural land without existing urban infrastructure. In its case, the impact of new housing developments on the roads (62 km of planned radial highway and other roadways) was estimated to be $106 million. The national government became the responsible party for collecting the fees from developers for two reasons: the

[24] Froes and Robelo (2006)
[25] Peterson (2009, pp. 76-7)

municipal governments did not have enough capacity; and the developments spanned across multiple municipal jurisdictions.

In its original vision, the formula derived the impact fee from several factors: location relative to the existing road network, project size, socioeconomic status, and estimated travel demands. Flexibility was introduced into the program by allowing lower income households to be exempt from the development impact fee. Of the money collected, US$25 million would be paid to the concessionaire and the rest to the government. For the average housing unit, this amount collected was about $1,600. The government agreed to finance 39% of infrastructure development costs while the impact fee would cover the rest.

According to Peterson, this worked in Chile because: planning capacity in these municipalities was advanced compared to other developing countries; regulatory controls over land-use were effective; and market principles were incorporated into infrastructure (e.g. toll roads). However, this mode of impact fees has not spread widely throughout Chile, probably because the national government is not as financially constrained as the local governments, and therefore there is less need to implement development impact fees.

Institutional issues with impact fees may also be the cause for their limited implementation. Developers resist the fees (as organized groups) because they cannot always recover the fees from customers. Furthermore, the benefits of these fees are distributed across the communities with no single party to defend them. Politically, these policies are also difficult to implement because they essentially raise costs to landowners while the uses of raised funds may not be transparent.

All these types of taxes and fees including the betterment levy, development fee, and impact fee are more common in developed countries, partially because of the administrative capacity to record land values and to implement tax collection.

In short, the advantage of non-land acquisition-based techniques is that they avoid troubles of land acquisition. However, it is very difficult to value improvements for each parcel of land in monetary terms. To implement this model, a transparent and competent administrative system is required. In addition, the taxes or fees that are imposed from infrastructure development projects may find resistance from the public or organized groups of developers. From that point of view, it is important to allow some flexibility as in the case of Bogota's betterment levies and Chacabuco's impact fee.

Section 2. Land-based financing cases in Ho Chi Minh City

Land-based financing has been applied in Vietnam in general and HCMC in particular for a long time. However, most of the cases are the land acquisition-based financing. For non-land acquisition mode, though several techniques have been introduced and applied, the result is still modest. There are at least two reasons causing this problem: (1) impractical (or at least unreasonable) regulation such as the fee for land conversion from agriculture land to commercial or industrial land is based on productivities of agriculture products instead of appreciation of land value or investment costs; and (2) the complication of these techniques. Due to the lack of information and uncommon of non-land acquisition-based financing model, this section only analyzes the land acquisition-based through all three modes: transferring land to developers for infrastructure; joint venture with developers; and government-led building of infrastructure and sale of improved land with three cases including Phu My Hung, Thu Thiem and TSN–BL projects.

Phu My Hung New Urban Area

Twenty years ago, PMH was only a swamp area seven kilometers from the downtown of HCMC to the south and one of the poorest regions of the city, but it now becomes one of the most coveted residential areas in Vietnam, and is used as a national model for urban development.[26]From almost nothing, the price of a square meter of land is about US$4,000. The price of a 100 square-meter apartment is roughly $150,000 and equivalent to 150 times of Vietnam's GDP per capita or 60 times of HCMC's GDP per capita in 2009. While private developers are almost wholly responsible for the planning and construction of PMH, the city benefited from its development by receiving a ten-lane roadway (as well as other infrastructure) as part of the development. Interestingly, this is a rare case which was built successfully through land-based financing in Vietnam.

The process

PMH is one of the first examples of land-based financing projects since Vietnam's reunification in 1975. It was part of a larger scheme by HCMC to develop an area to the south of the city (Saigon South) including three main projects: Tan Thuan export processing zone (EPZ), PMH area and Hiep Phuoc industrial park in which Tan Thuan EPZ was built first.

The concept of developing the Saigon South was not yet completed from the beginning. It was started from the initiative to build EPZs and has been evolved over time. In the late 1980s, when Vietnam was only beginning its transition to the market economy, the market economy was a new and strange

[26]http://www.forbes.com/global/2008/0929/024a.html

concept for many people. The political environment had barely begun the policy of stimulating foreign investment into Vietnam. Considered as the cradle of the market economy in Vietnam, HCMC was at the forefront of the liberalization process. Due to the unique context that might cause high potential of risk, the HCMC government hesitated to lure foreign business enthusiastically and foreign investors were wary of the idea of investment in Vietnam, however. The initiative to build EPZs to attract foreign investors and promote exports was originated from intellectuals belonging to a group of high ranking officials and closely watched individuals related to the former Saigon government led by Phan Chanh Duong.[27] In 05/1988, this group conducted *the study of building EPZ in HCMC* and it was put in the list of *the pilot programs to develop foreign economic development in the period of 1989-1995 of HCMC*.[28] On 10/24/1989, the Tan Thuan EPZ program, a quasi-government agency and state-owned enterprise without capital was established and Mr. Phan was appointed the director of the program. The main constraint was that due to the duplication of programs, this program only got implicit support of some municipal leaders including the top one instead of an official program of the city.

After painstaking efforts with many memorandums as well as rejections, Mr. Phan finally found a group of investors from Taiwan seeking oversea investment opportunities.[29] In the early 1950s, these investors had seen the Taiwanese economy encounter a situation similar to Vietnam's situation in the 1990s. Taiwan was among the first countries having EPZs. Using their experience with EPZs, these investors recognized the opportunities for Vietnam to grow through its export sector.[30]

The result of the negotiation between the two partners, the HCMC government and the Taiwanese investors, was to establish a joint venture to build a 300 ha EPZ at Tan Thuan, a site along a peninsula toward the South of Saigon's core. The scheme was in fact bigger than an EPZ because it would also include a 17.8 km road to connect the EPZ to the National Highway 1 (the backbone transportation route of Vietnam).[31] In addition, the idea for PMH was conceived during the negotiation process between the government and the Taiwanese partners.[32] Due to the circumstances, two projects, the Tan Thuan EPZ and the PMH urban area project have been built sequentially through land-based financing by which the city government contributed land and Taiwanese partners contributed material, equipment, cash and expertise. Investment costs would be covered from leasing land in the EPZ and exploiting (sales of leasing rights or building apartments to sell) land surrounding the road.

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[27] Vo (2005, p.32), Nguyen, et al (2006, vol.1, pp.65-6, and IPC (2001, p.2).
[28] See the announcement No 30/TB-UB dated 03/07/1989
[29] Interviewed Mr. Phan
[30] Interviewed Albert K. Ting, a son of Lawrence S. Ting
[31] See the Tan Thuan joint venture contract and the proposal numbered 4712/UB-ĐN, dated 09/30/1992 of HCMC's people committee
[32] According Mr. Vo Tran Tri, the city's secretary or top leader at that time, the initiative to build Tan Thuan EPZ was originated from Viet Nam and Taiwanese partners echoed it while the initiative to build Nguyen Van Linh Road and PMH was the initiative of Mr. Lawrence S. Ting and Phan Chanh Duong (see Vo, 2005).

To build the EPZ, the city government established Industrial Promotion Corporation (IPC) as the Vietnamese company to venture with its foreign counterparts[33] that were led by the Central Trading and Development Corporation (CT&D), a Taiwanese company in which the Kuomintang (KMT) initially held a 75 percent stake.[34] The Tan Thuan Corporation was thus formed as a joint venture in which IPC, on behalf of the city government, contributed 300 ha of land to own a 30 percent interest and CT&D contributed financing and expertise to own 70 percent. The investment license of the Tan Thuan EPZ was officially issued by Vietnam's government in July 1991. This joint venture was successful in building and operating the EPZ. From 1993 to 2009, manufacturers had invested more than US$1 billion and employed 60,000 people.[35] It was rated as the best industrial zone in Asia by Euromoney's Corporate Location Magazine.[36] As of 2008, its annual exports were valued at about US$1 billion.[37]In terms of size, Tan Thuan EPZ was even bigger than the aggregate area of three EPZs in Taiwan which contributed about one eighth of Taiwan's total export manufacturing product.[38]

After the EPZ was constructed, the 17.8 km road was next. To build the road (later to be named Nguyen Van Linh Road), 970 hectares of land was reserved for land acquisition-based financing: 220 ha was for the road; 600 ha was for a second joint venture to exploit to cover the investment under a 50 year lease; and the other 150 ha with complete infrastructure was to be transferred for public use. The maintenance cost of the road would be covered by road toll collection. Basically, HCMC would exchange 600 of land for a ten-land road and 150 ha of infrastructure-built land. The total investment cost of the whole project was estimated at US$242 million with $79 million for the road, and $29 million for the 150 ha of land.[39]

Table 1: Estimated Project Investment Costs at 1993

Construction	Area (ha)	Cost ($million)
17.8 km of 10 lane road	220	79
Reserved land for the joint venture	600	119
Infrastructure for HCMC government	150	29
Clearance cost	970	15
Total	*970*	*242*

Source: The PMH joint venture documents

[33]PanViet was also a part of this group but later sold its equity share for 5%
[34]http://tuoitre.vn/Chinh-tri-Xa-hoi/49484/Ong-Lawrence-STing-da-chiu-ap-luc-gi.html
[35]Nguyen et. al. (2006, vol.1, p. 223)
[36]http://ttc-vn.com/about/
[37]http://www.forbes.com/global/2008/0929/024a.html
[38]This number was taken from the interview with Albert K. Ting
[39]See the proposal of HCMC's people committee to the government dated 09/30/1992

To build the project, another 70-30 joint venture, the Phu My Hung Corporation, was established with $60 million equity (charter capital). IPC, on behalf of the city contributed the land to the venture, and in return it received a 30 percent interest valued at $18 million. CT&D contributed $42 million with equipment, material and foreign currency.[40]

The results

With the land for the road and about 300 ha has been handed over to the joint venture, in 2007, the 10 lane road was finished on time. This is a rare case of timely road completion in Vietnam. The road has become a key transportation route in the south of Saigon with thousands of vehicles traveling every day. Moreover, after nearly 2 decades from the initial idea, a modern urban area has been created. PMH has become one of the most desired places to live for many people in Vietnam.

Besides the road and other benefit, in terms of the city budget, the PMH project appears to be a good investment for the city government. Even in 1993, the city received a sizable share of the venture for its land contribution. Each hectare of swampland it transferred to PMH was valued at about $30,000 worth of shares.[41] This value is even higher than the land that the Karnataka government used to build the new Bangalore airport joint venture, where one hectare at the 2005 prices was around $23,000.[42] Moreover, from 1998 through 2009, the government received about half of a billion US dollars (about two-thirds of which came from VAT and income taxes, and one-third from earnings of its 30 percent share of the joint venture). The city budget has received about 60 percent of the pre-tax income from the PMH Corporation joint venture. This is not to mention the benefits of housing for thousands of residents and infrastructure improvements in roads, telecommunications, electricity, water, and sewer systems, especially the Tan Thuan EPZ, Hiep Phuoc industrial park and power plant which have played as the nucleuses of the development of the South of Saigon.

Moreover, the 970 ha of land above are actually spotted over an area of 2,600 hectares instead of just one piece of land. Therefore, the benefits of the development serve the wider South Saigon area, and not only the land within the official boundaries given to the PMH Corporation. The success of PHM has also created positive impacts for residents and businesses in HCMC and travelers on the road.

Besides successes, there have also been disputes and concerns. Even though the city received a good deal financially, public opponents still complain that foreign investors have been earning too much

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[40] See the investment license

[41] In the joint venture contract, it was written that the land contributed to the joint venture was "clean" land. This meant that the city had to take responsibility for the land clearance by its own cost estimated at $15 million and the government would only net $3 million for the 600 ha. An important point to note, however, was that CT&D assisted the compensation for residents by providing IPC with a loan of $15 million interest free. This allowed HCMC to have a 30 percent stake in the PMH Corporation without any financial contribution.

[42] Peterson (2009, p.70)

money, and that Vietnam should have a larger share. As the result, the tax policy was changed in 2004 to retain more profits for Vietnam. Another controversy relates to the actual land given for PMH so far. According the investment license and the joint venture contract, 600 hectares of land would be transferred to the joint venture. However, up to now the joint venture has only received 300 hectares.[43] The possibility that the joint venture will receive the rest of the land is uncertain.

Risk taking

An important aspect in this case is the risk taking by key individuals and organizations in the project. On Vietnam's side, this was the first time Vietnam would give a large area of land to a foreigner, albeit an investor, after fierce wars to protect the land of Vietnam. It was a divisive controversy in terms of ideology and politics. Moreover there was no institutional experience to guide the city in its joint venture or in its regulatory role. On the foreign investors' side, it was indeed very risky to invest into such a country at the time. In fact, many investors had turned down the opportunity until CT&D came forth. The question is why HCMC's leaders agreed to support the project and why the Taiwanese investors dared to invest millions of dollars?

First, the implicit supporting system helped to alleviate the risk for Vietnam's side. As we know, Vietnam's economic reforms with Doi Moi (innovation) in the late 1980s called for market-based initiatives across government. However it had been particularly risky for civil servants and politicians to experiment with new ideas especially related to foreign investment. It was difficult to get explicit support from leaders. Moreover most government officials did not have much knowledge of the market economy. However, it was possible to get their implicit support because if an initiative became successful those informally supporting it would claim credit and could stay away unsuccessful cases.

If everybody had acted as above, nothing would have been done. To make the business worked, someone had to take risk. Fortunately, the HCMC government had such risk taking cadres. The political context in Vietnam at that time was complicated and those relating to the former regime of the Saigon government were considered suspect. However, some of the intellectuals and high ranking officials were given limited assignments in at least two groups to provide advice for the new municipal government. For these people it was a rare chance for them to use their knowledge. Therefore they had much useful advice and contribution, playing a critical role in helping Vietnam to deal with mistakes of the central planning model.[44] The plan to build an EPZ was among the recommendations of these groups. The proposal was put into pilot projects of the city and those writing this proposal were given approval by some leaders of the city to implement it as mentioned.[45]

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[43] Interviewed Mr. Phan and Mr. Ting Jr.
[44] Dang Phong (2008 & 2009)
[45] Nguyen et. al. (2006)

Second, due to the extremely high risk, CT&D's ownership structure is a critical factor. CT&D was in fact a company established in 1989 by Taiwan's Kuomintang (KMT), the ruling party, to seek overseas development opportunities. The Central Investment Corporation (CIC- KMT) owned 75 percent of the company while the rest belonged to three private shareholders of which Chairman Lawrence S. Ting, a Columbia University graduate, a 20-year veteran of China Gulf Plastic and a son-in-law of a Finance Minister of Taiwan, owned 10 percent. One overarching reason for KMT overseas development opportunities was the uncertain international political position of Taiwan at this time especially considering its relationship with China.[46] It was, therefore, understandable for KMT to spend some money in such high risk projects because not only was it for financial purpose, but also for political and national security reasons. However, due to the political change in Taiwan, the KMT completely pulled out its investments at CT&D in late 1994 even though by then it had invested $97 million in Vietnam.[47]

Moreover, that much of CT&D's initially financing came from the KMT is also important. [48]The investment by CT&D raises the question of whether this was an example of a principal-agent problem, where the agent absorbed more risk than the principal preferred.[49]At least initially, the financial risks in these projects were counter-balanced by KMT funding. However, after some time deeper analyses of the investments were conducted. Further information about the investment and its environment reduced the risk for the project significantly. KMT funding for CT&D was eventually removed, but by that time the managers of CT&D became even further convinced of the projects' potential, investing more of their own money after some of their initial perceptions of risks had been dispelled. This is similar to the prior to and aftermath of the process that a green-field project was implemented.

Factors made the success of the project

Nguyen Van Linh Road, the new 17.8 km road, was built on schedule along with establishment of a modern urban area. Many factors made this case successful. PMH is a good example of how the joint venture works well using the strengths of private as well as public partners. In this land acquisition-based financing example, the partners came to a relatively tenable agreement written into the basic joint venture contract. The Vietnamese partner took charge of dealing with local issues such as the

[46] Interviewed Mr. Phan

[47]http://tuoitre.vn/Chinh-tri-Xa-hoi/49484/Ong-Lawrence-STing-da-chiu-ap-luc-gi.html and http://www.lawrenceting.com/

[48] There is an argument that the equity was only a small proportion of the total liabilities and equity and the customs in Taiwan that the chairman of a company traditionally takes unlimited responsibility of debt guarantee. However, this may not always be the case. Moreover, there is a dispute about this characteristics even in this case (see: http://tuoitre.vn/Chinh-tri-Xa-hoi/49484/Ong-Lawrence-STing-da-chiu-ap-luc-gi.html)

[49]Theoretically, proving that there is no principal-agent problem would require demonstrating that the same decision would be made regardless to the ownership structure of the company.

land clearance process and the administrative and paper procedures related to Vietnamese authorities from the central to local governments. The foreign partner took charge of financing and technical as well as management issues.[50] The expertise and experience of the staff who were truly knowledgeable about their localities in land clearance and other processes combined with the availability of capital financed by foreign partners created a system of strengths and incentives for the clearance process to be done quickly and decisively.[51] Each partner has executed its role well. Moreover, the road has had a significant impact on the accessibility of PMH and the quality of life of residents (and therefore its land prices). Both the government and investors have also seen competitive returns on their investments in the PMH Corporation.

Besides these features that might be more universally applied to other projects, there are some unique factors that helped the success of PMH including: the relatively low cost of resettlement; professional leadership by Mr. Phan Chanh Duong and Mr. Lawrence S. Ting; and the distribution of risk.

First, the relatively low cost of resettlement borne by the HCMC government and the resettlement process was quite favorable. Of 970 ha of land, most of land was vacant swampland, so there were not many people occupying the land. Therefore, to clear the land for PMH and related infrastructure development, the cost to the city was only $15 million, or about $1.5/sq m. Several factors allowed the resettlement costs to be this low. First, the swampland of PMH was considered unfit and risky for development when compared to other areas around HCMC. Second, private real estate development was a new concept in post-war Vietnam. Reclaiming land for private development was a new process, and there had been few, if any, precedents indicating that resettling residents from the South Saigon area should command a significantly higher cost.

The compensation price was based on a formula mainly incorporating agricultural yield, and there were not many large buildings to be cleared. For example, the rice yield of a good crop was 3 ton/ha. The value of a ton of rice was about a million VND or US$90 at 1993 price. Calculated for 30 years of production, the value of a hectare of rice land was about $8,000. Including the value of buildings and structures on the land, the average compensation price of a hectare was only about $15,000/ha.[52] This price is very cheap compared to the current cost in Thu Thiem, about $2 millions/hectare. Moreover, PMH was not recognized as a potential residential area twenty years ago. It was not in the city's master plan[53] and not many people believed that it would be successful.[54] Landholders at the time did not perceive the value of their land to be very high. Therefore it was relatively easy for the

[50]See the joint venture contract, article 12
[51]Nguyen et. al (2006, pp. 151-60)
[52]Ibid
[53]See the 1993 and 1998 master plan
[54]Interviewed Mr. Phan

city and the joint-venture to recall a large area of land.[55]

Second, the role of individuals was important. Mr. Phan Chanh Duong and Mr. Lawrence S. Ting played important roles. In the initial years, Mr. Phan and his colleagues had to deal with a wide range of issues to convince the city government to allow them to experiment with this project and to connect with the Taiwanese investors who would eventually invest in Vietnam. Since coming to Vietnam, Mr. Ting had introduced many new ideas for Vietnam. With the Tan Thuan and PMH projects, Mr. Ting prioritized job creation and ample living space. He led CT&D to develop PMH without deviating much from the award-winning master plan designed by Skidmore Owings Merrill. He resisted the urge for opportunism, for example, by avoiding building extra floors or removing green space. Furthermore, Nguyen Van Linh Road remains one of the largest (being 12-lanes in some sections) and modern corridors in Vietnam's road network. Although PMH has had its challenges, it is widely recognized as one of the best urban areas in Vietnam.

Third, the finances and incentives available to the PMH project were very favorable. It was rare for the city to receive special access to $22 million in loans with free interest from CT&D for land clearance and initial issues. As analyzed above, it was the like-venture capital and the money of an organization, so that the managers of the PMH project felt at liberty to employ the capital for more venturing uses.

While the joint venture mode of land acquisition-based financing can suffer from prolonged challenges of ambiguity and disagreement, it can also facilitate long-term incentives for commitment between partners as a remedy for contract incompleteness. In the case of PMH, the joint venture presented an investment vehicle for the principals of the government (IPC) and the foreign investor (CT&D) where there were unproven intentions of good faith. The PMH Corporation permitted the resolution of ongoing issues regarding good faith and administrative barriers in the investment climate. Therefore, when the investments were made, the partners possessed the necessary space and time to execute on their good faith. The act of the private investors led by Mr. Ting investing their own capital (after the withdrawal of the KMT from CT&D) is one such result of risk reduction from the long-term partnership with the HCMC government. On the Vietnamese side, Mr. Phan and his colleagues had strong motivations to implement the PMH project successfully because this seemed to be a rare chance to demonstrate their value. Moreover, the partnership embodied in the PMH Corporation was a motivating force behind the government's liberalization of policies regarding land use rights. For example, at the time the contract was signed between IPC and CT&D, foreign individuals were not yet allowed to own land-use rights. However, after the commitment in the PMH Corporation and persistent bargaining between CT&D and different government agencies (as well as

[55]Nguyen et al (2006, p.)

other important political actors), foreign ownership of land use rights finally became law.[56]

Troubles of the project

As with any venture, there were also problems in the PMH project. Difficulties confronting PMH were: disputes regarding appropriate shares and profits in the joint venture; opposition in the land clearance; motivation in building and maintaining the road; and the underlying ambiguity of the concession contract.

First, a major controversy with the story of PMH is with CT&D which owns 70% of PMH Company. The perception that PMH is making enormous profits has attracted lots of negative attention from the press and political interests. The government, naturally, has also tried to increase the pressure on PMH to pay more in taxes, and probably make other sacrifices, in order to satisfy its political constituency but also to the city secure a "fair share" of the returns. For example due to the ambiguity of Vietnamese regulation over a decade, in 2004 the government decided to increase the income tax rate from 10 percent to 25 percent for PMH Corp. This caused a big dispute in 2004 but PMH still has to pay at the new rate, eventually. Moreover, there is a severe dispute between the PHM corporation and its clients in paying tax of transferring the land use rights now.

In the PMH case, even though HCMC received a majority of the profits from the project and the net benefits seem to have been very positive, it has not been easy for the city and those participating in the deal to avoid criticism that city assets were sold too cheaply. Because there was no competitive and transparent bidding (in some sense CT&D was the only interested investors in the project), the PMH project becomes an easy target. This is a fundamental problem of the land acquisition-based financing mode. Land valuation, especially in an uncompetitive environment, is typically a controversial issue.

Second, politically, the land compensation and resettlement process for PMH faced its own problems. The process took many months to complete, and it required more time than originally anticipated by both the HCMC government and CT&D. Some residents also demonstrated their discontent during the early stages of the project, protesting in front of the PMH Corporation headquarters.[57] Nevertheless, the land clearance was completed within the budget, and the land was delivered to allow Nguyen Van Linh Road to be built on time.

Third, Nguyen Van Linh Road was a well executed road. The quality of the road is, however, disparate throughout its different segments. While the road sections near residential and commercial areas belonging to the PMH Corporation are well maintained and implemented the full ten-lane

[56]Interview with Khue Jacobs, former staff of CT&D.
[57]Interviewed several people

design (or even more), other parts of the road are still six-lanes and not as well maintained as the above segments. One may argue that some segments are not yet completed to the full ten-lane design because some remaining land is not yet ready, and PMH may not have the responsibility to complete the road because it has not yet received all committed land as agreed by the city. However, this is an example about incentives. Enforcement or creation of incentive for concessionaires to maintain the quality of infrastructure service is a challenge universally.

In short, PMH is a rare case successful in applying land-based financing in Vietnam. Even though it has faced some troubles throughout its development, the success has been partly due to universal advantages of the joint venture mode and partly due to some of its specific fortunate circumstances.

Thu Thiem Peninsula Project

Thu Thiem, is a 737-hectare peninsula located within HCMC's northeast growth corridor, at an extraordinary location directly across the Saigon River from the downtown.[58] It has been considered a strategic location or "golden land" of HCMC for a long time. In many respects, Thu Thiem, is a more ambitious project than Phu My Hung. The city's vision for Thu Thiem is that it will become the new center of HCMC with high-end commercial office towers in a dense, modern form, and it would also relieve pressure on the historic quarter around District 1. Since its early beginnings, Thu Thiem has been compared to Shanghai's Pudong area in terms of its potential and role in supporting urban growth. However, after 14 years from the first approval by the Prime Minister, Thu Thiem has been relatively slow to develop. An ambitious plan has been drawn, and a huge amount of money has been invested. To connect Thu Thiem with the rest of HCMC, the city has spent more than US$500 million on the Thu Thiem Tunnel and Thu Thiem Bridge. For land compensation and acquisition, more than a US$1 billion has been spent and a half billion dollars is planned to be disbursed. Chronic problems of land clearance have intensified as additional capital is committed to Thu Thiem. Currently, the price of a square-meter of land in Thu Thiem, un-serviced by infrastructure, is on average $2,000.[59] This relatively high price of land, combined with land owners expectations of future development, and the presence of powerful interests makes the implementation of the plan opaque and complex.

The plans

In the 1993 master plan of HCMC approved by the Prime Minister of Vietnam, the idea for developing the Thu Thiem Peninsula had been mentioned only briefly. However, in 1996, Vietnam's Prime Minister approved the new master plan to develop 930 ha of Thu Thiem and in the 1998 master development plan of HCMC, it was clearly announced.[60] Looking at the potential of Thu Thiem,

[58] http://www.thuthiem.hochiminhcity.gov.vn/english/managementboarddetail.php?cid=9&id=18
[59] Interviewed real estate traders and brokers
[60] See Prime Minister's decisions: 20/TTg dated 01/16/1993 and 123/1998/QĐ-TTg dated 07/10/1998

HCMC's government has decided to build this area by itself to become a modern urban area instead of handing it to private developers as in the case of PMH. A summary of the land use plan is in Table 2.

Table 2: Land Distribution plan of Thu Thiem

Used purpose	Ha
Commercial land	166*
Public and special purpose used land	82
Transportation and park	238
Water surface (i.e. streams, ponds, and Saigon River)**	300

** This number seems low. However it is likely that some commercial land is in the second and third categories due to some implicit reasons*
** The surface of the Saigon River is estimated to be 130 ha*
Source: Authors' calculation based on various sources

To implement the project, the Investment & Construction Authority for Thu Thiem new urban area was established in 2001 by HCMC's chairman,[61] and an ambitious plan was drawn. International consulting firms were invited to bid for the design of this area. The city planned to finish land acquisition by 2005 and 40-50% of investments on the plan by 2010. However, up to the writing of this paper, the land clearance is still facing a bundle of troubles and almost no construction has been completed in Thu Thiem.

Land clearance problems

The city has planned to recall all land in the Thu Thiem area. This includes the space for infrastructure and private use. The city will then sell lots to private developers. By this model the city planned to profit enormously. However, the situation has not been as simple as expected. The process has taken a long time, and land-users have recognized the value of their land as speculators have also bid up property prices in this area.

The situation in the Thu Thiem case has been complicated. The rise in prices for land has also influenced the compensation payments demanded by current residents. From 2002-2009, the city has changed the compensation payment to land-users many times. As estimated in June 2006 by *Nguoi Lao Dong* newspaper, the total amount of compensation in the 2002 decision had been US$350 million, increasing to about $550 million in the 2006 decision of HCMC.[62] However, one year later, *Tuoi Tre* newspaper estimated the compensation in the 2006 decision would be about $800 million,[63] and in the 2009 decision of HCMC the figure was raised to about $1.4 billion. Moreover, if we include resettlement costs, the total capital for the land clearance will be estimated at $2 billion.[64]

[61] See HCMC's people committee's decision 103/2001/Q Đ-UB dated 11/01/2001.
[62] http://worldcup.nld.com.vn/153700p0c1002/tien-den-bu-khu-do-thi-thu-thiem-tang-len-9000-ti-dong.htm
[63] http://vneconomy.vn/68792P0C17/khu-do-thi-moi-thu-thiem-den-dau-roi.htm
[64] Authors' estimation

However, the issue has not been resolved yet. Many land-users seem to accept the compensation price, but the most difficulty is the compensation of the rest. The problem is that compensated and uncompensated lands are mixed together. According to discussion with some property developers, Thu Thiem's land may not be ready for the construction. To compound the problem, many land-use rights have already been transacted a number of times, so that disputes remain among these property traders as to who will hold the final land-use rights. In addition to the direct problem of the land compensation, the potentially negative impacts for those who have already returned their land to the government, and suddenly received large amounts of money without jobs or land for planting is another social issue.

Financial burdens and risks for the city budget

According to the current plan, the compensation and resettlement cost is about $2 billion and the internal investment cost is about $1.2 billion (Table 3). Moreover, if the cost of main infrastructure (bridges and the tunnel) to connect Thu Thiem with other areas of the city is included, the total cost without interest of borrowing could be $4-5 billion. Taking into account the land use plan summarized in Table 2 (there is only166 ha commercial land), the city budget may encounter serious financial trouble.

We consider two possible financial scenarios for Thu Thiem where HCMC would use land sales to recover its investment in land compensation and internal infrastructure. In the case the city uses its own money interest-free, and requires a five year payback, the price of land would need to be about $2,000 per square meter (and nearly all the 166 ha of commercial land sold). This excludes any opportunity cost of forgone investment returns. If the costs for Thu Thiem are borrowed at 12% interest for five years, the price of land would need to be about $2,700 per square meter and also nearly all commercial land would need to be sold (see Table 3). In the borrowing case, for each delayed year, the cost will increase more than $300 per square meter. This is indeed real risk for the city budget because the major proportion of the compensation cost has already been borrowed.[65]

Table 3: Cost estimation

Item	City budget	Borrowing
Compensation cost ($million)	2,000	2,000
Internal infrastructure investment cost ($million)	1,200	1,200
Total cost ($million)	3,200	3,200
Interest rate	0%	12%
Numbers of payment years	5	5
Annual payment (million)	640	888
Price of commercial land ($/square meter)	2,000	2,700
Price of commercial land ($million/ha)	20	27
Required sales per year (ha)	32	33

[65]http://nhansuvietnam.vn/tintuc/kinh_te/vay-them-5-000-ty-dong-den-bu-khu-do-thi-thu-thiem/69083.html

Required sales over 5 years (ha)	160	164

Source: authors' estimation based on various sources

Troublesome factors for the Thu Thiem project

In contrast to PMH project, there are at least four causes of problems for the Thu Thiem project.

First, decisively claiming such a large area of land is perhaps outside HCMC's capacity. The land acquisition and clearance is very complicated because it impacts nearly twelve-thousand households and some land-right holders who are influential. Because the process has been so long and many pieces of land have been sold several times over, the documents of current land-holders may not even be fully legal. Legal disputes have arisen, with buyers and sellers suing each other when the compensation prices have changed significantly. This has made the land clearance process more complicated and difficult.

Second, organizational difficulties within the city government have exacerbated the lengthy planning and land clearance process. Although the clearance process is conducted by local officials who are knowledgeable about their localities and neighbors, they have minimal incentives to resolve new issues not conforming to traditional regulatory procedures. The internal culture of risk averseness perpetuates the sense that a cadre will be punished if he brings failure or damage to the organization, but if he brings success he may also not be rewarded. Furthermore, the cadre's superior would be the one to claim positive credit (while the cadre himself may still be punished for violating procedures). Therefore, it is expected that officials working within this type of organization resist trying creative solutions that are not instructed in existing regulations. A common response from public servants in such cases is to await instruction from superiors after their sending proposals.

Additional, the frequent changing of the leadership has also caused trouble for the Thu Thiem project. Commonly, one needs several years to set up an administrative system. In this case, from 2001 up to now, the head of the authority has been changed twice or on average, each person only leads this agency for three years. It is indeed short.

Third, the gap between the city's financial resources and needs of the project has dragged on the land clearance process. If the cost for resettlement is included, land clearance costs are almost equivalent to the city budget at the year the compensation prices were announced. Of course, the city budget does not have enough money. It has had to borrowed capital from state-owned financial institutions with a bundle of bureaucratic procedures. Moreover, the process to disburse capital as well as adjust cost estimation is similar to the process of state expenditure. There are many complicated procedures hindering the efforts of the public servant who wants to accelerate the land clearance process.

A problem in Thu Thiem has been that the city government has not decisively announced a rule for land compensation. Instead of limiting compensation values to an inflation or growth index while the city implements its land acquisition process, it has entered into successive, ongoing negotiations with landholders. During this time, the value expectations of landholders and the real estate market in HCMC in general have skyrocketed. This, combined with the slow process of land acquisition, has put the city government into a perverse position where it must pay twice for infrastructure in Thu Thiem. First, it must pay for the planning and outlay of infrastructure. As the plans are rolled out, the land prices have increased largely in expectation that infrastructure will built. With a slow land acquisition process, land prices have increased and given landholders the opportunity to demand more compensation. As the result, the city must pay a second time.

The experience in Thu Thiem demonstrates a perversion of the value capture concept in land acquisition-based financing. Recall that the motivation for land acquisition is to allow the government to capture some of the value increments in land from infrastructure improvements. Where increases in previously agreed "fair value" to landholders in Thu Thiem are the result of expectations of infrastructure improvement, this is "unearned increment" by private citizens. In Thu Thiem, land value that benefits from infrastructure investment by government, rather than private parties, should therefore be attributed to the government.

Although the political negotiation between interest groups and the government realistically necessitates some value sharing, it would be perverse to require the government to pay extra for land at the expense of the wider public. Take, for example, an alternative scenario where the city cannot complete the land acquisition process because renewed claims for increased compensation make it simply too expensive. Some of the infrastructure improvements may be completed, but the public ownership of infrastructure assets would be jeopardized especially if the city cannot repay debt incurred for the projects. The city would not have the land value capture necessary to cover its costs, and landholders' expectations in land appreciation from infrastructure may not be realized. Pressure would mount for the city to transfer funds (or possibly Thu Thiem's infrastructure assets) to satisfy lenders. Essentially, the wider public would be forced to bail out Thu Thiem's bad finances due to the disjuncture between landholder expectations and municipal financial resources.

Fourth, theoretically, Thu Thiem sits on land that is perceived to be more valuable and in higher need for infrastructure service than PMH. It also represents a case where limits of the government's administrative power has delayed (and possibly prevented) infrastructure from being built.

The compensation problem of Thu Thiem is, in fact, similar to the second stage of the project in Bangalore as mentioned above. The intended acquisition and sale of the 400 acres of land for the airport highway encountered major public opposition when land prices increased strongly after the airport was built.[66] Thu Thiem is in a case quite similar to Bangalore or Paris more than one and a half centuries ago.[67] The government has not been able to implement its plans to acquire land at cheap prices and sell at high prices. This is different from China where local governments have the ability to raise enormous revenues from limited market land-use rights. Some municipalities of China are especially empowered by strong administrative powers to require that farmers sell their land below market rates, allowing the government to resell the land at market rates. In some cases, the purchase price could be more than 100 times less than the resale price. After considering the costs of land improvement, net revenues may be 10 times the total cost of the land.[68]

In fact, China and Vietnam are usually successful in recalling agricultural land thanks to farmers' limited expectations and information about the property market. But in Vietnam, cases related to urban citizens are much more complicated and difficult; furthermore, they aware of their negotiating leverage on land acquisition.

In short, the Thu Thiem project is encountering significant troubles now. It may take a long time before the city recovers its investments in Thu Thiem. However, due to its strategic location, a new urban area will likely be built in the future. However, it is perhaps too costly to implement the project through the current way. While the rest of the city awaits Thu Thiem's development, the economic waste from years of delay is possibly huge. Now that a seemingly definitive decision has been made on compensation, billions of dollars are being spent on infrastructure and land clearance. The relevant question now is at which price the city will need to sell the land use rights for private developers.

Tan Son Nhat - Binh Loi – Outer Ring Road

The most serious problem of transportation infrastructure in HCMC in the last two decades is, perhaps, not infrastructure for projects like PMH or Thu Thiem. It is inner city infrastructure. The city government has made a significant effort on upgrading and building infrastructure for existing districts. However, the result is still far behind expectations, although some projects such as the Nguyen Tri Phuong bridge, the Binh Trieu bridge, the Hanoi highway and so on so forth have been built. Outside of these projects, much infrastructure remains in planning and have not reached much progress. The Tan Son Nhat – Binh Loi – Outer ring road is one such project. Within the scope of the TSN-BL project, a 14 km road will connect Tan Son Nhat, the biggest airport in Vietnam, with HCMC's major transportation routes in its northeast.

In 1997 Vietnam's Prime Minister agreed for HCMC to build this ring road through the build –

[66] Peterson (2009, p.70-1)
[67] Peterson (2009, p.17)
[68] Ding (2005)

operate and transfer (BOT) model. Multi Usage Holdings Berhad (MUH), a Malaysian company intended to build this project with $210 million estimated cost. However, the plan was canceled due to the 1997-1998 financial crisis in East Asia. The project was postponed until 2004 when LG E&C, a South Korean company now renamed GS E&C, proposed to build the project through the build and transfer (BT) model, by which the contractor would build the road and the city would give it pieces of land whose value would be the same as the investment cost. In September 2007, HCMC's government signed a contract with GS Engineering & Construction to build this project.[69]GS E&C was expected to build a 340 million road in four years, in return for five pieces of "clean" land.[70]In the agreement, the city takes responsibility for the land clearance and GS E&C takes responsibility to build the road on time.[71]

After the contract was signed, GS E&C transferred $120 million to the city for the compensation cost and the city, in exchange, gave the contractor four of the five pieces of land valued at more than $150 million.[72]The problem is that these pieces of land are unrelated to the road and do not directly benefit from the improved infrastructure in the project.

Two issues have arisen since the money and land were exchanged. First, the progress of the project is very low due to the difficulty in the land clearance. According the contract, the city was required to give clean land to GS E&C in 2008 to build the road, but as of June 2010, land clearance has not yet been finished. 390 of 3,853 households have not yet agreed to move and only some construction structures such as pillars of Binh Loi bridge are being built.[73]Second, the issue of fair value of the land for the contractor has been called into question because it was not exchanged through an open and competitive bidding process. Some reporters have argued that the officially recognized value of the land is much lower than its true market value.[74]

In terms of implementation, the project's problems are fairly predictable. Once the land has been given to the private investor, it can focus on profit driving activities related to real estate development despite any delays in land clearance for the infrastructure right-of-way. After all, the market value of land given to GS E&C does not suffer directly from the TSN-BL highway remaining un-built. Moreover, GS E&C may find itself in a position to blame the city government for delays, and demanding compensation for penalties incurred to it by its contractors and other increased costs. To be

[69] http://www.tainguyenmoitruong.com.vn/phap-luat/111uong-tan-son-nhat-binh-loi-vanh-111ai-ngoai-tp-cm-nhieu-111ieu-bat-thuong-cua-du-an-111oi-111at-lay-111uong-bai-1-map-mo-hinh-thuc-111au-tu/

[70] http://www.gsconst.vn/popup_hotnews.php?id_pnewsv=342&lg=vn&start=0 and http://tintuconline.vietnamnet.vn/vn/kinhte/449367/index.html

[71] http://niengiamnongnghiep.com/index.php?self=article&id=11025&start=20&type=1 and http://www.thanhnien.com.vn/news/Pages/201025/20100618003752.aspx

[72] http://tintuconline.vietnamnet.vn/vn/kinhte/449367/index.html

[73] http://www.thanhnien.com.vn/news/Pages/201025/20100618003752.aspx

[74] http://tintuconline.vietnamnet.vn/vn/kinhte/449367/index.html and http://www.thanhnien.com.vn/news/Pages/201025/20100616011320.aspx

certain, the highest priority of the contractor is to maximize the profitability of the land resources which it has been given. GS E&C is now selling apartments being built in two pieces of land along with requesting the Prime Minister permission to sell another piece of land to fulfill capital requirements brought on by the global financial crisis after getting the green light of the city government.[75]

In short, along with the pricing and bidding process in this case, the biggest problem is that the concessionaire has been given land totally unrelated to the infrastructure improvement project. This has not given the concessionaire any direct incentive in building the road after getting the land. Nor does the public sector feel the pressure that would otherwise come from private investors to complete the highway's land clearance. Even though the TSN-BL project exchanged land for the highway construction, it does not conform to the core principle of land-based financing in that it lacks any direct land value appreciation from its respective infrastructure improvements.

In Conclusion

Three land acquisition-based financing techniques have been applied in HCMC. However, only the PMH project has been finished. We argue that it successfully utilized advantages of the joint venture model and benefitted from other specific factors of leadership and land clearance that are more difficult to replicate. But that is not to say that the joint venture is always the preferred mode of choice. Other issues that are pervasive in the joint venture, such as contract ambiguity and the requirement for long-term coordination between partners may not be desirable in all situations.

The Thu Thiem and TSN-BL projects have faced difficulty due to other fundamental problems. The land clearance processes of the Thu Thiem and TSN-BL projects are overly complicated and draw in many interest groups. Thu Thiem has been implemented by the government agencies, so that like other public businesses, there is minimal motivation for public servants to undertake land clearance quickly and in a way that minimizes risks to the public budget. In comparing the burdens to the public, Thu Thiem is a very ambitious project that has saddled the city government with billions of dollars in debt. Meanwhile, the TSN-BL project does not face the problem of unavailable financial resource because of its relatively smaller scale and the $120 million transferred from GS E&C.

Although the land prices in Thu Thiem are quite similar those in PMH now, the two projects are very different in terms of finance. In PMH, the land is well serviced by various infrastructure services even though the city has spent little or no money its development. Furthermore, it has received nearly half a billion dollars in the last decade from PMH. Across the Saigon River in Thu Thiem, the situation is drastically different. The peninsula of Thu Thiem is effectively barren in terms of

[75] http://www.thesaigontimes.vn/Home/thoisu/sukien/29551/

infrastructure (although construction has been ongoing) while the city has been spending billions of dollars to awaken its potential. The city budget continues to bearing huge risks for this project, but the result of Thu Thiem is unclear as of yet. In addition, compared to several key contemporary transportation projects and the two projects here, Nguyen Van Linh Road was one of the few, if not the only, large-scale infrastructure project that was finished on time and on budget.[76]

[76]Rosengard et al (2006)

Section 3. Implications

In principle, there are two sets of techniques to build infrastructure through the land-based financing: land acquisition-based and non-land acquisition-based. Land acquisition-based financing may work better with situations that have low requirements for land clearance while non-land acquisition financing may work better with situations that have heavier burdens for land clearance.

Conditions to Apply Land Acquisition Based Financing

Through cases examined in this paper, there are several conditions to apply the land acquisition-based techniques. Each condition will be analyzed below.

Clearing land quickly and decisively

The prominent condition of this financing technique is to control land. Land clearance is usually the most difficult process. It is related to many complicated issues. The longer the process is, the more uncertain it is. An important issue for all land acquisition-based financing is the expediency of compensation and resettlement. Especially in market conditions where volatile jumps in property prices can jeopardize the availability of land for projects, the speed and decisiveness of land clearance becomes crucial. Balancing the need for expediency with the rights of landholders is never an easy task, but there are policy tools that have been used in other countries to allow access to land. For example, once an announcement for land clearance has been made, the government can mandate that any future increases in the compensation for land clearance will be fixed to a consumer price index. Furthermore, the section below describes several financing modes that can discourage land speculation that may result from development announcements. To some extent, it may be possible to use these in combination with the acquisition-based modes to raise funds for land acquisition.

Incentives and availability of financial resources

Land clearance is indeed complicated. To do it quickly and decisively, structuring incentives and financial resources is critical. This may help deal with newly-arisen issues quickly. For this reason, the government's land clearance programs may encounter trouble because they lack both incentives and availability of financial resources. This implies that the involvement of market forces is necessary.

With private sector's involvement, private investors can reap huge profits even through transparent bidding processes. This happens because private developers may equally bear huge risks and they may have execution capacity in managing these projects. Commonly, the sigh of foreign private investors earning large amounts of money can be unpalatable for many people, especially in countries emerging from the central planning or socialist model. Cultivating a friendly public perspective in such cases is perhaps necessary.

Determining land value

In the land acquisition-based financing mode, one of the main issues is pricing. In Vietnam, the land transfer process is rarely transparent, which can also create public anger when it is discovered that private investors earn huge profits at the expense of the government. Transparent bidding is a solution for this issue and is reflected in the case of Cairo, Egypt.

In the New Cities project around Cairo, Egypt, the auction of public land has been a successful way to raise money for infrastructure projects. In Egypt, the government owns all undeveloped desert land, and traditionally it has supported urban growth by self-financing and installing infrastructure and then selling off serviced to urban developers. However, the budget burdens associated with selling improved land through private negotiations (sales were often at prefixed, below-market prices) has pushed the government to implement auction reforms in its infrastructure development process.

Under the reforms, land has been auctioned competitively to developers and requires the buyers to install necessary infrastructure. This strategy has raised more money to cover its own costs while still providing the infrastructure needed to support rapid urban growth. For example, auctions in May 2007 alone helped Cairo raise US$3.12 billion. The government has used the proceeds to pay for the Cairo Ring Road and subsidies for low income housing.[77]

A transparent auction process is, indeed, important. Not only does this help avoid waste and corruption, it also improves efficiency of using resources because it helps to choose the right developers who have capacity to implement projects and will signal this through bidding prices.

Rules for land acquisition, uses of funding

While the decisiveness and speed of land clearance are key to land acquisition-based financing, having established rules for the process and the uses for funding may help in raising public trust in an investment program. In addition, the cases of Paris and Bangalore demonstrate the importance of public support for infrastructure investment programs dependent on land acquisition. Establishing clearer standards for government action would help to build trust and to rationalize government programs in infrastructure development. On the flip side, it may also help to limit a financially hungry government that would otherwise make economically flawed investments that drain its land resources.

[77]Peterson (2009, p.58)

Recommendations

Applying land acquisition-based financing

Each of the three land acquisition-based financing techniques including: (1) transferring land to private developers in exchange for infrastructures; (2) engaging in joint venture to build infrastructures; and (3) governments' building infrastructure and sell surrounding improved land has its own pros and cons. To use these techniques efficiently, issues related to each mode should be considered carefully.

First, transferring land to private developers in exchange for infrastructure may work for projects which have low requirement on land clearance and the appreciation of given land or property relies mainly on the infrastructures to be built. This technique has been applied in many places such as in building the railroad system across the United States 150 years ago; developing basic infrastructure for new towns in Cairo, Egypt and building the TSN-BL project in HCMC, Vietnam. The first two projects conformed to the two basic conditions of land being available and a strong link between land value and built infrastructure. The TSN-BL project, however, has run into trouble on these two conditions as well as on other fronts. First, the land clearance process has been very complicated. Second, the exchanged pieces of land are totally unrelated to the project, so that the contractor has minimal incentive to build the road. Third, the land clearance is implemented by public servants with suboptimal incentives in completing the process. Finally, the land has been given without any type of bidding or auction.

In projects like the TSN – BL highway, the build-operate-transfer (BOT) model along with a subsidy from the municipal budget may be an alternative that helps align incentives of investors with the city. In another alternative, the city can build the project itself. Land that is exchanged or sold should be auctioned through a transparent process and the money committed to accountable uses. Using the method applied in TSN-BL case is easy to get incompetent investors in both building the required infrastructures and exploiting the given lands.

Second, engaging in joint venture to build the infrastructure may be suitable for projects which have substantial requirements for land clearance but are not too complicated. This mode has been applied successfully in many countries such as the ring road project in Changsha, China; the new airport in Bangalore, India and PMH project in HCMC, Vietnam. This model is quite successful because it can usually take advantages of both the public and the private partners. The public partners usually have expertise to deal with local people in the land clearance process and related issues while private partners have motivation as well as financial availability to push the process.

The joint venture model may be good for providing incentives for public servants to work quickly for resettlement. This assumes that they have good capability to work with local conditions, and that the presence of potential earnings from land investments provides the incentive for the private partners in the joint venture to push processes to be done quickly. If this mode is applied, the articles of the joint venture contract need to be determined as clearly as possible. Moreover, similar to the first mode, the land value should be directly tied to improvements in infrastructure to align incentives of the investors with the public.

In the PMH project, besides fundamental conditions that helped the project successful, unique factors such as the motivation of Mr. Phan and his colleagues as well as Mr. Ting vision, and the public money were important. However, for the policy implication, these factors are difficult to replicate and perhaps specific to the good fortune of PMH.

Third, governments' building of infrastructure and selling of surrounding improved land has encountered difficulty in most countries. This mode may be applied in cases in which land is already available or land clearance is simple. This mode has also applied in many places such as Paris, New York, Cairo, Bangalore and Thu Thiem. The problem of this model is that the bureaucracy along with lacking incentive makes the land acquisition process very lengthy while land prices (or demands for compensation) may continue to rise thanks to completed (or expected) infrastructure investment. This creates opposition by land holders who may feel shortchanged. To avoid this, when plans to develop certain areas are revealed, governments should promulgate compensation prices that are capped and indexed to publicly known measures such as GDP plus inflation.

It is hard to know exactly where the Thu Thiem project remains because it continues to unfold. Huge amounts of money have been spent, and many people have already received their compensation. However, many have not yet agreed with the compensations. This makes the situation more complicated. According to some reports the land in Thu Thiem is available now for construction, but according to interviews with potential investors, it seems that there is not much available land due to the incomplete clearing and resettlement of residents. It is possible that the project will last much longer and will cost much more than expected.

However, HCMC's government could reassess the process. The current approach may require a long time before the revenues from land sales are enough to cover costs. Such a situation would create high risk for the city's budget; therefore, the city should focus only on recalling land necessary to build critical infrastructure. In such a scheme, remaining occupied and uncompensated land would be isolated, and the government could impose taxes or fees as mentioned in following sections.

In addition, there is a temptation for municipal governments to apply the technique that Paris and New York applied more than one and a half century ago and China has successfully applied recently to upgrade or improve infrastructure of the downtown of cities or population density areas. It is to recall a larger area of land required for the infrastructure. However, this technique is usually not feasible if governments are not strong and competent enough because dealing with a large numbers of people is extremely difficult, especially in the political perspective. This is one of main weaknesses of the public sector. Choosing approaches in which less people involving into a project is perhaps better.

Fourth, transparent land or asset auction is necessary. Peterson (2009) showed that majority of land sales are conducted off budget. There is little public accountability for these activities. Large amount of money for land sales or transfer invites corruption. This also creates social loss by choosing subpar developers and wasting public resources. A competitive bidding process may help choosing right investors and increase public revenue (usually significantly). For example, a transparent auction process in Cairo, Egypt helped increase proceeds of land sales to 10:1 factor.[78]

In short, the first and the third modes can be applied in cases in which the land clearance is not very heavy and not related to many people or interest groups. The land acquisition-based financing model may not work well for cases in which the land clearance process is complicated and involves many parties. In these cases, the non-land acquisition-based financing model may work better.

Applying non-land acquisition-based financing

Across the various modes (betterment levies, development fees, and impact fees), the biggest advantage of the non-land acquisition-based financing modes is the reduced requirement for land clearance. Beyond the amount of land needed for the infrastructure, government will not need to sell or lease additional land to cover investments. Therefore, non-land acquisition-based modes can exercise advantages in cases where land clearance is difficult and complicated. It helps reduce opposition of land acquisition because land is purely used for infrastructure.

However, for these non-land acquisition-based modes, there are difficult requirements for data and analysis to implement revenue collection. With the betterment tax, for example, the municipality will need to current and historical information on property values and also project the taxes needed to cover infrastructure costs. Often tax collection can be difficult to predict, making this mode more common in developed jurisdiction, where there is better administrative capacity to record land values and to implement tax collection. Quite frequently, land acquisition is extremely difficult in developed countries.

Another solution is to offer traditional financing like in Korea and Japan where private land holders give up their land to the public, in order to build infrastructure, and then they receive a portion back (like 40%) after the value of land has been much improved. This is, in fact, in-kind betterment levy.

[78]Peterson (2009,p. 106)

But theoretically it could also be used as an in-kind fee for development rights or impact on existing infrastructure. The benefit of the in-kind approach is that landowners do not have to pay the tax by cash which may be unavailable for payers.

Thu Thiem is, in fact, not the only case in HCMC. In the future, many more projects will rise in complexity and have greater requirements for land compensation (and therefore risk greater public opposition) if land-based financing is used. The non-land acquisition-based financing model, therefore, may be a reasonable way for the city to finance for its high demand of infrastructure. Moreover, this mode can help cities like HCMC to deal with the erecting of skyscrapers in the downtown. To avoid the overload of infrastructure, the city government can sell development rights. The price of these fees could be based on the height of structures, with each additional floor paying a certain amount. Alternatively, the municipality can use a policy that charges an impact fee on developments that stress supporting infrastructure. Through this policy, the infrastructure will be secured because increased utilization will be linked to cost recovery and allow upgrades and maintenance from these revenue streams.

Suppose that the city applied the sale of development rights to Thu Thiem. The government would build main infrastructure for the whole area and design the master plan, then allow private developers to build buildings along with internal infrastructure. Different policies could be applied. In one option, all developers are required to follow the master plan strictly. In another option, developers are required to buy development rights to build buildings in the case land is already residential or commercial land, and developers have to buy both development and land conversion (from agriculture land to other purposes) rights. Prices of these rights would depend on the purpose of buildings; public-oriented uses could receive a lower fee and more commercial-oriented uses, higher fees, for example. The fees will be based on the cost for building basic infrastructure including the land compensation.

A variation of this could apply a general assessment fee where holders of undeveloped land also are required to pay a fee for infrastructure upgrades (this fee could be lower than other developed areas). The city could also combine this with its land-use policies and charge a tax for land that is not put into operation after a certain period (e.g. 2 years). The result from the collection of these policies would be a source of revenue for infrastructure investments and required land acquisition for only main infrastructures that would be much less than the 690 hectares in the current plan. One may conjecture that the process would be faster and less costly than the current route.

Other Issues

This paper supposes that investment decisions have already made, so that economic value of projects was not mentioned or estimated. The bottom line is that which financing mode is appropriate. The main focus of our paper is to find appropriate solutions to finance infrastructure planned to be build.

We did not answer the question whether an infrastructure is economically good decision or not. To do this, the net present value of a project needs to be estimated. In this case the most challenge is to estimate opportunities cost of alternatives. As Altshuler and Gomez-Ibanez have shown "to estimate the effect of a new development on local services and revenues, the baseline must be established what the alternative might be. What might happen to the patterns of local land uses and public service demand in the absence of some contemplated or proposed new development?"[79] Studying the economic results of a project to learn whether it is a good decision is an option for further study.

[79]Altshuler andGomez-Ibanez (1993, p.87)

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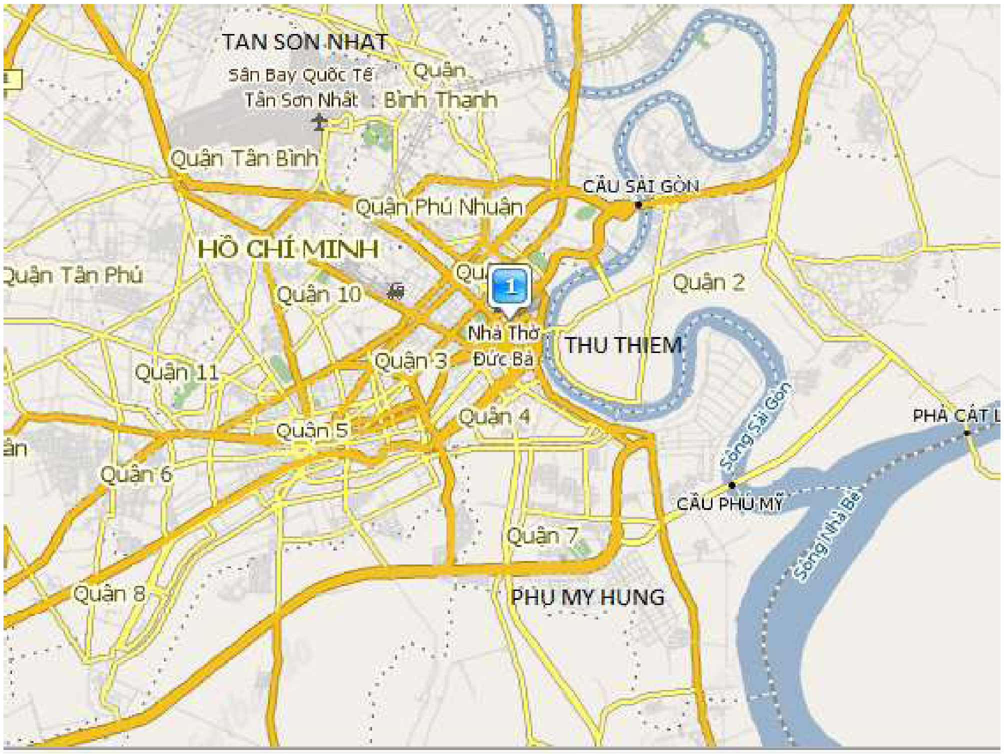
Appendix 1: Map of PMH, Thu Thiem and TSN-BL – Outer Ring Road Projects



Source: Captured from http://www.vietbando.com/maps/

Appendix 2: Nguyen Van Linh Boulevard

Source: http://phapluattp.vn/20100325123342234p0c1085/do-thi-phu-my-hung-dan-phai-doi-nha-vi-qua-on.htm

Appendix 3: Phu My Hung at Night

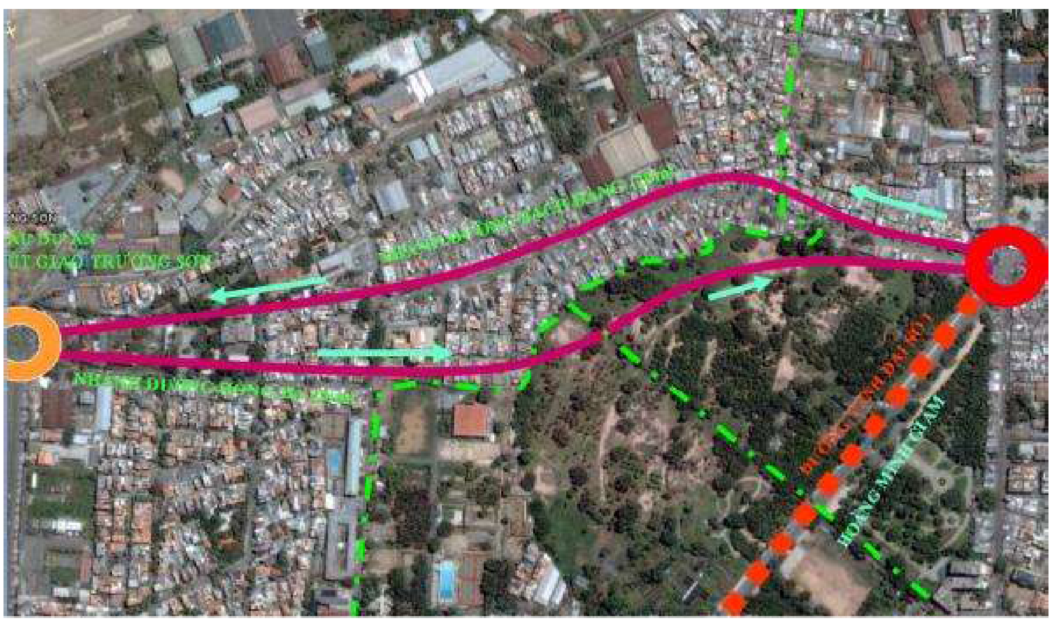
Source: http://www.phumyhung.com.vn/news_detail.php?id=799

Appendix 4: Thu Thiem Peninsula Plan

Source: http://www.dothi.net/news/tin-tuc/doi-song-do-thi/2009/07/3b9ae558/

Appendix 5: Thu Thiem Peninsula from Google Earth

Appendix 6: Tan Son Nhat-Binh Loi- Outer Ring Road plan



Source: http://www.tainguyenmoitruong.com.vn

Appendix 7: Key dates of the PMH, Thu Thiem and TSN-BL projects

Phu My Hung New Urban		Thu Thiem Peninsula Project		Tan Son Nhat – Binh Loi – Outer Ring Road	
1989	Tan Thuan Export Processing Zone established				
1993	Feasibility Study and the joint-venture contract signed	1993	Mentioned prudently in the master development plan of HCMC		
1996	Nguyen Van Linh Road kicked off	1996	The master plan of Thu Thiem approved by Vietnam's Prime Minister	1997	The prime minister approved the plan to build this road through BOT model
1998	A two lane road finished	1998	Thu Thiem defined clearly in the 1998 revised master plan of HCMC		
2000	Products (apartment and land lots for building house sold	2001	The Investment & Construction Authority for Thu Thiem new urban area established		
2003	The second stage of the Nguyen Van Linh road (4-6 lane) finished	2002	The first compensation plan for land recall approved. The estimated amount of money was about $350 million (VND5.5 trillion)		
2004	The tax dispute. The income tax increased from 10% to 25%	2005	The second compensation plan for land recall approved. The estimated amount of money was about $550 million (VND9 trillion)	2004	The negotiation between the city government and GS E&C started
2007	The final stage of the Nguyen Van Linh road finished	2006	The implementation plan approved. It was planned that 40-50% of the construction plan would be finished by 2010	2007	The contracted signed
2009	Dispute of paying land transfer fee	2006	The third compensation plan for land recall approved. The estimated amount of money was about $1.4 billion (VND25 trillion)		
2010		2010		08/2010	The land clearance was not finished yet

Sources: compiled from various sources

□ □ □ □ □ □ Does Asset Allocation Explain the Styles and Performance of Private Retirement Scheme (PRS) Funds in Malaysia

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The knowledge of equity style of PRS funds has benefited investors by mitigating the issue of asymmetric information between fund managers and investors. Using a return-based style analysis with PRS fund data from April 2013 to February 2015, our study found that: First, moderate funds have the highest degree of style of 61.31, followed by growth funds (52.37) and conservative funds (51.75). In other words, the fund managers of moderate funds practise more passive than active styles. Second, on average, conservative funds have the highest degree of selection (48.25) and lower degree of style. One would expect the opposite as conservative funds should act more like passive rather than active fund. Third, growth funds have higher degree of section (47.63) as compared to moderate funds. Fourth, conservative funds, as the name implies, have strong focus on the fixed income products rather than equity. Lastly, in terms of asset allocation to equity, on average, growth funds have higher allocation to foreign equity of 16.28, followed by moderate funds (9.18). In addition, growth funds focus on large growth stocks, while moderate funds focus on large value stocks. To the best of the authors' knowledge, this study is the first academic research done on PRS funds after the scheme was launched in July 2012. It is hope this study can be the catalyst for more academic work on this subject.

Keywords: style analysis, equity style management, asset allocation, performance, retirement fund

JEL classifications: G11, G23, H55, J26, L51

1. Introduction

A new private pension fund scheme known as Private Retirement Scheme (PRS) was launched by the Prime Minister of Malaysia Datuk Seri Mohd Najib on 12 July 2012 as part of the Capital Market Master Plan 2 (CMP2). The PRS scheme is a voluntary retirement savings scheme structured by private sector fund providers which are licensed by the Securities Commission. In order to facilitate the management of PRS, a new body known as Private Pension Administrator (PPA) is established to oversee the operation of PRS. First group of funds were made available to the public in September 2012 by eight asset management companies.

This new scheme aims to supplement the existing stated sponsored retirement scheme known as Employees Provident Fund (EPF). Studies by Asian Development Bank (ADB) and EPF have shown that there is a need to have more retirement scheme for Malaysian. An economist from ADB, Park (2012) reported that in Malaysia, only 48 per cent of the labour force and 32 per cent of the working age population 15 – 64 were covered by pension system in 2007.

In addition, as per the report by EPF (2015), it is reported that in 2014, 68 per cent of the EPF members at the age group of 54 has savings equal to RM50,000 or less in their retirement account. It is also found that 50 per cent of the retirees will spend their EPF retirement monies in 5 years or less. From the perspective of demographics, these findings are alarming in view that the average life expectancy for Malaysians is 75 years old, and given the retirement age at 60, there is 15-year gap. Hence, it is hoped that the Private Retirement Scheme (PRS) industry is able to complement and supplement the existing mandatory Employees Provident Fund (EPF). The schemes will be able to provide employees and self-employed people with an additional avenue to save for their retirement.

As a national project to uplift the country to a higher-income level society, the Private Retirement Scheme (PRS) is one of the entry point projects for the Financial Services National Key Economic Area (NKEA) under the Malaysia's Economic Transformation Programme (ETP). It is hoped the PRS will further enhance the growth of fund management industry and other ancillary business services which will create new values and income to the society. As stated by The Prime Minister, Najib Mohd during the launch of PRS on 12 July 2012:

> "*...A high income nation must have a sound and sustainable social framework to ensure adequate retirement savings. Private retirement schemes form an integral feature of the private pension industry with the objective of improving living standards for Malaysians at retirement through additional savings of funds….*"

The newly PRS has shown some outstanding result, as per the statistics as at 31 December 2013, there are 72,990 accounts registered with a total net asset value (NAV) of RM299.2 millions.[2]

1.1 The Benefits and Fund Type of PRS

The contribution can be made by the employees and employers without any fixed amount or interval. Employees and the self-employed have the option of specifying the type of fund they want to contribute to. To encourage savings, individuals are granted tax relief of up to RM3,000 and employees are provided tax deduction on contributions above the statutory rate of 19 per cent.

As shown in Figure 1, the PRS funds are divided into three types, namely the growth fund, moderate fund and conservative fund. The asset allocation are matched with age group and risk tolerance level, in line with the concept of life cycle of investing.

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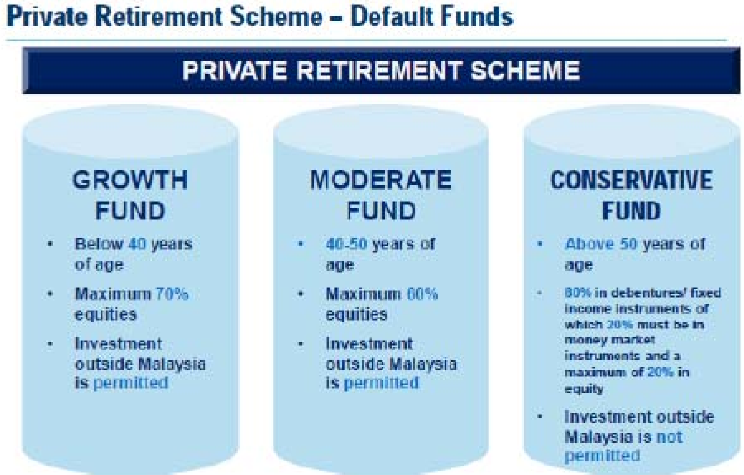
[2] Refer to the website of Securities Commission at http://www.sc.com.my/list-of-schemes-approved-for-sale/
As accessed on 08 January 2015

Figure 1: PRS –Default Funds



Source: www.ppa.my
As accessed on 08 January 2015

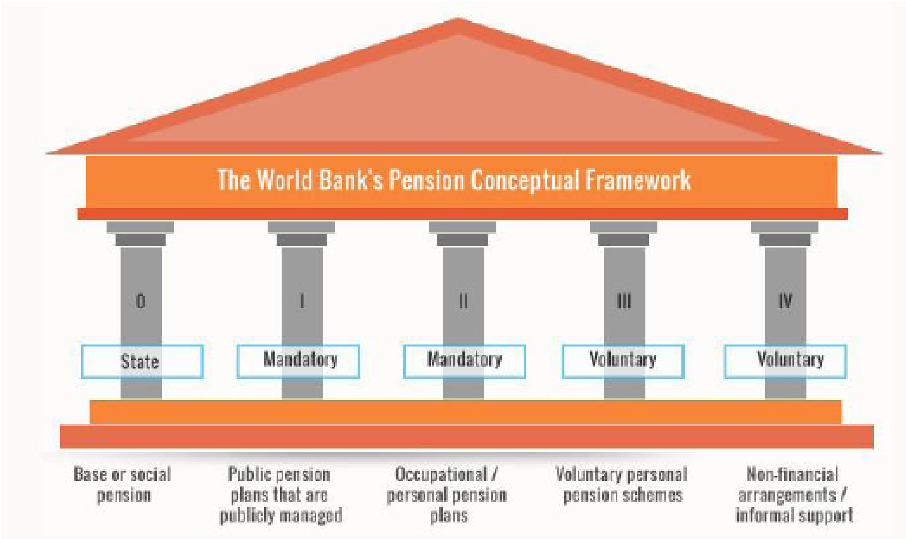
Conservative fund, as the name implies, is more suitable to the risk profile of older age group from 50 and above. They are not encouraged to hold risky asset as their time horizon for investment is shorter as compared to younger age group. Hence, no foreign asset class is allowed in their portfolio. In contrast, investment outside is permitted for both growth and moderate funds.

1.2 Conceptual Framework of Pension System

As fertility rate drops and aging society develops over the years, under the auspices of the World Bank, Holzmann and Hinz (2005) has developed the World Bank's Pension Conceptual Framework or which is also known as the World Bank's Five Pillar System. In an effort to reform the global pension system, they has provided a scheme of five-pillar model to classify the various ways to fund for the retirement system.

Everybody needs to have an adequate retirement provision when one reaches old age. Pension provisions or retirement benefits consist of various building blocks. The PRS is expected to contribute towards the Third Pillar to supplement the mandatory Employment Provident Fund (EPF) which is under the First Pillar, in order to have a robust pension system for Malaysia.

Figure 2: The World Bank's Five-Pillar System

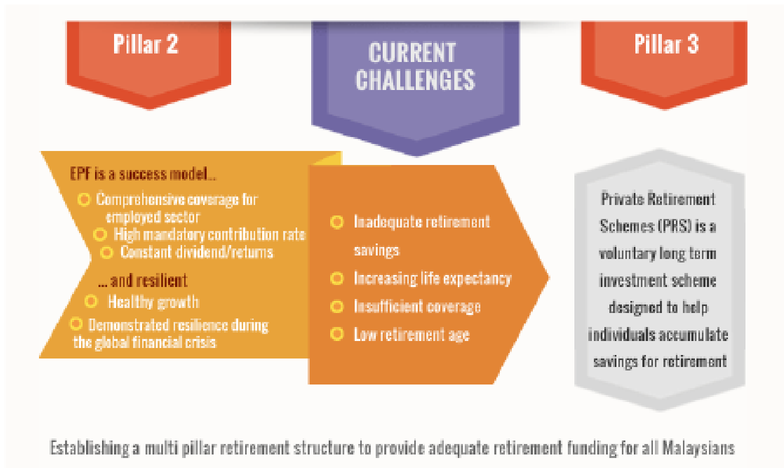


Source: www.ppa.my
As accessed on 08 January 2015

Under the Zero Pillar, there is no contributory social assistance from the State. Under Pillar One, there exists mandatory contribution which is linked to earnings. Under Second Pillar, there is mandatory defined contribution plan with independent management. There is voluntary savings under Third Pillar. Finally, retirees whom have no formal pension scheme will have to rely on informal support or their assets for post-retirement lives.

In this respect, Malaysia's PRS aims to promote the welfare of the population at retirement through a robust multi-pillar pension framework. The Securities Commission is reviewing the existing retirement landscape to make recommendations within the context of developing the private pension industry, which will complement the mandatory contribution to our existing Employees Provident Fund.

Figure 3: Current challenges in Malaysian Pension System



Source: www.ppa.my
As accessed on 08 January 2015

As identified by the Securities Commission and Private Pension Administrator (PPA), there exists four key challenges to retirement planning in Malaysia. They are inadequate retirement savings, low retirement age, insufficient coverage and increasing life expectancy.

1.3 Motivation

Like other funds managed by asset management companies or plan sponsors, *there is always asymmetric information between the fund managers and investors*. In our context, individuals or households who place their monies would like to know the asset allocation of their funds and the accompanying risk. As shown in the past studies using the US pension fund data, Brinson *et al.*(1986, 1991) show that asset allocation is the key determinant of portfolio performance in the long run.

Secondly, there exists the issue of over-rewarding the fund managers. Investors often could not tell whether the excess return to the fund (alpha) is contributed by the fund manager's selection or timing skills or simply the random occurrence of luck. As shown by past studies, using the US data, the Nobel Laureate, William Sharpe (1988, 1992) shows that the decomposition of returns to underlying asset allocation is possible through the return-based style analysis (RBSA). In addition, this technique enables one to examine the degree of styles and selection of a fund.

1.4 Research Objectives

There are two research objectives for this study:

Firstly, this study intends to attribute the performance of PRS funds to their respective underlying asset allocation; and

Secondly, this study intends decompose the returns to their respective of style and selection, how much the fund managers are able to add value or excess return per unit risk to the fund.

1.5 Organization of this study

The paper is organized as follows. The second section briefly reviews the literature on equity style classification and Malaysian mutual funds. The third, four and fifth sections are on data, methodology and results respectively. In final section, with respect to findings obtained from this study, this paper concludes on the application of return-based style analysis on decomposing asset allocation of PRS funds and its contribution to add to the extant literature in portfolio management in Malaysia.

2. Literature Review

2.1 Pension System and Social Security System

As discussed in section 1, numerous studies have touched on the need to reform the pension system in the world. Lee (1997) discussed the concern of sustainability of Government pension scheme in Malaysia in view increasing number of size of civil servants, and hence increasing cost of pension which will certainly add to the financial burden of the government.

There are also numerous studies on pension reform from Austria, Finland, Latin America and Japan (Brunner, 1994; Barrientos, 1996; Horiba and Yoshida, 2001; Hakola and Uusitalo, 2005). It shows the awareness is high as there are worries as to the sustainability of pension system in the respective countries. Interestingly, there is no study which focuses solely on private retirement scheme.

2.2 Investment Policy, asset allocation and fund performance

A fiduciary relationship exists between investors and their fund managers has underscored the importance of *investment policy*. In this respect, Gibson (1996) has enlisted a four-step approach in designing an investment portfolio for investing clients.[i] Of which, the first step being deciding which asset classes to be represented in the portfolio, and second, determining the long-term 'target' percentage of the portfolio to allocate to each of these asset classes. The third step being specifying the range within the allocation can be altered, and the fourth step being selection of securities within each of these asset classes. Therefore, it is pertinent for fund manager to follow his investment policy over a predetermined time horizon or until such time when the policy is altered.

Why investment policy is being emphasized in mutual fund investment? How does investment policy dictate asset allocation strategy and fund performance? In recent times, studies conducted in advanced financial markets notably the United States, have linked the performance of mutual funds to their respective asset allocation strategies [Brinson, Hood and Beebower (1986], Brinson, Singer and Beebower (1991), Ibbotson and Kaplan (2000)]. In addition, the emergence of style analysis research on mutual funds has also answered some of the questions on the relationship between asset allocation and the styles as well as performance of mutual funds [Sharpe (1992), Fama and French (1992 & 1993), Carhart (1997)].

2.3 Equity Style Classification

It is inevitable for the problem of asymmetric information between fund manager and investors to exist as timely mutual fund holdings are not readily updated even in the developed market as discussed by Lucas and Reipe (1996). Furthermore, they identified style analysis to be a useful tool for investors to comprehend a trust fund's investment policy and objective.

In a number of subsequent studies, in the course of identifying a system of classification for equity trust funds, the researchers have also presented the evidence of mis-classifications if self-reported investment objectives were to be compared to the estimated styles (diBartolomeo and Witkowski, 1997; Brown and Goetzmann, 1997; Kim, Shukla and Tomas, 2000).

In one of the recent studies, Amenc Sfeir and Martellini (2002) have proposed an integrated framework for assessing the risk-adjusted performance of mutual fund managers. This methodology is designed to be consistent with modern portfolio theory and constraints imposed by practical implementation of investment management where a variety of styles have to be accounted for. In another study, TerHorst, Nijman and DeRoon (2004) states that while the estimated portfolio may indeed differs from actual portfolio holdings, but "…if the aim is to predict future fund returns, factors exposures seem to be more relevant than actual portfolio holdings, and return-style based style analysis performs better than holding-based style-analysis"[5].

Recent studies have focused on the concept of equity style management in mutual funds. Using return based style analysis, Lau (2002) states that in addition to market benchmark comparison, the performance of funds can also be compared against their respective peer groups. In subsequent study, Lau (2005) finds that the risk-adjusted performance of growth style fund managers is more persistent than value style funds. The same effect was not found under mutual fund objective classification. In addition, Lau (2006) finds that under style classification based on MSCI style indices, investment style is found to communicate economic trends to investors. It is found that during the period of economic recovery, value style funds recover faster from distressed economic environment than growth style funds. On the other hand, during economic recovery, growth style funds exhibit recovery momentum better than value style funds.

In another study using an integrated framework of style analysis, Lau (2007) states that the inclusion of asset classes with negative correlation coefficient enhances the performance of funds and funds with relatively high degree of style (above 70 percent) that hold large-cap stocks together with high portion of liquid asset class (6 to 35 percent) tend to have higher alpha, translating into higher information ratio.

3. Data and Methodology

The sample of PRS fund data from 30 April 2013 to 27 February 2015 is obtained from Thomson Reuters Datastream. The Net Asset Value (NAV) for the last trading of the month is used in the analysis.

As discussed in section 1, there are three types of fund under the PRS definition. The study only focuses on core categories, namely Conservative, Growth and Moderate. Islamic funds are excluded as they are invested in asset classes different from conventional funds. In addition, REITS and feeder funds are also excluded as they constitute less than 1 per cent of available funds.

Table 1: Sample of PRS funds

No.	Fund name	Morningstar Category	Malaysia PRS Category
1	Affin Hwang PRS Conservative Fund	Cautious Allocation	Core (Conservative)
2	Affin Hwang PRS Growth Fund	Aggressive Allocation	Core (Growth)
3	Affin Hwang PRS Moderate Fund	Moderate Allocation	Core (Moderate)
4	AIA PAM-Conservative Fund	Cautious Allocation	Core (Conservative)
5	AIA PAM-Growth Fund	Aggressive Allocation	Core (Growth)
6	AIA PAM-Moderate Fund	Moderate Allocation	Core (Moderate)
7	AmPRS - Conservative Fund - Class D	Cautious Allocation	Core (Conservative)
8	AmPRS - Conservative Fund - Class I	Cautious Allocation	Core (Conservative)
9	AmPRS - Growth Fund - Class D	Aggressive Allocation	Core (Growth)
10	AmPRS - Growth Fund - Class I	Aggressive Allocation	Core (Growth)
11	AmPRS - Moderate Fund - Class D	Moderate Allocation	Core (Moderate)
12	AmPRS - Moderate Fund - Class I	Moderate Allocation	Core (Moderate)
13	CIMB-Principal PRS Plus Conservative - Class A	Cautious Allocation	Core (Conservative)
14	CIMB-Principal PRS Plus Conservative - Class C	Cautious Allocation	Core (Conservative)
15	CIMB-Principal PRS Plus Conservative - Class X	Cautious Allocation	Core (Conservative)
16	CIMB-Principal PRS Plus Growth - Class A	Aggressive Allocation	Core (Growth)
17	CIMB-Principal PRS Plus Growth - Class C	Aggressive Allocation	Core (Growth)
18	CIMB-Principal PRS Plus Growth - Class X	Aggressive Allocation	Core (Growth)
19	CIMB-Principal PRS Plus Moderate - Class A	Moderate Allocation	Core (Moderate)
20	CIMB-Principal PRS Plus Moderate - Class C	Moderate Allocation	Core (Moderate)
21	CIMB-Principal PRS Plus Moderate - Class X	Moderate Allocation	Core (Moderate)
22	Manulife PRS-Conservative Fund - Class A	Cautious Allocation	Core (Conservative)
23	Manulife PRS-Growth Fund - Class A	Aggressive Allocation	Core (Growth)
24	Manulife PRS-Moderate Fund - Class A	Moderate Allocation	Core (Moderate)
25	Public Mutual PRS Conservative Fund	Cautious Allocation	Core (Conservative)
26	Public Mutual PRS Growth Fund	Aggressive Allocation	Core (Growth)
27	Public Mutual PRS Moderate Fund	Moderate Allocation	Core (Moderate)
28	RHB Retirement Series - Conservative Fund	Cautious Allocation	Core (Conservative)
29	RHB Retirement Series - Growth Fund	Aggressive Allocation	Core (Growth)
30	RHB Retirement Series - Moderate Fund	Moderate Allocation	Core (Moderate)

Source: www.ppa.my
As accessed on 08 January 2015

Referring to table 1, a total of 30 funds from growth, moderate and conservative categories are chosen for this study.

The continuous compounding return for the fund is used as the dependent variable. It is calculated as

$$R_{j,t} = \ln(P_{j,t} / P_{j,t-1})$$

$$R_{m,t} = \ln(I_{m,t} / I_{m,t-1})$$

$$R_{f,t} = \ln(1 + r_{f,t})$$

Where:

$R_{j,t}$	=	the continuous compounded return for j unit trust fund at time t
$R_{m,t}$	=	the continuous compounded return for m benchmark portfolio for the month t
$R_{f,t}$	=	the continuous compounding risk free rate of interest for month t
$P_{j,t}$	=	the net asset value for j unit trust fund at time t
$I_{m,t}$	=	the asset class index at the end of month t
$r_{f,t}$	=	the discount rate of the 90-day T-Bill for month t as the proxy for the risk free rate of interest

Independent variables are returns series of asset classes invested by fund managers. The asset classes that represent the investment universe are shown in table 2. The continuous compounding return of independent variables are also calculate as per the formula in above. However, the KLIBOR rate is transformed in logarithmic form to avoid the problem heteroscedasticity. There is an effect of variance reduction for the overnight inter-bank rate, and this will assist in obtaining a more accurate and unbiased estimation.

Table 2. Asset class indices

Asset Class	Description
Growth Stocks	Represented by MSCI Malaysian Growth Index* quoted in local currency.
Value Stocks	Represented by MSCI Malaysian Value Index* quoted in local currency.
Cash	A proxy for short-term Ringgit money market instruments. Represented by Kuala Lumpur Inter-bank Offer Rate (KLIBOR). KLIBOR 1-month deposit rate is used.
Government Bonds	Represented by MGS-bond all tenure Index#, which account for MGS with value above RM100 million on issues for maturity greater than one year.
Corporate Bonds	Represented by Corporate Bond Index#, which account for all bonds and loan stocks listed on KLSE a term to maturity of more than one year. A proxy for listed private debt securities.
International Stocks	Represented by MSCI World Index*. A proxy for all international stocks index.

Source of data : Quantshop [accessed 1 March 2015]
* Available from http://www.msci.com

Style analysis in equation (2) attempts to capture the investment universe in the model, careful consideration has been taken to ensure that asset classes chosen are not correlated to one another. As stated by Sharpe (1992) "…while not strictly necessary, it is desirable that such asset classes should be 1) mutually exclusive, 2) exhaustive and 3) have returns that 'differ', and the asset classes returns should either have low correlations with one another or, in cases in which correlations are high, different level of standard deviations".

Figure 4 Large cap value

Source: MSCI

[accessed 28 February 2015]

Figure 5 Large cap Growth

Source: MSCI

[accessed 28 February 2015]

Table 3 Descriptive Statistics of Returns of Asset Classes

	MSCI LG	MSCI LV	MGS	CBI	KLIBOR	MSCI WORLD
Mean	0.001	0.001	0.002	0.003	1.162	0.008
Median	0.000	0.006	0.003	0.003	1.128	0.012
Maximum	0.039	0.033	0.017	0.010	1.264	0.055
Minimum	-0.033	-0.034	-0.015	-0.002	1.118	-0.038
Std. Dev.	0.019	0.019	0.008	0.003	0.049	0.028
Skewness	0.009	-0.411	-0.459	0.199	0.554	0.090
Kurtosis	2.279	2.224	3.036	2.196	1.799	1.948
Jarque-Bera	0.477	1.172	0.772	0.738	2.448	1.044
Probability	0.788	0.556	0.680	0.691	0.294	0.593
Sum	0.027	0.024	0.049	0.063	25.561	0.183
Sum Sq. Dev.	0.008	0.008	0.001	0.000	0.050	0.016
Observations	22	22	22	22	22	22

Table 4 Correlation Matrix of Asset Class Returns

	MSCI LG	*MSCI LV*	*MGS*	*CBI*	*KLIBOR*	*MSCI World*
MSCI LG	1.00					
MSCI LV	0.63	1.00				
MGS	0.54	0.08	1.00			
CBI	0.21	0.08	0.44	1.00		
KLIBOR	-0.03	-0.26	0.21	0.39	1.00	
MSCI World	0.50	0.69	0.05	-0.01	-0.19	1.00

As shown in table 4, there is no close correlation between the indices on the right hand side.

4. Methodology

Style Analysis

As in Sharpe (1992), this study initially introduces the generic factor model in equation (1) before adapting it into style analysis in equation (2).

$$\tilde{R}_i = \left[b_{i1}\tilde{F}_1 + b_{i2}\tilde{F}_2 + b_{ik}\tilde{F}_k + \ldots\ldots + b_{in}\tilde{F}_n \right] + \tilde{e}_i \qquad (1)$$

Where

$\tilde{R}_i$ = return of fund i

$\tilde{F}_k$ = return of factor k for fund i

b_{ik} = sensitivity of fund i to factor k

$\tilde{e}_i$ = non-factor return of asset i of mean zero with the assumption that the non-factor returns are uncorrelated $\sigma_{eiej} = 0$

Style Analysis is the use of constrained quadratic programming for solving the asset allocation problem. This approach incorporates two specific constraints: first, the coefficients must sum to 100 percent and second, coefficients must be positive. Negative coefficients can be interpreted as short positions in asset classes. This type of strategy is rarely used by the funds examined, and prohibiting these coefficients provides better, more usable results.[8]

The factor is rewritten as

$$\tilde{e}_i = \tilde{R}_i - [b_{i1}\tilde{F}_1 + b_{i2}\tilde{F}_2 + b_{ik}\tilde{F}_k + \ldots + b_{in}\tilde{F}_n] \qquad (2)$$

Where

$\tilde{e}_i$ = selection

$\tilde{R}_i$ = return of fund i

$\tilde{F}_k$ = return of factor k for fund i

b_{ik} = sensitivity of fund i to factor k

To obtain the style, minimize variance of residual return $\tilde{e}_i$
Subject to Constraints

$$\sum_{j=1}^{n} b_{ik} = 1 \text{ for any fund } i \text{ and asset class k}$$

$$\text{and } 0 < b_{ik} < 1$$

With the two specific constraints, the coefficients tabulated in equation (2) will resemble the weights within a portfolio and conveniently displayed as part of the portfolio. The asset class indices in table 2 which represent the factors in equation (1) and the sensitivity of each of the fund's return series to each of the asset class index factors is used to construct a passive benchmark portfolio return series for performance measurement. In other words, the return of funds will be measured against the style-based, passive benchmark contained as second, bracketed terms in the right hand side of equation (2).

Upon obtaining results from the quadratic programming in equation (2), the proportion of variance 'explained' by the selected asset classes, for fund i can be obtained as below:

$$R^2 = 1 - \frac{Var(\tilde{e})}{Var(\tilde{R})} \qquad (3)$$

The second term of the right-hand side of the above equation represents the proportion of variance 'unexplained" or due to active management (selection). In other words, the return of unit trust fund is decomposed into return on a set of asset classes and residual return. The former is attributed to *style* and represented by the R-square while the latter is attributed to *selection*.

In order to take into account the added (or subtracted) value provided by a fund i.e. its benchmark and the added risk, the monthly mean selection returns is divided by the standard deviation of monthly selection returns. This calculation gives an information ratio as stated in equation (4).

$$\text{Information Ratio} = \frac{E(\tilde{e}_i)}{\sigma_{\tilde{e}_i}} \qquad \textbf{(4)}$$

The monthly mean selection returns can be measured for its statistical significance using a t-statistic. The null hypothesis is stated as selection return equals to zero.

$$t = \frac{(r_s - \mu)}{s/\sqrt{n}} \qquad \textbf{(5)}$$

Where

r_s = the monthly mean selection returns

μ = zero, the null hypothesis

s = the standard deviation of monthly selection return

n = the number of observations

4. Result and Discussion

As per the discussion in section 3, the result of estimation is listed as below:

Table 5 Degree of Styles, Selection and Asset Allocation of Different Fund Types

No	Fund	Style	Selection	Large Growth	Large Value	MGS	Corporate Bonds	Money Market	MSCI World	Total
1	Affin Hwang PRS Conservative Fund	37.61	62.39	20.03	0.00	41.66	38.31	0.00		100
2	AIA PAM Conservative Fund	71.65	28.35	1.23	13.66	16.95	68.16	0.00		100
3	AmPRS Conservative Fund Class D	66.08	33.92	3.90	12.52	28.52	54.00	1.06		100
4	AmPRS Conservative Fund Class I	55.51	44.49	0.87	12.98	31.77	53.43	0.95		100
5	CIMB-Principal PRS Plus Conservative - Class A	58.78	41.22	7.97	15.34	11.28	65.42	0.00		100
6	CIMB-Principal PRS Plus Conservative - Class C	59.00	41.00	6.18	15.55	12.82	65.45	0.00		100
7	CIMB-Principal PRS Plus Conservative - Class X	62.08	37.92	5.78	16.43	13.37	64.43	0.00		100
8	Manulife PRS-Conservative Fund Class A	40.14	59.86	0.00	0.69	56.82	42.48	0.00		100
9	Public Mutual PRS Conservative Fund	20.08	79.92	9.19	4.12	6.71	79.56	0.00		100
10	RHB Retirement Series - Conservative Fund	46.57	53.43	1.68	16.21	13.59	63.43	5.08		100
	Conservative Fund	**51.75**	**48.25**	**5.68**	**10.75**	**23.35**	**59.47**	**0.71**		**100**
1	Affin Hwang PRS Growth Fund	39.30	60.70	33.10	0.00	62.43	0.00	0.00	4.47	100
2	AIA PAM Growth Fund	52.39	47.61	25.54	31.57	33.03	0.00	3.42	6.44	100
3	AmPRS Growth Fund Class D	62.79	37.21	33.71	10.23	49.93	0.00	6.13	0.00	100
4	AmPRS Growth Fund Class I	61.90	38.10	3.81	11.80	30.26	0.00	2.56	51.57	100
5	CIMB-Principal PRS Plus Growth - Class A	51.65	48.35	36.41	29.47	14.18	0.00	3.20	16.74	100
6	CIMB-Principal PRS Plus Growth - Class C	52.55	47.45	34.64	31.91	15.65	0.00	3.39	14.40	100
7	CIMB-Principal PRS Plus Growth - Class X	52.35	47.65	35.96	31.13	14.09	0.00	3.41	15.42	100
8	Manulife PRS-Growth Fund Class A	32.58	67.42	17.68	34.06	48.25	0.00	0.00	0.00	100
9	Public Mutual PRS Growth Fund	67.01	32.99	28.11	18.06	0.00	0.00	0.06	53.77	100
10	RHB Retirement Series - Growth Fund	51.20	48.80	30.10	37.20	26.61	0.00	6.09	0.00	100
	Growth Fund	**52.37**	**47.63**	**27.91**	**23.54**	**29.44**	**0.00**	**2.83**	**16.28**	**100**
1	Affin Hwang PRS Moderate Fund	55.79	44.21	35.07	0.00	64.93	0.00	0.00	0.00	100
2	AIA PAM Moderate Fund	70.34	29.66	22.36	27.45	28.33	17.95	2.70	1.21	100
3	AmPRS Moderate Fund Class D	71.91	28.09	9.05	29.98	60.98	0.00	0.00	0.00	100
4	AmPRS Moderate Fund Class I	71.85	28.15	9.82	29.32	60.86	0.00	0.00	0.00	100
5	CIMB-Principal PRS Plus Moderate - Class A	59.27	40.73	29.34	35.60	21.93	0.00	1.76	11.36	100
6	CIMB-Principal PRS Plus Moderate - Class C	59.56	40.44	29.71	35.67	19.52	0.00	1.69	13.41	100
7	CIMB-Principal PRS Plus Moderate - Class X	58.80	41.20	28.32	36.64	22.40	0.00	1.76	10.88	100
8	Manulife PRS-Moderate Fund Class A	36.49	63.51	10.09	28.35	61.55	0.00	0.00	0.00	100
9	Public Mutual PRS Moderate Fund	77.62	22.38	30.42	14.69	0.00	0.00	0.00	54.89	100
10	RHB Retirement Series - Moderate Fund	51.51	48.49	17.52	36.24	38.97	0.00	7.27	0.00	100
	Moderate Fund	**61.31**	**38.69**	**13.41**	**27.39**	**37.95**	**1.79**	**1.52**	**9.18**	**100**

Overall, Moderate funds have the highest degree of style of 61.31, followed by growth funds (52.37) and conservative funds (5175). In other words, the fund managers of moderate funds practise more passive style than active styles.

On the contrary, on average, conservative funds have the highest degree of selection (48.25) and lower degree of style. One would expect the opposite as conservative funds should act more like passive fund rather than active fund. Growth funds have higher degree of section (47.63) as compared to Moderate funds.

Looking at each category, it is interesting to note that for conservative funds, on average, they have allocated 59.47 per cent in corporate bonds, followed by 23.35 per cent in MGS, with a total of 82 per cent in debt instruments. In other words, conservative funds, as the name implies, have strong focus on the fixed income products rather than equity.

In terms of asset allocation to equity, on average, Growth funds have higher allocation to foreign equity of 16.28, followed by moderate funds (9.18). In terms of asset allocation between growth and value stocks, Growth funds, as name implies focus on large growth stocks, while moderate funds focus on large value.

However, within each respective category, it can be observed that the asset allocation does not follow a clear pattern and at times, the disparity can be wide between one another. For example, for conservative funds, Affin Hwang PRS has large growth of 20 percent of which around 4 times above the average. For growth funds, it is observed that AmPRS Growth Fund Class D has near to 50 per cent of asset allocation in MGS, while Affin Hwang PRS Growth Fund has 62.43 per cent in MGS. This brings to the issue of misclassification of fund objective in PRS fund. Hence, the comparison among the funds are not accurate.

Table 6 Cumulative Return Difference (Fund versus Style) and Selection Sharpe Ratio

No	Fund	Cum Ret Diff(%) Fund vs Style	Ave Return (% per mth)	StdDev (% per mth)	T statistics (Ave Return)		Monthly Selection Sharpe Ratio	Selection Sharpe Ratio
	Conservative Fund							
1	Affin Hwang PRS Conservative Fund	-5.00	-0.09	0.77	-0.87		-0.32	-0.67
2	AIA PAM Conservative Fund	0.08	-0.06	1.26	-0.38		0.02	0.06
3	AmPRS Conservative Fund Class D	26.96	0.41	0.32	9.67	***	-3.95	-1.00
4	AmPRS Conservative Fund Class I	-21.24	-0.40	0.37	-8.47	***	-3.11	-1.00
5	CIMB-Principal PRS Plus Conservative - Class A	0.78	0.01	0.39	0.26		0.10	0.40
6	CIMB-Principal PRS Plus Conservative - Class C	0.96	0.02	0.35	0.35		0.13	0.56
7	CIMB-Principal PRS Plus Conservative - Class X	0.80	0.01	0.34	0.30		0.11	0.46
8	Manulife PRS-Conservative Fund Class A	-2.56	-0.04	0.52	-0.65		-0.24	-0.56
9	Public Mutual PRS Conservative Fund	-10.09	-0.18	0.42	-3.31	***	-1.21	-0.99
10	RHB Retirement Series - Conservative Fund	-71.54	-2.11	0.56	-28.67	***	-10.63	-1.00
	Mean	-8.08	-0.24	0.53	-3.18		-1.91	-0.37
	Growth Fund							
1	Affin Hwang PRS Growth Fund	-3.62	-0.06	0.77	-0.62		-0.14	-0.39
2	AIA PAM Growth Fund	-52.70	-1.26	1.08	-9.00	***	-3.33	-1.00
3	AmPRS Growth Fund Class D	-77.30	-2.48	0.90	-21.24	***	-7.90	-1.00
4	AmPRS Growth Fund Class I	-80.66	-2.75	0.89	-23.68	***	-8.82	-1.00
5	CIMB-Principal PRS Plus Growth - Class A	-51.58	-1.22	1.18	-7.97	***	-2.95	-1.00
6	CIMB-Principal PRS Plus Growth - Class C	-53.97	-1.31	1.17	-8.58	***	-3.18	-1.00
7	CIMB-Principal PRS Plus Growth - Class X	-54.08	-1.31	1.18	-8.54	***	-3.16	-1.00
8	Manulife PRS-Growth Fund Class A	-9.25	-0.16	2.20	-0.57		-0.21	-0.52
9	Public Mutual PRS Growth Fund	1.92	0.03	0.63	0.39		0.14	0.65
10	RHB Retirement Series - Growth Fund	-77.79	-2.52	1.42	-13.65	***	-5.09	-1.00
	Mean	-26.09	-0.75	0.82	-6.11		-2.65	-1.00
	Moderate Funds							
1	Affin Hwang PRS Moderate Fund	-2.00	-0.03	0.77	-0.34		-0.10	-0.29
2	AIA PAM Moderate Fund	-44.97	-1.01	0.65	-11.95	***	-4.41	-1.00
3	AmPRS Moderate Fund Class D	-4.48	-0.08	0.96	-0.62		-0.23	-0.55
4	AmPRS Moderate Fund Class I	-5.02	-0.09	0.62	-1.09		-0.40	-0.75
5	CIMB-Principal PRS Plus Moderate - Class A	-31.94	-0.65	1.01	-4.92	**	-1.82	-1.00
6	CIMB-Principal PRS Plus Moderate - Class C	-30.92	-0.62	1.01	-4.76	**	-1.76	-1.00
7	CIMB-Principal PRS Plus Moderate - Class X	-32.48	-0.66	1.03	-4.97	***	-1.83	-1.00
8	Manulife PRS-Moderate Fund Class A	-8.66	-0.15	1.69	-0.70		-0.26	-0.59
9	Public Mutual PRS Moderate Fund	1.11	0.02	0.50	0.28		-7.36	-1.00
10	RHB Retirement Series - Moderate Fund	-83.58	-3.02	1.18	-19.71	***	-0.15	-0.41
	Mean	-24.30	-0.63	0.94	-4.88		-1.83	-0.76

***, ** and * denote level of significance at 1, 5 and 10 percent level respectively.

Table 6 highlights the results of the cumulative return difference (fund versus style) and selection sharpe ratio which are useful as performance measurements. As both measurements are originally obtained from the *cumulative selection return*[ii] from the style analysis, they report the same results with respect to performance of funds intuitively.

Across the fund styles, from the point of view of cumulative return difference, it could be observed that conservative funds are the best performers, followed by moderate funds and growth funds. From selection sharpe ratio point of view, it is observed that conservative funds are the best performer as compared to moderate and growth funds.

Individual funds that perform well in each category is CIMB-Principal PRS Conservative – Class C with selection sharpe ratio of 0.56, Public Mutual PRS Growth Fund of 0.65 and RHB Retirement series – moderate fund of -0.41 respectively

5. Conclusion

5.1 Findings and Original contribution

Through return-based style analysis, the study has managed to decompose the return to its asset allocation. This study contributes in a few aspects:

First, using the return-based style analysis (RBSA), the returns of various PRF can be decomposed into asset allocation. Second, the PRF holders would be able to mitigate the asymmetric information between the fund sponsor and PRF holders. Third, there is clear sign of misclassification of fund type as shown by the analytical result. To the best knowledge of the author, this study is first of its kind using PRS fund data in Malaysia.

5.2 Limitation of the study

Despite much effort has been put into data cleaning and analysis to ensure the accuracy of the output, the study is not without limitation. As PRF is relatively new, the fund data has not been sufficient long enough like other study which uses 3 years of data.

Much efforts have been put into cleaning the fund data as described:

(i) different starting period for the funds; and

(ii) relatively short period of data starting from 2012.

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Appendix I Existing PRS Funds

No.	Fund name	Morningstar Category	Malaysia PRS Category
1	Affin Hwang PRS Conservative Fund	Cautious Allocation	Core (Conservative)
2	Affin Hwang PRS Growth Fund	Aggressive Allocation	Core (Growth)
3	Affin Hwang PRS Moderate Fund	Moderate Allocation	Core (Moderate)
4	AIA PAM-Conservative Fund	Cautious Allocation	Core (Conservative)
5	AIA PAM-Growth Fund	Aggressive Allocation	Core (Growth)
6	AIA PAM-Islamic Moderate Fund	Moderate Allocation	Balanced
7	AIA PAM-Moderate Fund	Moderate Allocation	Core (Moderate)
8	AmPRS - Conservative Fund - Class D	Cautious Allocation	Core (Conservative)
9	AmPRS - Conservative Fund - Class I	Cautious Allocation	Core (Conservative)
10	AmPRS - Growth Fund - Class D	Aggressive Allocation	Core (Growth)
11	AmPRS - Growth Fund - Class I	Aggressive Allocation	Core (Growth)
12	AmPRS - Moderate Fund - Class D	Moderate Allocation	Core (Moderate)
13	AmPRS - Moderate Fund - Class I	Moderate Allocation	Core (Moderate)
14	CIMB-Principal PRS Plus Conservative - Class A	Cautious Allocation	Core (Conservative)
15	CIMB-Principal PRS Plus Conservative - Class C	Cautious Allocation	Core (Conservative)
16	CIMB-Principal PRS Plus Conservative - Class X	Cautious Allocation	Core (Conservative)
17	CIMB-Principal PRS Plus Equity -Class A	Other Equity	Equity
18	CIMB-Principal PRS Plus Equity -Class C	Other Equity	Equity
19	CIMB-Principal PRS Plus Equity -Class X	Other Equity	Equity
20	CIMB-Principal PRS Plus Growth - Class A	Aggressive Allocation	Core (Growth)
21	CIMB-Principal PRS Plus Growth - Class C	Aggressive Allocation	Core (Growth)
22	CIMB-Principal PRS Plus Growth - Class X	Aggressive Allocation	Core (Growth)
23	CIMB-Principal PRS Plus Moderate - Class A	Moderate Allocation	Core (Moderate)
24	CIMB-Principal PRS Plus Moderate - Class C	Moderate Allocation	Core (Moderate)
25	CIMB-Principal PRS Plus Moderate - Class X	Moderate Allocation	Core (Moderate)
26	Kenanga OnePRS Conservative Fund	Cautious Allocation	Core (Conservative)
27	Kenanga OnePRS Growth Fund	Aggressive Allocation	Core (Growth)
28	Kenanga OnePRS Moderate Fund	Moderate Allocation	Core (Moderate)
29	Manulife PRS-Conservative Fund - Class A	Cautious Allocation	Core (Conservative)
30	Manulife PRS-Growth Fund - Class A	Aggressive Allocation	Core (Growth)
31	Manulife PRS-Moderate Fund - Class A	Moderate Allocation	Core (Moderate)
32	Manulife Shariah PRS-Conservative Fund - Cla	Cautious Allocation	Core (Conservative)
33	Manulife Shariah PRS-Growth Fund - Class A	Aggressive Allocation	Core (Growth)
34	Manulife Shariah PRS-Moderate Fund - Class A	Moderate Allocation	Core (Moderate)
35	Public Mutual PRS Conservative Fund	Cautious Allocation	Core (Conservative)
36	Public Mutual PRS Growth Fund	Aggressive Allocation	Core (Growth)
37	Public Mutual PRS Islamic Moderate Fund	Moderate Allocation	Core (Moderate)
38	Public Mutual PRS Moderate Fund	Moderate Allocation	Core (Moderate)
39	RHB Retirement Series - Conservative Fund	Cautious Allocation	Core (Conservative)
40	RHB Retirement Series - Growth Fund	Aggressive Allocation	Core (Growth)
41	RHB Retirement Series - Moderate Fund	Moderate Allocation	Core (Moderate)

[i] Refer Gibson (1996) pp. 9 – 12.

[ii] Cumulative selection return is defined as the difference between fund's return and that of a passive mix with the same style.

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A Tale of Two Cities:Corporate Governance and Firm Valuation in Vietnam

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This study examines the effect of a unique institutional setting on the relation between the quality of corporate governance practices and firm valuation in Vietnam, where there are two major stock exchanges, one located in Ho Chi Minh City, the country's business center but far away from the regulators whereas the other one located in Hanoi, the capital city close to government offices and regulatory agencies. This setting allows a test of the impact of listing location on corporate governance while controlling for the effect of legal jurisdiction. Although firms in the two exchanges exhibit the same levels of the quality of corporate governance practices, the market valuation of firms listed in Ho Chi Minh City appear to be more responsive to the quality of corporate governance practices than that of firms listed in Hanoi. The findings suggest that corporate governance related to market valuation as a result of product market competition rather than regulation.

Keywords: Corporate governance, Firm value, Vietnam

JEL Classification: G32, G34

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1. Introduction

Finance literature suggests that the legal and institutional settings play critical roles in facilitating financial development. La Porta, Lopez-de-Silanes, Shleifer and Vishny (1997, 1998, 1999, 2000) posit that enforcement of private property rights, support of contractual arrangements and protection of legal rights of investors are pillars of financial market developments. Although there are disagreements on the impact of legal origins on investor protection and financial development (Rajan and Zingales, 2003; Roe, 1994), the consensus is that law and finance are interrelated. In addition, economists have noted that legal institutions, such as courts and regulatory agencies, influence corporate finance and financial development (Beck and Levine, 2008; Coffee, 2002). The main reason is that, under these conditions, corporate governance systems can effectively mitigate agency problems and other governance conflicts specific to the particular economy (Shleifer and Vishny, 1997; John and Senbet, 1998; Gompers, Ishii and Metrick, 2003).

This study contributes to the literature by examining the marginal effect of unique financial and institutional settings on the quality of corporate governance practices and firm valuation while controlling for the effect of legal jurisdiction. The main research question is whether economic forces or regulation has dominant impact on corporate governance within the same legal setting. Vietnam provides an ideal setting for this investigation because it has a unique institutional structure. Specifically, a Vietnamese firm can choose from two major stock exchanges for its listing. One stock exchange is located in Ho Chi Minh City (formerly Saigon), the largest city in Vietnam, thriving with economic activities but far away from the government and regulators. The second exchange is located in Hanoi, the capital city and a home to all government offices and regulatory agencies. In addition to geographic separation, the two cities also differ in other significant ways, including various distinct demographic and economic characteristics. Although these unique differences should not play a major role in developed economies, they may have significant impact on financial market development in emerging economies. Examining the two exchanges in Vietnam should provide additional insights on the issue.

Furthermore, political forces can affect the desired outcomes of the legal and regulatory frameworks (Rajan and Zingales, 2003). Previous research shows that political forces can distort the role that the legal setting and the financial institution setting play in corporate governance. Empirical evidence shows that firms benefit from political connections (Claessen, Feijen, and Laeven, 2008; Faccio, 2006; Fisman, 2001). In Asia, it is common to find many state-owned enterprises listed on the stock exchange. In theory, this structure can be more efficient than the normal widely-held corporate structure. The main reason is that state-owned enterprises can make better decisions and better serve the public without the agency conflicts observed between managers and shareholders. As a result, various forms of state-owned enterprises are observed in many countries. However, state-owned enterprises can also be detrimental to the public especially when under control by self-serving bureaucrats (Shleifer and Vishny, 1997). In Vietnam, state-owned enterprises are prevalent and politically connected. This provides a unique opportunity to examine the quality of corporate governance practices of state-owned enterprises in Vietnam and whether corporate governance affects market valuation of state-owned enterprises in Vietnam.

The remainder of this paper is organized as follows. Section 2 discusses the institutional background and corporate governance developments in Vietnam. Hypotheses are proposed at the end of this section. The data and empirical methods are presented in Section 3. Section 4 presents the empirical results and Section 5 concludes the paper.

2. Hypothesis Development

2.1 Regulatory structure in Vietnam

The Vietnam legal system is a civil law system, with some common law influences, especially the corporate governance framework (Robinett, Benedetta and Anh, 2013). There are three main laws underpinning the corporate governance framework in Vietnam, and the laws are quite recent. The three laws are: the Law on Enterprises and the Law on Investment, both of which were enacted in 2005, and the Law on Securities, which took effect in 2007. The Model Charter, introduced in 2002, is also an important document. In addition to the enactment of new laws, there have been rapid changes in the legal and regulatory frameworks which support corporate governance practices. For example, the Law on Enterprises mandates each shareholding company have an inspection committee. The inspection committee is charged with supervising the board of directors and the top executive at the firm. Another example of a recent change in the law concerns the 2007 Corporate Governance Regulations. The Regulations are mandatory for all public companies, as was the adoption of the Model Charter from its introduction in 2007. In 2012, the SSC revised the 2007 version of its Corporate Governance Regulations. After 2012, companies can create their own charters. The SSC issued a revised Model Charter for companies to use as a template. The Law on Enterprises was revised in 2009, while the Law on Securities was revised in 2010. New laws have been introduced since. The Law on Credit Institutions came into effect in 2010, replacing a 1997 law. The Law on Independent Audit took effect in 2011. The new laws have encouraged shareholder participation, protected shareholders' rights, and boosted disclosure (Robinett, Benedatta and Anh, 2013).

Regulations covering securities market disclosure were issued and revised in 2012. The Ministry of Finance, the State Securities Commission, and the State Bank of Vietnam have been especially active. These organizations have issued many decrees, decisions, and circulars. The overall legal framework has been strengthened by the new laws and regulations (Robinett, Benedatta and Anh, 2013). However, the laws, rules, and regulations have changed frequently, and the number of decrees issued by the three top regulatory agencies has increased markedly as well. The increase in the numbers of regulations, plus the frequent changes, has led to overlaps in the rules. Most importantly, there are some notable gaps and inconsistencies in the rules. The plethora of rules, along with frequent changes, has brought not a small amount of confusion by companies and investors (Robinett, Benedatte and Anh, 2013).

In general, the three key regulators, the Ministry of Finance, the State Securities Commission, and the State Bank of Vietnam, have clear areas of authority. The Ministry of Finance oversees insurance companies and the practices of auditing and accounting. The State Securities Commission (SSC), under the jurisdiction of the Ministry of Finance, regulates the securities market. The State Bank of Vietnam supervises bank and non-bank financial institutions. There are some areas of overlap, but cooperation between the three agencies is not common (Robinett, Benedatta and Anh, 2013). The SSC is charged with supervising the securities market. However, in the early part of its life, the SSC was not an independent securities regulator (World Bank, 2006). The actions of the SSC, as a regulator, were initially limited to the issuance of notices, rather than the invoking of stiffer penalties. The SSC received new powers after the enactment of the Law on Enterprises (2005) and the Law on Securities (2007). With its new-found powers, the SSC became much more active in its enforcement role. From 2008-2013, the SSC issued 150 fines on average each year. Most of the fines were assessed to public companies. Other enforcement actions, such as warnings, civil or criminal charges, or other administrative penalties, are quite rare however (Robinett, Benedetta and Anh, 2013).

2.2 Corporate governance reform in Vietnam

Corporate governance in Vietnam is in the early stages of development. The impetus for reform of corporate governance practices began in earnest in 2004. The International Finance Corporation (IFC), a branch of the World Bank, completed a baseline study of corporate governance practices in 2006. The purpose of the baseline study was to profile the current corporate governance practices of Vietnamese, identify ways to improve governance practices, and offer recommendations that regulators and legislators could use to overhaul and strengthen the existing legal and regulatory framework pertaining to corporate governance (World Bank, 2006). One of the main conclusions of the baseline study was Vietnamese firms did indeed comply with the existing laws and regulations. Though firms appeared to comply with the laws and regulations, the observed practices were often a significant departure from the spirit or intent of the laws and regulations. The study concluded that the current laws, rules, and regulations in effect in 2006 were not drafted clearly enough to provide guidance and direction for the firms. In addition, the enforcement or implementation of the regulations was not deemed effective. The report concludes with several clear recommendations to improve disclosure, strengthen the role of the board of directors and inspection committee, plus measures to strengthen and protect shareholder rights. Moreover, the institutions tasked to enforce, regulate, and develop the capital market were often constrained by insufficient resources. The World Bank Report highlights the many obstacles which needed to be overcome in order for corporate governance practices in Vietnam to reach levels equal to the practices of observed in its regional peer nations. Three major challenges: (i) implementing new laws, (ii) granting enhanced powers to the regulatory agencies, and (iii) strengthening enforcement, remain for the Vietnam capital market.

The baseline study predated the passage of the Enterprise Law and other regulatory and legal changes. The draft of the Enterprise Law included many of the recommendations included in the baseline report. As noted earlier, the passage of the Enterprise Law was followed by a flurry of other legal and regulatory changes from the Ministry of Finance, the State Securities Commission, and other regulatory bodies. Both the 2006 and the 2013 reports (World Bank, 2006; Robinett, Benedetta and Anh, 2013) summarize the observance of OECD Corporate Governance in Vietnam. The results in the table show corporate governance practices have improved at listed companies in Vietnam. However, recent surveys by the IFC paint a somewhat different picture.

In 2010, the IFC sponsored a series of studies designed to evaluate the corporate governance practices of the 100 largest public companies listed on the Hanoi and Ho Chi Minh City stock exchanges (Corporate Governance Scorecard Report, 2010, 2011, and Vietnam Corporate Governance Scorecard, 2012). The yearly studies, completed in 2010 through 2012, consistently found corporate governance practices at Vietnamese public companies lagging behind their peers in neighboring Asian countries. The surveys show firms included in the surveys struggling to make meaningful changes in their governance practices. The Vietnam Corporate Governance Scorecard 2012 report notes that the difficulty in improving practices was not for lack of a legal and regulatory framework. The report spotlights "[Corporate governance] practices in Vietnam remain more evident in rules than in application and implementation (p. 14)". The report also notes "[Corporate governance] developments in Vietnam have been 'top down' and led by the legal framework and regulatory action… (p. 23)". The report states that listed companies have not responded to the enhanced and clarified rules and regulations with substantive changes in their governance practices. Investors continue to wait for companies to take on their responsibilities and make meaningful changes.

In the end, it is concluded that the development of corporate governance in Vietnam has been advancing gradually. Most of the reform measures and activities occurred during the past decade. Question remains on the impact of the improvement in the quality of corporate governance practices on firm valuation.

2.3 The two cities

There are two major cities in Vietnam. Hanoi is the capital and the second largest city in Vietnam. It is the political center of the country with all the government offices located in the city. The agriculture sector plays a major role in Hanoi's economic development. Ho Chi Minh City (formerly known as Saigon) is the largest and most populous city in Vietnam. More importantly, Ho Chi Minh City is the economic center of the country. The city is home to many export processing zones and industrial parks. It is also the leading receiver of foreign direct investment (FDI) in Vietnam. The economy of Ho Chi Minh City consists of industries ranging from mining, seafood processing, agriculture, and construction, to tourism, finance, industry and trade. The service sector accounts for half of the economic activities while the manufacturing and construction sectors account for the other half. Agriculture sector only accounts for a small portion of economic activities in Ho Chi Minh City.

Table 1 presents demographic and economic data of the two cities. It is apparent that Hanoi has a larger area but less populous than Ho Chi Minh City. However, the contribution to the economic output of Ho Chi Minh City to Vietnam is much larger than Hanoi. For example, total value of export for Ho Chi Minh City is more than twice the amount for Hanoi. The real estate sector is booming because of many large multinational corporations established their headquarters in Ho Chi Minh City. In contrast, the agricultural sector is much more important to Hanoi than Ho Chi Minh City. The growth rate of Ho Chi Minh City is also slightly higher than that of Hanoi. In summary, the market development and competition are much stronger in Ho Chi Minh City than in Hanoi. Nevertheless, Hanoi remains the focal point when it comes to government affairs and regulatory activities.

2.4 The two exchanges

The capital markets in Vietnam are still in infancy stage. The country's first stock exchange, the Ho Chi Minh City Stock Exchange (HOSE), was established only in 2000. By 2006, there were 47 companies listed on HOSE and HNX (World Bank, 2006). In 2012, there were more than 700 public companies listed on HNX and HOSE. A larger number of firms are listed on HNX than

HOSE, but the total market capitalization for HOSE is greater than that of HNX. Figure 1 shows the index values and trading volume of HOSE and HNX since inception.

Both HNX and HOSE come under the purview of the State Securities Commission (SSC). Historically, listed companies in Vietnam must comply with the relevant regulations established by the State Securities Commission (SSC) and other regulatory bodies. In 2007, a newly-drafted Securities Law enhances the powers and responsibilities of the two stock exchanges. Additional amendment of the Securities Law in 2010 left the exchanges under the oversight of the SSC, but the exchanges were transformed into self-regulating organizations. As self-regulating organizations, each exchange was given more power over the regulations covering the rules for listings, trading, and information disclosure. Both HNX and HOSE independently have the responsibility to monitor the firms listed on their exchange and are expected to discipline (usually with fines) wayward companies. In addition, HNX and HOSE have separate listing rules that companies must meet in order to be listed in respective exchange. In practice, both exchanges are also free to alter their listing rules. Though the general regulatory framework is common to both exchanges, the listing requirements differ is several respects, as shown in the Table 2.

From Table 2, it is apparent that the listing requirements for HNX are not as strict as those for HOSE. Not apparent from public and official information is the disclosure and transparency requirements. Although firms listed in either HNX or HSX must follow the same regulation (Circular 52/2013/TT-BTC or disclosure rule issued by the Ministry of Finance), the actual enforcements of the two exchanges are different. Firms on both exchanges must follow the disclosure rule issued by the Ministry of Finance. However, the Ho Chi Minh City Stock Exchange has a reputation of being stricter and more willing to impose sanctions or fines against violators. A a result, the general perception is that HOSE is stricter and has more leverage over listed companies than HNX does. Anecdotal evidence gleaned from company executives suggests that listing on HOSE is more desirable. Firms listed on the HOSE are perceived to have a higher reputation and image by virtue of their choice of listing venue. From Figure 1, it is also apparent that HOSE-listed firms enjoy better liquidity compared to firms listed in HNX. In the end, a listing in HNX may be a more desirable choice for firms that cannot meet the stricter listing requirements of HOSE, or for firms whose managers have with good relations with the Hanoi. Overall, there appears to be a spillover effect from the product market competition in Ho Chi Minh City on to the stock exchange.

2.5 Hypotheses

There are two main hypotheses to be tested in this study.

H_{01}: There is no difference in the quality of corporate governance practices between firms listed in HNX and firms listed in HOSE.

The first hypothesis implies that the proximity to the regulators does not improve corporate governance. At the same time, it also implies that the market development or economic force do not have an impact on corporate governance.

H_{02}: There is no difference in the relation between the quality of corporate governance practices and firm valuation between firms listed in HNX and firms listed in HOSE.

The second hypothesis implies that neither the proximity to the regulator nor the market development and competition affects the relation between corporate governance and firm valuation.

3. Data and Methodology

3.1 Sample

The data are obtained from three major studies sponsored by the IFC during 2010-2012. Each year, 100 companies are chosen from the listed firm on the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE). Selected firms selected were typically the largest firms, in terms of market capitalization, at the time. Most firms are included in the survey for at least two years.

3.2 The Corporate Governance Index (CGI)

The proxy for the quality of corporate governance practices used in this study is the Corporate Governance Index (*CGI*). In each survey year, the research team collected financial and company data that are available to the general public, from the prior fiscal year. The types of source documents used were annual reports, published financial statements, plus meeting announcements and other documents pertaining to the general meetings of shareholders (GMS) or annual general meeting (AGM). The research team also searched publicly available filings made with the stock exchanges in Hanoi and Ho Chi Minh City, the State Securities Commission or SSC, plus information from company websites and other information firms made available to media outlets.

The survey instrument used to assess firms' corporate governance practices each year contained 110 questions (see Appendix). The survey is designed based on the OECD's Principles of Corporate Governance (1999), an internationally accepted set of corporate governance standards. Consequently, the survey instrument consists of five parts: (A) the rights of shareholders (21 questions on the survey and 15 percent a firm's total score), (B) equitable treatment of shareholders (18 questions and 20 percent), (C) role of stakeholders in corporate governance (8 questions and 5 percent), (D) disclosure and transparency (32 questions and 30 percent), and € the responsibilities of the board of directors (31 questions and 30 percent). The survey instrument is similar to other corporate governance surveys used in corporate governance studies in other emerging market nations in Asia such as Thailand, Hong Kong, the Philippines, China, and Indonesia.[1] Questions in each area also considered the local Vietnam regulations and requirements with regard to corporate governance. In the final survey questionnaire the number of questions on each individual area and the relative weight given to each area in the CG score, as determined by the project committee consisting of officers from the IFC and the regulators. The final composite score (*CGI*) is used as a proxy for the firm's quality of corporate governance practices.

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[1] See for example Cheung, Jiang, Limpaphayom and Lu (2010) for China, Cheung, Connelly, Limpaphayom and Zhou (2007), Cheung, Connelly, Jiang and Limpaphayom (2011) for Hong Kong, Connelly, Limpaphayom and Nagarajan (2013) for Thailand and Cheung, Connelly, Estanislao, Limpaphayom, Lu and Utama (2014) for selected Southeast Asian economies including Indonesia and the Philippines.

Table 4 present the summary statistics for the Corporate Governance Index (*CGI*) during the study period. Panel A shows the descriptive statistics for the *CGI* for the full sample plus the statistics for the sample in each of the three survey years (2010-2012). Panel A also presents the statistics with the sample divided according to the stock exchange where each survey firm is listed, the Hanoi Stock Exchange (HNX) or the Ho Chi Minh City Stock Exchange (HOSE). The survey includes more firms listed in Ho Chi Minh City than firms from Hanoi. This is simply an artifact of the sample, as firms on HOSE tend to be larger than firms listed on HNX.

The average *CGI* score for the full sample, across three years, is 43.7 percent with a maximum of 60.1 percent and a minimum of 17.4 percent. This average corporate governance score is quite low, when compared to CGI scores from other nations.[2] The yearly averages show the mean and median CGI scores are relatively stable through time. The survey results show *CGI* scores actually slipping in 2012, as the mean, median, and maximum scores in 2012 all declined from their 2011 levels. These figures are consistent with the notion that the quality of corporate governance practices in Vietnam is progressing at a slow pace. Panel B shows the corporate governance index score divided by exchange, and divided by industry group. The sample of firms listed in Ho Chi Minh City includes firms from a wider range of industries than the firms listed in Hanoi.

3.3 Empirical approach

In the initial analyses, the relation between the quality of corporate governance practices and firm valuation is examined using OLS regression analyses. Tobin's *q*, a measure of firm market valuation, is the dependent variable. The quality of corporate governance practices is measure by the composite scores from the *CGI*. Variables for family ownership and various board characteristics are included in the regressions, as are other firm characteristics serving as control variables. The first model, shown below as Equation 1, is evaluated using the whole sample.

$$
\begin{aligned}
q_i = {} & \beta_0 + \beta_1 \mathrm{CGI}_i + \beta_2 \mathrm{ROA}_i + \beta_3 \mathrm{SIZE}_i + \beta_4 \mathrm{LEV}_i + \beta_5 \mathrm{SGR}_i + \beta_6 \mathrm{LIQ}_i + \beta_7 \mathrm{IND}_i \\
& + \beta_8 \mathrm{BSIZE}_i + \beta_9 \mathrm{SOWN}_i + \varepsilon_{1i}
\end{aligned} \tag{1}
$$

Control variables used in the study are defined as follows. ROA is a proxy of profitability calculated as the ratio of net income after taxes divided by total assets. Firm size (SIZE) is the natural log of total assets. LEV is the ratio of long-term debt divided by total assets. Sales growth (SGR) is the year-on-year change in total revenue. LIQ is a measure of liquidity calculated as cash and cash equivalents divided by total assets. SOWN indicates the proportion of outstanding shares held by the State. A number of board-related measures have been used in other studies as control variables. These elements (i.e., board size and board composition) and their relation to firm performance have been investigated in the literature but show mixed results. In this study, board size (BSIZE) is the number of directors on a firm's board while board independence (BIND) is the proportion of directors who are independent/outside directors. To ensure robustness of the results,

[2] For example, the Vietnam Corporate Governance Scorecard 2012 report, prepared by the International Finance Corporation (IFC, 2012; p. 13), specifically notes corporate governance practices at Vietnamese firms, on average, lag firms in other Asian nations. The report states "[T]here were much higher average scores in similar, but not identical, CG Scorecards across Asia. For example, Thailand in 2011 scored 77%, Hong Kong in 2009 scored 73% and the Philippines in 2008 totaled 72%."

both Random and Fixed Effect specifications are employed. In the Random Effect specification, a series of dummy variables indicating industry affiliations are included in the model (Equation 1).

To test the effect of listing location on the relation between the quality of corporate governance practices and firm valuation, regression analyses (Equation 1) are performed separately on firms listed in each exchange. In the random effect specification with the whole sample, further, a dummy variable indicating listing location and the interaction term are included as shown in the following model.

$$q_i = \beta_0 + \beta_1 CGI_i + \beta_2 \mathrm{ROA}_i + \beta_3 \mathrm{SIZE}_i + \beta_4 \mathrm{LEV}_i + \beta_5 \mathrm{SGR}_i + \beta_6 \mathrm{LIQ}_i + \beta_7 \mathrm{BOD}_i + \beta_8 \mathrm{BSIZE}_i + \beta_9 \mathrm{SOWN}_i + \beta_{10} \mathrm{HNX}_i + \beta_{11} \mathrm{HNX}\times CGI_i + \varepsilon_{1i} \quad (2)$$

To control for the effect of endogeneity, the following model (Equation 3) with the *CGI* as the dependent variable is included in the next analysis. The simultaneous regression analysis using the Two-Stage Least Squares (2SLS) Regression is performed on both (2) and (3).

$$CGI_i = \beta_0 + \beta_1 q_i + \beta_2 \mathrm{ROA}_i + \beta_3 \mathrm{SIZE}_i + \beta_4 \mathrm{LEV}_i + \beta_5 \mathrm{SGR}_i + \beta_6 \mathrm{LIQ}_i + \beta_7 \mathrm{BOD}_i + \beta_8 \mathrm{BSIZE}_i + \beta_9 \mathrm{SOWN}_i + \beta_{10} \mathrm{HNX}_i + \beta_{11} \mathrm{HNX}\times CGI_i + \varepsilon_{1i} \quad (3)$$

Subsequent analyses focus on the choice of listing location by Vietnamese firms. A Logistic Regression Analysis is performed on the following model (Equation 4). The dependent variable is a dummy variable indicating firms listed on Hanoi Stock Exchange (DHNX). The dummy variable HQHNX indicates whether firm's headquarters is located in Hanoi. This variable is included to test whether the proximity to the exchange has any impact on the choice of listing location. The Logistic regression model is show below.

$$HNX_i = \beta_0 + \beta_1 q_i + \beta_2 CGI_i + \beta_3 \mathrm{ROA}_i + \beta_4 \mathrm{SIZE}_i + \beta_5 \mathrm{LEV}_i + \beta_6 \mathrm{SGR}_i + \beta_7 \mathrm{LIQ}_i + \beta_8 \mathrm{BOD}_i + \beta_9 \mathrm{BSIZE}_i + \beta_{10} \mathrm{SOWN}_i + \beta_{11} \mathrm{HQHNX}_i + \varepsilon_{1i} \quad (3)$$

The last series of regression analyses add a few key variables to the first model (Equation 1) to test the interaction between state ownership, proximity to Hanoi and *CGI*.

4. Empirical Results

Descriptive statistics for all variables used in the regression analyses are presented in Table 5. All variables used in the study have been Winsorized to eliminate extreme values. Panel B also shows the results for testing of differences in means and median values between the firms listed on the HNX and HOSE. The results indicate that firms in HNX and HOSE are quite different in many aspects. Specifically, firms listed on the HNX tend to have low market valuation, as measured by Tobin's q, low profitability, and located close to HNX compared to firms listed on HOSE. However, firms listed on HNX, on average, have high liquidity, a high percentage of independent directors on the board, and high state ownership compared with firms listed on HOSE. The tests for differences in median values are mostly consistent with the mean tests. Table 6 contains a correlation matrix. Overall, the correlation coefficients do not indicate any serious issue with multicollinearity.

Table 7 contains the regression results, using the full sample, for two types of regressions. Models 1 and 2 employ the Random Effect specification (OLS) while Model 3 uses the Fixed Effect specification. The main dependent variable is Tobin's *q*. IN the univariate test (Model 1), the regression coefficient for the Corporate Governance Index (*CGI*) is positive and statistically significant. This finding suggests that there is a positive relation between the quality of corporate governance practices and firm valuation, as measured by Tobin's *q*. This result is also consistent with those documented by other emerging market studies in Asia. To control for effects of other factors, Model 2, a random effects model, includes control variables for profitability, size, leverage, growth, liquidity, board characteristics, and state ownership along with industry fixed effects and time fixed effects. Dummy variables for the industries and for each survey year are included in the regression. The results from Model 2 also confirm a positive and statistically significant relation between the *CGI* and firm valuation even when the control variables are included. The results from Model 2 also show positive and significant relations between Tobin's *q* and profitability, leverage, and liquidity. The results also show negative relations between Tobin's *q* and the size of the board of directors. The results from the Fixed Effect specification confirm the positive relation between *CGI* and Tobin's *q*.

In Table 8, the sample is split by listing exchanges (HNX or HOSE). Models 1 and 3 are random effects models while Models 2 and 4 are fixed effects models. The results for Model 1 through Model 4 show a consistent pattern for the relation between *CGI* and Tobin's *q*. The *CGI* consistently shows a positive and statistically significant relation for firms listed on HOSE in both the random effects (Model 3) and fixed effects (Model 4) models. The positive and significant relation holds even when the full spectrum of control variables, and industry, time, and firm fixed effects. In contrast, there is no observed relation between *CGI* and firm valuation for firms listed on HNX. Model 5 is a random effects model utilizing the full sample. Model 5 contains two additional terms: a dummy variable that equals one if a firm is listed on HNX, and an interaction term, multiplying the HNX dummy variable with *CGI*. The results for Model 5 clearly show a positive relation between *CGI* and Tobin's *q*. The coefficient for the Hanoi dummy is positive and statistically significant, whereas the coefficient for the interaction term is negative and statistically significant. Netting the coefficients of the HNX dummy and the interaction term, the results show a negative relation between *CGI* and firm value for firms listed on the HNX. It appears that the positive relation between *CGI* and Tobin's *q* in earlier models for the full sample were driven mostly by firms listed on HOSE. Finally, there is also a positive relation between firm value and profitability, leverage, and liquidity, but a negative relation between state ownership and the *CGI*.

There is a possibility that the results are driven by endogeneity. As a robustness check, a Two-Stage Least Squares Regression analyses are performed with both *CGI* and Tobin's *q* as dependent variables. Table 9 shows the results from a two-stage least squares (2SLS) regression. The dependent variable in the first equation is Tobin's *q*, while the dependent variable in the second equation is the CGI. The first equation shows a positive relation between *CGI* and contemporaneous value of Tobin's *q*. The coefficient for the HNX dummy is positive and statistically significant, while the coefficient for the *CGI* and HNX interaction term is negative and statistically significant. This result is the same as in previous analyses. The net effect, just as before, shows that HNX-listed firms have lower firm valuation than HOSE-listed firms. In the second equation with *CGI* as the dependent variable, the coefficient for the lag of Tobin's *q* is positive and statistically significant, implying a positive relation between prior market valuation and the quality of corporate governance practices in current year. This is consistent with the notion that good companies try to improve their quality of corporate governance practices. Most importantly, the coefficient for HNX is not statistically significant indicating that there is no difference in terms of the levels of quality of corporate governance between the two exchanges.

Table 10 contains two Logistic regression models. The models are structured such that the probability of listing in Hanoi is the dependent variable. A range of explanatory variables, including the *CGI*, Tobin's *q*, and the same control variables as in the previous models, are also included in the regressions. Two other noteworthy explanatory variables are included in the logistic regressions: the percentage of state ownership (the percentage of a firm's outstanding shares owned by the government or government agency), and a measure of proximity. The proximity or location measure is the distance, in kilometers, from a company's headquarters office to the HNX. To control for the industry, Model 2 includes industry fixed effects.

The results for Model 1 show no relation between *CGI* or Tobin's *q* and the probability of listing on the HNX. Interestingly, the coefficients for sales growth and liquidity both show a positive and statistically significant relation with the probability of listing on the HNX. In contrast, profitability shows a negative and statistically significant relation, implying less profitable firms are more likely to list on HNX. Interestingly, nearness to Hanoi exhibits a positive and statistically significant relation with the probability of listing on HNX. This implies that firms tend to list in the markets close to their headquarters. The results for Model 2 largely confirm the results in Model 1, except the coefficient for liquidity is no longer statistically significant. In addition, the results for Model 2 show that firm size has a negative and statistically significant relation with the probability of listing on HNX. This finding confirms that, consistent with the implications from the listing requirements, firms listed on HNX tend to be smaller than those listed on HOSE.

Table 11 divides the sample data into different categories in an effort to more clearly discern the relations between firm value, *CGI*, state ownership, and location (proximity to HNX). Panel A splits the sample first by the percentage of state ownership and next by the exchange on which a sample firm is listed, yielding four subgroups. There is no significant difference in *CGI* across the four sample subgroups, whether the sample is divided by exchange or level of state ownership. However, there is a statistically significant difference between the Tobin's *q* for HNX-listed firms versus HOSE-listed firms. The average Tobin's *q* value for HNX-listed firms is 0.657 compared with 0.798 for HOSE-listed firms. The difference is statistically significant indicating that companies in HOSE tend to have higher market valuation than firms in HNX.

For the whole sample, the average state ownership percentage, for firms with the government as a shareholder, is 44.89 percent. About 70 percent (184 out of 270 firm-year observations) of the sample have some level of state ownership. The results show that there is a statistically significant difference in the level of state ownership for HNX-listed firms versus HOSE-listed firms. The average state ownership percentage for HNX-listed firms is 39.4 percent compared to 28.1 percent for HOSE-listed firms. The difference is also statistically significant indicating that the state has more control over firms listed on HNX than those listed on HOSE.

Panel B divides the sample according to the location a firm's headquarters office, and by exchange. As in Panel A, there are no significant differences in *CGI* across the four sample subgroups. The sample is split by exchange in both Panels A and B. As a result, the differences in the average Tobin's *q* value and the percentage of state ownership for Hanoi-listed firms versus Ho Chi Minh City-listed firms are significant, as in Panel A. There is a statistically significant difference between the levels of state ownership at firms with headquarters closer to Hanoi versus Ho Chi

Minh City. The average state ownership percentage for firms with a corporate headquarters closer to Hanoi is 38.1 percent, versus 25.7 percent for firms with their corporate office closer to Ho Chi Minh City. The difference is significant at the 5 percent level or better.

Table 12 presents ordinary least squares random effects models to tease out the effects of state ownership and headquarters location on firm value. Two additional explanatory variables are added to the regressions in Table 12: the percentage of state ownership, and a measure of proximity or location. These two explanatory variables were used in the logistic regressions in Table 10. Two interaction terms are also included: *CGI* multiplied by the percentage of state ownership, and *CGI* multiplied by the distance from a firm's headquarters to the Hanoi stock exchange. The effect of state ownership is evaluated separately in Model 1, while the effect of proximity is examined in Model 2. The combined effect of state ownership and proximity is evaluated in Model 3. Model 4 is a full model, including a dummy variable and an interaction term for Hanoi-listed firms.

The results for control variables in Table 12 confirm the earlier findings. The coefficient of *CGI* is not statistically significant in Models 1 and 3, but positive and statistically significant in Models 2 and 4. The coefficients for profitability and liquidity are positive and statistically significant. The results provide robust evidence of a positive relation between profitability and firm value, and a positive relation between liquidity and firm value. The coefficient for board size is negative and statistically significant only in Models 1 and 3. This is weak evidence of a negative relation between board size and firm value. The coefficients for state ownership and proximity, and the related interaction terms, are not statistically significant in any regression. Model 4 is the full model, including variables for state ownership, distance from Hanoi, a dummy variable for HNX-listed firms, plus interaction terms with *CGI*, ownership, proximity, and HNX-listed firms. The results confirm a positive relation between corporate governance index and firm value, but not for HNX-listed firms. The variables for state ownership and proximity, together with the interaction terms, are not statistically significant.

5. Conclusion

Finally, previous research also shows that institutions may not only shape the nature of the dominant governance problems in different countries, but also influence the efficacy of firm-level governance solutions. This study examines the effect of the financial and institutional settings on the relation between the quality of corporate governance practices and firm valuation in Vietnam. The objective is to under the factors that influence corporate governance development. Vietnam provides an ideal setting because it has a unique institutional structure. Specifically, a Vietnamese firm can choose from two major stock exchanges for its listing. In the case of Vietnam, the development of the financial and regulatory structures varies significantly between the two stock exchanges. The Ho Chi Minh Stock Exchange (HOSE) is located in the center of the country's economic activities and is known for its business-friendly environment. In contrast, the Hanoi Stock Exchange (HNX) is located in the country's political center where all securities market regulators are situated. In addition, firms listed on HNX tend to be state-owned enterprises governed closely by the central government. In contrast, firms listed on HOSE tend to be more heterogeneous.

Moreover, the two cities also differ in other significant ways, including geographical separation, along with distinct demographic and economic characteristics. This provides a unique setting to test the impacts of listing location on various aspects of corporate governance while controlling for the effect of legal jurisdiction. The competing hypotheses focus on comparing the impact of market competition and proximity to regulators on corporate governance in Vietnam. The purpose of this study is to investigate the ways in which institutional structure, specifically the listing locations, can shape the dynamics of corporate governance structure and practices in an emerging market.

This study employs the data on the quality of corporate governance practices obtained from the three yearly corporate governance scorecard projects funded by the IFC. The sample consists of the 100 largest companies listed in HOSE and HNX during 2010-2012. The empirical results show that companies in both markets are quite similar with respect to size and financial leverage. However, companies listed on the HOSE are, on average, more profitable and have higher market valuation than companies in HNX. In contrast, companies listed on the HNX tend to be more liquid and have higher proportions of independent directors on their boards than those listed on HOSE. Interestingly, there is no discernible difference in terms of the quality of corporate governance practices among firms listed on the two exchanges. The descriptive results suggest that the listing location or proximity to the regulators does not affect the quality of corporate governance practices.

The most striking finding is a difference between the relation between the quality of corporate governance practices and firm valuation in the two markets. For companies listed on the HOSE, the relation is positive and statistically significant indicating that the quality of corporate governance relates to market valuation. In contrast, the relation is not statistically significant among companies listed on the HNX. Although firms in the two exchanges exhibit the same levels of the quality of corporate governance practices, the market valuation of firms in HOSE appear to be more responsive to the quality of corporate governance practices than firms in HNX. Robustness tests show that the results are not driven by endogeneity.

In order to find possible explanations of the previous findings, the final part of the study focuses on examining the differences in the listing rules of the two exchanges and potential causes for self-selection biases. Relevant factors such as state ownership, the location of companies' headquarters, and the choice of listing location are examined and eliminated as potential explanations. In the end, the findings reveal that the differences are attributable to the dissimilarities between the two cities and the two exchanges.

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Table 1
Characteristics of Hanoi and Ho Chi Minh City

Table 1 presents demographic and economic data for the entire kingdom of Vietnam and its two major cities, Hanoi and Ho Chi Minh City.

	Unit	Ho Chi Minh City	Hanoi	Entire Country
Total land	KM^2	2,095.6	3,324.3	330,972.4
Population	Thousands	7,818.2	6,936.9	89,708.9
Population Density	people/KM^2	3,731.0	2,087.0	271.0
# of hospitals		50	41	963
Primary schools		523,403	520,355	7,202,767
High school		329,415	322,676	4,869,839
Secondary schools		193,954	206,472	2,674,472
Gross domestic product (in current price)	*Billion dong*	764,562	451,213	3,584,300
Gross domestic product (at 2010 price)	*Billion dong*	609,350	321,691	2,543,600
Growth rate	*%*	9.3	8.5	5.4
Total revenue of state budget	*Billion dong*	229,514	163,043	790,800
Gross output of industry (2010 prices)	*Billion dong*	775,267	423,542	3,841,000
Investment outlay (in current price)	*Billion dong*	227,033	279,201	1,091,000
Retail sale of general trade (in current price)	*Billion dong*	582,635	193,960	2,669,000
Total value of export	*Million USD*	26,575	9,913	132,135
Gross output of agriculture (at 2010 prices)	*Billion dong*	10,840	30,594	798,909
Output of food crops	*1000 tons*	94	1,257	49,250

Table 2
Listing Requirements in Vietnam

Table 2 compares listing requirements for the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE).

	Ho Chi Minh City Stock Exchange (HOSE)	**Hanoi Stock Exchange (HNX)**
Equity	• Minimum 120 billion dong (VND)	• Minimum 30 billion dong (VND)
	• Operating as a joint stock company for at least 2 years	• Operating as a joint stock company for at least 1 year
Profitability	• Profitable for two consecutive years prior to listing date	• Profitable for two consecutive years prior to listing date
	• No cumulative loss on date of listing	• No requirement
Financial Performance	• No bad debts more than 1 year overdue	• No bad debts more than 1 year overdue
	• ROE > 5 percent for the most recent fiscal year	• ROE > 5 percent for the most recent fiscal year
Shareholding structure	• At least 20 percent of the outstanding shares owned by at least 300 shareholders (not including the major shareholders)	• At least 15 percent of the outstanding shares owned by at least 100 shareholders (not including the major shareholders)

Table 3
Comparisons of Stock Exchanges in Vietnam

Table 3 presents the characteristics of the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE) and the summary statistics for stocks listed in respective exchange.

	Hanoi Stock Exchange (HNX)	Ho Chi Minh City Stock Exchange (HOSE)
Trade Volume/Day (million shares)	48.2	56.1
Trading Value/day (billion dong)	438.4	877.9
Index Value	55.0	399.7
Number of listed companies	398.0	314.0
Market capitalization (trillion dong)	85.9	655.8
EPS	2,063.2	3,478.6
P/E	12.6	11.3
P/B	0.7	1.5
ROA (%)	4.4	9.0
ROE (%)	10.9	18.9
D/E	1.9	1.4
Dividend yield (%)	9.7	3.7

Table 4
Descriptive Statistics of Corporate Governance Index by Survey Year

Table 4 presents the average of the corporate governance index (*CGI*) based on the OECD Corporate Governance Principles (1999) for three *CGI* surveys. The surveys were completed in three consecutive years from 2010 – 2012. The sample is drawn from publicly-traded firms in Vietnam which are listed on the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE). The *CGI* is expressed as a percentage and ranges from 0 to 100. The survey questions are shown in the Appendix.

Panel A: Full Sample, Divided by Exchange and by Year

Survey Year	Mean	STD	Median	Max	Min	Number of Firms
Full Sample, All Years	43.7%	6.9%	44.1%	60.9%	17.4%	147
Full Sample, 2010	44.1%	8.1%	45.1%	60.9%	20.5%	86
Full Sample, 2011	44.6%	5.7%	44.4%	57.8%	28.8%	90
Full Sample, 2012	42.5%	6.5%	43.0%	57.5%	17.4%	94
Hanoi Stock Exchange (HNX) Firms						
2010	41.7%	9.8%	43.3%	54.7%	20.5%	21
2011	43.9%	5.9%	44.4%	52.5%	28.8%	20
2012	42.7%	6.8%	44.2%	50.3%	23.1%	18
Ho Chi Minh City Stock Exchange (HOSE) Firms						
2010	44.8%	7.4%	45.4%	60.9%	21.9%	65
2011	44.8%	5.7%	44.4%	57.8%	31.7%	70
2012	42.5%	6.5%	42.1%	57.5%	17.4%	76

Panel B: Full Sample, Divided by Exchange and by Industry

Survey Year	Mean	STD	Median	Max	Min	Number of Firms
Hanoi Stock Exchange (HNX) Firms						
Basic Materials	30.3%	7.9%	29.1%	38.7%	23.1%	3
Consumer Goods	43.8%	- -	43.8%	43.8%	43.8%	1
Financials	44.6%	3.9%	44.3%	51.3%	36.8%	13
Industrials	42.6%	9.4%	44.5%	54.7%	20.5%	12
Oil & Gas	41.9%	8.2%	45.4%	50.1%	25.0%	3
Ho Chi Minh City Stock Exchange (HOSE) Firms						
Basic Materials	46.3%	5.4%	46.1%	58.2%	36.0%	13
Consumer Goods	43.7%	6.7%	43.6%	57.8%	21.9%	21
Consumer Services	44.4%	6.0%	43.3%	54.8%	39.0%	4
Financials	44.2%	6.6%	44.0%	55.3%	24.0%	33
Healthcare	51.8%	5.3%	51.6%	60.9%	42.9%	4
Industrials	41.7%	6.8%	43.7%	50.5%	17.4%	26
Oil & Gas	45.1%	5.4%	45.3%	52.1%	37.3%	2
Technology	43.2%	8.2%	43.7%	54.8%	26.9%	5
Utilities	42.1%	4.9%	42.2%	50.6%	35.0%	7

Table 5
Descriptive Statistics

Table 5 presents summary statistics of variables used in the study. The sample is drawn from publicly-traded firms listed on the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE) during 2010-2012. Corporate governance index (*CGI*) is the percentage score from the Corporate Governance Index Survey based on the OECD Corporate Governance Principles (1999). Tobin's *q* is the book value of long-term debt plus the market value of equity divided by the book value of total assets. Corporate governance index (*CGI*) is the percentage score from the Corporate Governance Index Survey based on the OECD Corporate Governance Principles (1999). Profitability (ROA) is the ratio of net income after taxes divided by total assets. Firm size (SIZE) is the natural log of total assets. Financial leverage (LEV) is the ratio of long-term debt divided by total assets. Sales growth (SGR) is the year-on-year change in total revenue, expressed as a decimal. Liquidity (LIQ) is cash and cash equivalents divided by total assets. Board composition (BIND) is the number of directors on the executive board who are independent or outside directors divided by board size. Board size (BSIZE) indicates the number of directors on the executive board. State ownership (SOWN) is the percentage of shares owned by the government or a government agency. Distance from HNX is the distance in kilometers between a firm's headquarters and the Hanoi Stock Exchange (HNX). Standard deviations are shown in parentheses. t-statistics are calculated for the differences in the averages between HNX-listed firms and HOSE-listed firms. Z-statistics are calculated for the Wilcoxon's Rank Sum Test for median difference. *, **, and *** denote statistical significant differences at the 10, 5, and 1 percent level (two-tailed) respectively. The sample comprises 270 firm-year observations.

	All Firms (1)	Hanoi Stock Exchange (HNX) (2)	Ho Chi Minh City Stock Exchange (HOSE) (3)	Difference (2) – (3) and t-statistics	Z-statistics (Wilcoxon's Median Test)
CGI	43.7 (6.90)	42.8 (7.66)	44.0 (6.64)	-1.20 (-1.19)	-0.40
Tobin's *q*	0.767 (0.37)	0.657 (0.33)	0.798 (0.37)	-0.140*** (-2.62)	-2.81***
Profitability (ROA)	0.059 (0.08)	0.026 (0.08)	0.068 (0.08)	-0.042*** (-3.49)	-2.61***
Firm Size (SIZE)	22.127 (1.41)	22.188 (1.53)	22.111 (1.38)	0.078 (0.37)	0.10
Financial Leverage (LEV)	0.267 (0.21)	0.282 (0.23)	0.263 (0.20)	0.019 (0.62)	0.16
Sales Growth (SGR)	0.140 (0.40)	0.213 (0.41)	0.119 (0.40)	0.094 (1.59)	1.02
Liquidity (LIQ)	0.155 (0.17)	0.207 (0.25)	0.141 (0.14)	0.066* (1.96)	0.97
Board Composition (BIND)	0.592 (0.22)	0.655 (0.22)	0.575 (0.22)	0.080** (2.47)	2.51**
Board Size (BSIZE)	6.119 (1.53)	6.136 (1.72)	6.114 (1.47)	0.022 (0.10)	-0.52
State Ownership (SOWN)	30.59 (28.08)	39.469 (28.81)	28.109 (27.43)	11.36*** (2.78)	2.78***
Distance from HNX	1,027.6 (806.2)	318.397 (620.59)	1225.904 (738.43)	-907.51*** (-8.62)	-6.71***
Number of Observations	270	59	211		

Table 6
Correlation Matrix

Table 6 presents correlation coefficients among variables used in the study. The sample is drawn from publicly-traded firms in Vietnam which are listed on the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE). Panel A contains the descriptive statistics for the full sample. Panel B contains a comparison of the mean and median values for each variable, with the sample split according to the exchange: the Hanoi Stock Exchange (HNX) or the Ho Chi Minh City Stock Exchange (HOSE). Corporate governance index (*CGI*) is the percentage score from the Corporate Governance Index Survey based on the OECD Corporate Governance Principles (1999). Tobin's *q* is the book value of long-term debt plus the market value of equity divided by the book value of total assets. Corporate governance index (*CGI*) is the percentage score from the Corporate Governance Index Survey based on the OECD Corporate Governance Principles (1999). Profitability (ROA) is the ratio of net income after taxes divided by total assets. Firm size (SIZE) is the natural log of total assets. Financial leverage (LEV) is the ratio of long-term debt divided by total assets. Sales growth (SGR) is the year-on-year change in total revenue, expressed as a decimal. Liquidity (LIQ) is cash and cash equivalents divided by total assets. Board composition (BIND) is the number of directors on the executive board who are independent or outside directors divided by board size. Board size (BSIZE) indicates the number of directors on the executive board. State ownership (SOWN) is the percentage of shares owned by the government or a government agency. Distance from HNX is the distance in kilometers between a firm's headquarters and the Hanoi Stock Exchange (DHNX). Standard deviations are shown in parentheses. t-statistics are calculated for the differences in the averages between HNX-listed firms and HOSE-listed firms. Statistically significanCE at the 10 percent level are shown in bold.

		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	***CGI***	1.00											
(2)	***q***	**0.25**	1.00										
(3)	**Lag *q***	**0.25**	**0.82**	1.00									
(4)	**ROA**	**0.22**	**0.51**	**0.51**	1.00								
(5)	**SIZE**	**0.18**	**-0.16**	**-0.21**	**-0.14**	1.00							
(6)	**LEV**	-0.12	0.10	0.00	**-0.37**	0.06	1.00						
(7)	**SGR**	**0.12**	**0.22**	**0.19**	**0.28**	**0.11**	0.06	1.00					
(8)	**LIQ**	**0.12**	**0.18**	**0.20**	**0.29**	**-0.18**	**-0.41**	0.01	1.00				
(9)	**BIND**	**0.15**	**-0.17**	**-0.18**	**-0.19**	**0.38**	**-0.15**	-0.03	**0.11**	1.00			
(10)	**BSIZE**	0.08	**-0.11**	**-0.13**	-0.09	**0.40**	-0.04	0.06	-0.09	**0.13**	1.00		
(11)	**SOWN**	-0.03	-0.03	-0.02	**0.11**	0.07	0.05	0.04	0.05	0.00	**-0.18**	1.00	
(12)	**DHNX**	**0.11**	0.09	0.06	**0.17**	-0.09	-0.03	0.01	**-0.10**	**-0.16**	-0.04	**-0.22**	1.00

Table 7
Regression Results for Tobin's *q*

Table 7 presents ordinary least squares (OLS) and fixed effects regression results with Tobin's *q* as the dependent variable. The sample is drawn from publicly-traded firms listed on the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE) during 2010-1012. Tobin's *q* is the book value of long-term debt plus the market value of equity divided by the book value of total assets. Corporate governance index (*CGI*) is the percentage score from the Corporate Governance Index Survey based on the OECD Corporate Governance Principles (1999). Profitability (ROA) is the ratio of net income after taxes divided by total assets. Firm size (SIZE) is the natural log of total assets. Financial leverage (LEV) is the ratio of long-term debt divided by total assets. Sales growth (SGR) is the year-on-year change in total revenue, expressed as a decimal. Liquidity (LIQ) is cash and cash equivalents divided by total assets. Board composition (BIND) is the number of directors on the executive board who are independent or outside directors divided by board size. Board size (BSIZE) indicates the number of directors on the executive board. State ownership (SOWN) is the percentage of shares owned by the government or a government agency. Reported standard errors are adjusted for heteroskedasticity. t-statistics are shown in parentheses. *, **, and *** denote statistical significant differences at the 10, 5, and 1 percent level (two-tailed) respectively.

		Random Effects	Fixed Effects
	(1)	(2)	(3)
CGI	1.311*** (3.40)	0.622** (2.05)	0.740** (2.44)
Profitability (ROA)		2.114*** (6.06)	0.689 (1.61)
Firm Size (SIZE)		0.016 0.93	-0.101 (-0.91)
Financial Leverage (LEV)		0.613*** (5.83)	0.651** (2.32)
Sales Growth (SGR)		-0.013 -0.22	-0.027 (-1.05)
Liquidity (LIQ)		0.440*** (3.73)	-0.008 (-0.04)
Board Composition (BIND)		0.010 0.12	0.088 (1.00)
Board Size (BSIZE)		-0.018* (-1.69)	0.002 (0.11)
State Ownership (SOWN)		-0.001* (-1.75)	-0.001 (-1.05)
Constant	0.194 (1.18)	0.064 (0.17)	
Industry Fixed Effects	No	Yes	No
Time Fixed Effects	No	Yes	Yes
Firm Fixed Effects	No	No	Yes
Adjusted R^2	0.057	0.507	0.920
F-Statistic	17.13***	15.56***	
N	270	270	201

Table 8
Regression Results for Tobin's *q* by Exchange

Table 8 presents ordinary least squares (OLS) and fixed effects regression results with Tobin's *q* as the dependent variable. The sample is drawn from publicly-traded firms listed on the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE) during 2010-2012. Tobin's *q* is the book value of long-term debt plus the market value of equity divided by the book value of total assets. Tobin's *q* is the book value of long-term debt plus the market value of equity divided by the book value of total assets. Corporate governance index (*CGI*) is the percentage score from the Corporate Governance Index Survey based on the OECD Corporate Governance Principles (1999). HNX is a dummy variable with a value of one if a firm is listed on HNX and zero otherwise. Profitability (ROA) is the ratio of net income after taxes divided by total assets. Firm size (SIZE) is the natural log of total assets. Financial leverage (LEV) is the ratio of long-term debt divided by total assets. Sales growth (SGR) is the year-on-year change in total revenue, expressed as a decimal. Liquidity (LIQ) is cash and cash equivalents divided by total assets. Board composition (BIND) is the number of directors on the executive board who are independent or outside directors divided by board size. Board size (BSIZE) indicates the number of directors on the executive board. State ownership (SOWN) is the percentage of shares owned by the government or a government agency. Reported standard errors are adjusted for heteroskedasticity. t-statistics are shown in parentheses. *, **, and *** denote statistical significant differences at the 10, 5, and 1 percent level (two-tailed) respectively.

	HNX	HNX	HOSE	HOSE	Full Sample
	Random Effects	Fixed Effects	Random Effects	Fixed Effects	Random Effects
	(1)	(2)	(3)	(4)	(5)
CGI	-0.501	0.739	1.079***	0.794**	1.127***
	(-1.22)	(1.64)	(4.03)	(2.09)	(4.24)
HNX Dummy					0.673**
					(2.05)
***CGI* ×HNX Dummy**					-1.614**
					(-2.26)
Profitability (ROA)	0.722	1.349	2.447***	0.841	2.057***
	(1.08)	(1.61)	(7.10)	(1.55)	(5.89)
Firm Size (SIZE)	-0.112***	0.137	0.033	-0.209	0.009
	(-3.54)	(1.10)	(1.63)	(-1.42)	(0.52)
Financial Leverage (LEV)	-0.166	0.206	0.682***	0.786**	0.577***
	(-0.52)	(0.25)	(6.70)	(2.57)	(5.30)
Sales Growth (SGR)	0.048	-0.087	-0.071	-0.028	-0.025
	(0.47)	(-1.09)	(-1.29)	(-1.12)	(-0.48)
Liquidity (LIQ)	-0.260	-1.232**	0.524***	0.139	0.429***
	(-1.27)	(-2.78)	(3.90)	(0.61)	(3.34)
Board Composition (BOD)	-0.078	0.357*	-0.121	0.044	0.008
	(-0.47)	(2.05)	(-1.52)	(0.46)	(0.10)
Board Size (BSIZE)	-0.001	0.026	0.009	0.009	-0.013
	(-0.03)	(0.28)	(0.77)	(0.46)	(-1.25)
State Ownership (SOWN)	-0.002	0.002	-0.001*	-0.002	-0.001*
	(-1.44)	(0.90)	(-1.83)	(-1.11)	(-1.65)
Constant	3.508***		-0.502		-0.003
	(4.84)		(-1.34)		(-0.01)

	HNX	HNX	HOSE	HOSE	Full Sample
	Random Effects	Fixed Effects	Random Effects	Fixed Effects	Random Effects
	(1)	(2)	(3)	(4)	(5)
Industry Fixed Effects	Yes	No	Yes	No	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	No	Yes	No	Yes	No
Adjusted R^2	0.381	0.926	0.593	0.923	0.521
F-Statistic	3.38***		21.37***		14.90***
N	59	45	211	156	270

Table 9
Two-Stage Least Squares Regression Results

Table 9 presents two-stage least squares (2SLS) regression results with Tobin's *q* and *CGI* score as the dependent variables. The sample is drawn from publicly-traded firms listed on the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE). Tobin's *q* is the book value of long-term debt plus the market value of equity divided by the book value of total assets. Corporate governance index (*CGI*) is the percentage score from the Corporate Governance Index Survey based on the OECD Corporate Governance Principles (1999). HNX is a dummy variable with a value of one if a firm is listed on HNX and zero otherwise. Profitability (ROA) is the ratio of net income after taxes divided by total assets. Firm size (SIZE) is the natural log of total assets. Financial leverage (LEV) is the ratio of long-term debt divided by total assets. Sales growth (SGR) is the year-on-year change in total revenue, expressed as a decimal. Liquidity (LIQ) is cash and cash equivalents divided by total assets. Board composition (BIND) is the number of directors on the executive board who are independent or outside directors divided by board size. Board size (BSIZE) indicates the number of directors on the executive board. State ownership (SOWN) is the percentage of shares owned by the government or a government agency. t-statistics are shown in parentheses. *, **, and *** denote statistical significant differences at the 10, 5, and 1 percent level (two-tailed) respectively.

	Tobin's *q*	*CGI*
CGI	13.68***	
	(3.41)	
Lag Tobin's *q*		0.03**
		(2.02)
HNX Dummy	6.06***	0.02
	(3.35)	(0.86)
***CGI*× HNX Dummy**	-14.00***	
	(-3.37)	
Lag Tobin's *q* × HNX Dummy		-0.04
		(-1.19)
Profitability (ROA)	0.01	0.16**
	(0.01)	(2.08)
Firm Size (SIZE)	-0.21***	0.02***
	(-2.91)	(9.36)
Financial Leverage (LEV)	-0.01	0.02
	(-0.01)	(0.86)
Sales Growth (SGR)	-0.11	0.01
	(-0.91)	(0.20)
Liquidity (LIQ)	-0.30	0.04
	(-0.80)	(1.44)
Board Composition (BIND)	-0.51*	0.05**
	(-1.76)	(2.51)
Board Size (BSIZE)	0.05	-0.01
	(1.25)	(-0.75)
State Ownership (SOWN)	0.01	-0.01
	(0.05)	(-0.74)
Industry Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Adjusted R^2	-2.74	0.222
N	270	270

Table 10
Logistics Regression Results

Table 10 presents logistics regression results. The dependent variable is the probability of listing on the Hanoi Stock Exchange (HNX). The sample is drawn from publicly-traded firms listed on the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE). Tobin's *q* is the book value of long-term debt plus the market value of equity divided by the book value of total assets. Corporate governance index (*CGI*) is the percentage score from the Corporate Governance Index Survey based on the OECD Corporate Governance Principles (1999). HNX is a dummy variable with a value of one if a firm is listed on HNX and zero otherwise. Profitability (ROA) is the ratio of net income after taxes divided by total assets. Firm size (SIZE) is the natural log of total assets. Financial leverage (LEV) is the ratio of long-term debt divided by total assets. Sales growth (SGR) is the year-on-year change in total revenue, expressed as a decimal. Liquidity (LIQ) is cash and cash equivalents divided by total assets. Board composition (BIND) is the number of directors on the executive board who are independent or outside directors divided by board size. Board size (BSIZE) indicates the number of directors on the executive board. State ownership (SOWN) is the percentage of shares owned by the government or a government agency. HQHNX is a dummy variable with a value of one if a firm's headquarters is located nearer to the Hanoi Stock Exchange (HNX) than the Ho Chi Minh City Stock Exchange (HOSE), and zero otherwise. Wald Chi-square statistics are shown in parentheses. *, **, and *** denote statistical significant differences at the 10, 5, and 1 percent level (two-tailed) respectively.

	(1)	(2)
CGI	-0.805	-0.545
	(0.09)	(0.03)
Tobin's *q*	-1.339	-1.019
	(2.70)	(1.24)
Profitability (ROA)	-6.97**	-10.546***
	(4.19)	(5.14)
Firm Size (SIZE)	-0.192	-0.359*
	(1.45)	(2.77)
Financial Leverage (LEV)	1.274	0.218
	(1.28)	(0.02)
Sales Growth (SGR)	1.530***	1.676***
	(9.17)	(7.79)
Liquidity (LIQ)	3.016***	2.058
	(6.07)	(2.11)
Board Composition (BIND)	1.264	1.701
	(1.49)	(2.02)
Board Size (BSIZE)	0.080	0.084
	(0.37)	(0.27)
State Ownership (SOWN)	0.01	0.001
	(1.44)	(0.05)
HQHNX	2.29***	2.874***
	(30.14)	(31.39)
Constant	0.640	0.904
	(0.04)	(0.05)
Industry Fixed Effects	No	Yes
Likelihood Ratio	87.78***	125.95***
N	270	270

Table 11
Summary Statistics by Exchange Characteristics

Table 11 presents the averages of *CGI*, Tobin's *q* and state ownership (SOWN) categorized by exchange and headquarters location. The sample consists of publicly-traded firms listed on the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE). Panel A splits the sample by percentage of state ownership while Panel B divides the sample according to the location a firm's headquarters office. Tobin's *q* is the book value of long-term debt plus the market value of equity divided by the book value of total assets. *CGI* is the percentage score from the Corporate Governance Index Survey based on the OECD Corporate Governance Principles (1999). State ownership (SOWN) is the percentage of shares owned by the government or a government agency.

Panel A: CGI and Tobin's q Categorized by Exchange and Percentage of State Ownership

	HNX	HOSE	Total
State Ownership > 0			
CGI	43.2	43.8	43.7
Tobin's *q*	0.654	0.784	0.751
State Ownership Percentage	50.6	43.0	44.89[a]
	n = 46	n = 138	n = 184
State Ownership = 0			
CGI	41.2	44.3	43.8
Tobin's *q*	0.667	0.824	0.800
State Ownership Percentage	0.0	0.0	0.0[a]
	n = 13	n = 73	n = 86
TOTAL			
CGI	42.8	44.0	43.7
Tobin's *q*	0.657[b]	0.798[b]	0.767
State Ownership Percentage	39.4[c]	28.1[c]	30.6
	n = 59	n = 211	n = 270

[a, b, c] Difference between group means is statistically significant at the five percent level.

Panel B: CGI and Tobin's q Categorized by Exchange and Location of Company Headquarters (HQ)

	HNX	HOSE	Total
HQ Closer to HNX			
CGI	43.2	42.6	42.9
Tobin's *q*	0.665	0.758	0.715
State Ownership Percentage	42.1	34.6	38.1[a]
	n = 49	n = 57	n = 106
HQ Closer to HOSE			
CGI	40.5	44.5	44.3
Tobin's *q*	0.616	0.812	0.800
State Ownership Percentage	26.2	25.7	25.7[a]
	n = 10	n = 154	n = 164
TOTAL			
CGI	42.8	44.0	43.7
Tobin's *q*	0.657[b]	0.798[b]	0.767
State Ownership Percentage	39.4[c]	28.1[c]	30.6
	n = 59	n = 211	n = 270

[a, b, c] Difference between group means is statistically significant at the five percent level.

Table 12
Regression Results for Tobin's *q* with Exchange Characteristics

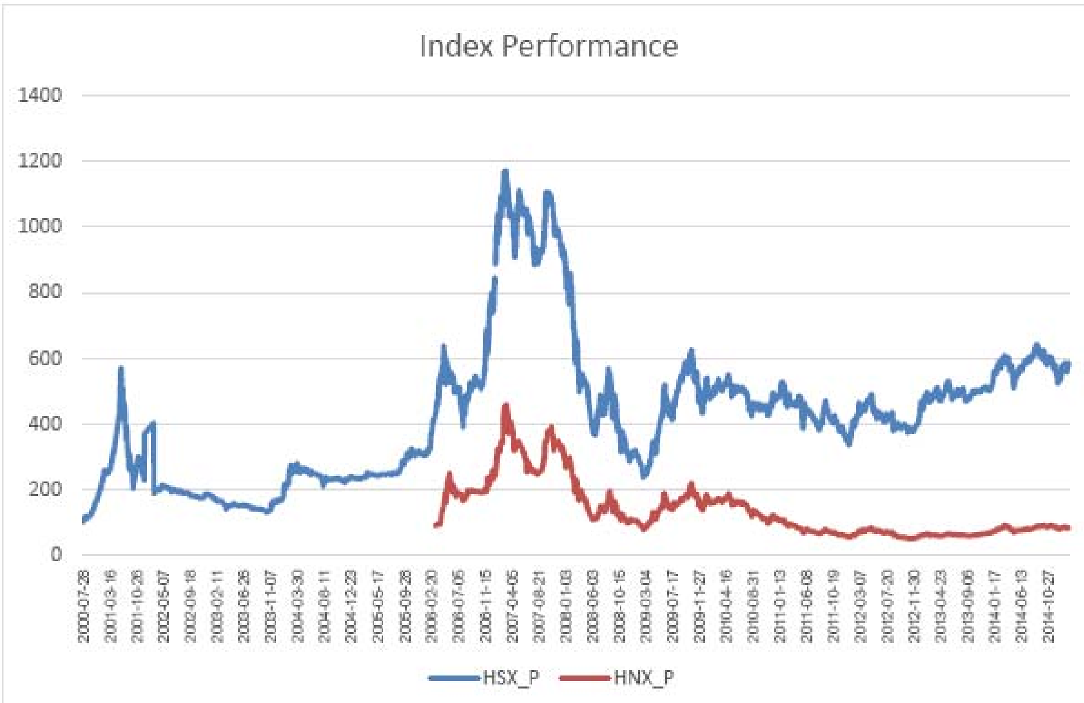
Table 12 presents ordinary least squares (OLS) regression results with Tobin's *q* as the dependent variable. The sample is drawn from publicly-traded firms listed on the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE) during 2010-2012. Tobin's *q* is the book value of long-term debt plus the market value of equity divided by the book value of total assets. Corporate governance index (*CGI*) is the percentage score from the Corporate Governance Index Survey based on the OECD Corporate Governance Principles (1999). HNX is a dummy variable with a value of one if a firm is listed on HNX and zero otherwise. Profitability (ROA) is the ratio of net income after taxes divided by total assets. Firm size (SIZE) is the natural log of total assets. Financial leverage (LEV) is the ratio of long-term debt divided by total assets. Sales growth (SGR) is the year-on-year change in total revenue, expressed as a decimal. Liquidity (LIQ) is cash and cash equivalents divided by total assets. Board composition (BIND) is the number of directors on the executive board who are independent or outside directors divided by board size. Board size (BSIZE) indicates the number of directors on the executive board. State ownership (SOWN) is the percentage of shares owned by the government or a government agency. CGI×SOWN is the product of the Corporate Governance Index (*CGI*) multiplied by state ownership. Distance from HNX is the distance in kilometers between a firm's headquarters and the Hanoi Stock Exchange (HNX). *CGI*×Distance is the product of the Corporate Governance Index (*CGI*) multiplied by Distance from HNX. The standard errors of the coefficients are adjusted for heteroskedasticity. t-statistics are shown in parentheses. *, **, and *** denote statistical significant differences at the 10, 5, and 1 percent level (two-tailed) respectively.

	(1)	(2)	(3)	(4)
CGI	0.598	0.766**	0.723	1.317**
	(1.15)	(2.25)	(1.20)	(2.48)
HNX Dummy				0.812**
				(2.05)
***CGI*× HNX Dummy**				-2.019**
				(-2.32)
Profitability (ROA)	2.115***	2.087***	2.127***	2.043***
	(6.06)	(6.05)	(6.10)	(5.85)
Firm Size (SIZE)	0.016	0.012	0.017	0.008
	(0.94)	(0.68)	(0.96)	(0.48)
Financial Leverage (LEV)	0.615***	0.608***	0.603***	0.575***
	(6.06)	(5.66)	(5.93)	(5.62)
Sales Growth (SGR)	-0.013	-0.011	-0.016	-0.025
	(-0.22)	(-0.17)	(-0.27)	(-0.52)
Liquidity (LIQ)	0.440***	0.431***	0.425***	0.428***
	(3.79)	(3.49)	(3.48)	(3.32)
Board Composition (BIND)	0.009	0.005	-0.002	-0.022
	(0.11)	(0.06)	(-0.02)	(-0.26)
Board Size (BSIZE)	-0.018*	-0.015	-0.019*	-0.014
	(-1.69)	(-1.40)	(-1.73)	(-1.31)
State Ownership (SOWN)	-0.001		-0.001	-0.004
	(-0.38)		(-0.33)	(-0.92)
***CGI*× SOWN**	0.001		0.001	0.007
			(0.00)	(0.67)
Distance from HNX		0.001	0.001	0.000
		(0.32)	(0.11)	(0.64)
***CGI*× Distance from HNX**		0.000	0.000	0.000
		(-0.40)	(-0.28)	(-0.93)

	(1)	(2)	(3)	(4)
Constant	0.074	0.034	0.052	-0.002
	(0.18)	(0.09)	(0.11)	(0.00)
Industry Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R^2	0.505	0.500	0.503	0.525
F-Statistic	14.73***	14.47***	13.40***	13.37***
N	270	270	270	270

Figure 1
Stock Market Performance in Vietnam

Figure 1 presents the index values and trading volume since inception for both the Hanoi Stock Exchange (HNX) and the Ho Chi Minh City Stock Exchange (HOSE). HNX_P indicates the index values for HNX (in red) while HSX_P indicates the index values for HOSE (in blue).



Appendix

The scorecard employed in this study is constructed based on the OECD's Principles of Corporate Governance (1999). Following the principles delineated by the OECD, the survey consists of five parts. Part A contains 21 questions. Part B contains 18 questions. Part C has 8 questions. Part D has 32 questions. Part E has 31 questions. For each question, there are three levels of responses: 0 point for non-compliance, in which an expected practice is not observed, deficient, missing or non-compliant information; 1 point for fair compliance, in which an expected practice is partially observed; and 2 points for good compliance, in which an expected practice is observed or exceeded.

PART	
A	**Rights of shareholders (Scorecard weight – 15 percent)**
	Shareholder rights defined and disclosed
A.1	Are the voting rights of shareholders clear and unequivocal?
A.2	Does the company offer ownership rights, more than basic rights (voting rights, right to freely transfer shares and right to timely information)?
A.3	Do shareholders have the right to nominate and remove members of the BOD and the SB?
A.4	Are the dividend and dividend payment policies transparent?
A.5	Do shareholders have the right to approve major corporate transactions (mergers, acquisitions, divestments and / or takeovers)?
A.6	Was the AGM held within four months of end of fiscal year?
A.7	Are there adequate company systems for shareholder attendance at AGMs?
A.8	Are the AGM shareholder meeting notices effective?
A.9	Are the policies and processes for shareholders to ask questions at the AGM clear and time is allowed on the agenda?
A.10	Does AGM information record opportunities for shareholders to ask questions?
A.11	Is the attendance at the last AGM of Chairman / Head of Supervisory Board / other board members / CEO / evident?
A.12	Are AGM policies and processes in the last year (if no nomination in the last year, go to check the two years back, or even three years back) two years (notices and information) sufficient for shareholders to evaluate individual board nominations?
A.13	Do shareholders effectively vote (receive information on, make their views known and vote) on board and key executive remuneration annually?
A.14	Did the external auditor attend the AGM and the express his views on audit/financial statements issues?
A.15	Did the shareholders effectively approve the appointment of the external auditor?
A.16	Did information provided to shareholders for the appointment of the external auditor include information on independence?
A.17	Is a full report provided to AGM on BOD performance?
A.18	Is a full report provided to AGM on the performance of the Supervisory Board?

PART	
A.19	Did the AGM notice include explicit information on accessible systems for proxy voting and voting in absentia?
A.20	Do AGM meeting minutes and the company website disclose individual resolutions, with voting results for each agenda item?
A.21	Are there no additional items included in the AGM minutes not included on the original meeting notice?

PART	
B	**Equitable treatment of shareholders (Scorecard weight – 20 percent)**
B.1	Does each share in the same class of shares have the same rights?
B.2	Does the company have a 'one share, one vote' policy?
B.3	Can minority shareholders impact the composition of the board?
B.4	Are directors' required to be re-nominated and re-elected at regular intervals?
B.5	Is cross border voting facilitated by the company?
B.6	Is a description of the company group structure available and clear and transparent?
B.7	Is there evidence of structures / mechanisms that have the potential to violate minority shareholder rights?
B.8	Are there mechanisms that provide effective redress for complaints of shareholders?
B.9	Do shareholders have the right to approve fundamental company changes?
B.10	How many days before the AGM were the meeting notices sent out?
B.11	Can a small shareholder place an item on the AGM agenda?
B.12	Are there company policies in place that effectively prohibit the misuse of information by directors, management and staff?
B.13	Are there any known cases of insider trading involving the company directors, management or staff in the past year?
B.14	Are there effective company policies for the company to approve relevant related-party transactions?
B.15	For large company transactions, does company policy require the provision of information to explain RPTs and require shareholder approval of RPTs above a certain threshold?
B.16	Have there been cases of non-compliance with requirements relating to related party transactions in the past year?
B.17	How does the board deal with declarations of conflict of interest?
B.18	Does the company have an effective investor relations / information policy and program?

PART	
C	**Role of stakeholders (Scorecard weight – 5 percent)**
C.1	Does the company recognize company obligations (in law and agreements) to key stakeholders and engage them?
C.2	Does the company provide a range of performance enhancing employee benefits to align company and employee interests?
C.3	Have mechanisms been introduced that facilitate communication to board members of illegal and unethical company practices?
C.4	Does company policies / information recognize the safety and welfare of employees?
C.5	Does company policies/information mention the environment?
C.6	Are stakeholders able to directly communicate on company performance with the BOD, BOM and Supervisory Board?
C.7	Is there some company recognition of its obligations to the broader community?
C.8	Is there a clear framework for the enforcement of creditors' rights?

PART	
D	**Disclosure and transparency – (Scorecard weight – 30 percent)**
D.1	Is there evidence that the concept of 'material information' is well understood by the company?
D.2	Does the Annual Report give a full and clear picture of the financial performance of the company?
D.3	Are the financial reports disclosed in a timely manner?
D.4	Did the company provide quarterly and semi-annual reports in the past year?
D.5	Do the CEO and Chief Accountant certify the annual financial statements, audited and unaudited?
D.6	Does the company use internationally accepted accounting standards?
D.7	Does the Annual Report include a full and clear picture of company operations, its competitive position and other non-financial matters?
D.8	Are details of current largest shareholdings provided?
D.9	Are directors' (BOD and SB) shareholdings disclosed?
D.10	Are senior management's shareholdings disclosed?
D.11	Are the company shares broadly held?
D.12	In the Annual Report is board member experience disclosed?
D.13	In the Annual Report, are non-executive directors specifically identified?
D.14	Does the Annual Report specifically identify 'independent' directors?
D.15	Does the Annual Report disclose BOD / SB meeting attendance of individual directors?
D.16	Is the basis (level and mix) of board remuneration disclosed in the Annual Report?
D.17	Does the latest Annual Report identify the company's main executives and their responsibilities?
D.18	Does the latest Annual Report disclose the remuneration of key executives?
D.19	Does the company have evidence for a disclosure policy requiring disclosure of related-party transactions?
D.20	Are statements requesting directors to report their transactions in company shares evident?
D.21	Does the Annual Report explain foreseeable business risks?
D.22	Does the Annual Report include a separate, quality corporate governance report?
D.23	Does the company have an annual external audit undertaken by an authorised auditor?
D.24	Do AGM and/or company documents refer to the 'independence' of the external auditor?
D.25	If a change of auditor is noted in the past two years, were the reasons for the change disclosed?

PART	
D.26	Is there a policy that reviews the external auditor when undertaking non-audit services?
D.27	Is the external auditor's opinion publicly disclosed?
D.28	Has there been any accounting / audit changes, qualifications or queries related to the financial statements in the past two years?
D.29	Does the company provide a variety of communication methods?
D.30	Is the information on the company website comprehensive and accessible?
D.31	Does the company have a policy and process to ensure continuous ad hoc disclosure of important matters?
D.32	Does the company provide easy public access to and contact details for the Investor Relations person or unit?

PART	
E	**Responsibilities of the board (Scorecard weight – 30 percent)**
E.1	Has the company promulgated good CG guidelines?
E.2	Does the company have clear company values and direction led by the BOD?
E.3	Does company CG guidance disclose the material transactions that must be approved by the board?
E.4	Is the Chairman's role at board meetings clearly described in the company CG guidance?
E.5	Is the Chairman a non-executive director?
E.6	Is the Chairman 'independent' of the company?
E.7	How many BOD members are non-executive?
E.8	What percentage of the BOD is 'independent'?
E.9	Is there evidence of the BOD being a 'balanced board'?
E.10	Does company information and director information clearly state/disclose the number of board seats each director holds?
E.11	Does the company have a board induction policy and program for new appointments to the BOD and SB?
E.12	Do the BOD and SB undertake an annual self assessment / evaluation?
E.13	Did BOD and SB members and CEO participate in CG training and report this?
E.14	How often did the BOD meet in the past year?
E.15	How often did the SB meet in the past year?
E.16	Are there mechanisms in place to ensure board members receive adequate notification of the board meeting for all BOD / SB meetings?
E.17	Do the BOD and SB keep meeting minutes and resolution records of each meeting?
E.18	Has the BOD established BOD committees (Audit Committee, Remuneration Committee and Human Resource Committee) or designated a BOD person?
E.19	Is there evidence the BOD receives regular management reports on the company activities and its financial position?
E.20	Is there evidence the BOD is responsible for the strategy and business plans of the company?
E.21	Is the BOD and SB is responsible for and oversees the risk management system of the company?
E.22	Do the BOD / SB assess the CEO and key executives annually?
E.23	Is there any evidence of non-compliance of the company over the last year?
E.24	Do company documents cover/explain internal control structures, policies and practices?
E.25	Does the internal audit function provide an independent evaluation of the internal control process and risk management of the company annually?

PART	
E.26	Does the company report on the activities of internal audit in its Annual Report and / or SB Report?
E.27	Is there evidence of the practical SB oversight of the external auditor?
E.28	Is there evidence of the SB review and approve the Annual Report and financial statements?
E.29	Does the SB report include discussion of the SB supervision of operational and financial condition of the company; and of the performance of BOD, BOM and executive officers?
E.30	Does the SB Report include reference to the SB's performance, issues discussed and decisions taken?
E.31	Does the SB report on its evaluation of the coordination between the SB, BOD, BOM and shareholders?

Firm’s operant resources and service value – a customer perspective

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Departing from the commonly understanding that a firm’s operant resources are used by firm to create service value, the purpose of this study is to examine how a customer’s perception of a firm’s operant resources (representational, cultural and social resources) affects the service value in a highly interaction service context. An empirical analysis was conducted on 263 patients in health care service in Vietnam. The results show that firm’s operant resources as viewed by customers have significant impact on service value. Of which, cultural resource has strongest weight on customer perceived value. Discussions and managerial implications have been presented accordingly.

Keywords: firm operant resources, service value, word-of-mouth, healthcare services, Vietnam..

1. Introduction

The term of value is essential for any firms (Woodruff, 1997) but it is not consistently understood by researchers because of its overuse in variety of fields such as finance, economics, management, information systems, ethics, marketing… (Khalifa, 2004). However, most of scholars agree that service value is formed by the perception of customers (Khalifa, 2004) when experiencing of any kinds of services (Heinonen, Strandvik and Voima, 2013). The customers' service experience may associate with both benefits that they enjoy after using a service, and what that they have during the service process (Heinonen, Strandvik and Voima, 2013).

In service dominant logic (SDL), firms and customers are considered as value co-creators, and both have to integrate their resources including operand and operant ones, in order to create value for customers. Firm's operant resources which refer reputation, employees' skills/knowledge, relationship value… (Baron and Warnaby, 2011) play an important role in the value creating process (Vargo and Lusch, 2004; 2008). Moreover, operant resources with their characteristics of dynamic and infinite can create additional values for themselves and additional operant resources (Vargo and Lusch, 2004). Therefore, it is necessary for service firms to understand the way their operant resources create value for customers will help them improving their performance to satisfy their customer. However, to the service where the quality of outcomes heavily depends on the service encounter credence, and requires intensity interaction of customers at each encounters in the service process, there are two questions should be concerned: How customers evaluate operant resources of a service firm during an intensity interaction process? And what kind of firm's operant resources has strongest effect on customer's service value which leads to positive word-of-mouth?

Based on previous argument, this study developed a model to test the different impacts of firm's operant resources including representational, cultural and social relational resources on service value co-created by both parties, and to validate the relationship of perceived value and positive word-of-mouth effect. The health care service was chosen because this service requires intensity interaction of patients and physicians during service process. The study was conducted in HoChiMinh city where this service occupies the biggest market share in Vietnam, which served 31 million cases in 2013 (according HCMC General Statistics Office).

Following this introduction, the literature review and hypothesis development, method, result, discussion and conclusion are presented.

2. 2. Literature review and hypothesis development

2.1. *Firm's operant resources*

In general, a firm's resources can be categorized as operand resources and operant resources. Operand resources are the typical material properties such as financial resources, infrastructure, and legal ownership while operant resources are the typical factors related to human, organization, communication and relationships (Constantin & Lusch (1994). They have different features in terms of value and the ability to copy (Clulow, Barry & Gerstman, 2007). Operant resources of a firm represent its capacity and capabilities that fluctuate when firms adapt to the surroundings to maintain operations and create value (Baron & Warnaby, 2011).

Although operant resources are properties of a firm, they can be observed and evaluated by customers (Clulow et al., 2007). On this view, Baron and Warnaby (2011) describe operant resources of a firm under the clients' perspective through three elements: representational resources: reputation, credibility and comfort; cultural resources: knowledge, management skills, capacity, quality of service and technical expertise; and social resources: the friendliness of staff, relations, C2C networking.

Cultural Resources are resources related to the mission of the organization, customs, skills and staff expertise, ability of organizing service, etc. They are divided into small groups: (1) the secret, capacity, staff expertise, (2) ability of organizing service, and (3) technical skills, technology, materials, etc. (Baron & Warnaby, 2011). This research borrows Dagger, Sweeney and Johnson (2007) who specify the components of cultural resources and suggest measurement scales for them including staff expertise, service process, and staff interaction. Staff expertise describes what the customer receives as a result of the interactions with the staff of a service company (Brady & Cronin, 2001; Donabedian, 1992; Grönroos, 1984; Rust & Oliver 1994). Staff expertise reflects the ability of a service provider adhering to high standards of service delivery (Zifko-Baliga & Krampf 1997). Adapting this notion to this specific research setting, staff expertise is manifested by the capacity and knowledge of physicians. Service process does not only facilitate the production of the core values of a service, but also increases the value in use for customers (Grönroos 1990, Lovelock, Patterson & Walker, 2001). This service process is reflected by timeliness, organizational management (i.e., the collaboration between the departments, the ability to organize and manage services, and support (i.e., convenience and ease in the administrative procedures for customers) (Dagger et al., 2007; Wensing, Grol & Smits, 1994). Staff interaction refers the communication between service provider and customer (Brady & Cronin, 2001; Grönroos 1984). It covers three core themes: manner, communication and relationship. Manner relates to the customer's perception on the attitude of service provider or service provider's employees in common discussion. Communication refers to the interaction between service provider and customer which bears a nature of interpersonal process and information transfer between both parties. Relationship refers to the close and strong relationship with provider and customer (Dagger et al., 2007).

Representational resources are things related to firm image, reputation that customers feel about a service provider when making decision to choose its service. Representational resources mostly imply a customer's positive mood, reflecting hospitality and reasonable comfort that he or she feels about the firm (Baron & Warnaby, 2011).

Social resources are resources relating to the relationships between a firm and its customers; between a firm and its employees, and between a firm and its partners and community (Baron & Warnaby, 2011). Madhavaram and Granot (2014) propose that network competences should also be seen as a firm's social resources which help to establish and use relationships with other firms.

2.2. *Service value*

Service value is defined as a consumer's overall assessment of the utility of a service based on perceptions of what is received and what is given (Zeithaml, 1988). There have been several approaches to the dimensionality of this highly abstract construct (Babin & James, 2010). For parsimonious reason, the current study adopts service value as consisting of two interrelated components, namely process value (or functional value) and outcome value (or technical value) (Hau and Thuy, 2012). Process value is the value which customers experience during the service process, while outcome value refers to customer's perception of its outcome benefits after using the service (Hau and Thuy, 2012).

The service-dominant logic (S-D logic) (Vargo and Lusch, 2004, 2008) emphasizes the role of customers as value co-creators. In the service process, value for customers is created and varied across different customers who possess different skills and knowledge (Vargo and Lusch, 2004; Grönroos, 2008). In contrast, providers play the role of value facilitators who provide foundation to facilitate customer's value creation (Grönroos, 2008). If service firms want to actively join in the process, they have to understand their customers. To do that, firms need to interact with their customers through which their operant resources can be deployed and integrated into the customer's value creation process (Grönroos, 2008).

2.3. *Firm's operant resources and customer perceived value*

According Vargo and Lusch (2004), during the service interaction process, customers may assess the firm operant resources which are manifested via frontline staff's capability and skills (i.e., cultural resources). Moreover, when customers take part in the service process, they experience service scripts at each of service encounters. Service value at that time will be formed via their behavioral procedures. The form of "activity-based experience" or "mental experience" provides customers with chances to see how good the firm provides operant resources to assist them having better service value (Heinonen et al., 2013).

When experiencing a healthcare service, customers embed their bodies and mental during the process. Consequently they are aware that the provider has reputation (1) and its employees show comfort and goodwill; realizes that physicians are skillful, and have good interaction with them. Additionally, the service process is reasonable and effective (2) and recognize that this healthcare service center has good connection with others. These positive assessments would lead to positive perception of the service value. Therefore, hypotheses are presented as follows:

H1: Firm's representational resource has positive impact on perceived service value.

H2: Firm's cultural resource has positive impact on perceived service value.

H3: Firm's social resource has positive impact on perceived service value.

2.4. *Service value and positive word-of-mouth effect*

Word-of-mouth effect refers to a process of personal influence, in which interpersonal communications between customers can change the customer's behavior or attitudes (Sweeney, Soutar & Mazzarol, 2008, Harrison-Walker, 2001). This effect is believed to result from a positive evaluation of an acquired service (Abdolvand et al., 2012). Hartline and Jones (1996) find a significant influence of perceived value on word-of-mouth, especially in the service context. In the context of health care service, patients are unwilling to use the service again. Therefore, loyalty through repeat patronization is not appropriate, whereas loyalty through positive word-of-mouth can be a powerful marketing tool. Ferguson et al. (2007) find that perceived value significantly affect word-of- mouth related to recommending the hospital to potential patients. Therefore, it is hypothesized that:

H4. There is a positive impact of perceived service value on word-of-mouth effect.

3. Method

The target respondents of this empirical research were the patients in HoChiMinh city. Data were collected by face-to-face interview and online survey using structured questionnaire which was administered at several hospitals and clinics. Convenient sampling was used in this study.

The measurement scales for firm's operant resources were adopted from Dagger et al. (2007) which included representational resources (3 items), cultural resources including service process (4 items), expertise (4 items) and staff interaction (7 items); and social resources (3 items). The scale measuring word-of-mouth was derived from Chaudhuri (2002) and Jurisic and Azevedo (2011) which includes 4 items. The scale measuring service value was adopted from Hau and Thuy (2012) which process value (2 items) and outcome value (4 items). All the scales were adjusted to the health care service context.

4. Results

In total, there were 263 patients responding the survey. Table 1 shows key characteristics of the sample.

Exploratory factor analysis was first employed to preliminary check construct validity and 14 variables was eliminated, then confirmatory factor analysis (CFA) was conducted in AMOS (Arbuckle & Wothke, 1999). The distributions of variables showed kurtosis values within -0.473 to +0.882 and skewness values range from -0.790 to +0.175 which proved that it is appropriate for maximum likelihood (ML) estimation to be applied (Kline, 1998). The CFA of the full measurement model with the remaining 17 items yielded the following measures: $\chi 2$ = 173.058; df = 91; p = 0.000; $\chi 2$/df = 1.902; GFI = 0.925; TLI = 0.956; CFI = 0.970; RMSEA = 0.059. It is also noted there is no requirement being violated (Hair et al., 2006).

	Frequency	%		Frequency	%
Gender			**Marital status**		
Male	111	42.2	Single	112	42.6

Female	152	57.8	Married, no child	25	9.5
Age			Married with child	126	47.9
< 25	32	12.2			
25-34	118	44.9	**Frequency in using service/year**		
35-44	61	23.2	1 time	63	23.95
≥ 55	52	19.7	2 – 3 times	134	50.95
Income			4 – 6 times	48	18.25
< 5 millions	97	36.9	> 6 times	18	6.85
5 – 10 millions	88	33.5			
10 –< 15 millions	51	19.4			
≥ 15 millions	27	10.3			

Besides, results showed that all item loadings on operant firm resources, perceive value and customer word-of-mouth constructs range from 0.668 to 0.928 indicating satisfactory convergent validity. Discriminant validity was also satisfactory as the correlations between 28 pairs of constructs resulted in the range from 0.304 to 0.831 which are well below 1. The composite reliability of the constructs range from 0.75 and 0.89 and the extracted variances ranged from 0.53 to 0.81, all exceed acceptable standards for exploratory research (Kline, 1998).

Next, the structural equation model was estimated using ML method. The result showed the research model fit the data satisfactorily: $\chi^2 = 227.293$; df = 107; p = 0.000; χ^2/df = 2.124; GFI = 0.899; TLI = 0.945; CFI = 0.957; RMSEA = 0.06. The results (Figure 1) indicated that Cultural Resource has a strongest significant standardized effect ($\beta = 0.733$; p = 0.036), the next one is Representational Resources ($\beta = 0.239$; p = 0.023) and the weakest significant standardized effect is Social Relation ($\beta = 0.126$; p = 0.039) on Service Value. Service Value in turn has a strongly significant standardized effect on word-of-mouth ($\beta = 0.718$; p = 0.025).

The results also show that three standardized coefficients representing the reflective paths from cultural resource (second-order construct) to its three dimensions (first-order construct) were Service process ($\beta = 0.703$; Expertise ($\beta = 0.728$; Staff Interaction ($\beta = 0.948$). Another second-order construct Service Value has been reflected by Outcome Value ($\beta = 0.927$) and then Process Value ($\beta = 0.894$).

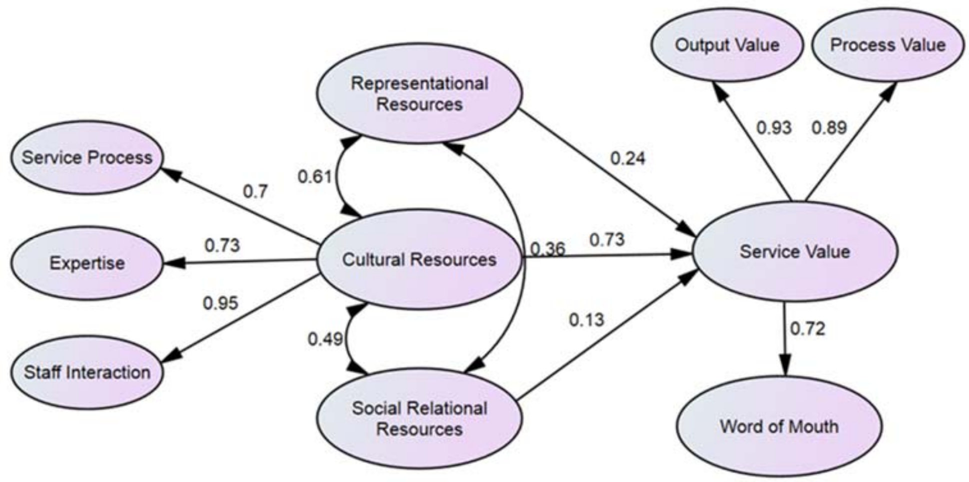

Figure 2: Research result

5. Discussions

This research focuses on how customer's perception on a firm's operant resources affects his or her perceived value by conducting the empirical test in the health care service. The results show that all three constructs of firms' operant resources (i.e., representational resources, cultural resources and social resources) positively affect the service value. In other words, a positive assessment of customers on firms' operant resources enhances their perception of service value, leading to customers' positive word-of- mouth.

Particularly, there reveal different impacts of three forms of operant resources. Culture resource has strongest influence on customer perceived value of service ($\beta = 0.733$). In health care context, the physician's expertise, enthusiastic interaction and efficient service process (fast and accurate administrative procedures) are the required and requisite conditions. Moreover, patients come to see the physician with the primary need to diagnose, cure and receiving advice related to their health problems. Therefore, they would care less about the trade-off between hospital reputation (Representational Resource) and the relationship of this hospital and other health service centers/other hospitals as well as its relationship with community (Social Resources)

The interaction between suppliers and customers increases the chance they influence each other in a process (service process and the service used) (Grönroos, 2011). In the health care industry, the interaction between physician and patient is the nature of service providing process. This dialogue would be information collection for further procure process and methods.

Consultation requires time, patience, active thinking and behavior of the doctor which might effect to recognizing the health problem and solution making. A good interaction requires qualities, skills and the willingness from the doctor. The interaction between doctor and patient (communication through the information exchange) has impacted significantly on the results of examination and treatment. And the results are directly affected to the service value of the patients when they use medical services.

This result is also in line with the research of McColl-Kennedy, Vargo, Dagger, Sweeney & van Kasteren (2012) which showed that the value evaluation of treatment process in health care service related to the interactions between individuals and their doctors (Michie, et al., 2003, McColl-Kennedy et al., 2012).

For physician expertise**,** following S-D logic mindset, expertise factor is considered as a non-physical important resource (Hunt, 2007; Baron, 2009) including doctor's specialized skills, know-how and knowledge and experience. Patients could easily observe and assess those resources during their medical examinations (Clulow et al., 2011; Baron & Warnaby, 2011). Moreover, health services are directly impacts on people health and lives. The accurate service is paramount requirement which need to be controlled via doctor's skills. Therefore, seeing well trained skill doctor, the patient will perceived the higher value compared to their time and efforts spending for the service.

Service process in healthcare service included the registration procedure, payment procedures, time on process. In the customer point of view the simpler administration procedure the less time and effort customer need to spend. Besides, patients using health services often worried about their health situation therefore they do not want to psychologically wait during the medical examination.

The relationship of the other two remain constructs of operant firm resources (Social Resource and Representational resources) and service value and customer word of mouth provide some implication on the operationalization in healthcare service but weaker impact on service value (β = 0.239 for Representational Resources and β = 0.126 for Social Relation). Since Representational Resources and Social relation did not directly affect to patient body and procure healthcare examination (related to hospital reputation and its relationship to other healthcare center/community or exchanging professional experience with other hospitals), their role in deriving value to customer is small consequently. So this can explain their low impacts on service value.

The significance of this paper is to explore whether customers' view on firms' operant resources affects their perception of value co-created. The result proved that customers perceive not only how strong process and how good usage operant resources of a firm to be in creating/offering the service outcomes/profits, but how strong and how favorite customers' view on operant resources would make customers perceive more value.

6. Conclusion

In an attempt to examine how a customer's view on firm's operant resources affect his or her perception of value co-created by both parties, this research conducted an empirical test in healthcare service in Ho Chi Minh city. This research enriches our understanding of firm's operant resources being viewed from customer side, which have received relatively little attention from service marketing literature. As being commonly understood, firm operant resources create service value by better exploiting operand resource and other operant resources (Vargo and Lusch, 2004, 2008). This study shows that positive views of customers on firm operant resources also lead to their better value perception.

The results of this study provide a base for drawing managerial implications. Accordingly, service providers should invest in training professional skills for service encounters to enhance quality of interaction, to encourage staff to show professional service procedure during service process. Besides, service providers could increase their service competitive advantages by reducing complicated administrative procedure in service process (e.g., well-setup system with clear and well-conducted service process) to create a fast and convenient service access for the customer with his/her minimal effort participation.

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□ □ □ □ □ □ Overcoming Negative Country of Origin: The Effects of Upward Extension

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Numerous studies have examined the effects of country of origin (COO). However, previous studies mainly focus on consumers' quality evaluations and intentions to purchase a product. Only a very limited number of research address strategic issues for those unfortunate firms suffering from negative COO stereotype.

Price is quite often used as a product quality cue – high price implies high quality. However, previous studies showed that charging high prices for products with weak COO did not work. The purpose of this research is to examine the effectiveness of adding a high-priced item in the product line in enhancing the quality perception and choice for products from emerging markets.

To achieve the above purpose, an experiment was conducted. The experiment tested the hypotheses that for a brand with a weak COO, adding a higher-priced item will enhance the quality perception, preference, purchase intention toward the products, and increase the choice share of the brand. The results supported the hypotheses.

This work showed that a negative COO cue can be overcome by putting forth multiply positive cues item. The contributions add to our knowledge related to COO and offer strategies for firms to overcome negative COO stereotyping.

Keywords: country of origin, extension upward.

1. Introduction

Since Dichter (1962) indicated that a product's country of origin influence the acceptance of a product and Schooler (1965) empirically tested it, numerous studies have examined the effects of country of origin (COO). COO, serving as an extrinsic information cue, influences consumer's product evaluations. Products from developed countries in general are perceived to have high quality, while products from emerging countries are perceived to have lower quality (Bartlett and Ghoshal, 2000; Verlegh and Steenkamp, 1999). Although COO research has been extensive, previous studies mainly focus on consumers' quality evaluations and intentions to purchase a product (Koschate-Fischer, Diamantopoulos and Oldenkotte, 2012). Only a very limited number of research address strategic issues for those unfortunate firms suffering from negative COO stereotype (Chao, 1989a).

Deshpandé (2010) offered several strategies to improve the quality perception of products from emerging markets, such as building a brand for the long haul, as Toyota and Honda did, flaunting country of origin, as Colombian coffee did, and downplaying your country of origin, as Corona beer, a Mexico product, focused on lifestyle. Kumar and Steenkamp (2013) proposed diaspora marketing, i.e., targeting emigrants abroad, for emerging market companies to build international brands. However, these strategies take decades to succeed and may require collaboration from channel members. For instance, research shows a product selling through a high-end channel would be perceived as having higher quality, as compared with selling through other channels (Dodds, Monroe and Grewal, 1991). However, high-end channels are unlikely to accept the products unless quality perception is already superior. Since COO is an extrinsic cue, i.e., a cue not related to the objective quality of the product, this research seeks to employ extrinsic cues to overcome the effects of COO stereotyping. Using extrinsic cues have the advantages of easy implementation, low costs, instant effects and no need to rely on other firms such as high-end retailers. Furthermore, extrinsic cues can be more effective than intrinsic cues in improving quality perception as Richardson, Dick and Jain (1994) demonstrated for store brand grocery items.

Price is quite often used as a product quality cue – high price implies high quality. However, setting price for products from emerging markets presents a dilemma for firms. Charging a price comparable to those from developed countries would not attract enough customers (Deshpandé, 2010) and cannot improve the quality perception of the product (Chao, 1993; Miyazaki, Grewal and Goodstein, 2005). On the other hand, setting a low price for the product would exacerbate further unfavorable quality perception. In this research, We suggest adding a high-price item in the product line. A high-price item had the potential of enhancing the quality perception of the products. In addition, upward extension may also incur context effects so as to enhance choice behavior. Consumer behaviors in general and choice behavior in particular, are rarely touched by the stream of COO research.

2. Literature Review

Numerous studies have examined the relationship between price and perceived quality in the marketing literature. Rao and Monroe (1989), in a meta-analysis of 36 studies that collectively report 85 effects of price, brand name or store name on perceived quality, found that, for consumer products, the price-perceived quality relationship was positive and statistically significant. In other words, consumers rely on price cue to make product quality judgment. One explanation for this phenomenon is that using price-perceived quality heuristic was cognitively much more efficient than evaluating product quality carefully. Although not statistically significant, their study also supported the notion that price-perceived quality effects actually increased slightly in the presence of brand information (Monroe and Krishnan, 1985). In other words, strong brands enhance the price-perceived quality relationship somewhat. Thus, consistent cues, meaning two or more positive cues, may reinforce price-perceived quality relationship, rather than suppressing it.

Recently, Völckner and Hofmann (2007) conducted a meta-analysis of study results published from 1989 to 2006 and include 71 effects of price on perceived product quality. The mean effect size r is 0.273, which is moderately strong, although it is lower than the mean effect size (r = 0.341) of Rao and Monroe (1989). They also found that the number of cues does not affect the price-perceived quality relationship significantly.

Although both meta-analysis studies show that high price enhances quality perception, setting a high price for a product from emerging country without any other considerations is not going to work. Miyazaki, Grewal and Goodstein (2005) indicated that price-perceived quality relationship is more pronounced when two cues are consistent. When two cues are inconsistent, the negative cue became more salient, resulting in ineffectiveness of the positive cue. In an experiment, they found that high price cue results in a significantly higher quality rating of tires from Germany, a strong COO, but not tires from Mexico, a weak COO. That is, when high price paired with a strong COO, a situation of cue consistency, resulting in positive price-perceived quality relationship. However, when high price paired with a weak COO, i.e., cue inconsistency, the price manipulation had no significant effect on quality perception. Since cue consistency is important in consumers' quality evaluation, two or more positive cues may be able to overcome the ineffectiveness of using only high price as a cue for weak COO. To overcome the cue inconsistency for products with weak COO, We will test two positive cues: adding a high-priced product, i.e., upward product line extension, and third-party approval.

Only a few studies examined the effects of product line extension in the same product category. Randall, Ulrich, and Reibstein (1998) show that for low-end products, brand equity is positively correlated with the quality level of the highest-quality model. Lei, De Ruyter, and Wetzels (2008) showed that a parent brand receives more positive evaluations after the introduction of an upward extension than that of a downward extension for a hotel chain. Kirmani, Sood, and Bridges (1999) examined owners versus non-owners in evaluating upward extension and downward extension. Their data for non-prestige products showed that upward extension enhances parent brand prestige for both owners and non-owners, although other attitude measures showed mixed results. Heath, DelVecchio, and McCarthy (2011) found that extending brands to higher quality improve brand evaluation, including attitude toward the overall brand, perceived brand expertise, brand prestige, and brand innovativeness. They indicated that higher-quality extensions are associated with overall brand evaluation, adds variety to the product line, and signals brand expertise.

Hamilton and Chernev (2010) demonstrated that the impact of product line extensions on price image is influenced by consumer goals: browsing or buying. Browsing tend to have broad focus, form impressions by integrating each piece of information. Thus, an upward extension would increase the overall price impression of the product. On the other hand, buying goals have relative narrow focus, causing consumers to pay their attention to a single alternative. Consumers would compare the focal option with other alternatives. Because of contrast effect, an upscale extension would make the focal option to be perceived as lower price. This viewpoint would make the upward extension by a product from an emerging country ever more appealing. An upward extension has the potential of enhancing overall price image of the brand, while at the same time, lower the perceived price of the focal option, resulting in increased purchase intention of the focal option.

Although Miyazaki, Grewal and Goodstein (2005) showed that cues consistency affect consumer perceptions, other characteristics, such as credibility, certainty, importance and the degree of inconsistency of the cues, may also play important roles. Adding a higher-price option is likely to be more consist with COO stereotyping and more credible than just setting a higher price for the product.

H1: For a brand with a weak COO, adding a higher-priced alternative will enhance the quality perception, preference and purchase intention toward the product

2.1. *Context Effects*

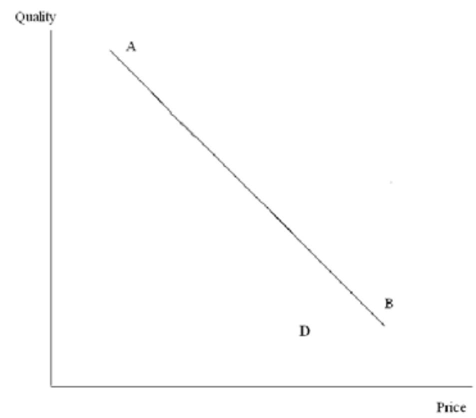
The rational choice theory assumes that consumers choose between two alternatives based on the subjective utility of each alternative, which is independent of the presence of the third alternative. However, consumer preference is often influenced by the set of options under consideration. This phenomenon is referred to as context effect, of which most notable are similarity, attraction, and compromise effects (Rooderkerk, Heerde and Bijmolt, 2011; Usher and McClelland, 2004).

Attraction effect means that adding a similar, but inferior, item raise the favorable perceptions of the original similar item in the choice set. In Figure 1(a), suppose there are only two options A and B in a choice set, the probability of a consumer choose A is P(A; [A, B]) and the probability of choosing B is P(B; [A, B]). Adding a third option D would change the relative probability of choosing A versus B. Because D is worse than B in both attributes, i.e., D is dominated by B, adding D would make B more attractive. The probability of choosing B relative to A when D present would be higher than when D does not present. That is, P(B, [A, B, D])/{P(A, [A, B, D])+ P(B, [A, B, D])} > P(B, [A, B]). For example, when only A and B present, the probability of choosing A is 0.7 and the probability of choosing B is 0.3. Adding option D may change the probability of choosing A, B and D to, say, 0.5, 0.4 and 0.1 respectively. The relative probability of choosing B out of A and B would increase from 0.3 to 0.4/(0.5+0.4) = .44.

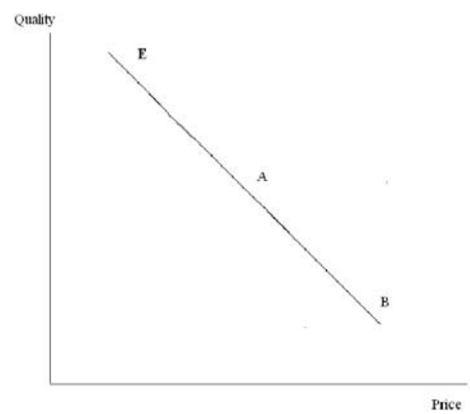
Compromise effect refers to the phenomenon that a middle option obtains a relatively large choice share than the extreme options. In Figure 1(b), suppose there are only two options A and B in a choice set, the probability of a consumer choose A is P(A; [A, B]) and the probability of choosing B is P(B; [A, B]). Adding a third option E would change the relative probability of A versus B. After adding E, E is the extreme option and A is in the middle, resulting in relative large share of A. Therefore, the probability of choosing A relative to B when E present would be higher than when E does not present. That is, P(A, [A, B, D])/{P(A, [A, B, D])+ P(B, [A, B, D])} > P(A, [A, B]). For example, when only A and B present, the probability of choosing A is 0.5 and the probability of choosing B is 0.5. Adding option E may change the probability of choosing A, B and E to 0.6, 0.3 and 0.1 respectively because of the compromise effect. The relative probability of choosing A would increase from 0.5 to 0.6/(0.6+0.3) = .67 Similarity effect stands for the phenomenon that adding an item decreases the choice share of a similar item more than a dissimilar item in the choice set. In Figure 1(c), suppose there are only two options A and B in a choice set, the probability of a consumer choose A is P(A; [A, B]) and the probability of choosing B is P(B; [A, B]). After adding F, which is similar to A, but not dominated by A, resulting in relative large decrease of A share. Therefore, the probability of choosing B relative to A when F present would be higher than when F does not present. That is, P(B, [A, B, F])/{P(A, [A, B, F])+ P(B, [A, B, F])} > P(B, [A, B]). For example, when only A and B present, the probability of choosing A is 0.7 and the probability of choosing B is 0.3. Adding option F may change the probability of choosing A, B and E to, say, 0.4, 0.3 and 0.3 respectively. That is, option F grab share from A. The relative probability of choosing B would increase from 0.3 to 0.3/(0.4+0.3) = .43.

Based on the context effects, upward extension can improve the choice of the brand. In the literature, the context effects are usually demonstrated with experiments in which the quality of products in the experiments was very clear cut. For example, a computer with 1000K memory as opposed to a computer with 640K memory, or a price discount of 35% vs. a discount of 10% (Simonson and Tversky, 1992). In real world, the quality perception may not be that apparent. For example, carbonated water may be considered as having higher quality than pure water. But, how much higher may vary among consumers. Hence, if a bottled-water company introduces carbonated water with a higher price, as compared with regular water, some customers may consider the carbonated water as having not much higher quality, but with much higher price, so that the carbonated water occupies the C1 position, as shown in Figure 1(d). This results in attracting effect, i.e., making B more attractive, which will increase the share of product B relative to product A, as compared with the situation with no C. If some consumers perceive the carbonated water as having somewhat higher quality, the product would occupy the C2 position, resulting in compromise effect, at least partially, since C2 is not exactly on the line connecting A and B. C2 would attract relatively large share of customers. Although the trade off line in the context effects literature is usually assumed to be a straight line, in microeconomics textbook the indifference curve is assumed to be convex. Thus, some consumers may switch to C, increasing the share of the brand as compared with the situation with no C introduced. If some consumers perceive the carbonated water as having much higher quality than the pure water, product C will occupies the C3 position, resulting in similarity effects. Again, this effect will increase the overall share of the brand (product B + product C). So by introducing a higher-priced alternative, brand B will enhance its image and increase its share relative to A.

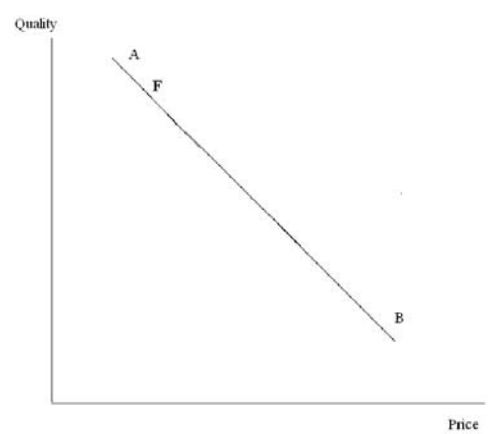
Figure 1 Context Effects



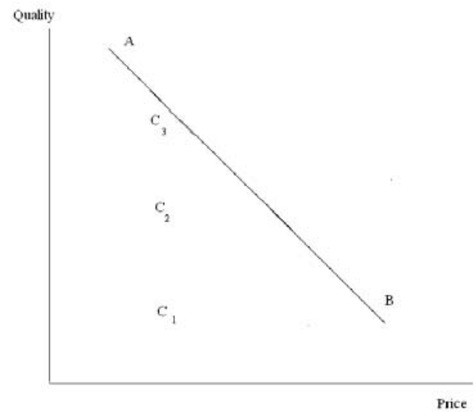
(a)



(b)



(c)



(d)

H2: For a brand with a weak COO, adding a higher-priced alternative will increase its choice share.

2.2. *Third Party Organization Endorsement*

Third-party organization (TPO) endorsement has been used quite frequently for enhance quality perception. For example, PC advertisements show PC Magazine rating, automobile ads utilize J.D. Power satisfaction rating, mutual funds employ Morningstar ranking, companies tout their ISO certifications and business schools promulgate their AACSB accreditation. TPO may come from a variety of sources, including but not limited to magazines (e.g., PC Magazine), for-profit companies (Morningstar), independent organizations (e.g., ISO), and government agency (e.g., FDA – U.S. Food and Drug Administration). TPO endorsement enhances message believability because consumers believed the information is unbiased (Wang and Muchling, 2012).

Working as a cue for product quality, TPO endorsements thus may reduce consumer uncertainty and risk perception of purchasing the product. Dean and Biswas (2001) found that, for a desktop computer or auto insurance, subjects exposed to an ad containing a TPO endorsement showed higher perceived quality, better attitude toward the manufacturer, and lower purchase risk than subjects exposed to either a celebrity endorsement or a no-endorsement ad for the same brand.

Among limited research into the effect of TPO endorsement, most show that TPO endorsement is effective in enhancing perceived product quality and improved purchase intention. However, not all studies come to similar conclusions. Peterson, Wilson and Brown (1992) found that claims of customer satisfaction contained in print advertisements were not more effective in improving attitude and purchase intention than comparable ads that did not contain such claims. The sources of the claims, including typical individual consumer, scientific survey from an independent marketing research firm, company survey, scientific survey plus personal endorsement, and company survey plus personal endorsement, did not produce any significant differences in attitude and purchase intention.

TPO endorsement may work better for less well-known brands than for well-known brands. Wu and Shaffer (1987) showed that indirect experience attitude were more susceptible to a counter-attitudinal message than were direct experience attitudes. Indirect experience attitude is believed to be less certain and less clear, hence is less confidently held. The indirect experience attitudes tend to be affected by communicator characteristic, i.e., going through the peripheral route to persuasion. On the other hand, the direct experience attitude tends to be affected by cognitive elaborations of the message arguments, i.e., the central route to persuasion. Dean and Biswas (2001) showed that well-known brands, which consumers are likely to have direct experience, may be less susceptible to attitude change. On the other hand, less well-known brands, which consumers are more likely to have no direct experience, are more susceptible to the persuasive influence of positive endorsements by TPOs. Hence, TPO endorsements are more effective for less well-known brand than for well-known brands. Similarly, Wang and Muchling (2012) found that TPO endorsement enhances advertising message believability and producing more favorable brand attitudes for underdog brands more than for topdog brands.

H3: For a brand with a low COO, TPO will enhance quality perception, affection and purchase intention of the brand

3. Research Methods

3.1. *Pretest*

We use four items, involving innovativeness, design attractiveness, prestige, and workmanship, from Roth and Romeo (1992) to measure the country image of France, Italy, Thailand and China. These four countries were used in the following experiments. Fifty respondents, 62% students and 38% young office workers, answered the four items on the web. The four items measure respondents' perception of a country on innovativeness, design attractiveness, prestige, and workmanship on a 7-point scale. The Cronbach alpha value is 0.837. The means and standard deviation of average scores for the four countries are as follows: France 5.75 (.691), Italy 5.48 (.709), Thailand 3.83 (.907), China 2.90 (.970). One-way ANOVA show that the means are significantly different ($F(3, 196) = 134.62$, p-value $< .001$). Scheffe's multiple comparison shows that respondents' perception of France and Italy are not significantly different, while perception of France and Italy are significantly better than that of Thailand, and finally perception of Thailand is significantly better than that of China. Thus the pretest shows that respondents perceive France and Italy much better than Thailand and China in terms of innovativeness, design attractiveness, prestige, and workmanship.

3.2. *Measurement items*

We measure brand image (8 items), from Park, Joworski and MachInnis (1986) and Porter and Claycomb (1997), perceived quality (6 items) from Dodds, Monroe and Grewal (1991), brand affect (6 items) from Voss, Spangenberg and Grohmann (2003), and Batra, and Ahtola (1991), and purchase intention (5 items) from Swinyard (1993) and Dodds, Monroe and Grewal (1991). All items are measured on a five point Likert-type scale with 1 indicating strongly agree and 5 indicating strongly disagree.

3.3. *Experiment*

An experiment was conducted to examine whether stretching up product line, i.e., adding a high-priced item and adding a TPO endorsement will enhance the product image, purchase intention and choice of a product from a less favorable COO. We use bottled water as the tested product since bottled water has been used in many previous studies. A 2 (without a high-priced item, with a high-priced item) x 2 (no seal of approval, with seal of approval) experiment was conducted. One of the bottled water is Evian from France and the other is Crystal from Thailand. Evian is marketed in Taiwan, while Crystal is not. Many people are familiar with Evian, but few know the Crystal brand. Three ads were created for three bottled water. One is for Evian, another one is for Crystal bottled water. The third one is for Crystal bubble water which is used as the stretch-up item.

In the questionnaire, respondents saw the ads of the two or three products first, depending on the cells they were in. In the ad, the origins of the products are clear indicated. The price of a bottle of Evian was NT$60 (around 2 U.S. dollars), while Crystal water is also NT$60, but given a discount of 30% off. The stretch up product is Crystal bubble water, selling for NT$80 per bottle, but given a discount of 10%. After seeing the ads, respondents were requested to answer questions about the Crystal bottled water, the focal brand. The measurement items also include respondent’s knowledge about water, price sensitivity and their traveling experience to Thailand. Those items were used as covariates in MANOVA analysis. The respondents were also asked to make a choice between the two items (without stretch-up product line extension) or among the three items (with stretch-up product line extension).

A total of 176 respondents answer the questionnaire.

4. Results

The results show that adding a high-priced item greatly enhance the effectiveness of brand image ($p = .041$), value ($p = .005$), and preference ($p = .037$), but not quality perception ($p = .121$). Thus, H1 was mostly supported. The results show that TPA enhances quality perception greatly ($p = .004$), but not brand image ($p = .135$), value ($p = .778$), and preference ($p = .290$). Thus, H3 was mostly not supported. The interaction between TPA and adding a high-priced item are not significant, meaning that TPA does not enhance the effectiveness of adding a high-priced item. An ANOVA analysis shows that adding a high-priced item greatly enhance the purchase intention of the original brand ($p = 072$).

Choice

We also asked respondent to make a choice of either Evian water or Crystal water for cells without the stretch-up products, and make a choice of either Evian water, Crystal water or Crystal bubble water for cells with the stretch-up products. We expect that the proportion of respondents who choose Crystal water would increase significantly for those cells with the stretch-up product. The results are shown on Table 1. In the cell with stretch-up product but no seal of approval, the proportion of respondents choosing Crystal water is not different from that in the no stretch-up product cells. However, in the cell with stretch-up product and seal of approval, the proportion of respondents who chose Crystal water is much higher than those in other cells. Adding the number of respondents who choose Crystal bubble water would make the choice share of Crystal brand higher than the choice share of Evian water (24/40 vs. 16/40), compared with other cells with choice share are 1/3 vs. 2/3. A logistic regression analysis shows that the odd of choosing Crystal brand is significantly higher for the cell with stretch-up product and seal of approval, as compared with other cells. This results support H2.

		Cell				
		No high-Priced Product No Approval	No high-Priced Product Approval	High-Priced Product No Approval	High-Priced Product Approval	Total
Choice	1.00	33	30	31	16	110
	2.00	15	15	10	15	55
	3.00	0	0	2	9	11
Total		48	45	43	40	176

Table 1 Cross Tabulation of Choice and Cell

5. Conclusions

An experiment was conducted to test three hypotheses. The results supported two hypotheses. This research contributed to the literature in several ways. First, this research showed that adding a high-priced product extension can enhance the quality perception, preference, and purchase intention of products for product from emerging markets. Second, this study revealed the effects of adding a high-priced item on brand choice.

The effect of upward extension and TPA on attitude (i.e., quality perception, preference, and purchase intention) and the effect of upward extension and TPA on choice differ in one important aspect. TPA does not enhance quality perception, preference, and purchase intention of product from an emerging market. However, TPA greatly increase the choice share of the product from an emerging market. The underlying reasons deserve further investigation.

This work showed that a negative COO cue can be overcome by putting forth positive cues, especially for improving choice. The contributions add to our knowledge related to COO and offer strategies for firms to overcome negative COO stereotyping.

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Optimizing MCSD Portfolios

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Marginal Conditional Stochastic Dominance (MCSD) states the probabilistic conditions under which, given a specific portfolio, one risky asset is marginally preferred to another by all risk-averse investors. Further- more, by increasing the share of dominating assets and reducing the share of dominated assets one can improve the portfolio performance for all these investors. We use this standard MCSD model sequentially to build optimal portfolios that are then compared to the optimal portfolios obtained from Chow's MCSD statistical test model. These portfolios are furthermore compared to the portfolios obtained from the recently developed Almost Marginal Conditional Stochastic Dominance (AMCSD) model. The AMCSD model restricts the class of risk-averse investors by not including extreme case utility functions and reducing the incidence of unrealistic behavior under uncertainty. For each model, an algorithm is developed to manage the various dynamic portfolios traded on the New York, Frankfurt, London, and Tel Aviv stock exchanges during the years 2000-2012. The results show how the various MCSD optimal portfolios provide valid investment alternatives to stochastic dominance optimization. MCSD and AMCSD investment models dramatically improve the initial portfolios and accumulate higher returns while the strategy derived from Chow's statistical test performed poorly and did not yield any positive return.

1 Introduction

The essence of portfolio theory is to design rules that will satisfy the choices of investors to increase wealth in an environment of risk and uncertainty. In a static world the simplest model amounts to choosing a portfolio of assets that maximizes the total expected return while keeping risk at a satisfactory level. This basic model has suffered major setbacks when the variance was used to estimate portfolio risk because in order to be compatible with investors preferences, it requires that assets be normally distributed. The failure of the mean-variance paradigm became evident when it appeared that, empirically, financial assets were not normally distributed and higher moments such as skewness and kurtosis could not be easily dismissed.[1] Afterwards, the mean-variance model was theoretically remedied with the use of expected utility maximization.

In practice, the solution of using expected utility empirically came with the advent of Second Degree Stochastic Dominance (SSD) by Hanoch and Levy (1969), Hadar and Russell (1969), and Rothschild and Stiglitz (1970) all of whom devise rules based on the entire statistical distribution of risky assets instead of a finite number of moments. Because of this, less restrictive assumptions regarding investor's behavior were needed, with the only requirement being that the utility functions describing a rational risk-averse investor be monotonically increasing and concave. SSD compares cumulative probability distributions of

[1] Furthermore, as shown by Lambert and Yitzhaki (2014), higher variance would not be so bad for low risk-averse investors.

risky assets to determinate their dominance. The main advantage of SSD lies in its ability to discriminate among existing assets. However, it lacks the power to reach portfolio optimality.

To overcome this last obstacle Shalit and Yitzhaki (1994) developed the concept of Marginal Conditional Stochastic Dominance (MCSD) in finance. Under the SSD assumptions, MCSD allows an investor holding a given portfolio to derive dominance relations between two assets. Then, a marginal increase in the share of the dominating asset at the expense of the dominated one will improve the portfolio for all risk-averse investors. A series of marginal improvements will lead to a SSD efficient portfolio regardless of whether a change in portfolio structure or a new investment opportunity is being considered. MCSD has enjoyed some success owing to the papers of Chow, Huang, and Hu (2007), Clark and Kassimatis (2012), Clark and Kassimatis (2013), Shalit and Yitzhaki (2003) and Shalit (2010) to cite a few. Most notably is that for portfolio management, Clark, Jokung, and Kassimatis (2011) used MCSD to develop a new methodology aimed at constructing SSD efficient portfolios.

Chow (2001) improved upon MCSD by introducing a statistical test to confine the number of assets to those with significant dominance relations. He basically reformulated the model to make it more suitable for statistical computation and testing. An additional issue regarding SSD and MCSD is that some extreme utility functions that satisfy the mathematical definition of risk aversion are hardly present in the real world. [2] To tackle this issue Denuit, Huang,Tzeng, and Wang (2014) recently developed the concept of Almost Marginal Conditional Stochastic Dominance (AMCSD). The basic idea of AMCSD is that the set of relevant utility functions is reduced by putting restrictions on the second derivative. Accordingly, Denuit et al (2014) obtained new MCSD conditions

[2]For instance, a lottery with equal probabilities prizes of 999$ or 100,000$ does not dominate a certain prize of 1,000$, although any rational agent will choose the lottery.

whose purpose was to increase the number of dominance relations.

In this paper, we apply the three different MCSD approaches to test active portfolio management. Our purpose is to show in practice how a series of small portfolio improvements leads to portfolio optimization for all risk-averse investors. Although MCSD was applied successfully to active portfolio management we are providing here a new comparison of three approaches related to MCSD. Our data consists of historical returns for the 2000-2012 period from four financial markets to test our optimization algorithms written in MATLAB.

In the next section we provide the theoretical framework of the three MCSD models. In section 3, we outline the optimization methodology . In section 4, we present the data and in Section 5 we show the main results. Section 6 concludes the paper as well as the implications of our findings.

2 MCSD Theory

We begin by providing the theoretical background for the three models we use to construct optimal portfolios, namely the original Shalit and Yitzhaki (1994) MCSD, the model derived from Chow's (2001) statistical test for MCSD, and Denuit et. al.'s (2014) recent model of AMCSD . The three models are rooted in the concept of SSD that expresses the probabilistic conditions under which all risk-averse investors prefer one risky asset to another. SSD was developed independently by Hadar and Russell (1969), Hanoch and Levy (1969) and, Rothschild and Stiglitz (1970) who derived the necessary and sufficient conditions by using the asset's cumulative probability distributions functions (CDF) as we now present. Let us consider a risk-averse investor who maximizes the expected utility of asset returns $EU(r)$ where U is non-decreasing and concave. Given two risky assets with random returns r_k and r_j and CDF $F_k$andG_j the SSD necessary and sufficient conditions are stated as follows:

Theorem 1. : $E_F[U(r_k)] \geq E_G[U(r_j)]$ *if and only if* $\int_{-\infty}^{x}[G_j(r_j) - F_k(r_k)] \geq 0$ *for all* x *and all concave* U.

It should be noted that these conditions are not so practical when applied to optimizing portfolios as they require infinite comparisons of CDFs, their intersections, and their areas under these CDFs. A more accessible and intuitive alternative for using CDFs was provided by Shorrocks (1983) who developed the absolute (generalized) Lorenz curves to rank distributions and derive appropriate necessary and sufficient conditions for SSD.[3] To see this equivalence, let us define the absolute Lorenz curve as the function relating conditional mean return to the cumulative probability of getting that return, namely:

$$L(\xi) = \int_{-\infty}^{x} r dF(r) \text{ } for \text{ } all \text{ } x, \tag{1}$$

where ξ is the cumulative probability $\xi = \int_{-\infty}^{x} dF(r)$. Gartswith (1977) has simplified the notation of the Lorenz curve as $L(\xi) = \int_{0}^{\xi} F^{-1}(\omega)d\omega$ and thus only one equation is needed to formulate the Lorenz curve. As shown by Thistle (1989), the SSD conditions using the Lorenz become:

Theorem 2. : $E_F[U(r_k)] \geq E_G[U(r_j)]$*if and only if* $L_k(\xi) - L_j(\xi) \geq 0$ *for all* $\xi \in (0, 1]$,

where $L_k(\xi)$ and $L_j(\xi)$ are the absolute Lorenz curves of asset k and asset j, respectively. In other words, the absolute Lorenz of the dominating asset must not lie below the absolute Lorenz curve of the dominated one. The main reason to prefer the SSD concept over some other alternatives is that there is no need for restrictive assumptions regarding the utility function and the distribution of the risky assets. Nonetheless, there are major shortcomings, the

[3]In welfare economics, relative Lorenz curves are used to measure income inequality and wealth distribution. In financial economics, absolute Lorenz curves are used to rank distributions and measure the risk and return of assets and portfolios. See Shalit (2014).

main one being SSD's ineptitude to obtain optimal portfolios. Indeed, once an optimum portfolio is attained it can always be improved by altering the allocation increasing the dominating asset and shortening the dominated asset and raising the portfolio expected return.

To correct upon SSD lacunae, Shalit and Yitzhaki (1994) developed the concept of MCSD, which as mentioned previously, provides dominating and dominated assets conditional upon holding a portfolio. For all risk-averse expected utility maximizers, MCSD provides the probabilistic rules for one asset to marginally dominate another one and improve upon the initial portfolio. Consider a risk-averse investor holding a portfolio p of n risky assets defined by the shares $\alpha \equiv \{\alpha_i\}$ such that $\sum_{i=1}^{n} \alpha_i = 1$. The assets yield risky returns $r \equiv \{r_i\}$and the portfolio return is obtained by $p = \sum_{i=1}^{n} \alpha_i r_i$. Expected utility maximizers who want to improve their current positions, but without the trouble of reorganizing their entire portfolios, can marginally alter some of their holdings. Usually MCSD provides the conditions for dominance in the case of two assets. To marginally increase the share of dominating asset j, one can marginally decrease the share of dominated asset k, such as: $d\alpha_k = -d\alpha_j$. Accordingly, portfolio return changes as $dp = d\alpha_k (r_k - r_j)$and the change in expected utility becomes: $dE[U(p)] = E[U'(p)\, d\alpha_k (r_k - r_j)]$, leading to:

$$\frac{dE[U(p)]}{d\alpha_k} = \int_{-\infty}^{\infty} U'(t)\,[\mu_k(t) - \mu_j(t)]\, f_\alpha(t)\, dt \qquad (2)$$

where $\mu_i(t)$ is the conditional expected return on asset i given the portfolio return t, i.e., $\mu_i(t) = E(r_i | p = t)$ and $f_\alpha(t)$ is the *pdf* of portfolio returns t. (See Shalit and Yitzhaki (1994)). Asset k dominates asset j if, and only if Equation (2) is non-negative and is increasing the share of asset k on account of asset j increasing expected utility. Since $U'(t)$is positive for all returns Equation (2) can be expressed in terms of Absolute Concentration Curves (ACCs) which are defined as the cumulative expected returns on an asset conditional on the return on the portfolio α. Namely,

$$ACC_i^{\alpha}(\xi) = \int_{-\infty}^{p} \mu_i(t)\, f_\alpha(t)\, dt \tag{3}$$

where p is the return implicitly defined by the CDF of the portfolio and ξ the cumulative probability:

$$\xi = \int_{-\infty}^{p} f_\alpha(t)\, dt\ . \tag{4}$$

Theorem 3. ($MCSD$) *Given portfolio α asset* k *dominates marginally asset* j *for all risk-averse investors if and only if*

$$ACC_k^{\alpha}(\xi) \geqq ACC_j^{\alpha}(\xi) \tag{5}$$

Proof: (See Shalit and Yitzhaki (1994))

MSCD conditions are provided for two assets given a portfolio. As shown by Shalit and Yitzhaki (2003) in the case of m assets, the conditions are derived by trying to maximize the Lorenz of Equation (1) which is written as:

$$L(\xi) = \int_{-\infty}^{p} t f_\alpha(t) dt = \sum_i^n \alpha_i \int_{-\infty}^{p} r_i f_\alpha(t) dt = \sum_i^n \alpha_i ACC_i^{\alpha}(\xi) \tag{6}$$

For a given portfolio $\{\alpha_0\}$, an alternative portfolio$\{\alpha_1\} = \{\alpha_0 + d\alpha\}$ is preferred by all risk-averse investors if portfolio $\{\alpha_1\}$ leads to a higher Lorenz i.e.,:

$$\textstyle\sum_i^n \frac{\partial L(\xi)}{\partial \alpha_i} d\alpha_i = \sum_i^n ACC_i^{\alpha}(\xi) d\alpha_i \geqq 0 \quad for\ all\, \xi \tag{7}$$

subject to $\sum_i^n d\alpha_i = 0$. One of the advantages of MCSD is that a series of marginal improvements will eventually lead to an optimal SSD portfolio. The main shortcomings of the method is that the inclusion of abnormal concave utility functions are compulsory. Another less important one is the lack of a statistical test, which, however was later devised by Chow and which is described as follows.

2.1 Chow's Statistical Test

The main issue not addressed by standard MCSD is whether dominance relations can be established from a sample of asset returns. Chow (2001) answered this question by developing a procedure that tests whether ACCs intersect statistically. The test is described as follows: Define anew the ACCs and the Lorenz to be more suitable for statistical computations. From Equation (4) the inverse $p = F_{\alpha}^{-1}(\xi)$ defines portfolio return p for the probabilityξ. Furthermore let $I(t)$ be an index function mapping 1 for $t \leq p$ and 0 otherwise. Hence, the ACC for asset i can be written:

$$ACC_i^{\alpha}\left(r_i | t \leq F^{-1}(\xi)\right) = \int_{-\infty}^{\infty}\int_{-\infty}^{\infty} r_i I(t) f_{\alpha}(t, r_i)\, dr_i dt\,. \tag{8}$$

Equation (8) allows us to construct a test that checks whether two unique ACCs intersect. Consider a sample of n assets and T time periods. We choose a set of S target returns from the portfolio distribution as indicated by $\{p_s | s \in [1, 2, ..., S]\}$. Every target return is a test point that checks the intersection of ACCs. From Equation (8) we can compute the ACC of asset i, at a target point $p_s$by averaging all the observations of vector $r_i I(p_s)$ which is calculated as:

$$\widehat{ACC}_i(r_i | t \leq p_s) = \frac{1}{T}\sum_{j=1}^{T} r_{i,j} I_j(p_s) = \overline{r_i I(p_s)}. \tag{9}$$

Using Equation (9) we then estimate the difference between two ACCs at the target return p_s as:

$$\widehat{\Phi}^{k-j}(p_s) = \widehat{ACC_k}(r_k|t \leq p_s) - \widehat{ACC_j}(r_j|t \leq p_s) \tag{10}$$

This allows us to obtain a vector of length S for all the target returns. The next step is to estimate the standard deviations using Rao's theorem and computing:

$$\widehat{\sigma}\left[\widehat{\Phi}^{k-j}(p_s)\right] = \frac{1}{T}\sqrt{\widehat{var}\left[r_k I(p_s)\right] + \widehat{var}\left[r_j I(p_s)\right] - 2\widehat{cov}\left[r_k I(p_s), r_j I(p_s)\right]} \tag{11}$$

Finally, we obtain the Z statistic of the estimator of (10) by dividing with the standard deviation in Equation (11) :

$$Z^{k-j}(\tau_t) = \frac{\widehat{\Phi}^{k-j}(p_s)}{\widehat{\sigma}\left[\widehat{\Phi}^{k-j}(p_s)\right]} \tag{12}$$

When parts of ACCs lie close to each other, conventional statistical inference methods cannot distinguish weak dominance relations from intersections. In this case, Chow suggests to obtain the critical values for every test point by using the Studentized Maximum Modulus distribution, with the normal approximation for large samples. The critical value given S test points and significance level α can be computed by the following approximation:

$$SMM(\alpha, S, \nu \to \infty) \to Z\left(0.5\left(1 - (1-\alpha)^{\frac{1}{S}}\right)\right) \tag{13}$$

Using the values obtained by (12) and (13) it is possible to test the dominance relations for the desired significance level using the following rule: Asset k dominates asset j if $Z^{k-j}(\tau_t) \geq SMM(\alpha, S, \nu \to \infty)$for all t and asset j dominates asset k if$Z^{k-j}(\tau_t) \leq -SMM(\alpha, S, \nu \to \infty)$ for all t . For other cases there are no significant dominance relations either because ACCs intersect or lie close to each other.

This statistical test can help us make real-life decisions when investment portfolios need to be revised. Though, generally, such a test can limit the number of pairs of assets with dominance relations only to those with strong and significant dominance and thus be very helpful for portfolio management. In practice, however, some questions remain unanswered regarding the desired significance of the test and its power. Indeed, one doesn't know what significance levels will produce the best operative results, as lower significance levels will be less discriminative and higher levels will show poor dominance relations to choose from.

2.2 Almost Marginal Conditional Stochastic Dominance

Some of the issues incurred with MCSD deal the inclusion of extreme utility functions in the set of risk-averse investors. Most of these extreme functions do not appear in the real world and hence should not be considered when optimizing portfolios of risky assets. Denuit, Huang, Tzeng, and Wang, (2014) developed "Almost Marginal Conditional Stochastic Dominance" (AMCSD) that applies the dominance relations to a smaller set of risk-averse investors by excluding those extreme utility functions. Thus, AMCSD reduces the set of risk-averse agents by restricting the second derivative of the utility function. This can be seen as follows: Let U^1 be the entire set of increasing and concave utility functions that are defined on portfolio return p. A new set, U^2 is defined using a single parameter $\epsilon \in (0, 0.5)$ that limits set of utility functions:

$$U^2(\epsilon) \equiv \left\{U(p) \in U^1 \middle| \forall p : -U''(p) \leq inf\left(-U''(p)\right)\left(\epsilon^{-1} - 1\right)\right\} \qquad (14)$$

Where $inf(\centerdot)$ is the infimum function. It can be easily shown that $U^2(0) = U^1$ and $U^2(0.5) = \emptyset$. In that case, U^2 can be considered as a set without extreme behavior functions,with the critical limit being set by a sole parameter ϵ.

By using Equation (4) and taking into consideration the fact that portfolio return p can be obtained for the probability ξ by applying $p = F_{\alpha}^{-1}(\xi)$ we can redefine the ACCs to be a function of p instead of ξ, and can define the set of portfolio returns in which there is a "transgression" of the standard MCSD criteria as : $\Omega \equiv \left\{p|ACC_k^{\alpha}(p) - ACC_j^{\alpha}(p) < 0\right\}$

Theorem 4. : (AMCSD) *For any utility function in* U^2*, the expression in (2) is non-negative if, and only if:*

$$\begin{cases} \int_{-\infty}^{\infty} -\left[ACC_k^{\alpha}(p) - ACC_j^{\alpha}(p)\right] | p \in \Omega \leq \varepsilon \int_{-\infty}^{\infty} \left|ACC_k^{\alpha}(p) - ACC_j^{\alpha}(p)\right| dp \\ \mu_k \geq \mu_j \end{cases} \tag{15}$$

Proof: See Denuit et al (2014)

We have shown that it is possible to derive dominance relations on a confined set of risk-averse utility functions. It is likely that by using the criteria described in (15) we can better model the behavior of real-world investors, and thus produce better performance. Still a valid question remains regarding what the proper value for ϵ is in limiting the extreme behavior utility functions. Levy, Leshno, and Leibovitch (2010) used a series of laboratory experiments to derive the value of 0.3. In the following we will try to shed some light on this issue.

3 Managing the MCSD Portfolios

We now present the rules directing the investment algorithm for the three portfolios. It is assumed that market participants behave rationally in the sense that, learning from historic returns, investors derive the dominance relations and then, buy the dominating stocks and sell the dominated ones. For each MCSD approach we start with two portfolios, one where the assets are weighted according to the market index of that specific stock exchange and the other where all assets are weighted equally, i.e., the so called 1/N portfolio.

3.1 Moving Window, Sample Size, and Computation Procedure

Following Chow's suggestion that a sample of 600 is the minimal size needed to achieve satisfying test power, the sample size upon which the dominance relations are established is set to 600 observations,. Going beyond 600 observations would probably introduce irrelevant and noisier data into the analysis. To be more consistent with the activity of a real-life portfolio manager, we assume that the portfolio changes every 30 observations, which accounts for approximately a month and a half of daily trades. For every data set, the first day a portfolio changes is with the 601-th observation, since dominance relations are established with the 1- 600 observations. The second trading day is with the 631-th observation since the sample used to compute dominance includes the 31-630 observations, and so on. After composing the new portfolio, it is used for the next 30 days until a new portfolio is formed, and the process is renewed all over again.

For every update point, i.e., observations 601,631, etc., a sample of 600 previous daily returns of K stocks and the initial portfolio consisting either in the market index, either the 1/N portfolio is used. With this data we construct the marginal change of $\alpha^{\Delta}$of K elements and compute the new portfolio returns for the next 30 days as follows: If R_p are the returns on the initial portfolio, then the returns on the new portfolio are $R_p^* = R_p + \sum_{i=1}^{K} \alpha_i^{\Delta} r_i$. This method was chosen because we ignore the exact weights of stocks in the initial market index portfolio and know only their returns. We restrict the marginal change to be in the±100% interval in order to avoid infinite loops and stay close to real life portfolios. We now explain how the α^{Δ} vector is constructed.

3.2 Pairing the Stocks

We choose a pair of stocks whose dominance relation is defined according to the model at hand. Using the sample data, two matrices are constructed: a Boolean dominance matrix and a dominance strength matrix. The Boolean dominance matrix indicates whether the i-th stock dominates the j-th stock with "1" in the i-th column and j-th row and "0" elsewhere. The dominance strength matrix quantifies the strength of the dominance relations. For example, in MCSD and AMCSD this value is the maximum difference between the ACCs of the two stocks. In the Chow test this value is the maximum of the Z-statistic for the two stocks. Once the matrices are computed, all pairs are sorted with respect to their dominance strength index. A pair is chosen that has the largest strength index value under two conditions: the pair was not used in the previous 10 iterations in order to avoid internal loops, and none of the stocks in the pair reached the ±100% limit. After a pair is chosen, the marginal change is obtained when the share of dominating stock is increased at the expense of the dominated stock. Thereafter, the Boolean dominance relation matrix and dominance strength matrix is computed again and the whole process is reiterated. Unless it is terminated due to lack of pairs with definite dominance relations, the process is restricted to a maximum of 1000 iterations.

3.3 Marginal Change

After a pair with a defined dominance is selected, a subroutine is conducted to compute the best marginal change of the weight of the dominating stock on account of the weight of the dominated stock. First, the weight of the dominating stock is increased by 50% and the weight of the dominated stock is subsequently decreased by 50%. Then, the dominance relations are computed for those two stocks again. If the dominance relation persists, then the change is preserved; otherwise it is discarded. Next, the whole process is reiterated with a change of 25%. At every step n, the change is $1/2^n$. This method allows us to get close enough to the point where dominance relations disappear within 20 fixed steps. For every step the $\pm 100\%$ limit is checked and the process stops if this weight exceeds this interval.

4 The Data

The research was performed in four different stock exchanges: For the Tel-Aviv stock exchange, we use daily prices for the period 03.01.2000 - 28.06.2012. The stocks were chosen from the constituents of the Tel-Aviv-100 index, and the index itself was taken as one of the initial portfolios. The constituents weights were computed by the market shares in the index. The New York stock exchange was represented with the S&P-500 index, and its constituents were the subsequent stocks listed for the period 03.01.2000 - 31.12.2011. The London stock exchange had a smaller sample for the period 03.03.2003 - 30.12.2011 and included the FTSE-100 index, and its constituents. The Frankfurt stock exchange had a similar sample for the period 02.01.2003 - 30.12.2011. The difference between the Frankfurt exchange and the other exchanges is the incongruence of the initial portfolio index DAX-30 and the list of the assets based on the DAX-100. The reason for this disparity is the lack of accessible data regarding the DAX-100 returns.[4] All the returns were corrected for dividends and splits. Assets with more than half of the data missing were eliminated and therefore in some mar-

[4]The data for the Tel-Aviv Stock Exchange data were obtained from its website and for the other three datasets were obtained from Yahoo! finance.

kets the final number of assets was less than 100. For the missing data, a linear interpolation was made using the prices before and after the gap. After these corrections, the daily return for day t was computed as $r_t = {}^{P_t}/_{P_{t-1}} - 1$.

5 Optimization Results

To check which MCSD managed portfolio approach produces statistically significant excessive returns, we used two tests: the simple mean difference test and the sign test. We begin to show the first test. Let $r_p^M$and r_p^I be the returns of the actively managed and initial portfolio, respectively. We set the null hypothesis as $H_0 : E\left(r_p^M - r_p^I\right) \leq 0$ and use the statistic $\bar{r}_p^M - \bar{r}_p^I$ where $\bar{r}_p^M$and $\bar{r}_p^I$ are the sample means. Hence, we use the standard Z-test with standard deviation $\hat{\sigma}\left(r_p^M - r_p^I\right)/\sqrt{N}$ as follows:

$$Z_{st} = \frac{\bar{r}_p^M - \bar{r}_p^I}{\hat{\sigma}\left(r_p^M - r_p^I\right)/\sqrt{N}} \ . \tag{16}$$

The sign test counts the instances that returns of the managed portfolio exceed those of the initial portfolio. When there is no significant increase in returns, the probability of sampling an occurrence with greater returns must be not different from 0.5. Thus, under the null $H_0 : Prob\left(r_p^M - r_p^I > 0\right) \leq 0.5$ we compute the subsequent Z-statistic as follows:

$$Z_{st} = \frac{N^+ - 0.5N}{0.5\sqrt{N}} \tag{17}$$

where $N^+$is the number of instances that the managed portfolio has outperformed the initial one. Since the procedures use the first 600 observations to establish dominance, MCSD-managed portfolios started from the 601st observation.

5.1 MCSD

At first, in every stock exchange, we use the market index as the initial portfolio and apply the standard MCSD portfolio management to check whether the method can improve portfolio performance. In financial theory the market index is often considered an efficient portfolio, hence, this test amounts to checking market efficiency. The results for the two tests are given in Table 1:

Table 1: Excess Returns of MCSD Managed Portfolios

	Tel-Aviv	New York	London	Frankfurt
$\bar{r}_p^{MCSD} - \bar{r}_p^I$	0.000367	-0.000037	0.000081	0.000417
p-value of the mean diff. test	0.076045	0.552780	0.402263	0.125767
p-value of the sign test	0.079495	0.508111	0.167100	0.042489
Observations	2470	2419	1631	1699

The results show that in three out of the four stock markets the portfolio management algorithm using the MCSD criterion produced greater average daily returns than the initial portfolio. In two of the markets the improvement was statistically significant. In the Tel-Aviv and the Frankfurt exchanges the algorithm produced an additional 0.0367% and 0.0417% to the average daily return, which amounts to approximately to 9.175% and 10.425% in annual returns. In the US market, the managed portfolio produced poorer results than the initial one, although those results were not statistically significant. We have established that the management algorithm efficiency depends upon which market it is applied and it generally improved the initial portfolio.

5.2 MCSD with the Integrated Chow Test

Although the purpose of the Chow test is to improve the performance of the standard MCSD, questions remain as to the validity of the parameters used. For one thing, what is the optimal value of the significance level α? As we would like to find only viable dominance relations, a small α should be chosen. However, a small α would lead to poor test power and viable dominance relations could be ignored due to statistical "noise". Another question regards the number of points that should be used in the simultaneous test. In his original work, Chow used simulated data and came to the conclusion that 10 points received higher power than 20 points. Finally, the location of these points seems completely arbitrary. To tackle these issues we used values of α of 0.05, 0.1, 0.2 and 0.3 and checked anew the notion that 10 points were better than 20 points. Finally, two approaches were used to locate the test points: either to place them equally on the return distribution or else to place them on the equal quantiles.

The combinations of these parameters produced different results and we reached the conclusion that using 10 test points instead of 20 yields better test power. Furthermore, placing the test points at equally spaced quantiles results in a better test power. Finally, for the significance level the best results were obtained using the greater values of α. In Table 2, we show the results using 10 test points placed at equally spaced quantiles, and setting $\alpha = 0.3$.

Table 2: Chow Test-Managed Portfolios

	Tel-Aviv	New York	London	Frankfurt
$\bar{r}_p^{Chow} - \bar{r}_p^{I}$	0.000267	-0.000082	0.000105	0.000195
p-value of the mean diff. test	0.058611	0.679168	0.299266	0.205474
p-value of the sign test	0.000069	0.014841	0.021305	0.000697
Observations	2470	2419	1631	1699

The results show the same pattern as with the MCSD-managed portfolios, but the statistically significant changes are much smaller. As compared with the MCSD managed portfolios, Chow's test algorithm produced only two thirds of the excess returns in Tel-Aviv and half of the excess returns in Frankfurt. In order to determine the best portfolio management, we calculated the statistics for the excess returns using Chow's test in lieu of the regular MCSD and compared them as shown in Table 3.

Table 3: Chow Test vs Standard MCSD-Managed Portfolios

	Tel-Aviv	New York	London	Frankfurt
$\bar{r}_p^{Chow} - \bar{r}_p^{MCSD}$	-0.000100	-0.000045	0.000025	-0.000221
p-value of the mean diff. test	0.672852	0.585092	0.464774	0.817302
p-value of the sign test	0.358609	0.572597	0.284505	0.623767
Observations	2470	2419	1631	1699

It seems that in three of the four markets, the portfolios managed according to Chow's test resulted in worse performances than those portfolios managed by the standard MCSD even when we used the best combination of test parameters. The results confirm what was evident in Table 2 i.e., that in most cases MCSD with an integrated Chow test reduces the average daily excess results although not always statistically significantly.

5.3 AMCSD

In the AMCSD procedure, only one parameter needs to be valued, i.e., the utility set restriction factor ϵ. Increasing this parameter confines the utility set that we are taking into account and increases the number of dominance relations pairs. In some recent work by Levy, Leshno, and Leibovitch (2010), a value of 0.3 was obtained. In the present paper we use the values of 0.1, 0.2, 0.3 and 0.4 to see how portfolio performance changes. It seems that the optimal value of the ϵ parameter is 0.4. In most cases, the mean excess returns are increasing monotonically and become more significant when ϵ rises. In Table 4 we present the AMCSD results of excess returns for the initial portfolio and in Table 5 we exhibit the results for the AMCSD portfolio vs the MCSD-managed portfolio.

Table 4: AMCSD-Managed Portfolios

For ϵ=0.4	Tel-Aviv	New York	London	Frankfurt
$\bar{r}_p^{AMCSD} - \bar{r}_p^I$	0.000619	0.000100	0.000252	0.000794
p-value of the mean diff. test	0.044458	0.401202	0.279602	0.118175
p-value of the sign test	0.045498	0.086559	0.022446	0.000741
Observations	2470	2419	1631	1699

Table 5: AMCSD- vs MCSD- Portfolios

	Tel-Aviv	New York	London	Frankfurt
$\bar{r}_p^{AMCSD} - \bar{r}_p^{MCSD}$	0.000252	0.000137	0.000172	0.000377
p-value of the mean diff. test	0.153745	0.243020	0.199042	0.182856
p-value of the sign test	0.018193	0.001225	0.006194	0.076160
Observations	2470	2419	1631	1699

The results clearly show that AMCSD can produce better portfolio returns in all markets and that those changes are statistically significant (at least, according to the sign test). The managed portfolios in Tel-Aviv, New York, London, and Frankfurt exchanges produce average excess daily returns of 0.0619%, 0.01%, 0.0252%, and 0.0794% , which amounts to annual mean returns of 15.475%, 2.5%, 6.3% and 19.85%. Moreover, when AMCSD portfolio management is used instead of MCSD we observe significant improvements in all four markets.

5.4 Changing the Initial Portfolio

As a test for robustness, we used the various MCSD procedures on the 1/N portfolio as the initial portfolio. Every asset in the portfolio is equally weighted from all the assets in the specific exchange. The results are not reported here and are available from the authors upon request. These results are somewhat astonishing since in all the markets and for all the procedures, the improvements were significantly lower than when the index portfolio was used as the initial portfolio. These results raise the following questions: Does this indicate that the 1/N portfolio is more efficient that the market index portfolio? This is quite possible since MCSD has far less room for improvement. Although these results to some extent contradict the general conclusions of De Miguel et. al. (2009) that 1/N naive portfolios are inefficient, we reiterate that the improvements provide portfolios that are marginally stochastic dominant. We have shown that improving performance strongly depends upon the initial portfolio and more specifically whether it is located near a local (or even global) optimum if such optimum exists.

5.5 The Market Effect

If we examine the mean excess return in the various exchanges, a pattern seems to prevail in all methods. The best results are obtained in the Tel-Aviv and Frankfurt exchanges followed by London and then New York. One possible explanation for this pattern is that the level of market competition and efficiency can affect the results of the managing algorithm. Namely, more efficient markets like New York and London exhibit fast price adjustments, and automatic trading systems perform poorly.

6 Conclusion

In this paper we used three different, yet interconnected, methods to manage portfolios. As shown, the standard MCSD procedure provides quite good results at least in the less efficient markets. Using Chow's test in MCSD resulted in poorer portfolio improvement probably due to the test power which ignores assets with growth potential. It may be possible to improve the test by deriving its optimal parameters by using 10 test points instead of 20 and locating them based on quantiles. Finally, we found evidence that using AMCSD improves the performance of the portfolio, beyond the standard MCSD. The reason is that if forced to satisfy "bizarre" concave utility functions, we ignore assets with improving returns.

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The study presented a framework of human resource management (HRM) practices and explores their scales in the context of Vietnam. The study investigates the relationships between HRM practices and business performance. Data were collected from 388 companies, using a questionnaire survey. The research showed that HRM practices in Vietnam can be measured through seven dimensions with tested construct validity. Except four traditional functions of HRM such as recruitment-selection, training- development, performance appraisal, and compensation, HRM practices in Vietnamese context involve three more advanced functions: two traditional soft practices including leading change and motivation, and one contemporary hard practice as talent management. This result implies that HRM practices in Vietnam are following the world trend in HRM practices. It indicates that HRM practices in Vietnam are beyond traditional functions of HR department and closer to the change agent role and hand-in-hand with line managers in talent management. Another finding is about the important role of HRM practices the firm's business performance. Particularly, HRM practices can explain 43% of variation in business performance.

Keywords: HRM practices, business performance, Vietnam.

Introduction

Researches into Human resource management (HRM) practices have been increased in recent years as the trend of HR transformation is diffused from developed countries to developing countries.

Traditionally, HRM practices just focused on which distinguished HRM from other functions in a firm. The most common practices mentioned in many studies in HRM are recruitment and selection, training and development, performance appraisal, compensation and benefits, work relations, employment law and compliance, etc. (Ying Zhu, 2005). These practices carry both hard and soft functions of HRM which normally belong to the accountability of HR department.

The common vision of 64 thought leaders in the book edited by Losey et al. (2005) is that HR in the 21^{st} century would be integrated into the basic organizational processes. Traditional HRM functions are not enough for the changing role of HRM today. HR department needs to work in partnering with line managers. In returns, line managers also need to take direct responsibility of HRM under their supervision. Thus, contemporary HRM practices, in both hard and soft ones, should be introduced to meet the requirements of this changing role.

With the journey of Vietnam in joining in the World Trade Organization (WTO) and Trans-Pacific Strategic Economic Partnership Agreement (TPP), a lot of changes had been taken in the practices of HRM in Vietnamese firms. HRM becomes responsibilities of not only HRM department but all line managers. This paper aims at providing discussion on a new framework of HRM practices in Vietnam after nearly 30 years of economic reform and open-door policy.

The main objectives of this research are:

1. To conceptualize a holistic framework of HRM practices which reflects the trend of evolution in HRM
2. To identify the dimensions of HRM practices currently implemented in Vietnam, based on this framework
3. To examine the role of these HRM practices in Vietnamese firm's business performance.

Before achieving these objectives, definition of HRM and HRM practices which fit Vietnamese context was reckoned. Previous studies about HRM practices and its relationship with firm performance, including those in Vietnam, were reviewed.

Literature review

Concept of Human resource management

Due to the importance of HRM, there have been so many researches on HRM. Variety of definitions of HRM cause diversity in HRM practices.

Guest (1987) focused more on policy when considered human resource management as a set of policies which are designed to maximize organizational integration, employee commitment, flexibility and quality of work. With more systematic view, Wright and McMahan (1992) defined strategic human resource management as the pattern of planned human resource deployments and activities intended to enable an organization to achieve its goals. The real challenge for the human resource manager is how to attract, motivate and retain good people (Oyesola, 2011). According to Amstrong (2009, p.4), human resource management is a strategic integrated and coherent approach to the employment, development, and well being of the people working in organization. In addition, Stone (2008) reckoned that human resource management involves the productive use of people in achieving organization's strategic objectives and the satisfaction of individual employee needs. These definitions indicate two concerns in HRM: a) What have been involved in HRM; and b) Objectives of HRM. A summary is in Table 1.

Table 1: Two concerns in HRM definitions

Authors	What have been involved in HRM	Objectives of HRM
Guest (1987)	A set of policies	Maximize organizational integration, employee commitment, flexibility and quality of work.
Wright and McMahan (1992)	The pattern of planned human resource deployments and activities	To enable an organization to achieve its goals
Stone (2008)	The productive use of people	Achieving the organization's strategic objectives and the satisfaction of individual employee needs
Amstrong (2009)	A strategic integrated and coherent approach	Employment, development, and well being of the people working in organization

As in other developing countries, many managers in Vietnamese firms just focus on developing market and reducing costs rather than developing their people and improving their satisfaction. They do not pay sufficient attention in HRM, neither understands the contribution of HRM to the organization's performance and sustainable development. Thus they would think HRM merely belongs to HR department's responsibility or they should just follow the government policies. Normally CEO just sends those who lack of capabilities in business, in technology, in marketing, in finance, etc. to HR department. Line managers tend to blame HR department at these shortages.

Some managers mistakenly think that personnel management is applied in organization which is micro level while HRM is applied in managing people at the macro level such as in provinces or country. To facilitate the right understanding and practicing of HRM in Vietnamese context, the first aspect of definition of HRM should indicates that HRM is not only activities, actions, programs but managers' philosophies and policies related to people. The second aspect is that objectives of HRM should emphasize mutual benefits of organization and its employees. The third aspect should mention about the HRM's objects of study and scope of impact in the organization.

In a Vietnamese context, human resource management comprises a set of philosophy, policies, procedures and actions related to attracting, training and development and remaining people to achieve the organization's objectives and employee satisfaction.

Functions of HRM and practices

HRM involves acquisition, development, reward and motivation, maintenance and departure of an organization's human resources with key activities: job analysis, human resource planning, recruitment, selection, performance appraisal, human resource development, career planning and development, employee motivation, remuneration, benefit, employee relations (Stone, 2008). According to Fombrun et al. (1984), the human resource cycle in Michigan's human resource management model comprises four functions of HRM which are selection, performance appraisal, development, and rewards. This group is the core of HRM functions, although the names of practices in this group were quite diversified.

- **Selection**: matching people to jobs, may have other name in research: Attracting, placement
- **Appraisal** of performance
- **Rewards:** emphasizing the real importance of pay and other forms of compensation in achieving results may have other name in research such as compensation, rewards, benefits
- **Development** of skilled individuals, may have other name in research: training, personal/organizational development, career development

From a viewpoint of practitioners, SHRM[1] reported HRM practices nowadays involve compensation & benefits, business leadership & strategy, diversity, employee relations, ethics & corporate, social responsibility, organizational & employee development, talent management, technology. Meanwhile, according to CIPD[2], three top current priorities for HR functions in 2014 were employee engagement, managing change and cultural transformation, and managing performance.

Theoretical framework of HRM practices

In general, with respect to the HRM model by Michigan university, there are three key questions that HRM has to deliver the answers to the firm: How to attract the right HR? How to increase their productivity and develop their competencies? How to recognize and reward for retaining competent and high performers?

That was why many researches applied all four functions into HRM practices as in Joseph and Dai (2009), Bhanugopan et al. (2013), or in the review of Aggarwal & Bhargava (2008), etc. These practices indicated that there was an emphasis on "technical", in other word "hard" side of HRM functions. In addition, less mentioned were some other "hard" practices such as promotion, job design, etc. Normally, HR department is the "owner" of this hard group. Depending on research purposes, characteristics of regional or industrial culture, some studies mentioned some further hard practices such as promotion (Singh, 2004; Tessema and Soeters, 2006; Katou, 2008), job design (Singh, 2004; Katou, 2008), employee relations (Ying Zhu, 2005), etc.

Besides, HRM practices also cover the "human" side of HRM functions such as teamwork, communication, employee involvement, motivation, etc. They can be considered as the "soft" HRM practices. Teamwork and communication used to be recognized Le Chien Thang and Truong Quang (2005) and (Katou, 2008), while employee involvement was studied in Singh (2004), and motivation in Šikýr (2013).

Among hard and soft groups, some HRM practices used to be applied for long time as basis for any HRM system. They can be called "traditional" HRM practices. With the shift of human resource management responsibility to line managers, specially, the development of a new role of HRM as a business partner, to support globalization and internalization, HR department today is expected to be able to connect its work inside the organization to customers, investors, and community leaders outside.

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[1] http://www.shrm.org/about/foundation/products/pages/shrmfoundationepgs.aspx

[2] http:www. www. cipd.co.uk/hroutlook

The collaboration between HR department and line managers will enhance business leadership and strategy, as well as focus more on customers, i.e. HR from the out-side in (Ulrich et al., 2009).

Boundary of HRM practices between HR department and line managers becomes blurred. However, there is a need to distinguish the accountability between these two groups in order to avoid overlapping and to provide clear goals and key performance indicators for the two groups. Only those practices led by HR department such as employee engagement, organization design, talent management, cultural transformation, retention, etc. are considered as HRM functions. We called them "Contemporary HRM practices" to distinguish them from those 'traditional' ones.

Learning from both academic and practical points of view, HRM practices can be classified into four groups (see Figure 1):

- Traditional HRM hard group: job analysis, work design, recruitment and selection, placement, training and development, performance appraisal, compensation and benefits, employment law and compliance, etc.
- Traditional HRM soft group: motivation, teamwork, employee involvement, leading change, etc.
- Contemporary hard group: organization design, staff retention, talent management, etc.
- Contemporary soft group: employee engagement, cultural transformation, etc.

Contemporary HRM practices, both hard and soft, are still emerging and expected to increase in the future. However, as this is an evolution of HRM, boundaries among the four groups of HRM practices are not discrete. The soft practices can work well only when the hard practices are already implemented. The contemporary ones need to base on traditional ones to develop. In other words, contemporary HRM practices cannot be implemented unless the traditional ones are effectively operated.

Thus, in this research, firstly four traditional dimensions of hard HRM practices were selected from literature review with respect to Vietnamese context: *Recruitment and selection, Training and development, Compensation and rewards.*

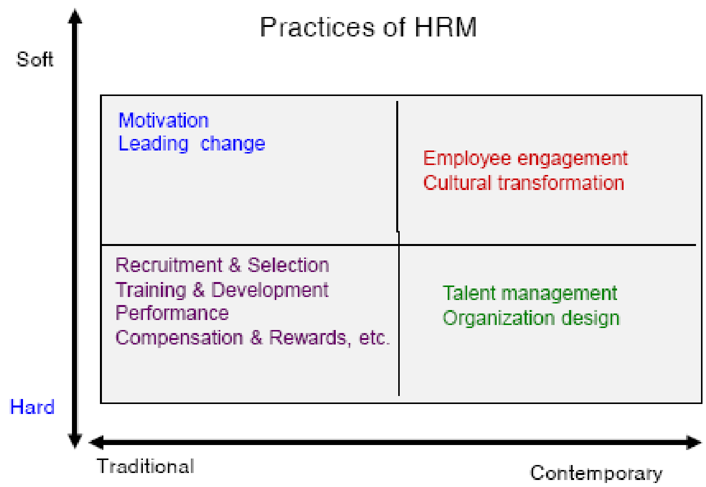

Figure 1: A framework of HRM practices

The fact that Vietnam has participated in WTO and TPP causes fierce competition even in domestic market. Improving productivity and business effectiveness become the keys for survival of Vietnamese firms. This situation forces managers in these firms to change their mindset and practices in order to motivate their people, attract and retain talents. Talent management becomes hot topic. Practitioners start to recognize the huge contribution of HRM to the business performance. The war for talents becomes more serious. Thus *talent management* is examined as a practice of HRM in this research as it was mentioned in a research of Šikýr (2013).

As a common situation in central planned economies, many managers focus on mandating rather than motivating. When moving to market orientation, managers have recognized the value of employee motivation. In addition, Vietnamese economy has not gone through the economic recession which has lasted since 2011. During economic recession, managers have to encourage people, not mandate them. Thus *motivation* is examined as a dimension of contemporary HRM practices in this research. Motivation was mentioned in recent researches such as Stone (2008), Šikýr (2013).

Vietnam comes from a central planed economy to a market oriented economy. This context has required firms to change accordingly. However, change management has been ignored for long time. Many managers do not want to change. Many HR policies in terms of salary and welfares are still being directed by the central government. Leading change was mentioned in research of Milkovich & Boudreau (2004) and discussion on "HR as change agent" by Ulrich et al. (2009). Thus, *leading change* is examined as dimension of contemporary HRM practices in this research.

However, organization design and employee engagement have not been chosen yet to put in our research model in Vietnam. The reason is about its rareness in Vietnamese firms. They might concern to some CEOs but they do not know how to assign these practices to which department. Cultural transformation relates across functions and reflects the mindset of CEO. It is expected to be more complicated in study. So it is suggested to be researched in a separate study.

In summary, HRM practices in Viet Nam can involve 7 dimensions. This research focused on the four traditional hard dimensions of HRM practices, which are quite popular in Vietnam, and two traditional HRM soft dimensions which are emerging in Vietnamese firms, including leading change and motivation. The research also added talent management as contemporary HRM hard dimension in the model (see Table 2). Contemporary HRM soft practices are not included in this research according the explanation in the paragraph above.

Table 2: Key concepts in the research model

Construct	Definitions	Literature
Recruitment & selection	The process of seeking and attracting a pool of qualified applicants for job vacancies through selection techniques and policy.	Fombrun et al (1984), Tran Kim Dung (2015)
Training & development	Build individual capability and knowledge to meet current and strategic requirements of the organization and personal career development.	Fombrun et al (1984), Tran Kim Dung (2015)
Performance appraisal	A system to record, fairly evaluate employee performance, with an aim to improving individual performance and hence achieving firm's objectives.	Fombrun et al (1984), Tran Kim Dung (2015)
Compensation & rewards	A system of payment to carry equality among job requirements, employee competencies, and individual and organizational performance and local market.	Fombrun et al (1984), Tran Kim Dung (2015)
Motivation	Policies and action plans to make employees feel happy and inspired in their jobs, desire to make efforts to give best contributions to the organization.	Robbins, S. (1986), Stone (2008), Šikýr (2013).
Leading change	Act as a role model leader, maximizing dynamic and positive force for stimulating creativity, diversity, learning and growth.	Ulrich et al. (2009), Milkovich & Boudreau (2004),CIPD (2015), Tran Kim Dung (2015)
Talent management	A system to ensure that the organization has the right resources, capability and talents to achieve its immediate and strategic objectives.	CIPD (2015), Šikýr (2013).
Business performance	The extent to which a firm increases sales, profits, market development and customer satisfaction	Singh (2004), Santos et al. (2007)

Relationships between HRM practices and firm's business performance

Effective HRM practices bring positive HR outcomes such as high competencies, satisfaction, high responsibility and commitment with the organization. Satisfied employees will make customers satisfied. As a result, business performance of the firm will be better.

Therefore, relationship between HRM and firm performance have been tested in many researches, with diversified respondents and in various contexts such as Fey at al. (2000) in Russia, Park, et al (2003) in Japan; Singh (2004) in India, Joseph and Dai (2006) in Abidjan, Absar et al (2010) in Bangladesh, Duke and Udono (2012) in Nigeria, Šikýř (2013) in Czech, Arshad et al. (2014) in Pakistan, etc.

In Vietnam, researches also showed that effective HRM practices can lead to higher organizational performance. Previous studies were conducted in different types of ownership and industries such as Le Chien Thang and Truong Quang (2005), Ying and Zhu (2007), Long Pham (2011), Nguyen Minh Ngoc and Ngo Van Tuan (2012).

As a result, our main hypotheses of this research are:

Hypothesis H1: The HRM practices are interrelated seven dimensional constructs.

Hypothesis H2: The HRM practices affect positively on firm's business performance.

Methodology

This research applied mixed methods to explore the current HRM practices and its importance in Vietnamese firms.

- Preliminary research was conducted with qualitative method to explore the current HRM practices in Vietnam and its contribution to business performance of Vietnamese firms. 9 managers and 12 employees were interviewed for reviewing those HRM practices in Vietnamese firms. The results were used for developing final measurement scales of all factors in the research model and then transferring to the survey questionnaire in the main research.
- Main research was conducted quantitatively via a survey of 388 firms. Respondents were managers and HR specialists working for firms in Ho Chi Minh city, Vietnam.

This research developed a set of valid and reliable instruments to measure 7 practices of HRM. Based on the definitions and conceptualizations in the literature and practices in Vietnamese firms, we develop measurement items for all these 7 dimensions of HRMP. All items were measured by a Likert seven-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

SEM is effective when testing latent constructs that are being measured with multiple items (Luna-Arocas & Camps, 2008.). Thus, SEM method was applied in this research to measure multi-dimensional HRM practices.

Sample and data collection

In the main survey, the data was collected by self-directed questionnaire through face-to-face contact. Convenient sampling method was applied. Data includes 635 valid responses from 388 firms, in different industries, with response rate of approximately 43 percent. Mean scores of those responses from the same firm was calculated for the firm's score, i.e. aggregated score.

Description of the sample is summarized Table 3 below.

Table 3: Sample characteristics

Type	*Characteristic*	*Statistics*
Ownership	Private	42.3%
	SOE	23.0%
	FDI	19.2%
	Joint stock and others	15.4%
Size	less 300	69.3%
	301-1000	12.1%
	>1000 employees	18.6%
Time established	less 5 years	25.8%
	5-10 years	27.8%
	more than 10 years	46.4%

Measurement

Based on the current review of HRM practices in theories and previous study in Vietnam, and in deft – interviewing, this concept comprises 7 components, including recruitment and selection, training and development, performance management, compensation, leading change, motivation, and talent management. Each latent variable is measured by 3 observable variables (see Table 4).

The firm's business performance is measured by 4 observable variables: Revenue, profit, customer satisfaction, and market development. The responses were about perceived performance.

Data analysis methods

The measurement model was firstly tested on the complete data set using exploratory factor analysis employing SPSS 20.0. The data exhibited the univariate Kurtoses and Skewnesses within the range of [-1, +1]. Thus, maximum likelihood method was used to determine the underlying factor structures (Muthen and Kaplan, 1985).

Then, confirmatory factor analysis was employed using AMOS 20 to further investigate the latent structure of the factors and testing the measurement model. It tests the construct validity with uni-dimensionality, reliability, convergent validity, discriminant validity, and predictive validity (Garver and Mentzer, 1999). These methods will help to confirm dimensions of HRM practices with their respective measurement scales. In order to test hypotheses, we tested the research model via structural equation modeling (SEM) using AMOS 20.

Data analysis and results

Measurement validation

The measurement of HRM practices produces model fit with: $\chi^2_{[182]} = 342.144$; p=0.000; GFI= 0.923; TLI=0.964; CFI=0.969; RMSEA=0.048. In addition, all factor loadings were high > 0.586 and significant ($p < 0.001$). These findings indicate that the scales measuring the seven dimensions of HRM practices were uni-dimensional. Within-method convergent validity was achieved based on the standard by Steenkamp and van Trijp (1991).

The results supported that the scales of 7 dimensions of HRM practices, including recruitment and selection, training and development, performance appraisal, compensation and rewards, leading change, motivation, and talent management are relevant to Vietnamese context.

Business performance is a multi-dimensional construct which have two dimensions, finance performance and market development, with four observed items. Scale of business performance produced model fit with: $\chi^2_{[1]}= 1.736$; p=0.000; GFI= 0.998; TLI=0.994; CFI=0.999; RMSEA=0.044.

See Table 4 for CFA item loadings, composite reliability, and average variance extracted of the scales validated.

Table 4: Mean, standard deviation, and standardized CFA factor loading of items

	Mean	Std. Deviation	Standardized loadings
HRM practices: Composite reliability Pc = **0.9317;** Average variance extracted VE=**0.6627**			
1. ***Recruitment***: Composite reliability Pc = 0.7594 Average variance extracted VE=0.5174			
Selection criteria are standardized according to job requirements	4.75	1.425	0.586
Recruitment process is relevant	4.6	1.387	0.815
There is a good collaboration between line managers and HR department in selection process	4.5	1.436	0.735
2. ***Training & development***: Composite reliability Pc = 0.8735; Average variance extracted VE=0.6983			
Training design and implementation align with the firm's strategic objectives	4.94	1.433	0.755
Employees are provided with training of knowledge and skills to carry out their tasks	4.34	1.575	0.839
Employees are provided with high quality training programs	4.44	1.544	0.907
3. ***Performance appraisal***: Composite reliability Pc =0.8211 Average variance extracted VE=0.6064			
Employees receive sufficient feedback and counseling based on their performance	4.48	1.326	0.688
The performance appraisal system in this firm focus on enhance employee performance	4.46	1.416	0.798
The performance appraisal system in this firm is fair and accurate	4.23	1.408	0.843

4. ***Compensation***: Composite reliability Pc = 0.8773 Average variance extracted VE=0.7046			
Payment in this firm is fair	4.55	1.511	0.825
Compensation in this firm is based on job requirements and employees' competencies	4.7	1.521	0.878
Employee income reflects performance results	4.58	1.605	0.815
5. ***Leading change***: Composite reliability Pc = 0.8313; Average variance extracted VE=0.6219			
Encourage to improve performance frequently	4.63	1.245	0.754
Change efforts are encouraged	4.81	1.367	0.83
Opportunities to apply improvement initiatives for improvement are opened to all employees	4.69	1.366	0.781
6. ***Motivation***: Composite reliability Pc = 0.8846 Average variance extracted VE=0.7187			
There are programs that make employees feel motivated in their jobs	4.3	1.257	0.83
Care of employee moods in the workplace is a priority	4.37	1.322	0.856
Motivation programs in this firm have good effects	4.47	1.375	0.858
7. ***Talent management***: Composite reliability Pc = 0.8816; Average variance extracted VE = 0.7129			
Programs to attract talents work well	4.23	1.46	0.814
Programs to remain talent work well	4.31	1.435	0.866
Programs to develop talent work well	4.4	1.442	0.851
Business performance: Composite reliability Pc =0.7660; Average variance extracted VE = 0.6245			
1. ***Financial performance***: Composite reliability Pc = 0.8845; Average variance extracted VE = 0.7936			
Achieve revenue target	4.86	1.411	0.83
Achieve profit target	4.97	1.401	0.95
2. ***Market development***: Composite reliability Pc =0.7405; Average variance extracted VE = 0.5893			
Market development	4.77	1.273	0.82
Customer satisfaction	4.86	1.207	0.71
Valid N (list wise)	388		

Relationships analysis and results

Measurement model produced model fit with: $\chi^2_{[202]}$= 354.693; df=202; p=0.000; GFI= 0.927; TLI=0.966; CFI=0.972; RMSEA=0.044. All composite reliability (Pc) ranged 0.740 to 0.932; Variance extracted (VE) ranged from 0.517 to 0.793. Factor loading ranged from 0.765 to 0.889. All correlations had estimate r ranged from 0.405 to 0.809; and $p< 0.000$, proving the discriminant validity of the constructs. The correlations between constructs, together with their standard errors, indicate that they were significantly different from unity, thus, supporting the construct discriminant validity (Steenkamp and van Trijp, 1991).

Therefore, hypothesis H1 is accepted. The HRM practices are interrelated seven dimensional constructs. In other words, HRM practices compose of seven dimensions.

Research model produced model fit with: $\chi^2_{[222]}$= 407.743; df=222; p=0.000; GFI= 0.917; TLI=0.962; CFI=0.967; RMSEA=0.046 (see Figure 2). A positive relationship between HRM practices and business performance was found (0.65) with $p < 0.001$. The results hence indicate that HRM practices are key factors predicting business performance of firms. HRM practices can explain 43 percent of the variance of business performance.

The squared multiple correlations for all variables ranged from 0.428 to 0.838.

Therefore, hypothesis H2 is accepted. These HRM practices affect positively on business performance of Vietnamese firms.

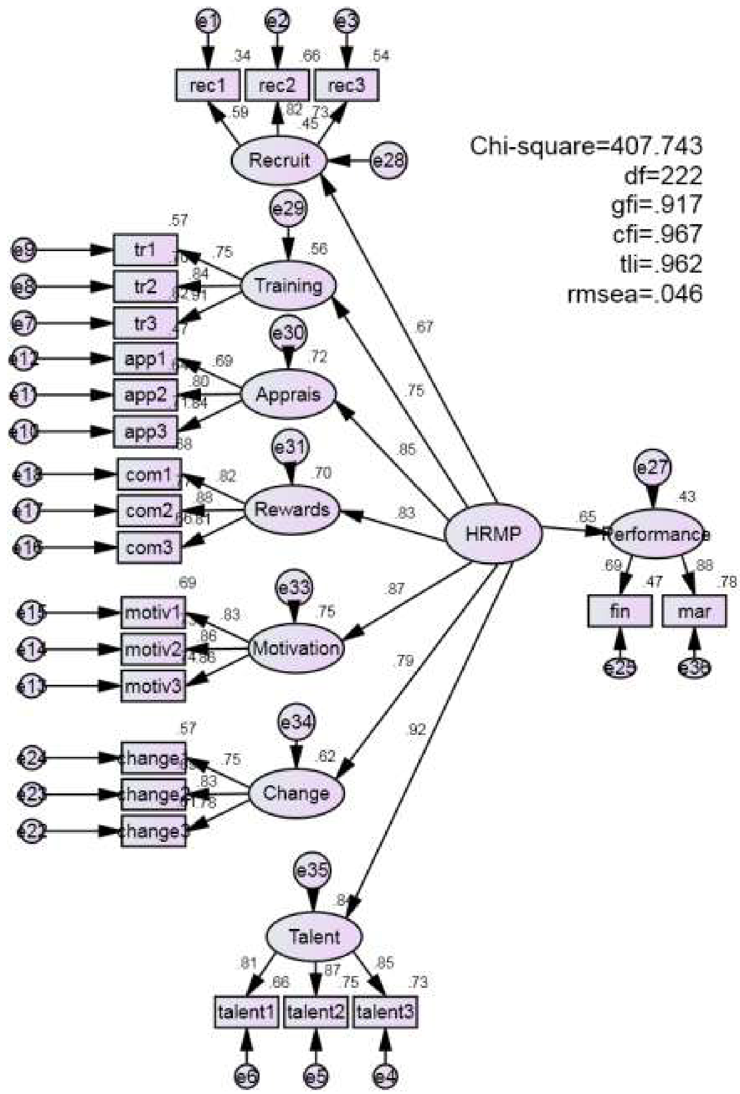

Figure 2: Impact of HRM practices to firm's business performance

Discussion and implications

Discussion

Construct validity for the practices of HRM was confirmed with 7 dimensions of HRM practices which include hard and soft dimensions, as well as traditional and contemporary HRM practices:

- Traditional hard dimensions of HRM practices: recruitment and selection, training and development, performance appraisal, and compensation and rewards. These practices comply with many previous studies in this field. It shows that Vietnamese firms nowadays apply all key functions of HRM. It is an improvement in comparison to the study by Ying Zhu (2005) in which HRM practices in Vietnamese firms depended much on the level of government, labor union, and foreign capital involvement. The improvement is on proactive HRM starting from how to recruit and select the right people to how to retain them by development and compensation.
- Traditional soft dimensions of HRM practices: motivation and leading change. These practices require insight understandings of employees, cross-functional collaboration about the business. They are big challenges to HR department. They also require a big change in mindset of line managers about their role and responsibility in HRM
- Contemporary HRM hard practices: talent management. These practices reflect a change in managers' mindset on the important role of talents to firm performance. Vietnamese firms today invest more in attracting, developing and retaining talents.

Benchmarking with some previous studies in Vietnam which represent for traditional approach and contemporary approach to HRM practices, it is indicated that those studies of all types of firms have reflected the trend of contemporary HRM practices in Vietnamese firms. Except in Long Pham (2011), equitized SOEs in Vietnam is still based on the government control, so only traditional HRM practices could be recognized (see Table 5).

Our research approaches to HRM practices in order to provide clearer concepts about HRM practices based on classifying them into hard vs. soft and traditional vs. contemporary groups of HRM practices, and to update the situation in Vietnam and attempts to close the gaps in these researches. Particularly:

- Research by Le Chien Thang and Truong Quang (2005) recognized some emerging HRM practices such as communication (belong to factor Information exchange) and retention management. However, an important function of HRM which is recruitment-selection was not examined. In addition, seniority-based compensation which was loaded in factor Group orientation is not appropriate in concept. And up to now, after ten years, many changes have been observed in Vietnam, with the participation into WTO and TPP recently.
- Among other studies in Vietnam about this topic then, Ying and Zhu (2007) qualitatively analyzed seven manufacturing firms in Vietnam to recognize work relations, employment relations, and employee involvement as key dimensions of HRM practices. It was just exploratory understanding the implementation of HRM practices, not yet statistically examined. Beside traditional hard HRM practices, one soft dimension of traditional practices, i.e. employee involvement, was recognized.
- Paper by Long Pham (2011) was still conceptual, not yet statistically testing, about HRM practices in equitized state-owned enterprises (SOEs) in Vietnam. Only traditional HRM hard functions were mentioned such as HR planning, recruitment and selection, compensation, training, performance appraisal.
- Research by Nguyen Minh Ngoc and Ngo Van Tuan (2012) which focused on 200 small and medium enterprises (SMEs) in Hanoi mentioned three traditional HRM hard dimensions of practices, including training, performance appraisal, and incentive compensation. No contemporary practices were discussed.

Table 5: Benchmarking among researches into HRM practices in Vietnam

	Le Chien Thang and Truong Quang (2005)	**Ying Zhu (2005)**	**Long Pham (2011)**	**Nguyen Minh Ngoc and Ngo Van Tuan (2012)**	**This research (Tran Kim Dung and Truong T. Lan Anh, 2015)**
Type of research	Quantitative Survey of 137 firms	Qualitative Case study with 7 cases	Conceptual	Quantitative Survey 200 firms	Quantitative Survey of 388 firms
Scope of research	Cross-sector, all types of ownership	Manufacturing SOEs, Join-ventures, FDIs	Equitized SOEs (i.e. run as joint-stock corporations)	Cross-sector, SME	Cross-sector, all types of ownership
Traditional hard dimensions of HRM practices	2 dimensions Training & development, Performance management,	3 dimensions Work relations, Employment relations, Employee involvement	4 dimensions HR planning, Recruitment and selection, Compensation, Training, Performance appraisal	3 dimensions Training, Performance appraisal, Incentive compensation	4 dimensions Recruitment & selection, Training & development, Performance appraisal, Compensation
Traditional soft dimensions of HRM practices	Information exchange, Group orientation,	No	No	No	Leading change, Motivation,
Contemporary HRM practices	Retention management (hard dimension)	No	No	No	Talent management (hard dimension)
Impact of HRM practices on firm's business performance	Yes HRM practices can explain 45% of variation in business performance.	Yes, but not statistically confirmed	Yes, but only with financial performance, and not statistically confirmed	Yes HRM practices can explain 42% of variation in business performance.	Yes, HRM practices can explain 43% of variation in business performance.

With a new framework of HRM practices, in comparison to previous studies in Vietnam, in different situations of economic changes, it is still true that HRM practices have significant impact to firm's business performance. This proves that people must be the vital key to firm success.

Implications

First, a framework of four groups of HRM practices suggested in this paper implies a need to design appropriate training programs to both HR professionals and line managers in order to effectively carry out them.

Second, the confirmatory results of HRM practices measurement model imply that HRM practices in Vietnam are following the world trend in HRM practices. Traditional hard practices are not enough for HRM in Vietnamese firms. It indicates that HRM practices in Vietnam are beyond traditional functions of HR department and closer to the change agent role and hand-in-hand with line managers in talent management. Such traditional HRM soft practices as motivation and leading change, and the contemporary HRM hard practices as talent management are practically appropriate to Vietnamese context.

Ten years after the research by Le Chien Thang and Truong Quang (2005), there are profound changes in Vietnamese economy with its participation in WTO and TPP that requires transformations in both mindset and practices of managers. Our research finds out that the emergence of traditional HRM soft practices and contemporary HRM hard practices is inevitable. Managers across functions should be aware of this trend and well prepared in terms of competencies to implement these practices.

A roadmap of HRM practices evolution can be learned from this research is from traditional hard group first, then traditional soft group, then contemporary hard group, and finally contemporary soft group (see figure 3). It would be more feasible when soft HRM practices are developed based on a well-designed system of hard HRM practices, and contemporary practices based on traditional practices. They are not mutually exclusive but reciprocal.

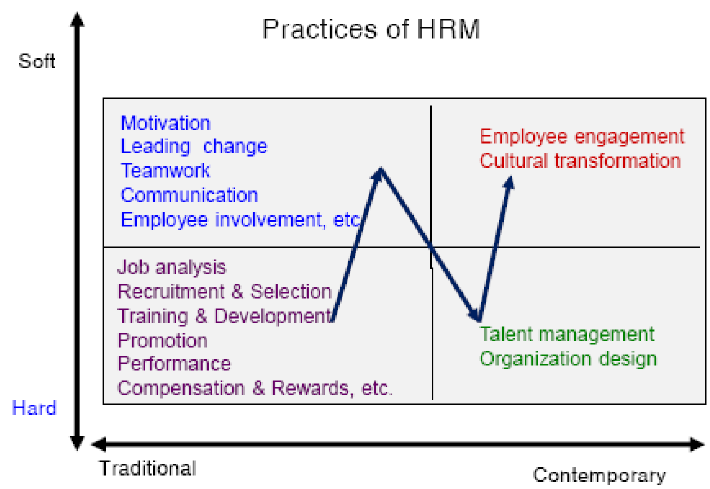

Figure 3: A suggested roadmap for HRM practices evolution in Vietnamese firms

Thirdly, investing in such contemporary HRM practice as Talent management will lead to better business performance. However, this practice challenges both HR department and line managers in a need to more collaboration with each other and to improve their human-related competencies.

Conclusions

HRM practices in Vietnam compose of seven dimensions with tested construct validity. Beside the four traditional hard dimensions of HRM such as recruitment and selection, training and development, performance appraisal, and compensation and rewards, HRM practices in Vietnamese context also involve two traditional soft dimensions such as leading change and motivation. The contemporary hard dimension which is significant in Vietnamese context is talent management. These HRM practices are recognized to have significant impact on business performance.

Contributions of the study

Firstly, this research suggests relevant concepts of HRM practices to Vietnamese firms. These concepts are presented in a framework which encourages right awareness about the changing role of HRM in the managerial circles. The framework of HRM practices in this study supports the concept of human resource management. HRM should be conceived and applied correctly in Vietnamese firms to replace the old concept of personnel management which still exist in many SOEs and SMEs in Vietnam.

Secondly, the research contributes to HRM field of study with valid measurement scales of HRM practices that would be significant to HR managers in Vietnamese context.

Thirdly, the research also contribute to theory a framework of HRM practices which helps recognize traditional vs. contemporary, and hard vs. soft groups. Based on this, firms in such developing countries as Vietnam can learn how to set a roadmap to upgrade their HRM functions following the world trend. CEOs can benchmark and envision the evolution process of HRM practices in their organizations. Accordingly, they can determine and distinguish responsibility of HR department and line managers in implementing HRM practices.

Forth, this research has confirmed the influences of HRM practices on firm's business performance. The significant role of HRM practices in leading firm performance is inevitable. The key is which specific HRM practices should be conducted in particular period of Vietnamese economy in order to bring in the most effective performance.

Limitations and directions for future research

This study has a number of limitations.

First, a sample is implemented by convenient method and we investigated only firms in Ho Chi Minh city, Vietnam. The model needs further replication in other places in Vietnam and critical evaluation to provide useful insights.

Secondly, this research did not measure organizational design, employee engagement, and cultural transformation as reviewed in our literature of contemporary HRM practices. In next few years, following the roadmap of HRM practices' evolution, these factors will become more popular in Vietnamese firms. So they should be tested in further research.

Thirdly, business performance was measured in perceived scales through an attitude survey. In such an environment of insufficient information about firm performance as in Vietnam, except those big ones on stock market, it is still impossible to access fact data about firm performance. So it just reflected managers' perceptions, not actual firm performance such as objective indicators.

For reviewer: Appendix 1: Item Correlations Matrix

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Appendix: Item Correlations Matrix

	rec1	rec2	rec3	tr1	tr2	tr3	app1	app2	app3	com1	com2	com3	change1	change2	change3	motiv1	motiv2	motiv3	talent1	talent2	talent3	fin1	fin2	market1	market2
rec1	1	.542**	.369**	.285**	.243**	.234**	.189**	.274**	.243**	.258**	.342**	.215**	.215**	.227**	.180**	.206**	.148**	.222**	.223**	.227**	.292**	.176**	.200**	.158**	.193**
rec2	.542**	1	.586**	.449**	.403**	.455**	.290**	.351**	.377**	.349**	.395**	.321**	.281**	.325**	.303**	.342**	.301**	.318**	.386**	.368**	.445**	.243**	.225**	.245**	.275**
rec3	.369**	.586**	1	.467**	.394**	.472**	.374**	.367**	.392**	.386**	.387**	.357**	.363**	.367**	.359**	.481**	.413**	.454**	.451**	.398**	.452**	.184**	.181**	.272**	.272**
tr1	.285**	.449**	.467**	1	.613**	.682**	.395**	.476**	.435**	.448**	.417**	.395**	.387**	.367**	.404**	.487**	.401**	.498**	.402**	.452**	.486**	.232**	.242**	.229**	.217**
tr2	.243**	.403**	.394**	.613**	1	.769**	.421**	.448**	.504**	.405**	.415**	.410**	.361**	.347**	.359**	.443**	.409**	.490**	.465**	.490**	.521**	.218**	.260**	.284**	.224**
tr3	.234**	.455**	.472**	.682**	.769**	1	.467**	.522**	.511**	.457**	.453**	.418**	.430**	.395**	.458**	.458**	.409**	.481**	.485**	.495**	.544**	.244**	.221**	.331**	.250**
app1	.189**	.290**	.374**	.395**	.421**	.467**	1	.577**	.563**	.472**	.443**	.370**	.352**	.371**	.417**	.416**	.402**	.428**	.404**	.391**	.419**	.198**	.211**	.292**	.270**
app2	.274**	.351**	.367**	.476**	.448**	.522**	.577**	1	.669**	.460**	.514**	.413**	.412**	.389**	.483**	.497**	.497**	.494**	.424**	.512**	.521**	.225**	.247**	.283**	.269**
app3	.243**	.377**	.392**	.435**	.504**	.511**	.563**	.669**	1	.506**	.550**	.460**	.433**	.472**	.448**	.518**	.523**	.517**	.528**	.588**	.596**	.235**	.280**	.369**	.358**
com1	.258**	.349**	.386**	.448**	.405**	.457**	.472**	.460**	.506**	1	.714**	.667**	.423**	.460**	.450**	.534**	.547**	.586**	.493**	.558**	.557**	.312**	.353**	.386**	.360**
com2	.342**	.395**	.387**	.417**	.415**	.453**	.443**	.514**	.550**	.714**	1	.730**	.434**	.464**	.419**	.543**	.524**	.534**	.539**	.548**	.585**	.301**	.333**	.388**	.428**
com3	.215**	.321**	.357**	.395**	.410**	.418**	.370**	.413**	.460**	.667**	.730**	1	.403**	.407**	.374**	.508**	.504**	.531**	.487**	.519**	.506**	.281**	.309**	.400**	.391**
change1	.215**	.281**	.363**	.387**	.361**	.430**	.352**	.412**	.433**	.423**	.434**	.403**	1	.644**	.553**	.464**	.394**	.472**	.462**	.444**	.510**	.330**	.341**	.344**	.315**
change2	.227**	.325**	.367**	.367**	.347**	.395**	.371**	.389**	.472**	.460**	.464**	.407**	.644**	1	.656**	.511**	.421**	.481**	.454**	.477**	.533**	.273**	.308**	.331**	.270**
change3	.180**	.303**	.359**	.404**	.359**	.458**	.417**	.483**	.448**	.450**	.419**	.374**	.553**	.656**	1	.525**	.521**	.536**	.438**	.476**	.500**	.298**	.330**	.328**	.303**
motiv1	.206**	.342**	.481**	.487**	.443**	.458**	.416**	.497**	.518**	.534**	.543**	.508**	.464**	.511**	.525**	1	.713**	.691**	.548**	.597**	.597**	.249**	.256**	.359**	.350**
motiv2	.148**	.301**	.413**	.401**	.409**	.409**	.402**	.497**	.523**	.547**	.524**	.504**	.394**	.421**	.521**	.713**	1	.748**	.557**	.607**	.598**	.227**	.302**	.385**	.350**
motiv3	.222**	.318**	.454**	.498**	.490**	.481**	.428**	.494**	.517**	.586**	.534**	.531**	.472**	.481**	.536**	.691**	.748**	1	.516**	.598**	.588**	.298**	.353**	.416**	.340**
talent1	.223**	.386**	.451**	.402**	.465**	.485**	.404**	.424**	.528**	.493**	.539**	.487**	.462**	.454**	.438**	.548**	.557**	.516**	1	.741**	.668**	.342**	.392**	.487**	.426**
talent2	.227**	.368**	.398**	.452**	.490**	.495**	.391**	.512**	.588**	.558**	.548**	.519**	.444**	.477**	.476**	.597**	.607**	.598**	.741**	1	.728**	.334**	.386**	.458**	.387**
talent3	.292**	.445**	.452**	.486**	.521**	.544**	.419**	.521**	.596**	.557**	.585**	.506**	.510**	.533**	.500**	.597**	.598**	.588**	.668**	.728**	1	.361**	.383**	.468**	.403**
Finance1	.176**	.243**	.184**	.232**	.218**	.244**	.198**	.225**	.235**	.312**	.301**	.281**	.330**	.273**	.298**	.249**	.227**	.298**	.342**	.334**	.361**	1	.787**	.499**	.458**
Finance 2	.200**	.225**	.181**	.242**	.260**	.221**	.211**	.247**	.280**	.353**	.333**	.309**	.341**	.308**	.330**	.256**	.302**	.353**	.392**	.386**	.383**	.787**	1	.583**	.493**
Market	.158	.245	.272	.229	.284	.331	.292	.283	.369	.386	.388	.400	.344**	.331**	.328**	.359	.385	.416	.487	.458	.468	.499	.583	1	.583**

1 Market 2	.193**	.275**	.272**	.217**	.224**	.250**	.270**	.269**	.358**	.360**	.428**	.391**	.315**	.270**	.303**	.350**	.350**	.340**	.426**	.387**	.403**	.458**	.493**	.583**	1

**. Correlation is significant at the 0.01 level (2-tailed).

□ □ □ □ □ □ Persuasive Effect of Signboards in Scenic Spots: The Influence of the Match between Language Style and Color Valence--Based on the Research of Chinese Cultural Circumstances

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Based on theories of the affective priming effect, implicit attitudes and conceptual fluency, this article has researched the persuasive effect of language styles of signboards in scenic spots on uncivilized behavior of tourists and probed into the influence of the matching methods between background color valence and language styles of signboards in scenic spots. The result indicates: (1) the language style of signboards exerts a distinct persuasive influence on tourists. (2) When the language style matches the background color valence, the persuasive effect becomes more effective. (3) Conceptual fluency forms the intermediate variable of the persuasive effect of in matching language style and background color valence. This article provides theories and guidance to enhance moral education and the intervening effect of signboards for uncivilized behavior.

Keywords: Color valence, Affective priming, Language style, Conceptual fluency, Persuasive effect.

1. Introduction

Tourism is nonresident and temporary, which leads to a lack of responsibility restriction and a weakened moral sense [1] and forms a significant factor of uncivilized behavior related to tourism. Cognitive psychologists have found that human behavior can be reached through internal motivation and purpose in a subconscious way [2]. As a message conveying social norms, signboards in scenic spots can have an impact involving warnings, reminders, requests, announcements, etc. to intervene with tourists' uncivilized behavior. However, in-depth research into the persuasive effect of signboards on tourists' uncivilized behavior is lacking.

Signboards bear differences in terms of language style and background color which offer an important clue for tourists' cognition and moral education. This article has conducted research on the persuasive effect of signboards on tourists through stimulated situational experimentation and further studied persuasive educational effects of the connection between language style and background color valence on tourist behavior, providing a theoretical basis and guidance for tourists' uncivilized behavior.

2. Paper review and research hypothesis

2.1 Influence of the persuasive effect of language style on tourists.

The standard focal point of this theory is that signal words described on signboards for tourism are mandatory social norms and behavior standards the majority agree or disagree with under a specific culture, which is attributed to an "ought-to-be" level [23] of social norms based on the theory. Signal words can be divided into two main sentence patterns: declarative sentences and imperative sentences. The declarative sentence is used to speak with a euphemistic and indirect mood, closed with a period. Compared to the declarative sentence style featuring certainty, the imperative sentence has a stronger negative meaning which is less acceptable to the public. Tourists' civilized behavior can be reached by different language-style signboards in scenic spots and generate the same result towards the pursuit of conscious civilized behavior. Tourists value their subjective feelings when accepting persuasive messages and prefer positive hints. In other words, they prefer the persuasion of a positive declarative sentence to that of a negative imperative sentence. Therefore, this study puts forward a hypothesis as follows:

H1: Declarative style sign wordage generates a more persuasive effect than imperative style sign wordage.

2.2 Interaction effect between language style of sign wordage and color valence of signboards.

Colors not only entail aesthetics, but also form a non-lexical stimulus which easily goes unnoticed and affects people's cognition and behavior [3]. Several studies have shown that colors exert effects on emotions, cognition and behavior [14] in relationships between men and women [7, 8], achievements [9], athletics [10], marketing and branding [11-13]. On the basis of the theory of color symbolism [4], people associate specific messages, concepts and experiences with specific colors. They are endowed with specific symbolic meanings to express different emotions and satisfy different psychological functions [6]. Under the Western mindset, red is associated with danger and mistakes (e.g. traffic lights and warning signs) [15]. Research done by Bock and others has also shown that red has a negative valence and confirmed that using red to deter people from undesirable behavior will backfire [17]. However, some research still indicates a positive effect for red. For instance, preschool children have a preference for red [18]. Maier and others owe individual red preference to different individual psychological circumstances which means under positive circumstances, people prefer red whereas under negative circumstance their preference will be totally the opposite [19]. Elliot and Niesta have proven that red has a positive influence on relationships between men and women: a red background will make women more attractive to men [20] and also make men more romantically attractive in women's eyes [21]. Red holds a respectable and traditional standing in the minds of Chinese because of folk magic of exorcising evil spirits and warding off bad luck. It is a joyous color representing luck and auspicious omens [22]. "Chinese red" has become the understanding and memory that people of other countries have for China. Therefore, under the Chinese circumstance, red has a positive psychological valence. Blue, standing for a typically cold color, has negative psychological effect, as opposed to red in terms of color and psychology.

Based on the priming effect, individuals will be affected by previous information when processing current information [24]. Emotions generate a priming effect and this individual emotional state is regarded as a prepared or starting state which influences individual cognitive actions. To be specific, individuals first process stimuli which have a certain emotional valence (prime stimulus), then process a subsequent stimulus (target stimulus). Generally, among stimuli of the same valence, people process target stimuli faster and more accurately [25]. Applying words consistent with the valence of a target stimulus as a priming stimulus will promote the processing of the target stimulus [26], but pictures have even higher levels than words as far as emotional arousal is concerned, thus have a more obvious priming effect [28]. Joyful images will be evaluated positively by respondents whereas angry images more negatively [27]. Elliot and Niesta (2007) conducted an intelligence test based on different background colors and proposed that social cognition should include color stimulus in stimulus materials with a priming effect [6]. Research done by Bock and others further proves that relatively abstract stimulus materials such as background colors do produce priming effects [17].

Background colors of tourist signboards are a kind of stimulus material and different language styles of signal words are the target stimulus. When thinking about tourist signboards, tourists can process colors and language styles of the same valence more quickly and accurately. Therefore, this study comes up with hypotheses as follows:

H2: When language styles match background colors of signboards in terms of valence, the signboards can have better persuasive effects.

H2a：Compared to signboards of declarative sentences with a blue background, signboards of declarative sentences with a red background have a stronger persuasive effect.

H2b: Imperative sentence style signboards with a blue background have a stronger persuasive effect then that of a red background.

2.3 Intermediate effect of fluency

Fluency is a subjective experience individuals have towards the difficulty levels of processing information of which conceptual fluency is a semantic analysis and semantic association between the target stimulus and the rendered scenario. The stronger the semantic association is, the higher the conceptual fluency will be, and psychological representation of target stimulus can be reached more easily. When the background color valence of signboards matches the semantic association of the language style on signboards, i.e. when a red background is paired with declarative sentences and a blue background is paired with imperative sentences tourists can experience conceptual fluency while processing information to inspire their positive affective state so as to influence the cognitive and persuasive effect in a positive way. Therefore, this study proposes a hypothesis as follows:

H3: When background color valence matches the language styles of signboards, tourists will experience conceptual fluency during information processing.

On the basis of above analyses, this conceptual modal of the study can be demonstrated in Fig. 1

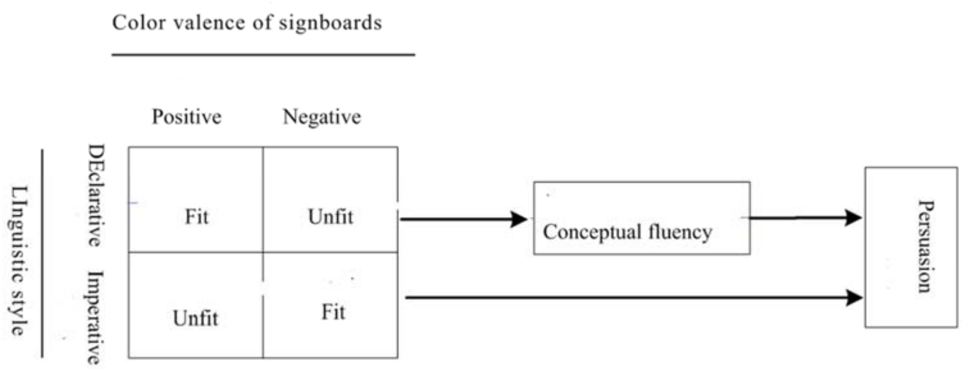

Fig.1 The concept model of the research

3. Research design

3.1 Analysis on psychological color valence

Colors convey different meanings when combined with different beliefs, customs and values of different nationalities, reflecting a unique experience of recording colors in different nationalities [33.] This study chooses tourists as its respondents, exploring tourist experiences and their emotional reaction associated with the 2 basic colors of red and blue and aims to identify the psychological valence of the 2 basic colors.

This study invited four tour guides to give out and retrieve 101 effective questionnaires when tourists were having a break. A professor majoring in psychology and 2 Ph.D. students collaborated together to arrange and summarize the words associated with the colors. Firstly, they independently screened color associated words related to psychological functioning and valence. Secondly, through discussions and combining synonyms or near-synonyms of associated words, they confirmed together that frequencies of red-and blue-associated words are respectively 210 and 251. Ultimately, they used the analysis of word frequency in a ROST content mining system to identity high-frequency words associated with red and blue and their cumulative association frequencies are respectively 84.8% and 77.7%. The research shows that, in rare cases, red is associated with danger and revolutions that have negative implications. Mostly, red is an affective and happy expression characterized by enthusiasm, jubilation, warmth, happiness, etc., which means red has positive psychological valence. Blue conveys a rational and negative emotion featuring vast, tranquility, melancholy, sophistication, etc indicating a negative psychological valence. The result of the analysis of variance ($F(1, 80) = 38.95$, $p<0.001$) signifies red and blue bear distinct differences in psychological valence.

3.2 Lab materials producing and measuring variables

According to common uncivilized behavior listed on the official website of the National Tourism Administration, the top one is “littering, spitting, blowing noses and spitting gum out in public places, no flushing after using the a toilet, lack of hygiene and leaving dirty marks”. Top 2 is smoking in nonsmoking areas which pollutes public space and impairs others’ health”. Based on that, the research experiment chose content and language style of signboards in scenic spots as follows:

(1) “If you spit on the ground, you're shooting your demeanor away.” (Declarative) and “No spitting” (Imperative)

(2)We hope you will not pick the flowers or walk on the grass for plants also have life and can feel. (Declarative) and “No picking flowers or walking on the grass” (Imperative)

(3) “I am an environmental protector and you are an emissary for your people.”(Declarative) and “No littering” (imperative)

Behavioral intent is based on the research of De Bock (2013) and “I am willing to accept the public behavior on tourist signboards”, “I am willing to abide by the public behavior on signboards while traveling”, and “I am willing to remind others to abide by the public behaviors on signboards while traveling” were extracted for measuring. Conceptual fluency was measured based on the methods of Schiffman and others. All the scales passed the reliability and validity tests.

4. Experiment Results

The study conducted hypothesis testing through 2 (signboard color: red vs. blue) by 2 (language style of sign wordage: declarative vs. imperative) between-subject design. 120 tourists from Chengdu scenic spots were invited to the official experiment. Steps were taken, including respondents grouping and guiding, experiment controlled tests, measuring cognitive and emotional responses, etc. SPSS 16.0 was also adopted to analyze and process the information.

（1）Analysis on the influence of the 2 language styles of sign wordage on persuasive effect.

Results of variance analysis on the influence of language style on persuasive effect show that respondents reading declarative sign wordage ($M_{\text{behavioral intention}}$=5.69) have a more positive behavioral intent ($F_{\text{behavioral intention}}(1,109)=25.87$, $p<0.001$）than that reading imperative sign wordage ($M_{\text{behavioral intention}}$=4.95), signifying that the language style of sign wordage described on signboards in scenic spots distinctly affects the persuasive effect on tourists, thereby supporting the hypothesis H1.

（2）Analysis on the persuasive effect of the matching between language style and background color valence of signboards on tourists.

Results stemming from variance analysis indicate that: in the declarative style, red signboards have better persuasive effect than blue on respondents, meaning a higher behavioral intent ($F_{\text{behavioral intention}}$ (1, 56) =10.26, p=0.002), among which respondents reading red signboards have a mean value of ($M_{\text{behavioral intention}}$ =5.98, $SD_{\text{behaviroal intention}}$=0.53), and respondents reading blue signboards have a mean value of ($M_{\text{behavioral intention}}$ =5.44, $SD_{\text{behaviroal intention}}$=0.71), thus supporting the hypothesis H2a. In the imperative style, blue signboards have a better persuasive effect than red on tourists, meaning a higher behavioral intent ($F_{\text{behavioral intention}}$ (1, 51) =15.91, $p<0.001$), among which respondents reading blue signboards have a mean value of ($M_{\text{behavioral intention}}$ =5.36, $SD_{\text{behaviroal intention}}$=0.76), and respondents reading red signboards have a mean value of $M_{\text{behavioral intention}}$ =4.56, $SD_{\text{behaviroal intention}}$=0.72), thus supporting hypothesis H2b.

In order to further study whether the psychological valence matching or mismatching between signboards colors and signal words language style can affect persuasive effects, this research introduces a dummy variable (1=valence matching between sign wordage language style and signboards color, 0=mismatching between sign wordage language style and signboards color) and adopts a one-way analysis of variance to conduct tests. Results obtained show that language style and background colors valence interact with each other reciprocally ($F_{behavioral\ intention}(1, 109)=18.14$, $p<0.001$＝ in terms of persuasive effects, i.e. when language style matches color valence, tourists have a higher acceptance of the persuasion, thus supporting hypothesis H2. Declarative sign wordage on red signboards and imperative sign wordage on blue signboards have different persuasive effects ($F_{behavioral\ intention}$ (1, 50) =11.82, p=0.001) and the result indicates that declarative signal words have better persuasive effect. Besides, signboard color valence itself does not affect persuasive effect significantly. ($F_{behavioral\ intention}$ (1, 109) =0.886, p=0.35)

（3）Test of intermediate effect of conceptual fluency

Referring to the cause and effect method put forward by Baron & Kennt, the study tested the intermediate effect of conceptual fluency and dealt with statistics with the help of dummy variables. The regression result (see Fig. 2) shows that conceptual fluency serves as an intermediate on the influence of the matching between language style and signboards color valence on a persuasive effect, thus supporting hypothesis H3.

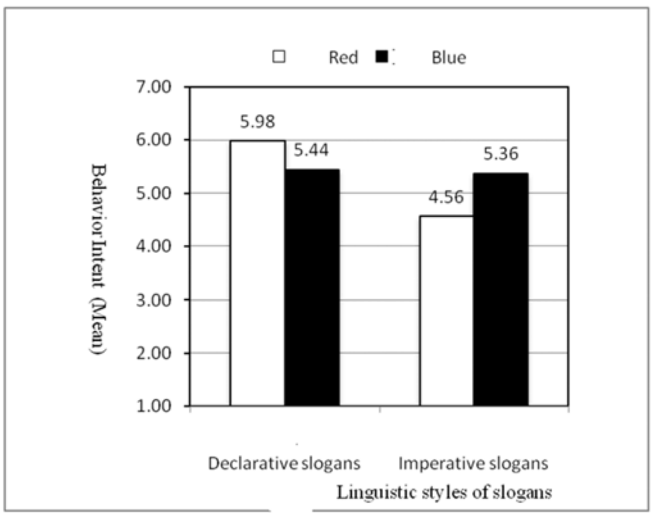

Fig.2 Interaction between linguistic style of slogans and color valence of signboards

5. Conclusion and discussion

5.1 Conclusion and discussion

（1）Under different cultural circumstances, different colors are associated with different psychological meanings. Different from Western cultural circumstances where red is associated with danger, mistakes and other negative meanings, in the color cognition experience of Chinese tourists, red and blue respectively have positive and negative psychological valence.

（2）Language style of sign wordage on signboards in scenic spots exerts significant influence on the persuasive effect. Researchers found that in contrast with the negative imperative style, the positive and euphemistic declarative style is more capable of arousing tourists' higher behavioral behavior. Imperative sign wordage directly mandates that people shall not behave immorally, which restricts people's freedom to some extent, reflecting a strong negative meaning. However, declarative signal words demonstrate positive information valence by encouraging people to enhance their morality.

（3）When language style matches the color valence of signboards, tourists are more willing to accept what is said on the signboards. This conclusion illustrates that background colors of signboards in scenic spots have an affective priming effect, people's morality is not a rational and deliberate reasoning process and color valence and other intuitive factors should be paid attention to.

（4）Conceptual fluency serves as an intermediate viable of the influence of the matching between language style and background color valence on the persuasive effect. Processing declarative sentences on red signboards makes tourists experience more conceptual fluency than that on blue signboards, thus bringing a stronger persuasive effect. Also, processing imperative sign wordage on blue signboards makes tourists experience more conceptual fluency than that on red signboards, thus bringing a stronger persuasive effect.

5.2 Management suggestions

Uncivilized tourist uncivilized behavior is a bad phenomenon of tourism, which not only endangers the ecological environments of tourist destinations, but also influences the quality of the experience of others. As an important means of spreading social norms, signboards in scenic spots have been given much attention by management departments of scenic spots. How to make tourists embrace social norms and behave in accordance with social norms are of much importance for tourist management practices. This study reveals that the matching between language style and background color valence of signboards impacts tourists' emotion, cognition and behavior through the formation of an implicit attitude. This study not only extends research on tourist behaviors, but deepens theories on uncivilized tourist behavior and also serves as a significant guide for tourist management departments to intervene in uncivilized behavior with proper signboards.

Moving toward Efficiency: The Study of Time-Varying Informational Efficiency in the Stock Exchange of Thailand

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The application of random walk or general auto-regressive model to investigate time-varying degree of informational efficiency in the previous literatures has some drawbacks. To make improvements on model specification, this study proposes the stochastic AR(p) coefficient model that relates the dynamic behavior of degree of efficiency with time in three functional forms. Using daily returns from Thailand's stock market from April 30th, 1975 to September 19th, 2014, this study finds the statistically relationship between degree of efficiency and time, which is well described either by the linear or the logistic function. Furthermore, the results suggest that degree of informational efficiency in the stock market improves through time as indicated by the decreasing numbers of day to disseminate particular amount of information.

Keywords: Time-varying market efficiency, informational efficiency, stochastic AR(p) coefficient model, Kalman filter

1. Introduction

Market efficiency is one of the most important foundations of finance theories. Although the hypothesis of efficiency has been extensively studied for financial markets in developed and emerging countries, the literature in this area is still growing. New sample markets as well as new techniques or improvements are introduced in order to achieve correct and insightful understanding. In the early period of the study, Fama (1970) concentrated his interest on informational efficiency, classifying efficiency into three separate forms, namely, weak-, semi-strong- and strong-form. Among these three forms, the test for weak form efficiency is the most popular because it employs market price data which are readily available to investigators. Examples of such studies include Fama (1965), Lo and Mackinlay (1988), Worthinton and Higgs (2006), Kim and Shamsuddin (2008), etc. Most of the tests for weak-form efficiency are restrictive in that they focus on whether the markets are or are not efficient during a sample period. Nevertheless, Grossman and Stiglitz (1980) argued that the market could not be fully efficient so that it was worth the effort of informed investors to gather the necessary information.

It should be noted that market efficiency is informational. The market is considered fully efficient if all information is known instantaneously to all investors and is reflected in prices. Based on this definition, the market should be interpreted as being more efficient, or less inefficient, if it takes less time for information to flow to investors and to be fully reflected in the relevant asset prices. So, even though the market is inefficient for a period in time, it is interesting to ask whether the market is less inefficient or more efficient in the following period. From a theoretical perspective, Lo (2004) proposed the Adaptive Market Hypothesis (AMH) to show that market efficiency is an evolutionary process and can be improved through time. Briefly, AMH asserts that individuals have their own interest and can make mistakes. However, they will learn from their mistakes and adapt themselves to the changing environments. Competition as well as innovation also leads to the evolution of the market, which, in turn, improves the degree of efficiency. His study found that degree of efficiency in US market varied over time as indicated by AR(1) coefficient from rolling regression. These findings point to the fact that, despite inefficiency, the degree may be time-varying.

The question as to whether the degree of market efficiency is time varying has been addressed in the literatures. Emerson et al. (1997) found evidence of changing auto-regression (AR) coefficients from a regression of stock returns in Bulgarian stock market. This study is the pioneer in support of time-varying degree of efficiency. Their framework has been broadly accepted and extended by subsequent studies. For example, Zelewska-Mitura and Hall (2000) employed this approach to investigate whether stocks listed in different periods have different degrees of efficiency, Li (2003a) applied it to study time-varying efficiency of two stock exchanges in China, Li (2003b) extended the scope of study using data from A-share and B-share markets of each stock exchange, while Arouri et al. (2010) employed it to investigate degrees of efficiency in emerging markets before and after liberalization. Apart from Emerson et al (1970)'s framework, Khantavit et al. (2012) recently applied time-varying smoothed transition autoregressive model (time-varying STAR) to the study of evolving market efficiency in Thailand's stock market.

The approaches used by the abovementioned studies have drawbacks at least in three respects. Firstly, the rolling regression model applied by Lo (2004) is inappropriate because AR coefficient of the model is fixed in each estimation window. Thus, the series of constant coefficients shall not be able to represent the correct dynamic process of degree of efficiency. Secondly, the time-varying AR(p) model suggested by Emerson et al. (1997) imposes random walk specification to AR(p) coefficient. With normally distributed disturbance of the random walk process, the coefficient is allowed to be any value between minus and plus infinity as well as to revert to the high level even if it has a falling trend. The theoretical and empirical evidences suggest otherwise. Once the market becomes more efficient, as indicated by a decreasing in magnitude of AR(p) coefficient, it is less likely to become less efficient in the future. Lastly, the time-varying STAR model applied by Khanthavit et al. (2012) imposes deterministic specification to AR(p) coefficient. It is, therefore, unable to capture stochastic behavior of the coefficient, if it indeed exists.

This study proposes the stochastic AR(p) coefficient model to examine time-varying degree of informational efficiency in Thailand's stock market. The degree of efficiency is measured by tracking the amount of time, as implied by the size of AR(p) coefficient from the regression of market return, the market needs to disseminate information. Besides, this model makes important improvements on what has been applied in the past. Firstly, this stochastic model is more suitable to investigate the time-varying degree of efficiency than the constant parameter model applied by Lo (2004). Secondly, the proposed specification is in a general form, which capable of accommodating the specification of AR(p) coefficient even if it is a random walk, as proposed by Emerson et al. (1997), or deterministic, as proposed by Khanthavit et al. (2012), or even a constant. Finally, and most importantly, the model imposes functional relationship of AR(p) coefficient with time in order to align with the theoretical perspective that the AR(p) coefficient has a negative relationship with time and should move towards a long-run value, not necessarily zero, as time goes to infinity. The key contribution of this study is to propose some improvements on the model as well as to provide an insightful analysis of how Thailand's market efficiency improves over time based on correct specification of the degree of efficiency that the market must have as time passes.

The scope of this study is limited to informational efficiency in weak form. That is, all the information should be reflected in the current market price so that past prices cannot predict future prices and abnormal returns cannot be made consistently. The author uses daily data of logarithm returns on SET Index from April 30th, 1975, the establishment of the Stock Exchange of Thailand (SET), to September 19th, 2014, totally 9,682 observations. Kalman filtering technique is applied to estimate the unobserved stochastic AR(p) coefficient based on the regression of the market returns. The remaining of this paper is organized as follows; Section 2 discusses the time-varying coefficient models applied in the previous literatures and the model proposed by this study. Section 3 briefly discusses the methodology for model estimation.

Section 4 presents data and descriptive statistics. Next, the empirical results are reported and discussed in Section 5. Finally, Section 6 provides conclusions of the study.

2. Time-Varying Coefficient Models for Investigating Evolving Market Efficiency

2.1 The Existing Models

There are at least three specifications of time-varying coefficient models applied in previous studies to investigate changes in the degree of efficiency. The first one is rolling regression applied by Lo (2004), yet this specification assumes that AR coefficient is constant in each estimation window (the reader may refer to Lo (2004) for more details on model specification). The second one is a time-varying AR(p) model proposed by Emerson et al. (1997). The model is expressed as follows:

$$r_t = \beta_{0t} + \sum_{i=1}^{p} \beta_{it} r_{t-i} + \nu_t,\ \nu_t \sim N(0, \sigma_\nu^2) \tag{1}$$

$$\beta_{it} = \beta_{it-1} + \omega_t,\ \omega_t \sim N(0, \sigma_\omega^2) \tag{2}$$

where r_t denotes return at time *t*,

β_{0t} denotes arbitrary time-varying drift parameter,

β_{it} denotes time-varying auto-regression coefficient of i^{th} lag order of returns for $i = 1,\ldots,p$,

ν_t denotes white noise disturbance of return, $\nu_t \sim N(0, \sigma_\nu^2)$, and

ω_t denotes white noise disturbance of auto-regression coefficient, $\omega_t \sim N(0, \sigma_\omega^2)$,

AR coefficient, β_{it}, in this model is stochastic and its behavior is described by random walk process in eq. (2). β_{it} plays a key role in determining the degree of market efficiency because it implies how fast information is reflected in the asset prices. Especially when AR(1) specification is imposed, the coefficient β_{1t} can be applied with half-life (HL) measurement to estimate the numbers of days for information dissemination. Basically, HL is computed by dividing minus logarithm 2 by the logarithm of AR(1) coefficient, i.e. $h = \frac{-\log 2}{\log \beta_1}$. The lower AR(1) coefficient, the faster a half of a particular amount of information is relayed to the market.

Some studies provide arguments on using random walk process to describe dynamic behavior of β_{it}. For example, Rockinger and Urga (2000) suggested that the best predictor of the future value of a parameter is its present value. Hence, the random walk process seemed to be the most appropriate choice. In addition, Li (2003a) mentioned that the random walk process was flexible enough to nest two possibilities of β_{it} to be both constant and time-varying in one specification. He also argued that the coefficient will be forced to change, even if it is constant when assuming other processes rather than random walk.

However, the author argues that random walk specification of AR coefficient is inaccurate. This is mainly due to the assumption of Gaussian white noise disturbance term, ω_t. It is obvious that β_{it} will have no directional trend and is likely to have any value. Without any mechanism to relate β_{it} with time, it is allowed to bounce back to a higher level once it is close to the long-run value. In such a case, it would say that once the market becomes more efficient or less inefficient, the degree of efficiency could be deteriorated at any point of time in the future. Intuitively, when a market has achieved a certain level of efficiency, it shall not turn back to being less efficient.

Apart from random walk, Li (2003b) assumed that β_{it} followed general auto-regression of order one process (GAR(1)). He claimed that the specification of GAR(1) was parsimonious to either constant or time-varying degree of efficiency. Nevertheless, the author considers that this specification still has some flaws. This is because it does not incorporate a mechanism to impose a functional relationship between the coefficient and time, and again, it is allowed a reversion to a higher value.

The third specification is a time-varying STAR model proposed by Khanthavit et al. (2012). The model is expressed as follows;

$$\begin{aligned} r_t = &\{\rho_0^1 + \textstyle\sum_{i=1}^{p} \rho_i^1 r_{t-i}\} \\ &+\{(\rho_0^2 - \rho_0^1) + \textstyle\sum_{i=1}^{p} (\rho_i^2 - \rho_i^1) r_{t-i}\} G(s_t;\theta_1, c_1) \\ &+\ldots+\{(\rho_0^m - \rho_0^{m-1}) + \textstyle\sum_{i=1}^{p} (\rho_i^m - \rho_i^{m-1}) r_{t-i}\} G(s_t;\theta_{m-1}, c_{m-1}) + \varepsilon_t \end{aligned} \tag{3}$$

where r_t denotes return at time t,
ρ_i^k denotes coefficient of return at lag order i^{th} of the k^{th} autoregressive process, for $i = 1,\ldots,p$ and $k = 1,\ldots,m$,
ρ_0^k denotes intercept of the k^{th} autoregressive process,
$G(s_t;\theta_k, c_k)$ denotes the logistic function, where s_t denotes time variable, $\theta_k \geq 0$, and c_k is parameter of the logistic function, and
ε_t denotes random disturbance, $\varepsilon_t \sim N(0,\sigma^2)$

This model explains market returns via a combination of autoregressive processes. They are related by a monotonic function of time, $G(s_t;\theta_k, c_k)$, to accommodate a smooth transition between each AR(p) process. Their study allowed lag order p to be greater than one and applied π-Absorption Time (AT) measurement to measure improvement in the degree of efficiency. AT measures the period of time a market requires to disseminate (1-π%) of information. If π is set at 50%, AT measurement will yield the same result as HL measurement.

This approach facilitates the investigation of time-varying degree of efficiency, especially when returns processes are described by AR(p) where p > 1. The aggregate size of all AR(p) coefficients are taken into consideration via the general impulse response function of AT measurement in order to make an inference on the improvement of degree of efficiency. Nevertheless, specification of autoregressive process of this model is deterministic. Therefore, with a particular set of parameters, market return at each period can be specified with certainty.

2.2 The Proposed Stochastic AR(p) Coefficient Model

This study proposes the stochastic AR(p) coefficient model that improves drawbacks of the existing models discussed above. The model is formulated as follows:

$$r_t = \beta_0 + \sum_{i=1}^{p} \tilde{\beta}_{it} r_{t-i} + \nu_t \tag{4}$$

$$\tilde{\beta}_{it} = \alpha_0^i + \alpha_1^i f(t) + \sum_{j=1}^{m} \sum_{k=j+1}^{m+1} \alpha_k^i \beta_{it-j} + \omega_t^i \tag{5}$$

where r_t denotes logarithm return at time t,

β_0 denotes longterm mean rate of return,

$\tilde{\beta}_{it}$ denotes stochastic AR coefficient of the i^{th} lag order of returns for $i = 1,\ldots,p$,

ν_t denotes white noise disturbance, $\nu_t \sim N(0, \sigma_\nu^2)$,

α_0^i denotes drift term or long-term mean of $\tilde{\beta}_{it}$,

α_1^i denotes time coefficient,

α_k^i denotes coefficient of the j^{th} lag order of $\tilde{\beta}_{it}$ for $j = 1,\ldots,m$,

$f(t)$ denotes a functional relationship of $\tilde{\beta}_{it}$ with time, and

ω_t^i denotes white noise disturbance, $\omega_t^i \sim N(0, \sigma_\omega^2)$.

Similar to the previous studies, $\tilde{\beta}_{it}$ is related to the degree of market efficiency as its magnitude reflects how much time the market takes to relay information. In case AR(1) specification is imposed, such as in Rockinger and Urga (2000) and Arouri et al. (2012), the HL measurement can be applied. And in case lag order p is greater than one, such as in Khanthavit et al. (2012), AT measurement can be applied. Though, this model is opposite to Emerson et al. (1997) in several respects.

Firstly, mean rate of market returns, β_0, in this model is assumed to be constant. The author considers that the assumption of time-varying long term mean rate of return is not only unnecessary, but also inaccurate. It is unreasonable to say that mean rate of return changes over time when economic conditions in the long run remain unchanged. Moreover, if β_0 follows random walk, when the model is restricted so that all AR(p) coefficients, $\tilde{\beta}_{it}$, are dropped to zero, r_t will also collapse to random walk, which is inconsistent with theory of time series model in which returns are stationary.

Secondly, eq. (5) nests the specification of $\tilde{\beta}_{it}$ to be a constant, or random walk process, or auto-regressive process into one. For example, if parameters restrictions are imposed such that α_0^i and α_1^i equal zero, m and α_k^i equals to one, the reduced-form specification will facilitate a random walk process. Again, if α_0^i and α_1^i are restricted to zero, but the absolute value of α_k^i is less than one, the reduced-form will accommodate auto-regressive specification. In addition, if $\alpha_1^i$and α_k^i are simultaneously restricted to zero and σ_{ω}^{2} is very small, the reduced-form specification will facilitate a constant degree of market efficiency.

Thirdly, a functional relationship with time, $f(t)$, is imposed to describe dynamic behavior of $\tilde{\beta}_{it}$. With a particular set of parameter values, $\tilde{\beta}_{it}$ shall be decreased through time, as suggested by the hypothesis of improving efficiency. As the true relationship of $\tilde{\beta}_{it}$ with time is unknown, $f(t)$ in eq. (5) can be a constant, increasing function or decreasing function. This study, however, proposes three functional forms as follows;

$$f_1(t) = t \tag{6}$$

$$f_2(t) = \frac{1}{t} \tag{7}$$

$$f_3(t) = 1 - \frac{1}{1+e^{-\theta(t-\tau)}} \tag{8}$$

The function of time in the eq. (6) linearly relates the stochastic AR(p) coefficient with time variable t. In case degree of efficiency has relationship with time in this manner, parameter α_1^{l} should be significant and negative. On the other hand, eq. (7) relates AR coefficient with time in a non-linear manner. This function accommodates the possibility of rapid improvement in the degree of market efficiency. In case the relationship between degree of efficiency and time can be explained by this non-linear function, parameter α_1^{l} should be significant and positive. In addition, $\tilde{\beta}_{it}$ will dramatically drop to an insignificant value within a few sample periods.

In eq. (8), the author applies the logistic function proposed by Khanthavit et al. (2012) to relate $\tilde{\beta}_{it}$ with time. In opposite to the specification in eq. (7), this specification facilitates either gradual or rapid improvement of degree of efficiency, as indicated by the size of parameter θ that could be estimated from the regression of market returns. From casual observation, like that of the development of communication network trading systems, as well as empirical evidences, such as Li (2003a and 2003b) and Khanthavit et al. (2012), it is more likely that the degree of efficiency slowly improves through time.

Lastly, the specification in eq. (5) is general in that the number of lag order m is not specified. However, this study proposes lag order m equals to one to estimate the model. With this specification, the proposed process for $\tilde{\beta}_{it}$ can be absolutely compared with random walk or GAR(1) specification applied in the previous studies. If the estimated parameters in eq. (5) are statistically significant, they will be the evidences to support the argument that neither random walk nor GAR(1) is correctly specified.

3. Model Estimation

3.1 Kalman Filter

This study will apply Kalman filter technique to estimate the stochastic, unobserved parameter $\tilde{\beta}_{it}$. Briefly, Kalman filter is a recursive procedure for computing the optimal estimator of state, e.g. the unobserved variable, at time *t*, based on the measurement, e.g. the observed information, available up to and including time *t*. This recursive procedure consists of predicting and updating phases. In the predicting phase, the state and prediction error variance are estimated using the observed information from the previous period. Once the new information at time *t* is available, the estimated state is updated. New observation plays an important role to update the state in such the way that the lower the variance of new observation (relative to the variance of prediction error), the greater impact of new observation it has on the estimated state at the next period, and vice versa (the reader can refer to Harvey (1991) for more details).

To apply Kalman filter, a time series model is put in a state space form, consisting of measurement equation and transition equation. The stochastic AR(p) coefficient model in equation (4) and (5) can be put in state space form as follows:

$$r_t = \boldsymbol{R_t B_t} + \beta_0 + v_t \tag{9}$$
$$\boldsymbol{B_t} = \boldsymbol{A B_{t-1}} + \boldsymbol{D_t} + \boldsymbol{\omega_t} \tag{10}$$

where $\boldsymbol{R_t}$ denotes observation vector, e.g. $[r_{t-1} \quad \cdots \quad r_{t-p}]$

$\boldsymbol{B_t}$ denotes state vector or vector of stochastic AR(p) coefficient, e.g. $\left[\tilde{\beta}_{1t} \quad \cdots \quad \tilde{\beta}_{pt}\right]'$

$\boldsymbol{A}$ denotes transition matrix. This is a diagonal matrix which contains α_k^i on its main diagonal, and

$\boldsymbol{D_t}$ denotes a vector of drift term, α_0^i, and function of time, $\alpha_1^i f(t)$.

The estimation of unobserved state vector $\boldsymbol{B_t} = \left[\tilde{\beta}_{1t} \quad \cdots \quad \tilde{\beta}_{pt}\right]'$ depends on a set of unknown parameters of the model, $\psi = \{\beta_0, \alpha_0^i, \alpha_1^i, \alpha_k^i, \theta, \tau, \sigma_v^2, \sigma_\omega^2\}$. This calls for a maximum likelihood estimation to estimate these parameters. With assumptions of normally distributed error terms, and independence between the error terms and initial state vector, the likelihood function can be written in prediction error decomposition form as follows:

$$Log\ L = -\frac{1}{2} T log 2\pi - \frac{1}{2}\sum_{t=1}^{T} log|F_t| - \frac{1}{2}\sum_{t=1}^{T} v_t' F_t^{-1} v_t \tag{11}$$

Denote v_t as prediction error and denote F_t as prediction error covariance. Maximum likelihood estimation finds the value of unknown parameters in ψ so that log likelihood function in eq. (11) is maximized.

3.2 Lag Order Identification

As the number of lag order p of the stochastic AR(p) coefficient model is unknown, it is crucial to specify lag order properly since it has important implications on the correctness of model specification as well as the interpretation of the degree of efficiency. This study applies information criteria to identify the appropriate order of p in eq. (4) because it provides a measurement of goodness-of-fit of the statistical model given a set of observations. Two particular information criteria tests are going to be estimated; Akike information criterion (AIC) and Schwatz Bayesian criterion (SBIC). These tests are also applied in Khanthavit et al. (2012) to identify lag order of time-varying STAR model.

Based on the auto-regressive process with constant parameter, AIC and SBIC can be calculated as follows:

$$AIC = T \times ln(\textstyle\sum_{t=1}^{T} v_t^2) + 2(p+1) \tag{12}$$
$$SBIC = T \times \ln(\textstyle\sum_{t=1}^{T} v_t^2) + (p+1) \times ln(T) \tag{13}$$

where T denotes total number of observations and v_t denotes disturbance term of the auto-regressive process and p is numbers of lag orders. The model with the most appropriate lag order is the one that gives the lowest AIC or SBIC. In case estimations of AIC and SBIC lead to an inconsistent conclusion, the higher order of lag term will be chosen in order to be more conservative and avoidance of model misspecification. It should be noted that these tests are preliminary because the AR(p) coefficients are assumed to be constant under testing procedures, whereas they are stochastic in the proposed model.

3.3 Model Comparison

This study proposes three functional forms in eqs. (6) to (8) to relate the degree of market efficiency with time. Though, these three specifications of the stochastic AR(p) coefficient model are nested with the constant and random walk specifications, neither of them are nested to each other. Thus, traditional tests for parameter restriction and model comparison cannot be performed. This calls for an alternative statistical test to compare the proposed specifications with one another. In this study, the author will follow the test for model comparison suggested by Voung (1989) because it is able to provide directional information for choosing between non-nested models.

Briefly, Voung (1989)'s test for model comparison is based on Kullback-Leibler Information Criterion (KLIC), which measures the distance between the true unknown distribution and hypothesized model. The test can be applied to any given pair of competing models, whether or not they are nested, non-nested, or overlapping, and both, only one or neither of them are correctly specified. KLIC is computed from the expected value of the difference between log likelihood values of the true unknown model and the competing model. Given this expression, KLIC will always be positive. However, when comparing KLIC of two competing models; namely the null model and the alternative model, by subtracting one from another, it can be either positive or negative. Therefore, in order to make conclusion, Voung (1989) suggested the following test statistic:

$$V = \frac{\sqrt{n}\left(\frac{1}{n}\sum_{i=1}^{n} m_i\right)}{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(m_i-\bar{m})^2}} = \sqrt{n}(\bar{m}/s_m), \quad m_i = \ln L_{i,0} - Ln\ L_{i,1} \tag{14}$$

where $\ln L_{i,0}$ denotes log likelihood value at the i^{th} observation, for $i = 1,\dots, n$, of the null model and $\ln L_{i,1}$ denotes the same for the alternative model. V statistic is compared with critical value at a conventional significant level from a standard normal distribution. If V is greater than the positive critical value, we reject the null hypothesis that both models are equivalent in favor of the null model. On the other hand, if V is lower than the negative critical value, we reject the null hypothesis that both models are equivalent in favor of the alternative model. If the absolute value of V is between minus and plus critical value, neither model is distinguished. In this study, the test statistic V will be compared with critical values at 99%, 95% and 90% for hypothesis testing.

4. Data and Descriptive Statistics

This study employs the daily closing price index of the Stock Exchange of Thailand (SET Index) obtained from the SETSMART database to represent the overall market returns. In fact, the Exchange provides SET Total Return Index (SET TRI) which can be used as a proper measurement of market performance as it is adjusted for changes in number of stocks resulting from corporate actions, e.g. right issuance, public offering, exercise of warrants, etc. However, the author proposes to use the SET Index to investigate evolving efficiency in Thailand's stock market based on the following two reasons. Firstly, the SET TRI series is available since January 2nd, 2002, while the SET Index series is available since April 30th, 1975, (the opening of the Exchange). The longer series of data, the more insightful it should provide on the changing degree of efficiency with respect to evolution of the stock market. Secondly, the SET Index and SET TRI are highly correlated, as evidenced by their correlation coefficient of 0.9906[1]. Therefore, estimated results using data from SET Index shall not be biased.

The samples cover the first official trading day from April 30th, 1975 to September 19th, 2014. Then, logarithm returns on SET Index is computed using $\ln(\frac{p_t}{p_{t-1}})$, where p_t denotes the daily closing index at time t. This logarithm returns, in total of 9,681 observations, is used for model estimation. The descriptive statistics of logarithm returns are summarized in Table 1.

[1] Sample period to estimate correlation is from January 2nd, 2002 to September 19th, 2014.

Table 1
Summary of Descriptive Statistics

Statistics	Mean	Standard deviation	Skewness	Kurtosis	JB (p-value)
SET Index	0.0003	0.0146	-0.1066	11.7664	1,547.60 (0.0000)

Table 2
Identification of Optimal Number of Lags Using AIC and SBIC

Numbers of lags	1	2	3	4	5
AIC	-54575.191	-54572.982	-54566.080	-54560.779	-54553.314
SBIC	-54560.835	-54551.448	-54537.368	-54524.891	-54510.248

Following the information reported in Table 1, logarithm returns is characterized as negative skewness and leptokurtosis, with a skewness of -0.10664 and kurtosis of 11.76642. These evidences of non-normality are affirmed by the Jarque-Bera (JB) normality test statistic, showing that the null hypothesis of normally distributed return series is rejected with 99% confidence interval. However, it should be noted that the application of Kalman filter shall not be affected by the non-normality of returns series. This is because Kalman filter is based on orthogonal projection theory so the classical assumption of Gaussian distribution is not required.

The results of AIC and SBIC tests are demonstrated in Table 2. They indicate that the model with only one lag order has the minimum AIC and SBIC. Although the results of these tests are derived from the estimation of classical time-invariant coefficient AR(p) model, the author proposes that it is applicable to the stochastic AR(p) coefficient model because the constant AR coefficient shall be considered as the average value of all stochastic AR(p) coefficients. Moreover, previous researchers such as Rockinger and Urga (2000), Arouri et al. (2012) also applied time-varying AR(1) coefficient model to describe return process in their studies. Therefore, this study specifies the stochastic AR(1) coefficient model to investigate time-varying degree of efficiency in Thailand's stock market.

5. Empirical Evidences

5.1 Estimation Results of the Stochastic AR(1) Coefficient Model

According to the indicative results from AIC and SBIC tests, the stochastic AR(1) coefficient model can be expressed as follows;

$$r_t = \beta_0 + \tilde{\beta}_{1t} r_{t-1} + \nu_t \tag{15}$$

$$\tilde{\beta}_{1t} = \alpha_0^1 + \alpha_1^1 f(t) + \alpha_2^1 \beta_{1t-1} + \omega_t \tag{16}$$

The proposed functions of time in eqs. (6) to (8) are substituted in $f(t)$ in eq. (16). Next, $\tilde{\beta}_{1t}$ is the smoothed estimate from the Kalman filter and other unknown parameters of the model are then derived from maximum likelihood estimation. Besides, when restriction is imposed such that α_0^l and α_1^l equal to zero, and α_2^l equals to one, the restricted model represents random walk specification applied in the previous studies. For purpose of comparison, this study estimates both restricted and unrestricted forms of the stochastic AR(1) coefficient model. The results are summarized in the following table.

Table 3
Estimation Results of Random Walk and Stochastic AR(1) Coefficient Model

Parameters	Random walk model	Stochastic AR(1) coefficient model with		
		linear function of time (eq. (6))	inverse function of time (eq. (7))	logistic function of time (eq. (8))
Panel A				
$\hat{\beta}_0$	0.0240	0.0191	0.0195	0.01806
	(1.6402)	(1.5047)	(1.5415)	(1.4155)
$\hat{\alpha}_0^1$	-	0.3980***	0.1837***	0.0643
		(12.4538)	(12.3323)	(1.4436)
$\hat{\alpha}_1^1$	-	-0.3756***	4.3810***	0.2813***
		(-7.4787)	(3.3986)	(3.3700)
$\hat{\alpha}_2^1$	-	0.0285	0.0369**	0.0285
		(1.5886)	2.0582	(1.0809)
$\hat{\theta}$	-	-	-	9.5281*
				(1.6798)
$\hat{\tau}$	-	-	-	0.5246***
				(7.9467)
$\hat{\sigma}_v$	1.4318***	1.0842***	1.0848***	1.0838***
	(137.2620)	(40.3541)	(40.4225)	(223.2911)
$\hat{\sigma}_\omega$	0.0095***	0.6937***	0.6983***	0.6942***
	(3.4769)	(24.6888)	(24.7853)	(65.39538)
Panel B				
LRT	-	1,854.7193***	1,815.0010***	1,856.6937***
df		3	3	5

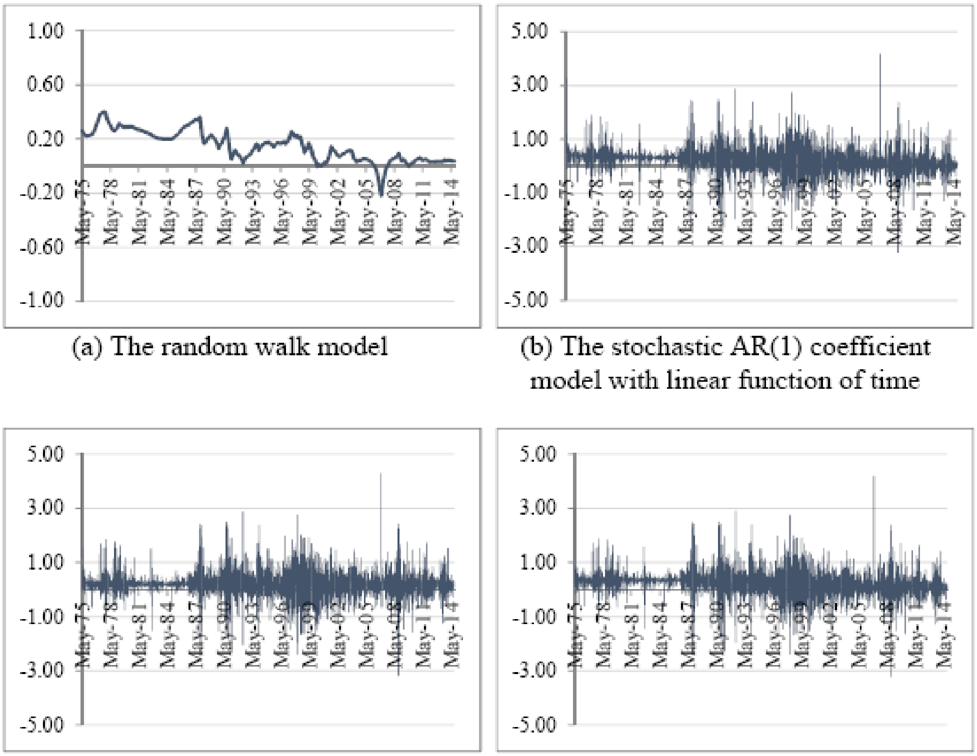
Note. Figure in parentless is t-statistic. *, ** and *** denote the estimated parameters are significant at 10%, 5% and 1% level, respectively. LRT denotes likelihood ratio test in which the random walk model is the restricted model and the stochastic AR(1) coefficient model is the unrestricted model. And df = $df_U - df_R$; where df_U and df_R represent numbers of free parameters of the unrestricted and restricted models, respectively.

Table 3 is separated into 2 Panels; Panel A presents the estimated coefficients together with the t-statistics, while Panel B presents likelihood ratio test (LRT) statistics. Several messages are presented in Panel A. Considering parameters in eq. (16); the results show that drift parameters, $\hat{\alpha}_0^1$, from two models are statistically significant. The estimated drift term in the model with linear function of time is equal to 0.3985, while it is 0.1837 in the model with inverse function of time. These figures represent a long-term mean value of the stochastic AR(1) coefficients, $\hat{\beta}_{1t}$. Suppose the dynamic process of $\hat{\beta}_{1t}$ is truly described by these two models, $\hat{\alpha}_0^1$ of each model will reflect the average number of day in which the information is disseminated to the stock market. However, this expression is subject to the test for model comparison, which will be discussed later in subsequent section.

Besides, coefficients of trend element, $\hat{\alpha}_1^1$, are statistically significantly different from zero in all three specifications. These evidences are very important because they indicate that the degree of market efficiency has a statistical relationship with time, which is consistent with the hypothesis of this study. The sign of $\hat{\alpha}_1^1$ is negative in the model with the linear function of time, while it is positive in the model with inverse and logistic functions of time. These results indicate that, in the long run, $\hat{\beta}_{1t}$ will behave in at least three manners; linearly decreasing, abruptly decreasing within a very short period of time, or S-shape decreasing. At the same time, they also imply how degree of efficiency in the stock market improves. In addition, parameter $\hat{\theta}$ in the model with logistic function of time is also important to explain how fast the degree of efficiency improves. A big positive value of $\hat{\theta}$ suggests a rapid improvement, while a small positive value suggests otherwise. In this study, $\hat{\theta}$ is equal to 9.5281 and is significantly different from zero. Nevertheless, its effect on $\hat{\beta}_{1t}$ is deprived by a small value of $\hat{\alpha}_1^1$, which equals to 0.2813. As a result, the magnitude of $\hat{\beta}_{1t}$ in the model with logistic function of time will gradually decrease throughout the sample period.

The estimated volatility $\hat{\sigma}_{\omega}$ is large vis-à-vis $\hat{\sigma}_{v}$ and is statistically significant. This indicates that $\hat{\beta}_{1t}$ is not constant, but rather time-varying and has a relationship with time as mentioned earlier. Nevertheless, except in the model with inverse function of time, this study finds no evidence of relationship between $\hat{\beta}_{1t}$ and its one-period lagged value. Lastly, LRT statistics are highly significant at 1% level, with the values of 1,854.7193, 1,815.0010, and 1,856.6937 for the stochastic AR(1) coefficient model with linear, inverse, and logistic function of time, respectively. The results suggest that the stochastic AR(1) coefficient model is significantly better than random walk model in terms of goodness-of-fit. The drift and trend terms are, therefore, meaningful to be incorporated into the model to explain the behavior of degree of market efficiency. Following these evidences, it shall be inferred that neither random walk nor GAR(1) specification applied in the previous studies is correctly specified.

Figure 1
The smoothed estimate of $\hat{\beta}_{1t}$



(a) The random walk model

(b) The stochastic AR(1) coefficient model with linear function of time

(c) The stochastic AR(1) coefficient model with inverse function of time

(d) The stochastic AR(1) coefficient model with logistic function of time

From Figures 1 (a) to (d), it can be seen that the smoothed estimate of $\hat{\beta}_{1t}$ from random walk model has a decreasing trend, while such a trend is not visually presented in the smoothed estimate of $\hat{\beta}_{1t}$ from the stochastic AR(1) coefficient model. Also, it is noticed that the absolute values of $\hat{\beta}_{1t}$ from random walk model are less than one, but some of $\hat{\beta}_{1t}$ from the stochastic AR(1) coefficient model are not. However, the arguments for these evidences can be explained in two folds. Firstly, coefficient $\hat{\alpha}_1^1$ are strongly statistically significant, which in turn indicate that values of $\hat{\beta}_{1t}$ from the stochastic AR(1) coefficient model are implicitly diminishing in the long-run.. Secondly and most importantly, the fluctuation pattern of $\hat{\beta}_{1t}$ is due to a Gaussian white noise property of the disturbance. However, the numbers of times that the absolute values of $\hat{\beta}_{1t}$ are greater than one is, on average, 2.78% of total observations. This is considerably small and shall be ignored.

Previously, Arouri et al. (2012) studied time-varying degree of efficiency in Thailand's stock market using a random walk model. Their results differ from the results of the stochastic AR(1) coefficient model in two respects. Firstly, Arouri et al. (2012) demonstrated that $\hat{\beta}_{1t}$ were very stable, while this study finds that $\hat{\beta}_{1t}$ are volatile, but decreasing with time. This is possibly due to the less frequency of data and shorter sampling period since Arouri et al. (2012) used monthly returns from January 1976 to March 2000. The different in model specification is also crucial. As discussed earlier, the random walk model is inferior to stochastic AR(1) coefficient model, hence, $\hat{\beta}_{1t}$ from the latter model shall be more accurate and well described the true process of time-varying degree of market efficiency in Thailand. Secondly, Arouri et al. (2012) asserted that Thailand's stock market was weak-form efficient, but did not indicate how much the degree of efficiency improved. In contrast, this study will demonstrate this improvement using the number of days for information dissemination in the stock market. The details will be discussed later.

5.2 Models Comparison

Table 4 below presents V statistics computed from each pair of models. Recall that a large negative value implies that the alternative model is preferred to the null model, while a large positive value implies otherwise. Comparing between the null random walk model and the alternative stochastic AR(1) coefficient model with three forms of function of time, the results show that all three specifications of the alternative stochastic AR(1) coefficient modes are favorable to the random walk model in describing the dynamic behavior of the degree of market efficiency. This is consistent to likelihood ratio test in Table 3, which indicates that the stochastic AR(1) coefficient model is better fitted to the data than random walk model.

Table 4
Summary of Model Comparison using Voung (1989)'s Test

Alternative models	**Null models**			
		Stochastic AR(1) coefficient models with		
	Random walk model	**linear function of time**	**inverse function of time**	**logistic function of time**
Stochastic AR(1) coefficient model with				
linear function of time	-10.3570***			
inverse function of time	-10.1283***	3.3277***		
logistic function of time	-10.3673***	-0.6272	-3.2556***	

Note. *, ** and *** denote the estimated parameter is significant at 10%, 5% and 1% level.

When comparing the three specification of the stochastic AR(1) coefficient models with one another, the results show that the model with linear function of time is superior to that with inverse function of time, indicated by a significant and positive V statistic of 3.3277. In addition, the model with logistic function of time is also superior to that with inverse function of time, indicated by significant and negative V statistic of -3.2556. Finally, when comparing between the models with linear and logistic functions of time, the sign of V statistic suggests that the model with logistic function of time would be more superior, however, the value of the test statistic, e.g. -0.6272, is not statistically significant. As a result, it can only be inferred that neither of the models with linear nor logistic functions of time are distinguished.

This result is understandable. With particular set of parameters, the logistic function is able to accommodate the linear function of time, especially when the magnitude of $\hat{\alpha}_1^1$ is small as observed in this study. Accordingly, these two specifications are almost identical in terms of describing dynamic behavior of degree of market efficiency. Nevertheless, it should be noted that the model with linear specification has a drawback. When time increases to infinity, $\hat{\beta}_{1t}$ will possibly be a huge negative value. In such a case, it implies that once the degree of efficiency improves, it can deteriorate in the future because the higher value of $\hat{\beta}_{1t}$, the greater time to disseminate information to the market. Opposite to the model with logistic function of time, the magnitude of $\hat{\beta}_{1t}$ estimated from this specification will tend to decrease continuously in the long run.

Furthermore, the model with the logistic function of time is more intuitive than the model with the linear function of time when it is applied to explain time-varying degree of market efficiency. In this regard, it suggests that degree of market efficiency gradually and continuously improves. At the opening of the stock market, degree of efficiency is low as indicated by the big magnitude of $\hat{\beta}_{1t}$. Thereafter, the developments of the stock market, such as improvements in the trading system, enforcement of disclosure rules, establishment of derivatives exchanges, etc., will lead to improvement in degree of informational efficiency. Rather than abruptly happens, this process arises moderately because it takes time for market participants to accumulate experience, learn, and adapt themselves. This process is reflected in the characteristic of the slowly decreasing trend of $\hat{\beta}_{1t}$ proposed by this model. Once the market participants gain more knowledge, combined with better price discovery mechanisms, the degree of market efficiency will then be improved.

Consequently, this study would suggest that the stochastic AR(1) coefficient model with logistic function of time is the most appropriate model specification to explain the dynamic behavior of degree of efficiency in Thailand's stock market.

5.3 Numbers of Days for Information Dissemination

The magnitude of AR(p) coefficient can be related to the degree of market efficiency as it implies how much time the market takes to disseminate information. In this study, results from the statistical test suggest that AR(1) specification is appropriate, therefore, HL measurement can be applied to investigate how much time, in numbers of days, information is disseminated to the market. Based on discussion above, the author will employ the smoothed estimate of $\hat{\beta}_{1t}$ from the stochastic AR(1) coefficient model with logistic function of time. In order to illustrate whether the numbers of days for information dissemination decrease, the calculation will be done at three points of time.

The first point of time is when $t = 1$, which is the opening of the stock market. The second point of time is when $t = \hat{\tau}$, and the last point of time is when $t = 9{,}682$, which is the latest sample of this study. As for the second point of time, the author proposes using $t = \hat{\tau}$ instead of using t equal to half of total observations because $\hat{\tau}$ provides an indicative point of time where trend element of degree of efficiency decreases by a half. Therefore, the estimation of half-life measure at this point of time is more informative. From Table 3, the point of time corresponds to $\hat{t}$ = 0.5245 is at the 5079th observation (variable t in this study is scaled by dividing by total number of observation), or approximately 20 years after the opening of the stock market.

Previously, the studies that interested in measuring units of time to dissipate a piece of information throughout the market generally use a half of information as a benchmark, so called HL measurement. In this study, being enthusiastic to see the different results if the other magnitudes of information are applied, the author develops the measurements to gauge the unit of time in order to spread out 25%, 50% and 75% of information. The empirical results are tabulated in the Table 5 below.

Table 5
Numbers of Days for Information Dissemination

Time	**Numbers of days for the magnitudes of information are disseminated to the market**		
	One-fourth	**Half**	**Three-fourth**
$t = 1$	0.3574	0.8612	1.7223
$t = 5{,}079$	0.1100	0.2651	0.5301
$t = 9{,}682$	0.1035	0.2494	0.4988

The results illustrated above support that degree of informational efficiency in Thailand's stock market has been improved as indicated by the decreasing numbers of days that the market utilizes to relay either one-fourth, a half, or three-fourth of information. Particularly, the numbers of days to spread out three-fourth of information decrease from 1.7223 days at the opening of market to 0.5301 day and 0.4988 day at the points of time t = 5,079 and t = 9,682, respectively. Considering the utilization of time to dissipate a half of information, it is interesting that the market employs less than one day at all three points of time. At t = 1, the market uses 0.86112 day to disseminate a half of information. Then, the period of time declines to 0.2651 day and 0.2492 day at t = 5,079 and t = 9,682, respectively. Moreover, the dissemination speed is also improving. For example, at t = 1, the market requires additional 0.8162 day in order to relay further information from a half to three-fourth (1.7223 – 0.8612), while it needs additional 0.2494 day at t = 9,682 (0.4988 - 0.2494).

However, numbers of days for information dissemination at the latest observation are not much different from those at the second point of time, i.e. at t = 5,079. This could be explained that, for the given data, the stock market has been developed until it has reached the long run level of market efficiency to so that the number of day for information dissemination at the second and the latest points of time is very close to each other.

6. Conclusions

Efficient market hypothesis has been studied and tested in a numbers of literatures. This hypothesis is important in economic and financial theories since it is a foundation in developing asset pricing models, investment strategies, as well as risk assessment. Recently, research framework on this topic focuses on investigating the time-varying degree of market efficiency, particularly on informational efficiency of an emerging financial market.

This study proposes the stochastic AR(1) coefficient model and imposes relationship of degree of efficiency with time in order to correct the drawback of the model specification applied in the previous studies. Based on the sample from daily returns of the SET index from April 30th, 1975 to September 19th, 2014, this study finds that the degree of market efficiency has a statistically significant relationship with time, at least in three functional forms. This evidence leads to the conclusion that both the random walk and GAR(1) models are mis-specified. Further statistical test also shows that the stochastic AR(1) model with linear and logistic functions of time are the best two models in describing the dynamic behavior of degree of market efficiency in Thailand. Finally, the results of HL measurement indicate that number of day for information dissemination decreases through time.

This study not only is an evidence of improving degree of market efficiency, but also contributes to research methodology of the study in this topic. For one who is interested in time-varying degree of market efficiency, further study can be performed to expand the edge of knowledge on this field. One of the interesting results from this study is that behavior of degree of market efficiency in Thailand's stock market is highly volatile. It would be interesting to find out the determinants to explain such dynamic behavior.

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□ □ □ □ □ □ Does Government ideology influence the shocks of natural disasters?

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We examine whether natural disaster losses vary under the tenure of a government with a different ideology. Using panel data for 123 countries over the period of 1975-2007, we find that right-wing governments experience fewer natural disaster losses, especially in non-OECD countries.

Keywords: Government ideology; Natural disasters

JEL Classification: P48; Q54

1. Introduction

Natural disasters are significantly associated with a destruction of physical and human capital in a country. The literature documents however that these natural disaster losses differ greatly across governments. For example, Kahn (2005) finds that countries with higher income, democratic institutions and stronger governments experience fewer natural disaster deaths. Toya and Skidmore (2007) find that nations with higher measures of development suffer less natural disaster losses.

In this paper, we contribute to the literature by examining the role of government ideology in mitigating the impacts of natural disasters. For example, it is possible that left-wing governments are more inclined to implement natural disaster prevention measures because these reforms usually imply that the government is increasing control in the economy. Keefer et al. (2012) argue that government regulation in the economy is critically important to mitigate the negative effects of natural disasters: governments who enforce natural disaster prevention standards experience fewer natural disaster losses.

In addition, it is also probable that right-wing governments may experience fewer consequences of natural disasters. Toya and Skidmore (2007) indicate that countries with higher growth rates allocate more resources to natural disaster prevention standards to lower natural disaster losses. Given that right-wing governments may associated with higher growth rates (Bjørnskov, 2005; 2008), they are more likely to implement natural disaster prevention measures to lower the negative effects of natural disasters. However, it against the partisan theory, advanced by Hibbs (1977), assumes that politicians are partisan, acting in accordance with their ideology. It typically presumes that the left wing (Democrats) pay more attention to promoting expansionary policies with have put more emphasis on increasing income and reducing unemployment.

In this paper we take a first step in that direction, examining the relationship between the impacts of natural disasters and the ideology of political party in huge samples countries. Despite theoretical salience and political relevance, we know of no previous attempt of this sort in historic agenda. More specifically, we test whether natural disaster losses vary under the tenure of a government with a different ideology employing panel data for 123 countries over the period of 1975-2007. Using two measures of government ideology, we find that right-wing governments experience fewer natural disaster losses, especially in non-OECD countries.

The remainder of this paper is organized as follows. In section 2, we describe the data and the model. Section 3 presents the empirical results, while the final section summarizes the major findings.

2. Data and Model

We collect annual data for a panel of 123 countries over the 1975-2007 period. The list of countries is reported in Table 1. We use three dependent variables to effective quantify all natural disaster losses. Our first dependent variable, death, represents the total number of "persons confirmed as dead and persons missing and presumed dead" caused by natural disaster. Our second measure of dependent variable, affected, is defined as the total number of "displaced or evacuated people" and "people requiring immediate assistance" caused by natural disaster. Our last measure of dependent variable, damages, includes all estimated economic damages (in US$) as a percentage of GDP caused by natural disaster. All this data is taken from EM-DAT (2011).

Our government ideology data comes from Beck et al. (2001) Database of Political Institutions. To ensure robustness, we use two measures of government ideology. On the first measure of government ideology (ideology1), we follow the general approach in Bjørnskov (2005) and code right-wing 1, centrist 0, and left-wing -1. On the second measure of government ideology (ideology2), we follow the methodology in Bjørnskov (2008), and assign right-wing 1, centrist 0, and left-wing -1, and weight single party ideologies with their proportion of seats in the parliament.

In choosing our control variables, we follow Toya and Skidmore (2007) and employ real per capita income (gdp), domestic credit/GDP (bank), (exports plus imports)/GDP (trade), total years of educational achievement aged 15 and over (education), government consumption/GDP (gov), where all variables are obtained from the World Bank (2011). We expect these measures of development to reduce natural disaster losses because nations with higher level of development allocate more resources to implementing natural disaster prevention standards (Toya and Skidmore, 2007).

We also follow Kahn (2005) and take into account the total number of natural disasters (disaster) that took place, drawn from EM-DAT (2011); and population size (population) based from World Bank (2011). Finally, we consider the effect of democracy (1 if the government is democratic, 0 otherwise) extracted from Cheibub et al. (2010). This is because democracies take strong actions to adequately provide public resources following a natural disaster and implement natural disaster prevention measures (Kahn, 2005; Keefer et al., 2012). All variables are logged, except for the dummy variable democracy. The descriptive statistics for all the variables are reported in Table 2.

In summary, our baseline model is expressed as follows:

$$y_{kit} = f\left(\text{ideology}_{it}, x_{it}, \varepsilon_{it}\right) \qquad (1)$$

where ykit is the dependent variable that represents the total number of death, affected, or damages caused by natural disaster k that took place in country i during year t. The variable ideology includes two measures of government ideology variables (ideology1 or ideology2); corresponds to a vector of control variables as discussed above; is the disturbance term. We estimate three set of regressions since we have three alternative dependent variables. Given the nonnegative count and discrete structure of the dependent variables death and affected, we estimate a Poisson regression model. For the dependent variable damages, we estimate a system GMM model to make use of the time series variation in the data and to account for possible endogeneity in our model.

3. Results

We provide the Poisson regression estimates for the dependent variables death and affected in columns 1-4 of Table 1. As can be seen, the variables ideology1 and ideology2 are negative and statistically significant at the 5% level, suggesting that right-wing governments experience fewer natural disaster deaths. We also find that less people are affected from natural disasters under the tenure of a right-wing government. The size is larger with the ideology2 since party's proportion of seats in the parliament is considered.

Next, it is important to account for possible heterogeneity in our sample. For example, Cohen and Werker (2008) argue that developing countries "may choose to invest very low amounts in disaster prevention (p. 805)." We therefore re-estimate the Poisson regression model differentiating between 30 OECD countries and 93 non-OECD countries. In columns 5-8 of Table 1 we include only non-OECD countries, whereas in columns 9-12 the sample is restricted to OECD countries.

As before, we find that right-wing governments have lower natural disaster losses (death and affected) in non-OECD countries. While the results indicate that less people are affected from natural disasters under the tenure of a right-wing government, we find no evidence that government ideology matters in protecting the general public from natural disaster death in OECD countries.

Further, we present the GMM regression estimates for the dependent variable damages in Table 2. The variables ideology1 and ideology2 are negative and statistically significant at the 5% level, indicating that right-wing government experience lower economic damages caused by natural disasters. We also find that right-wing governments suffer less natural disaster damages in non-OECD countries. However, this effect is statistically insignificant at conventional levels in OECD countries. In summary, we find strong evidence that right-wing governments experience fewer natural disaster losses, particularly in non-OECD countries.

We provide the results of Sargan and Arellano-Bond tests at the bottom of Table 2. The Sargan test of over-identification restrictions tests the validity of the instruments. As can be seen, the Sargan test cannot reject the null hypothesis (p-value > 0.10) in all equations, suggesting that the instrumental variables are valid in the estimation. Next, the Arellano-Bond test of second-order autocorrelation tests the estimated residuals does not produce second-order serial correlation. The Arellano-Bond test cannot reject the null hypothesis (p-value > 0.10) in all equations, indicating that the estimated residuals do not produce second-order serial correlation, and, thus, the estimators are consistent in all specifications.

Turning to control variables, most results are broadly in line with those of Kahn (2005), and Toya and Skidmore (2007). Countries with higher national income, government consumption and educational achievement experience fewer deaths and less people are affected but suffer more economic damages from natural disasters. Perhaps not surprisingly, nations with larger population and higher natural disasters endure more natural disaster losses, while trade openness reduces the negative consequences of natural disasters. Finally, it appears that the level of democracy and more developed financial system have a limited effect on mitigating the consequences of natural disasters.

4. Conclusion

We examine the effect of government ideology on natural disaster losses for 123 countries over the 1975-2007 period. Using two measures of government ideology, we find that right-wing governments experience fewer natural disaster losses, especially in non-OECD countries. We emphasize that government ideology matters in mitigating the consequences of natural disasters. We introduce this fundamental evidence for further research.

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Table 1. List of countries

Albania	Greece	Oman
Algeria	Grenada	Pakistan
Angola	Guatemala	Panama
Argentina	Guinea	Papua New Guinea
Australia	Guinea Bissau	Paraguay
Austria	Guyana	Peru
Bahamas	Honduras	Philippines
Bangladesh	Hungary	Poland
Barbados	Iceland	Portugal
Belgium	India	Russia
Belize	Indonesia	Rwanda
Benin	Iran Islam Rep	Senegal
Bolivia	Ireland	Sierra Leone
Botswana	Israel	Singapore
Brazil	Italy	Slovenia
Burkina Faso	Jamaica	Solomon Is
Cameroon	Japan	Somalia
Canada	Jordan	South Africa
Central African Rep	Kenya	Spain
Chad	Korea Rep	Sri Lanka
Chile	Lesotho	St Lucia
China P Rep	Liberia	Sudan

Colombia	Luxembourg	Suriname
Comoros	Madagascar	Sweden
Costa Rica	Malawi	Syrian Arab Rep
Cote d'Ivoire	Malaysia	Tajikistan
Cyprus	Mali	Thailand
Denmark	Mauritania	Togo
Dominican Rep	Mauritius	Trinidad and Tobago
Ecuador	Mexico	Tunisia
Egypt	Mongolia	Turkey
El Salvador	Morocco	Uganda
Equatorial Guinea	Mozambique	United Kingdom
Ethiopia	Myanmar	United States
Fiji	Namibia	Uruguay
Finland	Nepal	Vanuatu
France	Netherlands	Venezuela
Gabon	New Zealand	Viet Nam
Gambia The	Nicaragua	Yemen
Germany	Niger	Zambia
Ghana	Norway	Zimbabwe

Table 2. Descriptive Statistics

Variable	Mean	Standard Deviation	Observations
death	1.837	2.449	4059
affected	4.892	5.572	4059
damages	0.539	6.352	3816
ideology1	-0.067	0.509	3696
ideology2	-0.059	0.764	3570
disaster	1.858	3.465	4059
gdp	7.556	1.602	3798
banking	3.754	0.840	3605
openness	4.115	0.649	3831
government	15.984	6.584	3745
education	3.823	0.829	3048
population	15.851	1.821	4059
democracy	0.513	0.500	3914

Table 3. Poisson Regression Estimates

	Full Sample				Non-OECD				OECD			
	Death		Affected		Death		Affected		Death		Affected	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
ideology1	-0.069**		-0.091**		-0.094**		-0.105**		-0.037		-0.072**	
	(-2.673)		(-5.567)		(-2.496)		(-4.700)		(-0.998)		(-2.926)	
ideology2		-0.130**		-0.185**		-0.176**		-0.221**		-0.034		-0.129**
		(-2.953)		(-6.756)		(-2.926)		(-6.175)		(-0.512)		(-2.954)
gdp	-0.375**	-0.406**	-0.187**	-0.223**	-0.684**	-0.741**	-0.448**	-0.515**	0.225	0.207	0.507**	0.521**
	(-4.111)	(-4.367)	(-3.327)	(-3.875)	(-5.759)	(-6.125)	(-6.441)	(-7.210)	(0.984)	(0.899)	(3.360)	(3.421)
bank	-0.070	-0.065	0.001	0.005	-0.103*	-0.105*	-0.001	0.003	0.379**	0.374**	0.207**	0.190**
	(-1.392)	(-1.217)	(0.013)	(0.162)	(-1.914)	(-1.794)	(-0.027)	(0.089)	(2.421)	(2.386)	(2.190)	(2.006)
trade	-0.219*	-0.222**	-0.236**	-0.240**	-0.248**	-0.251**	-0.257**	-0.261**	0.707**	0.713**	0.465**	0.457**
	(-2.809)	(-2.835)	(-4.964)	(-5.041)	(-2.583)	(-2.591)	(-4.592)	(-4.621)	(3.504)	(3.530)	(3.508)	(3.438)
gov	-0.022**	-0.021**	-0.023**	-0.022**	-0.027**	-0.025**	-0.027**	-0.025**	-0.010	-0.009	-0.011	-0.008
	(-3.417)	(-3.184)	(-6.129)	(-5.822)	(-3.848)	(-3.595)	(-6.740)	(-6.399)	(-0.481)	(-0.445)	(-0.869)	(-0.659)
education	0.064	0.045	-0.175**	-0.168**	-0.043	-0.063	-0.266**	-0.264**	1.025**	1.027**	0.799**	0.855**
	(0.633)	(0.448)	(-2.861)	(-2.709)	(-0.396)	(-0.583)	(-4.093)	(-3.996)	(3.194)	(3.210)	(3.778)	(4.048)
disaster	0.056**	0.056**	0.070**	0.071**	0.086**	0.087**	0.088**	0.090**	0.031**	0.031**	0.050**	0.051**
	(10.557)	(10.553)	(19.290)	(19.383)	(11.914)	(12.072)	(19.123)	(19.396)	(3.757)	(3.725)	(8.407)	(8.423)
population	1.486**	1.509**	1.450**	1.441**	1.714**	1.747**	1.666**	1.662**	-3.117**	-3.111**	-2.370**	-2.416**
	(8.968)	(9.048)	(14.401)	(14.243)	(9.729)	(9.813)	(15.672)	(15.511)	(-4.354)	(-4.357)	(-5.189)	(-5.303)
democracy	0.013	0.015	-0.037	-0.040	-0.031	-0.031	-0.121**	-0.121**	0.120	0.127	0.224**	0.190*
	(0.241)	(0.271)	(-1.113)	(-1.196)	(-0.510)	(-0.509)	(-3.267)	(-3.253)	(0.752)	(0.796)	(2.150)	(1.826)
Observations	2346	2330	2288	2273	1601	1588	1604	1591	745	742	684	682
Log likelihood	-3478.03	-3454.29	-7032.09	-6996.00	-2427.28	-2405.09	-5136.57	-5103.18	-996.24	-992.47	-1802.65	-1794.54
Prob>χ^2	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Notes: The z-statistics are in parentheses. **and* indicates statistical significance at the 5% and 10% level, respectively.

Table 4. GMM Regression Estimates

	Full sample		Non-OECD		OECD	
	(1)	(2)	(3)	(4)	(5)	(6)
ideology1	-0.142**		-3.684**		0.026	
	(-26.522)		(-4.725)		(1.149)	
ideology2		-0.746**		-1.105**		0.049
		(-2.092)		(-1.977)		(1.239)
gdp	0.362	1.832**	4.923**	2.131	-0.901**	-0.900**
	(0.283)	(40.051)	(3.266)	(0.542)	(-3.075)	(-3.048)
bank	0.028	0.034**	-1.197**	-2.333*	-0.205**	-0.239**
	(0.063)	(4.065)	(-2.304)	(-1.953)	(-2.078)	(-2.292)
trade	-3.802**	-4.255**	-4.849**	-7.493**	-0.339**	-0.344**
	(-4.930)	(-820.444)	(-5.183)	(-3.749)	(-2.139)	(-2.153)
gov	0.250**	0.266**	0.312**	0.105	-0.016	-0.016
	(5.739)	(186.015)	(6.069)	(0.958)	(-1.280)	(-1.231)
education	2.722**	2.147**	5.029**	29.064**	0.014	0.003
	(2.491)	(66.157)	(3.951)	(10.909)	(0.049)	(0.009)
disaster	0.052	0.069**	0.112	-0.066	-0.017**	-0.017**
	(0.912)	(95.168)	(1.428)	(-0.397)	(-2.314)	(-2.304)
population	10.845**	10.450**	49.004**	-81.246**	-3.846**	-3.796**
	(3.198)	(36.113)	(9.326)	(-7.224)	(-5.475)	(-5.349)
democracy	0.921	-0.953**	0.805	-0.195	-0.033	-0.030
	(1.562)	(-34.318)	(1.126)	(-0.128)	(-0.256)	(-0.233)
$damages_{t-1}$	-0.237**	-0.316**	-0.364**	-0.288**	-0.014	-0.015
	(-14.126)	(-27.027)	(-20.121)	(-8.007)	(-0.513)	(-0.553)
Observations	2042	2026	1345	1333	697	693
Sargan test	13.880	14.260	19.330	13.230	6.070	5.670
(p-value)	(0.714)	(0.789)	(0.647)	(0.574)	(0.874)	(0.857)
Arellano-Bond test	-1.320	-1.000	-0.570	-0.220	-0.490	-0.500
(p-value)	(0.188)	(0.319)	(0.410)	(0.227)	(0.624)	(0.618)

Notes: The dependent variable is damages. The t-statistics are in parentheses. **and* indicates statistical significance at the 5% and 10% level, respectively.

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Asset Diversification and performance of Islamic and conventional banks – A dynamic panel data approach

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This study examines the effect of asset diversification on bank performance (profitability, cost efficiency, and asset quality). Given the uniqueness and rapid growth of Islamic banking, whether and how the prevailing diversification in conventional banks influences the performance of Islamic banks that have become increasingly diversified is necessary to be examined. A review of banks in Indonesia, Malaysia, and Pakistan from 2006 to 2012 indicates that diversification generally has a negative effect on the performance of conventional banks, whereas a minimal effect on that of Islamic banks. Considering bank size, diversification is found to positively affect the profitability of large banks (greater than bottom 25%), and this positive effect is more pronounced among Islamic banks. Moreover, diversification has a positive effect on the cost efficiency of large conventional banks (top 25%), whereas a negative and no effect on the cost efficiency of small and medium banks, respectively. Furthermore, diversification has a positive effect on asset quality of large Islamic banks (top 25%). By contrast, diversification has a negative effect on asset quality of conventional banks. However, this negative effect is weak for large conventional banks (top 25%).

Keywords: diversification; bank performance; Islamic banking; panel data.

1. Introduction

Existing literature has extensively explored the relationship between diversification and bank performance. The ability of Islamic banks to survive the recent global financial crisis has been recognized as well. However, no research to date has examined the effect of diversification from traditional (loans) to non-traditional assets, which is widely considered as value-reducing and conducive to the recent crisis, on profitability, cost efficiency, and asset quality of Islamic banks in Asian countries with a dual banking system. To address these research gaps, this study is conducted.

Muslims constitute approximately 1.6 billion or 23% of the global population (DeSilver 2013). With the Muslim population ranking as the second largest religious group and continually growing, financial services that are acceptable with Islam are increasing in demand, resulting in the rapid growth of Islamic banking. The emergence of Islamic banking also represents the growing population of wealthy Muslims. Most Islamic countries in the Middle East, for example, have become an important commercial and distribution center and the hub of many countries because of their abundance in oil. Given the growing world demand for oil, the revenue from oil sales has been a main income source for Middle East. With their accumulation of money from oil trading, rich Muslims demand financial services to meet their religious requirements to help manage and invest their oil revenues. In fact, with the ongoing trend of global financial market integration, Islamic banking is no longer limited to countries that have a large population of Muslims. Islamic banking has become popular outside the Muslim world, which is best exemplified by the recent widespread issuance of Sukuk (i.e., an Islamic financial certificate equivalent to the Western bond) in non-Islamic countries (The Economist 2014). Islamic banking or finance is not only expanding rapidly, but is also becoming globalized.

Islamic banks operate based on the Islamic law that has highly religious regulations, emphasizes on fair trade and non-payment of interest, prohibits gambling, and does not allow moral value speculations. The performance of Islamic banks or banking systems remains to be seen because Islamic banking has a relatively short history compared with that of conventional banking (Masruki et al., 2011). Nevertheless, the capability of Islamic banks to adapt with the recent global financial crisis prompts the examination of their unique features that allow them to achieve financial stability regardless of the crisis. In addition to compliance of the Islamic law, Islamic banks, for example, are generally less diversified than conventional banks. Therefore, Islamic banks are immune to the recent crisis that is triggered by over-diversification prevailing in conventional banks.

Given the emergence of Islamic banking, examining whether and how diversification, which is the product of bank deregulation and is long prevailing in conventional banks, affects the performance of Islamic banks that are becoming increasingly diversified is essential. This study examines the effect of asset diversification on the performance (profitability, cost efficiency, and asset quality) of Islamic banks in three Asian countries that practice dual banking systems. Conventional banks in the same countries are also included for comparison. The ultimate goal is to provide policy implications for Islamic banks that are becoming globalized and facing increasingly high competition against conventional banks with the so-called Islamic windows.

Existing literature mostly concludes that diversification causes a decrease in value because the benefit from the accompanied economy of scope is outweighed by the loss brought about by the accompanied diseconomies and increased risks associated with intensified agency problems. Given that conventional banks are generally more diversified than Islamic banks, such that the marginal cost of diversification likely outweighs the marginal benefit, this study initially hypothesizes that diversification negatively affects bank performance of conventional banks as opposed to that of Islamic banks. In addition, Islamic banks are generally less diversified, thus they have a higher potential to reap risk diversification benefits than conventional banks. With the compliance of Islamic banks with the Sharia law that should mitigate the negative effect of diversification on bank performance, this study posits that any positive effect of diversification on bank performance is stronger for Islamic banks than for conventional banks. Furthermore, given that large banks have better capacity and higher capability than small banks to engage in diversification, any positive effect of diversification on bank performance is assumed in this study among large banks and not among small banks. This phenomenon is more pronounced for Islamic banks than conventional banks because of the low level of diversification of Islamic banks compared with that of conventional banks.

Using data from 1,233 banks in three Islamic countries (Indonesia, Malaysia, and Pakistan) from 2006 to 2012 as the study sample, this study shows that diversification is a determinant of bank performance. Results based on the entire sample specifically indicate that diversification generally has a negative effect on the performance of conventional banks, whereas minimal effect on Islamic banks. However, with the consideration of bank size, diversification has a positive effect on profitability of large banks (outside bottom 25% range), and this positive effect is more pronounced among Islamic banks. In addition, diversification does not add to the cost efficiency of both Islamic and conventional banks, whether they are small or medium-sized banks. However, diversification has a positive effect on the cost efficiency of large conventional banks (in top 25%) only. Furthermore, diversification has a positive effect on the asset quality of large Islamic banks (top 25%). By contrast, diversification generally has a negative effect on the asset quality of conventional banks, but this negative effect is weaker for large conventional banks (top 25%). Overall, the results suggest that diversification remains valuable, especially for Islamic banks. Moreover, gains are obtained and fewer losses are incurred from diversification, if the bank, regardless of bank type, is a large bank. Hence, the results highlight the importance of considering bank size in examining the effect of diversification on bank performance because bank size contributes in modifying the effect of diversification on bank performance.

The remainder of the paper is structured as follows. Literature review on the background of Islamic banking and bank diversification that leads to hypotheses is first provided, followed by description of methodology and an analysis of the empirical results. The final section concludes the paper.

2. Literature Review

2.1. *Commercial Banks*

The role of commercial banks (hereafter called as conventional banks) is initially to serve as mere financial intermediaries that channel funds from depositors to borrowers. With the availability of lending and borrowing services through conventional banks, lenders, and borrowers can save costs associated with searching, performing transactions, evaluating liquidity risk, and monitoring. The profits of conventional banks are mainly from net interests spreading between borrowing and deposit rates, aside from those provided by other financial services such as fees for letters of credit and for account maintenance.

However, conventional banks face challenges of financial innovations that resulted in low funding costs decades ago. These banks subsequently began to engage in off-balance-sheet income activities such as creating derivative instruments to secure cost advantages and generate profits. This phenomenon became more pronounced in the latter part of the last century when banking regulations successively relaxed worldwide. For example, in 1999 when the Grammm–Leach–Bliley Act (GLBA), also known as the Financial Service Modernization Act of the US, was enacted, financial holding companies (FHCs) were permitted to engage in any financial activity. The biggest benefits of the GLBA are revenue efficiencies and scale and scope economies as a result of the so-called “universal banking” that is performed by cross-selling business products such as commercial loans and securities. Despite these appealing benefits, FHCs do not consider GLBA as advantageous as they expected, and instead they observed that the act worsens bank performance. For example, any positive effect of GLBA on the performance of FHCs can be attributed to the continual effort of Section 20 subsidiaries, prior to the enactment of GLBA, to exploit the synergies between investment and commercial banking not because of GLBA alone (Yeager et al. 2007). In addition, Stiroh and Rumble (2006) indicated that risk-adjusted returns decline with the increasing diversification of the income activities of banks. Furthermore, Laeven and Levine (2007) found that financial conglomerates (i.e., financial firms engaging in pure commercial and investment banking activities) have intensified agency problems that resulted in bank diversification discounts.

2.2. *Islamic Banks*

The establishment of Islamic banks can be attributed to the ever-growing worldwide demand for oil during the last century. Given that major oil producers are located in the

Muslim-populated Middle East, the increase in oil demand results in an increase in oil price and revenue, allowing oil producers in Muslim countries to accumulate huge wealth. The subsequent assets attained by these oil producers will necessitate financial institutions that can manage them. The Islamic banking system was then created to meet the needs of these wealthy Muslims and of the increasing number of Petrodollar investors. Therefore, the Islamic banking system has a key role in financial intermediation and resource allocation in the Islamic world.

Islamic banks provide lending and borrowing financial services that comply with the Sharia law and concur with the core philosophy of Islam. The basic principle of Islamic banking is that money has no intrinsic value and should be regarded as a unit of account only rather than a commodity. Islamic law similarly prohibits the charging of interests (riba) on loans or deposits (i.e., investment deposits). Moreover, an Islamic bank shares its net profit/loss with its depositors, and they are not permitted to invest in high-risk financial products to comply with the Islamic law. However, Islamic law allows the generation of wealth by trading and investing in financial products that are linked to real assets (Hopeneret al., 2011; Derigs and Mzrzban, 2008). Some researchers promote the Islamic banking system by arguing that the principles of Islamic finance, the concept of profit-and-loss sharing, a multitude of financing modes that are similar to the universal banking system, and financing that is closely linked to real-sector activities are deemed conducive to attaining bank stability in the future (Ahmed, 2009; Ahmed, 2010; Kayed and Hassan 2011).

Islamic and conventional banks differ in many ways. According to Masruki et al. (2011), Islamic banks have more stable bank operations though less profitable, as opposed to conventional banks. In addition, the higher profitability of conventional banks can be attributed to higher transaction fees charged and more channels of external financing than those of Islamic banks. Moreover, conventional banks have a pre-fixed rate payment of interest, whereas Islamic banks are based on profit sharing. Furthermore, liquidity in Islamic banks is higher because of their lower variety of loans or financial products than conventional banks. Lastly, Islamic banks are generally less cost-efficient compared with conventional banks; however, they have higher asset quality, capitalization, and intermediation ratio (Srairi 2010; Beck et al. 2013). In fact, any differences between Islamic and conventional banks can be attributed to the strict compliance of Islamic banks with the Sharia law on lending and investing.

Despite the previously mentioned unique features and differences, Islamic banking has failed to receive much attention prior to the 2008 global financial crisis when Islamic banks were observed to have been minimally affected by the crisis. The global crisis that originated from the US subprime mortgage crisis tested the foundation of the banking industry and caused economic recession worldwide. Most conventional banks were severely affected by the crisis, whereas Islamic banks remained intact. Specifically, the total value of Islamic financial assets grew by 29% in 2008, whereas that of conventional banks generally experienced a sharp decline (Tabash & Dhankar 2014). In addition, Islamic banks subsequently experienced a rapid asset and credit growth (Hasan and Dridi 2010). Existing literature has provided ample evidence indicating that Islamic banks outperformed conventional banks during the crisis through the use of rigorous approaches. One of the observations was the higher resilience of Islamic banks than conventional banks during the crisis (IMF 2010; Zaheer and Farooq 2014). Miniaoui and Gohou (2013) proved the superior performance of Islamic banks over that of conventional banks after comparing Islamic and conventional banks in the United Arab Emirates (UAE) from 1995 to 2010. Hidayat and Abduh (2012) examined the performance of both bank types in the Middle East Bahrain from 2005 to 2010 and determined that the financial crisis has no significant effect on Islamic banks during the global crisis.

The higher resilience and good performance of Islamic banks compared with those of conventional banks during the crisis prompted a growing body of research on whether these achievements can be attributed to the unique features of Islamic banking. Beck et al. (2013), for example, identified higher asset quality and capitalization as factors contributing to the superior performance of Islamic banks compared with that of conventional banks during the crisis. However, these financial characteristics, among other qualities that explain why Islamic banks performed better during the crisis, can be ultimately attributed to the compliance of Islamic banks with Islamic law. Given the previously mentioned and other unique qualities of Islamic banking, it has played an increasingly important role in today's global financial market (Masruki et al.,2011; Čihák and Hesse 2010; Liang, 2009; Hasan and Dridi 2010).

Despite the emergence of Islamic banking, some challenges persist. For example, the Muslim population is relatively young, with their average age of 35 (Pew Research Center, 2013). Since young generation is generally more open, they are more likely to utilize international conventional banks than old generations, resulting in the apparent edge of conventional banks in the modern times. In fact, with the growth of Islamic finance, large international non-Islamic banks, such as HSBC Direct, Standard Chartered Bank, Deutsche Bank, and Citigroup, have started offering Islamic investors with specialized financial products and services (i.e., Islamic window). Although these conventional banks can only provide simple financial services tailored to Muslims, as opposed to fully-fledged Islamic banks, they have established more Islamic subsidiaries to expand the scale and scope of their services, with their increased experiences and relaxed domestic government regulations. The competitiveness of conventional banks threatens the sustainability of Islamic banks. Hence, whether Islamic banks will eventually be disregarded by the Islamic world is worrisome. In addition, current Islamic banks are below the standards of Muslims because they are not only insufficiently inclined to Islam, but also more regulated, inefficient, and not as diversified as compared with conventional banks (Siddiqi 2002). Thus, Muslims demand Islamic banks to be similar to conventional banks, particularly with respect to diversification. Considering the competitiveness of conventional banks and the dissatisfaction of Muslims with Islamic banks, exploring whether and how the diversification prevailing in conventional banks and being sought for by Muslims is relevant for Islamic banks. This investigation is important because diversification can negatively affect bank performance, as evidenced by conventional banks during the crisis. Although Islamic banks indicate much room for improvement, some of the features of conventional banks that are preferred by Muslims should be reconsidered. The high level of diversification prevailing in conventional banks is particularly a subject of scrutiny and may need to be eschewed in transitioning to an increasingly diversified banking system. Over-diversification as a result of bank deregulation is considered a major culprit in the global crisis because of the complex financial products permitted and developed under such circumstances, which present high risks but were not captured by capital requirements and effective monitoring prior to the crisis. In fact, recent studies that explore bank failure during the financial crisis similarly concluded that any bank failure during the said period was primarily due to high investments in innovative financial products, such as commercial real estate loans that were assigned a small asset risk weight prior to the onset of the crisis (Altunbas et al., 2011; Berger et al., 2012; Cole and White 2012). Other studies further provided evidence indicating that diversification from traditional to non-traditional banking activities increases bank risks and bank failure probabilities during the crisis. Lepetit et al. (2008), for example, found that diversification into non-interest income results in elevated bank risks for European banks as opposed to traditional banks. Using US banks as the study sample, Stiroh (2004) determined that non-interest income, particularly trading revenue, leads to less risk-adjusted profits because non-interest income activities have minimal risk diversification benefits, and the total risk will likely increase with diversification. Demirgüç-Kunt and Huizinga (2010) further confirmed the limited risk diversification benefit of non-interest income activities and concluded that relying too much on non-interest income activities for profit generation led to bank failure in the US during the crisis. DeYoung and Torna (2013) examined non-traditional income sources across hundreds of US depository institutions between 2008 and 2010 and found that asset-based non-traditional banking activities have a positive effect on the probability of bank failure during the crisis.

In sum, bank deregulation and the resulting emergence of financial engineering and various financial products with non-interest income and intractable high risks are considered major factors contributing to bank failures during the crisis. The identification of factors further highlights the differences between conventional and Islamic banks. The latter do not engage in financial engineering and selling of financial products that are implicitly highly risky. Compared with the majority of conventional banks that suffered from the global financial crisis, Islamic banks generally survived the crisis smoothly because of their low level of diversification (Chatti et al. 2013). Hence, in transition to more advanced and westernized banking system, Islamic banks should preserve their unique features without becoming over-westernized to prosper without committing the mistake of conventional banks prior to the crisis. In particular, given the established relationship between

diversification and bank failure, Islamic banks should learn from the experiences of conventional banks and moderately engage in diversification in expanding their business.
Existing literature has documented the relation of diversification to bank performance. However, results indicating the effect of diversification on bank performance remain ambiguous and dependent on several factors such as the countries of interest, bank size and type, and diversification level (e.g., Čihák and Hesse 2010, Vallascas et al. 2012, Molyneux and Yip 2013). In addition, prior studies virtually used income diversity as a measure for bank diversification (Molyneux and Yip 2013). . Although Chatti et al. (2013) investigated the effect of asset/liability diversification on bank performance, the measure they used for asset diversification was the Herfindahl–Hirschman Index. Though asset diversification has been found to be negatively related to risks (Liang and Rhoades 1991), the link between "asset diversity" and Islamic bank performance remains unexplored. Furthermore, all prior studies on the subject used static models in examining the effect of diversification on bank performance. That is, they fail to consider the dynamic process of attaining bank performance and the endogeneity problem. Although recent studies have begun to investigate the effect of diversification on the performance of Islamic banks, they were unable to consider performance measures other than profitability and financial stability (Čihák and Hesse 2010; Chatti et al. 2013; Molyneux and Yip 2013). Therefore, this study aims to fill the research gap by examining whether and how asset diversification contributes to the performance of Islamic banks as opposed to conventional banks using the dynamic panel data approach that addresses the endogeneity problem. Given that Islamic banks are generally less diversified compared with conventional banks, whether the higher level of diversification sought by Muslims will worsen the performance of Islamic banks, such as in the case of conventional banks during the crisis, should be investigated.

2.3. *Hypothesis development*

As mentioned in this section, the effect of diversification on bank performance has been debated in existing literature. Diversification may not necessarily yield risk reduction benefits for banks as assumed. A group of studies has shown that banks tend to underperform with increased diversification. Gamra and Plihon (2011), for example, found a negative effect of diversification on bank performance in emerging markets because of the costs incurred from diversification in the form of aggravated agency problems that exceeded the gains. Using Italian banks as the study sample, Acharya et al. (2006) found that loan portfolio diversification tends to increase risk and decrease return because diversification results in diseconomies caused by factors such as adverse selection and ineffective monitoring. Laeven and Levine (2007) provided evidence from 43 countries, which indicated the presence of diversification discount. Specifically, financial conglomerates that engage in multiple activities face more severe agency problems; thus, they are outperformed by banks that specialize in specific activities. Mercieca et al. (2007)

determined a negative effect of income diversification on the performance of European small banks. DeYoung and Roland (2001) found that bank performance tend to worsen with increasing income diversity because earnings become more volatile under such circumstances.

By contrast, another group of studies, though only a few, revealed the positive effect of diversification on bank performance. Using the US banks as the study sample, Saunders et al. (2014) found that banks that diversify from the interest income to non-interest income activities have higher profitability and lower insolvency risk than other banks. In addition, using Italian banks as the study sample, Vallascas et al. (2012) observed the benefits obtained by banks from diversification across unrelated income groups rather than that within narrow income activities. In fact, such a positive effect of diversification on bank performance is particularly found in Islamic banks. A survey of Islamic countries practicing a dual banking system by Molyneux and Yip (2013) revealed that income diversification (e.g., trading income, commission, and fee income) has a positive effect on bank performance, as measured by ROA and ROE, which is more pronounced for Islamic banks than for conventional banks. This finding can be attributed to the low diversification of Islamic banks and their higher potential to reap the benefits of diversification compared with conventional banks. Chatti et al. (2013) examined eight Islamic banks in Malaysia and found that despite low efficiency, an increase in portfolio diversity can improve the performance of Islamic banks. Čihák and Hesse (2010) found that income diversity tends to have a positive effect on z-score (a proxy of bank stability) of large Islamic banks as opposed to that of small banks where no such effect was observed. Shahimi et al. (2006) investigated Malaysian Islamic banks and found that diversification from traditional debt financing to other non-traditional activities, such as fee income, tends to decrease bank risk and increase bank size.

Based on the empirical evidence described previously, the net effect of diversification on bank performance remains ambiguous and dependent on two opposing effects and bank types. However, with conventional banks as generally more diversified, the marginal benefit of diversification is likely smaller than its marginal cost. That is, any positive effect of diversification is likely overwhelmed by the negative effect. Thus, the net effect of diversification on bank performance should be negative for conventional banks as opposed to Islamic banks. The following hypothesis is therefore formulated.

Hypothesis 1: Asset diversification has a negative effect on the performance of conventional banks as opposed to Islamic banks in the Islamic world with similar openness level of banking environment.

Prior research that investigated on the effect of diversification on bank performance mostly focused on conventional banks. As mentioned previously, Laeven and Levine (2007) found a diversification discount based on multi-country sample. However, Islamic banks were excluded from their sample because of their unique accounting standards compared with conventional banks. In contrast to conventional banks, the net effect of diversification on bank performance should be non-negative or even positive for Islamic banks. The underlying reason is because all Islamic banks have to comply with the Sharia law. Therefore, any diseconomies and agency problems associated with diversification should be less severe for Islamic banks. More specifically, the feature of risk-sharing ensures the mitigation of any increase in risk associated with diversification. The requirement of financial transactions connected with real economic activities further reduces any positive effect of diversification on bank risk. The non-exploitative nature of Islamic banking ensures that diversification will not aggravate any agency problems. Finally, agency problems and diseconomies associated with diversification will further be under control with the prohibition of criminal behavior such as speculative financial transactions and risky investments.

Existing literature has provided evidence indicating that any positive effect of diversification on bank performance is more likely to be observed by Islamic banks as opposed to conventional banks (Molyneux and Yip 2013; Saunders et al. 2014; Chatti et al. 2013; Čihák and Hesse 2010; Shahimi et al. 2006). Molyneux and Yip (2013), for example, found that risk-adjusted returns are higher as the share of non-traditional or non-financing income increases and this positive effect is more pronounced for Islamic banks than for conventional banks. Given that conventional banks are generally more diversified, any potential gain from diversification will likely be dominated by the negative effect of diversification emerging from the accompanied diseconomies and agency problems. Therefore, the net effect of diversification is negative for conventional banks. By contrast, in addition to the compliance with the Sharia law that helps minimize the negative effect of diversification on bank performance, Islamic banks are typically less diversified. Therefore, their marginal benefit of diversification likely overweighs the marginal cost. As a result, Islamic banks are more likely to reap benefits from diversification than conventional banks (Molyneux and Yip 2013). Despite minimal research on the effect of asset diversification on bank performance, given the risk reduction associated with the compliance with the Sharia law and the low level of diversification of Islamic banks, asset diversification, similar to income diversification, should have a positive effect on the bank performance of Islamic banks. The following hypothesis is therefore formulated.

Hypothesis 2: Any positive effect of asset diversification on bank performance is more pronounced for Islamic banks than for conventional banks.

Although results are mixed, prior studies have shown that bank size matters in determining the effect of diversification on bank performance. The consensus is that large banks can afford to diversify their income activities and reap the risk diversification benefits as opposed to small banks. Mercieca et al. (2007), for example, found the negative effect of income diversification on the performance of European small banks compared with large banks because small banks are inexperienced and not sufficiently specialized such that diversification results in more losses than gains. However, the capability to engage in diversification does not guarantee better performance of large banks. Demsetz and Strahan

(1997) found that large bank holding companies (BHCs) are better diversified than small BHCs, but the total risk of large BHCs is similar to that of small BHCs, which suggests that diversification plays a minimal role in reducing bank risk of large banks because of other factors. In fact, given the documented positive relationship between bank size and diversification (Demsetz and Strahan 1997; Deng et al. 2007), any minimal effect of diversification on bank performance of large banks can be attributed to the potential negative effect of bank size on bank performance. This relationship is attributed to the likelihood that as banks increase in size and capability of diversifying their income activities or portfolios, agency problems will likely worsen, and the expected negative effect of diversification on bank risk is offset or overwhelmed by the positive effect of bank size on risk because of increased agency costs (Laeven and Levine 2007).

The negative effect of bank size on bank performance has been documented in prior research. Demirgüç-Kunt and Huizinga (2013), for example, showed that stock returns are discounted when banks are exceedingly large. Other studies further provided empirical evidence indicating the negative relationship between bank size and profitability among conventional banks, which can be attributed to increased costs associated with bureaucracy, agency problems, and management diseconomies as bank size increases (e.g. Stiroh and Rumble, 2006; Demirgüç-Kunt and Huizinga 1999).

However, another group of studies indicated the possible non-negative effect of bank size on bank performance. Given the documented positive relationship between bank size and bank efficiency (Altunbaş et al. 2001; Delis and Papanikolaou 2009) and that between bank efficiency and bank performance (Beccalli et al. 2006), large banks should achieve better performance by gaining efficiency. Any positive effect of diversification on bank performance is subsequently strengthened as the accompanied bank size increases. Thus, diversification has a positive effect on the bank performance of large banks. In addition, regarding financial stability, Čihák and Hesse (2010) found that large conventional banks are more financially stable than small ones. By contrast, large Islamic banks are less financially stable compared with their small counterparts and large conventional banks because large Islamic banks are less capable of credit and liquidity risk management. Nevertheless, financial stability is found to increase with income diversity of large Islamic banks, which indicates that a higher level of income diversification can offset the negative effect of bank size on financial stability, rendering diversification valuable for large Islamic banks (Čihák and Hesse 2010). That is, diversification helps improve financial stability of large Islamic banks, despite the negative relationship between bank size and financial stability for such banks. This positive effect of diversification on financial stability of large Islamic banks should carry over to other bank performance measures such as profitability, cost efficiency, and asset quality because reduced risk and increased financial stability accompanied by higher diversification can ensure better operating conditions. Large Islamic banks are therefore expected to be more profitable, more efficient, and have better asset quality under such circumstances than small Islamic banks.

In sum, given that large banks are more capable of engaging in diversification and likely to be more efficient than small banks, diversification should have a positive effect on the bank performance of large banks. In addition, given the observed positive effect of diversification on financial stability of large Islamic banks alone, any positive effect of diversification on bank performance should be more pronounced for large Islamic banks than for large conventional banks. The following hypothesis is therefore formulated.
Hypothesis 3: Diversification has a positive effect on bank performance of large banks as opposed to that of small banks; and this positive effect is particularly more observed among large Islamic banks than among large conventional banks.

3. Methodology

3.1. *Data*

Annual data on the financial variables of banks in Malaysia, Pakistan, and Indonesia are gathered through Bankscope. The sample period is from 2006 to 2012. Banks covered in this study include Islamic and conventional banks, and the latter include depository institutions, investment banks, savings banks, and cooperative banks. Table 1 lists the number of conventional and Islamic banks for each of the three countries.

The selection of these three countries is mainly based on the following reasons. First, Malaysia is a typical Islamic country with the largest Islamic financial assets in Asia. Specifically, Malaysia accounted for 10% of the world's Islamic banking assets and ranked third in 2012. Malaysia also ranked first in terms of equity, Sukuk (Islamic version of bond), and fund management markets in 2009 (PricewaterhouseCoopers 2010). With an open financial environment and as the world's largest Islamic bond market in Asia, Malaysia is recognized as the future center for Islamic finance (Sy 2007; Gelbard et al. 2014). In addition, other Islamic countries in Asia, such as Indonesia and Pakistan, have the potential to develop because of their large and rapidly growing population. According to the Pew Research Center (2011), Indonesia has the second largest Muslim population in 2010and is expected to surpass Indonesia and become the world's largest Muslim country in 2030. Second, conventional and Islamic banks co-exist in the three countries identified, indicating a similar level of openness in terms of banking environment.

Following Laeven and Levine (2007) and LeBaron and Speidell (1987), we first used the chop-shop approach to obtain excess value of return on asset (ROA) to measure profitability as one of the bank performance measures in this study.

ROA is adjusted according to the relative weights of lending and non-lending activities of banks. A new variable named Adjust_ROA is created subsequently.

$$\text{Adjust\_ROA}_{j} = \alpha_j P_1 + (1 - \alpha_j) P_2 \qquad (1)$$

, where α_j is net loans divided by total earning assets for bank j based on the balance sheet. P_1 and P_2 are ROA for pure commercial and investment banks, respectively. The values of P_1 and P_2 are obtained by calculating the mean values of the ROA of both pure commercial and investment banks, respectively, where pure commercial (investment) banks are defined as banks with the ratio of loans to total earning assets as greater than 0.9 (less than 0.1) (Appendix).

We then created another variable, namely, excess value of ROA (EV_ROA) to measure diversification discount or premium by subtracting Adjust_ROA from Actual_ROA. The equation is as follows:

$$\begin{aligned} EV\_ROA &= Actual\_ROA_j - Adjust\_ROA_j \\ &= Actual\_ROA_j - [\alpha_j P_1 + (1-\alpha_j)P_2] \end{aligned} \quad (2)$$

This measure of bank performance differs from that of Laeven and Levine (2007) who used Tobin's Q (i.e., the sum of the market value of common equity plus the book value of preferred shares divided by the book value of total assets). Given the limited data on market value of banks, this study follows the work of Tsai et al. (2009) by using ROA to measure bank performance and to derive excess value.

According to ECB (2010), bank performance measures should not be limited to ROA or ROE. Bank performance should also cover other measures such as cost efficiency and asset quality. Hence, to provide a better insight into the research question, in addition to EV_ROA, we use three other variables as dependent variables: ROA, cost to income ratio (CTI, an inverse proxy for bank (cost) efficiency), and loan loss reserve divided by gross loans (LLR_GL, an inverse proxy for asset quality or bank stability) (Beck et al. 2013; Vander Vennet 2002).

According to Laeven and Levine (2007), asset-based and income-based diversity measures can be used to determine the level of diversification from lending to non-lending activities. Considering that most of the ratios derived from the income statements are greater than 1, which renders such ratios as unqualified for the income-based measure, we use the asset-based diversity (AD) measure in the present study. The asset-based measure is less problematic compared with the income-based measure (Laeven and Levine 2007).

The asset-based diversity measure for a given bank is calculated as follows:

$$\text{Asset diversity (AD)} = 1 - \left|\frac{(Net\ loans - Other\ earning\ assets)}{Total\ earning\ assets}\right| \quad (3)$$

, where other earning assets include underwritten securities and investments whereas other two variables are as defined above. The value of the AD variable is between zero and one, inclusive. Higher values indicate higher asset diversity.

The selection of other control variables follows prior studies, including the ratio of deposits to liabilities (DL), the ratio of equity to asset (EA), growth in assets (GIA), and log of total assets (TA). DL, EA, GIA, and log(TA) are used to control the effect of bank intermediation, financial leverage, bank growth opportunity, and bank size on bank performance, respectively. , All these variables (except for AD) are winsorized at 1% and 99% levels to remove outliers from the sample.

Other dummy variables are created to distinguish between bank types and between countries. D_type is specifically a dummy variable that returns a value of one, if a given bank is a conventional bank, and zero otherwise. The conventional banks in this study include the following banks: commercial banks defined by Bankscope, savings banks, cooperative banks, and investment banks. Islamic banks are defined by Bankscope as well. C_ID is a dummy variable that returns a value of one, if a given country is Indonesia, and zero otherwise. The C_MY is a dummy variable that returns a value of one, if a given country is Malaysia, and zero otherwise. Although the three countries in this study are Islamic countries and practice Islamic banking, discrepancies are observed among them. For example, the driving forces behind Islamic banking system development for these countries are different. Specifically, the development of an Islamic financial system in Indonesia is driven by market force, whereas the Islamic financial systems in Malaysia and Pakistan are driven by government initiatives. In addition, despite the de jure dual banking system, all banks in Pakistan are de facto Islamized (KPMG 2007). Hence, country dummy variables are included to capture and control for country-specific effects.

Table 2 presents a summary statistics of the variables used in this study. A total of 495 conventional banks and 70 Islamic banks are used as the study sample. All statistics for AD are lower for Islamic banks than for conventional banks, indicating lower asset diversity of Islamic banks than that of conventional banks. The mean and median values of EV_ROA are lower for Islamic banks than for conventional banks, indicating lower profitability of Islamic banks than that of conventional banks. The mean and median values of CTI are higher for Islamic banks than for conventional banks, indicating lower cost efficiency of Islamic banks than that of conventional banks. The mean and median values of LLR_GL are lower for Islamic banks than for conventional banks, indicating higher asset quality of Islamic banks than that of conventional banks. Results concur with those in prior studies (e.g., Beck et al. 2013; Srairi 2010). As for other control variables, the mean and median values of EA, log(TA), and log (TOI) are lower for Islamic banks than for conventional banks, indicating higher financial leverage and smaller bank size for Islamic banks than for conventional banks. The mean and median values of DL and GIA are higher for Islamic banks than for conventional banks, indicating higher level of bank intermediation and greater bank growth opportunity for Islamic banks than for conventional banks.

3.2. *The model*

We examine the effect of asset diversification on bank performance (EV_ROA, ROA, CTI, LLR_GL) by estimating the econometric model similar to that used by Laeven and Levine (2007) and Beck et al. (2013). Specifically, we regress the bank performance variable on asset diversity (AD) and its interaction variable AD×D_type as well as other control variables to examine whether and how the effect of AD on bank performance differs between Islamic banks and conventional banks. As the data vary across banks and over time, the panel data model is used. Moreover, since past bank performance likely influences future performance, we estimate the dynamic panel model for bank performance to reflect such adjustment process as opposed to the static model used in all of prior studies. Different specifications of the following one-step difference and system generalized method of moment (GMM) dynamic panel model that is adjusted for heteroskedasticity are estimated to obtain robust estimators.

$$\begin{aligned} BP_{i,t} = {} & \beta_0 BP_{i,t-1} + \beta_1 AD_{i,t} + \beta_2 AD_{i,t} \times D\_Type_{i,t} + \beta_3 C\_ID_{i,t} + \beta_4 C\_MY_{i,t} \\ & + \beta_5 DL_{i,t} + \beta_6 EA_{i,t} + \beta_7 GIA_{i,t} + \beta_8 \log(TA)_{i,t} \\ & + \sum_{t=2006}^{2011} \gamma_t YEAR_t + \mu_i + \nu_{i,t} \end{aligned} \tag{4}$$

BP refers to bank performance measured by EV_ROA, ROA, CTI, or LLR_GL. AD, D_Type, C_ID, C_MY, DL, EA, GIA, and TA are as defined above. YEAR is the dummy variable that returns a value of one if a given year is t. YEAR is included to capture year-specific effects.   denotes the unobservable firm-specific effect for bank i;   is the remainder disturbance for bank i and year t.

Using this framework, our focus is on the coefficient of AD, which measures the effect of asset diversification on bank performance. When BP is captured by EV_ROA or ROA, this coefficient indicates whether there is any diversification premium or discount. In general, based on model 1, the effect of asset diversification on bank performance is measured as β_1+β_2 D_type, which equals β_1 if a given bank is an Islamic bank (D_type = 0) and β_1+β_2 if a given bank is a conventional bank (D_type = 1). According to H1, when bank performance is measured by EV_ROA or ROA (i.e., proxy of profitability), □2 is expected to be negative. By contrast, when bank performance is measured by CTI or LLR_GL (i.e., inverse proxies of cost efficiency and asset quality, respectively), □2 is expected to be positive. For H2, when bank performance is measured by EV_ROA or ROA, □1 is expected to be positive. By contrast, when bank performance is measured by CTI or LLR_GL, □1 is expected to be negative.

Given that bank size may play a role in determining the effect of diversification on bank performance (Mercieca et al. 2007), model 1 is reestimated using sample partitions classified based on bank size. Specifically, the entire sample is grouped into three partitions based on total assets for each year, i.e., bottom 25%, middle 50%, and top 25%. Alternatively, to provide more insight into the potential role of bank size in determining the effect of diversification on bank performance, model 1 is modified in a way to facilitate comparison of the effect of diversification on bank performance between banks with different size for each bank type. To this end, the following model is estimated:

$$\begin{aligned} BP_{i,t} &= \beta_0 BP_{i,t-1} + \beta_1 AD_{i,t} + \beta_2 AD_{i,t} \times Q1_{i,t} + \beta_3 AD_{i,t} \times Q4_{i,t} \\ &+ \beta_4 C\_ID_{i,t} + \beta_5 C\_MY_{i,t} + \beta_6 DL_{i,t} + \beta_7 EA_{i,t} + \beta_8 GIA_{i,t} + \beta_9 \log(TA)_{i,t} \\ &+ \sum_{t=2006}^{2011} \gamma_t YEAR_t + \mu_i + \nu_{i,t} \end{aligned} \tag{5}$$

All variables are as defined as for model 1 except for Q1 and Q4, which are dummy variables that indicate the bottom 25% and the top 25% ranges of total assets for a given year. Q1 (Q4) returns a value of one if total assets are in the bottom (top) 25% range and zero otherwise. When total assets are in the middle 50% range, Q1 and Q2 take on the value of zero.

Based on model 2, the effect of diversification on bank performance is measured as β_1+β_2 Q1+β_3 Q4, which equals □1 + □2 , □1, and □1 + □3 when total assets are in the bottom 25%, middle 50%, and top 25%, respectively. According to H3, when bank performance is measured by EV_ROA or ROA, the coefficient of AD is smaller when total assets are in the bottom 25% than that when total assets are in the top 25%. That is, □2 is expected to be lower than □3. By contrast, when bank performance is measured by CTI or LLR_GL (i.e., inverse proxies of bank performance), □2 is expected to be higher than □3. Since financial variables are likely codetermined, all independent variables are treated as endogenous except dummy variables (C_ID, C_MY, D_Type, Q1, and Q4), which are treated as exogenous. All available lags of the dependent variable BP and independent variables other than dummy variables are used as instruments for the transformed equation. The aforementioned dummy variables and year dummy variables are used as standard instrument variables.

4. Empirical Results

Table 3 presents the results of the effect of asset diversification (AD) on bank performances based on the entire sample. In Columns 1 and 2 where EV_ROA and ROA are used to measure bank performance and where the coefficient of AD is insignificant and that of AD D_type is significantly negative, the effect of AD on EV_ROA and ROA is measured as -3.279 D_type and -3.132 D_type, respectively. Results indicate that AD has a negative effect on EV_ROA and ROA of conventional banks, whereas no effect was observed among Islamic banks. In Column 3, the coefficients of AD and AD D_type are shown as insignificant, indicating no effect of AD on cost efficiency for both bank types. In Column 4, the coefficient of AD is shown as significantly positive, whereas the AD D_type is insignificant, indicating that AD has a negative effect on asset quality for both bank types, given that LLR_GL is an inverse proxy of asset quality. Overall, results in Table 3 indicate that AD has a negative effect on bank performance, particularly of conventional banks. That is, a diversification discount generally exists for conventional banks, concurring with the findings of Laeven and Levine (2007) and Tsai et al. (2009). Results further supported the view that agency problems emerging from financial conglomerates increase in severity when the level of diversification is higher, such that the net effect of diversification on bank performance is negative (Laeven and Levine 2007). These results support H1.

As mentioned previously, the effect of diversification on bank performance may depend on bank size (Mercieca et al. 2007), we re-estimate the model using sample partitions classified based on bank size, (i.e., bottom 25%, middle 50%, and top 25%). Results are presented in Table 4, where Panel A shows the effect of AD on EV_ROA and ROA and Panel B shows the effect of AD on CTI and LLR_GL.

In Panel A, the coefficients of AD and its interaction variable, AD×D_Type, are insignificant, as shown in Column 1, where banks with bank sizes at the bottom 25% range are examined, indicating that diversification has no effect on EV_ROA for both bank types with bank sizes within this range. In Column 2, findings from the examination of banks with bank sizes at the middle 50% range are presented. The coefficient of AD is significantly positive and that of AD×D_Type is significantly negative. Specifically, the effect of AD on EV_ROA is measured as 5.071-1.750 D_type, which is 3.321 if D_type has a value of one (i.e., a given bank is a conventional bank) and 5.071 otherwise (i.e., a given bank is an Islamic bank). Results indicate that for banks with sizes at the middle 50% range, AD has a positive effect on EV_ROA, and this positive effect is more pronounced for Islamic banks than for conventional banks. Column 3 shows the results of the examination of banks with bank sizes at the top 25% range. The coefficient of AD for these banks is significantly positive, whereas that of AD×D_Type is insignificant. AD therefore has a positive effect on EV_ROA for both bank types with bank sizes at the top 25% range. When the dependent variable is ROA, a similar pattern is observed. AD has no effect on ROA when the bank size is at the bottom 25% range (Column 4). In Column 5, the effect of AD on ROA is indicated as 3.515-1.626 D_type, which is 1.889 if D_type has a value of one (i.e., a given bank is a conventional bank) and 3.515 otherwise (i.e., a given bank is an Islamic bank), for banks with bank sizes at the middle 50% range. This result indicates that for banks at the middle 50% size range, AD has a positive effect on ROA, and this positive effect is more pronounced for Islamic banks than for conventional banks. When bank size is at the top 25% range, the coefficients of AD and AD×D_Types are insignificant, and no effect of AD on ROA for both bank types under such circumstance is observed (Column 6). In sum, results in Panel A of Table 4 strongly indicate that diversification has a positive effect on EV_ROA and ROA for medium or large-sized (i.e., outside the bottom 25% range) banks. In addition, this positive effect is stronger for Islamic banks than for conventional banks with bank sizes at the middle 50% range. Results further indicate that bank size is important in determining the effect of diversification on EV_ROA and ROA.

In Panel B, where bank performance is measured by CTI and LLR_GL, the coefficients of AD and AD×D_Type are insignificant in all columns, indicating that diversification has no effect on CTI and LLR_GL for both bank types, regardless of bank size.

To provide a better insight into the research question, we re-estimate the model using a slightly different approach. Instead of conducting estimations using samples classified based on bank size, we estimate the model for each bank type by including additional variables that interact AD with dummy variables that indicate bank size at the bottom 25% and top 25% ranges (i.e., Q1 and Q4, respectively). Results are presented in Table 5. Columns 1 and 2 present the results on the effect of AD on EV_ROA of Islamic and conventional banks, respectively. The effect of AD on EV_ROA of Islamic banks is measured as 1.697 – 1.501 Q1, which equals 0.196 if bank size is at the bottom 25% range (i.e., Q1 = 1) and 1.697 otherwise (i.e., Q1 = 0) (Column 1). This finding indicates that AD has a positive effect on EV_ROA of Islamic banks, and this positive effect is stronger for those with bank sizes beyond the bottom 25% range. By contrast, the coefficients of AD, as well as its interaction variables AD Q1 and AD Q4, are insignificant in Column 2, indicating that AD has no effect on EV_ROA of conventional banks, regardless of bank size. In Columns 3 and 4 where ROA is used as the proxy of bank performance, the effect of AD on ROA of Islamic banks is measured as -1.277 Q1, which equals -1.277, if bank size is at the bottom 25% range, (i.e., Q1 = 1) and zero otherwise (i.e., Q1 = 0). These figures indicate that AD has a negative effect on ROA of Islamic banks with bank sizes at the bottom 25% range, whereas no effect on ROA of those with bank sizes outside this range. By contrast, the coefficients of AD, as well as its interaction variables AD Q1 and AD Q4, are insignificant, as shown in Column 4, indicating that AD has no effect on ROA of conventional banks, regardless of bank size, and concurring with the observation listed in Column 2.

In sum, when bank performance is measured by EV_ROA or ROA, results strongly indicate that AD has no effect on the performance of conventional banks, regardless of bank size. By contrast, AD has a positive effect on bank performance or a diversification premium exists for Islamic banks, and this positive effect or diversification premium is more pronounced for large banks (outside the bottom 25% range). Hence, results suggest that Islamic banks should be sufficiently large to obtain immense benefits from diversification. These results support H3.

The effect of AD on CTI and LLR_GL is more revealed in the results in Table 5 than those in Table 4. The effect of AD on CTI of Islamic banks, specifically, is measured as 19.674 Q1 in Column 5, which equals 19.674 if bank size is at the bottom 25% range and zero otherwise. That is, given that CTI is an inverse proxy of cost efficiency, results indicate that AD has a negative effect on cost efficiency of Islamic banks with bank sizes at the bottom 25% range, whereas AD has no effect on cost efficiency for banks with bank sizes outside this range. For conventional banks, the effect of AD on CTI is measured as 46.435 Q1 – 30.812 Q4, which equals 46.435, 0, and -30.812 when bank sizes are at the bottom 25%, middle 50%, and top 25% ranges, respectively (Column 6). That is, given that LLR_GL is an inverse proxy of asset quality, AD has a negative effect, no effect, and positive effect on cost efficiency for banks with bank sizes at the bottom 25%, middle 50%, and top 25% ranges, respectively.

In Columns 7 and 8, the effect of AD on LLR_GL is indicated by the listed results. The effect of AD on LLR_GL of Islamic banks is measured as -7.069 Q4 in Column 7, which is equal to -7.069 if bank size is in top 25% (i.e., Q4 = 1) and zero otherwise (i.e., Q4 = 0). Given that LLR_GL is an inverse proxy of asset quality, AD has a positive effect on asset quality of Islamic banks with bank sizes at the top 25% range, whereas AD has no effect on those with bank sizes outside this range. In Column 8, the effect of AD on LLR_GL of conventional banks is measured as 7.291 – 3.243 Q4, which equals 4.048 if the bank size is at the top 25% range (i.3., Q4 = 1) and 7.291 otherwise (i.e., Q4 = 0). That is, AD has a negative effect on asset quality of conventional banks, and this negative effect is weaker for banks with bank sizes at the top 25% range.

Based on results in Columns 5 to 8, any positive effect of AD on cost efficiency and asset quality occurs when the bank size is at the top 25% range. In addition, any negative effect of AD on cost efficiency and asset quality occurs when the bank size is small (i.e., at the bottom 25% range and outside the top 25% range, respectively. For large conventional and Islamic banks (at the top 25% range), they tend to gain cost efficiency and asset quality, respectively, from asset diversification. The results highlight the importance of bank size in determining the effect of AD on cost efficiency and asset quality, concurring with the results in Columns 1 to 4 on the effect of AD on profitability.

The study results suggest that Islamic banks tend to benefit from asset diversification in terms of profitability and asset quality when they have large bank sizes. However, diversification does not add to the cost efficiency of Islamic banks, especially when the bank size is at the bottom 25% range in which a negative effect is observed. For conventional banks, diversification does not appear to add to profitability and asset quality. However, diversification can improve cost efficiency and has a weak negative effect on the asset quality of conventional banks when the bank size is large (i.e., at the top 25% range). In sum, banks should be sufficiently large to benefit from diversification. Furthermore, conventional banks seem to enjoy less performance gain from diversification as opposed to Islamic banks. In particular, this study provides evidence indicating the presence of diversification discount for conventional banks, consistent with the finding of Laeven and Levine (2007) and Tsai et al. (2009).

5. Concluding Remarks

This study examines the effect of asset diversification on bank performance in three Asian Islamic countries that have a dual banking system. With the data obtained from banks in Indonesia, Malaysia, and Pakistan, from 2006 to 2012, asset diversification is found to have a role in determining bank performance. Diversification, specifically, has a negative effect on profitability and asset quality of conventional banks, whereas no effect on cost efficiency and weak negative effect on asset quality of Islamic banks. In considering the bank size, the results reveal a positive effect of diversification on profitability of large banks (i.e., banks with sizes outside the bottom 25% range). This positive effect is stronger for Islamic banks than for conventional banks. In addition, diversification has a positive effect on the cost efficiency of conventional banks with bank sizes at the top 25% range, whereas no positive effect on the cost efficiency of Islamic banks. Furthermore, diversification has a positive effect on the asset quality of Islamic banks with bank sizes at the top 25% range. By contrast, diversification has a negative effect on the asset quality of conventional banks. However, this negative effect is weaker for conventional banks with bank sizes at the top 25% range. The results overall suggest that diversification remains to be valuable, especially for Islamic banks. Moreover, this study is the first to provide evidence indicating that size is important in examining the effect of diversification on bank performance. Any gain from diversification appears to occur and any loss from diversification appears to be smaller for large banks, regardless of bank type. That is, with diversification, the larger the bank is, the more gain or the lesser loss is attained.

The findings of this study provide implications for researchers, practitioners, and policy makers. For researchers, results suggest that diversification affects bank performance. Islamic banks have diversification premium, whereas conventional banks have diversification discount. In addition, size matters in determining the effect of diversification on bank performance. Hence, future studies should consider the type and size of banks to accurately identify the effect of diversification on bank performance. For practitioners, given that any gain from diversification is larger and any loss is smaller for large banks, Islamic banks are not recommended to engage in high diversification levels unless their bank sizes are sufficiently large. By contrast, while large conventional banks gain cost efficiency from diversification, diversification generally adds nothing to profitability and asset quality. These banks should moderately engage in diversification because, unlike Islamic banks, diversification will cause more harm than good for conventional banks. For policy makers, since conventional banks generally fail to gain from diversification, authorities should implement policies that will reduce the level of bank diversification to improve the performance of conventional banks. Meanwhile, policies or measures should be implemented to encourage Islamic banks to diversify their assets for better performance. These policies or measures will more likely work if Islamic banks will be sufficiently large to gain from diversification.

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Appendix

Following Laeven and Levine (2007), banks are classified into pure commercial banks and pure investment banks based on the following asset-based measure:

$$\text{Loans to total earning assets} \quad (\text{LEA}) = \frac{\text{Net loans}}{\text{Total earning assets}} \qquad \text{(A1)}$$

, where total earning assets includes loans, securities assets, operating mutual funds, etc. The value of this variable is between zero and one, inclusive. A higher ratio means that a bank focuses on deposit-taking and loan-making such that it is closer to a commercial bank whereas a lower ratio means that a bank is closer to an investment bank. Banks are classified as pure commercial banks and pure investment banks if their LEA is greater than 0.9 and less than 0.1, respectively.

Table 1 Numbers of conventional banks and Islamic banks across countries

	Malaysia	Indonesia	Pakistan	Total
Conventional banks	56	80	31	167
Islamic banks	17	4	9	30
Total	73	84	40	179

Table 2 Summary statistics for the variables used in the study

Bank type	Variable	Mean	Min	p25	p50	p75	Max	sd	N
Conventional	EV_ROA	-1.395	-26.382	-2.001	-1.293	-0.531	12.350	2.269	495
	CTI	65.920	3.960	45.439	57.006	71.693	723.141	51.062	495
	LLR_GL	4.697	0.014	1.406	2.533	5.366	47.566	5.995	495
	AD	0.396	0.081	0.262	0.370	0.495	0.973	0.173	495
	DL	0.877	0.082	0.846	0.917	0.957	0.997	0.128	495
	EA	13.643	-3.280	8.050	10.320	15.620	68.130	9.942	495

	GIA	22.960	-67.560	7.560	16.030	28.200	298.670	37.137	495
	Log(TA)	9.212	7.329	8.711	9.196	9.669	11.209	0.691	495
	Log(TOI)	4.245	1.985	3.731	4.240	4.779	6.269	0.789	495
Islamic	EV_ROA	-2.312	-5.726	-2.559	-2.094	-1.668	-0.578	1.100	70
	CTI	72.550	29.545	47.909	65.020	88.372	202.630	33.855	70
	LLR_GL	2.945	0.048	1.553	2.141	3.387	11.473	2.331	70
	AD	0.323	0.048	0.208	0.291	0.431	0.607	0.149	70
	DL	0.922	0.255	0.931	0.953	0.963	0.996	0.134	70
	EA	11.712	2.930	6.700	8.230	11.610	53.510	9.471	70
	GIA	50.266	-14.840	15.500	27.545	46.510	820.060	104.481	70
	Log(TA)	9.132	8.049	8.720	9.141	9.473	10.476	0.563	70
	Log(TOI)	3.911	2.158	3.459	3.920	4.465	5.161	0.677	70

Notes: This table presents descriptive statistics for variables used in the study, including mean, minimum value (Min), three quartiles with p25, p50, p75 indicating the first, second (median), and third quartiles, respectively), maximum value (Max), standard deviation (sd), and number of observations (N). Excess value of ROA (EV_ROA) is actual ROA minus adjusted ROA. Cost efficiency (CTI) is the ratio of operation cost to operation income. Asset quality (LLR_GL) is the ratio of loan loss reserve to gross loans. Asset diversity (AD) is 1-|(net loans-other earning asset)/total earning asset. Control variables include: DL (deposits/liabilities), EA (equity/assets), GIA (growth in assets), Log(TA) (Log (total assets)), Log(TOI) (Log (total operating income)).

Table 3 Effects of diversification on bank performance – full sample

Dependent variable BP_t = Independent variable	EV_ROA_t (1)	ROA_t (2)	CTI_t (3)	LLR_GL_t (4)
BP_{t-1}	0.223*	0.211*	0.525***	0.516***
	(0.116)	(0.111)	(0.082)	(0.093)
AD_t	4.020	2.445	-24.451	8.537*
	(2.466)	(2.453)	(25.352)	(4.874)
AD_t×D_type	-3.279**	-3.132**	21.210	1.473
	(1.450)	(1.494)	(19.696)	(1.890)
C_ID	0.639	0.624	-10.464*	-1.558**
	(0.467)	(0.461)	(5.879)	(0.776)
C_MY	-0.511	-0.535	-6.127	-1.236
	(0.415)	(0.420)	(6.805)	(0.768)
DL_t	-2.363*	-2.104*	-2.747	-5.134*
	(1.223)	(1.152)	(17.705)	(2.701)
EA_t	0.137***	0.140***	-0.945	-0.121**
	(0.038)	(0.039)	(0.689)	(0.051)

GIA_t	0.006	0.006	-0.030	-0.030***
	(0.005)	(0.005)	(0.057)	(0.009)
$Log(TA)_t$	3.269***	3.330***	-23.838*	-2.286*
	(0.877)	(0.899)	(13.612)	(1.192)
N	558	558	534	525
z statistic (p-value)	0.659	0.675	0.399	0.960
Hansen's J statistic (p-value)	0.994	0.997	0.986	0.998

Notes: Excess value of ROA (EV_ROA) is actual ROA minus adjusted ROA. Cost efficiency (CTI) is the ratio of operation cost to operation income. Asset quality (LLR_GL) is the ratio of loan loss reserve to gross loans. Asset diversity (AD) is 1-|(net loans-other earning asset)/total earning asset|. Control variables include: DL (deposits/liabilities), EA (equity/assets), GIA (growth in assets), LTA (Log (total assets)), LTOI (Log (total operating income)). D_TYPE is a dummy variable that returns a value of 1 if a given bank is a conventional (Islamic) bank. In all columns, year dummies are included to capture year-specific effects, but results are saved for brevity. N represents the number of bank-year observations. The numbers in the parentheses are Arellano–Bond robust standard errors. The p-values are calculated for the z statistic of the Arellano–Bond test for serial correlation at order two and for Hansen's J statistic. ***, **, and * stand for 1%, 5%, and 10% significant.

Table 4 Effects of diversification on bank performance – sample partitions by bank size

Panel A. Effects of diversification on profitability

Dependent variable BP_t =	EV_ROA_t	EV_ROA_t	EV_ROA_t	ROA_t	ROA_t	ROA_t
Independent variable	(1) Bottom 25%	(2) Middle 50%	(3) Top 25%	(4) Bottom 25%	(5) Middle 50%	(6) Top 25%
BP_{t-1}	0.385**	0.271*	0.560***	0.369**	0.270*	0.611***
	(0.168)	(0.159)	(0.147)	(0.166)	(0.151)	(0.138)
AD_t	0.832	5.071***	1.652**	0.216	3.515**	0.854
	(1.310)	(1.670)	(0.832)	(1.263)	(1.582)	(0.705)
AD_t×D_type	-1.991	-1.750**	0.871	-2.127	-1.626**	0.684
	(1.741)	(0.803)	(0.813)	(1.793)	(0.810)	(0.806)
C_ID	1.255	1.465***	0.378	1.401	1.408***	0.377*
	(0.865)	(0.462)	(0.233)	(0.880)	(0.453)	(0.223)
C_MY	1.001	0.217	0.471	1.319	0.157	0.446
	(1.367)	(0.327)	(0.376)	(1.484)	(0.333)	(0.379)
DL_t	-1.772	0.959	0.122	-1.499	1.162	0.212
	(1.505)	(1.963)	(0.768)	(1.423)	(1.969)	(0.731)
EA_t	0.052**	0.109	0.063*	0.055***	0.113	0.057
	(0.021)	(0.075)	(0.038)	(0.021)	(0.076)	(0.038)
GIA_t	0.009	-0.001	0.011**	0.009	-0.000	0.009
	(0.007)	(0.003)	(0.006)	(0.007)	(0.003)	(0.006)
$Log(TA)_t$	0.372	2.736	0.302	0.494	2.821	0.336**
	(0.881)	(1.930)	(0.191)	(0.857)	(2.006)	(0.167)
N	111	292	155	111	292	155
z statistic (p-value)	0.298	0.034	0.216	0.268	0.039	0.206
Hansen's J statistic (p-value)	1.000	1.000	1.000	1.000	1.000	1.000

Notes: Excess value of ROA (EV_ROA) is actual ROA minus adjusted ROA. Cost efficiency (CTI) is the ratio of operation cost to operation income. Asset quality (LLR_GL) is the ratio of loan loss reserve to gross loans. Asset diversity (AD) is 1-|(net loans-other earning asset)/total earning asset|. Control variables include: DL (deposits/liabilities), EA (equity/assets), GIA (growth in assets), LTA (Log (total assets)), LTOI (Log (total operating income)). D_TYPE is a dummy variable that returns a value of 1 if a given bank is a conventional (Islamic) bank. In all columns, year dummies are included to capture year-specific effects, but results are saved for brevity. N represents the number of bank-year observations. The numbers in the parentheses are Arellano–Bond robust standard errors. The p-values are calculated for the z statistic of the Arellano–Bond test for serial correlation at order two and for Hansen's J statistic. ***, **, and * stand for 1%, 5%, and 10% significant.

Panel B. Effects of diversification on cost efficiency and asset quality

Dependent variable BP_t =	CTI_t	CTI_t	CTI_t	LLR_GL_t	LLR_GL_t	LLR_GL_t
Independent variable	(1) Bottom 25%	(2) Middle 50%	(3) Top 25%	(4) Bottom 25%	(5) Middle 50%	(6) Top 25%
BP_{t-1}	0.498***	0.530***	0.804***	0.789**	0.600***	0.692***
	(0.122)	(0.056)	(0.055)	(0.346)	(0.086)	(0.103)
AD_t	8.332	-14.835	-3.691	11.567	4.137	2.160
	(20.588)	(27.143)	(5.869)	(8.894)	(3.613)	(3.132)

$AD_t \times$D_type	16.913	2.666	-5.692	-1.887	2.727	-1.341
	(28.088)	(18.641)	(6.346)	(5.006)	(1.935)	(1.587)
C_ID	-22.077**	-18.047**	-1.152	0.712	-1.745**	-2.007***
	(11.085)	(7.961)	(1.543)	(3.638)	(0.734)	(0.490)
C_MY	-0.915	-15.249**	-6.193**	-2.363	-1.096	-2.371***
	(13.670)	(6.813)	(2.633)	(4.522)	(0.989)	(0.803)
DL_t	9.143	-24.789	5.692	-7.313*	-6.466**	-0.815
	(15.732)	(37.309)	(5.845)	(3.851)	(3.220)	(1.870)
EA_t	-0.721	-0.538	-0.321**	-0.066	-0.241**	-0.029
	(0.442)	(0.936)	(0.155)	(0.053)	(0.105)	(0.052)
GIA_t	0.017	0.014	-0.030	-0.027**	-0.030**	-0.021*
	(0.096)	(0.032)	(0.034)	(0.012)	(0.015)	(0.012)
$Log(TA)_t$	-10.093	-6.808	-2.234	-0.980	-4.318	0.422
	(10.470)	(13.371)	(1.623)	(3.208)	(3.160)	(0.434)
N	105	274	155	84	286	155
z statistic (p-value)	0.198	0.581	0.348	0.383	0.720	0.097
Hansen's J statistic (p-value)	1.000	1.000	1.000	1.000	1.000	1.000

Notes: Excess value of ROA (EV_ROA) is actual ROA minus adjusted ROA. Cost efficiency (CTI) is the ratio of operation cost to operation income. Asset quality (LLR_GL) is the ratio of loan loss reserve to gross loans. Asset diversity (AD) is 1-|(net loans-other earning asset)/total earning asset|. Control variables include: DL (deposits/liabilities), EA (equity/assets), GIA (growth in assets), LTA (Log (total assets)), LTOI (Log (total operating income)). D_TYPE is a dummy variable that returns a value of 1 if a given bank is a conventional (Islamic) bank. In all columns, year dummies are included to capture year-specific effects, but results are saved for brevity. N represents the number of bank-year observations. The numbers in the parentheses are Arellano–Bond robust standard errors. The p-values are calculated for the z statistic of the Arellano–Bond test for serial correlation at order two and for Hansen's J statistic. ***, **, and * stand for 1%, 5%, and 10% significant.

Table 5 Effects of diversification on bank performance – sample partitions by bank types

Dependent variable BP_t = Independent variable	EV_ROA_t (1) Islamic	EV_ROA_t (2) Conventional	ROA_t (3) Islamic	ROA_t (4) Conventional	CTI_t (5) Islamic	CTI_t (6) Conventional	LLR_GL_t (7) Islamic	LLR_GL_t (8) Conventional
BP_{t-1}	0.461***	0.195	0.357***	0.196	0.618***	0.543***	0.608***	0.600***
	(0.091)	(0.129)	(0.073)	(0.128)	(0.059)	(0.066)	(0.085)	(0.069)
AD_t	1.697*	0.537	0.926	-1.061	-7.155	11.619	4.229	7.291**
	(1.011)	(1.427)	(0.968)	(1.429)	(11.524)	(16.604)	(2.707)	(3.477)
$AD_t \times Q1$	-1.501***	0.500	-1.277**	0.499	19.674**	46.435***	1.808	4.805
	(0.528)	(1.397)	(0.527)	(1.416)	(9.886)	(15.897)	(1.147)	(3.501)
$AD_t \times Q4$	0.739	1.638	0.780	1.751	3.628	-30.812*	-7.069***	-3.243*
	(0.934)	(1.207)	(0.881)	(1.240)	(17.882)	(16.895)	(1.414)	(1.763)
C_ID	0.223	0.723	0.461	0.677	-5.397	-5.863	-0.597	-1.915***

	(0.382)	(0.469)	(0.385)	(0.471)	(5.245)	(5.821)	(0.986)	(0.712)
C_MY	0.191	-0.006	0.299	-0.030	-8.741*	-5.510	-0.676	-2.026**
	(0.273)	(0.511)	(0.301)	(0.530)	(4.946)	(6.194)	(0.814)	(0.868)
DL_t	-2.216**	0.230	-1.963**	0.243	23.898***	-33.522	-0.580	-6.735**
	(0.988)	(1.734)	(0.906)	(1.794)	(8.348)	(26.616)	(0.877)	(3.107)
EA_t	0.023	0.126***	0.014	0.128***	0.833**	-1.312**	0.022	-0.100**
	(0.038)	(0.036)	(0.035)	(0.038)	(0.326)	(0.573)	(0.037)	(0.050)
GIA_t	-0.001	0.011*	-0.002	0.011*	-0.070*	-0.075	0.003	-0.032***
	(0.003)	(0.006)	(0.003)	(0.006)	(0.039)	(0.086)	(0.008)	(0.010)
$Log(TA)_t$	0.174	2.678***	0.173	2.685***	-1.479	-4.649	1.581***	-0.236
	(0.404)	(0.763)	(0.424)	(0.792)	(6.567)	(8.404)	(0.545)	(0.865)
N	81	477	81	477	77	457	66	459
z statistic (p-value)	0.081	0.780	0.056	0.754	0.790	0.247	0.357	0.836
Hansen's J statistic (p-value)	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Notes: Excess value of ROA (EV_ROA) is actual ROA minus adjusted ROA. Cost efficiency (CTI) is the ratio of operation cost to operation income. Asset quality (LLR_GL) is the ratio of loan loss reserve to gross loans. Asset diversity (AD) is 1-|(net loans-other earning asset)/total earning asset|. Control variables include: DL (deposits/liabilities), EA (equity/assets), GIA (growth in assets), LTA (Log (total assets)), LTOI (Log (total operating income)). D_TYPE is a dummy variable that returns a value of 1 if a given bank is a conventional (Islamic) bank. In all columns, year dummies are included to capture year-specific effects, but results are saved for brevity. N represents the number of bank-year observations. The numbers in the parentheses are Arellano–Bond robust standard errors. The p-values are calculated for the z statistic of the Arellano–Bond test for serial correlation at order two and for Hansen's J statistic. ***, **, and * stand for 1%, 5%, and 10% significant.

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Informativeness of Trades around Macroeconomic Announcements in the Foreign Exchange Market

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This paper studies the role of order flow in information dissemination around macroeconomic announcements.We find that,in the EBS trading platforms of EUR/USD and USD/JPY, a moderate fraction of information is revealed through order flows, and rates of information flow differ among sequential trading periods over a 24-hour trading day. In particular, trades taken place in the overlapping trading hours of London and New York are most informative than those in the other trading periods. The release of announcements actually does not alter the intraday pattern of trade informativenessacross different trading periods. The information content of trades even declines on days after the announcement release, which is consistent with Tetlock (2010), suggesting public announcements resolve asymmetric information.

*Keywords:*Order flow;Information content;Macroeconomic announcements; Foreign exchange markets; EBS

JEL Classification: C32; E44, F31; G14; G15

1. Introduction

Trading activities play an important role in the process of information incorporation into prices in the foreign exchange (FX) market (Lyons, 2001; Berger et al., 2008).We study whether rates of information dissemination differ among sequential trading periods over a 24-hour trading day, and whether rates of information flow differ between announcement and nonannouncement days. Examining how news is impounded into prices via order flowsaround the release of macroeconomic announcements in theFX market under asymmetric information, we use the actual trading data of EUR/USD and USD/JPY from the Electronic Broking Services (EBS). We use the approach proposed by Hasbrouck (1991) to decompose the variance of changes in the efficient price into trade-correlated and -uncorrelated components.

Recent studies provide evidenceof asymmetric information in the FX market(Lyons, 1995; Perraudin and Vitale, 1996; Payne, 2003; Menkhoff and Schmeling, 2010).Evans and Lyons (2002) report that order flows explain about 6o percentof exchange rate movement. Moreover, Evans and Lyons (2008)explore how information in macroeconomic news is incorporated into exchange rates via the channel of order flow.Love and Payne (2008)find announcement-relevant information is transmitted into exchange ratesdirectly or indirectly through order flow.

Informed traders prefer to trade in certain trading periods. Barclay and Hendershott (2003) study the effectsof trading after hours on the amount and timing of price discovery over the 24-hour tradingdayby examining the amount of private information revealed through trades in different periods, andfindthat prices are more efficient and more information is revealed per hourduring the trading day than after hours, however, individual trades containmore private information after hours than during the day. In the FX market, Wang and Yang (2011)show price discovery efficacy varies with trading regions, after dividing the 24 trading hours into four sub-markets, namely Asian, European, London and New York overlapping trading hour (London+NY) and US markets, and the London+NYmarket dominates the price discovery over the 24-hour day.

Furthermore, Jiang, Likitapiwat and Mclnish (2012) extendthe analysis of Barclay and Hendershott (2003)by examining whether earning announcementsaffect price discovery across different trading periods, and find that more information is revealed through order flow in the trading period with releases of earning news made in the period.

Previous studies have shown that new information istransmitted into prices before announcements. Huberman and Schwert (1985) find that 85% of the announcementsareanticipated by all traders and impounded into asset prices before the announcement date. Alternatively, Bhattacharya et al. (2000) indicatethat informed traders react to news before its release. However, Meulbreok (1992) shows that about half of price changes before announcements occurs due to informed trading, and the other half comes from public anticipation about the forthcoming news.

Exchange rate volatility rises after news releases since asset prices will not completely respond to macro announcements in the short run(Ederington and Lee, 1993; Bauwens, Omrane and Giot, 2005; Rime, Sarno, and Soji, 2010, among others), and the increased volatility may relate to investors' heterogeneity in news interpretation skills. Lyons (1995) and Evans and Lyons (2002) also suggest that customers'order flows provide dealers more information about fundamental value of the exchange rate, and this information advantage is particularly pronounced during the period of public information releases.

Priorresearch indicates that there exists abnormal trading volume and higher spread around news announcements (e.g., Libby, Mathieu, and Robb, 2002; Pronk, 2006; Graham, Koski, Loewenstein, 2006). Jiang et al. (2012) find that trading volume is positively correlated with the efficacy of price discovery, and infer that abnormal trading volume can come from informed traders who possess private information, whereas a negative relation between price discovery efficacy and spread may result from market friction.

Following Barclay and Hendershott (2003), weusethe approach of Hasbrouck (1991)to study the informativeness of trades in the FX market by distinguishing the variance of changes in exchange rate into trade-related and -unrelated components. Examining the content of private information contained in order flow across four sequent trading periods, including Asian, European, London+NYand UStrading periods, we findthat order flows significantly contain price-relevant information in the FX market. We compare the fractions of the fraction of variance attributed to order flows across four trading periods, and discover that trades in London+NYperiod are most informative than those inother periods.

Considering the release of macroeconomic announcements in the U.S., Japan, and Europe area, we studywhether information dissemination process differs on days with and without announcements. The results show that role of order flow in conveying informationremains the same between days with and without announcements.

Our results indicate that the informationcontent of order flows decreasesin Asian, European and U.S. trading periods before certain forthcoming announcements.Huberman and Schwert (1985) and Meulbreok (1992) point out thattraders would have anticipated the forthcoming news, and the forecasting of announcements will reduce the dispersion in opinionsabout the future exchange rate.However, we find that the informativeness of order flow improves in the overlapping trading period of London+NYC before the release of announcement.

Foster and Viswanathan (1996) suggest that heterogeneously informed traders may wait to preserve their informational advantage as long as possible rather than trade immediately after news announcements.We furtherexamine whether trade informativenesschanges after the announcement, and find that trades contain less information on days after the announcement. The results imply that public announcements resolve asymmetric information among tradersright after the release of announcement, which is consistent with Tetlock (2010).

Overall, we demonstratethat order flow plays an important role in the flow ofinformation on days with and without announcements.We further identify that trades in the London+NYperiod are most informative than those in Asian, European and U.S. periods. The informativeness of trades is also associated with trading volume and effective spread significantly.

The remainder of the paper is organized as follows. Section 2 introduces the structure of the FX market, the EBS trading data, and lists macroeconomic announcements released in the U.S., Europe and Japan we consider in the analysis. Section 3demonstrates the vector autocorrelation model used in Hasbrouck (1991) for the measurement of trade informativeness. Section 4 discussesthe empirical results. Section 5 concludes.

2. Data

2.1 FX trading data

FX trading starts in Asia, then moves on to Europe and New York, and ends in the United States over a 24-hour day. BIS (2013) addresses that FX markets are the most liquid financial markets, as the daily average turnover of the global FX marketsachieved $5.3 trillion in April 2013, and the spot transactions increases from $1.5 trillion in April 2010 to $2 trillion in April 2013.

The two primary global electronic broking systems for FX trading are EBS and Reuters D2000-2 (or D3000). Ito and Hashimoto (2006)alsoreveal that the market share (in absolute value) for trading of EUR/USD and USD/JPY in the EBS is the largestamong all electronic trading systems, which may be attributed to the acquisition of Minex, which was developed by the Tokyo Bank in 1995 and provided a significant market share in Asia.

We use the trading data of EUR/USD and USD/JPY provided by the EBS, covering the period of January 1, 2008 through December 31, 2012 for EUR/USD and the period from January 1, 2009 through December 31, 2012 for USD/JPY, due to the limitation of macroeconomic announcement data. For each trade, the EBS screen provides the best quoted prices for trades larger than 10 million, which contains the following detailed information: (1) date and time; (2) quote or deal indication; (3) bid/ask quotes price or executed price; (4) trading volume, and (5) the trading direction (buy or sell). Although the fast execution speed and disclosure in the EBS system lead to higher transparency, the information shown on EBS screens only includes the best bid and ask quotes, and the deal prices done on the bid side, or on the ask side.

To study the intraday pattern of trade informativeness, we separate 24 trading hours into four trading periods, following Wang and Yang (2011). The four sequential trading periods includeAsian trading, European trading,the overlapping trading hours in London and New York, and U.S. trading periods. We consider the Daylight Saving Time (DST) shift in the Europe and the U.S.when we deal with the intraday data. Table 1 reports the GMT hours and corresponding local time of three major markets in three panels which are split into the Normal Time (winter), DST (summer), and the period when New York is under the Summer Time, but London is not.[1]

Table 1 summarizes the Greenwich Mean Time (GMT) and corresponding local time of three major financial markets in the FX trading: Japan, London and New York.Panels A, B and C of Table 1 display the local time of three major markets in winter, summer and the period when New York is under the Summer Time, respectively.

The first trading period(in winter time)is the Asian trading period from 23 GMT to the end of 6 GMT the next day. The second period is the European trading period between 7

[1]Daylight Saving Time in 2008 is from March 9 to November 2 in the United States (US); from March 30 to October 26 in the United Kingdom (UK); in 2009, from March 8 to November 1 in the US; from March 29 to October 25 in the UK; in 2010, from March 14 to November 7 in the US; from March 28 to October 31 in the United Kingdom; in 2011, from March 13 to November 6 in the United States; from March 27 to October 30 in the UK; in 2012, from March 11 to November 4 in the US; from March 25 to October 28 in the UK.

GMT and 13 GMT. The third period is the overlapping hours of London afternoon session and New York morning session, covering the period between 13 GMT and 14 GMT, and is labelled as London+NY. The last trading period is the UStrading period that runs from 15 GMT to 22 GMT, as shown in Table 1.

Panels B and C of Table 1, respectively, summarize the hours for each trading period in summer time. We exclude all trading data on weekends and holidays from our sample, and delete observations with a larger bid quote price than the corresponding ask quote price, as suggested by Ito and Hashimoto (2006).

Tables 3 and 4 report summary statisticsof the trading activities of EUR/USD and USD/JPY market, respectively, for the four trading periods: Asian, European, London+NY and U.S. periods. We report per-hour trade numbers and per-hour trading dollar volume for each trading period.[2] Effective spread is calculatedby $2\left|\log(p_{it}/q_{it})\right|$, where $p_{it}$and q_{it}denote trading price and the mid-quote price at the end of period $i$on day$t$.

Wefind that numbers of trades, trading dollar volume and effective spread differ between days with and without announcements. Tables 3 and 4 display that numbersof trades and trading dollar volumein European and London+NYperiods are higher on announcement days in the EUR/USD market.Similarly, in the USD/JPY market, the number of trades and trading volume increase on U.S. announcement days for the four trading periods, suggesting that investors react to the arrival of information at the release of announcement.

As forthe trading cost,we find thateffective spreadsincrease in European and Asian, European, and London+NYperiods in both EUR/USD and USD/JPY markets on announcement days. Consistent with Libby, Mathieu and Robb (2002), we show that spreads are relatively wider as announcements are released.

[2] Since the trading hours of the four markets are different from each other. A market may have a larger number of trade and trading volume simply because of its long trading hours. We thus compare per-hour number of trade and trading volume.

2.2 Data of macroeconomic announcements

The macroeconomic announcement data used in the paper comesfrom the Econoday. Thedata archive of Econoday provides the median of professional forecasts for the macroeconomic indicator to be announced. The consensus forecasts are the medians of surveymade on Friday in the week prior to the announcement release day.

Table 2 lists the announcements we consider in the analysis. There are 32 US macroeconomic announcements, 15 Japanese macroeconomic announcements(during the 2008-2012 period), and 28 European macroeconomic announcements (during the 2009-2012 period). Most of U.S.announcements areannounced at 8:30 EST, most of Japanese announcements are announced at 8:50 JST, but the release time of European announcements varies over time.

3. Empirical Models

3.1Vector autoregressivemodel

Following Hasbrouck (1991, 1996) and Payne (2003), we measure the informativeness of trades by estimating a vector autoregressive model (VAR) of quote-midpoint revision and signed order flow. We denote $z_t = [r_{it} o_{it}]$, where r_{it} is calculated by $\log(qm_{i,t}) - \log(qm_{i,t\text{-}1})$, where $qm_{i,t}$is the midpoint of ask and bid quotes at time t, in trading period i, and$o_{i,t}$is defined as a 3×1 vector of the trade variablesat time$t$, which includes (i) a trade sign indicator (+1 for a buy order, and -1 for a sell order), (ii) signed trading volume, and (iii) the signed squareof trading volume. The VAR we estimate for four markets is as follows:

$$z_t = A_1 z_{t\text{-}1} + A_2 z_{t\text{-}2} + \ldots + A_k z_{t\text{-}k} + \nu_t, \quad (1)$$

whereA_j (j = 1, …, k) are coefficient matrices, k is the maximum lag length, and $\nu_t$is a vector of serially uncorrelated disturbances with the covariance matrix Ω.

Based on Hasbrouck (1991), we identify the trade informativeness under the assumption that the public information set includes the trade and quote history. We can calculate impulse responses recursively from Eq. (4) as follows.

$$E[z_t|v_t] = v_t, \tag{2}$$

$$E[z_{t+1}|v_t] = A_1 v_t = \Phi_1 v_t, \text{ and} \tag{3}$$

$$E[z_{t+2}|v_t] = (A_1^2 + A_1)\, v_t = \Phi_2\, v_t, \tag{4}$$

where Φ_i is the impulse coefficient matrix. We can also calculate the accumulated impulse responses Ψ_i by:

$$E[z_t|v_t] = v_t. \tag{5}$$

$$E[z_t + z_{t+1}|v_t] = (I + \Phi_1)\, v_t = \Psi_1. \tag{6}$$

$$E[z_t + z_{t+1} + z_{t+2}|v_t] = (I + \Phi_1 + \Phi_2)\, v_t = \Psi_2. \tag{7}$$

$$E[z_t + z_{t+1} + \ldots|v_t] = \Psi_{\infty,z} v_t. \tag{8}$$

The accumulated impulse response function measures the long-run impact of an innovation on the cumulative (quote-midpoint) return, and it can be used to measure the information content of the innovation. As noted in Hasbrouck (1996), although microstructure effects may motive transient effects on the cumulative return, any persistent long-term impact will reflect new information about fundamental value of a asset.

We also follow Hasbrouck (1991) to compute an alternative summary measure of the information contained in the order flow. As noted earlier, the left-hand side of Eq. (11) represents the impact of the innovation on the price net of any transient microstructure effects. The variance of this term approximately adds up to the return variance per unit time, provided that the return calculated over an interval long enough that transient price effects can be ignored. To measure the variance of this term, we can use the variance of the random walk component implicit in the price. Indicate this random walk component as w_t, and we can represent its variance as follows:

$$\sigma_w^2 = Var(w_t) = Var(E[r_t + r_{t+1} + \cdots | v_t]) = \Psi_{\infty,r}\, \Omega\, (\Psi_{\infty,r})' \tag{9}$$

With a diagonal Ω, we can decompose the variance of the random walk as:

$$\sigma_w^2 = \sigma_{w,r}^2 + \sigma_{w,o}^2, \tag{10}$$

The two variances on the right-hand side of Eq. (13) denote an incremental contribution to the variance of random walk component, relative to $r_t$and o_t. That is, that $\sigma^2_{w,r}$ is the incremental contribution from quote revision innovations, and $\sigma^2_{w,o}$ is the component of the variance explained by order flow. To measure the trade informativenessfrom the VAR model, we follow Hasbrouck (1996) and Payne (2003) to calculate the following variance component:

$$IS = \sigma^2_{w,o} \Big/ (\sigma^2_{w,r} + \sigma^2_{w,o}), \tag{11}$$

where*IS*reflects the trade informativeness or information content of trades, σ^2_{w,o_p} is the proxy to gauge the effect of private information, and $\sigma^2_{w,r} + \sigma^2_{w,o}$ refers to the variation of caused by the total information.

Overall, the VAR approach allows us to measure the dynamic relations among returns and order flows across the four markets. The variance decomposition offers a measure of the contribution of quote and order innovations to the total price innovation. Therefore, we can use the VAR approach to find the proportion of private information to total information, and use the ratio to measure the contribution to price discovery of each trading segment or market.

3.2 Regression analysis

To examine how the price discovery ability from trade-relative information shockin different periods changes on days with macroeconomic announcements, we use the linear regression model to examine the relationships between information contents, which is estimated by VAR.In this study, we usedummy variables to measure news effects, which equal 1 when the U.S.,European or Japanesemacroeconomic announcement are made on the day, and nonannouncement days refer to days without any U.S., Europeanor Japanese macroeconomic announcement.

Further, we add effective spread and trading volume into our model to make sure the results are robust which is as follows.

$$IS_{i,t} = \sum_{j=1}^{4} \beta_j MKT_{j,i,t} + \sum_{j=1}^{4} \sum_{m=-\kappa}^{\kappa} \lambda_{m,j} \times MKT_{j,i,t} \times USNEWS_{t+m} + \sum_{j=1}^{4} \sum_{m=-\kappa}^{\kappa} \gamma_{m,j} \times MKT_{j,i,t} \times EUNEWS_{t+m} + \tag{12}$$

$$\sum_{j=1}^{4} \sum_{m=-\kappa}^{\kappa} \sigma_{m,j} \times MKT_{j,i,t} \times BOTHEWS_{t+m} + \theta \times Volume_{i,t} + \delta \times SPREAD_{i,t} + \varepsilon_{i,t}$$

where $IS(VAR)_{i,t}$ is the information share from order flow of period$i$ on day t. $MKT_{j,i,,t}$ is a dummy variable for the j-th market, where j =1, 2, 3, 4, indicating Asian, Europe, London-New York and the U.S. markets, respectively. $MKT_{j,i,t}$ equals 1 for the j-th market, and 0 otherwise. $USNEWS_{t+m}$ is a dummy variable which equals 1 if only US announcements are released on day $t+m$, where m =-2, -1, 1, 2, indicating one day before, two days before, one day after, two days after the announcements day, respectively; $EUNEWS_t$ equals 1 if only European (Japanese) announcements are released on day t. $BOTHNEWS_t$equals 1 if U.S. announcements and European (Japanese) announcements are released on day t. We also consider the effect of announcements on the days before and after announcement by including the dummy variables for one to five days prior to the announcement day andone to five days after the announcement day into the regression model.H_Volume_{it}refers to per-hour trading volume of period i on day$t$; and, RE_Spread_{it}denotes the relative effective spread of the corresponding market on day t which equals to2× $|\log(p_{it}/q_{it})|$, where $p_{it}$is the trading price and $q_{it}$is the quote price at the close of period$i$ on day$t$.

4. Empirical Results

We calculate the ratios of private information to total information to investigate the role of order flow in information content related to private information shocks, and further compare the price discovery efficacyamong Asian, European, London+NY and U.S.trading periods on days with and without macroeconomic announcements. Furthermore, we examine whether information is incorporated into exchange rate before the release of macro announcements by informed trading. Moreover, to learn how news isrevealed into prices after announcements, we study whether information is still transmitted by trade-related channel after the announcement is known to all traders. Finally, as a robustness check, we add volume and effective spread into our analysis to examine the effect of news on price discoveryefficacy.

4.1 Informativeness of trades in different trading periods

Tables 5 and 6 report the trade informativenessover Asian, European, London+NY and U.S.periods for EUR/USD and USD/JPY, respectively. Panel A of Table 5 presentsthat the informationcontent of order flow forthe four trading periodsbased on the entire sample. We find that the ratio of private information to total informationcontained in order flows is 30% averagelyover the four trading periods, and the fraction of private information contained in order flow in the period of London+NYis significantly higher than those of other trading periods. Thus, Wang and Yang's (2011) finding that trading in London+NYsegment dominates price discovery in FX marketmay be attributed to the possibility that more informed trades occur during that period.

We observe thatannouncementssignificantly relate to the price discovery over the four periods in the EUR/USD market, as shown in Panels B, C, D, E of Table 5. Evans and Lyons (2008)demonstrate that there is still about 30% or more of information which is indirectly incorporated into exchange ratesthrough order flows on days with U.S. or European macroeconomic announcements. Hence, we conclude that order flow is an important channel of information incorporation. Moreover, our results show thatorder flow in the trading period ofLondon+NYcontains morefraction of private informationthan the trading periods of Asian, European and U.S. segments on days with and without announcements.

Table 6 showsthat ratios of private information to total information contained in order flow over the four trading periods on days with or without announcement in the USD/JPY market. Similarly, we find a high portion of information is transmitted into exchange rate throughorder flow, according to the estimation results of the entire sample. We find that about 30%to 40% of private information contained in order flow on days with public announcementreleases.

Table 6 also displaysthe information content oftradesin the period of London+NYis highest among the four trading periods on days with or without announcements. Moreover, we find a higher fraction of information content of order flowin the Asian trading period than in the European and U.S.periods on days with U.S. announcements only. This means that more informed traders enter the market to exploit information advantage during Asian period on days with U.S. announcements.

4.2 Trade informativenessaround the release day of macroeconomic announcement

Huberman and Schwert (1985) find that 85% of the announcementsisanticipated by all traders and impounded into asset prices before the announcement date.Moreover, Tetlock (2010) further deomonstratesthat public news will make traders have the same opinion about the asset valueafter information is known to all traders. If the prediction of Huberman and Schwert (1985)andTetlock (2010)holds in the EBS trading system, we expect that trade informativeness which is attributed to informed trading will decrease around announcements, if news releases will eliminate belief heterogeneity among dealers.

This paper uses regression analysis to analyze how trade informativeness differ on days around the release of announcement, in that we can investigate whether news announcements will resolve asymmetric information, and new information may be directly impounded into exchange rates instead of through order flows submitted by informed traders. The changes in trader-related information content across four trading periods for EUR/USD are shown in Table 7. In Asian period, Table 7 indicates that information content in order flowsdecreaseson three days beforeU.S. announcement only and both of U.S. and European announcements. Therefore, consistent with Huberman and Schwert (1985) and Meulbreok (1992), traders in Asian period will anticipate the releases of the U.S. announcement only and both of U.S. and European announcements, and the degree ofinformation asymmetry declines on days before the announcement release.

Also, Table 7 points out that information shares from trades decrease on four days after U.S. announcement only and both of U.S. and European announcements in Asian, which supports the suggestion of Tetlock (2010), public news resolves the information asymmetry of the market. However, we further find that the information content of order flows increases on two and three days before European announcement only. Meulbreok (1992) and Bhattacharya et al. (2000) indicate that part of information is revealed into price through informed traders before news is released. Hence, the increases in information content of order flow would imply that there is a higher ratio of information incorporated into prices through informed traders on days before the day with European announcement only.

We do not find informativeness of trades significantly decreases on days before news release during the European tradeingperiod. But, Table 7 also presents that the information contentof trades significantly decreasesone day and three, four and five days afterthe day with the U.S. announcementsonly and the day with both the U.S. and European announcements.

There is no any significantly decrease in informationcontent of order flow around days with news releases in London+NYC period. We even find that information content increases on three days before the day withboth U.S. and European announcements.Consistent with the finding for Asian and London+NYC periods, we find that trade informativeness increases on days with announcements, and the informativeness of trades in the U.S. period also increases four days before European announcements only. We also consider effective spread and trading volume in the regression model. Table 7 shows that less information is revealedthrough order flow when the spread is wider. Trade informativeness is positively related to trading volume.

Table 8 reports the estimation results for the USD/JPY market. Trade informativenessis reduced three days before the day with both U.S. and Japanese announcements. Similarly, trades carries less information on days after the announcement day. For the European trading period, trade informativenessdecreases three days before and four daysbeforethe day with both Japanese and U.S. announcements. For the U.S. trading period, Table 8 indicates that trade informativenessdecreases on days before and after the announcement. We find that the fraction of information carried by trade is relatively smaller five days before the day with the U.S.announcements only. Moreover, trade informativenessdecreases three days after the U.S announcement.

Overall, the results of Tables 7 and 8 are consistent with Huberman and Schwert (1985) and Tetlock (2010), showing the release of announcement resolvesasymmetric information as the informativeness of trades declines after the announcement day. We further find the informativeness of trade decreases on days before the announcement in Europe only, on days before the announcement in Japan only, and on days before the day with both U.S. and European (Japanese) announcements, consistent with Meulbreok (1992) and Bhattacharya et al. (2000).

5. Conclusions

We study the impact of trade-related information shocks around days with and without macroeconomic announcements, and address howprice-relevant information is revealed through the channel of order flowin the FX market.Our result is consistent with Evans and Lyons (2002) and Evans and Lyons (2008),showing a high portion of private information is transmitted into asset prices via order flows, even on days of announcement releases.

Examining the difference of informativeness of order flow across sequential trading periods: Asian, European, the overlapping trading period of London and New York (London+NY), and U.S. trading periods, we identify the intraday pattern of informativeness of order flow. Comparing therelative amount of public and private informationcontent in order flow for each trading period, we find that order flow in overlapping trading hours of London and New York is more informative than those in the other three trading periods.

Furthermore, we further study the change of information content before and after the announcement. Examining news effects before and after the announcement day, wefind thatinformativeness of order flow is reduced on days afterthe announcement. However, a higher ratio of private information is revealed through order flowbefore the announcement day.

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Table 1

Definition of Four Sequential Markets

This table provides the division of trading hours for the 4 sequential markets. The bold letters denote local trading hours in local time.

GMT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Panel A. Normal (Winter)																								
Asian Trading Period (Tokyo local time)	**9**	**10**	**11**	**12**	**13**	**14**	**15**	16	17	18	19	20	21	22	23	0	1	2	3	4	5	6	7	**8**
Europe Trading Period (London local time)	0	1	2	3	4	5	6	7	**8**	**9**	**10**	**11**	**12**	**13**	14	15	16	17	18	19	20	21	22	23
Europe-US Overlapping Trading Period (London local time)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	**14**	**15**	16	17	18	19	20	21	22	23
US Trading Period (New York local time)	-19	-20	-21	-22	-23	0	1	2	3	4	5	6	7	8	9	10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	18
Panel B. Daylight Saving Time (Summer)																								
Asian Trading Period (Tokyo local time)	**9**	**10**	**11**	**12**	**13**	**14**	**15**	16	17	18	19	20	21	22	23	0	1	2	3	4	5	6	7	**8**
Europe Trading Period (London local time)	1	2	3	4	5	6	7	**8**	**9**	**10**	**11**	**12**	**13**	14	15	16	17	18	19	20	21	22	23	0
Europe-US Overlapping Trading Period (London local time)	1	2	3	4	5	6	7	8	9	10	11	12	13	**14**	**15**	16	17	18	19	20	21	22	23	0
US Trading Period (New York local time)	-20	-21	-22	-23	0	1	2	3	4	5	6	7	8	9	10	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	19
Panel C. Daylight Saving Time in New York Only																								
Asian Trading Period (Tokyo local time)	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	17	18	19	20	21	22	23	0	1	2	3	4	5	6	7	**8**
Europe Trading Period (London local time)	0	1	2	3	4	5	6	7	**8**	**9**	**10**	**11**	**12**	13	14	15	16	17	18	19	20	21	22	23
Europe-US Overlapping Trading Period (London local time)	0	1	2	3	4	5	6	7	8	9	10	11	12	**13**	**14**	**15**	16	17	18	19	20	21	22	23
US Trading Period (New York local time)	-20	-21	-22	-23	0	1	2	3	4	5	6	7	8	9	10	11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	19

Table 2
Macroeconomic Announcements (January 2008–December 2012)

Announcement	Announcement time	Reporting agency	Number of observations
	US announcements		
Current Account Balance	8:30 EST	BEA	20
Durable Goods Orders	8:30 EST	BC	56
Existing Home Sales	10:00 EST	BC	52
Factory Orders	10:00 EST	BC	53
FOMC Rate Decision	14:15 EST	FRB	30
GDP Price Index	8:30 EST	BEA	57
House Price Index	10:00 EST	BC	51
Housing Starts	8:30 EST	BC	59
Import Price Index	8:30 EST	BEA	60
Industrial Production	9:15 EST	FRB	59
Initial Jobless Claims	8:30 EST	ETA	248
Leading Index	8:30 EST	CB	55
Monthly Budget Statement	14:00 EST	DT	46
New Home Sales	10:00 EST	BC	55
PCE Cor	8:30 EST	BEA	51
PCE Deflator	8:30 EST	BEA	51
Personal Consumption	8:30 EST	BEA	57
Personal Income	8:30 EST	BEA	51
Personal Spending	8:30 EST	BEA	51
PPI	8:30 EST	BLS	61
Retail Sales Advance	8:30 EST	BC	60
Business Inventories	10:00 EST	BC	60
Trade Balance	8:30 EST	BEA	57
Unemployment Rate	8:30 EST	ETA	58
Capacity Utilization	9:15 EST	FRB	59
Manufacture Payrolls	8:30 EST	BLS	58
Nonfarm Payrolls	8:30 EST	BLS	58
Chicago Purchasing Manager	9:45 EST	NAPMCI	57
Construction Spending	10:00 EST	BC	52
CCI	10:00 EST	CB	57
Consumer Credit	15:00 EST	FRB	37
Continuing Claims	8:30 EST	DL	248

Table 2 (Continued)

Announcement	Announcement time	Reporting agency	Number of observations
	European announcements		
Business Climate Indicator	Varies	EC	122
Construction Output	Varies	Eurostat	84
Consumer Confidence	Varies	EC	106
CPI Core	Varies	Eurostat	68
Current Account NSA	Varies	ECB	60
ECB Current Account SA	Varies	ECB	60
Economic Confidence	Varies	EC	60
Employment	Varies	Eurostat	30
EU27 New Car Registrations	Varies	ECB	56
GDP SA	Varies	Eurostat	30
Govt Debt/GDP Ratio	Varies	Eurostat	10
Govt Expend	Varies	Eurostat	30
Gross Fix Cap	Varies	Eurostat	30
Household Cons	Varies	Eurostat	30
Industrial Confidence	Varies	EC	60
Industrial Production SA	Varies	Eurostat	60
M3 Money Supply	Varies	ECB	60
PMI Composite-A	Varies	ME	60
PMI Manufacturing-A	Varies	ME	60
PMI Services-A	Varies	ME	60
PMI Services-F	Varies	ME	60
PPI	Varies	Eurostat	60
Retail Sales	Varies	Eurostat	60
Sentix Investor Confidence	Varies	SG	60
Services Confidence	Varies	EC	60
Trade Balance NSA	Varies	Eurostat	60
Unemployment Rate	Varies	Eurostat	60
ZEW Survey Expectations	Varies	ZEW	60

Table 2 (Continued)

Japanese announcements			
Announcement	**Announcement time**	**Reporting agency**	**Number of observations**
Coincident Index	14:00 JST	CO	66
Domestic CGPI	8:50 JST	MIC	58
GDP	8:50 JST	CO	37
Housing Starts	14:00 JST	BOJ	53
Industrial Production	8:50 JST	METI	55
Jobless Rate	8:30 JST	MIC	57
Large Retailers' Sales	8:50 JST	CO	54
Leading Index CI	14:00 JST	MOF	58
Machine Orders	8:50 JST	ESRI	59
Money Stock M2	8:50 JST	BOJ	54
Trade Balance	8:50 JST	MOF	58
Tokyo CPI	8:30 JST	MIC	56
Tankan Large Mfg Index	8:50 JST	BOJ	20
Tankan Large Non-Mfg Index	8:50 JST	BOJ	20
Retail Sales	8:50 JST	METI	56

Note:

Bureau of Labor Statistics (BLS), Bureau of Census (BC), Bureau of Economic Analysis (BEA), Conference Board (CB), Employment and Training Administration(ETA), Federal Reserve Board (FRB), Department of the Treasury(DT), National Association of Purchasing Management, Chicago Affiliate (NAPMCI), the Department of Labor (DL), European Comission(EC), European Central Bank (ECB), Markit Economics (ME), Sentix GmbH (SG), ZentrumfürEuropäischeWirtschaftsforschung (ZEW), Cabinet Office (CO), Bank of Japan Research and Statistics Department(BOJ), Ministry of Finance(MOF), Economic and Social Research Institute (ESRI). EST denotes the Eastern Standard Time (EST) inthe United States and Canada, andthis time zone is 5 hours behind the time zone of Coordinated Universal Time (UTC). Japan Standard Time (JST) is the standard time zone in Japan, and is 9 hours ahead of UTC, i.e. it is UTC+09:00.

Table 3 Summary Statistic of Trading in the EUR/USD Market

This table presents summary statistics for the EUR/USD tradingduringthe period from January 2008 to December 2012. We separate 24 trading hours into four periods in the winter time as following: GMT 23:00-07:00 (Asian), GMT 8:00-14:00 (Europe), 14:00-16:00 (London+NY), and 16:00-23:00 (U.S.). We adjust the ranges of trading hours in response to the Daylight Saving Time (DST) shift in the Europe and U.S. regions in summer.The sample periods include the entire sample (All), days only including US macroeconomic announcements (US-A), days only including Europeanmacroeconomicannouncements (EU-A), days including both of US and Europeanmacroeconomicannouncement and days without any macroeconomicannouncements (NO-A). Per-hourtrade size is the total number of tradesof a specific period divided by the number of hoursinthat period. Effective Spread equalsto 2× | log(p_{it}/q_{it})|, where$p_{it}$and q_{it}denotethe trading price and quote price at the close time of market *i*on day*t*.

	Asian					Europe					London+NYC					U.S.				
	All	US-A	EU-A	Both	NO-A	All	US-A	EU-A	Both	NO-A	All	US-A	EU-A	Both	NO-A	All	US-A	EU-A	Both	NO-A
A. Per-Hour Trade Size																				
Mean	302	296	304	303	309	795	792	791	806	768	1043	1048	1016	1064	998	375	372	361	385	371
Stdev	89	92	96	83	93	147	156	150	134	159	178	187	179	163	193	106	115	92	98	119
Skewness	0.40	0.43	0.49	0.31	0.39	-0.05	0.01	0.03	0.09	-0.33	-0.32	-0.50	-0.24	0.01	-0.40	0.48	0.52	0.31	0.42	0.68
Kurtosis	3.06	3.29	3.07	2.66	3.01	3.20	3.02	2.56	2.67	4.44	3.74	3.52	3.08	4.01	3.69	3.51	3.63	2.99	3.35	3.22
B. Per-HourTrading Volume (US million dollar)																				
Mean	539	525	543	542	560	1770	1755	1785	1788	1736	2528	2532	2497	2558	2458	794	799	799	811	799
Stdev	179	183	190	165	196	466	486	476	440	484	739	775	705	714	772	271	271	253	257	304
Skewness	0.56	0.57	0.83	0.39	0.56	0.31	0.38	0.45	0.35	-0.07	0.34	0.47	0.22	0.34	0.17	0.67	0.67	0.66	0.71	0.74
Kurtosis	3.41	3.40	4.41	2.77	3.07	2.73	2.49	2.78	2.73	3.07	2.73	3.09	2.30	2.45	2.60	3.93	4.04	3.90	4.18	3.70
C. Effective Spread (×10000)																				
Mean	0.34	0.35	0.34	0.31	0.35	0.36	0.40	0.37	0.34	0.30	0.41	0.38	0.39	0.43	0.48	1.28	1.17	0.75	1.54	1.40
Stdev	0.32	0.37	0.29	0.29	0.35	0.43	0.56	0.44	0.34	0.29	0.46	0.38	0.34	0.49	0.68	3.55	2.19	1.48	4.63	4.01
Skewness	2.99	4.43	1.63	1.51	1.51	4.35	4.44	3.67	2.69	2.05	5.27	3.61	2.65	3.90	6.81	9.61	4.79	7.54	8.78	6.49
Kurtosis	25.0	39.1	6.9	6.0	5.1	35.1	31.1	24.9	13.5	8.8	49.5	22.0	12.6	22.4	60.7	125.4	33.8	73.0	95.4	48.2

Table 4 Summary Statistic for Trading in the USD/JPY Market

This table presents summary statistics for the USD/JPYtradingduringthe period from January 2008 to December 2012. We separate 24 trading hours into four periods in the winter time as following: GMT 23:00-07:00 (Asian), GMT 8:00-14:00 (Europe), 14:00-16:00 (London+NY), and 16:00-23:00 (U.S.). We adjust the ranges of trading hours in response to the Daylight Saving Time (DST) shift in the Europe and U.S. regions in summer.The sample periods include the entire sample (All), days only including US macroeconomic announcements (US-A), days only including Europeanmacroeconomic announcements (EU-A), days including both of US and Europeanmacroeconomic announcement and days without any macroeconomic announcements (NO-A). Per-hour trade size is the total number of tradesof a specific period divided by the number of hoursinthat period. Effective Spread equals to 2× $|\log(p_{it}/q_{it})|$, where$p_{it}$and q_{it}denote the trading price and quote price at the close time of market i on day$t$.

	Asian					Europe					London+NYC					U.S.				
	All	**US-A**	**JP-A**	**Both**	**NO-A**	**All**	**US-A**	**JP-A**	**Both**	**NO-A**	**All**	**US-A**	**JP-A**	**Both**	**NO-A**	**All**	**US-A**	**JP-A**	**Both**	**NO-A**
A. Per-Hour Trade Size																				
Mean	301	296	291	308	292	397	395	372	410	386	576	588	512	596	557	212	217	196	216	209
Stdev	106	99	100	113	99	158	156	156	160	152	248	262	250	239	244	119	121	113	119	124
Skewness	1.42	1.13	1.14	1.60	1.00	1.15	1.20	1.12	1.18	1.04	0.88	0.80	1.12	0.85	1.06	1.66	1.65	1.40	1.67	1.92
Kurtosis	7.45	5.17	5.22	8.46	5.25	4.84	5.22	4.17	5.02	4.08	3.35	2.94	3.83	3.36	4.22	6.11	6.21	4.52	6.10	7.30
B. Per-Hour Trading Volume (US million dollar)																				
Mean	539	526	519	557	518	700	696	652	724	677	1081	1096	961	1123	1044	362	376	333	369	352
Stdev	233	204	188	267	182	250	255	236	256	222	421	437	418	416	379	170	198	164	162	148
Skewness	5.83	3.28	1.49	6.92	0.62	1.21	1.48	0.64	1.30	0.68	0.78	0.68	1.04	0.85	0.38	1.88	3.08	1.73	1.05	0.72
Kurtosis	82.0	28.65	8.06	90.2	2.98	8.30	10.5	3.90	8.82	3.31	4.39	3.64	5.30	4.90	2.47	12.5	21.4	8.17	4.87	3.33
C. Effective Spread(×10000)																				
Mean	0.45	0.47	0.45	0.45	0.42	0.46	0.48	0.42	0.47	0.43	0.52	0.48	0.58	0.52	0.48	2.81	2.91	2.53	2.79	3.13
Stdev	0.46	0.50	0.38	0.50	0.34	0.48	0.53	0.43	0.46	0.33	0.53	0.37	0.70	0.57	0.30	7.87	7.83	7.26	7.00	8.13
Skewness	4.44	4.29	1.42	5.05	1.34	4.85	5.06	1.76	1.83	1.09	7.76	3.70	5.58	8.70	1.71	6.09	6.27	5.43	4.81	4.35
Kurtosis	45.1	34.35	5.99	53.0	5.79	61.0	59.6	8.63	8,75	4.88	104	27.6	39.8	127	7.59	52.2	57.0	38.8	29.7	23.9

Table 5

Ratios of Private Information to Total Information: EUR/USD

This table presents the daily average of ratios of private information to total information, bases on the variance decomposition of a VAR model for one-minutereturns and order flow. The return and order flow are the difference in the logarithm of mid-quotes and the difference between buy and sell orderflow over a 1-minute interval, respectively. We calculate three Wald test statisticsto test the null hypothesis of no difference in the ratios of "Asian" and "Europe" periods (Wald test (1)), the null of no difference in the ratios of "Europe" and "London+NYC" periods (Wald test (2)), and the null of no difference in the ratios of "London+NYC" and "US" periods (Wald test (3)). ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Asian	Europe	London+NYC	U.S.
A. All data				
Mean	33.21%	30.72%	35.89%	29.22%
t-value	66.91***	61.90***	72.31***	58.88***
Wald test (1)		3.54***	-3.82***	5.68***
Wald test (2)			-7.36***	2.13**
Wald test (3)				9.49***
B. Nonannouncement days				
Mean	33.48%	31.25%	36.18%	28.51%
t-value	27.42***	25.83***	18.38***	22.70***
Wald test (1)		1.30	-1.16	2.84***
Wald test (2)			-2.13**	1.57
Wald test (3)				3.28***
C. Days with US announcements only				
Mean	32.43%	31.49%	35.17%	29.82%
t-value	43.37***	42.14***	31.56***	35.82***
Wald test (1)		0.89	-2.04**	2.33***
Wald test (2)			-2.74***	1.49
Wald test (3)				3.85***
D. Days with European announcements only				
Mean	31.84%	31.13%	36.03%	31.40%
t-value	31.47***	29.29***	21.64***	27.79***
Wald test (1)		0.48	-2.15**	0.29
Wald test (2)			-2.48***	-0.17
Wald test (3)				2.30**
E. Days with both US and European announcements				
Mean	34.25%	29.80%	36.31%	28.16%
t-value	55.58***	44.07***	34.63***	39.33***
Wald test (1)		4.86***	-1.69*	6.44***
Wald test (2)			-5.21***	1.66*
Wald test (3)				6.41***

Table 6

Ratios of Private Information to Total Information: USD/JPY

This table presents the daily average of ratios of private information to total information, bases on the variance decomposition of a VAR model for one-minutereturns and order flow. The return and order flow are the difference in the logarithm of mid-quotes and the difference between buy and sell orderflow over a 1-minute interval, respectively. We calculate three Wald test statisticsto test the null hypothesis of no difference in the ratios of "Asian" and "Europe" periods (Wald test (1)), the null of no difference in the ratios of "Europe" and "London+NYC" periods (Wald test (2)), and the null of no difference in the ratios of "London+NYC" and "US" periods (Wald test (3)). ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

	Asian	Europe	London+NYC	U.S.
A. All data				
Mean	34.27%	31.26%	37.67%	31.42%
t-value	69.87***	63.68***	76.79***	63.97***
Wald test (1)		4.34***	-4.89***	4.11***
Wald test (2)			-9.23***	-0.22
Wald test (3)				9.00***
B. Nonannouncement days				
Mean	33.94%	32.16%	41.25%	31.20%
t-value	22.82***	21.54***	27.74***	20.98***
Wald test (1)		0.84	-3.48***	1.30
Wald test (2)			-4.31***	0.46
Wald test (3)				4.78***
C. Days with US announcements only				
Mean	35.86%	31.33%	38.86%	31.95%
t-value	35.07***	30.63***	38.00***	31.18***
Wald test (1)		3.14***	-2.07**	2.70***
Wald test (2)			-5.21***	-0.43
Wald test (3)				4.77***
D. Days with Japanese announcements only				
Mean	33.36%	33.16%	38.78%	31.94%
t-value	27.92***	27.68***	32.45***	26.73***
Wald test (1)		0.12	-3.20***	0.84
Wald test (2)			-3.32***	0.72
Wald test (3)				4.04***
E. Days with both US and Japanese announcements				
Mean	33.92%	30.40%	35.95%	31.04%
t-value	48.65***	43.60***	51.56***	44.44***
Wald test (1)		3.57***	-2.06**	2.91***
Wald test (2)			-5.63***	-0.66
Wald test (3)				4.97***

Table 7

Regression Analysis of Information Contentfor EUR/USD

The table represents the estimation results of the following regression:

$$IS_{i,t} = \sum_{j=1}^{4}\beta_j MKT_{j,i,t} + \sum_{j=1}^{4}\sum_{m=-K}^{K}\lambda_{m,j}\times MKT_{j,i,t}\times USNEWS_{t+m} + \sum_{j=1}^{4}\sum_{m=-K}^{K}\gamma_{m,j}\times MKT_{j,i,t}\times EUNEWS_{t+m} +$$

$$\sum_{j=1}^{4}\sum_{m=-K}^{K}\sigma_{m,j}\times MKT_{j,i,t}\times BOTHEWS_{t+m} + \theta\times Volume_{i,t} + \delta\times SPREAD_{i,t} + \varepsilon_{i,t}$$

where$IS_{i,t}$the per-hour ratios of private information to total information of market*i*on day *t*. $MKT_{j,i,t}$ is a dummy variable for the *j*-th market, where *j* =1, 2, 3, 4, indicating Asian, Europe, London-New York and the U.S. markets, respectively. $MKT_{j,i,t}$ equals 1 for the *j*-th market and 0 otherwise. $USNEWS_t$ is a dummy variable which equals 1 if only US announcements are released on day *t*. $EUNEWS_t$equals 1 if only European announcements are released on day *t*.$BOTHNEWS_t$equals 1 if US announcements and European announcements are released on day *t*. H_Volume_{it} is per-hour trading volume in market *i* on day *t*; Re_Spread_{it} is the relative effective spread of the corresponding market on day *t* and is calculated as $2\times|\log(p_{it}/q_{it})|$, in which p_{it} is the trading price and q_{it} is the quote price at the close time of market *i*on day *t*.To look into news effects on changes of information share, we follow Jiang et al. (2012) to choose the length of lagged term *K* =5, that is, the model considers the effects of announcements one day before, two, three, four and five days before, one day after, and two, three, four and five days after the announcements.Due to the space limitation, we only report the results of significant coefficients..***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Independent Variables	Coefficient	*t*-Statistic
MKT_1	0.4112	7.14***
MKT_2	0.4333	7.91***
MKT_3	0.2392	2.76***
MKT_4	0.4638	8.30***
$MKT_1\times USNEWS_{t-3}$	-0.0334	-2.41**
$MKT_1\times SNEWS_{t+4}$	-0.0303	-2.13**
$MKT_1\times EUNEWS_{t-3}$	0.0322	2.17**
$MKT_1\times UNEWS_{t-2}$	0.0274	1.86*
$MKT_1\times BOTHNEWS_{t-3}$	-0.0342	-2.36**
$MKT_1\times BOTHNEWS_{t+4}$	-0.0374	-2.57**
$MKT_2\times USNEWS_{t+1}$	-0.0305	-2.03**
$MKT_2\times USNEWS_{t+3}$	-0.0255	-1.71*
$MKT_2\times USNEWS_{t+4}$	-0.0286	-1.88*
$MKT_2\times USNEWS_{t+5}$	-0.0256	-1.70*
$MKT_2\times BOTHNEWS_t$	-0.0270	-1.83*
$MKT_2\times BOTHNEWS_{t+1}$	-0.0294	-1.99**

Table 7 (Continued)

Independent Variables	Coefficient	t-Statistic
$MKT_2 \times BOTHNEWS_{t+3}$	-0.0307	-2.25**
$MKT_2 \times BOTHNEWS_{t+4}$	-0.0324	-2.18**
$MKT_2 \times BOTHNEWS_{t+5}$	-0.0345	-2.37**
$MKT_3 \times BOTHNEWS_{t-2}$	0.0388	1.75*
$MKT_4 \times USNEWS_{t-3}$	-0.0532	-3.45***
$MKT_4 \times USNEWS_{t-2}$	-0.0278	-1.81*
$MKT_4 \times USNEWS_{t+2}$	-0.0707	-4.37***
$MKT_4 \times USNEWS_{t+3}$	-0.0358	-2.24**
$MKT_4 \times USNEWS_{t+4}$	-0.0385	-2.48**
$MKT_4 \times EUNEWS_{t-4}$	0.0354	2.13**
$MKT_4 \times EUNEWS_{t}$	0.0303	1.74***
$MKT_4 \times EUNEWS_{t+2}$	-0.0286	-1.69***
$MKT_4 \times BOTHNEWS_{t-3}$	-0.0399	-2.62**
$MKT_4 \times BOTHNEWS_{t+1}$	-0.0258	-1.67*
$MKT_4 \times BOTHNEWS_{t+2}$	-0.0492	-3.30***
$MKT_4 \times BOTHNEWS_{t+3}$	-0.0291	-1.95*
RE SPREAD	-48.0953	-4.59***
H VOLUME	0.0001	5.33***

Table 8

Regression Analysis of Information Contentfor USD/JPY

This tablepresents the results of the regression of price discovery through order flows on depending variables which are below. The regression is

$$IS_{i,t} = \sum_{j=1}^{4}\beta_j MKT_{j,i,t} + \sum_{j=1}^{4}\sum_{m=-K}^{K}\lambda_{m,j}\times MKT_{j,i,t}\times USNEWS_{t+m} + \sum_{j=1}^{4}\sum_{m=-K}^{K}\gamma_{m,j}\times MKT_{j,i,t}\times EUNEWS_{t+m} +$$

$$\sum_{j=1}^{4}\sum_{m=-K}^{K}\sigma_{m,j}\times MKT_{j,i,t}\times BOTHEWS_{t+m} + \theta\times Volume_{i,t} + \delta\times SPREAD_{i,t} + \varepsilon_{i,t}$$

where$IS_{i,t}$the per-hour ratios of private information to total information of market*i*on day *t*. $MKT_{j,i,t}$ is a dummy variable for the *j*-th market, where *j* =1, 2, 3, 4, indicating Asian, Europe, London-New York and the U.S. markets, respectively. $MKT_{j,i,t}$ equals 1 for the *j*-th market and 0 otherwise. $USNEWS_t$ is a dummy variable which equals 1 if only US announcements are released on day *t*. $JPNEWS_t$equals 1 if only Japanese announcements are released on day *t*.$BOTHNEWS_t$equals 1 if US announcements and European announcements are released on day *t*. H_Volume_{it} is per-hour trading volume in market *i* on day *t*; Re_Spread_{it} is the relative effective spread of the corresponding market on day *t* and is calculated as $2\times\left|\log(p_{it}/q_{it})\right|$, in which p_{it} is the trading price and q_{it} is the mid-quote price at the close time of market *i*on day *t*. To look into news effects on changes of information share, we follow Jiang et al. (2012) to choose the length of lagged term *K* =5, that is, the model considers the effects of announcements one day before, two, three, four and five days before, one day after, and two, three, four and five days after the announcements.Due to the space limitation, we only report the results of significant coefficients. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Independent Variables	Coefficient	*t*-Statistic
MKT_1	0.5126	9.89^{***}
MKT_2	0.4111	8.21^{***}
MKT_3	0.5514	6.49^{***}
MKT_4	0.4884	9.01^{***}
$MKT_1 \times USNEWS_{t+1}$	-0.0240	-1.68^{*}
$MKT_1 \times USNEWS_{t+3}$	-0.0232	-1.65^{*}
$MKT_1 \times USNEWS_{t+4}$	-0.0324	-2.34^{**}
$MKT_1 \times BOTHNEWS_{t-3}$	-0.0295	-2.07^{**}
$MKT_1 \times BOTHNEWS_{t+1}$	-0.0320	-2.37^{**}
$MKT_1 \times BOTHNEWS_{t+2}$	-0.0368	-2.72^{***}
$MKT_1 \times BOTHNEWS_{t+4}$	-0.0396	-3.13^{***}
$MKT_2 \times USNEWS_{t+1}$	-0.0265	-1.75^{*}
$MKT_2 \times JPNEWS_{t-3}$	-0.0294	-1.82^{*}
$MKT_2 \times JPNEWS_{t-4}$	-0.0288	-1.91^{*}
$MKT_2 \times JPNEWS_{t-5}$	0.0254	1.69^{*}
$MKT_2 \times BOTHNEWS_{t-4}$	-0.0308	-2.46^{**}

Table 8 (Continued)

Independent Variables	Coeff.	*t*-Stat.
$MKT_2 \times BOTHNEWS_{t+1}$	-0.0460	-3.34***
$MKT_2 \times BOTHNEWS_{t+3}$	-0.0266	-2.01**
$MKT_3 \times USNEWS_{t-2}$	0.0493	1.98**
$MKT_3 \times USNEWS_{t+3}$	-0.0705	-2.71***
$MKT_3 \times JPNEWS_{t+3}$	-0.0565	-1.98**
$MKT_3 \times BOTHNEWS_{t-2}$	0.0417	1.77*
$MKT_3 \times BOTHNEWS_{t}$	-0.0576	-2.28**
$MKT_4 \times USNEWS_{t-5}$	-0.0257	-1.70*
$MKT_4 \times USNEWS_{t+3}$	-0.0365	-2.44**
$MKT_4 \times JPNEWS_{t-5}$	-0.0296	-1.81*
$MKT_4 \times JPNEWS_{t+2}$	-0.0270	-1.66*
$MKT_4 \times JPNEWS_{t+3}$	-0.0367	-2.43**
$MKT_4 \times JPNEWS_{t+5}$	-0.0420	-2.62***
$MKT_4 \times BOTHNEWS_{t-5}$	-0.0274	-1.96**
$MKT_4 \times BOTHNEWS_{t+2}$	-0.0272	-1.87*
$MKT_4 \times BOTHNEWS_{t+3}$	-0.0344	-2.58***
$MKT_4 \times BOTHNEWS_{t+5}$	-0.0341	-2.35**
RE_SPREAD	-20.1433	-4.01***

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□ □ □ □ □ □ Does Foreign Institutional Trading Improve Stock Liquidity?

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The purpose of this paper is to investigate the effect of foreign institutional trading activity on stock liquidity. Three dimensions of foreign institutional trading activity are associated with stock liquidity, institutional holdings, institutional herding and institutional aggressive/ passive trading. We apply dynamic panel generalized method of moments (GMM) estimation to deal with the two possibility sources of endogeneity: unobservable heterogeneity as well as dynamic relation between past stock liquidity and current foreign trading activity. We investigate whether foreign institutional trading activity facilitates stock liquidity using the GMM estimator based on a panel dataset of the Taiwan listed stocks monthly data between 2001 and 2012. Although foreign institutional holdings decrease stock liquidity, their net purchase does provide stock liquidity. Foreign institutional herding to buy provides stock liquidity; while their herding to sell deteriorates stock liquidity. Both aggressive and passive trading activities facilitate price impacts as measured by Amihud (2002). On the other side, their trading narrows the quoted spread as with higher stock returns and deteriorates liquidity as stock returns decrease.

Keywords: stock liquidity, foreign institutional trading, herding, passive trading, aggressive trading, endogeneity, dynamic panel GMM estimation.

1. Introduction

Financial liberalization to remove the foreign investment ceilings on common stocks in 2003 facilitates foreign institutional investors' participating in Taiwan stock market. Statistics from Taiwan Financial Supervisory Commission indicate that foreign institutional holding as a proportion of total market capitalization in Taiwan stock market increases from 6.99% in 2002 to 26.03% in 2012. Academic researchers and practitioners have devoted considerable efforts in analyzing the increasing impacts of foreign institutional holdings on stock liquidity (e.g. Rhee and Wang, 2009). It is expected that increased foreign institutional participation would reduce information asymmetry and increase stock liquidity. This study intends to investigate whether foreign institutional trading in Taiwan stock market facilitates stock liquidity.

The effects of foreign institutional participation are two-faced. Foreign institutional investments are recognized as benefits to local economies in that their trading lowers the cost of capital and enhances the firm value (e.g., Bekaert and Harvey, 2000; Ferreira and Matos, 2008). Alternatively, foreign investors may destablize local capital markets (Tesar and Werner, 1995; French and Poterba, 1991). It is noteworthy that previous literature was more about the impacts of foreign institutional trading on stock returns, but we know little about their impacts on stock liquidity in an emerging market like Taiwan. On the other side, the empirical studies by Chordia et al. (2000) and Kamara et al. (2008) found that institutional investing is critical to commonality in liquidity. Liang and Wei (2012) found that stocks with increased foreign institutional ownership subsequently experience higher liquidity. However, in an emerging market, Indonesia, Rhee and Wang (2009) found that foreign holdings had a negative impact on future liquidity, as measured by the bid-ask spread, depth and price sensitivity. One explanation to this negative impact contributes to information asymmetry. In emerging markets, the information asymmetry may be amplified due to foreign investors' participation in local firms. The company becomes "foreign" to local investors, which reduces liquidity. Empirical evidences regarding the impacts of foreign institutional holdings on stock liquidity are still in dispute and this paper will identify how foreign investors impact stock liquidity in Taiwan.

The other mechanisms through which stocks become more liquid are foreign institutional trading activities. Chen et al. (2008) proved that foreign institutional investors participating in Taiwan stock market do herd towards some particular stocks. Lai and Huong (2010) proposed that due to information advantages, foreign institutional herding lead individual investors to follow their trading so that stock liquidity improves. This raises our interests to investigate whether foreign institutional herding behavior in Taiwan affects stock liquidity. On the other side, Boehmer and Kelley (2009) classified foreign institutional trading into aggressive and passive strategies. If foreign institutional investors are better informed about the firms' fundamentals or about impending order flow, they need liquidity to trade in the appropriate direction and are identified as aggressive traders. Alternatively, if foreign institutional investors are able to recognize uninformed sellers as stock prices drop, they can gain by providing liquidity, which is identified as passive trading (e.g. Chan and Lakonishok, 1993; Boehmer and Kelly, 2009).

In sum, institutional trading strategies may impact on stock liquidity. To confine with the data availability in Taiwan stock market, we define the passive and aggressive trading strategies by foreign institutional investors in Taiwan stock market as what Boehmer and Kelley (2009) did. The direction of institutional trading relative to the current month's return is exploited. If foreign institutions end with a positive (negative) trade imbalance on negative (positive) return days, they are likely to provide liquidity in the market and result from a passive trading strategy. In contrast, if foreign institutions end with a positive (negative) trade imbalance on positive (negative) return days, they probably demand liquidity via an aggressive trading strategy. The impacts under different trading strategies are compared.

This paper is structured as follows. Section 2 describes the variables used in this paper and provides summary statistics of the data. Section 3 provides empirical models and results of our findings. We conclude our paper in Section 4.

2. Data

Our data consist in three datasets of TEJ (Taiwan Economic Journal) database for TWSE/GTSM stocks. The first one provides the daily stock trading summary, including daily stock returns, trading value and end-of-day bid and ask prices. The second one provides institutional trading activities, including institutional ownership level and change by the three main types of institutional investors (foreign institutional investors, mutual funds and proprietary traders), foreign institutional trading imbalances and the number of foreign institutional investors buying and selling for each stock. The third one provides the fundamentals of listing firms in Taiwan stock markets, including firm capitalization, book-to-market ratio and shares outstanding for each stock. The sample period is from January, 2001 to December, 2012.

2.1. *Liquidity Measures*

Literature focused on understanding the liquidity impacts from the microscope of market microstructure often uses high-frequency liquidity measures, such as the quoted bid-ask spread, quoted depth, and the effective bid-ask spread, etc. (e.g. Chordia et al., 2000, 2008; Boehmer and Kelley, 2009; Rhee and Wang, 2009). However, as mentioned by Amihud (2002), high-frequency measures require a lot of microstructure data that are not available in many stock markets. On the other side, Goyenko et al. (2009) run horseraces of some liquidity measures against the benchmarks and proved the illiquidity measure of Amihud (2002) does well measuring price impact. In this study, we use both the proportional quoted spread (Chordia et al., 2000) and price impacts (Amihud, 2002) as measures of stock (il)liquidity.

The proportional quoted spread (Chordia et al., 2000) is computed as a proportion of the end-of-day spread to the midpoint of the bid-ask price for each stock i and averaged it for each month m, denoted as . The price impact measure is from Amihud (2002), defined as the average ratio of the daily absolute return to the (dollar) trading volume on that day, . It follows that,

$$AMIHUD_{i,m} = 1/T_{i,m} \sum_{t=1}^{T_{i,m}} \left|R_{i,t,m}\right| / VOLD_{i,t,m} \qquad (1)$$

where is the return on stock i on day t of month m, is the respective daily trading value and is the number of days for which data are available for stock i in month m. It should be noted that both

SPREAD and AMIHUD are inverse measures of stock liquidity, so we denote both measures as ILLIQ to proxy for stock illiquidity.

2.2. *Foreign institutional trading activities*

We consider three activities involved by categories of foreign institutional trading, foreign institutional ownership, foreign institutional herding and their passive/ aggressive trading. Foreign institutional ownership as well as its change are widely used as proxies of foreign institutional trading activities (e.g. Kamara, et al., 2008; Boehmer and Kelley, 2009; Rhee and Wang, 2009). Our study uses monthly foreign institutional ownership (FOI) and its monthly change (DFOI) to proxy for foreign institutional trading activities.

On the other side, Sias et al. (2006) proposed that aggregate institutional trading may drive the correlation between changes in institutional ownership and same-quarter returns and there is a temporary liquidity component associated with institutional trading, which implies that institutional herding is associated with stock liquidity. According to Sias (2004), herding is defined as a group of investors following each other into (or out of) the same securities over some period of time. We define institutional herding based on the fraction of institutional investors trading the security i that are buyers, which is calculated as follows (Sias, 2004). The herding measure is denoted as HERD and we further separate the herding measures into institutional herding to buy (HERD>0.5) and institutional herding to sell (HERD<0.5).

$$HERD_{i,m} = \frac{number\_of\_institutional\_buyers_{i,m}}{number\_of\_institutional\_buyers_{i,m} + number\_of\_institutional\_sellers_{i,m}} \quad (2)$$

The other foreign institutional trading strategies associated with stock liquidity refer to the effects of institutional aggressive and passive trading strategies. Boehmer and Kelley (2009) exploit the direction of institutional trading relative to the current day's return to identify institutional trading strategy. Because negative (positive) return days arise due to overall selling (buying) pressure, institutional buying (selling) on negative (positive) return days results from institutional passive trading and is likely to provide liquidity. In contrast, if institutions trade in the same direction as the return, they probably demand liquidity via an aggressive trading strategy.

To confine with the data availability in Taiwan stock market, we define the passive and aggressive trading strategies by foreign institutional investors in Taiwan stock market as what Boehmer and Kelley (2009) did and exploit the direction of institutional trading relative to the current day's return. If foreign institutions end with a positive (negative) trade imbalance on negative (positive) return days, they are likely to provide liquidity in the market and result from a passive trading strategy. In contrast, if foreign institutions end with a positive (negative) trade imbalance on positive (negative) return days, they probably demand liquidity via an aggressive trading strategy. We denote institutional ownership for stock i when the passive trading is executed on positive (negative) return days as SellUp (BuyDown) and that when the aggressive trading is executed on positive (negative) return days as BuyUp (SellDown).

2.3. *Dynamic panel generalized method of moments (GMM) estimation*

In this paper, we focus on how foreign institutional trading activity affects market liquidity in Taiwan stock market. To investigate the relationship between market liquidity and foreign institutional trading activity, a dynamic panel-data with fixed effects model is constructed as follows.

$$ILLIQ_{i,m} = \alpha_i + \beta \cdot FIO_{i,m} + \delta \cdot ILLIQ_{i,m-1} + \sum_{k=1}^{K} \gamma_k \cdot X_{ki,m} + \varepsilon_{i,m} \quad (3)$$

where $ILLIQ_{i,m}$ is the measures of liquidity for stock *i* at time *m*. $FIO_{i,m}$ represents for foreign institutional trading activity. α_i is a firm fixed effect to capture the unobserved characteristic of firm. . ***X*** is a vector of observable firm-specific determinants of market liquidity, including the logarithm of market capitalization (*Ln(Size))*, stock price (Ln(Price)), volatility (Volatility), number of trades, trading size, a dummy of MSCI indexation, and the institutional holdings from two domestic institutional investors, mutual fund and securities traders (*MOI* and *SOI*).

Since the dependent ($ILLIQ_{i,m}$) and independent variables ($ILLIQ_{i,m-1}$) both depend on the unobserved time-invariant firm characteristic (α_i), it is obviously that covariance of independent variable and error term is not zero, leading an endogeneity problem. Basically, we can first-difference model (3) to remove the time-invariant fixed effect as follows:

$$(ILLIQ_{i,m} - ILLIQ_{i,m-1}) = \beta(FIO_{i,m} - FIO_{i,m-1}) + \delta(ILLIQ_{i,m-1} - ILLIQ_{i,m-2}) + \sum_{k=1}^{K} \gamma_k (X_{ki,m} - X_{ki,m-1}) + (\varepsilon_{i,m} - \varepsilon_{i,m-1})$$

However, the differenced lagged dependent variable remains correlated with the differenced error term. Without the fixed effect, the instrumental variables estimator with suitable instruments can be used to deal with this endogeneity problem. In practice, identifying and justifying a strictly exogenous instrument is very difficult. Anderson and Hsiao (1981) use the lagged differences of dependent variables ($ILLIQ_{i,m-2} - ILLIQ_{i,m-3}$), or $ILLIQ_{i,m-2}$ and $ILLIQ_{i,m-3}$ as instruments for ($ILLIQ_{i,m-1} - ILLIQ_{i,m-2}$). Arellano (1989) pointed out that $ILLIQ_{i,m-2}$ performs better for finite-sample properties. However, as Arellano and Bond (1991) and Ahn and Schmidt(1995) observed, there is still a lot of information can be used for estimation. Arellano and Bond (1991) use the all possible past dependent variables uncorrelated with differenced error term. Basically, the values of $ILLIQ_{i,m-2}$ lagged two periods or more can be used as valid instruments which are uncorrelated with the differenced error term. For example, for the period $m = 3$, we have

$$(ILLIQ_{i,3} - ILLIQ_{i,2}) = \beta(FIO_{i,3} - FIO_{i,2}) + \delta(ILLIQ_{i,2} - ILLIQ_{i,1}) + \sum_{k=1}^{K} \gamma_k (X_{ki,3} - X_{ki,2}) + (\varepsilon_{i,3} - \varepsilon_{i,2})$$

In this case, $ILLIQ_{i,1}$ is a valid instrument, it is correlated with $(ILLIQ_{i,2} - ILLIQ_{i,1})$ but uncorrelated with $(\varepsilon_{i,3} - \varepsilon_{i,2})$. Similarly, for the period $m = 4$, we have

$$(ILLIQ_{i,4} - ILLIQ_{i,3}) = \beta(FIO_{i,4} - FIO_{i,3}) + \delta(ILLIQ_{i,3} - ILLIQ_{i,2}) + \sum_{k=1}^{K} \gamma_k (X_{ki,4} - X_{ki,3}) + (\varepsilon_{i,4} - \varepsilon_{i,3})$$

But in this case $ILLIQ_{i,1}$ and $ILLIQ_{i,2}$ are valid instruments. Thus, for the period *M*, the valid instruments are $ILLIQ_{i,1}$, $ILLIQ_{i,2}$, $\cdots$, and $ILLIQ_{i,M-2}$. The previous argument implies the following $(M-2)(M-1)/2$ moment conditions:

$$\mathrm{E}\{ILLIQ_{i,m-s}(\varepsilon_{i,m} - \varepsilon_{i,m-1})\} = 0, \quad s = 2, 3, \ldots, M-1; \; m = 3, 4, \ldots, M \qquad (4)$$

For each stock *i*, we can define the instruments matrix $\mathbf{Z}_i$ as follows:

$$\mathbf{Z}_i = \begin{pmatrix} [ILLIQ_{i,1}] & & & 0 \\ & [ILLIQ_{i,1}, ILLIQ_{i,2}] & & \\ & & \ddots & \\ 0 & & & [ILLIQ_{i,1}, ILLIQ_{i,2}, \ldots, ILLIQ_{i,T-2}] \end{pmatrix}$$

here $\mathbf{Z}_i$ is a $(M-2)$ by $(M-2)(M-1)/2$ matrix. Now, we rewrite (a5) expressed in vector form:

$$\mathbf{Y}_i = \mathbf{X}_i \boldsymbol{\beta} + \mathbf{e}_i \qquad (5)$$

where $\mathbf{Y}_i$ is a $(M-2)\times 1$ vector defined as $(\Delta ILLIQ_{i,3}, \; \Delta ILLIQ_{i,4}, \; \cdots, \; \Delta ILLIQ_{i,M})'$ and Δ is the first-difference operator. $\mathbf{X}_i$ is a data matrix of all explanatory variables defined as $(\Delta\mathbf{FIO}_i \;\; \mathbf{Y}_i^{-1} \;\; \Delta\mathbf{X}_{ki})$ with $\Delta\mathbf{FIO}_i$ and $\mathbf{Y}_i^{-1}$ are both $(M-2)\times 1$ vectors defined as $(\Delta FIO_{i,2}, \; \Delta FIO_{i,4}, \; \cdots, \; \Delta FIO_{i,M-1})'$ and $(\Delta ILLIQ_{i,2}, \; \Delta ILLIQ_{i,3}, \; \cdots, \; \Delta ILLIQ_{i,M-1})'$, respectively. $\Delta\mathbf{X}_{ki}$ is a data matrix of control variables. $\boldsymbol{\beta}$ is a parameters vector of interest. $\mathbf{e}_i$ is a $(M-2)\times 1$ vector defined as $(\Delta\varepsilon_{i,3}, \; \Delta\varepsilon_{i,4}, \; \cdots, \; \Delta\varepsilon_{i,M})'$.

Similarly, we can rewrite the previous moment conditions expressed in vector form as follows:

$$E(\mathbf{Z}_i^{'}\mathbf{e}_i) = E\left\{\sum_{t=1}^{T}\mathbf{Z}_i^{'}(\mathbf{Y}_i - \mathbf{X}_i\boldsymbol{\beta})\right\} = 0, \ \ i = 1, 2, \ldots, \ \ N. \quad (6)$$

and its sample analog is $1/N\sum_{i=1}^{N}\mathbf{Z}_i^{'}\mathbf{e}_i$. Arellano and Bond (1991) estimate (5) using GMM estimator based on the moment conditions (6). We can apply the two-stage least-squares (2SLS) estimator with instruments $\mathbf{Z}_i$ to estimate $\boldsymbol{\alpha}$ as follows:

$$\hat{\boldsymbol{\beta}}_{2SLS} = \left[\left(\sum_{i=1}^{N}\mathbf{X}_i^{'}\mathbf{Z}_i\right)\left(\sum_{i=1}^{N}\mathbf{Z}_i^{'}\mathbf{Z}_i\right)^{-1}\left(\sum_{i=1}^{N}\mathbf{Z}_i^{'}\mathbf{X}_i\right)\right]^{-1}\left[\left(\sum_{i=1}^{N}\mathbf{X}_i^{'}\mathbf{Z}_i\right)\left(\sum_{i=1}^{N}\mathbf{Z}_i^{'}\mathbf{Z}_i\right)^{-1}\left(\sum_{i=1}^{N}\mathbf{Z}_i^{'}\mathbf{Y}_i\right)\right] \quad (7)$$

and obtain the sample residuals $\hat{\mathbf{e}}_i$. Then, compute the weight matrix $\widehat{\mathbf{W}}$ for GMM estimator based on those residuals as follows:

$$\widehat{\mathbf{W}} = \left[\frac{1}{N^2}\left(\sum_{i=1}^{N}\mathbf{Z}_i^{'}\hat{\mathbf{e}}_i\hat{\mathbf{e}}_i^{'}\mathbf{Z}_i\right)\right] \quad (8)$$

The GMM estimator based on the moment conditions (6) minimizes the quadratic function:

$$Q(\boldsymbol{\beta}) = \left[\sum_{i=1}^{N}\mathbf{Z}_i^{'}(\mathbf{Y}_i - \mathbf{X}_i\boldsymbol{\beta})\right]\widehat{\mathbf{W}}^{-1}\left[\sum_{t=1}^{T}\mathbf{Z}_i^{'}(\mathbf{Y}_i - \mathbf{X}_i\boldsymbol{\beta})\right] \quad (9)$$

The GMM estimator that minimizes this quadratic function (9) is obtained as

$$\hat{\boldsymbol{\beta}}_{GMM} = \left[\left(\sum_{i=1}^{N}\mathbf{X}_i^{'}\mathbf{Z}_i\right)\widehat{\mathbf{W}}^{-1}\left(\sum_{i=1}^{N}\mathbf{Z}_i^{'}\mathbf{X}_i\right)\right]^{-1}\left[\left(\sum_{i=1}^{N}\mathbf{X}_i^{'}\mathbf{Z}_i\right)\widehat{\mathbf{W}}^{-1}\left(\sum_{i=1}^{N}\mathbf{Z}_i^{'}\mathbf{Y}_i\right)\right] \quad (10)$$

2.4. *Summary Statistics*

Following Chordia et al. (2000), Amihud (2002) and Kamara et al. (2008), we filter the data according to the criteria below. First, the liquidity measure, AMIHUD, is calculated only for positive trading values (VOLD) and non-missing, non-zero stock returns (R). Second, we exclude the stocks traded at a price less than the par value of common stock in Taiwan (NT$10). Third, we trim off the outliers of liquidity measure, AMIHUD, in the lowest and highest 1% percentiles and multiply the measure by 10^6, performed in Amihud (2002) and Lesmond (2005). Fourth, the proportional quoted spread is calculated only for non-missing, non-zero midpoint of end-of-day bid-ask prices. Finally, we include the stock in our sample only if the stock has at least 10 valid observations each month after applying the previous filters.

There are 109,008 firm-month observations and on average, there are 757 sample firms for each month over our sample period. Table 1 provides a sketch of stock illiquidity and institutional investing in Taiwan from January, 2001 to December, 2012. The price impact measure of illiquidity, AMIHUD is much more volatile than the spread measure, SPREAD. The average foreign institutional ownership is almost 5 times more than that held by mutual funds and 9 times more than that held by proprietary traders. The average change of institutional ownership is 0 for three types of investors, indicating that the proportion of institutional buying may cancel off that of institutional selling.

To investigate whether foreign institutional trading facilitates stock liquidity, we use 2012 data to rank institutional ownership (both holding level and its relative change) and the controlling variables, firm capitalization and book-to-market ratio from the lowest quintile to the highest one as shown in Table 2. For each quintile, we present the average illiquidity measures, AMIHUD and SPREAD. As both SPREAD and AMIHUD are inverse measures of stock liquidity, the smaller the measures, the more liquid the stocks are. The results of t-test on the null hypothesis that for each independent variable, the stock illiquidity in the highest quintile (Q5) does not differ from that in the lowest (Q1) quintile are presented. Some insights are found as follows. First, except for the facet of foreign institutional holding level (FOI), we find that stock liquidity monotonically increases with the holding levels of domestic institutional investors (mutual funds, MOI and proprietary traders, SOI) and firm size, but decreases with the book-to-market ratio. For these facets, stock liquidity in the two extreme quintiles statistically differs, implying that stock liquidity may be associated with institutional trading, firm's size and firm's growth. Furthermore, as we observe the changing facets of institutional holdings (DFOI, DMOI, and DSOI), the most liquid stocks fall on the two extreme quintiles where stocks are most actively sold (Q1) and bought (Q5). For the changing facets of foreign institutional investors and proprietary traders, stock liquidity in the most-buying quintile is statistically higher than that in the most-selling quintile, implying stock liquidity is more likely to be associated with institutional buying.

3. Empirical Results

3.1. *Does Foreign Institutional Ownership Impact on Stock Liquidity?*

As investigating whether foreign institutional ownership impacts on stock liquidity in Taiwan, one may argue that stock liquidity may simultaneously attract institutional trading; i.e. the relationship between foreign institutional trading and stock liquidity may be endogenous. One cannot estimate one-way relationship without dealing with the endogenous problem. On the other hand, as the lagged term of stock liquidity is considered in our estimated model, one cannot bypass the correlation between the regressors and the error term since the lagged term of stock liquidity depends on the residual terms, which is a function of the firm specific effect. Due to this correlation, the dynamic panel data estimation suffers from Nickell's (1981) bias problem. Several econometric techniques have developed to correct the bias, including instrumental variables, generalized method of moments (GMM) estimators, long differencing, and bias correction formulae. Flannery and Hankins (2013) demonstrate that the Blundell and Bond's system GMM estimator (1998) is reliable regardless of the level of endogeneity or dependent variable persistence. Taking both endogeneity and bias problems into consideration, we construct our model as follows and the associated coefficients are estimated by using the Blundell and Bond's system GMM,

$$ILLIQ_{i,m} = \alpha_i + \tau_m + \beta \cdot FIO_{i,m} + \delta \cdot ILLIQ_{i,m-1} + \sum_{k=1}^{K} \gamma_k \cdot X_{ki,m} + \varepsilon_{i,m} \tag{11}$$

where ILLIQ represents for the measures of stock illiquidity, SPREAD and AMIHUD. FIO represents for foreign institutional ownership and we use foreign institutional holding level and the monthly change of foreign institutional ownership (FOI and DFOI) to identify the effects from foreign institutional trading. X represents for the controlling variables, including the market capitalization (Ln(Size)), the book-to-market ratio (BM) and the institutional holdings from two domestic institutional investors, mutual fund and proprietary traders (MOI, DMOI, SOI and DSOI).

Model (3.1) in Panel A of Table 3 uses institutional holding level (FOI, MOI and SOI) to investigate the effects of institutional trading on stock liquidity as measured by Amihud (2002) and the proportional quoted spread (SPREAD). The results indicate that both AMIHUD and SPREAD increase as foreign institutional investors' holding levels increase, indicating a decrease in stock liquidity as foreign institutional holdings increase. Since the average foreign institutional ownership is almost 5 times more than that held by mutual funds, the higher the proportion of stocks preserved in foreign institutional portfolios, the less free floats of the stocks traded in the stock market, leading illiquidity of the stock. As observed in the preliminary statistics, stocks of large firm size are more liquid, but stocks with high book-to-market ratios are less liquid. Stock liquidity also varies with time and firm characteristics.

As institutional ownership level reveals institutional interests to preserve stocks in their portfolios in the long run, the change of institutional ownership reveals the net purchases or sales of stocks some moment in time. Model (3.2) uses the change of institutional ownership to investigate the effects of foreign institutional short-term trading. We find that foreign institutional short-term trading does narrow the quoted spreads of stocks, which facilitates stock liquidity in Taiwan; while it brings no effects on the price impact measured by AMIHUD. Domestic institutional trading of mutual funds and proprietary traders does not provide stock liquidity, either.

Since the average change of foreign institutional ownership (DFOI) mixes up foreign institutional buying and selling effects, we further divide our sample into two subsamples, foreign institutional net buying (DFOI>0) and net selling (DFOI<0) and run the Blundell and Bond's system GMM as models (3.3) and (3.4). We find that foreign institutional buying does facilitate stock liquidity in Taiwan. However, the coefficient of DFOI, -0.2740 in Model (3-4) of Panel B indicates that foreign institutional selling increases the quoted spread, which decreases stock liquidity. On the other hand, mutual funds' buying activities also facilitate stock liquidity here. But, it is beyond the market's expectations that proprietary traders' trading has no effects on stock liquidity in our study. This may be due to their relatively low trading volumes as compared with those of foreign institutional investors and mutual funds. The effects from two controlling variables are consistent, where the larger (smaller) the firm size (book-to-market ratio), the more liquid the stock.

3.2. *Does Foreign Institutional Herding Behavior Provide Stock Liquidity?*

Literature on the relationship between institutional herding and stock liquidity lays particular stress on whether stock liquidity attracts institutional herding (e.g. Sias, 2004; Cremer and Nautz; 2013). However, few have ever investigated the impacts of institutional herding on stock liquidity. Chen et al. (2008) proved that foreign institutional investors participating in Taiwan stock market do herd towards some particular stocks. Except for institutional holding, we further investigate whether institutional intents to trace the same stock facilitate stock liquidity by adding herding measure (HERD) for stock i to equation (11), taking institutional ownership levels as the controlling variables.

$$ILLIQ_{i,m} = \alpha_i + \tau_m + \beta \cdot FIO_{i,m} + \eta \cdot HERD_{i,m} + \delta \cdot ILLIQ_{i,m-1} + \sum_{k=1}^{K} \gamma_k \cdot X_{ki,m} + \varepsilon_{i,m} \qquad (12)$$

To identify whether institutional herding to buy or to sell is related to greater stock liquidity, we divide our sample into two subsamples each month. The first subsample includes stocks with the herding measure (HERD) larger than 0.5, which represents a subsample with institutional herding to buy. The other subsample includes stocks with the herding measure (HERD) less than 0.5, which represents a subsample with institutional herding to sell. We then perform the Blundell and Bond's system GMM to estimate the associated coefficients in equation (12).

Table 4 reports the impacts of institutional herding on stock liquidity as taking endogeneity problem into consideration. The result in the subsample of HERD>0.5 indicates that foreign institutional herding to buy reduces both the price impacts and the quoted spreads, which does facilitate stock liquidity. However, the negative coefficients of HERD in the subsample of HERD<0.5, -57.9784 and -0.0604, indicate a decrease in stock liquidity as foreign institutional investors herd to sell.

3.3. *Does Foreign Institutional Passive/ Aggressive Trading Matter with Stock Liquidity?*

Boehmer and Kelley (2009) suggested that negative (positive) return days arise due to overall selling (buying) pressure. Thus, institutional buying (selling) on negative (positive) return days may result from institutional passive trading, which is likely to provide liquidity. On the contrary, if institutions trade in the same direction as the return, they probably demand liquidity via an aggressive trading strategy. We calculate foreign institutional imbalances for stock i when the passive trading is executed on positive (negative) return months as SellUp (BuyDown) and those when the aggressive trading is executed on positive (negative) return months as BuyUp (SellDown) and perform the Blundell and Bond's system GMM to estimate the associated coefficients in equation (13), taking institutional ownership levels as controlling variables.

$$\begin{aligned} ILLIQ_{i,m} &= \alpha_i + \tau_m + \beta \cdot FIO_{i,m} + \zeta_1 \cdot SellUp_{i,m} + \zeta_2 \cdot BuyDown_{i,m} \\ &\quad + \zeta_3 \cdot BuyUp_{i,m} + \zeta_4 \cdot SellDown_{i,m} + \delta \cdot ILLIQ_{i,m-1} + \sum_{k=1}^{K} \gamma_k \cdot X_{ki,m} + \varepsilon_{i,m} \qquad (13) \end{aligned}$$

Table 5 reports the impacts of foreign institutional passive/ aggressive trading strategies on stock liquidity. We find that foreign institutional trading is related to smaller price impact as measured by Amihud (2002) regardless of whether trading strategies are passive or aggressive, indicating that no matter stock prices go up or down, foreign institutional investors provide stock liquidity on the one hand, but they also need liquidity. We also find that on the negative return days, foreign institutional trading widens quoted spreads. It is possible that on negative returns, foreign institutional investors quote at a relatively low price to buy and a relatively high price to sell, leading a larger spread on the negative return days.

4. Conclusion

Financial liberalization to lift foreign investment ceilings on the common stocks in 2003 facilitates foreign institutional investors' participating in Taiwan stock market. Foreign institutional holding as a proportion of total market capitalization in Taiwan stock market increases from 6.99% in 2002 to 26.03% in 2012. It is expected that increased foreign institutional participation would reduce information asymmetry and increase stock liquidity. This paper investigates whether foreign institutional trading in Taiwan stock market facilitates stock liquidity.

We apply the proportional quoted spread (Chordia et al., 2000) and price impact of Amihud (2002) as stock illiquidity measures and find that foreign institutional ownership level decreases stock liquidity. It is intuitive since the higher the proportion of stocks preserved in institutional portfolios, the less the free floats of the stocks available to be traded in the stock market, leading to stock illiquidity. However, foreign institutional ownership change decreases the quoted spreads of stock, indicating an improvement on stock liquidity. As we divide our sample into two subgroups, we find that foreign institutional buying does facilitate stock liquidity, but their selling increases the quoted spread, which decreases stock liquidity.

Furthermore, we identify two types of foreign institutional trading strategies, herding and passive/ aggressive trading and examine whether these strategies facilitate stock liquidity. Foreign institutional herding is defined as the proportion of the number of foreign investors buying to the total number trading the same stock. We find that their herding to buy reduces both the price impacts and the quoted spreads, which does facilitate stock liquidity. However, a decrease in stock liquidity is found as foreign institutional investors herd to sell.

As suggested by Chan and Lakonishok (1993) and Boehmer and Kelly (2009), institutions can gain by trading passively if they have superior ability to recognize that sellers in the market are uninformed. In such a case, institutional investors are identified as passive traders. On the other side, if institutions have private information about the firms' fundamentals or about impending order flow, they need liquidity to trade in the appropriate direction and are identified as aggressive traders. In this study, we examine whether foreign institutional passive/ aggressive trading is associated with stock liquidity. The results indicate that foreign institutional trading is related to greater stock liquidity regardless of the trading strategy.

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Table 1 Summary Statistics of Stock Illiquidity and Institutional Investors' Trading Activities

	min	max	mean	p10	p25	median	p75
AMIHUD	0.52	24748.18	561.25	7.8182	24.8501	97.8157	402.048
SPREAD	0.10	10.64	0.60	0.2280	0.3245	0.4795	0.723
FOI	0.00	96.64	9.01	0.0200	0.4382	3.4061	10.911
DFOI	-6.96	6.05	0.00	-0.0275	-0.0036	0.0000	0.006
MOI	0.00	50.86	1.77	0.0000	0.0000	0.1714	1.790
DMOI	-1.77	2.05	-0.00	-0.0325	-0.0025	0.0000	0.001
SOI	0.00	264.33	0.20	0.0000	0.0000	0.0053	0.122
DSOI	-1.94	17.60	-0.00	-0.0067	-0.0006	0.0000	0.000
N	109008						

This table reports the summary statistics of stock illiquidity and institutional investors' trading activity over the period from January, 2001 to December, 2012. For each firm, we require a minimum of ten monthly observations. Here, both *SPREAD* and *AMIHUD* are inverse measures of stock liquidity. *SPREAD* is the effective spread and *AMIHUD* is the monthly illiquidity measure proposed by Amihud (2002). The foreign institutional ownership (*FOI*) as well as its change (*DFOI*) are widely used as proxies of institutional investor' trading activities. *D* indicates the change during the current month. *MOI*, *ΔMOI*, *SOI* and *ΔSOI* are the institutional holdings from two domestic institutional investors, mutual fund and securities dealers, respectively.

Table 2 Summary Statistics of Stock Illiquidity Based on the Ranking of Institutional Investors' Trading Activities

	Q1	Q2	Q3	Q4	Q5	Q5-Q1
AMIHUD	1768	616	404	327	490	-1277.6***
SPREAD	0.838	0.529	0.447	0.399	0.451	-0.386***
FOI	0.092	1.282	4.661	11.105	38.058	
AMIHUD	212	1657	789	326	145	67.21***
SPREAD	0.382	0.792	0.559	0.450	0.355	0.0273***
DFOI	-0.0397	-0.0011	0.0011	0.0056	0.050	
AMIHUD	1533	269	165	79		-1454.5***
SPREAD	0.790	0.412	0.359	0.306		-0.484***
MOI	0.000	0.058	0.668	4.995		
AMIHUD	98	1157	230	92		5.697
SPREAD	0.326	0.676	0.390	0.331		-0.005
DMOI	-0.0297	-0.0001	0.0006	0.0339		
AMIHUD	1354	410	125	58		-1296.3**
SPREAD	0.735	0.457	0.348	0.297		-0.437***
SOI	0.000	0.006	0.036	0.393		
AMIHUD	130	1133	342	103		27.21**
SPREAD	0.341	0.669	0.420	0.327		0.0132**
DSOI	-0.0057	-4.38E-06	0.0005	0.0072		
AMIHUD	2278	799	365	154	28	-2250.3***
SPREAD	0.960	0.624	0.452	0.348	0.284	-0.675***
Size	891	1885	3623	7688	82841	
AMIHUD	381	628	682	819	1064	683.7***
SPREAD	0.483	0.500	0.490	0.562	0.623	0.139***
BM	0.321	0.548	0.740	0.964	1.383	

This table reports stock illiquidity based on the ranking of institutional investors' trading activities from the lowest quintile (Q1) to the highest quintile (Q5) in 2012. *SPREAD* and *AMIHUD* are inverse measures of stock liquidity. The foreign institutional ownership (*FOI*) as well as its change (*DFOI*) are widely used as proxies of institutional investor' trading activities. *D* indicates the change during the current month. *MOI*, *DMOI*, *SOI* and *DSOI* are the institutional holdings from two domestic institutional investors, mutual fund and securities dealers, respectively. *Size* and *BM* are respectively the market capitalization and book-to-market. The column of Q5-Q1 reports the results of t-test on the null hypothesis that institutional ownership in Q1 does not differ from that in Q5. Statistical significance at 10%, 5% and 1% is denoted by *, ** and ***, respectively.

Table 3 Regressions of Foreign Institutional Trading Activities on the Stock Liquidity

Panel A	Model 3.1		Model 3.2	
	AMIHUD	*SPREAD*	*AMIHUD*	*SPREAD*
FOI	36.4541***	0.0106***		
	(25.44)	(26.03)		
DFOI			62.3673	-1.1368***
			(0.24)	(-15.66)
Lag*AMIHUD*	0.6159***		0.6438***	
	(187.57)		(265.86)	
Lag*SPREAD*		0.4275***		0.4482***
		(99.02)		(98.80)
Ln*Size*	-327.0301***	-0.1393***	-139.4699***	-0.0842***
	(-42.40)	(-60.55)	(-69.30)	(-96.68)
BM	222.9666***	0.0383***	207.9709***	0.0372***
	(29.52)	(17.83)	(26.80)	(16.31)
MOI	-1.4940**	-0.0030***		
	(-2.06)	(-14.20)		
SOI	1.4655	-0.0002		
	(1.22)	(-0.63)		
DMOI			-55.2590	0.0093
			(-1.44)	(0.79)
DSOI			4.3786	-0.0069
			(0.11)	(-0.55)
_cons	2617.6466***	1.5196***	1327.7812***	1.1485***
	(23.26)	(42.98)	(12.19)	(33.55)
Year Effect	YES	YES	YES	YES

AR(1)	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	[0.084]	[0.125]	[0.008]	[0.000]
Observations	100569	100569	100569	100569

This table reports the regression results of foreign institutional trading activities on the stock liquidity from panel-data regression with firm and year effects from January, 2001 to December, 2012. Estimations are performed using Blundell and Bond (1998) system GMM estimator. *AMIHUD* and *SPREAD* represent for the measures of monthly stock illiquidity. *FOI* and *DFOI* are the monthly foreign institutional ownership and its monthly change to proxy for foreign institutional trading activities, respectively. *D* indicates the change during the current month. Lag indicates a value lagged by one month. Ln*Size* and *BM* are respectively the natural logarithm of market capitalization and book-to-market ratio. *MOI*, *DMOI*, *SOI* and *DSOI* are the institutional holdings from two domestic institutional investors, mutual fund and securities dealers, respectively. The numbers in parenthesis are the t statistics. Statistical significance at 10%, 5% and 1% is denoted by *, ** and ***, respectively. AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 3 Regressions of the Foreign Change in Institutional Holdings on the Stock Liquidity

Panel B	Model 3.3 (DFOI>0)		Model 3.4 (DFOI<0)	
	AMIHUD	*SPREAD*	*AMIHUD*	*SPREAD*
DFOI	-691.8925***	-0.1190***	-90.4557	-0.2740***
	(-5.75)	(-3.86)	(-0.75)	(-8.16)
Lag*AMIUD*	0.5143***		0.6276***	
	(124.76)		(129.95)	
Lag*SPREAD*		0.3033***		0.4371***
		(48.35)		(58.69)
Ln*Size*	-70.4610***	-0.0673***	-80.1998***	-0.0668***
	(-36.47)	(-76.58)	(-37.91)	(-62.99)
BM	72.0607***	0.0441***	130.0710***	0.0563***
	(10.54)	(18.07)	(17.27)	(19.97)
DMOI	-60.6651**	-0.0205**	-28.1388	0.0029
	(-2.25)	(-1.98)	(-0.92)	(0.24)
DSOI	-13.5909	0.0004	1.5147	-0.0019
	(-0.48)	(0.04)	(0.06)	(-0.19)
_cons	749.0040***	1.1816***	779.5667***	1.0206***
	(11.73)	(37.94)	(9.97)	(28.91)
Year Effect	YES	YES	YES	YES
AR(1)	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	[0.096]	[0.295]	[0.012]	[0.108]
Observations	42304	42304	37155	37155

This table reports the regression results of foreign institutional ownership change (*DFOI*) on the stock liquidity from panel-data regression with firm and year effects from January, 2001 to December, 2012. Estimations are performed using Blundell and Bond (1998) system GMM estimator. *AMIHUD* and *SPREAD* represent for the measures of monthly stock illiquidity. *DFOI* is the monthly foreign institutional ownership change to proxy for foreign institutional trading activities. *D* indicates the change during the current month. Lag indicates a value lagged by one month. Ln*Size* and *BM* are respectively the natural logarithm of market capitalization and book-to-market ratio. *DMOI* and *DSOI* are the change in institutional holdings from two domestic institutional investors, mutual fund and securities dealers, respectively. The numbers in parenthesis are the t statistics. Statistical significance at 10%, 5% and 1% is denoted by *, ** and ***, respectively. AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 4 Regressions of Foreign Institutional Herding Behavior on the Stock Liquidity

	HERD>0.5		*HERD*<0.5	
	AMIHUD	*SPREAD*	*AMIHUD*	*SPREAD*
FOI	0.6820***	0.0020***	1.3730***	0.0028***
	(5.75)	(9.15)	(10.43)	(6.40)
HERD	-20.8204***	-0.0349***	-57.9784***	-0.0604***
	(-6.34)	(-6.50)	(-16.19)	(-6.12)
Lag*AMIHUD*	0.5794***		0.6371***	
	(139.50)		(121.57)	
Lag*SPREAD*		0.1756***		0.1438***
		(29.02)		(13.79)
Ln*Size*	18.9611***	0.0680***	21.9306***	0.0723***
	(17.09)	(32.74)	(16.94)	(17.12)
BM	-1.0698***	-0.0016***	-1.1220***	-0.0022***
	(-12.51)	(-10.22)	(-10.22)	(-6.14)
MOI	-0.1100	0.0001	0.0393	0.0001
	(-1.17)	(0.63)	(0.37)	(0.27)
SOI	0.0294	0.0002	0.0532	0.0003
	(0.23)	(0.93)	(0.35)	(0.80)
_cons	175.0660***	0.6251***	188.6920***	0.7309***
	(25.03)	(47.54)	(24.20)	(29.33)
Year Effect	YES	YES	YES	YES

AR(1)	[0.000]	[0.000]	[0.000]	[0.000]
AR(2)	[0.128]	[0.122]	[0.085]	[0.096]
Observations	17387	17387	12902	12902

This table reports the results of foreign institutional herding behavior (*HERD*) on the stock liquidity from panel-data regression with firm and year effects from January, 2001 to December, 2012. Estimations are performed using Blundell and Bond (1998) system GMM estimator. *AMIHUD* and *SPREAD* represent for the measures of monthly stock illiquidity. *FOI* is the monthly foreign institutional ownership to proxy for foreign institutional trading activities. Lag indicates a value lagged by one month. Ln*Size* and *BM* are respectively the natural logarithm of market capitalization and book-to-market ratio. *MOI* and *SOI* are the institutional holdings from two domestic institutional investors, mutual fund and securities dealers, respectively. Here, we divide the sample into two subsamples each month. The first subsample includes stocks with the herding measure (*HERD*) larger than 0.5, which represents a subsample with institutional herding to buy. The other sample includes stocks with the herding measure less than 0.5, which represents a subsample with institutional herding to sell. The numbers in parenthesis are the t statistics. Statistical significance at 10%, 5% and 1% is denoted by *, ** and ***, respectively. AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

Table 5 Regressions of Foreign Institutional Passive Trading or Aggressive Trading on the Stock Liquidity

	AMIHUD	*SPREAD*
FOI	41.4995***	0.0111***
	(24.14)	(22.93)
SellUp	-2011.9822***	-0.7904***
	(-4.67)	(-6.41)
BuyDown	-1814.3307***	0.4489***
	(-4.01)	(3.69)
BuyUp	-1294.1014***	-0.4958***
	(-5.95)	(-7.87)
SellDown	-899.7400***	0.3565***
	(-3.40)	(4.64)
Lag*AMIHUD*	0.6197***	
	(182.88)	
Lag*SPREAD*		0.4296***
		(95.71)
Ln*Size*	-310.1521***	-0.1352***
	(-37.62)	(-55.38)
BM	202.3294***	0.0362***
	(26.32)	(16.24)
MOI	4.0973***	-0.0027***
	(3.78)	(-8.62)
SOI	2.8653**	0.0004
	(2.40)	(1.03)
_cons	1675.4008***	1.1165***

	(18.17)	(40.61)
Year Effect	YES	YES
AR(1)	[0.000]	[0.000]
AR(2)	[0.228]	[0.064]
Observations	97325	97325

This table reports the results of foreign institutional passive trading and aggressive trading on the stock liquidity from panel-data regression with firm and year effects from January, 2001 to December, 2012. Estimations are performed using Blundell and Bond (1998) system GMM estimator. Here, we consider foreign institutional ownership under four alternative trading strategies, *SellUp*, *BuyDown*, *BuyUp*, and *SellDown*. *AMIHUD* and *SPREAD* represent for the measures of monthly stock illiquidity. *FOI* is the monthly foreign institutional ownership to proxy for foreign institutional trading activities. Lag indicates a value lagged by one month. Ln*Size* and *BM* are respectively the natural logarithm of market capitalization and book-to-market ratio. *MOI* and *SOI* are the institutional holdings from two domestic institutional investors, mutual fund and securities dealers, respectively. The numbers in parenthesis are the t statistics. Statistical significance at 10%, 5% and 1% is denoted by *, ** and ***, respectively. AR(1) and AR(2) are the p-values for first and second order autocorrelated disturbances in the first differences equations.

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□ □ □ □ □ □ The Impacts of Board Characteristics on Performance and Risk-taking: Evidence from the U.S. Banking Industry

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This study examines the impact of board characteristics on bank performance and risk-taking behavior during the financial crisis and non-financial crisis periods, using a sample of 59 U.S. commercial banks and savings banks during 2000 to 2013. The empirical findings indicate that board structure does affect bank performance and their risk-taking behavior at different performing banks. For high-performing banks, CEO duality would decrease bank's market performance either in crisis or non-crisis period, and it would also decrease market volatility. For low-performing banks, board structure plays more significant effect on bank performance and bank risks than it does on high-performing banks either crisis or non-crisis period. We find that independent board, CEO duality and board size have significantly positive effects on low-performing bank performance, but only CEO duality stays its influence in bank performance during financial financial tsunami of 2008. Moreover, board size, CEO duality and independent board have significantly negative effects on low-performing bank risks and only board size stay its significant influence in bank risks during financial tsunami.

Keywords：Bank Performance, Risk-taking, Board structure, Financial Crisis

1. Introduction

Since the Asian Financial crisis in year of 1997, the issue of corporate governance has been extensively addressed not only in the related research of financial studies but also in the practice of corporate business.

Corporate governance has been defined by several organizations, for instance, Organization for Economic Co-operation and Development, Basel Committee, World Bank, and so on. According to the Organization for Economic Co-operation and Development (OECD), corporate governance is defined as the protection between shareholders' rights and stakeholders' rights, fairness to all shareholders, board of directors' responsibilities, financial disclosure, and financial transparency. According to the Basel Committee, the role of corporate governance in banking industry is used to emphasize on the roles of management and board of directors (especially independent directors), effective management to reduce conflicts, internal and external audit, governance transparency, and importance of regulations. Moreover, World Bank proposes the structure of corporate governance in 1999, including internal governance and external governance. It asserts that board of directors should ensure information and management transparency, managers and board of directors should balances stakeholders rights and fairness. However, internal governance might involves moral hazard problems, external governance (ex: regulations) also plays an important role to improve the effectiveness of governance and thereby maximizes the value of a firm.

The definition and scope of corporate governance varied with the industries. In general, the board of director plays a key role in the corporate governance. The Sarbanes-Oxley Act (SOX) at year of 2002 mandated strict reforms to improve function of corporate governance for US-listed firms, it emphasizes the independence of auditing committee and board of director to enhance the financial transparency in order to achieve better shareholder's protection. This motivates to examine the impact of board structure on firm performance in this study.

The subprime crisis in 2008 heavily deteriorated bank performance due to high risk loan and high leverage operation, and the financial globalization speeded up the shocks to the other countries. Past literature has discussed the risk-taking behavior from different perspectives, for example, bank regulatory capital (Distinguin et al., 2013), ownership structure (Knyazeva et al., 2013), market discipline (Cubillas et al., 2012). Thus, the risk-taking behavior in banks that is seldom addressed in current literature deserves further investigation, especially in the role of board structure to bank's risk-taking.

This study focuses on the influence of board structure in bank performance and risk-taking behavior, and compares the different influences between crisis period of 2008 and non-crisis period, using a sample of U.S. commercial banks and savings banks during 2000 to 2013. The empirical findings indicate that board structure does affect bank performance and their risk-taking behavior at different performing banks. For high-performing banks, CEO duality would decrease bank's market performance either in crisis or non-crisis period, and it would also decrease market volatility. For low-performing banks, board structure plays more significant effect on bank performance and bank risks than it does on high-performing banks either crisis or non-crisis period. We find that independent board, CEO duality and board size have significantly positive effects on low-performing bank performance, but only CEO duality stays its influence in bank performance during financial financial tsunami of 2008. Moreover, board size, CEO duality and independent board have significantly negative effects on low-performing bank risks and only board size stay its significant influence in bank risks during financial tsunami.

2. Literature review and hypothesis establishments

Changes of corporate governance at banks during past decades substantially altered the governance of banking organization. Adams and Mehran (2003) has documented the difference of corporate governance, especially in board structure, between US banking holding companies and manufactured firms. How does these changes in corporate governance affect bank performance and risk-taking behavior needs to be further addressed.

2.1 The impact of board structure on bank performance

Adams and Mehran (2003) pointed out that average board size of US BHC (bank holding company) during 1986 to 1999 is 18 directors on the board which is significantly higher than that in manufactured firms of 12 directors. Will larger board size improve bank performance ? Most literature indicated that there existed positive relationship between board size and firm performance (Dalton et al. ,1999; Mak and Li ,2001;Kiel and Nicholson,2003;Dalton and Dalton,2005). Andres and Vallelado (2008), using firm sample of six OECD countries, think larger board size would enhance firm performance due to various background and professional knowledge from larger board; the optimal board size is 19 directors in the board. They also found the inverse U shape relationship between bank performance and board size. Aebi, Sabato and Schmid (2012) also supported the positive relationship between board size and US bank performance during financial crisis.

Based on above, we establish the following hypotheses.

H_{1a} : The board size has positive effect on bank performance.

H_{1b}: The board size has positive effect on bank performance in financial crisis.

2.2 The impact of CEO duality on bank performance

Past literature have proposed that dual role of CEO also serving the president of the board plays certain influence on the firm performance. Fama and Jensen (1983) and Jensen (1993) think that CEO duality would weaken the independent monitoring of the board. However, according to Boyd (1995), CEO duality helps efficient decision making to improve firm performance in financial crisis, thus, the positive relationship between CEO duality and firm performance exists during financial distress period. Thus, we establish the following hypotheses.

H_{2a}: CEO duality has negative effect on bank performance.

H_{2b}: CEO duality has positive effect on bank performance during financial crisis.

2.3 The impact of independent board on bank performance

The function of independent board is to mitigate the potential opportunism of CEO so as to decrease the interest conflicts between managers and shareholders (Crespí-Cladera and Pascual-Fuster, 2013). Lee, Rosenstein and Wyatt(1999) and Byrd and Hickman (1992) also supported the positive relation between independent director and firm performance.

Whether above positive relation between independent director and firm performance exists during financial distress period had been barely documented. Francis et al. (2012) investigated the influence of corporate governance in firm performance. They found that firm performance during crisis period which is measured by accumulated stock return during crisis could be improved by higher ratio of independent director in the board. Based on above, we establish the following hypotheses.

H_{3a} : The board independence has positive effect on bank performance.

H_{3b} : The board independence has positive effect on bank performance during financial crisis.

This research is designed to test the relation between board characteristics and bank performance. Considering the higher risk-taking followed by greater profitability, we examine above hypotheses by measuring bank performance in terms of both bank performance and risk-adjusted bank performance.

2.4 The impact of board size on bank risks

Whether agency problems between management and shareholders with respect to risk-taking behavior may also vary with the bank's board characteristics. Past literature has documented whether bank risk-taking varies with bank's ownership structure (leaven and Levine, 2009; Jensen and Meckling, 1976) and with managerial incentives (Coles, Naveen and Naveen, 2006). Yet, few research has assessed how board structure shapes the risk taking behavior of banks. The way to meet capital requirement is either to reduce risk-taking incentives of banks by restricting banks from engaging in nonlending activities, such as securities and insurance underwriting or to raise bank capital. Some research suggested that loss for bank shareholders from stringent capital requirements might intensify shareholder's risk-taking incentives(Koehn and Santomero, 1980; Buser, Chen, and Kane,1981). We would investigate the role of board characteristics in the agency problems between management and shareholders with respect to bank risk-taking behavior in this study.

Pathan (2009) show the significantly positive relation between strong board and risk-taking behavior, that is, risk control capability is stronger for strong board in terms of smaller board, higher ratio of independent directors. Accordingly, we establish the following hypotheses.

H_{4a} : The board size has negative effect on bank's risk-taking behavior.

H_{4a} : The board size has negative effect on bank's risk-taking behavior during financial crisis.

2.5 The impact of CEO duality on bank risk

Amihud and Lev(1981),Pathan(2009),Castañer and Kavadis (2013) suggested the negative relation between CEO power and bank risk management. CEO power is measured by CEO duality and whether internally hired. The wealth of dual CEO is less likely to be diversified, considering the expected value of debt tax shield and bankrupt costs(Parrino et al., 2005), CEO would choose to be a risk-averter to avoid the wealth loss. Castañer and Kavadis (2013) indicated that dual CEO tends to decrease risk exposure in the way of diversification. However, Ferrero et al. (2012) presents insignificant relation between dual CEO and risk-averse in S&P500 firms during 2008 financial financial tsunami. Even though, we argue that dual CEO would help reduce bank's risks during financial crisis. Accordingly, we establish the following hypotheses.

H_{5a} : The dual CEO has a negative impact on bank risks.

H_{5b} : The dual CEO has a negative impact on bank risks during financial crisis.

2.6 The impact of independent board on bank risks

Fredrickson, Hambrick and Baumrin(1988), Connors(1989), Baysinger and Hoskisson(1990) indicated that independent board could effectively monitor CEO's decision making in the development of firms. Also, Ferrero, Izquierdo and Torres (2012) show that higher ratio of independent directors on the board could restrict over risk-taking during financial financial tsunami of 2008. Accordingly, we establish the following hypotheses.

H_{6a} : The independent board has a negative impact on bank's risk-taking.

H_{6b} : The independent board has a negative impact on bank's risk-taking during financial crisis.

3. Research methodology

3.1 sample description

We examine the impact of board structure on both bank performance and risks by using pooled sample of 59 US commercial banks during 2000 to 2013. The financial information and board structure data are obtained from Bankscope, Execucomp and U.S. Securities. Board information are hand-collected from Exchange Commission website.

3.2 Empirical model

The empirical models are established as follow.

$$perform_{it} = \beta_0 + \beta_1 bosize_{it} + \beta_2 indepr_{it} + \beta_3 dual_{it} + \beta_4 lnass_{it} + \beta_5 debt_{it} + \beta_6 liqratio_{it} + \beta_7 capratio_{it} + \beta_8 yeardum_{it} + \beta_9 intbosz_{it} + \beta_{10} intdual_{it} + \beta_{11} intyrind_{it} + \varepsilon_{it}$$

Where i=1,...,N , t=1,...,T (1)

$$risk_{it} = \beta_0 + \beta_1 bosize_{it} + \beta_2 indepr_{it} + \beta_3 dual_{it} + \beta_4 lnass_{it} + \beta_5 debt_{it} + \beta_6 liqratio_{it} + \beta_7 capratio_{it} + \beta_8 yeardum_{it} + \beta_9 intbosz_{it} + \beta_{10} intdual_{it} + \beta_{11} intyrind_{it} + \varepsilon_{it}$$

Where i=1,...,N , t=1,...,T (2)

Variable definition:

Dependent variables:

$perform_{it}$ is measured by ROA, ROE and one-year stock return (RET1YE).

$risk_{it}$ is measured by the standard deviation of performance of three-year at t, t-1 and t+1,VOLROA, VOLROE, and VOLRET.

Independent variables:

Board structure is measured by board size (BOSIZE), dual role of CEO (DUAL) and the ratio of independent directors (INDEPR).

(1) BOSIZE：number of directors on the board

(2) DUAL：1 if CEO also serves as the president of the board, otherwise, it is 0

(3) INDEPR： the ratio of independent directors on the board

(4) Yeardum：1 if the sample year is equal to 2008 or 2009, otherwise, it is 0

(5) Intbosz：interaction term of Yeardum and BOSIZE

(6) Intdual：interaction term of Yeardum and DUAL

(7) Intyrind：interaction term of Yeardum and INDEPR

Control variables

(1) CAPRATIO：bank's capital divided by total risky assets

(2) lnass：logarithm of total Assets。

(3) DEBT：total debt divided by total assets

(4) LIQRATIO：total liquidity assets divided by total assets

4. Empirical results

4.1 Descriptive statistics

Table 4.1 show the descriptive statistics of all variables. Panel A is the measure of bank performance with mean ROA of 0.89%, ROE of 8.15% and RET1YE of 8.94%, and the mean ADJROA of 11.04%, ADJROE of 11.55% and ADJRET of 8.94%. Panel B show the bank risks, both ROE and RET1YE have greater volatilities than that in ROA. We also list the performance and risks before, during and after financial financial tsunami year defined as year of 2008 and 2009. In general, we find the performances before and after financial tsunami year are better than that in financial tsunami year; and the risk of financial tsunami year is much higher than that before and after financial crisis. Comparing performance and risks before and after financial tsunami year, we find the performance is generally higher and risks is lower before crisis than those after crisis.

There is around 60% of the sample with CEO duality, and mean board size is 25 showing banks with greater board size. The average ratio of independent directors is 79%.

Table 4.1 Descriptive statistics

Variable name	N	mean	Standard deviation	Min	Max
Panel A：bank performance					
ROA	624	0.8976	1.4002	-6.53	12.15
ROE	623	8.1536	27.9217	-487.57	211.1
RET1YE	732	8.9493	35.9590	-92.686	284.158
ADJROA	571	11.0461	20.0776	-16.2076	204.3819
ADJROE	570	11.5580	33.4513	-10.4876	676.7011
ADJRET	657	0.3406	2.3425	-17.8406	27.9846
Panel B：bank risks					
VOLROA	571	0.4190	0.7017	0.0057	7.7439
VOLROE	571	7.1403	26.7957	0.0141	356.2554
VOLRET	657	26.9435	20.9885	0.0989	205.0164
Bank performance and risks before Financial tsunami (2000 ~ 2007)					
ROA	322	1.2128	0.4681	-0.72	2.71
ROE	322	13.8230	6.0565	-8.99	47.88
RET1YE	400	11.1679	30.7692	-69.706	175.8010
ADJROA	319	14.0278	20.4448	-0.4459	204.3819
ADJROE	319	15.1170	41.9269	-0.4787	676.7011
ADJRET	386	0.7583	2.4595	-13.1925	27.9846
VOLROA	319	0.2669	0.4178	0.0057	3.7264
VOLROE	319	3.4096	5.8457	0.0141	56.2598
VOLRET	386	24.3923	18.1929	0.0989	114.1294
Bank performance and risks during Financial tsunami (2008 ~ 2009)					
ROA	99	-0.1770	1.6007	-5.84	2.79
ROE	99	-4.7112	27.5320	-145.05	27.42
RET1YE	113	-17.9957	33.3229	-92.686	58.826
ADJROA	99	5.4519	20.7668	-16.2076	168.0089
ADJROE	99	2.2402	5.5416	-10.4876	32.7526
ADJRET	110	-1.04359	2.7001	-17.8406	1.5232
VOLROA	99	0.74028	0.8195	0.0057	3.7046
VOLROE	99	11.6363	25.1366	0.4209	218.6847
VOLRET	110	27.5429	19.0037	2.6192	97.0343
Bank performance and risks after Financial tsunami (2010 ~ 2013)					
ROA	203	0.9217	1.9315	-6.53	12.15
ROE	202	5.4212	42.9406	-487.57	211.1

Table 4.1 Descriptive statistics (continued)

RET1YE	219	18.8004	39.3665	-72.833	284.158
ADJROA	153	8.4493	17.7001	-13.4350	183.5973
ADJROE	152	10.1576	20.2244	-2.9807	163.9712
ADJRET	161	0.2850	1.1114	-6.4754	3.0491
VOLROA	153	0.5282	0.9593	0.0057	7.7439
VOLROE	153	12.0094	46.3403	0.0624	356.2554
VOLRET	161	32.6505	26.7383	2.0810	205.0164
Panel C：board characteristics					
BOSIZE	561	12.5918	3.1508	6	25
DUAL	1460	0.6047	0.4890	0	1
INDEPR	466	0.7963	0.1144	0.4	1
Panel D：control variables					
Asset(thousand)	624	85,992,564.23	274,613,984	333,100	2,264,909,000
DEBT	624	0.8952	0.0742	0.064	99.67
LIQRATIO	615	0.0736	0.0913	0.0036	0.6594
CAPRATIO	552	0.141	0.0382	0.013	0.499

Note: ROA is EBIT divided by total assets; ROE is EBIT divided by total equity value; RET1YE is one year stock return; VOLROA is the standard deviation of ROA at year t-1,t, t+1; VOLROE is the standard deviation of ROE at year t-1,t, t+1; VOLRET is the standard deviation of RET1YE at year t-1,t, t+1; DUAL is one if CEO also serving as the president of the board, otherwise, 0; BOSIZE is the total number of directors on the board; INDEPR is the ratio of independent directors to board size; Asset is logarithm of total assets (in thousands dollars); DEBT is total debt divided by total assets; LIQRATIO is total liquid assets divided by total assets; CAPRATIO is total capital divided by total risky assets.

4.2 Empirical results

All regression analyses are results of robust adjusted regressions. In section 4.2.1, Table 4.2 and 4.3 present the results for both bank performance and bank risks respectively. In section 4.2.2, the high and low bank performance empirical results are shown in Table 4.4, 4.5, 4.6 for high-performing banks and in Table 4.7,4.8 and 4.9 for low-performing banks.

4.2.1 Board structure, performance, and risk

From Table 4.2, we find that CEO duality has a significantly positive effect on bank performance in terms of ROA and ROE while they become insignificant after adjusting the risks, implying the risk increasing with higher performance. Board size has a significantly positive effect on adjusted ROA only. The independent board doesn't present any influence in bank performances. Therefore, H_{2a}, H_{2b}, H_{3a}, H_{3b} are not confirmed in this study. Taking a look at the results on financial crisis, we find bank performance does show significantly lower at ROA and ROE during financial tsunami (Yeardum), but, the adjusted performance presents to be insignificant which again might be due to the high volatilities during financial tsunami. As to the effect of board on bank performance during crisis period, we only find board size has significantly negative effect on adjusted stock return, meaning larger board size during crisis period would deteriorate bank adjusted performance. Most hypotheses for crisis period cannot be confirmed. We think the insignificant results might be because the cross out effects between high and low performance. Therefore, we further try to explore the analysis by dividing sample into high and low performance group based on median value of bank performance. Those results are shown in section 4.2.2 later.

Table 4.3 reveals the results of board effect on bank risks. We find significantly positive effect of board size on bank risks in terms of ROA volatility, that is, larger board help mitigate bank risks, confirming H_{4a}. Besides, CEO duality also shows significantly negative influence in stock volatility, confirming H_{5a}. During financial tsunami, there is not any board characteristics shown significant effects on bank risks.

In summary, we cannot find consistently significant results of the board structure on bank performance or banks risks from whole sample. However, we argue that the insignificant results might be because the cross out effects between high and low performance. Thus, we further examine the same issue by using high-performing and low-performing banks sample next in section 4.2.2.

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Table 4.2 Regression analysis of bank performance

	Bank performances			risk-adjusted bank performances		
Variables	ROA	ROE	RET1YR	ADJROA	ADJROE	ADJRET
Intercept	1.439	-77.342	70.224	15.682	10.006	-0.934
	(0.2948)	(<.0001)	(0.3565)	(0.3244)	(0.4913)	(0.7699)
Bosize	0.013	0.1374	0.500	0.242 *	0.1876	0.039
	(0.2972)	(0.2827)	(0.4682)	(0.0950)	(0.1520)	(0.1692)
Dual	0.150 **	1.4851 **	2.505	1.261	0.6911	0.223
	(0.0216)	(0.0281)	(0.4921)	(0.1025)	(0.3208)	(0.1483)
Indepr	-0.331	-3.5669	11.698	-1.706	-2.3217	-0.927
	(0.2530)	(0.2330)	(0.4685)	(0.6169)	(0.4508)	(0.1715)
Yeardum	-1.292*	-15.082**	-28.262	-8.436	-8.0466	-0.421
	(0.0502)	(0.0266)	(0.4400)	(0.2483)	(0.2220)	(0.7727)
Intbosz	0.033	0.232	-1.484	0.101	-0.0732	-0.105 *
	(0.2049)	(0.3936)	(0.3108)	(0.7294)	(0.7811)	(0.0718)
Intdual	-0.126	0.185	0.175	0.291	0.8114	-0.083
	(0.3880)	(0.9022)	(0.9828)	(0.8579)	(0.5795)	(0.7983)
Intyrind	0.478	7.368	23.557	2.346	4.7516	1.339
	(0.4531)	(0.2621)	(0.5054)	(0.7406)	(0.4569)	(0.3418)
lnass	-0.048 **	-0.545 **	-0.180	-0.595**	-0.4882**	0.008
	(0.0434)	(0.0275)	(0.8923)	(0.0305)	(0.0491)	(0.8762)
DEBT	0.668	109.555***	-101.793	-2.557	4.3688	0.083
	(0.5977)	(<.0001)	(0.1472)	(0.8616)	(0.7468)	(0.9773)
LIQRATIO	-0.124	-0.1426	12.094	4.014	6.5025 *	0.277
	(0.7193)	(0.9682)	(0.5291)	(0.3173)	(0.0727)	(0.7278)
CAPRATIO	-0.011	-0.052	1.025 *	0.008	-0.0909	0.069***
	(0.2990)	(0.6363)	(0.0809)	(0.9439)	(0.4118)	(0.0043)
N	383	382	382	342	341	340
R-Square	0.1016	0.2097	0.1296	0.0936	0.0999	0.0916

Note: ROA is EBIT divided by total assets; ROE is EBIT divided by total equity value; RET1YE is one year stock return; VOLROA is the standard deviation of ROA at year t-1,t, t+1; VOLROE is the standard deviation of ROE at year t-1,t, t+1; VOLRET is the standard deviation of RET1YE at year t-1,t, t+1; DUAL is one if CEO also serving as the president of the board, otherwise, 0; BOSIZE is the total number of directors on the board; INDEPR is the ratio of independent directors to board size; Asset is logarithm of total assets (in thousands dollars); DEBT is total debt divided by total assets; LIQRATIO is total liquid assets divided by total assets; CAPRATIO is total capital divided by total risky assets; Yeardum is one if sample year is 2008 and 2009, otherwise, 0; Intbosz is the interaction term between Yeardum and BOSIZE; Intdual is the interaction term between Yeardum and dual; Intyrind is the interaction term between Yeardum and INDEPR.

*,**,***represents significance level at 10%,5% and 1%.

Table 4.3 Regression analysis of bank risks

Variables	VOLROA	VOLROE	VOLRET
Intercept	1.947	10.005	10.390
	(0.0004)	(0.0936)	(0.8156)
Bosize	-0.010**	-0.082	-0.534
	(0.0452)	(0.1326)	(0.1850)
Dual	-0.002	0.050	-4.771**
	(0.9225)	(0.8622)	(0.0269)
Indepr	-0.094	-1.280	-11.489
	(0.4207)	(0.3168)	(0.2243)
Yeardum	0.158	0.550	-28.081
	(0.5310)	(0.8407)	(0.1673)
Intbosz	-0.001	-0.009	0.851
	(0.8545)	(0.9325)	(0.2963)
Intdual	0.029	0.233	-7.150
	(0.5959)	(0.7014)	(0.1143)
Intyrind	-0.003	1.509	30.913
	(0.9872)	(0.5701)	(0.1158)
lnass	0.017*	0.119	1.368*
	(0.0681)	(0.2458)	(0.0729)
DEBT	-1.943***	-7.681	0.131
	(0.0001)	(0.1624)	(0.9974)
LIQRATIO	-0.073	-0.758	13.995
	(0.5981)	(0.6142)	(0.2088)
CAPRATIO	-0.006	-0.0647	0.497
	(0.1345)	(0.1571)	(0.1435)
N	342	342	340
R-Square	0.0414	0.0418	0.0668

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

4.2.2 Regression analyses for high-performing and low-performing banks

We further examine the same issue by using median value of bank performance to further separate sample into high-performing and low-performing banks. Table 4.4, 4.5 and 4.6 show the results for sample of high-performing banks, Table 4.7 to 4.9 for sample of low-performing banks. Table 4.4 presents performance results of both basic models and models with interactions between board characteristics and crisis year. Similarly, Table 4.5 gives the results of adjusted performances and Table 4.6 shows the results of bank risks. As shown in Table 4.4 and Table 4.5, we find the CEO duality has significantly negative effects on stock returns at high-performing banks, but, it becomes insignificant after adjusting the risk factor. The interaction term between CEO duality (DUAL) and crisis year (Yeardum) has a significantly negative effect on stock returns, adjusted ROA and adjusted ROE, that is, during financial crisis, high-performing banks with CEO duality would have significantly lower performances than those without CEO duality.

Table 4.7 shows the results of bank risks for high-performing banks. The results indicate that high-performing banks with CEO duality have relatively lower stock volatility than those without CEO duality. During financial tsunami, CEO duality would intensify bank's volatility of ROE; high-performing banks with higher ratio of independent director and larger board have relatively lower bank risks in terms of ROA measure.

In summary of results in high-performing banks, we find the CEO duality does play certain role on bank performance and risks. When bank CEO also serving as the president of the board will reduce bank market performance in favor of H_{2a} and also decrease market volatility in favor of H_{5a}. During crisis period, high-performing banks with CEO duality will reduce bank's accounting performance in terms of ROA and ROE after adjusting risk factor. Besides, higher independent board in terms of independent director ratio and higher board size will also help control bank risks during financial tsunami in favor of in favor of H_{4b} and H_{6b}.

Table 4.7 to 4.9 show the results for sample of low-performing banks. We do find the significant influence of board structure on low-performing bank's performance and risks. Banks with CEO duality have a consistently and significantly positive impact on bank accounting performance in terms of ROA and ROE while this significant effect on performance disappears after considering the risk factor. Although CEO duality does not have significant effects on market performance of stock return, it reduces market volatility of low-performing banks in favor of H_{5a} and also helps improve risk-adjusted bank market performance during crisis period, confirming H_{2b}. Those results indicate that CEO duality helps efficient decision making to improve firm performance in financial crisis, thus, the positive relationship between CEO duality and firm performance exists during financial distress period which result is consistent with findings in Boyd (1995).

Except for CEO duality, board independence is also supported to have a significantly positive effect on low-performing bank's performance and negative effects on bank risks. Table 4.7 shows that bank performance in terms of ROA is improved by the higher ratio of independent directors on the board regardless of ROA or risk-adjusted ROA, confirming H_{3a}. We also find that higher independence of the board helps mitigate the low-performing bank's risks in terms of VOLROA and VOLRET, in favor of H_{6a}. Independent board could mitigate the potential opportunism of CEO though monitoring of independent board, thus, improve bank performance and reduce bank risk-taking behavior. However, above positive relation between independent board and bank performance, hypothesis H_{3b}, is not supported during financial distress period.

Taking a look at the effect of board size on low-performing bank's performance and risks, we find significantly positive relation between board size and market performance in terms of RET1YR and ADJRET (confirming H_{1a}), and significantly negative relation between board size and bank risks in terms of VOLRET and VOLROE, confirming H_{4a}. During financial tsunami, larger board will enhance low-performing bank's risk adjusted accounting performance (ADJROA) in favor of H_{1b}, and also help control market volatility (VOLRET) in favor of H_{4b}.

Overall, we conclude that using the whole sample to test research hypotheses, board structure seems unrelated to bank performance and bank risks in terms of inconsistent results. However, dividing bank performance to high-performing and low-performing banks based on median of performance, we find different results for high- and low-performing banks. For high-performing banks, CEO duality would decrease bank's market performance either in crisis or non-crisis period, and it would also decrease market volatility. For low-performing banks, except for CEO duality, independent board and board size also play significant role in bank performance and bank risks. We find that independent board, CEO duality and board size have positive effects on bank performance, but only CEO duality stays its influence in bank performance during financial tsunami. As to the effect of board structure on bank risks at low-performing banks, we find board size, CEO duality and independent board have negative effects on bank risks and only board size stay its significant influence in bank risks during financial tsunami.

Table 4.4 Regression analyses of bank performance for high-performing banks

Variables	ROA	ROA	ROE	ROE	RET1YR	RET1YR
Intercept	1.08	1.0596	-24.0863	-23.9355	54.4162	57.565
	(0.3392)	(0.3609)	(0.0602)	(0.0678)	(0.4209)	(0.3824)
BOSIZE	-0.0117	-0.0106	-0.0576	-0.0656	0.3949	0.1679
	(0.2323)	(0.2926)	(0.5745)	(0.5471)	(0.4586)	(0.7513)
DUAL	0.0264	0.0153	-0.4942	-0.5798	-5.9564**	-2.655
	(0.6057)	(0.7726)	(0.3536)	(0.3065)	(0.0450)	(0.3825)
Indepr	-0.2816	-0.2885	-2.3209	-2.0963	17.2771	15.4381
	(0.1979)	(0.1955)	(0.2964)	(0.3583)	(0.1853)	(0.2400)
Lnass	0.0085	0.0071	0.2047	0.2185	-0.4156	-0.1552
	(0.6843)	(0.7384)	(0.3077)	(0.2859)	(0.7256)	(0.8933)
DEBT	0.6677	0.7064	42.1349***	41.5417***	-51.8544	-55.6659
	(0.5555)	(0.5409)	(0.0009)	(0.0013)	(0.4204)	(0.3747)
LIQRATIO	-0.2951	-0.2429	4.0224	5.1309*	4.3089	0.2321
	(0.3167)	(0.4365)	(0.1713)	(0.0940)	(0.7813)	(0.9878)
CAPRATIO	-0.0071	-0.0066	-0.0502	-0.0455	0.7119	0.5784
	(0.3440)	(0.3920)	(0.5441)	(0.5918)	(0.1390)	(0.2178)
Yeardum	-0.1284	0.4269	-1.5593*	11.7011	-3.3001	-2.1653
	(0.1766)	(0.7507)	(0.0534)	(0.2564)	(0.4443)	(0.9643)
Intyrind		-0.4655		-14.7805		5.9058
		(0.6873)		(0.1449)		(0.8860)
intdual		0.1528		1.9413		-25.298***
		(0.5376)		(0.3357)		(0.0065)
intbosz		-0.0207		-0.1701		1.0708
		(0.6479)		(0.5680)		(0.5618)
N	171	171	175	175	175	175
R-Square	0.0524	0.0568	0.0941	0.1010	0.0560	0.0897

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

Table 4.5 Regression analyses of adjusted bank performance for high-performing banks

Variables	ADJROA	ADJROA	ADJROE	ADJROE	ADJRET	ADJRET
Intercept	-2.6460	-13.7746	40.5011	42.2435	-5.1875	-4.8902
	(0.9205)	(0.5784)	(0.1099)	(0.1040)	(0.5561)	(0.5790)
BOSIZE	0.3123	0.2028	0.2634	0.2682	0.1097	0.0871
	(0.1714)	(0.3440)	(0.1911)	(0.2123)	(0.1072)	(0.2122)
DUAL	-0.1930	1.0724	-1.3117	-0.6791	0.358	0.6202
	(0.8739)	(0.3508)	(0.2141)	(0.5478)	(0.3577)	(0.1349)
Indepr	-3.1351	-2.8409	-0.7998	-0.3704	-1.127	-1.5424
	(0.5394)	(0.5482)	(0.8547)	(0.9344)	(0.5010)	(0.3771)
Lnass	-0.7321	-0.3786	-0.2923	-0.3327	-0.1006	-0.0727
	(0.1346)	(0.4022)	(0.4598)	(0.4109)	(0.5036)	(0.6298)
DEBT	20.485	25.0067	-31.4221	-33.4183	7.8144	7.5728
	(0.4415)	(0.3116)	(0.2122)	(0.1949)	(0.3496)	(0.3643)
LIQRATIO	16.434**	15.1876**	3.6982	3.4013	4.2406**	3.9556**
	(0.0140)	(0.0182)	(0.5139)	(0.5654)	(0.0329)	(0.0472)
CAPRATIO	0.2195	0.3058*	-0.0647	-0.0701	0.1168*	0.1086*
	(0.2039)	(0.0610)	(0.6881)	(0.6719)	(0.0573)	(0.0769)
Yeardum	-2.7508	43.3228	-2.3441	28.8817	0.7435	0.1565
	(0.1963)	(0.1123)	(0.1284)	(0.1424)	(0.1435)	(0.9783)
Intyrind		-22.3971		-28.7351		1.3238
		(0.3400)		(0.1383)		(0.7886)
Intdual		-18.4253***		-9.3297**		-1.5727
		(0.0003)		(0.0156)		(0.1604)
Intbosz		-0.9981		0.0941		0.0506
		(0.2780)		(0.8687)		(0.8181)
N	154	154	164	164	139	139
R-Square	0.0337	0.1078	0.0291	0.0616	0.0689	0.0813

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

Table 4.6 Regression analyses of banks risks for high-performing banks

Variables	VOLROA	VOLROA	VOLROE	VOLROE	VOLRET	VOLRET
Intercept	0.5588	0.5844	-3.7705	-2.5136	20.2991	20.7022
	(0.2765)	(0.2400)	(0.5672)	(0.6976)	(0.3782)	(0.3747)
BOSIZE	-0.0042	-0.002	-0.0606	-0.046	-0.2296	-0.2631
	(0.3409)	(0.6383)	(0.2478)	(0.3897)	(0.1970)	(0.1544)
DUAL	0.0134	-0.0045	0.3594	0.0624	-2.4638**	-1.8387*
	(0.5693)	(0.8465)	(0.1906)	(0.8245)	(0.0154)	(0.0939)
Indepr	0.0508	0.0482	-0.2084	-0.2031	-3.828	-4.5781
	(0.6076)	(0.6114)	(0.8545)	(0.8561)	(0.3818)	(0.3219)
Lnass	0.0066	0.0040	0.0201	-0.0076	0.5507	0.5767
	(0.4860)	(0.6617)	(0.8451)	(0.9397)	(0.1611)	(0.1486)
DEBT	-0.4833	-0.4820	6.8196	6.0288	-16.372	-16.2631
	(0.3483)	(0.3311)	(0.2980)	(0.3476)	(0.4534)	(0.4616)
LIQRATIO	-0.2922**	-0.2631*	-1.6915	-0.8857	-2.4529	-3.4429
	(0.0240)	(0.0415)	(0.2511)	(0.5477)	(0.6369)	(0.5139)
CAPRATIO	-0.0038	-0.0037	-0.0055	-0.0114	0.0890	0.0725
	(0.2595)	(0.2589)	(0.8960)	(0.7826)	(0.5796)	(0.6551)
Yeardum	0.0937**	2.0484***	1.0765***	3.6343	-1.0797	-7.0993
	(0.0231)	(0.0002)	(0.0073)	(0.4585)	(0.4162)	(0.6413)
Intyrind		-0.9723**		-3.5294		7.0721
		(0.0390)		(0.4646)		(0.5883)
intdual		0.0917		-2.8727***		-3.4412
		(0.3648)		(0.0028)		(0.2458)
intbosz		-0.0888***		-0.131		0.2094
		(<.0001)		(0.3550)		(0.7192)
N	154	154	164	164	139	139
R-Square	0.0292	0.0889	0.0368	0.0724	0.0728	0.0839

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

Table 4.7 Regression analyses of bank performances for low-performing banks

Variables	ROA	ROA	ROE	ROE	RET1YR	RET1YR
Intercept	0.6289	0.6019	-77.8641	-77.3427	39.6335	31.8588
	(0.6700)	(0.6999)	(<.0001)	(<.0001)	(0.5487)	(0.6279)
BOSIZE	0.0173	0.0187	0.1601	0.1374	1.1934*	1.3272**
	(0.1473)	(0.1719)	(0.1837)	(0.2827)	(0.0534)	(0.0496)
DUAL	0.1502***	0.1669**	1.4783**	1.4851**	2.1245	0.8776
	(0.0080)	(0.0168)	(0.0147)	(0.0281)	(0.4474)	(0.7854)
Indepr	0.4441*	0.4623	-2.6902	-3.5669	17.8367	18.8443
	(0.1086)	(0.1755)	(0.3254)	(0.2330)	(0.1701)	(0.1955)
Lnass	-0.0563**	-0.0566**	-0.5335**	-0.5459**	-3.6782***	-4.0273***
	(0.0170)	(0.0230)	(0.0299)	(0.0275)	(0.0015)	(0.0005)
DEBT	0.6656	0.6599	108.711***	109.5555***	-29.6806	-17.4041
	(0.6005)	(0.6180)	(<.0001)	(<.0001)	(0.6204)	(0.7697)
LIQRATIO	0.1543	0.1322	0.0135	-0.1426*	-8.0978	-2.9639
	(0.6576)	(0.7167)	(0.9970)	(0.9682)	(0.6557)	(0.8699)
CAPRATIO	-0.0189	-0.0195	-0.0473	-0.052	0.555	0.5948
	(0.1488)	(0.1565)	(0.6640)	(0.6363)	(0.3160)	(0.2790)
Yeardum	-0.2738***	-0.137	-5.8575***	-15.0822**	-17.8235***	1.0138
	(<.0001)	(0.8066)	(<.0001)	(0.0266)	(<.0001)	(0.9703)
Intyrind		-0.0595		7.3682		-14.5901
		(0.9157)		(0.2621)		(0.5928)
intdual		-0.1009		0.1852		7.6898
		(0.4252)		(0.9022)		(0.2123)
intbosz		-0.0017		0.2323		-0.9221
		(0.9421)		(0.3936)		(0.4111)
N	212	212	382	382	207	207
R-Square	0.0699	0.0709	0.2075	0.2097	0.1579	0.1607

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

Table 4.8 Regression analyses of bank adjusted performances for low-performing banks

Variables	ADJROA	ADJROA	ADJROE	ADJROE	ADJRET	ADJRET
Intercept	10.9347	8.2805	10.1931	10.0062	-0.3628	0.3024
	(0.4172)	(0.5419)	(0.4850)	(0.4913)	(0.9536)	(0.9610)
BOSIZE	-0.0042	-0.1259	0.1837	0.1876	0.1084*	0.083
	(0.9699)	(0.3112)	(0.1377)	(0.1520)	(0.0585)	(0.1850)
DUAL	0.3062	-0.3555	0.9004	0.6911	0.414	0.0937
	(0.5545)	(0.5697)	(0.1471)	(0.3208)	(0.1153)	(0.7579)
Indepr	5.5091**	7.167**	-1.0833	-2.3217	-0.341	-0.1464
	(0.0315)	(0.0218)	(0.6998)	(0.4508)	(0.7814)	(0.9157)
Lnass	-0.3916*	-0.4808**	-0.5137**	-0.4882**	-0.2251**	-0.2618**
	(0.0635)	(0.0240)	(0.0388)	(0.0491)	(0.0362)	(0.0137)
DEBT	-4.866	-0.3383	3.5991	4.3688	0.7365	1.1028
	(0.6768)	(0.9767)	(0.7910)	(0.7468)	(0.8965)	(0.8436)
LIQRATIO	2.3631	2.8394	6.4522*	6.5025*	-0.7411	0.0908
	(0.4653)	(0.3786)	(0.0750)	(0.0727)	(0.6597)	(0.9567)
CAPRATIO	-0.1248	-0.0823	-0.0938	-0.0909	0.0838	0.0811
	(0.3003)	(0.4931)	(0.3985)	(0.4118)	(0.1101)	(0.1172)
Yeardum	-2.2815***	-5.8003	-4.5572***	-8.0466	-1.9097***	-2.5388
	(<.0001)	(0.2197)	(<.0001)	(0.2220)	(<.0001)	(0.3177)
Intyrind		-2.9771		4.7516		-2.1261
		(0.5351)		(0.4569)		(0.4003)
intdual		1.6422		0.8114		1.6261***
		(0.1243)		(0.5795)		(0.0045)
intbosz		0.3855*		-0.0732		0.0827
		(0.0574)		(0.7811)		(0.4267)
N	188	188	341	341	201	201
R-Square	0.0794	0.0959	0.0954	0.0999	0.1563	0.1759

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

Table 4.9 Regression analyses of bank risks for low-performing banks

Variables	VOLROA	VOLROA	VOLROE	VOLROE	VOLRET	VOLRET
Intercept	3.9914	4.1248	10.0593	10.0057	45.9362	49.4149
	(0.0082)	(0.0091)	(0.0878)	(0.0936)	(0.0484)	(0.0316)
BOSIZE	0.004	-0.0018	-0.0841*	-0.082	-0.5003**	-0.7156***
	(0.7469)	(0.9007)	(0.0972)	(0.1326)	(0.0193)	(0.0021)
DUAL	0.0026	0.0360	0.0682	0.0503	-0.9462	-2.1444*
	(0.9644)	(0.6216)	(0.7886)	(0.8622)	(0.3348)	(0.0579)
Indepr	-0.5725**	-0.5257	-1.1346	-1.2805	-10.9897**	-12.1911**
	(0.0462)	(0.1485)	(0.3235)	(0.3168)	(0.0166)	(0.0178)
Lnass	0.0311*	0.028	0.1226	0.1197	0.6238	0.5547
	(0.1886)	(0.2582)	(0.2282)	(0.2458)	(0.1198)	(0.1606)
DEBT	-4.3443***	-4.4318***	-7.9075	-7.6812	-28.4617	-26.2833
	(0.0009)	(0.0010)	(0.1457)	(0.1624)	(0.1779)	(0.2063)
LIQRATIO	-0.0854	-0.1373	-0.7649	-0.7588	5.8581	6.7981
	(0.8138)	(0.7148)	(0.6056)	(0.6142)	(0.3510)	(0.2743)
CAPRATIO	0.0072	0.0087	-0.0652	-0.0647	-0.4341**	-0.4382**
	(0.5962)	(0.5333)	(0.1480)	(0.1571)	(0.0265)	(0.0228)
Yeardum	0.197***	0.0197	1.8462***	0.5508	0.5828	-12.7527
	(0.0004)	(0.9715)	(<.0001)	(0.8407)	(0.5581)	(0.1773)
Intyrind		-0.1485		1.509		3.0181
		(0.7905)		(0.5701)		(0.7482)
intdual		-0.1067		0.2338		3.0285
		(0.3912)		(0.7014)		(0.1549)
intbosz		0.0297		-0.0093		-0.6964*
		(0.2091)		(0.9325)		(0.0721)
N	188	188	342	342	201	201
R-Square	0.0930	0.0930	0.0415	0.0418	0.0488	0.0698

Note: Variable definitions are the same as shown in Table 4.2.

*,**,***represents significance level at 10%,5% and 1%.

5. Conclusion

This study investigates the role of board structure on US bank performance and risks during crisis and non-crisis period by using 59 commercial banks during 2000 to 2013. We find that board structure does affect bank performance and their risk-taking behavior at different performing banks. For high-performing banks, CEO duality would decrease bank's market performance either in crisis or non-crisis period, and it would also decrease market volatility. For low-performing banks, board structure even plays more significant effect on bank performance and bank risks either financial tsunami or non-crisis period than it does on high-performing banks. We find that independent board, CEO duality and board size have significantly positive effects on bank performance, but only CEO duality stays its influence in bank performance during financial tsunami. Moreover, board size, CEO duality and independent board have significantly negative effects on low-performing bank risks and only board size stay its significant influence in bank risks during financial tsunami.

Overall, our results show that board structure presents to play more important role on low-performing banks than on high-performing banks. During financial crisis, CEO duality would deteriorate bank's risk-adjusted performance. These results suggest that corporate governance during crisis period in banking industry still remains room to be improved, especially in board independence. Sound bank governance system definitely helps banks risk management and safely experience through financial crisis.

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Banking Relationships, Innovation and Growth Opportunities in China

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This study investigates if a firm's innovation influences its performance via firms' banking relationships. Using a panel data of Chinese listed firms over1999 to 2008, this study examines the issue by exploiting the impact of banking relationships on innovation and then the impact of this innovation on firm growth opportunities. Using a 2SLS simultaneous equation model, we find that a non-linear relationship between banking relationships and innovation, however, innovation significantly and positively influences firm growth opportunities. We also find that maintaining the banking relationships with one or two is the optimal number for firms to obtain an innovative capacity and better performance. When firms borrow from more than five banks, it destroys the innovation investments. Some implications are valuable for banks and enterprises.

Keywords: Innovation, Banking Relationship, Growth Opportunity.

JEL Code: G32, L33, O31, O43.

1. Introduction

Innovation had been viewed as one of the key instrumentals for firm growth to increase profit in an existing market, enter new markets, and sustain competitive advantages over the long term. There are numerous studies investigating the relationship between innovation and firm growth over the past decades. The original point of view of Schumpeter (1934) claims a positive impact of innovation on firm profitability. This view holds for the last few decades.

Recently, Sirelli (2000) suggests that firms are encouraged to innovate since it leads to a higher growth rate. Klette and Griliches (2000) present the model of endogenous firm growth with innovation as an engine of growth. Bottazzi et al. (2001) analyze the world's largest pharmaceutical companies across 11 years and provide the evidences that either new chemical entities or patent products which captured by innovation have significant impact on firm growth. They are the starting point for our research. We adopt the above discussion in the case of Chinese firms. China is the typical example of the incredible booming economy thanks to ramping up on innovation. Start from the mid of 1990s, the Chinese Government has engaged in nurturing technology-based industries which government encouraged firms to innovate product and process. Romer (1994) states that the judicious direction is considered are the crucial factor for the rapid economic growth.

The unique characteristics of innovation as it is intangible and contains greater asymmetric information than physical investment make it to be difficult for investors to measure the effect of innovation on firm growth. However, it is still attracted researchers to examine the correlation between innovation and firm growth. Chan et al. (1990) and Zantout and Tsetsekos (1994) find a positive market response to innovation for high-tech-industry firms, but an inverse market response for firms in low-tech industries. Acs and Isberg (1996) indicate that the impact on innovation on Tobin's Q depends on the size of firms. Nelson and Winter (1982), Aghion and Howitt (1992), Klette and Griliches (2000), Klette and Kortum (2004) suggest a close relationship between innovation and firm growth in sales. Ho et al. (2006) suggests that firm growth opportunity is associated with innovation by firm size, leverage and industry diversify. In contrast, some researchers find an insignificant relationship between these two factors. The contradictory conclusions from the previous studies are the pioneers for us to investigate how innovation adds value to firm growth in the case of Chinese firms.

The other issue we consider is whether presenting a model endogenous innovation via banking relationships may indirectly influence firm growth. Banking relationships represent the access-to-credit ability has been recognized as the key component of innovation in the extant research. Frazzoni et al.(2014) show that the strength of banking relationships significantly affects the probability of innovation in introducing product. Lagaras (2014) demonstrates that banking relationships stimulate firm innovation. Another point that makes banking relationships valuable to innovation is banks reduce the asymmetric information between outsiders and firms. One argument for the appreciation of banking relationships in fostering innovation is the fact that banks may access inside information as insiders through the bilateral contracts whereas outside debt holders must rely mostly on publicly available information (Fama, 1985). Prior literature also provides the evidences support that banking relationships are the power factors to determine firm growth, Gambini and Gazzaro (2011) consider the link between banking relationships and firm growth. They report the influence of close banking relationships on asset growth of a large sample of Italian firms. Otherwise, the findings of Gopalan et al. (2011) suggest small U.S firm experienced an increase in sales growth when they form a new banking relationship. The results of this work document the relationship between firm growth and banking relationships leave us a room to analyze whether banking relationships impacts firm growth through innovation.

The unique characteristic of Chinese bank-firm relations is quite different among other economies. Chinese banks tend to focus on loan quality, so they reduce amount of loans for individual enterprise and widen the firm-client portfolios in order to limit the risks (Chang et al., 2010). Therefore, almost the large firms are in favor of multiple banking relationships since banks recognize those firms are less likely to default. Conversely, small and medium firms are associated with single banking relationships as they are not the optimal choice for banks (Yin and Matthews, 2014). Maintaining single banking relationships, firms face to low monitoring cost and collateral requirements (Farinha and Santos, 2002) but they are also more likely to be locked-in by the lending bank and cope with higher switching cost. However, multiple banking relationships may help firms control the informational locked-in and liquidity risks, but they have to suffer from higher transaction and monitoring costs (Yin and Matthews, 2014). The topic of single versus multiple banking relationships has not been explored in China. We hence concern this issue by testing whether the number of banking relationships has a significant impact on innovation.

The aim of this paper is to illuminate the effect of innovation on firm growth based on the Chinese firm-level data in the period on 1999 to 2008. We use 2SLS regression to explain the impact of innovation on firm growth through the number of banking relationships. In other words, banking relationships are used as an instrumental variable for innovation to employ the correlation of innovation and firm growth. Moreover, we add industry dummies and owner diverse dummies to control for the biases resulting from industry characteristics and different firm owners.

The remainder of the study is organized as follows. The next section summarizes theories on the relationship among the three dimensions. The third section describes the data and methodology used in this study, followed by a report of the estimation and the expected results in the next section. The results and suggestions for future research in this area are discussed in the last section.

2. Literature review

The idea to link innovation and banking relationships is discussed in theoretical literature. Banks directly affect the quantity of R&D and investment spending. They affect the nature of selected projects, the quality of internal inputs, and their effectiveness in generating innovation. First, when firms launch innovative products, banking relationships may assist them in selecting appropriate distribution channels. Second, firms can improve the quality of internal inputs by disclosing information to the relationship bank without worrying about unauthorized disclosure to competitors. Finally, the bank can offer firms multi-period contracts, which are more effective (saving transaction costs) and safe (extracting information) than one-shot contracts. Thus, the arrangement allows firms to commit resources to innovative activities. Giannetti (2009) suggests a higher share and a longer relationship with a main lending bank have a positive impact on the innovation capacity of high-tech firms. Herrera and Minetti (2007) test the correlation of the information of firms' main bank - measured by the duration of credit relationship- and innovation and state that it promotes innovation

Innovation is a powerful factor that affects firm performance. Companies that innovate successfully have superior performance to that of their less able competitors. To survive, a firm must not only produce a given set of goods or employ a given set of inputs and process technologies, but also develop the ability to innovate and profit from that innovation (Nelson, 1991). R&D investment is a crucial factor for firm success. Yang and Huang (2005) examine the effect of R&D on firm growth and find that firms with intensive R&D are associated with high growth rates. Niefert (2005) also find evidence on the positive effects of innovation on firm growth.

Numerous studies extend the association of innovation and firm growth opportunity. Roper (1997) emphasizes on SMEs and indicates that innovative products significantly contribute to the sales growth of SMEs, which grow faster than non-innovative SMEs. Engel et al. (2004) analyze German SMEs and conclude that the sales turnover of innovative SMEs grows faster than that of non-innovative firms. All these findings suggest that fast-growing firms are innovative firms.

3. Data and methodology

3.1 Data

Data are collected from four sources, namely, (a) the China Stock Market and Accounting Research (CSMAR) database, (b) the Ju-Chao website on Listed Firms Information Release Panel, (c) the Shanghai Stock Exchange, and (d) the Shenzhen Stock Exchange. We obtained 10,929 observations from approximately 1400 firms listed on the Shanghai and Shenzhen exchanges of financial data and 6,407 observations of banking relationship data from 1999 to 2008.

3.2 Methodology

Because the two equations are estimated using the same data, their error terms may be correlated. To address this problem, we use a 2SLS regression model, an extension of the linear regression model, to solve correlated errors between equations.

This study investigates the nature of the relation between innovation and firm growth as measured by Tobin's Q using a 2SLS regression for Chinese listed firms. The study also examines the difference of innovation and growth between Stated-owned firms (SOEs) and private-owned firms (POEs). We use the percentage of shares owned by the state as a proxy for state owner diverse. Firms with more than 50% public ownership are defined as state-owned, whereas firms with less than 50% public ownership are considered private firms.

Our simultaneous equations are expressed as Equations (1) and (2).

$$GROWTH\_OPP = \beta_0 + \beta_1 INNOVATION_{t-1} + \beta_2 AGE + \beta_3 SIZE + \beta_4 DEBT\_TA + \beta_5 CAPEX\_TA + \beta_6 FCF\_TA + \beta_{7-12} INN\_D + \beta_{13}\ POEs + \varepsilon_t \quad (1)$$

$$INNOVATION = \gamma_0 + \gamma_1 BR \quad + \gamma_2\ SIZE + \gamma_3 AGE + \gamma_4 FCF_{TA} + \gamma_5 POEs\ + \gamma_{6-11} INN_D + \propto_t \quad (2)$$

3.2.1 Description of variables in Eq. (1)

We use Tobin's Q as a proxy for growth opportunities GROWTH_OPP. Tobin's Q is given by the market value of assets (the market value of equity plus the book value of debt) divided by the book value of assets. For a given year, growth companies are firms with Tobin's Q greater than the median for that year.

One determinant of GROWTH_OPP is INNOVATION, as measured above. We use the ratio of expenditure on intangible assets to total assets, such as the R&D expenditure ratio and property rights, to present this variable. Because data on the R&D expenditure ratio are incomplete before 2005, the results may be biased. Roper (1997) and Engel et al. (2004) find a strong relationship between firm innovation and growth opportunity. Yasuda (2005) shows a significant correlation between R&D expenditure per employee and firm growth. We expect the significant and positive effect of INNOVATION on GROWTH_OPP.

Firm age and size are the two most common independent variables that affect firm growth. The SIZE logarithm of total assets and AGE, which pertains to the age or maturity of the company, are labeled as firm size and firm age. Almus and Nerlinger (1999) find that firm age affects growth negatively, implying that old firms grow more slowly than young firms. Hall (1987) analyzes US manufacturing firms and indicates that large firms are associated with low growth. Becchetti and Trovato (2002) also find an inverse relationship between growth and size. Following the most recent findings, we expect that the size and age of firms negatively affect the growth of firms.

The capital expenditure ratio (CAPEX_TA) is the ratio of capital investment expenditure to total assets. The evience from Houston and James (1996) document that market value (Tobin's Q) definitely relies on firm growth opportunities, which are impacted by capital expenditure. We control the firm liquidity by cash ratio (CASH_RT). It is calculated by the ratio of total cash and cash equivalents to total liabilities. This determinant suggests that companies grow faster if they hold a sustained level of current assets to pay off their short-term liabilities. An increase in the cash ratio reinforces the liquidity position of the firm. Gill and Mathur (2011) suggest that maintaining a high liquidity level helps firms face less severe financing constraints. We expect that liquidity positively affects firm growth.. The debt ratio (DEBT_TA) is the ratio of short-term debt to total assets. According to Majumdar and Chhibber (1999), it is found to have sifnificantly negative impact on firm performance for the sample of Italian firms. Conversely, Abor (2005) reveals the evidence to support that short term debt to total assets is significantly positively correlated with firm profitability (measured by ROE).

We also add different industry dummies (INN_D) to our model to control for industry-specific differences in growth rates. Firms in different industries exhibit different growth rates. Harhoff (1998) suggests that the effects of different growth factors are slightly different in four selected industries, namely, the manufacturing, construction, trade, and service industries. Almus and Nerlinger (1999) split their sample into firms that operate in high-, medium-, and low-technology industries. Dunne and Hughes (1994) include 19 industry dummies in their investigation. We investigate the possibility that the effect of the independent variables varies with the industry. Furthermore, we run the model include six industries, namely, public utilities, real estate (property) development, general, industrial (manufacturing), commercial and other industries

We include POEs as a dummy variable to measure the growth difference of two types of owners diverse. POEs is 1 for private-owned firms or 0 otherwise. Because each firm has different characteristics, we expect different rates of growth.

3.2.2 Description variables in Eq. (2)

Our dependent variables are presented by INNOVATION. Consistent with Equation (1), we use the ratio of expenditure on intangible assets to total assets, including the expenditure on R&D expenditure and property rights, to represent innovation.

We add the number of the banking contacts of firms to this model as a control variable. We use BR to measure the closeness of the bank–borrower relationship. BR is the number of banks the firm borrows from, that is, borrowing concentration. Benfratello et al. (2008) indicate that banking relationships significantly affect process innovation but weakly affect product innovation. Bhattacharya and Chiesa (1995) point out that an inverse relationship exists between firm innovation and the number of banking relationships because of information dissemination problems.

The variables that describe the internal structure of the company include variable SIZE, which shows the size of the business; the natural logarithm of total assets; and AGE, which shows the age or maturity of the company. Fernández (1996) claim that large companies have advantages to innovate, such as economy of scale, low risk, a large market, and great opportunities for appropriation. Thus, we find a report on the positive relationship between size and innovation. On the age variable, an old firm indicates that the experience and knowledge it accumulated throughout its history are advantageous to the creativity and communication necessary to innovate (Galende and De la Fuente, 2003). Therefore, the expected sign for the age variable is positive, consistent with literature.

The free cash flow ratio (FCF_TA), which pertains to the availability of the internal cash of the firm, is one key determinant of innovation. It is measured by taking free cash flow divided by total assets. The variable is considered such a determinant and the main form of financing innovation because of its lower cost and risk than external finance. Pinkowitz et al. (2012) state that if firms have insufficient internal funds, some innovations will not be accomplished. Therefore, we hypothesize that firms with high free cash flow invest in considerable innovation and are thus more innovative than others.

We also include ownership, which may significantly affect firm innovation. POEs is the owners diverse dummy variable, used to test the influence of corporate ownership. POEs is 1 if the firms are private-owned or 0 otherwise. According to a Russian research, inefficient and unprofitable firms are not forced into bankruptcy because of state intervention. Policies reduce the incentive of SOEs to develop new methods and products and thereby reduce innovation. By contrast, POEs face the threat of bankruptcy and the constraints of financing. They are constantly under pressure to meet their target profits. POEs have strong incentive to adopt new practices and introduce innovative products that would further increase their innovation capacity because of the pressure.

The last determinant of innovation is industry-specific characteristics, which, in the form of knowledge externalities, may determine innovation activity (Cohen et al., 1987). We cluster the sample firms into six groups according to firm type as in Equation 1, namely, public utilities, real estate (property) development, general, industrial (manufacturing), commercial and other industries. We employ firm diversification as the dummy variable. For example, 1 denotes the public utility industry, and 0 denotes others; 1 denotes the general industry, and 0 denotes others.

4. Empirical Results

Panel A of Table 1 shows the results of the summary statistics on the endogenous and exogenous variables for full sample data. For the endogenous variable GROWTH_OPP, the highest value of Tobin's Q is 40774.68, whereas the lowest is 0.6. All sample firms grow, but significant differences are observed in growth ability among them. The mean of GROWTH_OPP is 6.59 (with a median of 1.82) which is high compared to U.S firms that have an average of 2.89 (Cui and Mak, 2002). The second endogenous variable is INNOVATION, which has a mean of 0.04, which is low compared to American firms that have average of 0.1 to 0.16 (Ho et al., 2006; Cui and Mak, 2002). The min is 0 reveals that some firms even do not spend expenditure on any innovation projects

The minimum of BR is 0, implying that firms do not borrow from banks. By contrast, some firms even deal with as many as 15 banks. SIZE represents the size/scale of the firm and has an average value of 21.12, which significantis higher in comparison of US firms that have the mean of 17.89 (Cui and Mak, 2002), implying that the difference in firm size may exist. The average age of firms is 26, the youngest firms are 3, and the oldest is 107 years old. The DEBT_TA mean is 0.67 while the average value of CAPEX_TA is -0.19. Free cash flow to total assets ratio (FCF_TA) have the value approximately equal to cash ratio (CASH_RT) with the mean and median are 0.14 and 0.12.

Panel B of Table 1 is the comparison on statistics of variables for firms with multiple and those with single banking relationships. Firm that maintain single banking relationships have extremely larger GROWTH_OPP than those with multiple banking relationship (21.4 compared to 2.77) even the expenditure on innovation of two type firms are almost equivalent (0.04). Firms that deal with single bank have the average value of size and age are 21.1 and 24.88 whereas those values of multiple-bank lending firms are 21.22 and 26.49 indicate that small and young firms tend to deal with one bank while large and old firms are in favor of lending from multiple banks. The results are consistent with the study of Yin and Matthews (2014).

Panel C of Table 1 reports the different statistics which is classified by owner diverse.. The mean (median) of Tobin's Q for POEs is 14.24 (1.71) and range from 0.6 to 40774.68 implies the far different of growth opportunity among private firms. SOEs even have lower Tobin's Q on average (2.38) but it substantially changes from 0.65 to 52.91, which is significantly different to the range of POEs. The mean of BR (3 vs. 2) and cash ratio (0.14) of two type firms are close similar . Not surprisingly, POEs show higher growth opportunity (14.24 vs 2.38), higher innovation expenditure

(0.046 vs 0.038) , extremely higher debt ratio (0.91 vs 0.14) and larger size (21.43 vs 21.06). However, it shows a lower median capital expenditure ratio (0.02 vs 0.03) and free cash flow ratio (0.12 vs. 0.48) compared to SOEs. It implies that POEs are lager, spend more on innovation projects, have higher liquidity capability and higher growth opportunity. However, these firms have lower capital expenditure and free cash flow.

Panel D summarizes the selective statistics on different industries. Commercial shows the highest innovation expenditure of 5% associated with the highest growth opportunity of 9.16 and the highest banking relationship of 2.9, follows by general and other industries. Public utilities remain the lowest innovation expenditure of 3.7% associated with 1.56 growth opportunity and 0.69 number of banking relationships. The results in panel D and chart 2 demonstrate the correlation of innovation expenditure and growth opportunity with in an industry.

Table 2 shows the sample distribution and the Tobin's Q and innovation across different years, industries, ownership types. First, the growth opportunity of Chinese enterprises decreased from 2000 to 2005 and then increased from 2006 to 2008. Innovation rose twice from 0.032 to 0.065 during the decade (panel A). Panel B implies the different firm opportunities and innovations across the five industries. Commercial has the highest firm opportunity innovation, whereas public utilities have the lowest value. Panel C measures the change in innovation and banking relationship based on the number of banking relationships. Firms obtain the highest innovation expenditure at three banking relationships for both full sample and two ownership types. We also note that banking relationships are rising with the number of banking relationships when banking relationships are less than three. Otherwise, when banking relationships are greater than three, innovation is decreasing with an increasing of banking relationships. These are the evidenced to expect the significant effect of banking relationship on innovation.

Table 3 shows the results of the simultaneous equation model, implying that growth opportunity and innovation are endogenous variables. Column (1) shows the results of the full sample. It reports an insignificant impact of number of banking relationships on innovation expenditure. However, when we divide the full sample in to three sub-samples by the number of banking relationships, the results are different. For the first sub-sample ($0<BR<3$), banking relationships significantly affect innovation expenditure with positive coefficient of 0.003. It suggests dealing with one or two banks is optimal for firm to innovate since firms may access to abundant capital but the cost paid not too high. Firm size and free cash flow are decreasing with innovation with the coefficients are -0.01 and -0.082, respectively which means small firms are more likely spend much more on innovation and firms with high free cash flow are not interested in investing in innovation projects. Firm owner diverse is correlated positively with innovation with the coefficient of 0.009 indicates that POEs have higher innovation expenditure compared to SOEs. The second regression on firm growth opportunity in column (6) reports the significant positive relationship between innovation and growth opportunity. Innovation is increasing with growth opportunity with the coefficient of 350.8 which reflects that innovation is the powerful determinant of firm growth opportunity. However, owner diverse is negative correlated with growth opportunity suggests that even POEs invest much more in innovation than SOEs but they have lower growth opportunity compared to SOEs. The other variables also have significant impacts on growth opportunity as we expected.

For the second sub-sample ($3 \leq BR < 5$), we do not find the significant effect of banking relationship on innovation, implies that dealing with three or four banks is not helped to explain the expenditure on innovation. The results of the last sample ($5 \leq BR \leq 15$) are reported in column (4) and (8). Column (4) provides the significant and negative coefficient of banking relationships on innovation expenditure (-0.002), points out that borrowing from numerous of banks (from five to fifteen banks) leads to low innovation. It is converse to the positive relationship between those variables in the first sub-sample which demonstrates that banking relationships effect is non-linear rather than linear. This finding sounds reasonable: main banking relationships with one or two banks helps reduce asymmetric information problem and save costs so firms have great advantages and resources to innovate. In contrast, innovation investment is destroyed for those firms which maintain more than five banking relationships. Dealing with too many banks put firms in the pressure of information leakage and extremely high transactional costs, thus innovation expenditure declines compared to other firms.

Although banking relationships shows different impact on innovation in each sub-sample, the correlation between innovation and growth opportunity is consistent. Innovation adds value to Tobin's Q with the coefficient is 33.447. The significant coefficients of AGE, DEBT_TA and CASH_RT are -0.018, 1.303 and 3.995 respectively show that small firms, high debt ratio and cash ratio have higher growth opportunity. The effect of SIZE and POEs are insignificant while the effect of CAPEX_TA is significantly negative. This finding differs from most of the extant literature.

The coefficients on the industry dummies (INN_D1 – INN_D6) in model (1)-(4) show that there is no effect of industry type on innovation expenditure. For growth opportunity regression, just only IND_D1 is correlated with Tobin's Q suggests that firm growth opportunity is increasing in public utilities industry.

5. Conclusion

Using 2SLS SEM approach of the Chinese firm-level data, our results have implications for the understanding of the effect of innovation on firm growth opportunity through the number of banking relationships. First, we find that innovation significantly and positively influences a firm's Tobin's Q. Firms invest more in innovation, the higher growth opportunity they exhibit. Secondly, a non-linear relationship between banking relationships and innovation was found. Banking relationships add value to firms via innovation investment when firms deal with one or two main banks; whereas it destroys innovation and the reflective Tobin's Q when firms maintain more than five banking relationships. Additionally, we hypothesize that POEs spend more innovation investments compared to SOEs, however, these investments may not be efficient enough that lower Tobin's Q on POEs was found . Besides, we find significant industry effects on growth opportunities, whereas it is insignificant on innovation expenditure, implying that innovation investments do not differ significantly across various industries. Enterprises, especially some special industries, should make more efforts to create the comparative advantage via innovation inputs.

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Table 1 Summary Statistics

This table shows the results of a two-stage least squares SEM. The first model is based on firm innovation (INNOVATION), and the second model is based on firm growth (GROWTH).
GROWTH is the firm growth opportunity; measured by Tobin's Q. Tobin's Q is given by the market value of assets (the market value of equity plus the book value of debt) divided by the book value of assets. INNOVATION refers to R&D expenditure, determined by the ratio of R&D expense to the total assets of the firm. BR is the number of banks the firm has to access loans. SIZE shows the size of the business, the natural logarithm of total assets, and the variable AGE shows the age or maturity of the company. . CAPEX_TA is the capital expenditure ratio, which captured by the ratio of capital expenditure and total assets. FCF_TA is the free cash flow ratio, which is free cash flow divided by total assets. DEBT_TA is the debt ratio, measured as short-term debt divided by total assets. CASH_RATIO is the ratio of cash and cash equivalent and total liabilities.

Panel A: Full sample

Variables	Obs	Mean	Median	Max	Min	25%	75%	Std
Endogenous								
GROWTH_OPP	10.894	6.59	1.82	40774.68	0.60	1.32	2.78	391.87
INNOVATION	10.885	0.04	0.02	0.84	0	0	0.05	0.06
Exogenous								
BR	6407	2.85	2	15	0	1	4	2.35
SIZE	10928	21.12	21.10	28.08	10.84	20.525	21.79	1.09
AGE	10928	26.16	22	107	3	13	31	16.3
CAPEX_TA	10912	-0.19	0.03	0.81	-1386.05	0	0.08	17.31
DEBT_TA	10927	0.67	0.5	877.25	0	0.36	0.62	8.7
FCF_TA	10909	0.14	0.12	1	0	0.07	0.19	0.11
CASH_RT	10910	0.14	0.12	1	0	0.06	0.19	0.11

Panel B: Single banking relationships vs. multiple banking relationships

Single BR								
Variables	Obs	Mean	Median	Max	Min	25%	75%	Std
Endogenous								
GROWTH_OPP	2235	21.4	1.89	40774.68	0.68	1.37	2.87	862.72
INNOVATION	2230	0.04	0.019	0.63	0	0	0.04	0.06
Exogenous								
BR	2245	0.72	1	1	0	0	1	0.45
SIZE	2244	21.1	20.98	28.08	10.84	20.37	21.69	1.26
AGE	2245	24.88	20	107	3	12	31	15.45
CAPEX_TA	2240	-0.52	0.02	0.78	-1159.75	0	0.07	24.55
DEBT_TA	2244	0.6	0.43	142.71	0	0.25	0.59	40.4
FCF_TA	2227	0.18	0.14	1	0	0.08	0.25	0.14
CASH_RT	2227	0.18	0.14	1	0	0.08	0.25	0.14

Multiple BR								
Variables	Obs	Mean	Median	Max	Min	25%	75%	Std
Endogenous								
GROWTH_OPP	8659	2.77	1.81	3001.08	0.60	1.31	2.76	33.05
INNOVATION	8655	0.04	0.0213	0.84	-0.027	0	0.05	0.06
Exogenous								
BR	4162	4.01	3	15	2	2	5	2.15
SIZE	8683	21.22	21.12	27.68	12.31	20.55	21.81	1.05
AGE	8683	26.49	23	107	4	13	31	16.48
CAPEX_TA	8672	-0.11	0.02	0.81	-1386.05	0	0.08	14.88
DEBT_TA	8683	0.68	0.51	877.25	0.01	0.38	0.63	9.53
FCT_TA	8682	0.13	0.11	0.85	0	0.06	0.18	0.1
CASH_RT	8682	0.13	0.11	0.85	0	0.06	0.18	0.09

Panel C. Owner diverse

Private-owned enterprises								
Variables	Obs	Mean	Median	Max	Min	25%	75%	Std
Endogenous								
GROWTH_OPP	3872	14.24	1.71	40774.68	0.60	1.25	2.65	657.3
INNOVATION	3903	0.046	0.025	0.84	0	0	0.05	0.07
Exogenous								
BR	2854	3.14	2	15	0	1	5	2.59
SIZE	3904	21.43	21.36	28.08	10.84	20.66	22.11	1.25
AGE	3905	23.22	17	107	3	12	31	15.7
CAPEX_TA	3898	-0.64	0.02	0.81	0.77	0	0.07	28.97
DEBT_TA	3904	0.91	0.52	877.25	0	0.38	0.65	14.5
FCT_TA	3901	0.14	0.12	1	0	0.06	0.19	0.11
CASH_RT	3901	0.14	0.12	1	0	0.06	0.19	0.11

Stated-owned enterprises								
Variables	Obs	Mean	Median	Max	Min	25%	75%	Std
Endogenous								
GROWTH_OPP	7022	2.38	1.89	52.91	0.65	1.37	2.83	1.75
INNOVATION	6982	0.038	0.019	0.79	-0.02	0	0.04	0.06
Exogenous								
BR	3553	2.63	2	14	0	1	4	2.11
SIZE	7023	21.06	20.97	27.32	17.12	20.45	21.61	0.97
AGE	7023	27.79	25	107	5	16	31	16.3
CAPEX_TA	7014	0.05	0.03	0.81	-2.45	0	0.08	0.11
DEBT_TA	7008	0.14	0.11	0.78	0	0.66	0.19	0.1
FCT_TA	7023	0.53	0.48	43.07	0	0.34	0.61	0.72
CASH_RT	7008	0.14	0.11	0.78	0	0.06	0.19	0.1

Panel D. Industry diversify

Industries	GROWTH_OPP	INNOVATION	BR
D=1 (Public Utilities)	1.56	0.037	0.69
D=2(Real Estate Development)	2.06	0.040	2.72
D=3 (General)	2.59	0.045	3.21
D=4 (Manufacturing)	2.38	0.042	2.86
D=5 (Commercial)	9.16	0.050	2.9
D=6 (Other industries)	2.5	0.045	2.7

Table 2: Sample Distribution Analysis

Panel A: Endogenous variables and five largest shareholder ownerships by year

	GROWTH	INNOVATION	TOP1	TOP2	TOP3	TOP4	TOP5
1999	2.88	0.032	44.924	8.199	3.241	1.827	1.235
2000	3.93	0.037	44.413	8.116	3.182	1.736	1.156
2001	3.00	0.035	44.019	8.206	3.251	1.724	1.097
2002	2.38	0.029	43.696	8.608	3.365	1.813	1.131
2003	1.91	0.025	42.869	9.114	3.506	1.867	1.153
2004	1.63	0.020	42.386	9.539	3.734	1.965	1.240
2005	1.47	0.017	40.584	9.732	3.859	2.066	1.320
2006	4.39	0.042	35.920	8.966	3.570	2.003	1.397
2007	5.16	0.045	35.390	8.496	3.383	1.976	1.359
2008	9.87	0.053	36.130	8.488	3.434	1.957	1.360

Panel B: Endogenous variables and five largest shareholder ownerships by industry

	GROWTH OPPORTUNITY	INNOVATION	TOP1	TOP2	TOP3	TOP4	TOP5
Public Utility	1.56	0.037	22.357	6.645	4.801	3.990	2.824
Real Estate Development	2.06	0.040	42.342	10.108	3.718	1.869	1.117
General	2.59	0.045	41.545	7.090	2.274	1.486	1.038
Industrial	2.38	0.042	36.949	9.739	4.314	2.281	1.468
Commercial	9.16	0.050	42.250	8.499	3.181	1.729	1.138

Panel C: Distribution of innovation and banking relationships between state- and private-owned firms

	INNOVATION		
BR	**Full sample**	**SOEs**	**POEs**
0	**0.0327**	**0.0361**	**0.0294**
1	**0.0523**	**0.0395**	**0.0420**
2	**0.0594**	**0.0489**	**0.0547**
3	**0.0679**	**0.0639**	**0.0652**
4	**0.0550**	**0.0498**	**0.0533**
5	**0.0534**	**0.0478**	**0.515**
6	**0.0523**	**0.0469**	**0.491**
7	**0.0475**	**0.0417**	**0.448**
8	**0.0403**	**0.0334**	**0.0416**
9	**0.0342**	**0.0310**	**0.0374**
10	**0.0211**	**0.0211**	

Table 3 Results of 2SLS Simultaneous Equation Model between Banking Relationships, Innovation, and Growth Opportunity

This table shows the results of a two-stage least squares SEM. The first model is based on firm innovation (INNOVATION), and the second model is based on firm growth (GROWTH).

GROWTH is the firm growth opportunity, measured by Tobin's Q. Tobin's Q is given by the market value of assets (the market value of equity plus the book value of debt) divided by the book value of assets. INNOVATION refers to R&D expenditure, determined by the ratio of R&D expense to the total assets of the firm. BR is the number of banks the firm has to access loans . SIZE shows the size of the business, the natural logarithm of total assets, and the variable AGE shows the age or maturity of the company. . CAPEX_TA is the capital expenditure ratio, which captured by the ratio of capital expenditure and total assets. FCF_R is the free cash flow ratio, which is free cash flow divided by total assets. DEBT_TA is the debt ratio, measured as short-term debt divided by total assets. CASH_RATIO is the ratio of cash and cash equivalent and total liabilities.

Model	INNOVATION				GROWTH_OPP			
	Full sample	0<BR<3	$3 \leq$ BR<5	$5 \leq BR \leq 15$	Full sample	0<BR<3	$3 \leq$ BR<5	$5 \leq BR \leq 15$
Coefficients	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
INNOVATION					14882.45***	350.8**	354.174***	33.447***
					(2468.91)	(181.664)	(168.458)	(9.745)
BR	0	0.004***	-0.002	-0.002**				
		(0.001)	(0.003)	(0.001)				
SIZE	-0.009 ***	-0.01(***)	-0.009***	-0.007***	118.1***	5.924***	3.137***	-0.091
	(0)	(0)	(0.001)	(0.001)	(23.4)	(1.934)	(1.57)	(0.091)
AGE	0.0002***	0**	0***	0***	-3.676***	-0.027	-0.092**	-0.018***
	(0)	(0)	(0)	(0)	(0.652)	(0.039)	(0.048)	(0.005)
FCF_TA	-0.083 ***	-0.082***	-0.069***	-0.087***				
	(0.007)	(0.008)	(0.017)	(0.024)				
POEs	0.012 ***	0.009***	0.014***	0.019***	-166.585***	-4.972***	-4.386**	-0.151
	(0.001)	(0.002)	(0.003)	(0.004)	(30.446)	(1.938)	(2.455)	(0.197)
DEBT_TA					-56.052***	-5.197***	6.33***	1.303***
					(0.29)	(0.243	(0.076)	(0.014)
CAPEX_TA					-39.296***	-35.747***	1.841***	-0.911***
					(0.146)	(0.399)	(0.048)	(0.321)
CASH_RT					1233.043***	29.69**	31.632***	3.995***
					(210.13)	(16.761)	(11.799)	(0.952)
INN_D1	0.009	0.007			83.945***		-16.681***	
	(0.015)	(0.017)			(36.723)		(7.441)	
INN_D2	0.01***	0.009	-0.013	-0.017	-12.214	6.689	-8.594**	0.4**
	(0.005)	(0.007)	(0.031)	(0.012)	(11.103)	(8.991)	(4.561)	(0.212)
INN_D3			-0.039			11.736		0.326
			(0.032)			(9.241)		(0.271)
INN_D4	0.007**	-0.001	-0.014	0	-13.357	11.808	-8.742***	-0.172
	(0.004)	(0.006)	(0.031)	(0.01)	(10.039)	(8.915)	(4.375)	(0.22)
INN_D5	0.005	0	-0.015	-0.009	-3.196	11.146	-8.204***	0.131
	(0.004)	(0.006)	(0.031)	(0.009)	(9.551)	(8.85)	(4.048)	(0.164)
INN_D6	0.001	0.007	-0.004	-0.012	-12.183	9.183	-11.921***	
	(0.005)	(0.007)	(0.031)	(0.012)	(2469.1)	(9.072)	(5.983)	
Residual					-14991.27***	-344.312**	-352.991***	-34.592***
					(2469.09)	(181.852)	(168.484)	(9.761)
Constant	0.241***	0.265***	0.257***	0.223***	-3123.06***	-146.845***	-75.003***	1.447
	(0.016)	(0.022)	(0.046)	(0.039)	(606.521)	(51.378)	(35.746)	(2.222)
R-squared	0.06	0.07	0.06	0.05	0.927	0.99	0.99	0.89
Obs	6202	3361	1555	1286	6163	3340	1548	1275

Chart 1

Relationships between firm growth and innovation across years (1999–2008)

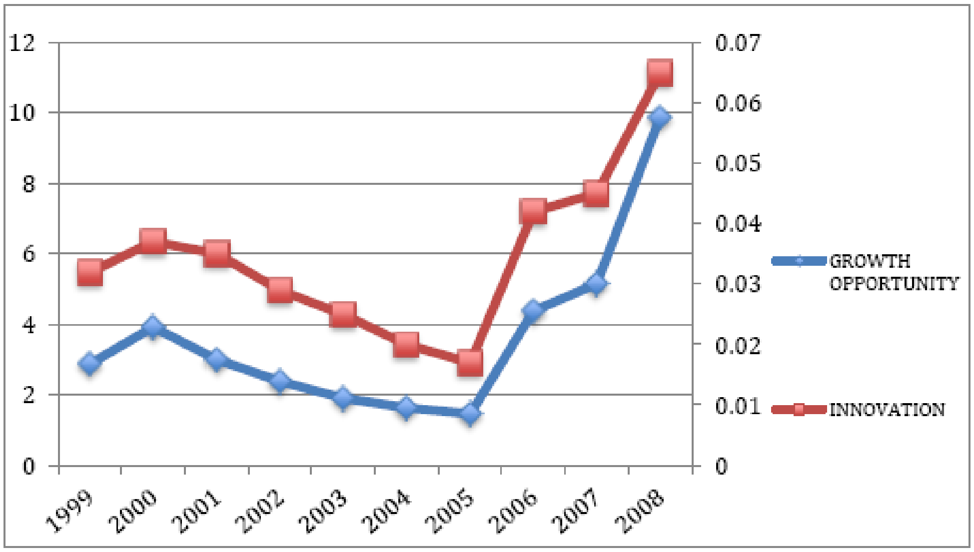


Chart 2

Relationships between firm growth and innovation across different industries

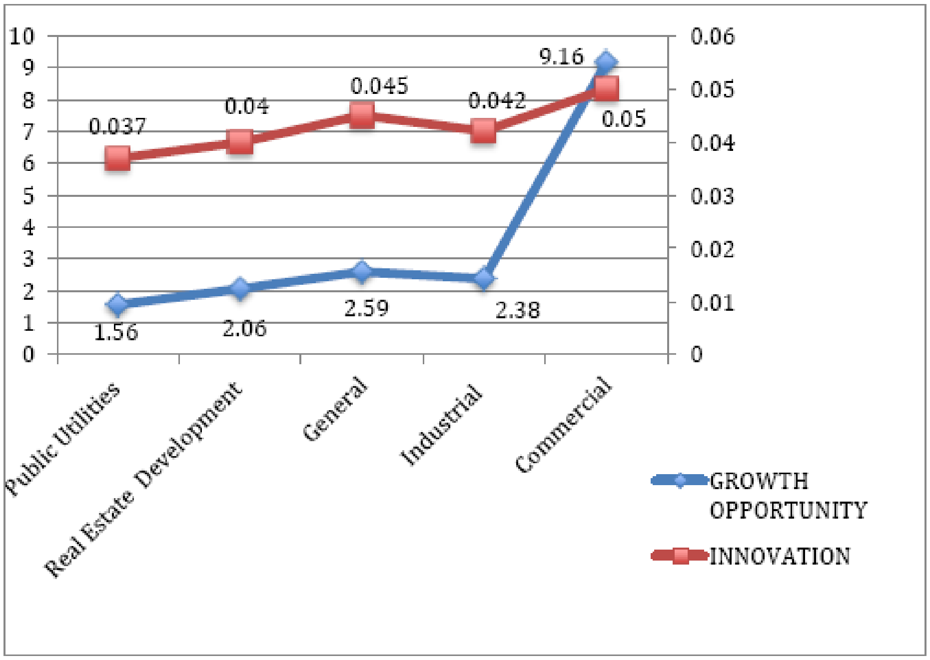


Chart 3
Relationships between firm growth and innovation pre- and post-events

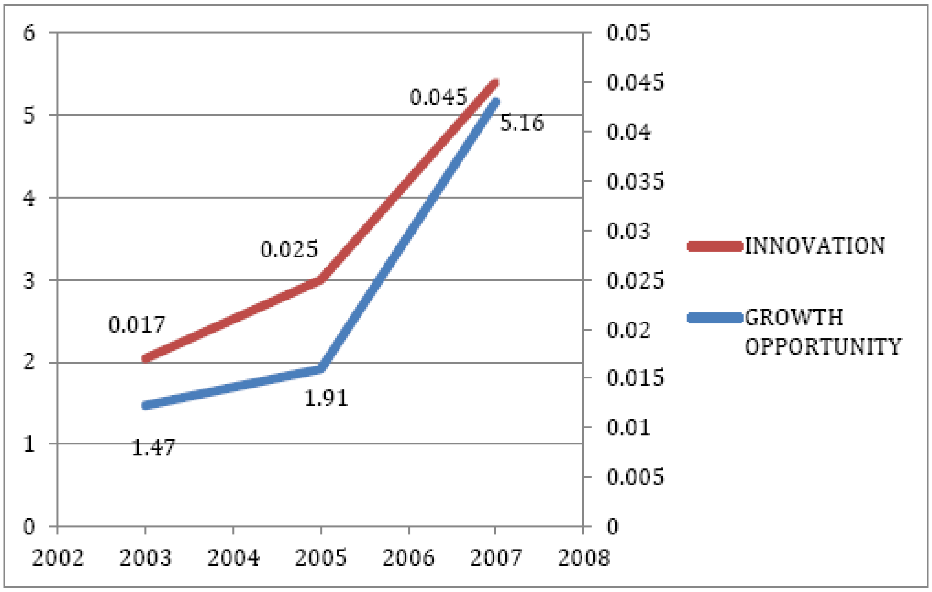
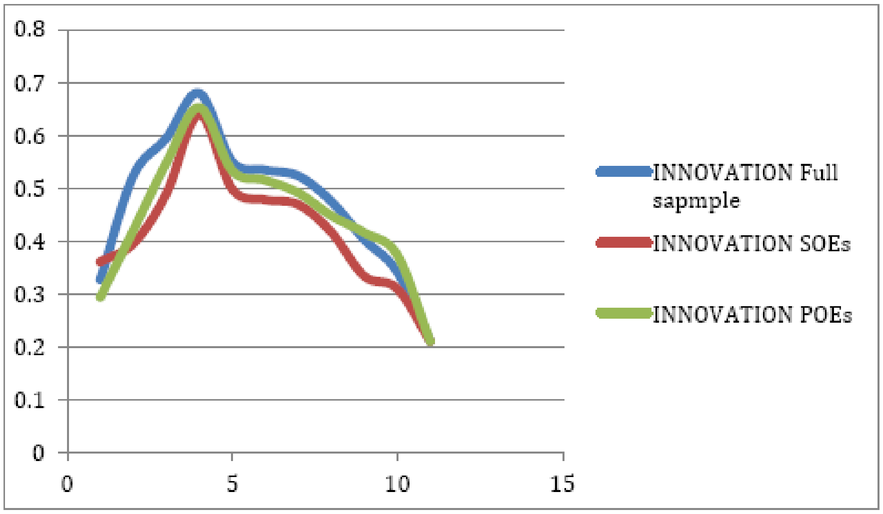


Chart 4

Relationships between innovation and banking relationships based on number of banking relationships



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□ □ □ □ □ □ CEO Compensation, Ownerships and Innovation Performance: A Simultaneous Equation Model for US listed Firms

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This paper examines if CEO compensation moderates the relationship between ownerships types and firm innovation performance. Using a simultaneous equation model for U.S listed firms over 1992-2013, we find that compensation significantly and positively moderates the relationships between different types of ownerships and innovation. Due to different types of ownerships have different incentives on innovation activities, the compensation scheme may apply variously. Some valuable implications are developed for enterprises for setting an incentive mechanism.

Keyword: Compensation, Ownership Structure, Innovation.

1. Introduction

Executive compensation or executive pay is composed of the financial compensation and other non-financial awards received by an executive from their firm for their service to the organization and rewards for performance. Schumpeter (1934) argued that anyone seeking profits must innovate. Scott (2003) stated that executive compensation plan is the agency contract between the company and his manager is trying to unite the interests of owners and managers by basing compensation manager at one or more sizes of business managers to operate companies. Generally, managers or executives are portrayed in the literature as being risk-averse rather than a risk - taker. Mondy (2008) defines compensation as a total of all rewards provided employees to return to their services.

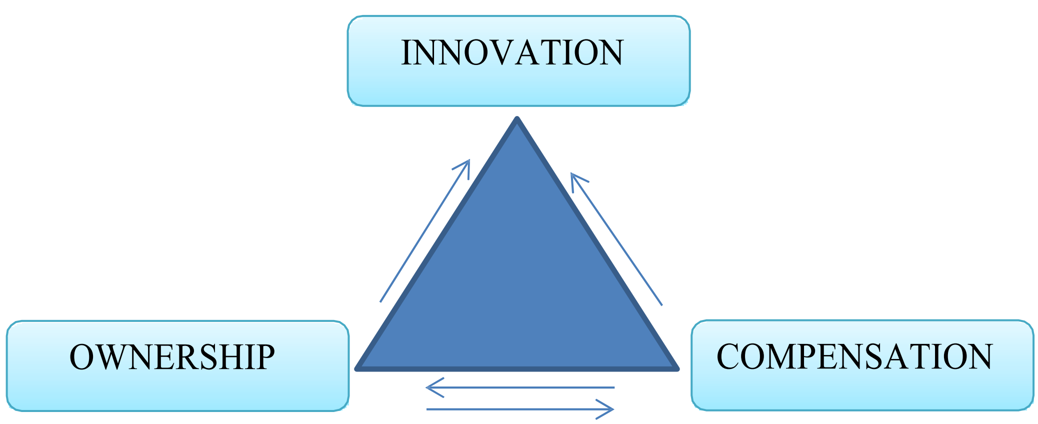
There are a number of papers that discuss the relationship between CEO compensation and firm performance. Faria, et al. (2014) examines the relationship between corporate performance and the Chief Executive Officer compensation in high technology firms in the S&P 1500. Their findings indicate that there is a strong and positive relationship between CEO compensation and firm performance. Canyon (2013) investigates US executive compensation and governance, he finds on average executive pay is positively correlated to firm performance and firm size. Conyon & He (2011) they find that executive compensation is positively correlated to firm performance. Study from Lilling (2006) to find the relationship between CEO Compensation and market value of a firm, he reports a positive relationship between CEO compensation and market value of a firm. This study concludes that incentive based contracts are effective, due to the positive pay-to-performance link, when controlling for simultaneity.

Chen et.al (2008) examines the relationship between ownership and innovation show that the distinct types of owners have different objectives and motivations and this will affect how they exercise their control right over the firm invest in and because executive wealth was sensitive to firm performance (Frydman and Saks 2010). This research in line with Love et al., 2009, Choi et al., 2011, and Jiang et al., 2013. From family firm perspective Lodh et al., (2014) found that the impact of family ownership on innovation productivity is positive (after controlling for possible endogeneity).

Several studies have been conducted to examine the relationship between ownership, and compensation. The research carried out on some type of ownership such as a family firm, private and state ownership enterprises (SOEs) in different places. Study from Cheung et.al. (2005), Sapp (2008) and Adu et.al (2010), found a positive relationship between ownership and compensation. Most of all research above examines separately and rarely that examines the triangular relationship between ownership, compensation, and innovation a simultaneous. However, the research not examines the ownership in dual class share. Thus, this is lack in the literature of financial management. Furthermore the research that used panel data using US Firm. Thus, this research will contribute to fill the lack of literature in this area.

This study makes three contributions to the extant literature. First, until recently, the empirical study mostly discussed separately to examine the relationship between ownership, compensation and innovation. Second, we analyze three relationship, they are: the impact of the type of ownership in dual class share to the innovation, the impact of the compensation to innovation, and the relation between ownership in dual class share and compensation simultaneity. Lastly, this study investigated the interrelationship used a simultaneous equation model (SEM). After examines the puzzle among ownership dual class share, compensation and innovation. My research question will be as follows: how do the relation between the executive ownership, compensation and the innovation in US.Firm?

The conceptual model of this research as figure below:



2. Literature Review

Linking between Ownership and Compensation

Mondy (2008) define compensation as a total of all rewards provided employees in return to their services. The overall purposes of providing compensation are to attract, retain, and motivate employees. Furthermore Byars & Rue (2008) stated that compensation as all the extrinsic reward that employees receive in exchange for their work. Composes of the base wage or salary, any incentive or bonus, and any benefit. In other word Milkovich & Newman (2011) stated that compensation is refers to all form of financial returns and tangible services and benefits employees receive as part of an employmentrelationship.

Bergman & Scarpello (2001) stated that they are two goals of compensation. Firstly is to elicit desired behaviors from employees and secondly is to achieve the first goals within a set of constraints (the organization's ability to pay, legislation, labor unions, internal labor market and external labor market). At least they are three goals of compensation. Firstly, motivate people to join the organization. Every organization uses people in the process of producing its unique goods or services. Organizations must create this labor force by motivating appropriate individuals to join the organization. Secondly, motivate people to stay with the organizations. Motivating people to join the organization does little good if the organization cannot retain them. Thus, motivating individuals to stay with organization is also influenced by a complex set of variables. Thirdly, motivate people in the organization to perform at high level, most organizations would like to motivate employees to perform beyond minimally acceptable levels. Organization do many things other than use wage payment to elicit high performance. Thus, the goals of compensation in line with equity theory that mentioned about motivation theory: people assess their performance and attitudes by comparing both their contribution to work and benefits they drive from it to contributions and benefits of comparison others whom they select – and who in reality may or may not be like them.

Jensen and Meckling (1976) argue that the ownership structure is believed to have the ability to influence the company that eventually can affect the performance of a company. In order to understand whether and when family firms are more or less valuable than nonfamily firms Villalonga and Amit (2004) stated one must distinguish among three fundamental elements in the definition of family firms: ownership, control, and management. They argue that family ownership creates value only when the founder serves as the CEO of the family firm or as its

Chairman with a hired CEO. Control mechanisms including dual share classes, pyramids, and voting agreements reduce the founder's premium. When descendants serve as CEOs, firm value is destroyed. Based on agency theory Combs et.al (2010), describe a different scenario wherein family representatives engage in strategic control that reduces family-member CEOs' compensation. Family-member CEOs accept lower compensation only when additional family members are represented in management or on the board. In comparison with CEOs at nonfamily firms, they find that family-member CEO compensation is 13% lower when multiple family members are involved, but 56% higher when the CEO is the lone family member.

From Continental Europe study, Croci et.al (2012) investigates the impact of family control and institutional investors on CEO pay packages in. They find that family control curbs the level of CEO total and cash compensation, and the fraction of equity-based compensation. Moreover, they do not observe a significant effect of family control on the excess level of total and cash compensation. This evidence indicates that controlling families do not use CEO compensation to expropriate wealth from minority shareholders. They show that institutional ownership is associated with higher levels of CEO cash and total compensation in Continental Europe, especially in family firms. Also, foreign institutional investors have a positive and significant impact on CEO compensation level. Finally, results indicate that institutional investors affect CEO pay structure: they increase the use of equity-based compensation in both family and non-family firms.

Thus, we suppose the hypothesis besides explanation according the relationship between Ownership and Compensation in hypothesis 1 below:

H1. Ownership Concentration will be positively related to the Executive Compensation.

Linking between Compensation and Innovation

The sensitivity of executive pay to share price performance has been the main focus of Western executive pay studies, reflecting shareholders' efforts to reduce agency problems by better aligning the rewards of executives with their own. However, these studies have ignored motivational effects and possible two-way pay–performance causation. Buck et.al (2008) reports Chinese executive pay–performance sensitivity, with international comparisons, to examine whether China's unique institutional environment has produced outcomes consistent with those for Western market economies. This same unique environment makes possible the first estimates of two-way causation based on panel data analysis. The results show that executive pay and firm performance mutually affect each other through both reward and motivation.

Chhaochharia and Grinstein (2009) In Response to corporate scandals in 2001 and 2002, major U.S. stock exchanges issued new board requirements to enhance board oversight. Find a significant decrease in CEO compensation for firms that were more affected by these requirements, compared with firms that were less affected, taking into account unobservable firm effects, time-varying industry effects, size, and performance. The decrease in compensation is particularly pronounced in the subset of affected firms with no outside blockholder on the board and in affected firms with low concentration of in investigating the relationship between CEO compensation and firm diversification over.

Rose and Shepard (1997) Investigating the relationship between CEO compensation and firm diversification over 1985-1990, they find that the CEO of a firm with two lines of business averages 13% more in salary and bonus than the CEO of a similar-sized but undiversified firm, ceteris paribus. Kato and Kubo (2006), present the first estimates on pay-performance relations for Japanese CEO compensation. finds consistently that Japanese CEO's cash compensation is sensitive to firm performance (especially accounting measures), and that the "semi-elasticity" of CEO's cash compensation with respect to ROA is 1.3 to 1.4, which is in general agreement with prior estimates. They also find that stock market performance tends to play a less important role in the determination of Japanese CEO compensations and they find that the bonus system makes CEO compensation more responsive to firm performance in Japan. The finding is in contrast to the literature on compensation for regular employees in Japan which often argues that bonus is a disguised base wage.

Furthermore Firth.et.al (2006) examines the compensation of CEOs in China's listed firms. They discuss what is known about the setting of CEO compensation and then examine factors that may help explain variations in the use of performance related pay. In China, listed firms have a dominant or controlling shareholder and they argue that the distinct types of controlling shareholder have different impacts on the use of incentive pay. They find that firms that have a State agency as the major shareholder do not appear to use performance related pay. In contrast, firms that have private blockholders or SOEs as their major shareholders relate the CEO's pay to increases in stockholders' wealth or increases in profitability. However the pay–performance sensitivities for CEOs are low and this raises questions about the effectiveness of firms' incentive systems. Therefore, compensation is being important aspect to encourage high more firm performance in many countries.

Thus, we suppose the hypothesis besides explanation according the relationship between Compensation and innovation in hypothesis 2 below.

H2. Compensation will be positively related to Innovation or firm performance.

Linking between Ownership and Innovation

Cyert & March (2001) argue that the assumption of rationality in theory of the firm can be reduced to two propositions. Firstly, firms seek to maximize profit, secondly, firms operate with perfect knowledge. So, the owners will ask to managers to improve more innovation for pursuing profits. Joseph Schumpeter (1934) has comprehensive definition according to innovation. Definitions of innovation are: The introduction of a good (product), which is new to consumers, or one of higher quality than was available in the past, methods of production, which are new to a particular branch of industry, the opening of new markets, the use of new sources of supply, new form of competition, that leads to restructuring of an industry.

Furthermore Michael porter (1990) defined innovation: to include both improvements in technology and better methods or ways of doing things. It can be manifested in product changes, process changes, new approaches to marketing, new forms of distribution, and new concepts of scope (innovation) results as much from organizational learning as from formal R&D. Both Schumpeter and Porter use the word "new" in their definition. Freedman (1988) stated when a company decides to innovate, it make an investment. It commits fund resources. If the investment comes from existing business within the parent organization, it will show up on the respective balances sheets of enterprises. If the corporate office decides to invest in a new innovation group its commitment will often resemble that of a venture capital firm, this time the commitment will show up on balances sheet of the corporation.

Kellermanns et.al (2012) argues that family firm influence can have both positive and negative consequences for family firm performance. Jefferson (2002) using a panel of these enterprise data for 1994–1999 from China, find a rapidly diversifying ownership structure in which the role of the state is steadily retreating. At the same time, they find considerable variation in measures of performance across ownership types and see emerging within Chinese industry, evidence of high-intensity R&D performers that exhibit substantial innovation capabilities. Furthermore Ding et.al (2008) confirms that family-owned firms in China achieve significantly better performances than state-owned enterprises. These results support the general consensus that China is increasingly reliant on private companies as an engine for economic growth and an employment hub. Xu and Wang (1999) investigate whether ownership structure significantly affects the performance of publicly listed companies in China within the framework of corporate governance. A typical listed stock company in China has a mixed ownership structure with three predominant groups of shareholders the state, legal persons (institutions), and individuals. Empirical analysis shows that the mix and concentration of stock ownership do indeed significantly affect a company's performance. Therefore, ownership concentration is being important aspect to encourage innovation in many countries.

Thus, we suppose the hypothesis besides explanation according the relationship between ownership and innovation in hypothesis 3 below.

H3. Ownership will be positively related to Innovation.

3. Data and Methodology

Data Construction

We use three data sets: Execucomp provides us with data on CEO compensation. Regressions presented in this article were performed with Execucomp data extracted from WRDS in 2013. We use Compustat to retrieve information on the size of US-based firms. The data were obtained from Compustat North America and is a panel data from the years 1992 through 2013. with 48,755 total observations. We Use Patent Numbers of US Firm that issued outside US from IPtech Taiwan.

Methodology

Dependent Variables. *CEO Compensation*. Following Mehran (1995) we use three measures of compensation; (1) percentage of total compensation in grants of new stock option, with the options valued by the black-Scholes Formula, (2) percentage of total compensation that is equity based, and (3) percentage of total compensation in salary plus bonus. Following Michiels et.al (2012) we take the logarithm of the CEO compensation to reduce the impact ofoutliers.

Independent Variables. *Firm Performance*. The proxies for firm performance are Tobin's Q measure by the ratio of the market value of the firm. Return on Asset (ROA) measured by the ratio of net income to the book value of the firm's total asset.

Ownership structure. Is measured by the variables of owners, which indicate the number of shareholder. Following Mitchiels et.al (2012) we take the natural logartithm of the number of owners to account for the nonlinear effect of an increasing number of owners.

Control variables. We include several control variables in our model to account for other factor that affect CEO Compensation. ***Patents number*** from IPtech, we measured innovation in terms of the number U.S. patent issued in IPtech submitted by our sample firms. ***R&D ratio***, measure by the R&D Expenditure to total assets. G***rowth opportunities***, the proxy for growth opportunity is research and development as percentage of sales. **Leverage** ratio, The proxy for leverage is the ratio of long term debt to total assets. ***Firm size***, Size is measured by the log of the book value of assets. **CEO Age**, Firm age measures by the log of firm's age. **CEO Tenure**, CEO Tenure measures by the numbers of year that an executive serve as CEO.

Table 1
Deskription of variables

Variables	Descriptive
Dependent Variables	
Total Compensation	Log[1+(Salary+Bonus+Other annual Compensation+Restricted stock Gain)]
Cash Compensatio	Log [1+(Salary+Bonus)]
Equity Based Compensation	Log[1(value of restricted stock granted+The Balck Sholes value of Stock option Granted)]
Independent Variables	
Tobin Q	Market to book ratio= (market value of equity + The book value of total assets – The book value of equity)/the book value of total assets.
ROA	Net profit divided by total assets
Control Variables	
Patents Number	Numbers of patents issued by the sample
R&D Ratio	R&D expenditure to total assets
Growth Opportunities	Percentage of sales
Leverage	Long term debt/Total assets
Firm Size	Log (total assets)
CEO Age	CEO Age
CEO Tenure	The numbers of year that an executive serve as CEO

To test hypothesis 1 we follow Cheung et al (2005). The empirical models for this test is:

$$\ln(\text{CEOcomp}) = \alpha + \beta 1 \text{ Tobin's Q} + \beta 2 \text{ ROA} + \beta 3 \text{ Owners} + \delta \text{ Controls} + \varepsilon \qquad (1)$$

The independent variable of this research is the owners, is measured as the fraction of total company shares outstanding held by the types of ownership. And the dependent variable is Executive compensation that measure by the natural logarithm of the cash emoluments (salary, bonus, housing allowance and other benefits) received by the CEO and the Chairman. And also analysis the proportion of cash emoluments in the total compensations (where total compensation includes cash emoluments and dividend income derived from shareholdings), and the firm's dividend yield (dividend per share divided by share price). This research includes regressions two sets of control variables. They are: Set comprises firm characteristics. ROA (net profit divided by total assets), Market-to-book ratio (market value of equity divided by book value of equity), Debt-to-assets ratio (long-term debt divided by total assets), Annual sales growth, and The natural logarithm of the firm's deflated total assets. Set of control variables includes proxies for corporate governance. CEO duality (dummy variable equal to one when the CEO is also Chairman of the board of directors), The natural logarithm of the number of directors on the board, The fraction of independent non-executive directors on the board, and The presence of an audit committee (dummy variable equal to one if such a committee exists).

To test hypothesis 2, we follow Michiels et.al (2012) empirical model. They model is:

$$\ln(\text{CEOcomp}) = \alpha + \beta_1 \text{ Tobin's Q} + \beta_2 \text{ ROA} + \delta \text{ Controls} + \varepsilon \qquad (2)$$

The dependent variable is CEO compensation as total CEO compensation. This measure contains one figure that comprises both base salary and cash bonuses. Variables: CEO comp measures by Total CEO cash compensation, ROA Return on assets measure by calculated by income after expenses excluding taxes divided by total assets, Owners measure by The number of shareholders, Firm size measure by The total number of employees in the firm, Firm age measure by The number of years since the firm was founded

To test hypothesis 3 we follow Lodh et al (2014) model. For measure operating performance use some measurement as: Innovation productivity measure by Number of patents/R&D expenses, R&D intensity measure by R&D expenditure/Sales, Management ownership measure by (%) Percentage of all classes of shares held by the Management, Firm size measure by Log of total sales, Firm age measure by Log of firm's age, Knowledge stock measure by Number of patents in last 4 years assuming 15% annual depreciation and an 8% growth backward in times.

4. Preliminary Results

We find that compensation significantly and positively moderates the relationships between different types of ownerships and innovation. But different types of ownerships firms have different incentives for innovation. The compensation incentive may apply variously. Some valuable implications are developed for enterprises for setting an incentive mechanism.

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□ □ □ □ □ □ FACTORS RELATED TO THE PROCESS OF ACCOUNTING TREATMENT AFFECTING THE QUALITY OF FINANCIAL STATEMENTS

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In terms of the economy of our country is in the process of integration with the world economy, the publicized accounting information of enterprises in general and the company's shares in particular is essential to an enterprise can improve the competitiveness and sustainability of their business operations. This study was carried out for the purpose of finding out the factors that affect the quality of the information presented in the financial statements. With data collected from surveys and through processing, statistical data analysis, this study hopes to provide for the management of the company in particular and the use of financial reporting general insight and a more comprehensive level of influence of each factor on the quality of the information presented in the financial statements. From the above research issues, addressing only a single answer the following questions: What factors in accounting processes affect the quality of financial reporting by enterprises in Vietnam?.
Keywords: quality, financial reporting, accounting processing, accounting and State regulations.

1. Introduction

Although, Vietnam has accounting law, accounting standards and accounting regulations, but in fact the work of accounting firms still have the false information, affecting the quality of the information presented on financial statement. Thus, the question is the legal framework Vietnam issued based on the provisions of international accounting practices, and based on the actual situation of economic - social development in Vietnam, but not guaranteed on the reliability of financial reporting. The study indicates the quality of financial reporting is affected by how the process accounting transactions (including the provisions on the system of accounting documents, the account system, the system of bookeepings and the financial reporting system, the tools support for accounting done its job), the tax policy of the state (which is essentially the value added tax, income tax policy now) as well as perceptions of administrators in the management of the company to ensure the implementation of corporate objectives but does not affect the quality of financial reporting.

2. Overview of Research

For research in 2003 "Factors affecting the transparency of information" Robert Bushman, Joseph Piotroski and Abbie Smith based on the results of factor analysis of the variables measuring environmental information scope of business are collected from companies in several countries and the author has found two factors: financial factors and governance factors. They also put two factors in relation to the legal system and political economy to draw conclusions about their interactions. The result is that the governance factors related to the legal system during the financial factors related to the national political economy. Uyen Thi Thao Doan (2009) has carried out research "Lessons and solutions to enhance the role of accounting information from the economic crisis of 2008" with the object of study is the accounting information in the financial statements of the largest financial institutions in the United States Lehman Brothers Holdings Inc.'s investment funds of Bernard Madoff and Stanford Interational Bank. The study says the importance of accounting information for business decisions of companies, investors, especially for the management and control of the government’s macro-economy. Le Truong Vinh (2008) research "Modeling and verification of quantitative scale information transparency of listed companies in Ho Chi Minh City Stock Exchange" with 30 listed businesses, the authors offer models with 5 variables determine the factors affecting the information transparency of listed companies is: firm size is expected, the profitability of the company, the rotation assets, fixed assets, liabilities. Vo Thi Anh Hong (2008) with the theme "The solutions to improve the usefulness of accounting information for decision-making process of investors in the stock market," surveyed 100 investors on the market the securities in which bank employees 59% and 41% in other sectors including financial sector is 14%, accounting 7%, 3% production business, trade in services is 10% is other components. The results show that investors most interested to increase the EPS, income/equity ratio P/E, income/total assets, the ratio of debt/equity and margin from business activities. The above results show that accounting information is a reference resource important to investors implementing investment decisions and the accounting information is not currently clear and transparent, so investors’ desire provided information transparency.

On the other hand, Sutherland, Edwin H. (1924) – a study of the American crime – the study of the principles of criminal offense that is growing due to links with the offender rather those who have not sinned. From his research, he concluded that offenses arising from the environment, a person can not motivated crime without the impact of external factors. To understand the nature and identify criminals, we need to study and promote attitudes offense. Cressey, Donald R. - is an excellent student of Sutherland, but he studied fraud under the direction of embezzlement, unlike his mentor. Cressey focused analysis through fraud conducted a survey of about 200 cases of economic crime in order to find out the causes of the violations of the law on. The model of "fraud triangle" is one of his typical study, presented the factors leading to the fraud that is now widely used in many occupations relevant as audit, security, criminal investigation ... Meanwhile, Pham Thi Ngoc Anh author (2004) in "Understanding the common errors and fraud in audits of financial statements" refers to three most common ways to deal with fraud: prevention, detection and punishment. In addition, the author Tran Thi Giang Tan (2009): "Fraud on the financial statements and the study of fraud" refers to the 10 signs of the staff suggests the possibility of fraud appear high as most live below the average, high debt, the desire to have a high income, have a close relationship with the client, that the remuneration received disproportionate contribution, have a good relationship with owners, who wish to demonstrate that could pass the control of the company, has a habit of gambling, from excessive pressure, no company is recognized for achievement, signs related to organization. Ten signs of organization suggests the possibility of fraud appear highest placed too much trust in key personnel, lack of relevant approval procedures, not full disclosure of investments and receivables personal income, no separation of functions and functional preservation approval, lack of testing independently review the implementation, not detailed monitoring activities, no separation of functions with accounting preserved, not separating some related accounting functions, lack of clear guidance on the responsibilities and powers, lack of supervision of internal auditors.

These situations may indicate the possibility of financial statements free of material misstatement due to fraud include: The difference between actual and accounting books, such as transactions are recorded in full and on time, or write the wrong amount, misclassified, is inconsistent with the policy of the unit; transactions or balances not approved or no documentation, the adjustment at the end of the reporting period had a material effect on the business results in particular or on the financial statements in general, there is evidence of the employees have no authority to access the accounting system and records of the unit, bribery or complained to the auditor about alleged fraud. The contradiction between the evidence or lack of evidence, such as a missing document, the document may have been altered, only undocumented photo or electronic documents instead of providing the original document, with the Large differences can not explain, answer inconsistency between staff and board of management or board of directors when auditors interviewed or perform analytical procedures, abnormal difference between books and unique authentication establishment of an auditor, loss of inventory or other assets in large numbers, e-vouchers can not or have lost, inconsistent with the actual notes or policies of the company, may not provide evidence of the development of information systems or test key change programs and activities related to the implementation of changes and implementing information systems in the current year. Relationship abnormalities or problems between the auditors and the Board of Directors, eg, Board of

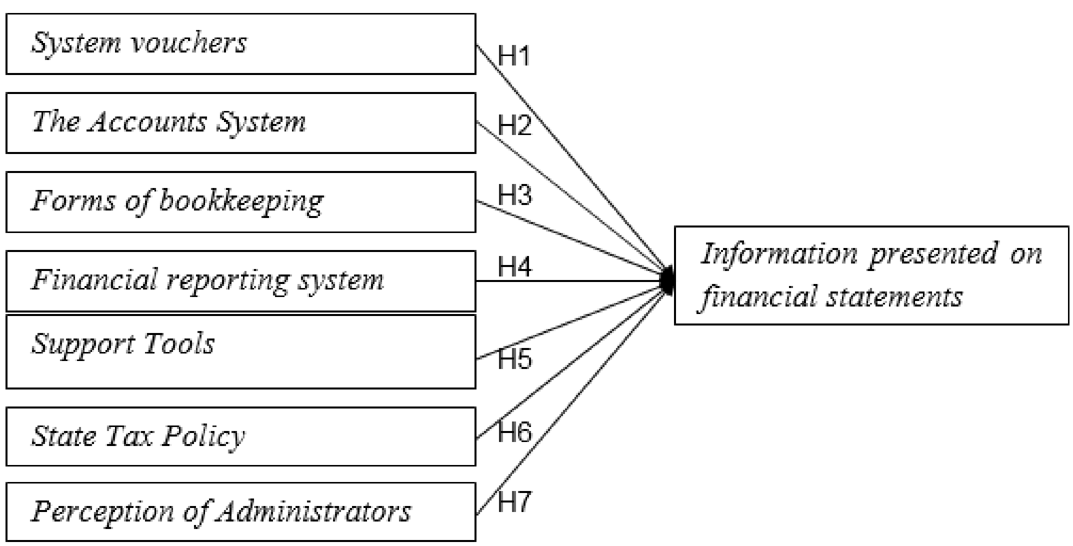
Directors does not allow or deny or restrict auditors access to some documents, employees, customers supplier or some other individuals have the ability to help auditors gather audit evidence. Board of Directors created great pressure on auditors of time solving complex problems or disagreements. The board of directors' complaining of the audit, or a threat from the board of directors for the audit team, especially as related to the assessment, review of auditors or audit evidence about the resolve potential disagreements with the Board of Directors. Board of directors deliberately delaying the provision of information at the request of the auditor, is not willing to allow auditors to access the electronic document is important to check with the technical audit with the assistance help of computers. Refusing contact between auditors with information technology personnel or equipment of key information technologies, including security personnel, operation and development of the system. Do not agree to add or edit auditors of financial statements in order to make full financial statements and transparent, easier to understand. Along with the view to recognize the factors affecting the accounting process but considered in relation to small and medium-sized enterprises, according to Nguyen Thi Huyen Tram author (2007) "Organization of accounting in small and medium enterprises in Vietnam". Topics raised the factors affecting the accounting work in small and medium enterprises as legal regulations, internal control systems, the ability to apply information technology, financial services, accounting and thereby propose a complete solution of accounting in small and medium enterprises in Vietnam. Meanwhile, the author Tran Dinh Khoi Nguyen (2010) mentioned: "Discussing the model of factors affecting the accounting regime applied in small and medium enterprises", including factors such as: The level of accountants; The independence of the profession; The complexity of the standards; Results of the study will be the basis to be able to create and develop on many aspects of accounting. From the perspective of micro and macro, consider the impact of the model to the accounting of small and medium enterprises. For author Anh Tuyet Nguyen (2013) are only interested in Binh Dinh province "The accountant in small and medium enterprises in the province of Binh Dinh" include: Organization of business accounting now. The organization of accounting; The nature and work of outsourced accounting; Provides information of business accounting; The objective of accounting small and medium enterprises; Organization of accounting firms; The organization of accounting; The nature and work of outsourced accounting; Provides information of business accounting; The objective of accounting small and medium enterprises; The views of the administrators with the accounting work. The study results indicated that targets small and medium businesses today it is particularly concerned about issues like tax compliance of tax declarations and minimize the cost to pay. The goal of providing information to the corporate governance are also interested. The provision of information to other entities outside the enterprise hardly be emphasized, in the survey sample size was too small compared to the actual. The business survey is not representative for small and medium enterprises in the province. The previous studies though in a different perspective and recognize each separate issue, but the factors affecting the quality of the information presented in the financial statements are related to the rules of evidence accounting, financial accounting, the accounting records, the financial statements, support tools, policies and awareness of the state of governance.

3. Research Methodology

Research conducted through two steps: preliminary research and formal research. Preliminary research conducted through qualitative research methods are discussed between the experts group on the basis of reference articles and reviews related to the topic, the research team carried out discussions to find out the factors affecting the quality of the information presented in the financial statements; since it will serve as a basis to establish the questionnaire used in formal study. Formal research using quantitative methods, using survey techniques directly through questionnaires. In particular, the random sample of non-probabilistic method for conducting data collection. The data is encrypted and processed by SPSS 22.0 software. To consolidate multiple choice and composition of the scale, the researchers used the method Cronbach's Alpha testing, EFA factor analysis to determine the hidden factor behind the observed variables. Linear regression analysis was used to determine the coefficients of the factors in the equation of linear regression and analysis of the impact of these factors to the information presented in the financial statements of the business.

Research data sources include primary data is the data that the team collected directly at the data source and process to serve the research, will be collected by surveys, online surveys and secondary data to the type of data has been collected through the documents available, openly on the net ...

4. The proposed research model



5. The assumptions are set for research

H1: Accounting documents are the appropriate regulations affecting the same way with the quality of the information presented in the financial statements.

H2: Flexible account systems affect the quality of the information presented in the financial statements in the same way.

H3: Simple bookkeeping forms impact the quality of the information presented in the financial statements in the same way.

H4: Presentation of financial statements in compliance with the fundamental principles of accounting change in the same direction with the quality of the information presented in the financial statements.

H5: Favorable support tool impact in the same direction with the quality of information presented in the financial statements.

H6: Rational tax policy affect the quality of the information presented in the financial statements in the same way.

H7: Perceptions of administrators affect in the same direction to the quality of information presented in the financial statements.

From the study of the theoretical basis of the factors in business processes affect the quality of the information presented in the financial statements of the business including: Accuracy of the information, timeliness, the satisfaction of the users, to meet the needs of information, ... with the ultimate goal is to help managers make appropriate decisions and provide the necessary information for those wishing to use. Derived from the practice of accounting in the enterprise, the authors have studied the design and construction of the model. According to this model, the process accounting operations depends on the eight groups of factors: (1) factors related to the accounting records; (2) factors related to the accounts, (3) factors related to bookkeeping, (4) factors related to the accounting reporting, (5) factors related support tools (6) factors related to tax policy, (7) factors related to the perception of managers and (8) factors related to the information presented in the financial statements. Each group includes several elements observed variables (independent variables), each observed variable is built on 5 point Likert scale, with a choice of "1-entirely without influence" to " 5-Full influence ". Tools collected primary data in this study is designed questionnaire covering all observed variables, then, was sent to the chief accountant, accountant, chief financial officer, auditor ... in the business in the provinces of southern, central and northern Vietnam.

With 280 samples generated, number of samples used to meet the requirements of 225 (80.4% occupancy rate). The questionnaire was distributed to the accountants in many different joint stock companies. After collection, the questionnaires were reviewed and eliminated the table unsatisfactory. Then, the observed variable is encrypted, data entry and data cleaning using SPSS software version 22.0 and conducted statistical analysis of the data was collected.

From the results of testing the reliability of the scale, the overall scale of measurement for the observed variables as well as two groups of factors - the system of accounts (Alpha = 0.679), group 3 elements - window system accounting (Alpha = 0.806), the factor 6 - tax policy (Alpha = 0.660) and group factors 8 - quality requirements (Alpha = 0.630). The observed variables corresponding to the factors mentioned above are acceptable. This proves that the items are correlated with each other questions and we have contributed to measure "quality of the information presented in the financial statements," which the authors are studying.

Implementation of factor analysis in this study to help to realize a set of a few dominant variables from a set of variables to be used in multiple regression analysis.

With 38 observed variables used to measure the independent factor 8 (1) The system of accounting documents; (2) financial accounting system; (3) The system records; (4) accounting reporting system; (5) Support Tools; (6) The tax policy; (7) Aware of the administrator; (8) the information presented in the financial statements chinhPhan volume element is performed by the method of extracting the main components - Principal Components, just extract the valuable element Eigenvalue greater than 1 (because of factors Eigenvalue smaller one will not work better summary original variable, so after normalization of each original variable variance is 1), using Varimax rotation angle of the material factors to minimize the number of large amounts of variable coefficients in the same factor. So, will enhance the ability to explain the factors, observed variables are selected variable coefficients load factor (Loading factor) greater than or equal to 0.45. This coefficient that each item asked "belong" public key factors. Also, check the KMO with 0.5 <KMO <1 and 95% significance level.

Summary of Cronbach Alpha testing and factor analysis (EFA) includes: Scale of "accounting system account" Alpha coefficient = 0.679; The scale of "bookkeeping system" Alpha coefficient = 0.806; The scale of "tax policy" Alpha coefficient = 0.660; The scale of "quality requirements of financial statements" coefficient alpha = 0.630.

Name factor	**The observed variations in factors**
Factor 1: Account Details	TK1, TK2, TK3, TK4
Factor 2: Flexibility account	TK5, TK6
Factor 3: Bookkeeping	SS1, SS2, SS3, SS4, SS5, SS6
Factor 4: Tax Policy	TT1, TT2
Factor 5: Objects used	BC1, BC4, BC5
Factor 6: Rationality information	BC2, BC3

Overall, six new factors are average values of factors point to achieve relatively high.

In particular, the users information (F5), the tax policy of the state (F4) and the validity of the information that companies provide (F6) are accountants particularly interested in assessing regulations processing accounting transactions affecting the quality of information in the financial statements. Besides, the number of F4 mode - policy of the State Tax is assessed as very high, showing how important and special interest of the accountants to handle the accounting profession and presents information on the financial statements. On the other hand, the observed variable coefficient higher load factors were rated as more important and influential than the name represents that factor.

Results of factor analysis to explore, we have a new model consisting of six factors. In particular, there are five independent factors, including details of the account properties (F1), Flexibility of accounts (F2), the form of bookkeeping application (F3), the tax policy of the State (F4) and the users information (F5) and a dependent factor is the validity of information (F6). In this section, researchers consider the quality of information on financial statements decided rationality of accounting information depends on how the business processes from the use of the account details, flexible of the accounts, books and applicable forms, tax policy of the State and the users of accounting information. The steps are as follows:

Multivariate regression analysis in SPSS 22.0, using Enter, this is the default method in SPSS, SPSS handle all variables are put into one. The inclusion and exclusion of other variables are based on the role of the independent variable on the dependent variable, based on implicit behavior between the variables, the reliability of the data collected, the ability to explain ability to collect data processing.

Regression analysis in SPSS, select Collinearity diagnostics to check the phenomenon of multicollinearity (Multicollinearity). Acceptance of variables (tolerances) and magnification factor variance (VIF) was used to detect the phenomenon of multicollinearity. The rule is when the VIF exceeds 10 signs of multicollinearity occurs.

Coefficients[a]

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
1 (Constant)	1.336	.325		4.117	.000		
F1	.134	.069	.131	1.930	.045	.754	1.326
F2	.038	.066	.041	.585	.049	.708	1.413
F3	.105	.076	.101	1.381	.009	.655	1.527
F4	.271	.059	.304	4.612	.000	.801	1.248
F5	.104	.084	.087	1.236	.008	.704	1.421

a. Dependent Variable: F6

From the table we see Coefficientsa, regression coefficients of the independent variables are statistically significant (Sig. <0.05). The significance of the partial coefficients measure the average change Y values when exporting to change one unit, keep the independent variables remaining constant. Beta coefficient was used to compare the independent variables and measurement units. We can rewrite the model as follows: Rationality = 1.336 + 0.134 Information (As detailed account) + 0.038 (Flexibility account) + 0.105 (Form bookkeeping) + 0.271 (the State tax) + 0.104 (Who uses accounting information).

Multivariate regression stepwise method estimates show that providing appropriate information (quality of information): As the details of the account, the account Flexibility, Forms bookkeeping , tax policy of the State and target users of accounting information can impact directly proportional to the "Provide information reasonably". In particular, the tax policy of the State to have the strongest impact on the "Provide information reasonably".

Observe coeficients table saw, VIF values are very small (<2) for all independent variables. Thus, this model is no multicollinearity phenomenon occurs. Through the above analysis, we can see the Adjusted R2 explained 50% of the dependent variable (in fact, there are other factors affecting the dependent variable - the random factor, but the model has not explained) and the t-test results showed five independent variables we included in the accepted sense because they explain the dependent variable. On the other hand, the phenomenon does not exist multicollinearity. Therefore, this model is appropriate.

Results of the analysis above shows, the model explains only 50% of the dependent variable. In particular, elements of the tax policy of the state is considered the most important, followed by factors related to the accounts, accounting records and information to users. Thereby, we can conclude, this model may be suitable for today's perspective of accountants in business in Vietnam.

6. Conclusion

Results of testing the scale Cronbach Alpha, 38 observed variables using 5 point Likert scale was eliminated after turning 19 by non-standard, 19 observed variables remaining after performing factor analysis was extracted into 6 factors: (1) As detailed account, (2) Flexibility of account, (3) Forms bookkeeping, (4) Tax policy of the State, (5) Who uses accounting information and (6) The reasonableness of accounting information (quality of information on the financial statements). Thus, the combination of factors, may be used as criteria to assess the quality of the information presented in the financial statements diminishing influence as follows: (1) The tax policy of the State; (2) As the details of the account; (3) Form of bookkeeping; (4) Who uses accounting information and (5) Flexibility of the account.

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Applying Intuitionistic Fuzzy with MCDM to Measure the Enterprises' ICT Maturity in Vietnam

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Generally, measuring the Information and Communication Technology (ICT) maturity is the first step to build a knowledge system in an enterprise. Knowing their ICT maturity helps enterprises make a plan for improving their ICT state to strengthen their competitive capability. In this paper, the concept of intuitionistic fuzzy set is applied to Analytic Hierarchy Process (AHP) and Analytic Network Process (ANP) approaches to propose a model for measuring enterprise's ICT maturity under uncertain environment. A case study in Vietnam is also used to show a better performance of the new method for ICT maturity measurement.
Keywords: ICT maturity, Intuitionistic fuzzy logic, IF-AHP, IF-ANP.

1. Introduction

In the era of information and knowledge, knowledge has become an essential resource that organizations need to manage effectively. Many studies approved that the knowledge management in organizations is one of the most important element to enterprises' innovation capability to help them get their own competitive advantage and develop steadily. Obviously, the knowledge management in enterprise depends mostly on the development level of Information and Communication Technology. The ICT maturity of an enterprise is a solid foundation for successful implementation of knowledge management. This reason encourages most enterprises to increase their ICT status. With the very fast development of technology, most enterprises need to know their current state of ICT use or ICT maturity in order to apply effectively ICT to do their business better. Moreover, knowing current ICT maturity state is the foundation of making plan to newly build or to improve an information system.

This research concentrated on designing a new measurement of ICT maturity in enterprise and dealing with uncertainty of fuzzy environment that influences the accuracy of measured result. And it is also tested practically in several Vietnam's enterprises for effective performance. To measure the ICT maturity, we have to know the importance weights of each factor and their indicators. In this paper, aggregative intuitionistic fuzzy AHP (IF-AHP) and ANP (IF-ANP) approaches are both used to determine the weights. The following parts of this paper consist: Session 2 defines ICT maturity and introduces a measurement for it. In session 3, the basic concept of intuitionistic fuzzy set will be given. Session 4 proposes a model to measure enterprise ICT maturity using group IF-AHP and IF-ANP. An illustrative example is presented in session 5. The paper will be ended by conclusion part.

2. DEFINITION, MODEL AND MEASUREMENT FOR ICT MATURITY

2.1. *Definition and Model*

The term ICT maturity of enterprise refers to a state of an enterprise, in which the enterprise reaches full development in applying ICT in doing its business. Other words, ICT maturity shows how well an enterprise uses ICT in support its business. To determine the current maturity state of ICT use in an enterprise, it is required to carry out measuring the ICT maturity of that enterprise.

Following is a proposed model to measure ICT maturity of an enterprise. There are four main ICT factors inside an enterprise: ICT Infrastructure, ICT Application, ICT Human Resource and ICT Policy, see Figure 2-1.

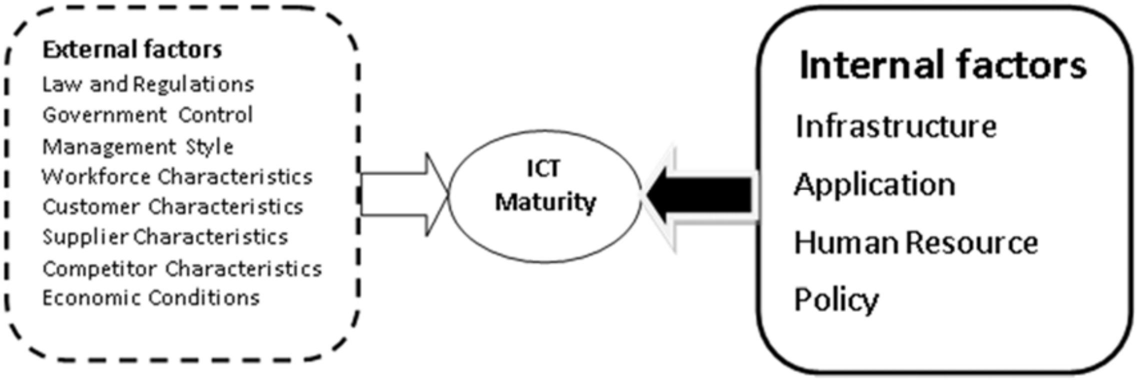

Figure 2 1. Model for main factors of ICT maturity in an enterprise

- ICT infrastructure is considered as hardware consisting of ICT devices and services such as server, desktop, laptop, telephone, mobile, fax, network, internet, LAN, WAN… for enterprises to collect, store, process, achieve, distribute and search information. This factor is considered as the basic foundation on which ICT applications are set up.
- ICT application are software and firmware. ICT applications must be installed upon ICT infrastructure. These applications facilitate all business activities in enterprise. Some kinds of application typically used in enterprises are Transaction Processing System (TPS), Management Information System (MIS), Decision Support System (DSS), Executive Information System (EIS), E-commerce, Knowledge-based System, Social Network Services, etc.
- ICT human resource includes staff literacy, ICT skills, innovation skills, IT experts, IT leaders, ICT training, R&D activities. It is very important factors of ICT maturity in enterprise.
- ICT policy consists of regulations, rules and procedures relating to the ways of using and developing ICT in an enterprise. Policy factor effects on all other factors of ICT maturity.

In this research we only focus on 4 main internal factors, because they have strong influences on ICT development in enterprises. Moreover, we can go further to consider the relations between 4 internal main factors influencing on ICT maturity. It is not always possible to assume the main factors to be independent. The more optimal result can be obtained by considering inner dependences among main internal factors. The network relation model of main internal factors is depicted schematically in Firgure 2-2.

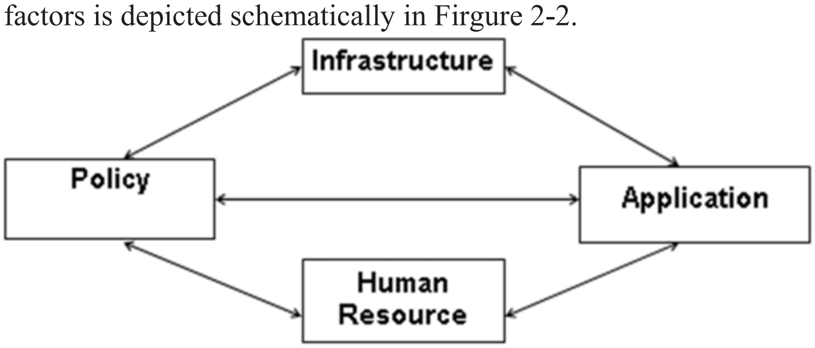

Figure 2 2. Inner dependences among main internal factors

In addition, to measure the ICT maturity, we have to know the importance weights of factors and their respective indicators. To serve this purpose, the proposed model of this research has suggested methods to calculate importance weights of each indicators. The calculation is based on decision makers' judgments and multiple criteria decision making approaches combining with intuitionistic fuzzy logic. The existing models commonly are based on single judgment from one expert and are working in certain situations, not in fuzzy environments where the uncertainty and impreciseness on judgments of the decision makers always exist. The fuzzy environment is caused by the increasing complex of socio-economic environment and the subjective nature of human thinking.

In this research, an aggregative intuitionistic fuzzy analytic hierarchy process (IF-AHP) approach and an aggregative intuitionistic fuzzy analytic network process (IF-ANP) approach were used to determine the importance weights of measurement indicators in uncertain environment. Multiple criteria decision making (MCDM) becomes more and more popular recently and has been widely applied to solve decision problems in many different fields. This research utilized two most commonly-used MCDM approaches AHP and ANP as calculation methods in building a complete model for measuring ICT maturity in enterprises.

2.2. *Measurement for ICT Maturity*

In this research, we utilize the 5-stage road-map suggested by Pham in his work (Pham, 2010). This road map of ICT develop is to determine the level of ICT maturity in an enterprise.

- Stage 1: Inactive – no current use of ICT in company
- Stage 2: Basic – including word processing and other desktop packages
- Stage 3: Substantial – extending into the networking of PCs and applications
- Stage 4: Web-based – extending to e-commerce with many web-based services
- Stage 5: Knowledge-oriented – integration of applications and using ICT tools for innovation and knowledge management.

In order to create a list of indicators for measuring ICT maturity in enterprise, more details should be added to the model of ICT maturity. Each dimension of 4 main factors could be measured by many indicators. The main purpose is that these indicators should be easy to get information as well as exactly show the ICT maturity of an enterprise. Table 2-1 shows the list of 52 indicators that will used to measure the ICT maturity of enterprise. They are divided into 4 main groups respectively corresponding to 4 main factors. The column 'Stage' expresses the development stage of each indicator. Note that, all indicators listed below are used to evaluate the development level of ICT use. That is why there is no indicator with the stage 1. The stage values will be used to make a futher classification on all indicators in respect to a particular main factor.

The ICT maturity index (ICTMI) will be calculated by following formula:

$$ICTMI = \alpha I + \beta A + \gamma H + \theta P \quad (0 \le I, A, H, P, ICTMI \le 1, \alpha + \beta + \gamma + \theta = 1) \qquad (1)$$

I, A, H, P are respectively contributions of 4 main factors Infrastructure, Application, Human Resource and Policy to the ICTMI. The α, β, γ, θ are coefficients of 4 main respective factors. In his paper, Pham let the weights of I, A, H, P as $\alpha=\beta=\gamma=\theta=1/4$. The calculated ICTMI can be mapped to 5 stages of ICT development road-map by the rule: 0-1/5: Inactive; 1/5-2/5: Basic; 2/5-3/5: Substantial; 3/5-4/5: Web-based; 4/5-1: Knowledge–oriented. This paper uses group IF-AHP and IF-ANP approaches to determine more appropriate coefficients for I, A, H and P in order to get a better ICTMI.

Table 2 1. Indicators of the proposed ICT maturity measurement

Number	Factor		Indicator	Stage
1	Infrastructure (I)		Number of fixed telephones	2
2			Number of mobile devices	5
3			Number of computers (desktop, laptop)	2
4			Type of internet access	4
5			Local Area Network (LAN)	3
6			Internet bandwidth	4
7			Security of Internet server/ Hosting	4
8			Security & backup system	4
9			Wide Area Network (WAN/ GAN)	3
10			Wireless LAN/ Wi-Fi Internet	5
11			WAP/ i-mode access	5
12			Telephoning over the internet/ VoIP	4
13	Application (A)		Standard application software	2
14			Getting information about goods/ services via Internet	4
15			Getting information about government organizations	4
16			Website presence	4
17			Internet service is used	4
18			Proportion of online purchases	4
19			Proportion of online sales	4
20			Providing customer services	5
21			Delivering product online	5
22			E-mail/ IM for communicating	2
23			Social network for cooperate	5
24			Remote meeting/ video conference	5
25			Using services through Intranet/ Extranet	3
26			Internet banking	5
27			Management/ transaction information systems	3
28			Integrated Information Systems (SCM/ ERP/ CRM)	3
29			Business intelligent/ Knowledge-Based systems	5
30	Human Resource (H)		ICT training	3
31			Share of employee using a computer	2
32			Share of employee using the internet	4
33			Average royalty payment & receipt per year	5
34			Number of patent/ license application	5
35			Average company spending on R&D per year	5
36			Capacity for innovation	5
37			Number of IT specified employee	3

38			Separate IT department with CIO	4
39			Number of business specified employee	2
40			Self-learning encouragement	5
41			ICT use for supporting expertise reuse	5
42	Policy (P)		ICT investment	3
43			Quality policy	2
44			Privacy policy	4
45			Regulatory policy	2
46			Security policy	4
47			Piracy policy	5
48			IT expert recruitment/ training	5
49			Staff internal or external recruitment/ training	5
50			Upgrade ICT hardware/ software	3
51			Assessment effectiveness	5
52			ICT use for KM is a priority	5

3. BASIC CONCEPT OF INTUITIONISTIC FUZZY SET

3.1. *Triangular Fuzzy Number*

A triangular fuzzy number Ã can be defined by a triplet (l, m, u), where u ≤ m ≤l, l and u stand for the lower and upper value of the support of Ã respectively, and m is the mid-value of Ã. If l = m = u, it is a non-fuzzy number by convention (a crisp number). The graph of triangular fuzzy can be shown in Figure 3-1.

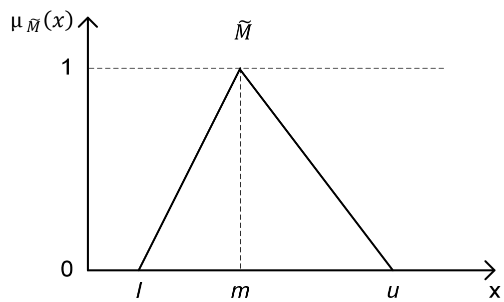

Figure 3 1. A triangular fuzzy number.

The membership function μÃ (x) is defined as:

$$\mu_{\tilde{A}}(x) = \begin{cases} \dfrac{x-l}{m-l} & 1 \le x \le m \\ \dfrac{u-x}{u-m} & m \le x \le u \\ 0 & otherwise \end{cases}$$

3.2. *Intuitionistic Fuzzy Set*

Let a set X be fixed, an intuitionistic fuzzy set (IFS) Ã in X is an object having the form

Ã = {<x, μÃ(x), νÃ(x)> | x ∈ X}, where the μÃ(x): X ⍰ [0,1] and νÃ(x): X ⍰ [0,1] define the degree of membership and degree of non-membership respectively, of the element x ∈ X to the set Ã, which is a subset of X, for every element x ∈ X, 0≤ μÃ(x) + νÃ(x) ≤1. An IFS is shown in Figure 3-2.

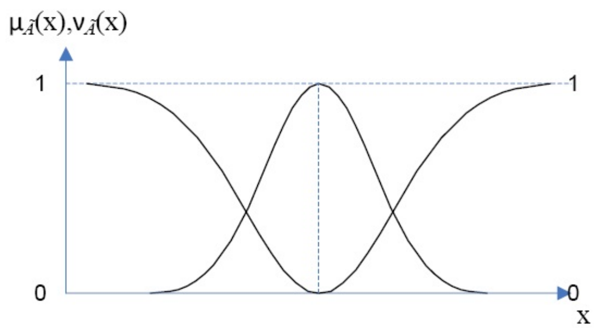

Figure 3 2. Membership and non-membership function of Ã

Definition of intuitionistic fuzzy index:

For each IFS Ã in X, if $\pi_{\tilde{A}}(x)=1-\mu_{\tilde{A}}(x) - \nu_{\tilde{A}}(x)$, $0\leq \pi_{\tilde{A}}(x) \leq 1$, then $\pi_{\tilde{A}}(x)$ is the third parameter of IFS and is usually called the intuitionistic fuzzy index or hesitation degree. IFSs is reduced to fuzzy sets when $\nu_{\tilde{A}}(x) = 1- \mu_{\tilde{A}}(x)$ and $\pi_{\tilde{A}}(x) = 0$.

Definition of triangular intuitionistic fuzzy number:

A triangular intuitionistic fuzzy number (IFN) Ã is represented as:

$$\tilde{A} = <[(a'_1, b'_1, c'_1); \mu_{\tilde{A}}], [(a_1, b_1, c_1); \nu_{\tilde{A}}]>.$$

The membership functions $\mu_{\tilde{A}}$ is used to derive the lower bounds of membership μ_L for IFN Ã, where the upper bound of membership μ_U is derived by taking the compliment of non-membership functions $\nu_{\tilde{A}}$, respectively. A triangular IFN is shown in Figure 3-3.

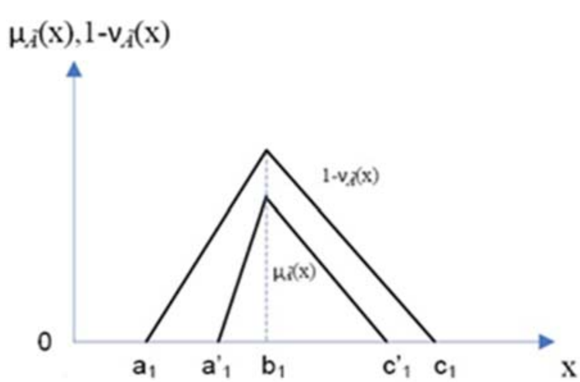

Figure 3 3. A triangular IFS Ã

3.3. *Arithmetic Operation for Triangular Intuitionistic Fuzzy Number*

For two triangular IFNs
$\tilde{A}1 = \langle[(a'1,b'1,c'1);\ \mu\tilde{A}1],\ [(a1,b1,c1);\ \nu\tilde{A}1]\rangle$ and $\tilde{A}2 = \langle[(a'2,b'2,c'2);\ \mu\tilde{A}2],\ [(a2,b2,c2);\ \nu\tilde{A}2]\rangle$
Four common arithmetic operations for IFNs:
Addition
$\tilde{A}1 + \tilde{A}2 = \langle\ [(a'1+a'2,\ b'1+b'2,\ c'1+c'2);\ \min(\mu\tilde{A}1,\ \mu\tilde{A}2)],\ [(a1+a2,\ b1+b2,\ c1+c2);\ \max(\nu\tilde{A}1,\ \nu\tilde{A}2)]\ \rangle$ (3-2)
Subtraction
$\tilde{A}1 - \tilde{A}2 = \langle\ [(a'1+c'2,\ b'1-b'2,\ c'1+a'2);\ \min(\mu\tilde{A}1,\ \mu\tilde{A}2)],\ [(a1-c2,\ b1-b2,\ c1+a2);\ \max(\nu\tilde{A}1,\ \nu\tilde{A}2)]\ \rangle$ (3-3)
Multiplication
$\tilde{A}1 \times \tilde{A}2 = \langle\ [(a'1 x a'2,\ b'1 x b'2,\ c'1 x c'2);\ \min(\mu\tilde{A}1,\ \mu\tilde{A}2)],\ [(a1 x a2,\ b1 x b2,\ c1 x c2);\ \max(\nu\tilde{A}1,\ \nu\tilde{A}2)]\ \rangle$ (3-4)
Division
$\tilde{A}1 / \tilde{A}2 = \langle\ [(a'1/c'2,\ b'1/b'2,\ c'1/a'2);\ \min(\mu\tilde{A}1,\ \mu\tilde{A}2)],\ [(a1/c2,\ b1/b2,\ c1/a2);\ \max(\nu\tilde{A}1,\ \nu\tilde{A}2)]\ \rangle$ (3-5)
The above arithmetic operations are used to develop group IF-AHP and IF-ANP methods.

4. THE PROPOSED MODEL FOR MEASURING ICT MATURITY

A group intuitionistic fuzzy AHP or ANP method is applied in the proposed model to measure an enterprise's ICT maturity. The process of measuring includes following steps:
Step 1: Define measuring factors, indicators and linguistic variables.
Firstly, define measuring factors and indicators. As presented in previous chapter, the measurement of ICT maturity consists of 4 main factors. Each factor has its own indicators: 12 indicators for Infrastructure (I), 17 indicators for Application (A), 12 indicators for Human resource (H) and 11 indicators for Policy (P). In a particular factor, each indicator is assigned to a stage of ICT development. So we will divide indicators from one factor into 4 groups respectively 4 stages (from 2 to 5) later.
Then, define the appropriate linguistic variables for the importance weight of factors, indicators and stages. This research suggests linguistic terms that can be expressed in triangular fuzzy numbers and intuitionistic fuzzy numbers, see Table 4-1.

Table 4 1. Linguistic variables for important weight

Linguistic terms		**Linguistic value in fuzzy set**	**Value in intuitionistic fuzzy set**
JE	Just Equal preferred	(1,1,1)	<[(1,1,1),0.8],[(1,1,1),0.1]>
EP	Equally preferred	(1,1,3/2)	<[(1,1,3/2),0.8],[(1,1,2),0.1]>
WMP	Weakly more preferred	(3/2,2,5/2)	<[(3/2,2,5/2),0.8],[(1,2,3),0.1]>
SMP	Strongly more preferred	(5/2,3,7/2)	<[(5/2,3,7/2),0.8],[(2,3,4),0.1]>
VMP	Very strongly more preferred	(7/2,4,9/2)	<[(7/2,4,9/2),0.8],[(3,4,5),0.1]>
AMP	Absolutely more preferred	(9/2,5,11/2)	<[(9/2,5,11/2),0.8],[(4,5,6),0.1]>

Step 2: Develop pairwise comparision matrix using intuitionistic fuzzy

In F-AHP, a paiwise comparison can be expressed by a triangular fuzzy number as (value-Δ, value, value+Δ), where Δ is fuzzification factor used to account for the vagueness in uncertainty. In case of IF-AHP, a pairwise comparison is expressed by an interval-value membership [μL, μU]. In addition, the decision makers can specify their degree of belief and degree of non-belief for the pairwise comparisons. The belief is represented by a membership function μx so the lower bound membership μL = μX. The non-belief is represented by a non-membership function ϑ_x, so the upper bound membership $\mu_U = 1 - \vartheta_x$. The fuzzification factors $\Delta^{\mu L}$ and $\Delta^{\mu U}$ for μL and μU respectively may not be the same. Therefore, a pairwise comparison in term of triangular IFS can be written as $([(value - \Delta^{\mu L}, value, value + \Delta^{\mu L}), \mu_X], [(value - \Delta^{\mu U}, value, value + \Delta^{\mu U}), \nu_X])$.

To simplify the problem, in the practical experiment (session 5) we assume that the degree of belief μX = 80% = 0.8 and the degree of non-belief ϑ_x = 10% = 0.1. The fuzzification factors for μL and μU are $\Delta^{\mu L}$= 0.5 and $\Delta^{\mu U}$= 1.0 respectively.

Firstly, collect judgments in term of linguistic variable from a group of some experts then create a intuitionistic fuzzy pairwise comparison matrix. Consider a IF judgment matrix $\bar{\bar{J}}$ with n criteria.

$$\bar{\bar{J}} = \begin{bmatrix} \bar{\bar{j}}_{11} & \bar{\bar{j}}_{12} & \cdots & \bar{\bar{j}}_{1n} \\ \bar{\bar{j}}_{21} & \bar{\bar{j}}_{22} & & \bar{\bar{j}}_{2n} \\ \vdots & & \ddots & \vdots \\ \bar{\bar{j}}_{n1} & \bar{\bar{j}}_{n2} & \cdots & \bar{\bar{j}}_{nn} \end{bmatrix}$$

For diagonal entries i=j, =1. Upper right-hand triangle entries are pairwise comparisons defined by decision makers, whereas lower left-hand triangle entries are derived by taking reciprocal, i.e., .

Step 3: Check for consistency of judgments

The AHP utilizes consistency index (CI) and consistency ratio (CR) to determine if the fuzzy judgment matrix is consistent or not. The threshold of the CR is usually 0.1.

Step 4: Determine the IF weights for main factors, stages and indicators.

There are several techniques to compute the weights. In this paper, the geometric mean is used to compute the intuitionistic fuzzy weights. For each row , firstly taking the geometric mean (equation 3-6) , then calculating IF weights (equation 3-7).

$$\bar{\bar{J}}_i = \left(\bar{\bar{J}}_{i1} \times \bar{\bar{J}}_{i2} \times \ldots \times \bar{\bar{J}}_{in}\right)^{1/n}$$ **(Error! No text of specified style in document.**-1)

$$\bar{\bar{w}}_i = \bar{\bar{J}}_i \times \left(\bar{\bar{J}}_1 + \bar{\bar{J}}_2 + \ldots + \bar{\bar{J}}_n\right)^{-1}$$ **(Error! No text of specified style in document.**-2)

Applying the method above, we can calculate the local weights of 4 main factors, the local weights of 4 stages (from 2 to 5) within each main factor, then the local weights of each indicators within a stage of a particular main factor.

Step 5: Normalization and intuitionistic defuzzification for IF weights

The intuitionistic fuzzy weights calculated in previous step will be normalized based on then most likely value. Firstly, use the equation (3-8) & (3-9) as a procedure proposed by Wang, Y. M. and Elhag, T. (2006) to check for normality. If it is not satisfied, they suggested a normalization method in equation (3-10).

$$\sum_{i=1}^{n} w_i^{LI} + \max_j\left(w_j^{UI} - w_j^{LI}\right) \le 1 \quad and \quad \sum_{i=1}^{n} w_i^{UI} - \max_j\left(w_j^{UI} - w_j^{LI}\right) \ge 1$$

(Error! No text of specified style in document.-3) & (**Error! No text of specified style in document.**-4)

$$(\widehat{w}_i)_\alpha^{LI} = max\left\{(w_i)_\alpha^{LI}, 1 - \sum_{j\neq i}^{n}(w_i)_\alpha^{UI}\right\} \; and \; (\widehat{w}_i)_\alpha^{UI} = min\left\{(w_i)_\alpha^{UI}, 1 - \sum_{j\neq i}^{n}(w_i)_\alpha^{LI}\right\}$$

(Error! No text of specified style in document.-5)

The intuitionistic defuzzification converts an IF-AHP weight into a crisp value that includes two following tasks:

Task 1: Mendel, J. M. (2004) suggested a method to reduce an IFS into a fuzzy set by taking an arithmetic mean of interval-value memberships [μL, μU] at each xd, representing predefined discrete points over the universe of discourse.

Task 2: Lee & Li (1988) and Chen, Hwang, Beckmann & Krelle (1992) suggested the use of generalized mean and standard deviation in defuzzification. Consider $\overline{w_i}$ is "reduced fuzzy set" of $\overline{w_i}$. Generalized mean and standard deviation are:

$$\overline{x}(\overline{W_i}) = \frac{\int_a^b x\,\mu_{\overline{W_i}}(x)\,dx}{\int_a^b \mu_{\overline{W_i}}(x)\,dx}$$

(Error! No text of specified style in document.-6)

$$\sigma(\overline{W_i}) = \left[\frac{\int_a^b x^2\mu_{\overline{W_i}}(x)dx}{\int_a^b \mu_{\overline{W_i}}(x)dx} - [\overline{x}(\overline{W_i})]^2\right]^{1/2}$$

(Error! No text of specified style in document.-7)

In two equations above, a and b are the lower and upper bounds when the membership is not equal to zero.

Step 6: Calculate the ICTMI.

Use formula from (3-1) to (3-5) along with the result of survey (to get the values of indicators) to calculate the ICTMI.

5. PRACTICAL EXPERIMENT (CASE STUDY)

Based on the proposed measurement of 52 indicators in Table 2-1, a questionnaire is designed, then a survey was conducted in numerous enterprises in Vietnam. The questionnaires were delivered to 124 enterprises all located in Ho Chi Minh city, Vietnam by sending e-mail to or direct interviewing the person responsible. The number of valid response is 80 enterprises.

After having questionnaires given back, the data of all indicators have to be quantized in the range of (0, 1), mainly by proportion, percentage, frequency.
A group of 3 experts have convened to pass their judgments on relative importance of main factors and stages. Next step is to determine relative importance weights of 4 main factors and relative importance weights of indicators with respect to each main factor. For simplicity, in the scope of this study we don't go further to calculate the relative importance weights of each indicators in respect to one main factor. All indicators in the same one main factor are assumed to have equal importance weight. Then, ICTMI of enterprises will be calculated.

5.1. Using IF-AHP Approach:

All pair-wise comparisons then are arranged in a common matrix popularly called pairwise comparison matrix (PCM), see Table 5-1. For each pair of main factors, we have 3 judgments corresponding to 3 experts.
Firstly, we will check the data consistency for judgments from each expert. The consistency ratio (CR) of expert-1 is 0.015 which is less than the consistency threshold 0.1. So expert-1's opinion is consistent. Similarly, we can test the consistency for judgments from 2 other experts. The second expert has the consistency ratio 0.038. The third expert has the consistency ratio 0.030. They are both less than the consistency threshold 0.1. So expert-2's and expert-3's judgments are also consistent.

Table 5 1. Pair-wise comparison matrix of main factors given by expert group

	I	**A**	**H**	**P**
I	JE	WMP	1/SMP	EP
	JE	WMP	1/WMP	EP
	JE	EP	1/WMP	1/WMP
A		JE	1/VMP	1/SMP
		JE	1/SMP	1/SMP
		JE	1/VMP	1/SMP
H			JE	WMP
			JE	SMP
			JE	WMP
P				JE
				JE
				JE

In this experiment, assume that degree of belief □x=0.8, degree of non-belief □x =0.1, the fuzzification factors for □L and □U are □□L=0.5 and □□U=1.0 respectively. The geometric mean method is used to obtain the combined pairwise comparison matrix for whole group of experts, see Table 5-2.

Table 5 2. Combined pair-wise comparison matrix given by expert group

	I	**A**	**H**	**P**
I	<[(1.000,1.000,1.000),0.8], [(1.000,1.000,1.000),0.1]>	<[(2.359,2.884,3.402),0.8], [(1.817,2.884,3.915),0.1]>	<[(2.500,3.000,3.500),0.8], [(2.000,3.000,4.000),0.1]>	<[(1.000,1.000,1.500),0.8], [(1.000,1.000,2.000),0.1]>
A	<[(0.294,0.347,0.424),0.8], [(0.255,0.347,0.550),0.1]>	<[(1.000,1.000,1.000),0.8], [(1.000,1.000,1.000),0.1]>	<[(1.500,2.000,2.500),0.8], [(1.000,2.000,3.000),0.1]>	<[(2.109,2.621,3.129),0.8], [(1.587,2.621,3.634),0.1]>
H	<[(0.286,0.333,0.400),0.8], [(0.250,0.333,0.500),0.1]>	<[(0.400,0.500,0.667),0.8], [(0.333,0.500,1.000),0.1]>	<[(1.000,1.000,1.000),0.8], [(1.000,1.000,1.000),0.1]>	<[(1.990,2.520,3.041),0.8], [(1.442,2.520,3.557),0.1]>
P	<[(0.667,1.000,1.000),0.8], [(0.500,1.000,1.000),0.1]>	<[(0.320,0.382,0.474),0.8], [(0.275,0.382,0.630),0.1]>	<[(0.329,0.397,0.503),0.8], [(0.281,0.397,0.693),0.1]>	<[(1.000,1.000,1.000),0.8], [(1.000,1.000,1.000),0.1]>

If we consider the whole group of experts as a "new expert". The consistency ratio of "new expert" or entire group of expert is 0.015 less than the consistency threshold 0.1. Thus, the whole group comparison is consistent.

The weight vectors of main factors are determined by using equation (3-6):

$\overline{\overline{J}}_1$ = <[(0.767, 0.861, 1.079), 0.8], [(0.677, 0.861, 1.348), 0.1]>

$\overline{\overline{J}}_2$ = <[(0.425, 0.490, 0.559),0.8], [(0.379, 0.490, 0.661), 0.1]>

$\overline{\overline{J}}_3$ = <[(1.774, 2.089, 2.385), 0.8], [(1.428, 2.089, 2.667), 0.1]>

$\overline{\overline{J}}_4$ = <[(0.940, 1.134, 1.278), 0.8], [(0.786, 1.134, 1.463), 0.1]>

Next, the intuitionistic weights $\overline{\overline{w}}_i$ can be computed by using formula (3-7):

$\overline{\overline{w}}_1$ = <[(0.145, 0.188, 0.276), 0.8], [(0.110, 0.188, 0.412), 0.1]>

$\overline{\overline{w}}_2$ = <[(0.080, 0.107, 0.143), 0.8], [(0.062, 0.107, 0.202), 0.1]>

$\overline{\overline{w}}_3$ = <[(0.335, 0.457, **0.611**), 0.8], [(0.233, 0.457, **0.816**), 0.1]>

$\overline{\overline{w}}_4$ = <[(0.177, 0.248, 0.327), 0.8], [(0.128, 0.248, 0.447), 0.1]>

Sum of the most likely values of intuitionistic fuzzy weights above is $\sum \overline{\overline{w}}_i$ = 0.188 + 0.107 + 0.457 + 0.248 = 1 complies with the basic axiom of AHP.

Next step is to check for normality of newly obtained weights above. At μ_L=0.8 and α=0, the lower interval weights are

$(w_1)_{\alpha=0}$=[0.145, 0.276] $(w_2)_{\alpha=0}$=[0.080, 0.143] $(w_3)_{\alpha=0}$=[0.335, 0.611] $(w_4)_{\alpha=0}$=[0.177, 0.327]

Using the equation (3-8) and (3-9), it can be shown that:

$\sum_{i=1}^{n} w_i^{LI} + \max_j\left(w_j^{UI} - w_j^{LI}\right) = 0.737 + 0.276 = 1.013 \leq 1$ (unsatisfied) and

$\sum_{i=1}^{n} w_i^{UI} - \max_j\left(w_j^{UI} - w_j^{LI}\right) = 1.358 - 0.276 = 1.081 \geq 1$ (satisfied)

At μ_U = 0.9 and α=0, the upper interval weights are:

$(w_1)_{\alpha=0}$=[0.110, 0.412] $(w_2)_{\alpha=0}$=[0.062, 0.202]

$(w_3)_{\alpha=0}$=[0.233, 0.816] $(w_4)_{\alpha=0}$=[0.128, 0.447]

Using the equation (3-8) and (3-9), it can be shown that:

$\sum_{i=1}^{n} w_i^{LI} + \max_j\left(w_j^{UI} - w_j^{LI}\right) = 0.533 + 0.583 = 1.116 \leq 1$ (unsatisfied) and

$\sum_{i=1}^{n} w_i^{UI} - \max_j\left(w_j^{UI} - w_j^{LI}\right) = 1.878 - 0.583 = 1.294 \geq 1$ (satisfied)

Since the normality is not satisfied, the lower and upper interval weights have to be adjusted by using equation (3-10). The final results are:

$\overline{\overline{w}}_1$ = <[(0.145, 0.188, 0.276), 0.8], [(0.110, 0.188, 0.412), 0.1]>

$\overline{\overline{w}}_2$ = <[(0.080, 0.107, 0.143), 0.8], [(0.062, 0.107, 0.202), 0.1]>

$\overline{\overline{w}}_3$ = <[(0.335, 0.457, **0.598**), 0.8], [(0.233, 0.457, **0.700**), 0.1]>,

$\overline{\overline{w}}_4$ = <[(0.177, 0.248, 0.327), 0.8], [(0.128, 0.248, 0.447), 0.1]>

With this new set of adjusted weights, equations (3-8) and (3-9) are satisfied now, which means the adjusted weights meet requirement of normality. Using equation (3-11) and (3-12) to do intuitionistic defuzzification for adjusted weights above, we have generalized mean, standard deviation. Then the generalized means are continually normalized so that sum of them equals to 1, thus we have the normalized final weights. The result is in Table 5-3.

Table 5-3. Final importance weights of main factors

Main factors	Generalized mean	Standard deviation	Normalized final weight
I – Infrastructure	0.224	0.058	**0.210**
A – Application	0.114	0.020	**0.107**
H – Human resource	0.458	0.081	**0.431**
P – Policy	0.267	0.056	**0.251**

Finally, the importance weights of 4 main factors corresponding to I, A, H, P is

Table 5-4. Relative importance weights of main factors

Factor	Infrastructure	Application	Human Resource	Policy
Weight	**0.210**	**0.107**	**0.431**	**0.251**

Now we have all the relative importance weights of 4 main factors like above Table 5-4. Note that, in the scope of this study we don't go further to calculate the relative importance weights of each indicators in respect to one main factor. Next, based on the result of survey along with obtained importance weights above, we applied the formula from (3-1) to (3-5) to calculate the ICTMI for enterprises in this experiment. Lastly, the ICT maturity status of enterprise was achieved by match ICTMI with the 5-stage road-map for ICT maturity development. In this experiment, we used an instance of 5-stage road-map as following:

Table 5-5. An instance of 5-stage road map

ICTMI	0.0 - 0.2	0.2 - 0.4	0.4 - 0.6	0.6 - 0.8	0.8 - 1.0
Status	Inactive	Basic	Substantial	Web-based	Knowledge-oriented

5.2. Using IF-ANP Approach:

In ANP approach, it emphasizes the network relation especially the feedback relation between factors. As we mentioned in section 2.1, the more optimum result can likely be obtain by considering inner dependences among main internal factors. We are going to apply IF-ANP approach to determine the importance weights of main factors under consideration of inner dependences among them.

In previous section 5.1, we assumed that 4 main factors are independent. Then we used IF-AHP method to calculate their priority weight as the result in Table 5-4. That result can be called local weight vector of 4 main factors

$$\mathbf{W = (0.210, 0.107, 0.431, 0.251)}$$

To calculate the interdependent weights of 4 main factors, we firsly consider the inner dependence matrices of factors with respect to every other factor. Based on the inner dependence presented in Figure 2-1, pairwise comparison matrices are formed for factors.

Here is the inner dependence matrix of main factors with respect to Policy factor, given by expert group.

P	I	A	H
I	JE	WMP	1/WMP
	JE	WMP	1/WMP
	JE	SMP	1/WMP
A		JE	1/VMP
		JE	1/VMP
		JE	1/VMP
H			JE
			JE
			JE

In this experiment, the degree of belief $\mu_x=0.8$, degree of non-belief $\upsilon_x=0.1$, the fuzzification factors for μ_L and μ_U are $\Delta^{\mu L}=0.5$ and $\Delta^{\mu U}=1.0$ respectively. Applying the same way of calculation we did in section 5.1 with IF-AHP, we have the vector of relative importance weight of factors with respect to Policy factor is $\mathbf{W_P} = \mathbf{(0.321, 0.141, 0.537)}$.

Next, we consider the inner matrices of main factors with respect to Application factor, the vector of relative importance weight of factors with respect to Application factor is $\mathbf{W_A} = \mathbf{(0.279, 0.449, 0.272)}$. Similarly, the vector of relative importance weight of factors with respect to Infrastructure factor is $\mathbf{W_I} = \mathbf{(0.334, 0.666)}$ and the vector of relative importance weight of factors with respect to Human Resource factor is $\mathbf{W_H} = \mathbf{(0.293, 0.707)}$.

Based on 4 vectors W_I, W_A, W_H and W_P we have the dependence matrix of main factors as following

$$\begin{bmatrix} 1.000 & 0.279 & 0.000 & 0.321 \\ 0.334 & 1.000 & 0.293 & 0.141 \\ 0.000 & 0.449 & 1.000 & 0.537 \\ 0.666 & 0.272 & 0.707 & 1.000 \end{bmatrix}$$

The interdependent weights of main factors are calculated by multiplying the dependence matrix above with the local weight vector of factors as following

$$\begin{bmatrix} 1.000 & 0.279 & 0.000 & 0.321 \\ 0.334 & 1.000 & 0.293 & 0.141 \\ 0.000 & 0.449 & 1.000 & 0.537 \\ 0.666 & 0.272 & 0.707 & 1.000 \end{bmatrix} \times \begin{bmatrix} 0.210 \\ 0.107 \\ 0.431 \\ 0.251 \end{bmatrix} = \begin{bmatrix} 0.320 \\ 0.339 \\ 0.614 \\ 0.725 \end{bmatrix}$$

After normalization, the final interdependent weights of 4 main factors are

$$\mathbf{W = (0.160, 0.170, 0.307, 0.363)}$$

So, we have the relative importance weights of 4 main factors as following.

Factor	Infrastructure	Application	Human Resource	Policy
Weight	0.160	0.170	0.307	0.363

Note that, in the scope of this study we will not go further to calculate the relative importance weights of each indicators with respect to one main factor. With the same calculation method used with IF-AHP approach, we can to calculate the ICTMI for enterprises in this experiment.

6. CONCLUSION

This paper contributes to an aspect of building a knowledge system by doing the very beginning step, that is measuring the ICT maturity level in an enterprise. The model of ICT maturity used includes 4 main factors ICT policy, ICT infrastructure, ICT application and ICT human resource. Group intuitionistic fuzzy AHP and ANP approaches are used to determine efficiently important weight of each factor or indicator to ICT maturity. With the obtained result, the enterprise can evaluate their current ICT maturity, so that they make a plan to improve their ICT state. The proposed model using intuitionistic fuzzy set helps to deal with imprecise and uncertain human comparison judgments.

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□ □ □ □ □ □ Quantile Causality between Corporate Social Responsibility and Corporate Performance

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This study adopt quantile causality approach to explore the possibility of a causal relationship between corporate social responsibility (CSR) and firm value under different quantile of corporate social responsibility (CSR) and firm value, using the CSR Index created by Chen and Hung (2013). The results show that CSR holds a two-way influence toward firm value, meaning that the effect CSR has on a firm is correlated with the firm's value. A firm with relatively low value can benefit immensely from emphasizing social responsibility, whereas when a firm makes an effort to enhance its value, it will not necessarily enhance engagement in CSR at the same time, owing to a crowding out effect. Keywords: Corporate social responsibility, Quantile regression, Firm value

I. INTRODUCTION

As investors show greater concern for sustainable corporate development, it has also become a coveted goal for firms. Corporate social responsibility (hereunder referred to as CSR) has been gaining ever more attention from firms, investors and society at large. When a firm engages in social responsibility, is there any noticeable impact on the firm's value? What kind of other effects, if any, does CSR bring? As of yet, the literature has not been able to provide any definitive answers. Furthermore, few studies have explored whether firms are willing to put forth effort in performing CSR when the firm seeks to increase its value. Preston & O'Bannon (1997) have ventured the following hypotheses regarding the relationship between CSR and corporate performance: First, the social impact hypothesis, which is based on stakeholder theory, assumes a positive correlation between stakeholder expectations of a firm and the firm's financial performance (Freeman, 1984). Second, trade-off hypothesis assumes that CSR exerts negative effects on corporate financial performance, thus the cost of social responsibility may diminish the firm's profits and as well as the wealth of shareholders. Third, positive synergy hypothesis presumes that when businesses take on ethical duties toward social welfare, their corporate performance will get better, and therefore such businesses obtain more resources that can be put toward social responsibility. This is a positive cycle for firms and society (Allouche & Laroche, 2005). Fourth, negative synergy hypothesis assumes that taking social responsibility on might have a negative effect on a firm's performance, thus curtailing its further investment in social welfare.

Chen, Hung and Lee (2014, 2015) seem to have proved otherwise: according to their research results, a firm with relatively low value can benefit immensely from taking CSR on as an intangible asset to the firm, whereas when a high-valued firm takes on social responsibility, the effect of CSR on firm value enhancement is decreased. This suggests that for a firm with higher value, CSR does not help much in enhancing firm value. On the other hand, when the CSR efforts are relatively low, a moderate increase in firm value does little to boost CSR due to a crowding out effect; yet when involvement in CSR increases, increasing firm value paves the way for the firm to engage in even greater social responsibility.

Therefore this paper proposes that a differing causal relationship exists between firm value and CSR among various conditional quantiles. It follows that the conditional distribution provided by quantile regression will prove to be a more workable tool for testing non-abnormal distribution, as Leider (2012) suggested, rather than using mean distribution by least regression (Leider, 2012).

II. METHODOLOGY

II.1 Non-parametric Granger Causality Test

The non-parametric causality method developed by Granger considers two time series and determines whether one causes the other. Yet such causality might be composed of different quantiles and thus demonstrates differing causal relationships(Lee and Yang, 2012). According to Hong et al. (2009) the Granger causality test produces a more robust result. Balcilar et al. (2014) defined the Granger causality quantile as follows:

1. x_t does not cause y_t in the θ-quantile with respect to $\{y_{t-1}, \dots, y_{t-i}, x_{t-1}, \dots, x_{t-j}\}$
if $Q_\theta(y_t|y_{t-1}, \dots, y_{t-i}, x_{t-1}, \dots, x_{t-j}) = Q_\theta(y_t|y_{t-1}, \dots, y_{t-i})$ (1)

2. x_t is a Granger cause y_t in the θ-quantile with respect to $\{y_{t-1}, \dots, y_{t-i}, x_{t-1}, \dots, x_{t-i}\}$ if $Q_\theta\left(y_t | y_{t-1}, \dots, y_{t-i}, x_{t-1}, \dots, x_{t-j}\right) \neq Q_\theta\left(y_t | y_{t-1}, \dots, y_{t-j}\right)$ (2)

where $Q_\theta(y_t|\Lambda)$ is the θth conditional quantile of y_t given Λ which depends on t and $0 < \theta < 1$.

Let's consider $\{x_t, y_t\} = \{Tobin'q, CSRI\}$, with *Tobin'q* as the proxy variable of firm value, while CSRI serves as the index for CSR.

$X_{t-1} \equiv (x_{t-1}, \dots, x_{t-i})$, $Y_{t-1} \equiv \left(y_{t-1}, \dots, y_{t-j}\right)$, $Z_{t-1} \equiv \left(y_{t-1}, \dots, y_{t-i}, x_{t-1}, \dots, x_{t-j}\right)$, $V_t = (X_t, Z_t)$. $\mathrm{F}_{y_t|Z_{t-1}} = \mathrm{F}_{y_t|Z_{t-1}}(y_t|Z_{t-1})$ and $\mathrm{F}_{y_t|Y_{t-1}} = \mathrm{F}_{y_t|Y_{t-1}}(y_t|Y_{t-1})$ stand for the conditional probability of Y_t under Z_{t-1}, and Y_{t-1} respectively. Therefore they can be used to announce the null hypotheses of definitions (1) and (2):

$$H_0 = \mathrm{P}\left\{\mathrm{F}_{y_t|Z_{t-1}}\{Q_\theta(y_t|Y_{t-1})|Z_{t-1}\} = \mathrm{F}_{y_t|Z_{t-1}}\{Q_\theta(Z_{t-1})|Z_{t-1}\}\right\} = 1, \tag{3}$$

$$H_1 = \mathrm{P}\left\{\mathrm{F}_{y_t|Z_{t-1}}\{Q_\theta(y_t|Y_{t-1})|Z_{t-1}\} = \mathrm{F}_{y_t|Z_{t-1}}\{Q_\theta(Z_{t-1})|Z_{t-1}\}\right\} < 1. \tag{4}$$

If the evidence is against the null hypothesis (H_0), there is a causality, and vice versa. Jeong et al.(2012) reduced the problem of irrelevancy in all the tests for quantile causality by using $D = \{\varepsilon_t \cdot E(\varepsilon_t|Z_{t-1})f_z(Z_{t-1})\}$) as a distance masure, where ε_t is the regression error term and $f_z(Z_{t-1})$ is the marginal density function of Z_{t-1}. The regression error ε_t arises because the null hypothesis in (3) can only be true if $\mathrm{E}[\mathbf{I}\{y_t \leq Q_\theta(Y_{t-1})|Z_{t-1}\}] = \theta$ or equivalently $\mathbf{I}\{y_t \leq Q_\theta(Y_{t-1})\} = \theta + \varepsilon_t$, where $\mathbf{I}\{\cdot\}$ is the indicator function. Jeong et al. (2012) identified the distance function as

$$D = \mathrm{E}\left[\left\{\mathrm{F}_{y_t|Z_{t-1}}\{Q_\theta(Y_{t-1})|Z_{t-1}\} - \theta\right\}^2 f_z(Z_{t-1})\right] \tag{5}$$

where $D \geq 0$ and the equality holds if and only if the null hypothesis H_0 in equation (3) is true, while $D > 0$ holds under the alternative H_1 in equation (4). Additionally, Jeong et al. (2012) specified that the feasible kernel-based test statistic based on D takes the following form:

$$\hat{D}_T = \frac{1}{T(T-1)h^{2p}} \sum_{t=1}^{T} \sum_{S \neq t}^{T} K\left(\frac{Z_{t-1} - Z_S}{h}\right) \hat{\varepsilon}_t \hat{\varepsilon}_S \tag{6}$$

where T denotes the number of all data, $K(\cdot)$ is the kernel function with bandwidth h, and $\hat{\varepsilon}_t$ is estimated from the unknown regression error of $\hat{\varepsilon}_t = \mathbf{I}\{y_t \leq \hat{Q}_\theta(Y_{t-1}) - \theta\}$ where $\hat{Q}_\theta(Y_{t-1})$ is an estimate of the θ-th conditional quantile of y_t given Y_{t-1}. $\hat{Q}_\theta(Y_{t-1})$ can be estimated by the nonparametric kernel method as $\hat{Q}_\theta(Y_{t-1}) = \hat{F}^{-1}_{y_t|Y_{t-1}}(\theta|Y_{t-1})$. $\hat{F}_{y_t|Y_{t-1}}(y_t|Y_{t-1})$ is the Nadarya-Watson kernel estimator given by

$$\hat{F}_{y_t|Y_{t-1}}(y_t|Y_{t-1}) = \frac{\sum_{s \neq t} L\left(\frac{Y_{t-1} - Y_s}{h}\right) I(Y_s \leq Y_{t-1})}{\sum_{s \neq t} L\left(\frac{Y_{t-1} - Y_s}{h}\right)} \tag{7}$$

with the kernel function $L(\cdot)$ and bandwidth h.

III. DATA ANALYSIS

The data were obtained from listed companies during the 2010 to 2011 period. The data regarding CSR was gleaned from the CSR index compiled by Chen and Hung (2013). Data frequency is annual. The financial reporting data was derived from the TEJ, and actual corporate value was denoted as Tobin's q. A total of 772 companies and 1487 annual reports were employed. Cross-sectional information from both of the 2 year time-series were pooled over the 772 companies to estimate the predictability of the coefficients). Descriptive statistics are shown in Table 1.

Table 1: Summary of statistics for listed, Taiwan-based companies, 2010-2011. N=1487

	Mean	Max.	Min.	Std.	Sk.	K.	J-B
Tobin's q	1.223	5.820	0.460	0.546	2.960	16.463	13400.470***
CSRI	12.215	24.000	0.000	3.733	0.145	3.610	28.222***

Note: Std. denotes standard deviation, SK. denotes the skewness, K. denotes the kurtosis and J-B denotes the Jarque-Bera test for normality. ** and *** indicate significance at the 5% and 1% level, respectively. H_0: SK.=0, K.=3 (normality).

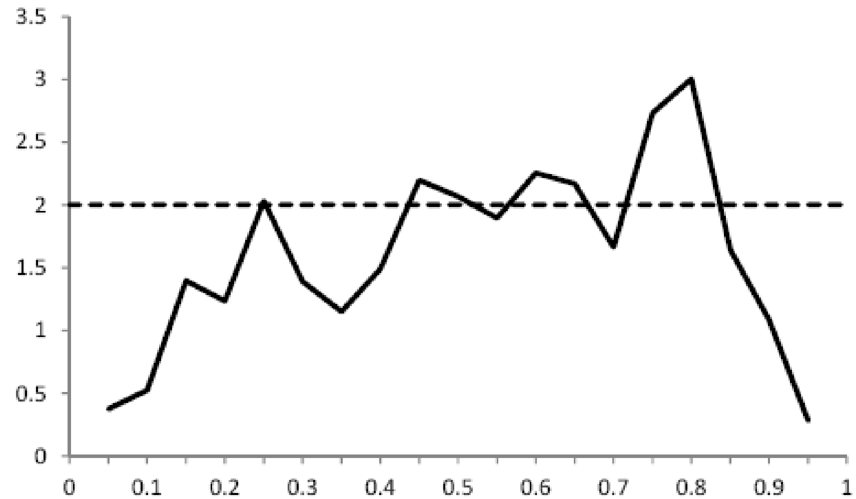

Figure 1: Test statistics with respect to different quantiles for firm value to CSR causality.

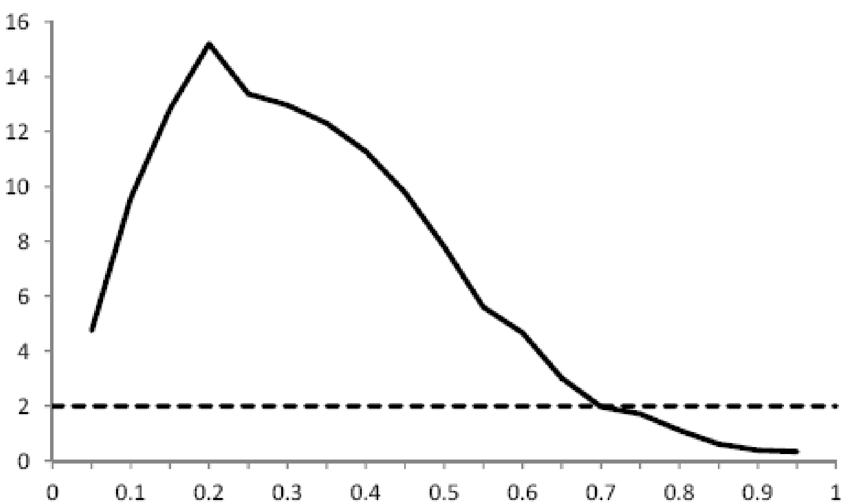

Figure 2: Test statistics with respect to different quantiles for CSR to firm value causality.

IV. RESULTS

Figures 1 and 2 show that (1) when a firm has relatively low value, CSR initiatives may boost prestige and intangible assets, thereby enhancing firm value. On the other hand, CSR initiatives play only a minor role in boosting the value of a firm if the company already has higher firm value. (2). When engagement in CSR is low, the enhancement of firm value does not necessarily lead to an increase in CSR, perhaps owing to a crowding out effect, whereas if engagement in CSR is high, an increase in firm value helps to motivate the company to make continued CSR efforts.

This paper utilized the quantile Granger causality method proposed by Jeong et al., (2012) to explore the two-way causality between the CSR of listed companies in Taiwan and firm value. The solid lines in Figures 1 and 2 denote standardized statistics under different dependent variable quantiles, whilst the dotted lines=1.96 implies a significance level of 5%. Therefore from Figure 1 and 2, we can clearly see causality between CSR and firm value in each conditional quantile. Figure 1 shows the causal relationship between firm value and CSR under various conditional quantiles of CSR. When the equation $\tau = 0.25$ $0.45 < \tau$[1]< 0.85 is true, the causality of firm value and CSR becomes apparent, which suggests higher involvement in CSR is correlated with higher firm value, and higher firm value then gives rise to better involvement in CSR. A crowding out effect is also demonstrated. This phenomenon suggests that a newly founded company only thinks about making money, and cares less about social responsibility. Only when a firm puts considerable effort into enhancing firm value does it also perform ethical duties for social welfare. Figure 2 shows the causality between firm value and CSR under each conditional quantile of firm value. When $\tau<0.70$, CSR exerts a noticeable effect on firm value, which suggests that a firm with lower firm value can turn to CSR initiatives in an effort to enhance firm value. This validates the idea that an enterprise can be protected with a corporate social responsibility shield; therefore, a low value firm may take the CSR initiatives to boost value.

V. CONCLUSION

Corporate social responsibility affects firms in very different ways since only low value firms get a significant boost in firm value from performing CSR. The two-way influences of

[1] τ represents the quantiles (considered quantiles 0.10 – 0.90 with 0.05 increments).

CSR and firm value may vary in accordance with firm value and the way a company performs social welfare duties. A lower-valued firm might see a remarkable benefit from taking on corporate social responsibility. Some firms will put forth little CSR effort owing to a crowding out effect, despite their need to enhance firm value. This validates the idea that a social enterprise needs intervention from the public sector or other resources from society.

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□ □ □ □ □ □ A MATHEMATICAL MODEL FOR SUPPLY CHAIN NETWORK DESIGN: direct shipment and outsourcing consideration

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In this research, we proposed a model for capacitated facility location problem, our model deals with outsourcing strategy consideration and direct shipments problems in which products are considered shipments from suppliers or manufacturing plants to retailers directly. Thus, we employed a dummy distribution centers (dummy DCs) to link from manufacturing plants to retailers. We assumed dummy DCs capacities as vehicles capacity (truck load). The advantage of this model is that we can control the number of vehicles requirement at each period. Morever, our proposed model can modified for outsourcing startegy by changing manufacturing plant sources to supplier sources. We believe that this model helps the investors reducing the total investment cost (total fixed costs for openning manufacturing plants and distribution canters). This makes the difference among our model and existing ones. For validation testing, we compared our solutions to the solutions obtained by proposed model of Duong and Hung, 2014 in the same input parameters.
Keywords: Logistic, direct shipment, outsourcing, supply chain, mixed integer linear programming, network design.

1. Introduction

Nowadays, we know that, supply chain (SC) network combines and integrates all business functions in companies such as suppliers, inbound logistics, core manufacturer, outbound logistics, marketing and sales, and end customers (e.g., Chan et al., 2003, Stadtler, 2005, and Klibi et al., 2010). This follows that, SC network is emphasized on modern business activities. In addition, with global market competition, investors and managers paid their attention on their SC network (Simchi-Levi et al., 2000, Matinrad et al., 2013). Therefore, SC operations play a very important role in business activities. Making the SC network effective that is paid attention by managers and researchers, hence, SC problems become a popular topic (Chan and Qi, 2003). Integrating many components and operational functions, the SC problems are very complex, so studying about this field is still valuable.

To support a long-term effectiveness in strategies and operations for the SC network systems, SC network design problems should be serious consideration for realistic cases, specializing in capacitated facilities location problems. One of the initial publications with capacitated facilities location problem for SC network design was developed by Geoffrion and Graves (1974). In their study, a MILP for designing multi-product distribution network by satisfied single-period demand. The objective of this research is to minimize the total cost which consists of transportation cost and fixed cost of the opening distribution centers. A Benders decomposition algorithm was also developed for getting solutions. Continuing this research idea, Pirkul and Jayaraman (1998), Mazzola and Neebe (1999) also studied multi-item and single-period demand for distribution network design, however, they used the lagrangian relaxation algorithm, in which they broke their original problem into n small sub-problems that related to each warehouse and plant by dropping some constraint sets. Recently, Shankar et al., (2013) developed multi objective optimization to support location and allocation decisions in SC network, this model applied for single product in the system.

In the review works of Klibi et al., (2010), Arabani and Farahani (2012), Matinrad et al., (2013), and Farahani et al., (2014) showed that the researchers try to develop complex models for general application in relistic systems. Dynamic approach, multi-objective programmings, uncertainty demands, multi-period, multi echolon/stage,… are futher trends for studying SC, off course, these models require the complex algorithms for finding solutions. However, in the modern SC network operations and management, managers, investors and researchers deal with many realistic cases, they need the specific models with real factors consideration related to their problems. There are many existing research's models meeting realistic requirement. They focused their research on practical problems in SC network. For example, Melachrinoudis and Min (2007) proposed redesign a warehouse distribution network model, as this research, they considered truck-delivery-time parameter as a main factor to make their decision, so some current warehouses maybe closed and some new ones maybe located. Many specific cases in supply chain problems are studied such as: Rezaei and Davoodi (2008) considered the percentage of defective items from suppliers as a new factor in their model, or Bilgen and Ozkarahan (2007) developed a MILP model for bulk grain blending and shipping. Dondo et al. (2011) minimized the total transportation cost by considered vehicle routing problem with cross-docking in their research. Recently, Nagurney and Nagurney (2012) used a tractable network model for SC design to supply medical nuclear products. Sarkis et al., (2011) mentioned about green, environment, social response, sustainable supply chain in their review work. This topic is very specific situations for realistic.

In other research direction, Eksioglu et al. (2006) studied inventory level and inventory cost in operations at the end of each period in their SC network design model. Hinojosa et al. (2000, 2008) also developed MILP models for SC network design by considering multi-product, multi-period and inventory level. Recently, Duong and Bui (2014) considered facilities' capacity levels factor in a mixed integer linear programming for SC network design. We think that this real factor is very important for investors when a SC network is established. For special case with critical needs for survival (disasters, emergencies, epidemics, and attacks…) Nagurney et al., (2011) had considered outsourcing strategy in their SC network design model, we believe that outsourcing strategy is a key successful global SC network, therefore, this factor should be consideration in SC design problems. Moreover, shipment strategies are very important factor for consideration. For instance, the effective transshipment network is studied in research of Lien et al., (2011). Before that, Lejeune and Margot (2008) developed an integer linear programming model for solving inventory-production-distribution problems with the natural of products (bulk, chemical,…), that research employed full truck load distribution policy between suply chain nodes with direct shipments. Other research of Pishvaee and Rabbani (2011) considerd both direct and indirect shipment in supply chain network design. In that research, direct shipment from plants to customers, and indirect shipment from plants to Dcs and DCs to customers are considered, that complex model was solved by heuristic approach.

According to the above review, supply chain management and design become a common topic for mangers and researchers, this topic is still attractive and valuable to study for both general and specific cases. Moreover, in practical situations, we see that the investors and managers paid their attention on total fixed cost for openning all facilities in the new systems. They want to reduce the investment risk when the new SC network is established. Thus, transshipment and outsourcing strategies should be considered seriously. Therefore, our research tries to detect this problem.

In this research, we develop a mixed integer linear programming (MILP) model for supply chain network design problems which considered direct shipment and/or outsourcing strategy. Thus, we employed a dummy distribution centers (dummy DCs) to link from manufacturing plants to retailers. We assumed dummy DCs capacities as vehicles capacity (truck load). The advantage of this model is that we can control the number of vehicles requirement at each period. Morever, our proposed model can modified for outsourcing startegy by changing manufacturing plant sources to supplier sources. We believe that this model helps the investors reducing the total investment cost (total fixed costs for openning manufacturing plants and distribution canters). This makes the difference among our model and existing ones (e.g., Duong and Bui (2014), Pishvaee and Rabbani (2011), Lien et al. (2011), Lejeune and Margot (2011), and Amiri (2006), …). For finding solutions, we then employed a Lagrangian relaxation algorithm. This algorithm is based on relaxing one constraint sets which lead to the decomposition of the MILP model into two sub-problems that can be easily solved to provide an efficient solution to the original problem.

This paper is organized as follows. In the next section, a mathematical formulation of the model is presented. In section 3, the lagrangian relaxation discussion is presented. The extension and discussion of proposed model are discussed in section 4. Some numerical experiments and comparing are discussed in section 5. And the concluding remarks are then presented in last section.

In the remaining parts of the paper, the following notations are used:

(1) indices:

i	index of potential sites for manufacturing plants $i = 1, 2, .., I$
j	index of potential sites for distribution centers $j = 1, 2, .., J$
g	index of dummy distribution centers $g = 1, 2, .., G$
r	index of retailers $r = 1, 2, .., R$
t	time index $t = 1, 2, .., T$

(2) parameters:

T	length of the planning horizon
f_i	fixed cost for opening manufacturing plant i in the system
$f_i^{(1)}$	fixed cost for opening DC j in the system
c_{ij}	transportation cost for shipping a unit of product from plant i to DC j in one period
$c_{jr}^{(1)}$	transportation cost for shipping a unit of product from DC j to retailer r in one period
$c_{ir}^{(2)}$	transportation cost for shipping a unit of product directly from plant i to retailer r in one period
$c_{ig}^{(2)}$	transportation cost for shipping a unit of product from plant i to dummy DC g in one period
$c_{gr}^{(2)}$	transportation cost for shipping a unit of product from dummy DC g to retailer r in one period
p_i	unit production cost at plant i
h_i	holding cost for one unit of product at plant i in one period
$h_j^{(1)}$	holding cost for one unit of product at DC j in one period
$h_r^{(2)}$	holding cost for one unit of product at retailer r in one period
d_{rt}	demand of product at retailer r in period t
wp_i	production capacity at plant i
wd_j	storage capacity at DC j
wh_l	vehicle capacity levels l at dummy DC g

(3) decision variables:

X_{ijt} amount of product shipping from plant i to DC j in period t

Y_{jrt} amount of product shipping from DC j to retailer r in period t

$X^{(1)}_{iglt}$ amount of product shipping vehicle l from plant i to dummy DC g in period t

$Y^{(1)}_{glrt}$ amount of product shipping by vehicle l from dummy DC g to retailer r in period t

Z_{it} a binary variable which indicates whether plant i is operated in period t or not

$Z^{(1)}_{jt}$ a binary variable which indicates whether DC j is operated in period t or not

$Z^{(2)}_{glt}$ a binary variable which indicates whether dummy DC g is operated at level l in period t or not

V_{it} volume of product produced at plant i in period t

Q_{it} volume of product stored at plant i in period t

$Q^{(1)}_{jt}$ volume of product stored at DC j in period t

$Q^{(2)}_{rt}$ volume of product stored at retailer r in period t

2. Mathematical Model

In this research, the mathematical model for capacitated facilities location problem is developed based on the following assumptions:

1) If a plant or DC is opened at a certain site, it will not be closed;
2) All cost factors in the model are known in advanced, i.e. the opening cost of plants and DCs, the production cost, transportation cost, and inventory cost are given;
3) All beginning inventory levels (at plants, DCs, and retailers) are zeros;
4) Each required volume from retailer to dummy DC equals vehicle capacity level at dummy DC respectively.
5) Storage capacity of retailer is large enough to fulfill demand.

The detailed development of the mathematical model is presented in the following paragraphs.

The initial mathematical model that helps to deal with the capacitated facilities location problem considered in this research can be summarized as follows:

Objective function

$$Min\ Z=\sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{t=1}^{T}c_{ij}X_{ijt}+\sum_{i=1}^{I}\sum_{g=1}^{G}\sum_{t=1}^{T}c^{(2)}_{ig}X^{(1)}_{iglt}+\sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{t=1}^{T}c^{(1)}_{jr}Y_{jrt}+\sum_{g=1}^{G}\sum_{r=1}^{R}\sum_{t=1}^{T}c^{(2)}_{gr}Y^{(1)}_{glrt}+\sum_{i=1}^{I}\sum_{t=1}^{T}f_i\left(Z_{it}-Z_{i(t-1)}\right)$$
$$+\sum_{j=1}^{J}\sum_{t=1}^{T}f^{(1)}_{j}\left(Z^{(1)}_{jt}-Z^{(1)}_{j(t-1)}\right)+\sum_{i=1}^{I}\sum_{t=1}^{T}p_iV_{it}+\sum_{i=1}^{I}\sum_{t=1}^{T}h_iQ_{it}+\sum_{j=1}^{J}\sum_{t=1}^{T}h^{(1)}_{j}Q^{(1)}_{jt}+\sum_{r=1}^{R}\sum_{t=1}^{T}h^{(2)}_{r}Q^{(2)}_{rt}$$,(1)

Subject to

$$Q^{(2)}_{r(t-1)}+\sum_{j=1}^{J}Y_{jrt}+\sum_{g=1}^{G}Y^{(1)}_{glrt}\geq d_{rt}\quad \forall r\in R,\forall t\in T, \tag{2}$$

$$V_{it}\leq wp_iZ_{it}\qquad \forall i\in I,\forall t\in T, \tag{3}$$

$$\sum_{j=1}^{J} X_{ijt} + \sum_{g=1}^{G} X_{iglt}^{(1)} \le V_{it} + Q_{i(t-1)} \quad \forall i \in I, \forall t \in T, \tag{4}$$

$$\sum_{i=1}^{I} X_{ijt} + Q_{j(t-1)}^{(1)} \le wd_j Z_{jt}^{(1)} \quad \forall j \in J, \forall t \in T, \tag{5}$$

$$\sum_{r=1}^{R} Y_{jrt} \le \sum_{i=1}^{I} X_{ijt} + Q_{j(t-1)}^{(1)} \quad \forall j \in J, \forall t \in T, \tag{6}$$

$$X_{iglt}^{(1)} = wh_l Z_{glt}^{(2)} \quad \forall l \in L, \forall g \in G, \forall t \in T, \tag{7}$$

$$Y_{glrt}^{(1)} = wh_l Z_{glt}^{(2)} \quad \forall l \in L, \forall g \in G, \forall t \in T, \tag{8}$$

$$Q_{rt}^{(2)} = \sum_{j=1}^{J} Y_{jrt} + \sum_{g=1}^{G} Y_{glrt}^{(1)} + Q_{r(t-1)}^{(2)} - d_{rt} \quad \forall r \in R, \forall t \in T, \tag{9}$$

$$Q_{it} = V_{it} + Q_{i(t-1)} - \sum_{j=1}^{J} X_{ijt} - \sum_{g=1}^{G} X_{iglt}^{(1)} \quad \forall i \in I, \forall t \in T, \tag{10}$$

$$Q_{jt}^{(1)} = \sum_{i=1}^{I} X_{ijt} + Q_{j(t-1)}^{(1)} - \sum_{r=1}^{R} Y_{jrt} \quad \forall j \in J, \forall t \in T, \tag{11}$$

$$Z_{it} \ge Z_{i(t-1)} \quad \forall i \in I, \forall t \in T, \tag{12}$$

$$Z_{jt}^{(1)} \ge Z_{j(t-1)}^{(1)} \quad \forall j \in J, \forall t \in T, \tag{13}$$

$$Z_{it}, Z_{jt}^{(1)}, Z_{glt}^{(2)} = 0,1 \quad \forall i \in I, \forall j \in J, \forall g \in G, \forall l \in L, \forall t \in T, \tag{14}$$

$$X_{ijt}, X_{igt}^{(1)}, V_{it}, Q_{it} \ge 0 \quad \forall i \in I, \forall j \in J, \forall g \in G, \forall t \in T, \tag{15}$$

$$Y_{jrt}, Y_{grt}^{(1)}, Q_{jt}^{(1)}, Q_{rt}^{(2)} \ge 0 \quad \forall j \in J, \forall r \in R, \forall g \in G, \forall t \in T, \tag{16}$$

In the above model, objective function is to minimize the total cost which includes transportation costs from plants to DCs, transportation costs from DCs to retailers, transportation costs from plants to dummy DCs, transportation costs from dummy DCs to retailers, fixed costs for opening plants, fixed costs for opening DCs, production costs, and holding costs at plants, DCs, and retailers.

Related to the constraints, constraint set (2) ensures that demands at retailers are always satisfied. Constraint set (3) represents the capacity constraint at manufacturing plant, they ensure that the products only produce at opened manufacturing plant. Constraint set (4) ensures that the amount of product shipped from a plant in each period will not exceed the on-hand inventory. Constraint set (5) ensures that the total amount of goods stored at a distribution center will not exceed the maximum storage capacity of that distribution center. Constraint set (6) ensures that the total amount of goods shipped from a distribution center does not exceed the on-hand inventory at that distribution center. The vehicle capacity constraint sets (7), and (8) represent the required lot size for each vehicle from plant to dummy DC and from dummy DC to retailer respectively. Constraint sets (9), (10), and (11) are flow balance constraints, these constraints balance the inventory levels at retailers, plants and DCs respectively for each period. Constraint sets (12), and (13) ensure that when a plant or DC is opened, it will not be closed. And the rest constraint sets are variable constraints.

Actually, in the initial formulation presented above, it includes some redundant constraints that must be discarded from the original model to be simplified before applying the Lagrangian relaxation technique. These redundant constraints will be identified as follows (see more detail in Duong and Bui 2014, 2015):

Considering constraint set (9), (10), and (11) which express the balance equations for inventory level at retailers, plants and DCs respectively:

$$Q_{rt}^{(2)} = \sum_{j=1}^{J} Y_{jrt} + \sum_{g=1}^{G} Y_{glrt}^{(1)} + Q_{r(t-1)}^{(2)} - d_{rt} \quad \forall r \in R, \forall t \in T,$$

$$Q_{it} = V_{it} + Q_{i(t-1)} - \sum_{j=1}^{J} X_{ijt} - \sum_{g=1}^{G} X_{iglt}^{(1)} \quad \forall i \in I, \forall t \in T, \text{ and}$$

$$Q_{jt}^{(1)} = \sum_{i=1}^{I} X_{ijt} + Q_{j(t-1)}^{(1)} - \sum_{r=1}^{R} Y_{jrt} \quad \forall j \in J, \forall t \in T,$$

The above equations can be rewritten respectively as follows:

$$Q_{r(t-1)}^{(2)} + \sum_{j=1}^{J} Y_{jrt} + \sum_{g=1}^{G} Y_{glrt}^{(1)} \geq d_{rt} \quad \forall r \in R, \forall t \in T,$$

$$\sum_{j=1}^{J} X_{ijt} + \sum_{g=1}^{G} X_{iglt}^{(1)} \leq V_{it} + Q_{i(t-1)} \quad \forall i \in I, \forall t \in T, \text{ and}$$

$$\sum_{r=1}^{R} Y_{jrt} \leq \sum_{i=1}^{I} X_{ijt} + Q_{j(t-1)}^{(1)} \quad \forall j \in J, \forall t \in T,$$

The above expressions are exactly constraint sets (2), (4), and (6) respectively. Therefore, constraint sets (2), (4), and (6) become redundant constraints, which should be dropped from the initial mathematical model. The structure of the revised mathematical model is more simple, it is easily used the Lagrangian relaxation technique to help find solution for large size problems. This issue will be discussed in details in the next section.

3. A Lagrangian relaxation of the proposed model

It should be noted that the proposed model is a mixed integer linear programming, and it usually takes time for finding solution, especially with large scale problems. Therefore, Lagrangian relaxation technique will be used in this research for solving purpose. For more detailed discussion on the Lagrangian relaxation technique, the reader can refer to Fisher (1981), Duong and Bui (2014, 2015).

Before applying Lagrangian relaxation technique, the revised model in section 2 will be modified as presented below, see Duong and Bui (2014, 2015) for the proof.

At first, considering constraint set (11), i.e.,

$$Q_{jt}^{(1)} = \sum_{i=1}^{I} X_{ijt} + Q_{j(t-1)}^{(1)} - \sum_{r=1}^{R} Y_{jrt} \quad \forall j \in J, \forall t \in T,$$

In generally, can be rewritten as follows:

$$Q_{jt}^{(1)} = \sum_{i=1}^{I} \sum_{\tau=1}^{t} X_{ij\tau} - \sum_{r=1}^{R} \sum_{\tau=1}^{t} Y_{jr\tau} \quad \forall j \in J, \forall t \in T, \tag{17}$$

and,

$$\sum_{t=1}^{T} Q_{jt}^{(1)} = \sum_{t=1}^{T} (T-t+1) \left(\sum_{i=1}^{I} X_{ijt} - \sum_{r=1}^{R} Y_{jrt} \right) \quad \forall j \in J \tag{18}$$

Using (18), the cost component related to total inventory holding cost at DCs in the total cost function can be expressed as:

$$\begin{aligned}\sum_{j=1}^{J}\sum_{t=1}^{T} h_j^{(1)} Q_{jt}^{(1)} &= \sum_{j=1}^{J} h_j^{(1)} \sum_{t=1}^{T} \left(T-t+1\right)\left(\sum_{i=1}^{I} X_{ijt} - \sum_{r=1}^{R} Y_{jrt}\right) \\ &= \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{t=1}^{T}\left(T-t+1\right) h_j^{(1)} X_{ijt} - \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{t=1}^{T}\left(T-t+1\right) h_j^{(1)} Y_{jrt}\end{aligned} \tag{19}$$

It is also noted that constraint set (5) can be rewritten via expression (17) as follows:

$$\begin{aligned}\sum_{i=1}^{I} X_{ijt} + Q_{j(t-1)}^{(1)} - wd_j Z_{jt}^{(1)} &= \sum_{i=1}^{I} X_{ijt} - wd_j Z_{jt}^{(1)} + \left(\sum_{i=1}^{I}\sum_{\tau=1}^{t-1} X_{ij\tau} - \sum_{r=1}^{R}\sum_{\tau=1}^{t\text{-}1} Y_{jr\tau}\right) \\ &= \sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ij\tau} - wd_j Z_{jt}^{(1)} - \sum_{r=1}^{R}\sum_{\tau=1}^{t\text{-}1} Y_{jr\tau}\end{aligned} \tag{20}$$

According to the above analysis, we see that equation constraint set (11) is changed to expression (17). We apply this equational characteristic for expression (19) and (20) that are replaced into the objective function (1) of original model. Therefore, equation constraint set (11) is discarded before applying Lagrangian relaxation technique.

So, by introducing Lagrange multiplier $\lambda_{jt}'s$ for the constraints in (5), the objective of the Lagrangian relaxation problem (problem (L)) associated with the original mathematical model can now be derived as

$$\begin{aligned}Min\ Z_L &= \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{t=1}^{T} c_{ij} X_{ijt} + \sum_{i=1}^{I}\sum_{g=1}^{G}\sum_{t=1}^{T} c_{ig}^{(2)} X_{igt}^{(1)} + \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{t=1}^{T} c_{jr}^{(1)} Y_{jrt} + \sum_{g=1}^{G}\sum_{r=1}^{R}\sum_{t=1}^{T} c_{gr}^{(2)} Y_{grt}^{(1)} \\ &+ \sum_{i=1}^{I}\sum_{t=1}^{T} f_i\left(Z_{it} - Z_{i(t-1)}\right) + \sum_{j=1}^{J}\sum_{t=1}^{T} f_j^{(1)}\left(Z_{jt}^{(1)} - Z_{j(t-1)}^{(1)}\right) + \sum_{i=1}^{I}\sum_{t=1}^{T} p_i V_{it} + \sum_{i=1}^{I}\sum_{t=1}^{T} h_i Q_{it} + \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{t=1}^{T}\left(T-t+1\right) h_j^{(1)} X_{ijt} \\ &- \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{t=1}^{T}\left(T-t+1\right) h_j^{(1)} Y_{jrt} + \sum_{r=1}^{R}\sum_{t=1}^{T} h_r^{(2)} Q_{rt}^{(2)} + \sum_{j=1}^{J}\sum_{t=1}^{T} \lambda_{jt}\left(\sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ij\tau} - wd_j Z_{jt}^{(1)} - \sum_{r=1}^{R}\sum_{\tau=1}^{t\text{-}1} Y_{jr\tau}\right)\end{aligned}$$

in which,

$$\sum_{j=1}^{J}\sum_{t=1}^{T}\lambda_{jt}\left(\sum_{i=1}^{I}\sum_{\tau=1}^{t} X_{ij\tau}\right) = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{t=1}^{T}\lambda_{jt}\left(\sum_{\tau=1}^{t} X_{ij\tau}\right) = \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{t=1}^{T}\left(\sum_{\tau=t}^{T}\lambda_{j\tau}\right) X_{ijt}$$

$$\sum_{j=1}^{J}\sum_{t=1}^{T}\lambda_{jt}\left(\sum_{r=1}^{R}\sum_{\tau=1}^{t\text{-}1} Y_{jr\tau}\right) = \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{t=1}^{T}\left(\sum_{\tau=t+1}^{T}\lambda_{j\tau}\right) Y_{jrt}$$

Problem (L) can be easily decomposed into two sub-problems (L1) and (L2) as follows:

Sub-problem (L1):

$$\begin{aligned}Min\ Z_{L1} &= \sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{t=1}^{T}\left[c_{ij} + \sum_{\tau=t}^{T}\lambda_{j\tau} + \left(T-t+1\right) h_j^{(1)}\right] X_{ijt} + \sum_{i=1}^{I}\sum_{g=1}^{G}\sum_{t=1}^{T} c_{ig}^{(2)} X_{iglt}^{(1)} \\ &+ \sum_{i=1}^{I}\sum_{t=1}^{T} f_i\left(Z_{it} - Z_{i(t-1)}\right) + \sum_{i=1}^{I}\sum_{t=1}^{T} p_i V_{it} + \sum_{i=1}^{I}\sum_{t=1}^{T} h_i Q_{it}\end{aligned} \tag{21}$$

Subject to (3), (7), (10), (12), and (15).

Sub-problem (L2):

$$\begin{aligned}Min\ Z_{L2} &= \sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{t=1}^{T}\left[c_{jr}^{(1)} - \sum_{\tau=t+1}^{T}\lambda_{j\tau} - \left(T-t+1\right) h_j^{(1)}\right] Y_{jrt} + \sum_{g=1}^{G}\sum_{r=1}^{R}\sum_{t=1}^{T} c_{gr}^{(2)} Y_{glrt}^{(1)} \\ &+ \sum_{j=1}^{J}\sum_{t=1}^{T} f_j^{(1)}\left(Z_{jt}^{(1)} - Z_{j(t-1)}^{(1)}\right) - \sum_{j=1}^{J}\sum_{t=1}^{T}\lambda_{jt} wd_j Z_{jt}^{(1)} + \sum_{r=1}^{R}\sum_{t=1}^{T} h_r^{(2)} Q_{rt}^{(2)}\end{aligned} \tag{22}$$

Subject to (8), (9), (13), and (16).

For fixed values of $\lambda_{jt}'s$, it is noted that the value of the objective function of the original model can be determined via the solutions of the two sub-problems (L1) and (L2) as $Z = Z1 + Z2$, in which

$$Z1=\sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{t=1}^{T}\left[c_{ij}+(T-t+1)h_j^{(1)}\right]X_{ijt}+\sum_{i=1}^{I}\sum_{g=1}^{G}\sum_{t=1}^{T}c_{ig}^{(2)}X_{iglt}^{(1)}+\sum_{i=1}^{I}\sum_{t=1}^{T}f_i\left(Z_{it}-Z_{i(t-1)}\right)+\sum_{i=1}^{I}\sum_{t=1}^{T}p_iV_{it}+\sum_{i=1}^{I}\sum_{t=1}^{T}h_iQ_{it},$$

$$Z2=\sum_{j=1}^{J}\sum_{r=1}^{R}\sum_{t=1}^{T}\left[c_{jr}^{(1)}-(T-t+1)h_j^{(1)}\right]Y_{jrt}+\sum_{g=1}^{G}\sum_{r=1}^{R}\sum_{t=1}^{T}c_{gr}^{(2)}Y_{glrt}^{(1)}+\sum_{j=1}^{J}\sum_{t=1}^{T}f_j^{(1)}\left(Z_{jt}^{(1)}-Z_{j(t-1)}^{(1)}\right)+\sum_{r=1}^{R}\sum_{t=1}^{T}h_r^{(2)}Q_{rt}^{(2)}$$

Therefore, the value of the objective function of the original model is an acceptable one if and only if the two sub-problems can give feasible solutions. However, with the current formulations of the two sub-problems, it might happen that the above requirement cannot be ensured. This issue will be tackled in the next paragraphs.

Considering sub-problem (L1), it can be seen that there exists no constraint that forces binary variables Z_{it} to receive positive values. This will lead to the fact that all $Z_{it}'s$ will be set to zeros when (L1) is solved. All other decision variables will also receive the value of zero, and hence, the objective value is always zero. To deal with the above problem, sub-problem (L1) requires one additional constraint sets that will be pointed out below.

Additional constraint set 1:

$$\sum_{i=1}^{I}\sum_{j=1}^{J}\sum_{\tau=1}^{t}X_{ij\tau}+\sum_{i=1}^{I}\sum_{g=1}^{G}\sum_{\tau=1}^{t}X_{igl\tau}^{(1)}\geq\sum_{r=1}^{R}\sum_{\tau=1}^{t}d_{r\tau}\quad\forall t\in T, \tag{23}$$

This constraint will also be added to sub-problem (L1) to help ensure that the cumulative shipping quantity of product at time period t from all manufacturing plants to DCs and dummy DCs will exceed the total cumulative demand of retailers.

Similarity, considering sub-problem (L2), there is no constraint that forces binary variables $Z_{jt}^{(1)}$ to receive positive values, and all $Z_{jt}^{(1)}$ will be set to zeros when (L2) is solved. Moreover, avoiding to product shipping to retailers from non-operating DCs, sub-problem (L2) requires one additional constraint sets as folows:

Additional constraint set 2:

$$\sum_{r=1}^{R}Y_{jrt}\leq wd_jZ_{jt}^{(1)}\qquad\forall j\in J,\forall t\in T, \tag{24}$$

This constraint is added to sub-problem (L2) to help ensure that the amount of product shipped to all retailers from an operating DC j will not exceed the capacity of DC j.

The Lagrangian relaxation algorithm for the model the reader can refer to Duong and Bui (2014, 2015).

4. The extension and discussion of proposed model

The our proposed models can be easily found out the solutions (see Duong and Bui, 2014, 2015), our model considered direct shipments from manufacturing plants to retailers via dummy DCs. The our solutions show that products shipped directly from manufacturing plants to retailers will help investors to save total cost for openning distribution centers in long-term operations, and investment risk will be reduced, speciallized in the decreasing demand in the future.

Moreover, the established systems can be controlled the number of vehicles at each period by added some constraint set as follows:

$$\sum_{g=1}^{G} Z_{glt}^{(2)} \geq N_l \quad \forall g \in G, \forall t \in T, \forall l \in L, \tag{25}$$

Constraint set (25) presents minimum total number of vehicles l at period t

$$\sum_{g=1}^{G} \sum_{l=1}^{L} Z_{glt}^{(2)} \geq N \quad \forall g \in G, \forall t \in T, \forall l \in L, \tag{26}$$

Constraint set (26) presents minimum total number of vehicles in the system at period t

In addition, our model can be modified to outsourcing strategy when we replace the manufacturing plant sources to outside suppliers by using a supplier set *S*. In this modified model, a new set of variables will be introduced as follows:

$X_{sglt}^{(1)}$ amount of product shipping vehicle l from outside supplier s to dummy DC g in period t

With using the set of variables $X_{sglt}^{(1)}$, products shipped to retailers from outside suppliers. In this case, our model is relevant to outsourcing strategy which is very popular strategies in modern/global supply chain systems. We can control total outsource products to meet the system's demand at each period. Therefore, some manufacturing plants are not necessary to open, the investors can reduce total fixed cost for openning plants, and investment risk will be reduced.

5. Numerical results

In this section, we conduct numerical experiments to compare with the work of Duong and Bui, (2014). Six test problems and comparing results are summarized in Table 1. All six problems, we used 3 types of vehicle with capacity (truck load) 100 units, 150 units, and 200 units respectively. The price of outsourcing products is average of production costs. And the other data are the same for both models.

Table 1: Comparing solutions between our proposed model and model of Duong and Bui (2014)

Problems	I	J	R	T	No. of opened plants	No. of opened DCs	Total No. of vehicles			Optimal cost	Remarks
							N1	N2	N3		
1	4	4	4	4	02 (M1,and 2)	02 (DC2, and 4)				3159800	Model 1
					01 (M2)	01 (DC2)	20	4	1	2297180	Model 2
2	5	5	5	5	03 (M1, 2, and 3)	03 (DC2, 4, and 5)				4026330	Model 1
					02 (M2, and 5)	02 (DC2, and 5)	25	8	0	3137170	Model 2
3	6	6	6	6	03 (M2, 3, and 6)	03 (DC2, 5, and 6)				3820810	Model 1
					02 (M2, and 6)	02 (DC2, and 6)	21	2	0	3118240	Model 2
4	8	8	8	8	04 (M2, 5, 6, and 8)	04 (DC2, 5, 6, and 8)				5616190	Model 1
					02 (M2, and 6)	02 (DC2, and 6)	6	0	18	5317610	Model 2
5	8	8	8	10	05 (M1, 2, 3, 6, and 8)	05 (DC2, 3, 5, 6, and 8)				11406850	Model 1
					04 (M2, 3, 5, and 6)	04 (DC2, 5, 6, and 8)	10	5	26	10716700	Model 2
6	10	8	8	10	06 (M1, 2, 3, 5, 6, 8)	06 (DC2, 3, 5, 6, 7 and 8)				12938640	Model 1
					04 (M2, 3, 5, and 6)	04 (DC2, 5, 6, and 8)	5	3	38	11811800	Model 2

Model 1: model of Duong and Bui (2014)
Model 2: the our proposed model
N1: number of vehicles type 1 (capacity 100 unit); N2: number of vehicles type 2 (150 units);
N3: number of vehicles type 3 (200 units);
M: manufacturing plant; DC: distribution centers
Optimal cost: obtained from LINGO software
I: number of potential sites for opening manufacturing plants;
J: number of potential sites for opening distribution centers;
R: number of retailers;
T: length of the planning horizon.
All test problems are solved by LINGO10.0 software. And the obtained results are optimal solutions from Lingo programs. According to the results in table 1, we see that the total cost (optimal value) of model 2 is better than model 1 because of less than number of opened facilities in the new system. We think that this achievement is very important for managers and investors when the product demand decreases in the future. Moreover, our model can control the number of vehicles in the new systems at each period based on vehicle resource. In addition, we can also manage the total outsource products from outside suppliers. Therefore, our model helps to open effective number of facilites in the SC networks. Based on the results presented in Table 1, and the above analysis, we belive that our model is very usefull and can be applied for realistic situations.

6. Conclusions

In this research paper, we develop a mix integer linear programming model for capacitated facility location problem in supply chain network design. Our model deals with direction shipment and outsourcing strategies that are very common strategies in practice. Our research is succeeded in combining outsourcing strategy with opening facilities in the new established systems. This helps the investors to save the total investment cost, and then reduce the investment risk. Moreover, controlling the total number of vehicles and total outsourcing products are also detected in our model.

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Loan quality, ownership and efficiency of Indian Banks: A Bootstrap Truncated Regression Approach

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Many prior studies on Indian banking efficiency have typically regressed non-parametric estimates of production efficiency on environmental variables in a two-stage process. However, Simar and Wilson (2007, 2011) have demonstrated that the studies that use such conventional approaches are invalid due to complicated and unknown serial correlation among estimated efficiencies. Using the data envelopment analysis bootstrap procedure suggested by these authors, for the first time, we analyse the technical efficiency of Indian banks and regress the bootstrap scores on a set of environmental variables using a truncated regression. Banks that are on efficiency frontier as per conventional analysis are actually away from the frontier when bootstrap scores are used. Contrary to many prior studies, state ownership was found to have significant negative impact on efficiency.
Keywords: Indian banks, efficiency, truncated regression, bootstrap.

1. Introduction

The objectives of this study are (a) to assess the production efficiency of Indian banks using the bootstrap approach to data envelopment analysis and (b) to examine the impact of loan quality and ownership on bias-corrected bootstrap efficiency scores. It explores these issues by addressing five related questions:

(i) What is the production efficiency of Indian banks using the unbiased bootstrap approach?

(ii) What is the effect of state ownership on bank inefficiency?

(iii) What is the effect of bank soundness on bank efficiency?

(iv) What is the effect of size on bank efficiency?

(v) What is the effect of loan quality on bank efficiency?

The paper also considers whether there was a change in bootstrap efficiency scores of Indian banks during the three periods: pre-GFC, during the GFC and post GFC.

The immediate motivation for the paper is the passage in December 2012 of the Banking Liberalisation Bill in the Indian Parliament that raises the foreign investment limits in Indian banks to 26 per cent from the present 10 per cent and liberalizes the licensing regime for banks (FT 2012). The liberalization is intended to improve the efficiency of the banking system, which is tipped to become the third largest in the world, next only to China and the United States, by 2025 (FT 2012). Further, the extant studies on Indian banking efficiency have used the non- parametric data envelopment analysis and the two-stage regression approach without bootstrapping the efficiency scores. The Reserve Bank of India (2008), for example, found that 17 out of 81 banks were on the efficiency frontier using the data envelopment approach. However, the efficiency scores were not bootstrapped. Simar and Wilson (2007) have demonstrated that these studies are invalid due to complicated and unknown serial correlation among estimated efficiencies.

Further, Dyson and Shale (2010), state that the true efficient frontier lies within the confidence limits that are produced by bootstrap procedures. This removes the main drawback that statistical inference can’t be conducted with DEA efficiency scores (Halkos and Tzeremes, 2010).

Using the data envelopment analysis bootstrap procedure suggested by these authors, for the first time, we analyze the technical efficiency of Indian banks and regress the bootstrap scores on a set of environmental variables using a truncated regression. Second, while the banking sector in many countries of the developed world faced enormous problems of financial stress and sustainability, the Indian banking sector came out of the global financial crisis (GFC) relatively unscathed. Barr et al. (2000) found that banks with higher efficiency are more likely to survive than those with relatively low scores. Consequently, an examination of the efficiency of Indian banks post-GFC becomes important. Podpiera and Cihak (2005) stated that regular screening of banking efficiency is important, as it can serve as an early warning system. Third, The Economist (2012) stated that the Indian banking system runs the "risk of Spanish disease" and that "India has a bigger bad-debt problem than the rather stable level of banks' official 'non-performing" loans suggests." The magnitude of the impact of such non-performing loans (loan quality) on banking efficiency is also an issue that we examine in this paper. Fourth, few studies on Indian banking efficiency have examined the impact of ownership and credit risk (loan quality) together on production efficiency in second-stage regression. Where they have, it is either multiple regression or tobit regression that has been used on non-bootstrapped efficiency scores instead of truncated regression as suggested by Simar and Wilson (2007). Finally, the results would be of interest to researchers in emerging economies like China, Brazil, Russia and other developing countries where banks continue to be publicly owned. Fry (1995) states that a key stylised fact about developing countries is financial intermediation is mostly carried by commercial banks rather than by financial markets. Ataullah and Le (2006) emphasize that it is vital for governments in developing countries to create an environment that enhances commercial banking efficiency for overall economic growth.

Furthermore, as stated by Simar and Wilson (2007), the procedure ensures the efficient estimation of the second stage estimators, a property which is not guaranteed with alternative methods. The use of truncated regression enables us to obtain more reliable evidence (Barros and Garcia-del-Barrio, 2011).

The study proceeds as follows. Section 2 provides a background of the Indian banking system in brief, section 3 reviews prior studies, section 4 provides data and analysis and section 5 provides results. Conclusions of the study are presented in section 6

2. Overview of the Indian banking system

India has a massive banking system that caters to the financial needs of over 1 billion people. At the top of the banking system is the Reserve Bank of India, which is the central bank of the country. Commercial banks are the major type of financial intermediary and consist of 26 public sector, 22 private sector and 41 foreign banks (see Table 1). Besides the commercial banks, cooperative banks, which are also state-partnered institutions, mainly cater to the needs of the rural sector. As per RBI (RTPB 2012, Table IV.1), total assets of the Indian banking sector are Rs 82,994 billion with total deposits of Rs 64,537 billion and total advances of Rs 50,746 billion (INR55/USD). The return on assets of 1.08 (2012) is comparable with that of other countries of the world. The figure for the net non-performing assets as a percentage of net advances at 1.4 does, however, indicate an area of concern, given the report in The Economist cited above that a huge amount of restructured loans are not included in the ratio.

3. Prior studies

Studying banking efficiency is important. Fiordelisi et al. (2010) found that reduction in efficiency increases banks' future risks and indicated bad management. For measuring bank efficiency, the frontier analysis approach is increasingly being used. The approach consists of separating institutions that are performing poorly as compared to those that are performing well using a particular standard. The separation is achieved either by applying the non-parametric or parametric frontier method. The parametric approach includes stochastic frontier analysis,

the free disposal hull, thick frontier and the distribution-free approaches (DFAs), while the non-parametric approach is data envelopment analysis (DEA) (Molyneux et al. 1996).
Though many empirical studies have examined banking efficiency over the years, few have used the bootstrap DEA procedures. Consequently, the results obtained through the use of conventional DEA would need to undergo renewed scrutiny. Matthews et al. (2009) examined the Malmquist productivity (not efficiency) and non-performing loans in Chinese banks using bootstrap procedures. Curi et al. (2013) examined foreign-bank bootstrap DEA efficiency in Luxemburg. Barros and Assaf (2011) and Halkos and Tzeremes (2013) examined bootstrap efficiency of Japanese and Greek banks respectively. Chortareas et al (2013) used bootstrap DEA to examine banking efficiency in the European Union.
As can be seen from the above the bootstrap DEA efficiency studies in banking have largely been confined to developed countries. Examining banking efficiency using bootstrap is important in the context of developing countries since they generally have predominance of public sector banks which are typically known to be saddled with inefficiency (Fry, 1995; Ataullah and He, 2006). Governments in these countries need an efficient banking sector for promoting growth. The starting point of this is to accurately assess the banking efficiency in these countries. We address this gap in the literature using data of Indian banks.
Bhattacharya et al.'s paper (1997) was the first to apply frontier analysis (both DEA and stochastic frontier analysis) to assess the efficiency of 86 Indian banks during the early liberalization period (198̃61991). The study found publicly-owned banks to be most efficient, followed by foreign banks and privately-owned banks. Das (1997) used DEA to examine the efficiency of 65 Indian commercial banks for the year 1995 and compared their technical and allocative efficiency and found the former to be more efficient. Mukherjee et al. (2002) examined the technical efficiency of 68 commercial banks for the period 199̃61999. The findings were similar to those of the Bhattacharya et al. (1997) study□that is, the publicly-owned banks were found to be more efficient than both private and foreign banks. Sathye (2003) examined the impact of ownership on Indian banking efficiency using DEA and found that publicly-owned banks were more efficient than foreign banks and privately-owned banks. Ram Mohan and Roy (2004) also found publicly-owned banks to be more efficient than privately- owned banks, but foreign banks had caught up with them over the years.
Das and Ghosh (2009: 193) examined the banking efficiency during 199̃22002, and found that 'medium-sized public sector banks performed reasonably well and are more likely to operate at higher levels of technical efficiency. A close relationship is observed between efficiency and soundness as determined by bank's capital adequacy ratio. The empirical results also show that technically more efficient banks are those that have, on an average, less nonperforming loans'. Ghosh (2009) studied the cost and profit efficiency of Indian banks during the period 199̃22004. The study found that big state-owned banks performed well in terms of efficiency, and a close relationship was found between efficiency and soundness as determined by a bank's capital adequacy ratio. Ray and Das (2010) examined the cost and profit efficiency of Indian commercial banks during a 7-year period beginning 199̃697. The study found that publicly-owned banks were more profit efficient than were privately-owned banks. Gulati and Kumar (2008) found that when non-traditional activities were accounted for in the output specification, the foreign banks appeared to be more efficient than were public and private sector banks. Kaur and Kaur (2010) used DEA to examine the impact of mergers on the cost efficiency of Indian

banks during the period 1990–91 to 2007–08. These authors found that the average cost efficiency of publicly-owned banks was lower than that of privately-owned banks. Dwivedi and Charyulu (2011) studied banking efficiency for the 5-year period 2005–2006 to 2009–2010 and found that new privately-owned banks and foreign banks were more efficient than were publicly- owned banks

Our study makes several new contributions. None of the above studies have used bootstrap DEA scores. As already stated by Simar and Wilson (2007), conventional DEA approach, that is, without bootstrap can give misleading results. Thereafter we examine how ownership, size, soundness, loan quality variables impact on the bootstrap DEA efficiency scores and thus provide robust analysis of Indian banking efficiency as compared to prior studies. In particular, we examine the important issue of efficiency differences resulting from foreign vs domestic ownership as well as public vs private ownership and contribute to the literature discussing this theme. We examine whether, on average, these ownership types have positive or negative effects on bank efficiency. Furthermore, we analyse Indian banking efficiency in a period subsequent to what prior studies have analysed – especially the post GFC years.

4. Data and Method

The data for the study were drawn from the Reserve Bank of India (RBI) publication A Profile of Banks available online and refer to the 5-year period 2007–2008 to 2011–12.

Table 1 presents the total number of banks in various categories, and, of these, the number included in our sample. The banks for which data as required for the study were not available were excluded from the sample.

Table 1: Distribution of banks in India and banks in the sample

	2007–08	2008–09	2009–10	2010–11	2011–12	Total
Foreign						
total	28	31	32	34	40	
in the sample	9	14	17	14	14	
Private sector banks						
total	23	22	22	21	20	
in the sample	19	19	19	19	19	
Public sector banks						
total	28	27	27	26	26	
in the sample	26	26	26	26	26	
Total	79	80	81	81	86	407
in the sample	54	59	62	59	59	293

DEA efficiency calculation

DEA is a linear programming technique initially developed by Charnes, Cooper and Rhodes (1978) to evaluate the efficiency of public sector non-profit organizations. It involves calculation of relative efficiency scores of decision-making units (DMUs) in the sample. The DMUs could be banks or branches of banks. A major advantage of DEA is the identification of peers with which the efficiency could be compared. For choosing the inputs and outputs to be used in DEA analysis, two major approaches, the production approach and the intermediation approach, are prevalent. The production approach involves use of physical inputs and outputs and relevant processes. The intermediation approach is commonly used and has some variants. The asset approach involves use of labour and capital as inputs and loans as output (Sealy and Lindley 1977). Under the user cost approach, the outputs are where the financial returns on an asset exceed the opportunity cost of the funds and the financial costs of a liability are less than the opportunity cost. If it is vice versa, it is treated as inputs (Hancock 1985). The value-added approach considers as outputs those assets or liabilities that contribute to bank value added□that is, business associated with the consumption of real resources (Berger et al. 1987). According to Jemric and Vujcic (2002), yet another popular approach is the operating or income- based approach. In this approach, interest income and non-interest income are considered as outputs, and interest expenses and non-interest expenses are considered as inputs. The approach has been used in many prior studies□for example, Leightner and Lovell (1998), Avkiran (1999), Sathye (2003) and Das and Ghosh (2006). In the present study, we use this approach.
Charnes et al. (1976) described the original DEA model as follows. There are N units producing J outputs, with I inputs. Efficiency is measured by maximising the ratio weighted outputs to weighted inputs for that unit under following constraints:

$$Max\ e^0 = \frac{\sum_{j=1}^{J} u_j^o y_j^o}{\sum_{i=1}^{I} v_i^o x_i^o} \qquad (1)$$

Subject to

$$\frac{\sum_{j=1}^{J} u_j^o y_j^n}{\sum_{i=1}^{I} v_i^o x_i^n} \leq 1; \quad n = 1, \ldots, N,$$

$$v_i^o, u_j^o \geq 0; \quad i = 1, \ldots, I; \ j = 1, \ldots, J.$$

y_j^n, x_i^n represent the outputs and inputs of the n^{th} unit called a decision making unit (DMU)

and v_i^o, u_j^o are the variable weights. These are determined by solving problem (1).

Given the difficulty in solving the above non-linear problem the objective function is transformed into a linear one as follows:

$$Max h_o^o = \sum_{j=1}^{J} u_j^o y_j^o \qquad (2)$$

Subject to

$$\sum_{i=1}^{I} v_i^o x_i^o = 1, \quad \sum_{j=1}^{j} u_j^o y_j^n - \sum_{i=1}^{I} v_i^o x_i^n \leq 0; \quad n = 1,\dots\dots,N,$$

$$v_i^o \geq \varepsilon, \quad u_j^o \geq \varepsilon, \; i=1,\dots I, \quad j=1,\dots\dots,J.$$

The variables in (2) above are the same as in equation (1) above. Readers interested in knowing the details of the DEA procedure are advised to refer to the original paper by Charnes et al. (1976).

In the present study, we use the variable returns to scale (an input-oriented model) to compute technical efficiency. It shows the extent to which the output could be enhanced by each of the banks in the sample with the existing inputs.

The bootstrap approach

Simar and Wilson (1998, 1999, 2007) stated that the DEA scores calculated above have strong association with each other and using them in second-stage regression may be inappropriate. The scores are relative and not absolute, and as these are calculated and not estimated, it is difficult to obtain statistical properties of DEA. Consequently, these authors proposed a double bootstrap procedure that enables computation of confidence intervals and standard errors for the DEA scores. This computer-based method draws from the theory of re-sampling original data to assign statistical properties to it and also enables accounting for the impact of environmental variables on efficiency (Simar and Wilson 2007). These authors also did not consider the use of ordinary least squares to estimate the relationship between DEA scores and environmental variables as appropriate since regression assumption of no auto-correlation and absence of multi-collinearity get violated, and they suggested instead the use of truncated regression. The procedure for the bootstrap method has been described in detail by Simar and Wilson (2007) and is not repeated here. Descriptive statistics of inputs and outputs used in DEA are presented in Table 2.

Table 2: Descriptive statistics of input and outputs used for DEA

Year/Variable	Obs.	Mean	Std. Dev.	Min	Max
2007–08					
Interest expenses	54	36785.56	54625.04	4	319291
Non-interest expenses	54	13313.89	20515.99	27	126086
Interest income	54	54028.81	79550.46	45	489503
Non- Interest income	54	10247.56	16724.3	36	88108

2008–09					
Interest expenses	59	43938.03	66450.71	6	429153
Non-interest expenses	59	15080.78	23701.45	34	156487
Interest income	59	64497.95	96153.47	14	637884
Non- Interest income	59	12699	20665.51	46	126908
2009–10					
Interest expenses	62	43255.61	68959.56	4	473225
Non-interest expenses	62	15827.39	27866.65	40	203187
Interest income	62	65902.77	102390.4	11	709939
Non- Interest income	62	12537.65	22054.29	1010	149682
2010–11					
Interest expenses	59	50393.9	73581.3	7	488680
Non-interest expenses	59	20619.08	32746.39	43	230154
Interest income	59	82555.22	120504.3	12	813944
Non- Interest income	59	13183.97	23115.34	35	158246
2011–12					
Interest expenses	59	110027	158398.5	23.298	1065215
Non-interest expenses	59	14207.14	22714.62	995.57	143514.5
Interest income	59	72571.31	98984.41	8.479	632303.7
Non- Interest income	59	22960.72	37077.77	49.522	260689.9

Descriptive statistics of the bias-corrected scores for the years 2007̃08 to 2011̃12 are presented in the table below:

Table 3: Descriptive statistics of bias-corrected efficiency scores

Year	Banks	Mean	Std. Dev.	Min	Max
2007–08	54	1.124906	0.097194	1.0212	1.523
2008–09	59	1.158169	0.109709	1.0286	1.5036
2009–10	62	1.193563	0.2211	1.0178	2.1587
2010–11	59	1.125178	0.095275	1.0194	1.4239
2011–12	59	1.159812	0.150925	1.0346	1.8622

It will be seen from the above that outputs could be increased on average for all banks by approximately 12 per cent (2007̃08), 16 per cent (2008̃09), 19 per cent (2009̃10), 13 per cent (2010̃11) and 16 per cent (2011̃12). As can be seen, the post-crisis average efficiency of banks has deteriorated. In 2007̃08, there was scope to increase efficiency by 12 per cent, while in the year 2011̃12, a 16 per cent increase in efficiency could be achieved with the given inputs.

Truncated regression

The environmental variables that we use are drawn from relevant theory and prior empirical studies. We use the following model to assess the link between environmental variables and the bootstrap efficiency score.

$$\theta_i = \beta_0 + \beta_1 ForOwn_i + \beta_2 Soundness_i + \beta_3 StateOwn_i + \beta_4 LoanQuality_i + \beta_5 Size_i + \varepsilon_i$$

When bootstrap procedure followed by truncated regression is used the issue of ‘separability condition’ becomes relevant. Simar and Wilson (2011:207) say that by separability they ‘mean that the support of the output variables does not depend on the environmental variables in Z’ where Z refers to environmental covariates. As the data generation process (DGP) used in our study corresponds to DGP 2 described by the above authors, separability is a reasonable assumption in this study.

ForOwn: Foreign versus domestic ownership is a binary variable. Foreign ownership equals 1, while domestic ownership equals zero. It is intended to detect the influence of foreign ownership on technical efficiency. The variable could have either negative or positive influence on efficiency. Studies such as that of Williams and Strum (2007) found foreign banks more efficient than domestic banks; however, in the Indian context barring Dwivedi and Charyulu (2011), other studies found domestic banks to be more efficient than foreign banks. Consequently, we do not postulate an a priori sign for this variable.

Soundness: The soundness of a bank depends upon the capital it holds vis-à-vis risk-weighted assets. We use the capital-to-risk-assets ratio (CRAR) as a measure of soundness. Many prior studies such as those of Das and Ghosh (2006) and Ghosh (2009) have used CRAR as a measure of soundness. Better capitalized banks are expected to be more efficient because of their ability to attract more business. Fiordilisi et al. (2010) stated that higher capital levels positively impact efficiency. Das and Ghosh (2006) stated that financial soundness reduces uncertainties and systematic risk and thus contribute to lowering inefficiency. Consequently, we expect a positive relationship a priori between soundness and technical efficiency.

StateOwn: State versus private ownership is a binary variable. State ownership equals 1 while non-state ownership equals zero. It is intended to detect the influence of state ownership on technical efficiency. Most prior studies in Indian banking have found that state-owned banks are more efficient than are other banking groups; however, recent study by Dwivedi and Charyulu (2011) already cited above, finds that the case is otherwise. Consequently, we do not postulate an a priori sign for this variable.

LoanQuality: Similar to prior studies (such as Das and Ghosh [2006] and Ghosh [2009]), we capture loan quality by the ratio of non-performing loans to net advances. Inadequate loan monitoring and bad debt control can lead to lesser interest income. Further, bad loans require higher supervision and monitoring, which increase operational expenses. The combined effect would be lower efficiency. This is consistent with the bad management hypothesis of Berger and DeYoung (1997). We expect that a priori this variable will have a negative sign□as non-performing loans increase, efficiency will lower.

Size: As per public choice theory and principal agent framework, different types of ownership impact on efficiency differently. ‘The theoretical argument is straightforward: a lack of capital market discipline weakens owners’ control over management, enabling the latter to pursue their own interests, and giving fewer incentives to be efficient’ (Das and Ghosh, 2006). Prior studies have used assets, deposits, advances, number of ATMs, number of employees, number of branch offices as measures of size. We use number of employees as a measure of size.

As stated by Keuleneer and Leszczynska (2011) ‘Size is claimed by many to bring economies of scale and cost reductions almost per definition.’ In the banking context, studies in the US indicate that economies of scale appear in small banks but not in the large banks (Short, 1979; Miller and Noulas, 1996). However, studies such as Sun and Chang (2011) have found that size impacts efficiency negatively. We postulate a negative sign for this variable a priori.

To run the truncated regression, data from a total of 293 banks were used, and the procedure suggested by Simar and Wilson (2007) was deployed to obtain the following results.

5. Results and discussion

Table 4 provides for the year 2012 (for other years, data are available on request from the authors) output-oriented DEA bootstrap scores and the raw scores. It indicates the extent to which output could be increased with the current input levels. The details of the variable returns to scale (VRS) technical efficiency scores of each of the 68 banks in the sample together with the bias-corrected efficiency scores, the extent of bias and the lower and upper confidence levels are presented.

Following Simar and Wilson (1999), we used 2,000 bootstrap replications (B=2,000). According to these authors, this should provide an adequate coverage of the confidence intervals.

It will be noticed that although 24 out of 68 banks are on the frontier with a score of 1 (when raw efficiency is computed), after the bias is corrected, even these banks have inefficiencies and their output could be increased. For example, in the case of first bank□AB bank□the efficiency could be improved by 9.84 per cent. The bias-corrected column shows that few banks are quite close to the frontier but are not exactly on the frontier, suggesting that there is scope to further increase output with the same inputs. The information could be useful to bank managements to take appropriate strategic actions.

Table 5: Truncated regression results

Variable	Co-eff	Std Error	*p*-value
Foreign-owned=1	-0.06093	0.024	0.01
Soundness	-1.7E-05	0.001	0.99
State-owned=1	-0.09497	0.019	0.00
LoanQuality	-0.0148	0.006	0.02
Size (staff numbers)	-5.93E-07	3.06E-07	0.05
Constant	1.201007	0.023	0.00
Log likelihood: 168.47 (Prob > chi square = 0.000) No. of observations=293, LL=0, Wald chi2(5) = 42.66			

Foreign ownership was found to have significant negative association with efficiency. Berger et al. (2009, 2010) in the context of Chinese banks found that foreign banks were most efficient. In the Indian context, Mohan and Ray (2004) and Das et al. (2005) found that foreign-owned and state-owned banks were not significantly different in efficiency. Our study, however, shows that foreign-owned banks had significantly lower efficiency. Thus, foreign banks in these two countries show divergent results with respect to efficiency. Berger et al. (2009) study, however, refers to the 1994-2003, that is, the pre-GFC period. Our finding is in line with that of Lensink et al. (2008), who found that foreign ownership negatively affects bank efficiency. However, in countries with good governance, this negative effect is less pronounced. Chen et al. (2013) state that efficiency flows through two channels, that is, the monitoring channel and the information channel reducing issues associated with agency problem and information asymmetry. However, corporate governance in Indian banks is wanting. A senior official of

RBI recently stated 'sserious lapses observed in governance framework during the crisis, tilted the balance in favour of more rigorous regulation' (Sinha, 2013).

This could be because many foreign banks suffered badly during the GFC, and their income deteriorated also due to high bad debt provision. Many foreign banks curtailed operations due to problems in their home countries.

The soundness variable is not found to be significant. Earlier studies have found that well capitalized banks are more efficient. During the GFC, most banks were required to beef up capital given the rising bad debts; consequently, it appears that the normal salutary effect that increased capital may have on efficiency through increased business and increased income is not seen. The additional capital was to provide a buffer against bad debts rather than for expanding business because of the unusual circumstances through which the banks were passing.

The state ownership variable shows a negative significant result. This is particularly interesting. Many prior studies of Indian banks have found the relationship to be positive for medium-sized state-owned banks (Kumbhakar and Sarkar 2005; Das and Ghosh 2006; Chatterjee 2006). However, our results are consistent with recent studies such as those by Kaur and Kaur (2010) and Dwivedi and Charyulu (2011), who found that state-owned banks were less efficient than were non-state-owned banks. Lensink et al (2008:841) also found that 'state-owned banks are, in general, less efficient than non-state owned banks'. It appears that after the GFC, the foreign and private sector banks have considerably improved their efficiency vis-à-vis the state-owned banks. Further, given the archaic labour laws in India, it may be hard for state-owned banks to take drastic measures such as curtailing staff, which could be possible for private sector and foreign banks.

The loan quality variable, which measures credit risk, has significant negative association with technical efficiency. Higher credit risk (non-performing loans) implies lower interest income and higher operational expenses in loan collections and monitoring. The result is consistent with prior work of Berger and Mester (1997), who found that poor management of credit portfolio,

has an unfavorable impact on efficiency. Ghosh (2009) also found similar results for Indian banks.

Size has a significant negative influence on efficiency. As the number of employees increases, the operational costs, which include salary and wages, would increase, and unless it is compensated by increased income through increased business, the efficiency would be negatively impacted. The result is similar to those of prior studies such as Sun and Chang (2011), Ghosh (2009) and Das and Ghosh (2006). These studies found that large banks are less efficient than are small banks.

Next we examine if there was significant difference in bootstrap banking efficiency in the pre – GFC years, during GFC years and between GFC years and post GFC years. The impact of GFC (using a decline in GDP as the criteria to define GFC years) on the GDP was felt by India in the years 2008-09 and 2009-2010. The GDP growth rate which showed a rising trend prior to these years showed a sharp decline and stagnancy in these years. Thereafter, the GDP rose significantly in 2010-11 (over 10 per cent from 7 per cent in earlier years) but again sharply declined in 2011-12 to the GFC years' level.

We use Kruskal-Wallis test to assess whether there was significant difference in banking efficiency in the above periods. The computation returned chi square value of 4.889 (with 1 d.f.) and probability of 0.027. This demonstrates that the GFC years did affect banking efficiency. While comparing GFC years with the post-GFC years, an interesting result can be found. When we compare the efficiency scores GFC years with 2010-11 (GDP rose significantly exceeding 10 per cent), we get the chi square value of 5.378 (with 1 d.f.) and a probability of 0.020 indicating that post GFC year there was significant difference in efficiency. However, if we use the year 2011-12 data as well, then the results are not significant. This was because in 2011-12, India's GDP sharply declined to GFC years' level. Overall, when we compare pre-GFC year with post- GFC years, no significant difference in banking efficiency was noticed.

As indicated by Podpiera and Cihak (2005), regular screening of banking efficiency is important as it can serve as early warning system. Indian banking efficiency does show signs of stress in the post GFC years. It appears that the Government of India too is concerned about the inefficiencies that plague the Indian banking system and has taken policy measures like the recent Banking Reforms Bill 2012, which raises limit on foreign capital to 26 per cent from 10 per cent. Hopefully, these measures would help improve Indian banking efficiency over the years. Berger et al. (2009) observation in the context of Chinese banking could be equally applicable to Indian situation. 'The ''real" reward of such reforms may be continued economic growth because an open and flexible banking environment not only provides more credit, but a better allocation of credit, funding more positive net present value projects that contribute to economic growth'.

6. Conclusion

In the current study, we provide a bootstrap efficiency analysis of Indian banks for the 5-year period from 200̃708 to 201̃112 using Simar and Wilson's (2007) method. Such an analysis is being done for a developing country for the first time, to our knowledge. These authors have already demonstrated that DEA analysis using conventional methods (non-bootstrap) may not provide reliable results. In the current paper, we not only rectify the situation in the Indian banking context but also provide results from truncated regression, which has not been employed in prior studies on Indian banking. Consequently, our study provides more appropriate analysis of Indian banking efficiency than found in studies hitherto.

Interestingly, contrary to prior studies, we find that state ownership has a negative impact on efficiency in the Indian context. Similarly, foreign ownership also was found to have negative influence on efficiency. The bad management hypothesis finds support, as the loan quality variable was found to have significant negative impact on efficiency.

The bootstrap scores suggest that there is room for expanding output with current input levels by banks. It is hoped that the study would provide an impetus for similar studies that use bootstrap efficiency analysis and second-stage truncated regression so as to draw valid conclusions.

Besides the above conceptual contributions, the study is expected to help bank managements in further improving efficiency by suitable strategic actions such as reducing inputs or making better use of inputs and to policy makers to continue with banking reforms agenda. Regulatory authorities in developing countries may also like to consider conducting similar studies of banks in their respective countries so that efficiency is accurately measured so as to draw valid conclusions for policy actions.

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Labour Unions, Unit Labour Cost and Competitiveness: The Case of Singapore

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In Singapore, we have been able to achieve full employment. Indeed, our natural rate of unemployment is always close to our actual unemployment rate (Groenewold and Tang, 2004). We have been able to achieve this result because our wage costs are fully flexible. During good years, we enjoy wage increases and during a recession, we allow wage costs to fall to protect employment. However, the business cycles are shorter and more extreme. We need more and more foreign workers to act as buffer. Consequently, the low income workers in Singapore suffer even when there is full employment on the account of higher cost of living and depressed wages caused by foreign workers.

The purpose of this paper is to show that with the right kind of labour unions, Singapore economy can recover fast in terms of lower ULC. Of course, low wage workers suffer too when there is a recession because their take-home pay is reduced significantly. In other words, we do not have inclusive growth when there is a negative demand shock. Consequently, the government would have to increase public spending to help the poor. The strategy of relying on foreigners, coupled with globalization has caused the Gini coefficient in Singapore to continue to rise. We need additional instrument to look after low income workers. Our unions can play a role here.

1. Introduction

This paper will present a scenario which shows that besides wages and worker benefits which are provided by the employers, the labour movement can help to mitigate the hardship caused this strategy of relying excessively on foreign workers by providing union benefits to union members. Workers at non-unionized plants are also eligible to join as social union members.

These union benefits can be regarded as country club benefits in the sense that workers joining the union is like joining a country club except this is a big country club. The paper will present evidence of the country club benefits provided by the unions to the workforce in Singapore as part of the inclusive growth strategy.

2. The Economics of Joining the Trade Union

Booth (1984) presents a model of union membership where a worker's decision to acquire trade union membership depends on his wage premium plus non-contractual benefits and his probability of being retrenched. The amount of wage premium is positively related to the probability of retrenchment, as the demand curve for labour has a negative slope. At the same time, effective union strategies can enhance a worker's valuation of non-contractual services (benefits provided by the union) and thereby increase union membership. Unions also provide benefits to members in terms of an insurance scheme (Boyer 1988). This type of union benefits can be regarded as country club benefits as workers join the union in the same way as they join a country club.

However, reliance on the creation of wage premium is not effective in increasing union membership as firms worldwide face intense competition and the market constraint would limit the amount of wage premium a union can effectively command since the number of employed would fall, while country club benefits are not able to reverse the declining union membership trends because these benefits are not substantial owing to job mobility and/or shorter job tenure and most of all, the limited financial resources of a union. In the USA where labor militancy has been strong but the number of strikes has decreased steadily from 1995 to 2005 due to globalization (Borjas, 2009). The traditional labour unions which can be regarded as micro-focused unions need to rethink about union strategy in order to stay relevant.

Macro-focused unions

Contrary to micro-focused unions, a macro-focused union will not trade higher wages for lower level of employment. In other words, a macro-focused union would want to maximize the employment level. But being a labour union, the objective is to raise wages. Hence, a macro-focused union would work with the government to raise the competitiveness of the country and would work with the management to increase profitability of the firm, all with the sole objective of raising purchasing power of the workers (see Chew and Chew (2010) for reference on macro-focused unions). During a recession, wages and employment would fall in the normal economic circumstance. But a macro-focused union would work with the government and the management to reduce labour cost such that the employment can best be protected.

However, as a macro-focused union provides a public good, it has difficulties in inducing workers to join the union. Consequently, the macro-focused union needs to provide country club benefits to induce workers to join the union.

Diagram 1 shows that the labour market is in equilibrium at E. A macro-focused union will set the wage rate at W so that the employment level is maximized. The macro-focused union will work closely with the government to attract foreign investment such that the demand for labour curve will shift to D’. The new equilibrium point is at E’ and the wage rate is at W’. There is no union wage premium for union members. A macro-focused union can provide country club benefits of AE’ to union members. Hence, the macro-focused union can achieve full employment and at the same time increase union membership.

Diagram 1: Demand and Supply curves

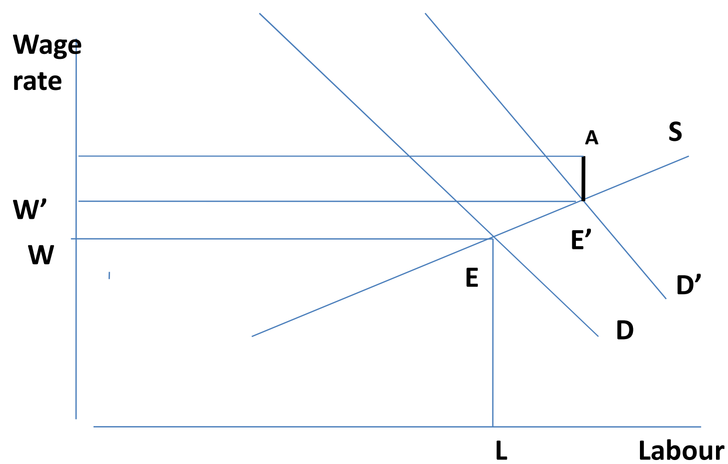
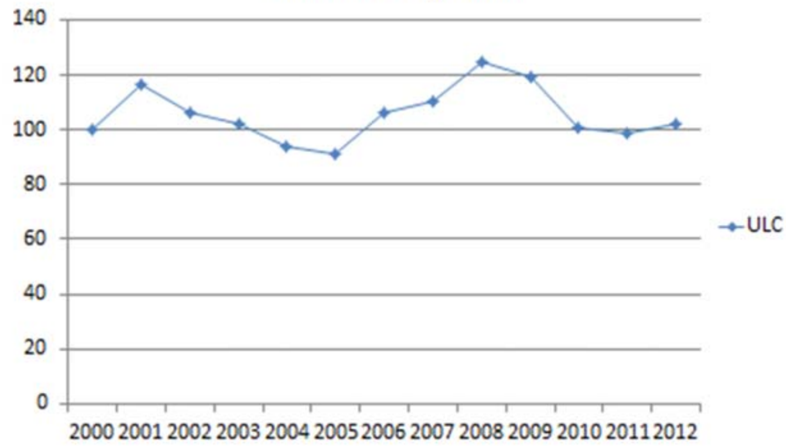


Diagram 2 shows that the original equilibrium was at E in another situation. Suppose a recession has shifted the demand curve to D’ and under normal circumstance, both wage rate and employment will fall and the Gini will be bibber. In order to maintain the level of employment, the new wage rate has to be at W’. Workers will suffer a wage cut in exchange for employment. This is a better outcome for the workers, which is the objective of an inclusive growth strategy.

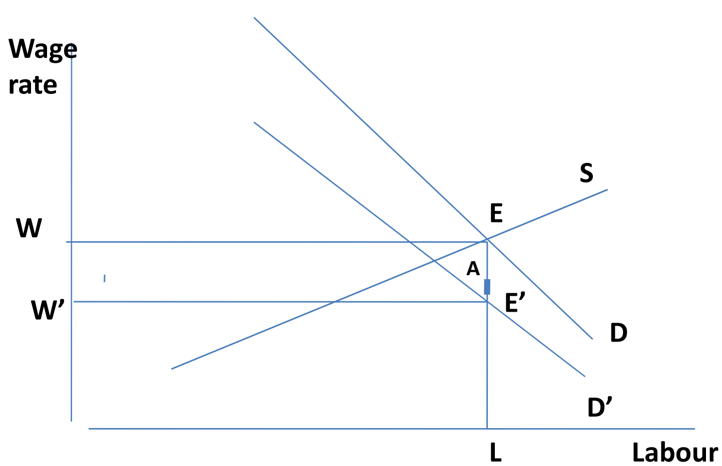
At E’, unit labour cost is lower because employment level and output is the same but wage cost is lower. This will help Singapore to recover from recession. Diagram 1 shows that ULC in Singapore’s manufacturing sector is flexible downward during economic slowdown. In most countries, wage costs cannot be lowered due to unions’ objections but labour unions in Singapore behave differently.

**Diagram 1:
Index of Unit Labour Cost (ULC) within the
Manufacturing Sector**



At the same time, if the union can offer to both union members AE’ in country club benefits, the reduction of wages will be mitigated by the country club benefits of AE’. The purpose of this paper is to provide as estimate of AE’ based on a survey of workers in Singapore.

Diagram 2: Demand and Supply curves



It is not easy for a union to provide a significant amount of country club benefits to the workforce. But the government can help the union in the provision of country club benefits because the union is macro-focused.

Labour Unions in Singapore

The labour movement in Singapore is represented by the National Trades Union Congress (NTUC). NTUC is a macro-focused union as she looks after the interests of all workers in

Singapore. For instance, NTUC provided vouchers worth one million dollars to 10,000 workers for the Family Recreation Fund in 2007。

As a macro-focused union, NTUC also promotes employment and training. This strategy is, as expected, strongly endorsed by the government and the employers. NTUC has also openly supported the government policy of attracting foreign talents and foreign workers as this policy will induce more foreign investment in Singapore and consequently raise standard of living for the locals (See Lim Chong Yah, at al., for an extensive discussion on economic policies in Singapore) . In 1985 and 1998, when Singapore registered negative GDP growth rates, the government had, with the support of the NTUC, used labour cost reductions as an effective solution to prevent retrenchment (see Diagram 1 for reference). In 2008, when the world was crushed by the global financial crisis, the NTUC persuaded the Singapore government to use past reserves to fund wage subsidies in the order of SE' in Diagram 1 in order to stabilize employment.

NTUC has two types of union members. The normal union members are entitled to collective bargaining benefits and of course they enjoy country club benefits. In early 90s, NTUC has set up the General Branch Union for workers in non-unionised firms to join the labour movement (See Chew, 1990 for the theoretical framework of General Branch Union) . Hence, members of the General Branch Union only enjoy country club benefits. As the union due per month is $9 in Singapore, the country club benefits per month have to be worth far more than the $9. Table 1 shows that about 30% of NTUC membership is from the General Branch Union.

Table 1: Union members of NTUC

year	Union Members	Members of General Brach Union	Traditional Union Members
0 1	3 45935	112,009	2 33 926
02	389,676	147,706	241,970
03	417,166	175,383	241,783
04	443,893	206,684	237,209
15	850,000	30%	70%

The extent of union benefits in Singapore

Both 2008 and 2009 were bad for Singapore and the world, the union benefits offered to the Singapore society by the NTUC was around $76 million and $107 million respectively.

However, these benefits are estimated based on NTUC's expenditures. It is not clear to what extent individual members benefited in dollars and cents.

The objective of this paper is to present a survey where we ascertain the preferences of Singapore workers the extent to which they benefit from the union benefits.

Estimation of EE' based on a survey

A survey is conducted to explore the total savings that members can reap, regularity of frequenting the merchant and lastly, the importance of the benefits that is provided.

The first part of the survey looks into gather some basic information of the survey respondents on their age, gender, occupation, marital status and number of dependents (This information will be supplied upon request). Furthermore, the survey also seeks to uncover the preferences of respondents on the importance of the availability of discounts based on broad categories of household expenditures as defined by Singapore Statistics Department. The survey results should reveal the ideal set of benefits that people would need or prefer to have.

The subsequent section of the survey contains the entire list of benefits provided by NTUC for its members, listed by merchants. The collated list of 185 merchants and its listed benefits will also be supplied upon request. Respondents will be asked to disclose how frequent they visit these vendors. The survey is expected to reveal the taste and preference of NTUC members and non-members and that if NTUC is attracting the correct the target audience. Computing the amount of savings / benefits that people will receive as a NTUC member will also be possible.

Cost-Benefit Analysis of union membership

The following section will present and analyse the data collected from the findings. The survey has 70 respondents with 20% of them being NTUC members. Having survey participants' age ranging from 20 to 60, with 58.6% being males, the survey is conducted on a random basis so long they are residing within Singapore.

From the survey, we gathered expenditure data of both union and non-union members. Union members enjoy $52.8 in savings monthly. The total amount of saving is derived using the average savings that can be obtained from the discount tied up NTUC has with its participating merchants. This coupled with survey results used to find out the frequency of visits, allowed the computation of savings that one gets as a union member. Hence, the country club benefits are significant as the monthly union due is only $9.

For non-union members, they are not entitled to discount but if they were union members, based on our calculations, they stand to gain $47.2 in savings per month.

Generally, the monthly wages of workers who are eligible to join the labour movement in Singapore range from $1,000 to $$2,500. This represents an implicit wage increase of 5.3% to 2.1% for union members and 4.7% to 1.9% for would be union members. According to Year Book of statistics of Singapore, the average monthly household expenditures for labourers in 2012 is about $1,925. If both husband and wife will be working and if both are union members, the household savings would exceed $100 a month which would present an increase of 5.2% in purchasing power.

3. Conclusion

Having a macro-focused is desirable for an inclusive growth strategy for the following reasons; we can ensure sustainable employment level and salary level during good times. During a recession, wage costs can be lowered to protect employment level which is the most important aspect of inclusive growth strategy.

Regardless of economic situations, low income workers can benefit from country club benefits. If unions know the preferences of the workforce, the country club benefits can increase significantly.

However, it is not easy to have a macro-focused union. It depends on the leadership of the labour movement and also the leadership of the ruling party. We will discuss this in another paper.

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□ □ □ □ □ □ Performance Pricing Debts and Earnings Management

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This paper examines whether and to what extent a firm's performance pricing loans provide an incentive for managers to manipulate earnings more aggressively. We find that firms with a higher slope of the performance pricing schedule have significantly larger discretionary accruals, which is consistent with the prediction of the positive accounting theory (Watts and Zimmerman, 1986, 1990). However, the positive relationship between the slope of performance pricing schedule and discretionary accruals is significantly attenuated in firms borrowing from high reputation banks or banks with a prior lending relationship. These results suggest that bank reputation and prior lending relation serve as an effective monitoring mechanism, which in turn mitigates managers' incentive and ability to manipulate earnings.

Keywords: Performance pricing, debt contracting, earnings management, discretionary accruals, performance pricing schedule.

JEL Classifications: G21, G32

1. Introduction

Performance pricing is a provision in bank loan contracts that ties loan spread with a borrower's performance, e.g., credit rating or accounting ratios like debt-to-EBITDA ratio. A typical performance pricing loan charges lower (higher) interest rates as borrower’s performance becomes better (poorer). The use of performance pricing provision has become increasingly popular in the last two decades. Hu, Mao, and Naveen (2014) document that about 1% of bank loans were performance priced in 1991 and the usage goes up to 49% in 2006.

In this study, we examine the contractual role of the performance pricing provision in resolving the conflicts of interest problem that arises between lenders and borrowing firms, and its potential impact on firms’ earnings management. Jensen and Meckling (1976) and Myers (1977) recognize the conflicts of interest that exist between a firm’s shareholders and debt-holders, and debt covenants and other provisions can be used to mitigate the conflicts (Smith and Warner, 1979; Bradley and Roberts, 2004). Covenants impose constraints on managers’ actions and prevent them from taking actions that will hurt debt-holders. Since many debt covenants involve accounting measures, the positive accounting theory suggests that managers have an incentive to change accounting method or make financial reporting decisions that reduce the likelihood of violating accounting-based covenants in debt contracts (Watts and Zimmerman, 1986, 1990). Empirical studies provide evidence supporting the existence of such incentives (DeFond and Jiambalvo, 1994).

While debt covenants regulate the allocation of control rights between shareholders and debt-holders via covenant thresholds (specific levels of performance), performance pricing provisions provide a continuous and direct link between accounting measures and interest payments on bank loans. Prior studies show that performance pricing provision is used in a debt contract to lower renegotiation costs (Beatty, Dichev, and Weber, 2002; Asquith, Beatty, and Weber, 2005), to reduce moral hazard between managers and shareholders (Tchistyi, 2013), and to reduce information asymmetry (Manso, Strulovici, and Tchistyi, 2010). In particular, a scheme that punishes bad performance with higher interest rates could serve as an additional incentive for the manager to exert effort. As a result, performance pricing would better align the interests of shareholders and debt-holders. Since performance pricing grids usually have multiple levels, a small improvement in a borrower’s performance will result in a decrease in interest payments. In the same spirit of positive accounting theory, performance pricing may give managers additional incentives to manage accounting information so as to achieve a lower cost of debt, even when the firms are in compliance with debt covenants. Hu, Mao and Naveen (2014) show that a manager’s incentive to manipulate earnings is indeed a determinant for whether a firm is able to obtain a performance pricing loan.

In this study, we aim to address the following questions: Do performance pricing loans encourage managers to manipulate earnings more aggressively? Does bank monitoring curtail the extent of earnings manipulation associated with performance pricing loans? We use discretionary accruals as measures of earnings management because they are able to reveal subtle manipulation strategies related to revenue and expense recognition (DeFond and Jiambalvo, 1994). We use the slope of the performance pricing schedule in the loan contract as a proxy for managers’ incentive to manipulate earnings. A steeper performance pricing schedule (a steeper slope) implies a larger decrease (increase) of interest rate given a fixed level of firms' performance improvement (deterioration). Therefore, a steeper pricing schedule (a steeper slope) would offer greater savings in interest payments through inflated accounting performance, which hence provides a greater incentive for managers to manipulate earnings. Based on dollar weighted average slope of all loans for each firm in a given year, we find that firms with steeper performance pricing schedules have significantly larger discretionary accruals, and the results are robust with various measures of discretionary accruals adopted in the literature. The findings are consistent with the prediction of the positive accounting theory.

Previous research suggests that bank reputation and prior lending relationship serve as an effective monitoring mechanism (Pichler and Wilhelm, 2001; Haubrich, 1989), because higher reputation banks and relationship banks have greater incentive to monitor borrowers and an expertise to monitor effectively. Therefore, borrowing from high reputation bank or banks with prior lending relationship potentially constraints managers' incentive and abilities to manage earnings. We document evidence supporting this conjecture. We find that discretionary accruals are less positively related to the slope of performance pricing loans in firms borrowing from banks with high reputation or with prior lending relationship.

Our study contributes to the literature on debt contracting and earnings management. It is the first study that directly examines the effect of performance pricing provision on earnings management. This study also shed light on how banks assert their monitoring effects to mitigate borrowers' incentive and ability to manipulate accounting information related to performance pricing loans.

The rest of paper proceeds as following. Section 2 provides a literature review and develops hypotheses. Section 3 describes our sample, variables construction, and summary statistics. Section 4 reports empirical results and section 5 concludes the paper.

2. Literature Review and Hypotheses Development

2.1. *Debt Contracting and Earnings Management*

Agency theory in Jensen and Meckling (1976) and Myers (1977) recognize the conflicts of interest problem that exists between shareholders and debt-holders. Debt covenants and other provisions are in place to impose constraints on managers' actions and prevent them (in the interest of shareholders) from taking actions that will hurt debt-holders, e.g., investing in higher risk project (Smith and Warner, 1979; Bradley and Roberts, 2004). Many debt covenants and provisions are based on accounting variables, e.g., EBITDA. The positive accounting theory suggests that managers have an incentive to make financial reporting decisions that reduce the likelihood of violating accounting-based covenants in debt contracts (Watts and Zimmerman, 1990). Several empirical studies suggest that managers do respond to such incentives. DeFond and Jiambalvo (1994) document that managers use abnormal accruals to avoid debt covenant violation. Sweeney (1994) finds that managers make income-increasing accounting changes during periods prior to technical default. Jaggi and Lee (2002) also show that managers of financial distressed firms use income-increasing discretionary accruals if they are able to obtain waivers for debt covenant violations. Dichev and Skinner (2002) document an unusually small number of observations with financial measures just below covenant thresholds and an unusually large number of observations with financial measures at or just above covenant thresholds.

Compared to covenants that restrict managerial actions at a particular threshold stipulated by the contract, performance pricing provisions provide a direct and continuous link between firm performance and loan spread since lower (higher) interest rate would be charged if the borrower's performance becomes better (worse). In contrast to loan covenants, in which firms would manipulate earnings only when they are close to the covenant threshold, the performance pricing provisions offer firms an incentive to manipulate earnings more frequently, since even relatively small changes in earnings could be translated into substantial savings in interest payments. Consistent with this argument, Beatty and Weber (2003) document that the performance pricing provisions give managers additional incentives to make income-increasing changes in accounting method. Hu, Mao and Naveen (2014) find that firms with poorer accounting quality are less likely to receive performance pricing loans. The likelihood of receiving performance pricing loans is significantly reduced after borrowers' accounting quality deteriorates.

In this study, we examine the effect of the performance pricing provision on earnings management. The provision often includes a pricing schedule that stipulates the level of loan spread for each performance level. In the same spirit of the positive accounting theory, we expect that firms with a steeper slope of performance pricing schedule would manage earnings upward to a greater extent. This is because a steep performance pricing schedule implies a rapid decrease of interest payments when a firm improves its performance and a rapid increase of interest payments when firm's performance deteriorates. As such, a larger slope of the performance pricing provision provides greater reduction in interest payments for each unit change of performance, thereby provides a greater incentive for managers to manipulate earnings. Therefor we propose the following hypothesis:

H1: Steeper performance pricing schedules are associated with higher levels of earnings management.

2.2. *Banks' Monitoring Role: Bank Reputation and Lending Relationship*

As 'informed lenders' and delegated monitors, lead banks in syndicated loans have an incentive to monitor borrowers due to their large holding in the loan syndicate, as well as their long-run reputation consideration. Since banks are aware of borrowers' incentive to manipulate earnings so as to reduce interest payments on performance pricing loans, they would exert effort to monitor borrowers' performance and accounting information to restrict firms' opportunistic behavior. For example, Beck, Lin, and Ma (2014) find that firms in countries with higher bank branch penetration are less likely to evade taxes. In addition, bank monitoring makes manipulation of accounting information more costly to firms. Graham, Li, and Qiu (2008) document a significant increase in the cost of bank loans due to illegal misconduct, e.g., corporate misreporting. More reputable banks in the lending market will have a stronger incentive (to preserve their reputation) and better skills (due to greater experience) to monitor their borrowers effectively. Billett, Flannery and Garfinkel (1995) find that stock market reaction to bank loan announcements is more positive as the lenders of bank loans have a higher credit rating. Pichler and Wilhelm (2001) argue that lead arrangers' reputation could serve as

an effective monitoring mechanism. As a result, we expect that bank monitoring is essential to mitigate the moral hazard problem of borrowers in managing earnings. Thus, we have the following hypothesis:
H2: All else equal, borrowing from high reputation lead banks will mitigate the effect of the performance pricing schedule on earnings management.

In addition to lender reputation, prior lending relationship could mitigate information asymmetry between borrowers and lenders hence reduce monitoring costs. Through close and repeated interaction over time, relationship lending allows a bank to acquire information through screening and monitoring the borrower at a lower cost. Therefore, banks having repeated relationship with their borrowers are able to monitor the borrowers more effectively. Haubrich (1989) argue that in a repeated relationship between a bank and a borrower, the bank can keep track of reports from the borrower and penalize it if too many reports are bad. While firms have an incentive to manipulate earnings as a result of the performance pricing loans, the incentive will be significantly reduced as they borrow from relationship banks. This is because relationship banks “know” the borrower well through previous lending relationship, and would monitor the borrowers' performance and accounting information closely and intensively. Therefore, firms borrowing from banks with which they have a prior lending relationship have less chance to manage earnings even if they want to save interest payments. Thus, we have the hypothesis below:
H3: All else equal, existence of a prior lending relationship with the lead bank will mitigate the effect of performance pricing schedule on earnings management.

3. Data and Summary Statistics

3.1. *Data Source*

We start with all loans of U.S. borrowers from 1993 to 2007 recorded in the Dealscan database. Dealscan contains detailed information on bank loans worldwide, such as borrower and lender identity, loan amount, loan spread, issue and maturity date, financial and general covenants, etc. About 60% of loan data in Dealscan are collected from SEC filings and the rest are obtained from direct contact with borrowers and lenders.

There are more than eight performance measures used in performance pricing loan contracts, such as debt-to-EBITDA ratio and senior debt rating. Hu, Mao and Naveen (2014) find that the most commonly used measure is debt-to-EBITDA ratio, which accounts for about half of the performance pricing loans. The second widely used performance measure is senior debt rating, which accounts for about 22.3% of the performance pricing loans. All other types of performance measures account for a much smaller portion of the sample. Therefore, we focus on performance pricing loans based on debt-to-EBITDA based ratio or senior debt rating for which we can clearly and uniformly quantify the slope of the performance pricing schedule of each loan facility. Accounting data of borrowers are obtained from the Compustat database. Firms in Dealscan are linked to the Compustat database using the Dealscan-Compustat link file that was kindly provided by Michael Roberts (Chava and Roberts, 2008). We exclude borrowers that cannot be linked to Compustat, as well as those observations with missing values in relevant firm characteristic variables. This leaves us with about 22,120 firm-year observations of 4,070 firms.

3.2. *Definition of Key Variables*

Below we define the main variables used on our study. More details are provided in Appendix A and B.

3.2.1. Slope of the Performance Pricing Schedule

As we discussed above, the slope of the performance pricing schedule is related to managers' incentive to manipulate earnings. A pricing schedule with a steeper slope implies a larger decrease (increase) of interest rate given a fixed level of firms' performance improvement (deterioration). As a result, a pricing schedule with a steeper slope will provide greater savings in interest payments through inflated accounting performance, which hence creates a greater incentive for managers to manipulate earnings. We compute the slope of the two types of performance pricing loans a bit differently. For debt-to-EBITDA based performance pricing loans, we compute the slope as the interest rate change of each debt-to-EBITDA increment in the pricing schedule divided by the difference of debt-to-EBITDA ratio over the same increment. Average slope is calculated as the average of all slopes across all debt-to-EBITDA segments between the upper and lower limits of the debt-to-EBITDA ratio specified in each performance pricing loan contract. Local slope is calculated as the average of the two slopes immediately above and immediately below the firm's debt-to-EBITDA ratio at the time of loan issuance. In appendix A, we present an example of the performance pricing schedule of a loan issued by Chemed Corp. on February 24, 2004 in which interest rate is tied to the debt-to-EBITDA ratio. We illustrate in details the way we compute average slope and local slope in the example. Non-performance pricing loans are assigned with a slope of zero.

As for senior debt rating based performance pricing contracts, we follow Tchistyi, Yermack and Yun (2011) to construct the slope of the performance pricing schedule. For each performance pricing loan facility, we identify interest rate change of each credit rating increment, and then divide it by the difference of market yields of corporate bonds over the same rating increments during the same time period. Slope of rating based performance pricing loan is computed as follows:

$$\text{Slope} = \frac{Spread(i-1) - Spread(i)}{MarketSpread(i-1) - MarketSpread(i)}, \tag{1}$$

where Spread(i) is a firm's loan spread above the LIBOR at rating i, MarketSpread(i) is the average yield spread above the LIBOR for corporate bonds with rating i, and rating i is a credit rating listed in the pricing schedule. We construct two measures of the slope of a performance pricing contract, the "average slope" and the "local slope." An average slope is calculated as the average of all slopes across all rating segments between the upper and lower limits of the credit ratings specified in each performance pricing loan contract. Local slope is defined as an average of the two spread ratios of the rating increments immediately below and above the borrower's rating at the time of loan issuance as shown below:

$$\text{Local slope} = 0.5\left\{\frac{Spread(i-1) - Spread(i)}{MarketSpread(i-1) - MarketSpread(i)} + \frac{Spread(i) - Spread(i+1)}{MarketSpread(i) - MarketSpread(i+1)}\right\}, \tag{2}$$

where Spread(i) is a firm's loan spread above the LIBOR at rating i, MarketSpread(i) is the average yield above the LIBOR for corporate bonds with rating i, rating i is the borrower's credit quality at the time of loan issuance, and rating i-1 and rating i+1 are the borrower's credit ratings one notch below and one notch above its rating at the time of loan issuance, respectively. Under such a scaling, non-performance pricing loans are assigned with a slope of zero. Slope is greater (smaller) than one if the interest rate change in performance pricing contract is larger (smaller) than the change of prevailing market yields.

After we compute the slope of each loan contract, we next aggregate the slopes of all bank loans outstanding for a particular borrower in a given year. However some borrowers have both rating based and debt-to-EBITDA based performance pricing loans outstanding, we cannot add up the slopes of both types of loans because their slopes are on different scales. To circumvent this problem, we adopt the idea in Anderson, Duru and Reeb (2009) and assign rank scores to the slope of each type of performance pricing loans, and then sum up the slope rank scores among loans with different performance measures. In particular, we every year assign rank scores to the average (local) slope of each type of debt-to-EBITDA based or senior debt rating performance pricing loans into quartiles, with the top 25% taking a value of 4 and the bottom 25% taking a value of 1. In this step we do not include non-performance pricing loans since more than 50% of our sample loans are not performance priced. Instead we assign a rank score of zero for non-performance pricing loans. Next, we compute firm level aggregated average (local) slope of all performance pricing loans in a particular year as the weighted average rank scores of all the outstanding loans with the weight equal to the facility amount divided by the total outstanding facility amount of the firm in that year, i.e.,

$$\text{Aggregated slope score}_j = \frac{\sum_i AMT_i * \text{Slope rank score}_i}{\sum_i AMT_i}, \tag{3}$$

where AMT_i is the outstanding amount of facility i, $\text{Slope rank score}_i$ is the slope rank score of a performance pricing facility i, $\sum_i AMT_i$ is the total amounts of all outstanding facilities of firm j.[1] The aggregated score of slope captures the relative steepness of the performance pricing schedule. A higher slope score implies a larger decrease (increase) of interest rate given a fixed level of firms' performance improvement (deterioration).

3.2.2. Measures of Discretionary Accruals

To measure earnings management, we construct discretionary accrual measures following Daniel, Denis and Naveen (2008). Total accrual is defined as income before extraordinary items (EBEXTRA) minus operating cash flows (OCF). There are two components of total accruals: non-discretionary and discretionary accruals, which are estimated using the following cross-sectional model of Jones (1991):

$$\frac{Total\ accruals_{j,t}}{Assets_{j,t-1}} = \varphi_0 \frac{1}{Assets_{j,t-1}} + \varphi_1 \frac{\Delta Sales_{j,t}}{Assets_{j,t-1}} + \varphi_2 \frac{PPE_{j,t}}{Assets_{j,t-1}} + \varepsilon_{j,t}, \tag{4}$$

where total accruals are regressed on annual change in sales and property, plant and equipment, with all variables scaled by lagged total assets. We estimate equation (4) using all

[1] For those facilities with missing maturity date, we set facility maturity date as the facility start date plus the sample median of years to maturity.

Compustat firms in each two-digit SIC coded industry for each year. Residual and predicted values from the above regression are the discretionary and non-discretionary components of total accruals, respectively. The discretionary components are then multiplied by the firm's lagged assets to retrieve the dollar value of discretionary accruals, which is used for our analysis. This measure is called 'discretionary accrual Modified Jones (1991)'.

We also compute 'discretionary accrual Modified KLW (2005)' based on modified Kothari, Leon, Wasley (KLW) model, which is an extension of 'Modified Jones (1991)', and attempts to improve the power and specification by developing a discretionary accrual model that is adjusted for a performance-matched firm's discretionary accruals. Specifically, we first calculate asset-scaled discretionary accruals for each firm based on equation (4) with ROA as an additional regressor. Then we compute the discretionary accruals of a sample firm and its matched partner based on ROA, industry and calendar year. The difference between these two discretionary accruals is our 'discretionary accrual Modified KLW (2005)'.

In addition, we construct three alternative measures of discretionary accruals following various models in the literature. We compute 'discretionary accrual TWW (1998)' based on Teoh, Welch, and Wong (1998), where discretionary accruals are estimated from equation (4), however total accruals are computed as net income minus operating cash flows. 'Discretionary accrual BS (2006)' is based on Ball and Shivakumar (2006). Ball and Shivakumar (2006) show that accrued loss recognition is more prevalent than accrued gain recognition. Therefore, we include variables that capture the asymmetric timely loss recognition of firms in the regression, which are cash flow from operation (CF), a dummy variable (DCF) that equals one if cash flow from operation implies a loss and the interaction term DCF*CF. Residuals from such a regression model are the discretionary component of total accruals 'Discretionary accrual Modified DD (2002)' is based on the Dechow and Dichev (2002) model. We augment the Dechow and Dichev (2002) model with variables from the Jones (1991) model, and 'Discretionary accruals Modified DD (2002)' are residuals estimated from the model below:

$$CA_{j,t} = \alpha_1 + \beta_1 CFO_{j,t-1} + \beta_2 CFO_{j,t} + \beta_3 CFO_{j,t+1} + \beta_4 \Delta Sales_{j,t} + \beta_5 PPE_{j,t} + \varepsilon_{j,t}. \quad (5)$$

where $CA_{j,t}$ is total current accrues and $CFO_{j,t}$ is cash flow from operation.

3.2.3. Other Firm Characteristic Control Variables

We construct firm specific variables that might affect the level of discretionary accruals, including firm size, market-to-book ratio, leverage and retained earnings. We measure firm size using the natural logarithm of total assets. The effect of firm size on the discretionary accruals is not clear. Larger firms are in general more transparent because of greater disclosure and more analyst coverage. Therefore, larger firms are less likely to manipulate earnings. On the other hand, Kim, Liu and Rhee (2003) find that both large and small firms manage earnings aggressively. While small firms are more likely to manage earnings to avoid reporting losses, large- and medium-sized firms exhibit more aggressive earnings management to avoid reporting earnings decreases. Market-to-book ratio is defined as the ratio of market value of assets (book value of debt plus market value of equity) and book value of total assets. Leverage is defined as the ratio of total amount of debt and book value of assets. Retained earnings are used to control for the potential inventory of payable funds. The effect of retained earnings on discretionary total accruals is also not clear. Daniel, Denis and Naveen (2008) find that retained earnings have a positive effect on discretionary accruals in some regression and negative effect in others.

3.2.3. Bank Reputation and Prior Lending Relation

To assess how bank reputation and prior lending relationship affects the extent of earnings manipulation, we construct variables to measure banks' reputation in the lending market and the existence of prior lending relationship between a lead bank and a borrower. While most loans in Dealscan involve several lenders, it is the lead arrangers' responsibilities to negotiate directly with the borrowers and monitor contractual terms. Our analysis on lender characteristics is thus focused on lead arrangers. To make data collection manageable, we follow Sufi (2007) and focus on the top 100 lead arrangers. This selection results in little bias, because according to Sufi (2007), the top 100 lenders represent about 96% of the total number of loans. To take into account bank mergers during our sample period, we track all mergers and acquisitions of financial institutions, and allow the acquiring banks to inherit all the lending history of the acquired bank after the acquisition date. For example, in April 1998, First Union Corp. acquired CoreStates Financial Corp. with the merged entity being called 'First Union Corp.' Thus for the purpose of computing lead bank-borrower relation after April 1998, we assume that First Union Corp. inherited CoreStates' entire lending history prior to April 1998.

Following previous literature (e.g., Bharath et al., 2007), we construct a lead bank's market share in lending during the previous five years as a proxy for bank reputation. It is computed as the dollar amount of loans arranged by a particular lead bank during the previous five years divided by the total amount of loans issued in the market in the same period. In addition, we create a dummy variable 'existence of prior lending relation' to capture whether the firm has a prior lending relationship with the current lead bank. It is equal to one if the firm has borrowed from the same lead bank of the current loan during the previous five years, and zero otherwise.

4. Empirical Results

4.1. Summary Statistics

We present summary statistics of our sample of firm year observations in Table 1. Our sample consists of a total of 4,070 firms (18,809 loan facilities and 22,120 firm-year observations) during 1993 to 2007. An average firm in our sample has over \$2.5 billion in total assets, retained earnings of \$498 million, leverage ratio of 0.276, and market-to-book ratio of 1.89. While discretionary accruals are on average negative, the median values of discretionary accruals are close to zero. Since about 62.5% of loans are non-performance priced (Hu, Mao and Naveen, 2014), are thus assigned with a slope rank score of zero, it is not surprising that the median values of average slope score and local slope score are zero. Lender characteristics show that about 52% of lead banks have a high reputation, and 49% firms are borrowing from lead banks with which they had a prior lending relationship.

4.2. The Slope of Performance Pricing Schedule and Discretionary Accruals

As we discussed above, based on the positive accounting theory, a steeper slope of the performance pricing loans provides a greater incentive for managers to manipulate earnings upward. To examine the effect of the slope of performance pricing contracts on earnings management, we estimate the following regression model:

$$Discretionary\ Accruals_{j,t} = \alpha_1 + \beta_1 Slope\ score_{j,t} + \sum_i \gamma_i Control\ variables_{j,t\text{-}1} + \varepsilon_{j,t} \quad (6)$$

Here, we use five different measures of discretionary accrual as described above. Control variables include firm characteristics as presented in Appendix B, dummies for each two-digit SIC code and each calendar year. The variable of our interest is Slope score, which captures the aggregated slope rank scores of all outstanding loans at each year end for a firm. OLS regression results of equation (6) are presented in Table 2.

In Panel A, we examine the effect of average slope of performance pricing loans on various measures of discretionary accruals. In column (1), the coefficient estimate of Average slope score is positive and statistically significant at 1% level. It suggests that discretionary accruals will increase by \$13.34 million if the average slope score increases from the sample median to the top quartile. The result indicates that the effect of Average slope score on earnings management is also economically significant. We use alternative measures of discretionary accruals in columns (2) – (5), and obtain similar results. The coefficient estimates of Average slope score are all positive and statistically significant, except in column (5) using discretionary accrual from the model 'Modified DD (2002)'. These results are consistent with our hypothesis H1, suggesting that a steeper pricing schedule provides greater incentive for managers to manipulate earnings upward.

Results on the control variables are in general consistent with Kim, Liu and Rhee (2003) and Daniel, Denis and Naveen (2008). Firm size and retained earnings have significant effect on discretionary accruals, although the size of their effect varies, depending on the type of discretionary accrual used in the regressions.

In Panel B, we investigate the effect of Local slope score of performance pricing schedule on different measures of discretionary accruals. The coefficient estimates of Local slope score are mostly positive, and statistically significant in two out of five columns. The results are again consistent with our hypothesis H1, although they are not as strong as those in Panel A.

Tchistyi, Yermack and Yun (2011) suggests that average slope measures CEO's desire of risk over a long horizon, and local slope measures CEO's desire of risk over a short horizon. One caveat with the local slope is that it is measured at the time of loan issuance rather than in a given sample year. As a firm's financial condition changes after issuance, the local slope at issuance becomes a poor measure of CEO's desire of managing earnings. In contrast, in a sample year after loan issuance, even if a firm's financial condition has changed, the average slope of the entire performance pricing schedule remains a better measure of the CEO's desire of managing earnings since it captures the slopes of the entire spectrum of performance. This potentially explains why our results in Table 2 are stronger with the average slope score than with the local slope score.

In summary, the findings in Table 2 support the predictions of the positive accounting theory that a steeper slope of performance pricing schedule provides managers a larger incentive to manage earnings upwards, which leads to a high level of discretionary accruals.

4.3. Does Bank Reputation Limit Earnings Manipulations Resulted from Performance Pricing Loans?

As shown above, we document a positive relationship between the slope of performance pricing schedule and earnings management. As a delegated monitor, lead banks have an incentive and ability to monitor borrowers closely after loans are issued, which in turn reduces the extent of earnings manipulations by managers. Thus we examine whether bank reputation will mitigate managers' incentive to manipulate earnings, as suggested in our hypothesis H2. For that purpose, we include a High bank reputation dummy and its interaction with Slope score in the regression columns as shown below:

$$\begin{aligned} &Discretionary\ Accruals_{j,t} \\ &= \alpha_1 + \beta_1 High\ bank\ reputation\ dummy_{j,t} + \beta_2 Slope\ score_{j,t} \\ &+ \beta_3 Slope\ score_{j,t} \times High\ bank\ reputation\ dummy_{j,t} + \sum_i \gamma_i Control\ variables_{j,t-1} + \varepsilon_{j,t}. \end{aligned} \tag{7}$$

In equation (7), captures the effect of performance pricing slope score on discretionary accruals for banks with low reputation. The impact of performance pricing slope score on discretionary accruals for banks with high reputation is captured by , while measures the differential effect of slope score on discretionary accruals between banks with high and low reputation.

The regression results are reported in Table 3. In Panel A, we examine the effect of Average slope score of performance pricing loans on discretionary accruals conditional on bank reputation. In column (1), the coefficient estimate of Average slope score is positive and significant, suggesting that as firms borrow from low reputation banks, discretionary accruals are higher as they have a larger Average slope score of performance pricing loans. However the coefficient estimate of the interaction term, Average slope score*High bank reputation dummy is negative and significant, which leads to an insignificant coefficient estimate of based on a F-test reported at the bottom of Table 3 Panel A. Since captures the impact of average slope score on discretionary accruals for banks with high reputation, this result indicates that as firms borrow from high reputation banks, discretionary accruals are not significantly related to the average slope score of performance pricing loans. Put another way, a steeper performance pricing slope does not lead to greater extent of earnings manipulation in the presence of higher reputation banks. This finding is robust with respect to alternative measures of earnings management. As shown in columns (2) - (5), we document a consistent pattern that the coefficient estimates of are all insignificant.

Panel B presents results regarding the effect of Local slope score of performance pricing schedule on discretionary accruals conditional on bank reputation, and the findings are similar to those in Panel A. While the coefficient estimates of Local slope score are positive and mostly significant, the coefficient estimates of are generally insignificant based on a F-test reported at the bottom of Table 3 Panel B, except in column (5). Collectively, we find evidence supporting our hypothesis H2 that the association of the slope of performance pricing schedule and discretionary accruals is significantly weakened in firms borrowing from high reputation banks. This is because banks with high reputation would monitor borrowers more diligently and effectively, which in turn curtails borrowers' incentive and ability to manipulate earnings.

4.4. Does Prior Lending Relationship Mitigate Earnings Manipulations Resulted from Performance Pricing Loans?

Above we find evidence that high bank reputation can mitigate borrowers' incentive and ability to manipulate earnings. Next we will examine whether the prior lending relationship between the borrowers and the lenders would mitigate the effect of performance pricing schedule on earnings management, as suggested in our hypothesis H3. To test the hypothesis, we estimate the following regression model:

$$\begin{aligned}&Discretionary\ Accruals_{j,t}\\&=\alpha_1+\beta_1 Existence\ of\ prior\ lending\ relation_{j,t}+\beta_2 Slope\ score_{j,t}\\&+\beta_3 Slope\ score_{j,t}\times Existence\ of\ prior\ lending\ relation_{j,t}+\sum_i \gamma_i Control\ variables_{j,t\text{-}1}+\varepsilon_{j,t}.\end{aligned}$$

(8)

Similarly, captures the effect of performance pricing schedule on discretionary accruals for banks without any prior lending relationship, measures the differential effect of slope score on discretionary accruals between banks with prior lending relation and banks without prior lending relation, and measures the effect of performance pricing schedule on discretionary accruals for banks with a prior lending relation.

Table 4 presents the OLS regression results of equation (8). As shown in Panel A, the coefficient estimate of Average slope score is positive and significant in three out of five columns. In contrast, the coefficient estimates of are insignificant in all five models. Panel B presents results regarding the effect of Local slope score of performance pricing schedule on discretionary accruals conditional on prior lending relationship. The results in Panel B are qualitatively similar as those in Panel A, except that is significant when we use Modified DD as dependent variable. These results suggest that when firms borrow from banks without any prior lending relationship, discretionary accruals increase significantly as the slope of performance pricing schedule becomes higher. In contrast, as they borrow from banks that have lent them in the past, discretionary accruals are not significantly related to the slope of performance pricing schedule. Consistent with our hypothesis H3, relationship banks monitor the borrowers more effectively, which alleviates managers' incentive and ability to manipulate earnings.

4.5. Endogeneity Issue

Our results above are consistent with our hypotheses H2 and H3 that relationship banks and high reputation banks monitor the borrowers more effectively, which alleviates managers' incentive and ability to manipulate earnings. It is noteworthy that banks are not randomly assigned to firms. It is possible that banks with good monitoring mechanism only lend money to firms which are less likely to manipulate earnings. For example, Dinc (2000) suggests that banks offer relationship lending only to borrowers of the highest credit quality. To address the selection issue between borrowers and banks, we employ a two-stage instrumental variable approach. In the first stage, we regress the existence of prior lending relation / high bank reputation dummy on borrower characteristics, including firm size, ROA, asset tangibility, and a rating dummy variable for whether the firm has access to the public debt market:

$$\begin{aligned}&(High\ bank\ reputation\ dummy\ or\ Existence\ of\ \ prior\ lending\ relation\ dummy)_t\\&= \lambda_0 + \lambda_1 FirmSize_{t-1} + \lambda_2 ROA_{t-1} + \lambda_3 AssetTangibility_{t-1}\\&+ \lambda_3 RatingDummy_{t-1} + \varepsilon_t .\end{aligned} \tag{9}$$

The choice of these instruments is based on Bharath et al. (2007), who show that borrowers' size, credit rating, and tangibility of assets are significantly related to a firm's use of a relationship bank for future loans. In the second stage, we estimate the following model in which the predicted value of bank reputation or prior lending relation from the first stage is used to explain whether banks' monitoring mechanism would mitigate the effect of performance pricing schedule on earnings management:

$$\begin{aligned}&Discretionary\ Accruals_{j,t}\\&= \alpha_1 + \beta_1 Predicted\ value\ of\ bank\ monitoring_{j,t} + \beta_2 Slope\ score_{j,t}\\&+ \beta_3 Slope\ score_{j,t} \times Predicted\ value\ of\ bank\ monitoring_{j,t}\\&+ \sum_i \gamma_i Control\ variables_{j,t-1} + \varepsilon_{j,t} .\end{aligned} \tag{10}$$

Table 5 and 6 report the results of the second stage regressions of equation (10). As shown in Panel A of Table 5 and Table 6, the coefficient estimate of Average slope score is positive and significant in three out of five columns. The coefficient estimate of interaction term is negatively and significant in three out of five models, suggesting a mitigating effect of bank monitoring on managers' incentive to manipulate earnings resulted from the performance pricing schedule. For the effect of local slope as shown in Panel B of Table 5 and Table 6, the coefficient estimate of Local slope score is mostly positive and significant and the coefficient estimate of interaction term is significantly negative. Those results are consistent with our findings in Table 3 and Table 4, supporting our hypotheses that stronger bank monitoring via higher bank reputation or prior lending relation alleviates managers' incentive and ability to manipulate earnings. Our results appear robust after controlling for the endogeneity issue.

5. Conclusion

Positive Accounting Theory (Watts and Zimmerman, 1986, 1990) suggests that managers have the incentive to change accounting method or make financial reporting decisions to reduce the likelihood of violating accounting-based covenants in debt contracts. Compared to debt covenants, the performance pricing provision provides a more continuous and direct link between accounting information and interest costs. In this study, we examine whether performance pricing loans encourage managers to manipulate earnings more aggressively. We find that firms with steeper slopes in their performance pricing loans have significantly higher discretionary accruals. We further investigate whether high lender reputation and relationship lending will curtail firms' extent of earnings management associated with performance pricing loans. We find that in firms borrowing from high reputation banks or from banks with prior lending relationship, discretionary accruals are not related to the slope of performance pricing schedule. In contrast, discretionary accruals is significantly and positively related the slope of performance pricing loans for firms borrowing from low reputation banks or from banks without any prior lending relationship. These results suggest that bank reputation and prior lending relation serve as an effective monitoring mechanism, which in turn mitigates managers' incentive and ability to manage earnings.

Compared with previous research on performance pricing loans, we directly examine the effect of performance pricing provision on earnings management, and investigate the role of high bank reputation and prior lending relationship on this effect. One interesting venue for future research is to investigate whether and how firms manage earnings when their performance measure is close to the performance threshold in the pricing schedule.

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Appendix A: An Example of the Performance Pricing Schedule

Below is an example of the performance pricing schedule of a loan contract from Chemed Corp. in which interest rate is tied to debt-to-EBITDA ratio. This loan was issued on February 24, 2004, with an amount $35 million. The initial interest rate is LIBOR+350 basis points. The pricing schedule specifies how the interest rate on the loan will change with respect to the firm's debt-to-EBITDA ratio.

	Debt-to-EBITDA	**LIBOR Margin**	**Slope**
LEVEL I	Less or equal to 2.5	225 Basis Points	
LEVEL II	Between 2.5 and 3	275 Basis Points	(275-225)/(3-2.5)=100
LEVEL III	Between 3 and 3.5	300 Basis Points	(300-275)/(3.5-3)=50
LEVEL IV	Between 3.5 and 4	325 Basis Points	(325-300)/(4-3.5)=50
LEVEL V	**Between 4 and 4.75**	**350 Basis Points**	**(350-325)/(4.75-4)=33.3**
LEVEL VI	Between 4.75 and 5	375 Basis Points	(375-350)/(5-4.75)=100
LEVEL VII	Larger than 5	400 Basis Points	

$$Average\ slope = \frac{100+50+50+33.33+100}{5} = 66.7,$$

$$Local\ slope = 0.5\left(\frac{375-350}{5-4.75} + \frac{350-325}{4.75-4}\right).$$

Appendix B: Variable Definitions

Variable	Definition
Discretionary Accruals	
Modified Jones (1991)	We first regress following model: $\frac{Total\ accruals_{j,t}}{Assets_{j,t-1}} = \varphi_0 \frac{1}{Assets_{j,t-1}} + \varphi_1 \frac{\Delta Sales_{j,t}}{Assets_{j,t-1}} + \varphi_2 \frac{PPE_{j,t}}{Assets_{j,t-1}}$, where total accruals = income before extraordinary items (EBEXTRA) – operating cash flows (OCF). Regression is estimated using all Compustat firms in each two-digit SIC industry for each year. Residuals from the above regressions are the discretionary components of total accruals. The discretionary components are multiplied by firm's lagged assets to obtain the dollar value of discretionary accruals, which are used in our analysis.
Modified KLW (2005)	Based on modified Kothari, Leon, Wasley (KLW) model. We first calculate asset-scaled discretionary accruals for each firm based on Jones (1991), in which ROA is included as an additional regressor. Then we compute the discretionary accruals of a firm matched based on ROA, industry and year. The difference between these two discretionary accruals is our discretionary accrual measure 'Modified KLW (2005)'.
TWW (1998)	Based on Teoh, Welch, and Wong (1998) model, where total accruals = net income – operating cash flows.
BS (2006)	Based on Ball and Shivakumar (2006) model. This method includes variables that capture the asymmetric timely loss recognition of firms, including cash flow from operation (CF), a dummy variable (DCF) that equals one if cash flow from operation implies a loss and an interaction term DCF*CF in the model.
Modified DD (2002)	Based on Dechow and Dichev (2002) model. We augment the Dechow and Dichev (2002) model with variables from Jones (1991): $CA_{j,t}=c+\varphi_1 CFO_{j,t-1}+ \quad \varphi_2 CFO_{j,t}+\varphi_3 CFO_{j,t+1}++$

	$\varphi_4 \Delta Sales_{j,t}$++ $\varphi_5 PPE_{j,t}$ $+\upsilon_{j,t}$, where $CA_{j,t}$ is total current accrues and $CFO_{j,t}$ is cash flow from operation.

Borrower Characteristics

Retained earnings	Data item 'RE' from Compustat
Firmsize	Natural logarithm of book value of total assets
Leverage	Total debt divided by total assets
Market-to-book	The sum of market value of equity and book value debt divided by book value of total assets
ROA	Net income divided by total assets
Rating dummy	A dummy variable that equals one if any type of S&P debt rating of a firm is available in Compustat.
Tangibility	Net PP&E divided by total assets.

Lender Characteristics

High bank reputation dummy	A dummy variable taking a value of one if a lead bank's market share in lending in the previous five years is above the sample median, and zero otherwise
Existence of prior lending relationship dummy	A dummy variable taking a value of one if the lead bank of the current loan has acted as a lead bank of a loan issued by the same firm during the previous five years, and zero otherwise

Slope of the Performance Pricing Schedule

Average slope of a debt-to-EBITDA based performance pricing loan facility	Slope is computed as the interest rate change of each debt-to-EBITDA increment in the pricing schedule divided by the difference of debt-to-EBITDA ratio over the same increment. Average slope is calculated as the average of all slopes across all debt-to-EBITDA segments between the upper and lower limits of the debt-to-EBITDA ratio specified in each performance pricing loan contract.

Local slope of a debt-to-EBITDA based performance pricing loan facility	Local slope is calculated as the average of the two slopes immediately above and immediately below the firm's debt-to-EBITDA ratio at the time of loan issuance.
Average slope of a senior debt rating based performance pricing loan facility	Slope is computed as the interest rate change of each credit rating increment in the pricing schedule divided by the difference of market yields of corporate bonds over the same rating increments during the same time period, i.e., $\frac{Spread(i-1)-Spread(i)}{MarketSpread(i-1)-MarketSpread(i)}$, where *Spread(i)* is a firm's loan spread above the LIBOR at rating *i*, *MarketSpread(i)* is the average yield spread above the LIBOR for corporate bonds with rating *i,* and rating *i* is a credit rating listed in the pricing schedule. Average slope is calculated as the average of all slopes across all rating segments between the upper and lower limits of the credit ratings specified in each performance pricing loan contract.
Local slope of a senior debt rating based performance pricing loan facility	$0.5\{\frac{Spread(i-1)-Spread(i)}{MarketSpread(i-1)-MarketSpread(i)} + \frac{Spread(i)-Spread(i+1)}{MarketSpread(i)-MarketSpread(i+1)}\}$, *Spread(i)* is a firm's loan spread above the LIBOR at rating *i*, *MarketSpread(i)* is the average yield spread above the LIBOR for corporate bonds with rating *i,* rating *i* is the borrower's credit quality at the time of loan issuance, and rating *i-1* and rating *i+1* are the borrower's credit ratings one notch below and one notch above its rating at the time of loan issuance, respectively.
Average (Local) slope score of a firm in a given year	We aggregate the slopes of all bank loans outstanding for a particular borrower in a given year. First, every year we assign rank scores to the average (local) slope of each type of debt-to-EBITDA based or senior debt rating performance pricing loans into quartiles, with the top 25% taking a value of 4 and the bottom 25% taking a value of 1. In this step we do not include non-performance pricing loans since more than 50% of our sample loans are not performance priced. Instead we assign a rank score of zero for non-performance pricing loans. Second, we compute firm level aggregated average (local) slope of all performance pricing loans in a particular year as the weighted average rank scores of all the outstanding loans with the weight equal to the facility

	amount divided by the total outstanding facility amount of the firm in that year, i.e., $\text{Aggregated slope}_j = \frac{\sum_i AMT_i * \text{Slope rank score}_i}{\sum_i AMT_i}$, where AMT_i is the outstanding amount of facility i, $\text{Slope rank score}_i$ is the slope rank score of a performance pricing facility i, $\sum_i AMT_i$ is the total amounts of all outstanding facilities of firm j.

Table 1: Sample statistics

This table reports summary statistics of our sample. The sample includes 22,120 firm year observations of 4,070 firms during 1993 - 2007. We require the observations to have non-missing values in relevant firm characteristic variables listed in the table. Borrower characteristics and discretionary accruals are computed using the *Compustat* database. Slope variables of the performance pricing schedule and lender characteristics are constructed using the Dealscan database. We focus on debt-to-EBITDA based and senior debt rating based performance pricing loans to quantify the slope of the performance pricing schedule of each loan facility, since these two types account for more than 77% of all performance pricing loans. Variable constructions are detailed in Appendix B.

Variable	N	Mean	Median	75th Percentile	Std Dev
Borrower Characteristics					
Retained earnings	22120	497.585	31.304	232.446	2824.140
Assets	22120	2512.830	345.336	1292.120	15219.510
Leverage	22120	0.276	0.252	0.391	0.228
Market-to-book	22120	1.893	1.455	2.070	1.793
Discretionary accruals ($ million)					
Modified Jones (1991)	21858	-23.504	-0.458	11.278	577.327
Modified KLW (2005)	21801	-41.267	-1.658	7.332	559.932
TWW (1998)	21858	-23.671	-0.632	10.959	572.126
BS (2006)	20652	-9.192	0.098	10.144	688.308
Modified DD (2002)	17699	3.075	0.826	11.800	245.846

Performance pricing schedule					
Average slope score	22120	0.521	0.000	1.000	0.799
Local slope score	21281	0.413	0.000	0.646	0.734
Lender Characteristics					
High bank reputation dummy	14647	0.516	1.000	1.000	0.500
Existence of previous lending relation	14647	0.489	0.000	1.000	0.500

Table 2: Effect of the slope of performance pricing schedule on discretionary accruals

These tables report regression results examining the effect of performance pricing schedule on discretionary accruals. We use five different accrual measures. 'Modified Jones (1991)' is based on the modified Jones (1991) model; 'Modified KLW (2005)' is based on the modified Kothari, Leon, Wasley (KLW) model; 'TWW (1998)' is based on the Teoh, Welch, and Wong (1998) model; 'BS (2006)' is based on the Ball and Shivakumar (2006) model; 'Modified DD (2002)' is based on the Dechow and Dichev (2002) model. We examine the effect of average slope in Panel A and the effect of local slope in Panel B. All variables are as defined in Appendix B. P-values are reported in parentheses below each coefficient estimate. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel A: Average slope of performance pricing schedule and discretionary accruals

	Modified Jones (1991)	Modified KLW (2005)	TWW (1998)	BS (2006)	Modified DD (2002)
Variable	(1)	(2)	(3)	(4)	(5)
Average slope score	13.344***	12.794***	12.140**	19.640***	2.505
	(0.010)	(0.008)	(0.018)	(0.002)	(0.293)
Retained earnings	-0.009***	-0.055***	-0.009***	0.052***	-0.021***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(assets)	-25.282***	-22.141***	-24.962***	-38.819***	8.900***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-23.260	-28.389*	-26.642	39.323*	-23.590***
	(0.197)	(0.090)	(0.136)	(0.089)	(0.007)
Market-to-book	-3.683*	-7.263***	-2.973	1.063	0.070
	(0.099)	(0.000)	(0.179)	(0.689)	(0.950)
Industry dummy	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes

Observations	21,858	21,801	21,858	20,652	17,699
Adj R^2	0.020	0.104	0.021	0.045	0.068

Panel B: Local slope of performance pricing schedule and discretionary accruals

Variable	Modified Jones (1991) (1)	Modified KLW (2005) (2)	TWW (1998) (3)	BS (2006) (4)	Modified DD (2002) (5)
Local slope score	9.741*	7.640	8.113	17.438**	-2.734
	(0.088)	(0.149)	(0.151)	(0.012)	(0.297)
Retained earnings	-0.010***	-0.057***	-0.010***	0.053***	-0.022***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(assets)	-24.824***	-21.364***	-24.456***	-39.441***	8.502***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-26.058	-31.122*	-30.144*	40.208*	-25.869***
	(0.155)	(0.067)	(0.097)	(0.088)	(0.003)
Market-to-book	-3.930*	-7.140***	-3.217	0.608	-0.174
	(0.084)	(0.001)	(0.153)	(0.822)	(0.878)
Industry dummy	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes
Observations	21,075	21,025	21,075	19,919	17,048
Adj R^2	0.021	0.107	0.022	0.046	0.074

Table 3: Bank reputation, performance pricing schedule, and discretionary accruals

These tables report regression results examining how bank reputation affects the relationship between the performance pricing schedule and discretionary accruals. We use five different accrual measures. ‘Modified Jones (1991)’ is based on the modified Jones (1991) model; ‘Modified KLW (2005)’ is based on the modified Kothari, Leon, Wasley (KLW) model; ‘TWW (1998)’ is based on the Teoh, Welch, and Wong (1998) model; ‘BS (2006)’ is based on the Ball and Shivakumar (2006) model; ‘Modified DD (2002)’ is based on the Dechow and Dichev (2002) model. High bank reputation dummy is equal to one if the lead bank's lending market share is above the sample median, and zero otherwise. We examine the effect of average slope in Panel A and the effect of local slope in Panel B. All other variables are as defined in Appendix B. P-values are reported in parentheses below each coefficient estimate. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel A: Effect of average slope on discretionary accruals conditional on bank reputation

	Modified Jones (1991)	Modified KLW (2005)	TWW (1998)	BS (2006)	Modified DD (2002)
Variable	(1)	(2)	(3)	(4)	(5)
High bank reputation dummy	35.731***	32.347***	34.705***	10.012	9.456*
	(0.001)	(0.001)	(0.001)	(0.439)	(0.079)
Average slope score (□2)	21.544***	20.726***	21.712***	10.006	-0.291
	(0.004)	(0.004)	(0.005)	(0.283)	(0.941)
Average slope score× High bank	-22.123**	-13.361	-22.823**	-3.120	-4.516
reputation dummy (□3)	(0.034)	(0.180)	(0.036)	(0.812)	(0.407)
Retained earnings	-0.024***	-0.071***	-0.020***	0.052***	-0.023***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(assets)	-22.447***	-22.914***	-25.512***	-26.349***	13.918***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-46.287**	-55.291***	-49.456**	48.865*	-21.614**

	(0.014)	(0.002)	(0.012)	(0.056)	(0.035)
Market-to-book	-7.285***	-12.175***	-6.261**	0.219	-0.344
	(0.007)	(0.000)	(0.026)	(0.947)	(0.814)
$\square_2+\square_3$	-0.579	7.365	-1.111	6.886	-4.807
P-value of F-test	(0.941)	(0.320)	(0.891)	(0.480)	(0.231)
Industry dummy	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes
Observations	14,486	14,459	14,486	13,671	11,826
Adj R^2	0.042	0.186	0.039	0.057	0.094

Panel B: Effect of local slope on discretionary accruals conditional on bank reputation

Variable	Modified Jones (1991) (1)	Modified KLW (2005) (2)	TWW (1998) (3)	BS (2006) (4)	Modified DD (2002) (5)
High bank reputation dummy	40.224***	38.060***	39.689***	11.219	13.749***
	(0.000)	(0.000)	(0.000)	(0.386)	(0.010)
Local slope score ($\square_2$)	20.728**	18.673**	20.250**	13.003	0.122
	(0.011)	(0.015)	(0.016)	(0.202)	(0.977)
Local slope score× High bank	-34.560***	-25.558**	-36.268***	-8.326	-15.993***
reputation dummy ($\square_3$)	(0.004)	(0.023)	(0.003)	(0.576)	(0.009)
Retained earnings	-0.025***	-0.073***	-0.022***	0.052***	-0.024***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(assets)	-22.238***	-22.248***	-25.176***	-26.165***	13.199***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-49.100**	-59.960***	-53.208***	49.268*	-23.854**
	(0.011)	(0.001)	(0.008)	(0.060)	(0.021)
Market-to-book	-7.275***	-11.880***	-6.292**	0.189	-0.759
	(0.008)	(0.000)	(0.028)	(0.956)	(0.610)
$\square_2+\square_3$	-13.832	-6.885	-16.018*	4.677	-15.871***
P-value of F-test	(0.124)	(0.421)	(0.087)	(0.680)	(0.001)
Industry dummy	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes
Observations	13,921	13,895	13,921	13,143	11,350
Adj R^2	0.044	0.194	0.041	0.058	0.102

Table 4: Prior lending relationship, performance pricing schedule, and discretionary accruals

These tables report regression results examining how prior lending relationship affects the relation between the performance pricing schedule and discretionary accruals. We use five different accrual measures. 'Modified Jones (1991)' is based on the modified Jones (1991) model; 'Modified KLW (2005)' is based on the modified Kothari, Leon, Wasley (KLW) model; 'TWW (1998)' is based on the Teoh, Welch, and Wong (1998) model; 'BS (2006)' is based on the Ball and Shivakumar (2006) model; 'Modified DD (2002)' is based on the Dechow and Dichev (2002) model. *Existence of prior lending relation* is a dummy that equals one if the lead bank of the current loan has acted as a lead bank of a loan issued by the same firm during the previous five years, and zero otherwise. We examine the effect of average slope in Panel A and the effect of local slope in Panel B. All other variables are as defined in Appendix B. P-values are reported in parentheses below each coefficient estimate. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel A: Effect of average slope on discretionary accruals conditional on prior lending relation

Variable	Modified Jones (1991) (1)	Modified KLW (2005) (2)	TWW (1998) (3)	BS (2006) (4)	Modified DD (2002) (5)
Existence of prior lending relation	44.142***	33.739***	52.688***	11.851	10.863*
	(0.000)	(0.001)	(0.000)	(0.395)	(0.059)
Average slope score ($\square_2$)	22.181***	18.371**	24.390***	14.196	-0.355
	(0.005)	(0.015)	(0.003)	(0.148)	(0.932)
Average slope score × Existence of prior lending relation ($\square_3$)	-24.695**	-10.928	-29.649***	-11.592	-4.839
	(0.020)	(0.281)	(0.007)	(0.383)	(0.382)
Retained earnings	-0.023***	-0.070***	-0.020***	0.052***	-0.023***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(assets)	-24.872***	-24.641***	-28.779***	-26.609***	13.349***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Leverage	-45.561**	-54.368***	-49.665**	49.601*	-21.306**
	(0.016)	(0.003)	(0.012)	(0.052)	(0.037)
Market-to-book	-6.637**	-11.616***	-5.567**	0.414	-0.219
	(0.014)	(0.000)	(0.047)	(0.901)	(0.881)
$\square_2+\square_3$	-2.514	7.443	-5.259	2.604	-5.194
P-value of F-test	(0.736)	(0.296)	(0.499)	(0.782)	(0.180)
Industry dummy	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes
Observations	14,486	14,459	14,486	13,671	11,826
Adj R^2	0.042	0.186	0.040	0.057	0.094

Panel B: Effect of local slope on discretionary accruals conditional on prior lending relation

Variable	Modified Jones (1991) (1)	Modified KLW (2005) (2)	TWW (1998) (3)	BS (2006) (4)	Modified DD (2002) (5)
Existence of prior lending relation	46.139***	38.753***	54.092***	8.866	13.302**
	(0.000)	(0.000)	(0.000)	(0.527)	(0.020)
Local slope score (□2)	16.774**	14.180*	17.024*	10.763	-2.400
	(0.049)	(0.080)	(0.055)	(0.313)	(0.589)
Local slope score × Existence of	-27.370**	-18.065	-30.815**	-3.981	-10.414*
prior lending relation (□3)	(0.022)	(0.110)	(0.013)	(0.790)	(0.092)
Retained earnings	-0.025***	-0.072***	-0.021***	0.052***	-0.024***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(assets)	-25.036***	-24.375***	-28.889***	-26.570***	12.466***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Leverage	-48.042**	-58.609***	-53.078***	49.797*	-23.201**
	(0.012)	(0.001)	(0.008)	(0.057)	(0.024)
Market-to-book	-6.565**	-11.232***	-5.537*	0.357	-0.598
	(0.017)	(0.000)	(0.053)	(0.917)	(0.688)
□2+□3	-10.596	-3.885	-13.791	6.782	-12.814***
P-value of F-test	(0.218)	(0.635)	(0.123)	(0.533)	(0.004)
Industry dummy	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes
Observations	13,921	13,895	13,921	13,143	11,350
Adj R^2	0.044	0.194	0.041	0.058	0.102

Table 5: Bank reputation, performance pricing schedule, and discretionary accruals: A two-stage instrumental variable approach

In the first stage, we regress the *high bank reputation dummy* on borrower characteristics, including firm size, ROA, asset tangibility, and a rating dummy variable for whether the firm has access to the public debt market. In the second stage, the *predicted vale of bank reputation* from the first stage is used to explain how it affects the relation between the performance pricing schedule and discretionary accruals. We examine the effect of average slope in Panel A and the effect of local slope in Panel B. All other variables are as defined in Appendix B. P-values are reported in parentheses below each coefficient estimate. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel A: Effect of average slope on discretionary accruals conditional on predicted bank reputation

	Modified Jones (1991)	Modified KLW (2005)	TWW (1998)	BS (2006)	Modified DD (2002)
Variable	(1)	(2)	(3)	(4)	(5)
Predicted value of bank	127.320***	213.029***	122.033***	-27.817	23.706
reputation	(0.001)	(0.000)	(0.002)	(0.377)	(0.359)
Average slope score ($\square_2$)	32.629***	39.046***	30.907***	-3.028	10.549
	(0.002)	(0.000)	(0.004)	(0.726)	(0.125)
Average slope score× Predicted	-64.813***	-72.558***	-62.750***	9.307	-22.352*
value of bank reputation ($\square_3$)	(0.001)	(0.000)	(0.002)	(0.565)	(0.080)
Retained earnings	-0.010***	-0.036***	-0.010***	-0.014***	0.010***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(assets)	-13.995***	-25.172***	-15.332***	-1.076	4.500**
	(0.000)	(0.000)	(0.000)	(0.625)	(0.014)
Leverage	8.731	9.816	8.272	-3.423	16.515***

	(0.342)	(0.239)	(0.392)	(0.681)	(0.010)
Market-to-book	-7.947***	-12.771***	-7.399***	1.084	-2.793***
	(0.000)	(0.000)	(0.000)	(0.297)	(0.001)
Industry dummy	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes
Observations	14,108	14,085	14,108	13,343	11,534
Adj R^2	0.017	0.087	0.018	0.012	0.019

Panel B: Effect of local slope on discretionary accruals conditional on predicted bank reputation

Variable	Modified Jones (1991) (1)	Modified KLW (2005) (2)	TWW (1998) (3)	BS (2006) (4)	Modified DD (2002) (5)
Predicted value of bank	121.654***	197.703***	117.418***	-3.989	36.898
reputation	(0.001)	(0.000)	(0.003)	(0.897)	(0.155)
Local slope score (□2)	44.229***	37.857***	44.882***	18.113*	20.374**
	(0.000)	(0.001)	(0.000)	(0.067)	(0.012)
Local slope score× Predicted	-94.575***	-72.216***	-98.456***	-40.478**	-44.052***
value of bank reputation (□3)	(0.000)	(0.001)	(0.000)	(0.040)	(0.006)
Retained earnings	-0.012***	-0.037***	-0.011***	-0.015***	0.010***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(assets)	-12.415***	-23.603***	-13.400***	-1.227	3.977**
	(0.000)	(0.000)	(0.000)	(0.572)	(0.031)
Leverage	8.226	7.958	7.178	-5.104	14.921**
	(0.373)	(0.341)	(0.457)	(0.532)	(0.021)
Market-to-book	-7.730***	-12.195***	-7.197***	0.851	-2.999***
	(0.000)	(0.000)	(0.000)	(0.407)	(0.001)
Industry dummy	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes
Observations	13,541	13,519	13,541	12,811	11,056
Adj R^2	0.016	0.082	0.016	0.014	0.019

Table 6: Prior lending relationship, performance pricing schedule, and discretionary accruals: A two-stage instrumental variable approach

In the first stage, we regress the *existence of prior lending relation* dummy on borrower characteristics, including firm size, ROA, asset tangibility, and a rating dummy variable for whether the firm has access to the public debt market. In the second stage, the *predicted value of prior lending relation* from the first stage is used to explain how it affects the relation between the performance pricing schedule and discretionary accruals. We examine the effect of average slope in Panel A and the effect of local slope in Panel B. All other variables are as defined in Appendix B. P-values are reported in parentheses below each coefficient estimate. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel A: Effect of average slope on discretionary accruals conditional on predicted value of prior lending relation

	Modified Jones (1991)	Modified KLW (2005)	TWW (1998)	BS (2006)	Modified DD (2002)
Variable	(1)	(2)	(3)	(4)	(5)
Predicted value of prior	83.518	-82.468	121.261**	114.292**	-21.372
lending relation	(0.135)	(0.104)	(0.039)	(0.014)	(0.571)
Average slope score (□2)	23.261***	25.300***	22.359***	-0.402	2.909
	(0.001)	(0.000)	(0.002)	(0.943)	(0.519)
Average slope score× Predicted	-48.247***	-47.214***	-47.979***	3.622	-7.600
value of prior lending relation (□3)	(0.000)	(0.000)	(0.000)	(0.720)	(0.342)
Retained earnings	-0.010***	-0.035***	-0.009***	-0.014***	0.010***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(assets)	-15.799**	-1.232	-22.102***	-16.874***	8.377*
	(0.024)	(0.846)	(0.003)	(0.004)	(0.077)

Leverage	14.552	25.627***	12.799	-8.829	18.306***
	(0.105)	(0.002)	(0.175)	(0.277)	(0.003)
Market-to-book	-7.810***	-12.674***	-7.273***	1.033	-2.729***
	(0.000)	(0.000)	(0.000)	(0.321)	(0.002)
Industry dummy	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes
Observations	14,108	14,085	14,108	13,343	11,534
Adj R^2	0.017	0.085	0.018	0.012	0.019

Panel B: Effect of local slope on discretionary accruals conditional on predicted value of prior lending relation

Variable	Modified Jones (1991) (1)	Modified KLW (2005) (2)	TWW (1998) (3)	BS (2006) (4)	Modified DD (2002) (5)
Predicted value of prior lending relation	57.613	-105.431**	98.430*	128.139***	-10.267
	(0.308)	(0.039)	(0.096)	(0.005)	(0.788)
Local slope score ($\square_2$)	28.786***	21.391***	29.438***	14.182**	10.919**
	(0.000)	(0.002)	(0.000)	(0.024)	(0.035)
Local slope score× Predicted value of prior lending relation ($\square_3$)	-67.224***	-42.973***	-71.272***	-33.740***	-25.919**
	(0.000)	(0.002)	(0.000)	(0.007)	(0.012)
Retained earnings	-0.012***	-0.037***	-0.011***	-0.016***	0.010***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Log(assets)	-11.515	1.960	-17.773**	-17.014***	7.591
	(0.105)	(0.760)	(0.017)	(0.003)	(0.114)
Leverage	14.017	23.332***	11.607	-9.839	17.147***
	(0.120)	(0.004)	(0.218)	(0.217)	(0.006)
Market-to-book	-7.538***	-12.169***	-6.985***	0.978	-2.886***
	(0.000)	(0.000)	(0.000)	(0.340)	(0.001)
Industry dummy	Yes	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes	Yes
Observations	13,541	13,519	13,541	12,811	11,056
Adj R^2	0.016	0.081	0.016	0.015	0.019

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A reexamination of pricing dynamics of discounts between Chinese cross-listed stocks - the intervention of centrally planned economy

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This study mainly explores price discounts of Chinese public listed companies which have issued ADRs (overseas shares in the U.S. market), H-shares (shares traded in the Hong Kong market) and A-shares (shares traded in the China market). We use time-varied panel data models to investigate the effect of different market share prices are affected by the long-term centrally planned economy and financial policies of the Chinese government, and not like other countries, share prices are much influenced by share liquidity, investors sentiment and other factors.

Keywords: ADRs; H-shares; A-shares; Cross-listing; Financial crisis; China's Five-Year Plan; financial policies; China.

JEL classification: C12; C33; F23; F31; F51; G01; G18.

I. Introduction

This study focuses on the Chinese market rather than developed markets as we observe that the Chinese market has some unique and promising characteristics. Specifically, China is a fast growing economic with high economic growth rate 30 years in a row (average 10%). China has become the largest economy country in the world by nominal GDP in 2015. The China's capital market grow fast and the total equity market value of the Shanghai stock exchange (SHSE) reached USD 2,479 billion in 2013. The total market value, turnover of equity market, and overall capital raised rank No. 7, No.5 and No.6 respectively in the world. It was the leading FDI recipients, receiving almost USD 34.8 billion in 2013[1]. How the Chinese government attracts international funds and international know-how to accomplish its high economy growth is an important issue, and we would investigate the Chinese equity market behavior and Chinese companies' overseas listings.

Special attention should be given to that China is a planned economy country, without considering that, studies would have misinterpreted the valuation of share prices of Chinese companies in different markets. A planned economy is an economic system that all major decisions are under the control of the government and that

[1] The economic growth rate, nominal GDP, forecasting nominal GDP, exporting amounts, and importing amounts of China are according to the International Monetary Fund (IMF). The total market value, turnover of equity market, and overall capital raised ranking data are according to Fact Book of the SHSE. The FDI data is according to World Bank statistics.

securities prices are not mainly decided by the market. Therefore, the decision made by Chinese companies are different from companies of other countries which always list their company on their home market first, and then turn to foreign markets. The Chinese government plays a dominate role in choosing selective companies to be listed on markets. For example, when Chinese government wants to attract international capital, Chinese companies are listed in the Hong Kong market first, and later, for showcasing Chinese companies on the international stage and introduce international capital, some profitable and stable Chinese companies are chosen by the Chinese government, to use H-shares as underlying shares to list ADRs[2]. Chinese government want further Chinese companies to learn from international experience and to solidify the A-shares market, so most Chinese companies go back to list in the home market after listing in the foreign markets (see. *e.g.*, Malkiel *et al.*, 2008)[3].

Accordingly, Chinese companies can issue A-shares, B-shares, H-shares, and ADRs simultaneously. According to the law of one price, under no investment barriers of market, security price in the cross-listed stock markets should equal to each other if evaluated under the same currency. In other words, there is a parity between each shares. In recent years, there are a number of researches documenting that, when the

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[2] H-shares represent those shares which are registered in China and traded in Hong Kong stock exchange (HKSE).ADR is one kind of negotiable security that represents securities of non-US companies traded in the U.S. financial market. It provides the unique investment channel for Americans to invest in foreign companies.

[3] A Chinese company could issue A-shares or B-shares on the SHSE. A-shares are only available to Chinese investors, whereas B-shares are only accessible to foreign investors.

same or equivalent securities are traded in multiple markets, the law of one price is often violated with global data (see. *e.g.*, Rosenthal and Young, 1990; Froot and Dabora, 1999; Kim *et al.*, 2000; Chan *et al.*, 2003; Eun and Sabhereal, 2003; Chan *et al.*, 2008; Foucault and Gehrig, 2008; Moulton and Wei, 2009; Gagnon and Karolyi, 2010; Kehrle and Peter, 2013). Security price in the cross-listed stock markets might also not equal in the Chinese market by two reason. First, to protect fledging China's securities market, China controls its capital inflows, capital outflows, exchange rate, and foreign currency exchange. Chinese residents and institutions cannot freely exchange Renminbi (RMB) to foreign currencies. Chinese investors (mostly individuals) can only trade A-shares in RMB and foreign investors (mostly institutions) can only trade B-shares, H-shares and ADRs in foreign currency[4]. Second, there are fundamental difference of investment considerations between Chinese investors and foreign investors; for example, different tax regimes, different stock liquidity, and different market sentiment. leads to different stock prices in different markets. Several researches have shed some lights on the subject of price deviations of the Chinese companies in different markets in recent years. (see. *e.g.*, Sun and Tong, 2000; Wang and Jiang, 2004; Chiang *et al.*, 2008; Gul *et al.*, 2010; Cai.

[4] ADR are traded in U.S. dollars on the United Stated stock exchanges, and H-shares are traded in HK dollars on the HKSE.

et al., 2011; Eichler, 2011; Chung *et al.,* 2013)[5].

This study does not only discuss whether Chinese companies have different prices in different markets; we do several extended investigations and have some findings which are different from previous literatures. First, we extend Arquette *et al.* (2008) which examine price deviations between ADRs and A-shares and price deviations between ADRs and H-shares, for all underlying stocks of cross-listed level 2 and level 3 ADRs are H-shares, with no ADR can be converted to A-share (home market shares). It is due to A-shares and ADRs cannot transfer into each other[6]. It can explain why there are a big price deviation between A-shares and ADRs. And because H-shares and ADRs can transfer into each other, the price of H-share and the price of ADR should get close to each other by the law of one price. Second, China is a planned economy country. A planned economy is policy-oriented and share prices and transactions are under the direct influence of the government's policies. Long-term planning and government policies are important factors when we research on the China's securities market. Chinese Five-Year Plan is an important guidance of economic growth and helps establish principles and direction to the China's securities

[5] Wang and Jiang (2004) examined a group of stocks cross-listed as A-shares and H-shares. They found that the price discount of H-shares relative to A-shares is highly correlated with the domestic and foreign stock market indices, the relative market illiquidity and the expected devaluation of the Chinese currency. Chung *et al.* (2013) showed that price deviations between A-shares and H-shares are inevitable as long as the presence of information asymmetry and limited arbitrage, which leads to investors have different assessments of the stock value and involved risk.

[6] Due to restrictive capital flow policy, Chinese investors (mostly individuals) can only trade A-shares and foreign investors (mostly institutions) can only trade H-shares and ADRs.

market. The timetable of the deregulation of the China's securities market can be separated into three periods: limitation period (the early limitation period after security market was established), the period of the progressive openness of investment limitation, and the period of encouraging Chinese companies to list in the home market. In the early limitation period (the eighth and ninth Five-Year Plan), the protection of the Chinese government to the fledgling China's securities market and the overexcited sentiment of Chinese investors have contributed to the much higher prices of A-shares to prices of H-shares and ADRs of the same Chinese company. In the period of the progressive openness of investment limitation (the tenth Five-Year Plan), the Chinese government gradually deregulate the China's securities market, and we could find that prices of A-shares, H-shares and ADRs of the Chinese companies gradually get closed to each other in different markets. In the period of encouraging Chinese companies to list in the home market (the eleventh and twelfth Five-Year Plan), there were more listed companies in the China's securities market, and deviations between prices of Chinese companies in different markets are fluctuated again. Third, previous studies focus on the relationship between pricing factors (liquidity, dividend taxes, *etc.*) and share prices in different markets, but without considering plans and regulations of China's government, the studies would have misinterpreted the impact estimation of share prices of Chinese companies in different markets. We collect important government policies through annual Fact Books from the SHSE and Chinese government's news releases published between 1991 and 2012, and factor the collective information into our research. And find that those policies are important factors to prices of the Chinese companies. Forth, China is experiencing the transition from a planned economy to a market economy today. Market economy is described which prices and transactions are determined by consumers and producers. This research further discusses on the progressive openness of the Chinese market, we investigate the impact of openness of the capital inflow and outflow, and the reform of the currency exchange rate on the China's securities market. Our research also indicates that prices of Chinese companies in different markets get close to their implied values with the effect of progressive openness of the Chinese market. Fifth, China's hybrid economy features a mixture of government-owned and privately owned enterprises. Most Chinese companies have significant government ownership, but also trade in the open market. We include the proportion of state-owned shares (relative to outstanding shares) in our research, and we predict the share prices of companies which have higher government ownership would be higher for more price support by the government, and higher confidence from Chinese investors. Sixth, for we can comprehensively interpret different prices of Chinese companies in different markets, our research also considers financial crises. We discover that price deviations are enlarged during financial crisis period for the Chinese government would protect the Chinese securities; for example, the limitation of the range of currency exchange rate volatility, price limit, *etc*.

The rest of the paper proceeds as follows. Section II introduces the data; Section III presents discounts and discusses the empirical results of discounts. Section IV investigates the effects of government ownership, government policies, China's Five-Year Plans, and financial crises on discounts. Finally, Section V summarizes the main conclusions.

II. **Data description**

A Chinese company could issue its stock in China, Hong Kong, and the United Stated markets at the same time by issuing A-shares and/or, B-shares, H-shares, and ADRs respectively[7]. The research only focuses on A-shares, H-shares, and ADRs[8].

[7] Our research involves three main stock exchange markets: New York, Hong Kong, and Shanghai. NYSE is by far the world's largest stock exchange by market capitalization of its listed companies, and one of the oldest developed markets. HKSE is one of the oldest liberal emerging stock markets in Asia. The SHSE is the first stock market in China. It is among the youngest emerging stock markets with ownership restrictions imposed by government. Because of these special market characteristics, we can see different performance of the underlying shares in different markets.

We exclude B-shares in this study for that the Chinese government is currently considering to terminate the B-shares trading[9]. We find that all underlying stocks of cross-listed level 2 and level 3 ADRs are H-shares, with no ADR can be converted to A-share[10].

In our analysis, we use daily firm stock data from Datastream to examine the dynamic behavior of price deviations at firm level. We also use SEC documents (20-F and 424A-B[11]) to get the ADR conversion ratio and other information related to our research, including: taxes, underlying stock companies.

III. Definition, investigation, and the cross-sectional panel data analysis of discounts

In this section, we definite and investigate ADR-A discount, H-A discount and

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[8] Our samples are constructed from the initial list of 292 ADRs (based on the databases of the Bank of New York, Datastream, and corrected by SEC documents), 176 H-shares (151 in the Main-Board Market (Main Board) and 25 in the Growth Enterprises Market (GEM)) and 2468 A-shares (943 in the SHSE and 1525 in the Shenzen stock exchange (SZSE)) which are listed by Chinese companies between December 1990 and December 2012. It is because of that China reopen it stock markets in the early 1990s. The current SHSE is re-established on Nov. 26, 1990 and is in operation on Dec. 19 of the same year. From this list, we exclude 170 144A and Level 1 firms for the liquidity of 144A and LEVEL 1 ADRs are too low, it would affect the outcome of the research. And 122 ADRs remain (53 in the NASDAQ Stock Market (NASDAQ) and 69 in the NYSE). We exclude 108 ADRs (include all ADR in the NASDAQ), 84 H-shares (include all H-shares in the GEM) and 2406 A-shares (include all A-shares in the SZSE) for they are not cross-listed. We further exclude one firm that has extremely high price discount. For shares in NASDAQ, GEM, and SZSE are excluded, we find that Chinese companies list in NASDAQ, GEM, and SZSE all list in the single market, that is, most Chinese small- and medium-sized enterprises and Chinese growth companies are listed in the single market. The common factor of NASDAQ, GEM, and SZSE is that they establish the Small- and Medium-sized Enterprise Board to facilitate the growth of start-up companies. Chinese companies list in NASDAQ, GEM, and SZSE all list in single market.

[9] The investment restriction of A-shares to foreign investors was deregulated in December 2002 which significantly diminished the importance of B-shares market.

[10] The example could see in the appendix 2.

[11] 424 is preliminary prospectus filed or pricing supplement filed. 20-F is an integrated form used both as a registration statement for purposes of registering securities of qualified foreign private issuers or as an annual report.

ADR-H discount, respectively. And we employ a general cross-sectional panel regression model which refers Arquette *et al.* (2008) to explain the variations in ADR-A discount, H-A discount and ADR-H discount[12].

III.1 ADR-A, H-A, and ADR-H discounts

We refer Arquette *et al.* (2008) to formulate ADR-A discount and H-A discount. According to the law of one price in a perfect market, the implied ADR price that it is the fundamental price in the home market (the Chinese market) after translated by a conversion ratio and translated into US dollar in comparison with other studies, and to examine evidences in the Chinese market. The difference between the ADR price and the implied ADR price (from the home market) is a premium or discount, which is denoted as $ER_{i,t}^{ADR-A}$. We define that there is a ADR-A discount when $ER_{i,t}^{ADR-A}<0$, and there is a ADR-A premium when $ER_{i,t}^{ADR-A}>0$. The ADR-A discount means that the ADR market price prevailing in the US market is lower than its implied value calculated by the fundamental price in the home market.

The implied ADR price which is transferred by the price of stock in the home market and the ADR-A discount (or premium) are expressed as equations (1) and (2), where *i*, *t* denotes the *i*-th sample company in the period *t*. The definitions are as

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[12] Arquette *et al.* (2008) examine the differential between the share prices of Chinese securities traded on their home market of Shanghai versus prices observed offshore in New York and Hong Kong to make basic model.

follows:

$$IP_{i,t}^{ADR(A)} = (P_{i,t}^{A-share} \times FX_{i,t}^{\$/RMB}) \times Ratio_i, \quad (1)$$

$$ER_{i,t}^{ADR-A} = (P_{i,t}^{ADR} - IP_{i,t}^{ADR(A)}) / IP_{i,t}^{ADR(A)}, \quad (2)$$

where $IP_{i,t}^{ADR(A)}$ is the implied ADR price for firm i on day t. $P_{i,t}^{A-share}$ is the A-share price in RMB for firm i on day t. $FX_{i,t}^{\$/RMB}$ is the exchange rate between US dollars and RMB (US dollars to RMB) for firm i on day t. $Ratio_i$ is the ADR conversion ratio for firm i. $P_{i,t}^{ADR}$ is the ADR price in dollars firm i on day t. $ER_{i,t}^{ADR-A}$ is the ADR-A discount (premium) for firm i on day t. Similarly, we define that the H-A discount to reflect the differences in the actual and the implied prices of securities cross-listed in Hong Kong and China.

Based on what we found, all underlying stocks of cross-listed level 2 and level 3 ADRs are H-shares, with all 13 ADRs can be converted to H-shares by 424B and 20-F SEC documents[13]. We extend Arquette et al. (2008) to explain the variations in the ADR-H discount[14].

To have a better understanding on the three discounts, we construct market-value

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[13] With no ADR can be converted to A-share.

[14] According to the law of one price in a perfect market, the implied ADR price is the fundamental price in the underlying stock market (the Hong Kong market) after translated by a conversion ratio and translated into US dollar, and the ADR price is the market price prevailing in the US market.

weight average portfolios of ADR-A discount, H-A discount, and ADR-H discount, shown in Figure 1. By eyeballing the figures, we find that both ADR-A discount and H-A discount tend to move close to zero as time advanced prior to 2007. This result is similar to the studies of Arquette *et al.* (2008) and Eichler (2011), and it is also consistent with the market integration hypothesis and the relaxation of the investment restrictions. We find that ADR-H discounts fluctuate around zero for all 13 ADRs which can be converted to H-shares[15]. During the financial crises, we can find both ADR-A discount and H-A discount became profound and ADR-H discount had higher volatility than ordinary time. After 2009, we can find that both ADR and H-share prices move close to their implied values in home market shares again. This result shows the elimination of market segmentation, and the effect of the financial crisis. We will examine those phenomena in the next section

[Please insert Figure 1 about here]

Further analysis is given to the dynamic relation between the ADRs, H-shares and A-shares, we refer Chiang *et al.* (2007) to apply a bivariate VAR(2)-GARCH(1,1)- DCC model to study the variances of ADR-A, H-A, and ADR-H

[15] The volatility of ADR-H discounts in the end of 1997 comes from the new ADR listing.

discounts, and also their correlations among A-shares, H-shares, and ADRs. We report the results of time-varying dynamic correlations in the empirical results in Figure 2 and Figure 3.

[Please insert Figure 2 about here]

[Please insert Figure 3 about here]

In figure 2, there are higher variances during financial crisis period than normal time, especially the average variance of the ADR-H discount is 2.44 during normal time, which is enlarged to 10.5 during financial crises[16]. The average variance of the ADR-A discount is 2.42 during normal time, and is enlarged to 4.2 during financial crises; the average variance of the H-A discount is 1.77 during normal time, and is enlarged to 3.04 during financial crises. We would examine ADR-A, H-A, and ADR-H discounts under the period of financial crises and discuss variances of discounts during financial crises in the later chapter.

In figure 3, the correlation between ADR and H-shares are mostly from 0.6 to 0.8. The correlation between H-shares and A-shares obviously increases from 0.29 to 0.72 after restrictions on Chinese investors' buying H-shares are liberated[17]. We split the

[16] We take off data in the end of 1997 for large volatility of ADR-H discounts by new ADR listing.

[17] Chiang *et al.* (2007) find that the correlation between A-share and B-share markets has increased

cross-section panel model by the time point of the investment's restriction relaxation and the currency exchange rate reform and further estimate the impact of China's policy change from the planned economy to free market economy.

III.2 Empirical model: a cross-sectional panel model of discounts

To examine the phenomena in Figure 1, we refer Arquette *et al.* (2008) to employ time-varied panel data models and study ADR-A discount, H-A discount, and further extend to ADR-H discount of the companies at each specific time. Furthermore, we study the correlations among the three mentioned discounts, the change of expected exchange rate, dividend taxes, illiquidity, and sentiment, and the models are as follows:

$$ER_{i,t}^{ADR-A} = \alpha + \beta_1 \Delta S_t^{\$/RMB} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{ADR-A} + \beta_4 DSENT_t^{S\&P/SSECI} + \beta_5 SENT_{i,t} + \nu_{i,t}, \quad (5)$$

$$ER_{i,t}^{H-A} = \alpha + \beta_1 \Delta S_t^{HKD/RMB} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{H-A} + \beta_4 DSENT_{i,t}^{HSI/SSECI} + \beta_5 SENT_{i,t} + \gamma_{i,t}, \quad (6)$$

$$ER_{i,t}^{ADR-H} = \alpha + \beta_1 \Delta E_t^{\$/HKD} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{ADR} + \beta_4 DSENT_t^{S\&P/HSI} + \beta_5 SENT_{i,t}^{Com} + \varepsilon_{i,t}, \quad (7)$$

where $ER_{i,t}^{ADR-A}$, $ER_{i,t}^{H-A}$, and $ER_{i,t}^{ADR-H}$ are the ADR-A discount (premium), H-A discount (premium), and ADR-H discount (premium) for firm *i* on day *t*. $\Delta S_t^{\$/RMB}$,

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since the relaxation of the restriction on B-share market investments by domestic investors.

$\Delta S_t^{HKD/RMB}$, are the change of expected exchange rate (US dollars to RMB, HK dollars to RMB and US dollars to HKD) on day *t*. $DIV_{i,t}$ is the dividend yield for firm *i* on day *t*. $DILLIQ_{i,t}^{ADR-A}$, $DILLIQ_{i,t}^{H-A}$, and $DILLIQ_{i,t}^{ADR-H}$ are relative illiquidity for firm *i* on day *t*. $DSENT_t^{S\&P-SSECI}$, $DSENT_t^{HSI-SSECI}$, and $DSENT_t^{S\&P-HSI}$ is the relative market sentiment on day *t*. $SENT_{i,t}$ is the company sentiment for firm *i* on day *t*.

The first major factor contributes to discounts is the change of the expected exchange rate. According to relative purchasing power parity (RPPP), higher inflation of China promotes the expectation of RMB appreciation which leads to a higher ADR discount (see. *e.g.*, Wheatley, 1988; Sarno and Valente, 2006; Eichler *et al.*, 2009). Eichler (2011) summarized several expected exchange rate theories, and applied Chinese cross-listed stocks to reconfirm those theories. The empirical results support that RMB depreciation would induce the increase of ADR discount[18]. The change of expected exchange rate is proxied by the 3-month forward premium [19]. Furthermore, tax structures in the cross-list market also play an important role in discounts.[20] Due to foreign investors cannot invest in the Chinese market before 2007, the tax structure would not affect the decisions of investors. After 2008, the dividend tax in A-share,

[18] For example, according to Harrod-Balassa-Samuelson effect, countries with a higher productivity growth will have a relative currency appreciation (Chinn, 2006); Follow uncovered interest rate parity states that the returns on risk-less assets are equal when adjust for exchange rate (Eichler *et al.*, 2009).
[19] We also use S_{t+1}-S_t, AR model -time series data for robustness.
[20] Arquette *et al.* (2008) showed that high dividend stocks tend to have ADR premium since tax rate in the United Stated market was lower than the Chinese market. (In a market that has higher tax rate, higher dividend paying stocks would be expected to sell at a discount for the reason of avoiding dividend tax.)

H-share and ADR are at about 10%, the tax structure still do not affect the decisions of investors[21]. Our research result might be more closer to dividend clientele effect that investors will invest by their preference for dividends; for example, investors think that getting cash earlier can reduce the investment risk (see. *e.g.*, Bekart *et al.*, 2007). Illiquidity is also a major factor to explain the discounts, which implies that the observed foreign share discounts are due to their lower liquidity[22]. The illiquidity proxy, according to Amihud (2002), is the daily ratio of absolute stock return to its dollar volume averaged over some period. These measures not only extend liquidity ratio, but also follow Kyle's (1985) concept of illiquidity[23] and Silber's (1975) measure of thinness[24]. These measures don't require a lot of microstructure data and could cover long periods of time. In our analysis, we use *ILLIQ* measure as the illiquidity proxy. It can consider the illiquidity effect of volume and price at the same time:

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[21] Before Jun 13, 2005, dividend income of A-share was part of the individual income and was taxed at about 20% rate. After Jun 13, 2005, the dividend tax was halved to 10%. Individual U.S. investors face dividend tax rate at about 30% in the United States of America but that ADR and H-share dividend taxes are based on Chinese withholding taxes and applicable tax treaties. A Chinese withholding tax levied at a flat rate of 20%, but it can be reduced by an applicable tax treaty. After Aug. 13, 2006, the deduction of the applicable tax treaty of H-shares decreased 10%-15%, and the dividend tax was at about 5%-10%. After Mar. 1, 2008, the deduction of the applicable tax treaty of ADRs decreased 10%, and the dividend tax is at about 10%.

[22]. For example, Chan *et al.* (2008) used the Amihud (2002) illiquidity measure to test the relationship between ADR premium and liquidity. They showed that a higher ADR premium is associated with a higher ADR liquidity and lower home share liquidity. (see. *e.g.*, Alexander *et al.*, 1988[22]; Ma, 1996; Domowitz *et al.*, 1998; Foerster *et al.*, 1999; Kadiyala and Subrahmanyam, 2004; Wang and Jiang, 2004; Chan *et al.*, 2008; Silva and Chavez, 2008; He and Yang, 2011; He and Yang, 2012)

[23] Kyle (1985) proposed that because market makers cannot distinguish between orders flows that are generated by informed traders and by liquidity (noise) traders, they set prices that are an increasing function of the imbalance in the order flows which may indicate informed trading.

[24] It is defined as the ratio of absolute price change to absolute excess demand for trading.

$$DILLIQ_{i,t}^{ADR-A} = \ln\left(1/D_{i,y}\sum_{t=1}^{Diy}\left|R_{i,y,t}^{ADR}\right|/Volume_{i,y,t}^{ADR}\right) - \ln\left(1/D_{i,y}\sum_{t=1}^{Diy}\left|R_{i,y,t}^{A-share}\right|/Volume_{i,y,t}^{A-share}\right), \quad (8)$$

$$DILLIQ_{i,t}^{H-A} = \ln\left(1/D_{i,y}\sum_{t=1}^{Diy}\left|R_{i,y,t}^{H-share}\right|/Volume_{i,y,t}^{H-share}\right) - \ln\left(1/D_{i,y}\sum_{t=1}^{Diy}\left|R_{i,y,t}^{A-share}\right|/Volume_{i,y,t}^{A-share}\right), \quad (9)$$

$$DILLIQ_{i,t}^{ADR-H} = \ln\left(1/D_{i,y}\sum_{t=1}^{Diy}\left|R_{i,y,t}^{ADR}\right|/Volume_{i,y,t}^{ADR}\right) - \ln\left(1/D_{i,y}\sum_{t=1}^{Diy}\left|R_{i,y,t}^{H-share}\right|/Volume_{i,y,t}^{H-share}\right), \quad (10)$$

where $ILLIQ_{i,t}$ is illiquidity for firm i on day t. $DILLIQ_{i,t}^{ADR-A}$, $DILLIQ_{i,t}^{H-A}$, and $DILLIQ_{i,t}^{ADR-H}$, are relative illiquidity for firm i on day t. $R_{i,y,t}^{ADR}$, $R_{i,y,t}^{H-share}$ *and* $R_{i,y,t}^{A-share}$ are the return for firm i on day t of year y in the US market, the Hong Kong market and the Shanghai market. $Volume_{i,y,t}^{ADR}$, $Volume_{i,y,t}^{H-share}$ and $Volume_{i,y,t}^{A-share}$ are the daily volume for firm i on day t of year y in the US market, the Hong Kong market and the Shanghai market. This ratio gives the absolute price change per dollar of daily trading volume. $D_{i,y}$ is the number of days for which data are available for firm i in year y. That is, $DILLIQ_{i,t}^{ADR}>0$ means that the ADR is more illiquidity relative to the H-share. The last important factor for discounts is sentiment[25]. Following Arquette *et al.* (2008), we separate sentiment into market sentiment and company sentiment by

[25] Lee *et al.* (1991) are the first ones to use the word "investor sentiment". After that, a considerable number of studies have been made on investor sentiment. Garbade and Silber (1979) tested the behavior of the prices of identical assets that are traded in different markets, and concluded that home market prices and ADR prices are relevant to both the United States market and the home market. Bodurtha *et al.* (1995) called it the country-specific sentiment. Suh (2003) first used a time series analysis and found that ADR premium movements are associated with changes in investor's sentiment over time. Wang and Jiang (2004) suggested that H-shares behave more reflected to Hong Kong market sentiment than the Chinese market sentiment. Wang *et al.* (2004) found the overreaction effect is most profound in the Chinese market than in the United Stated market. Baker and Wurgler (2006) separated investors' sentiment into optimistic and pessimistic. They concluded that when market sentiment is considered at higher level, investors would require relatively lower return. (see *e.g.*, Chen *et al.*, 1993; Swaminathan, 1996; Neal and Wheatley, 1998; Kim *et al.*, 2000).

using daily P/E ratios as a proxy of sentiment. The company sentiment variable is measured by the (one period) lagged natural log of each individual company's P/E ratio relative to the nature log of market's P/E ratio. In using the one period lagged value, we avoid the contemporaneous problem.

The sentiments are defined as:

$$DSENT_t^{S\&P/SSECI} = \ln(P/E)_t^{S\&P} - \ln(P/E)_t^{SSECI}, \tag{11}$$

$$DSENT_t^{HSI/SSECI} = \ln(P/E)_t^{HKMarket} - \ln(P/E)_t^{ChineseMarket}, \tag{12}$$

$$DSENT_t^{S\&P/HSI} = \ln(P/E)_t^{S\&P} - \ln(P/E)_t^{HSI}, \tag{13}$$

$$SENT_{i,t} = \ln(P/E)_{i,t-1} - \ln(P/E)_t^{Market}, \tag{14}$$

where $DSENT_t^{S\&P-SSECI}$, $DSENT_t^{HSI-SSECI}$, and $DSENT_t^{S\&P-HSI}$, is the relative market sentiment on day t. $SENT_{i,t}$ is company sentiment for firm i on day t. $P/E_t^{S\&P}$, P/E_t^{HSI}, and P/E_t^{SSECI} are the S&P 500 P/E ratio, the HANG SENG price index P/E ratio, the Shanghai index P/E ratio for time t. $(P/E)_{i,t-1}$ is the company P/E ratio for time $t-1$. $(P/E)_t^{Market}$ is the underlying market index trading volume for time t. The expected exchange rate fluctuations which represent the volatility change of exchange rate are measured by square of the change of expected exchange rate.

[Please insert Table 1 about here]

The positive coefficients in equation (5), (6), and (7) indicate that the variables make price larger than its implied value. On the contrary, the negative coefficients indicate that the variables make price lower than its implied value[26]. Table 2 represents the results to explain the price deviation by cross-sectional panel approach at different points of time.

[Please insert Table 2 about here]

Evidence from Table 2 show that there are similar results to Arquette *et al.* (2008), almost all variables play important roles in determining both ADR-A discount and H-A discount and almost all findings are consistent with hypotheses in 1996-2006. However, some results in ADR-H discount are not consistent with hypothesis[27].

[26] According to theories and existing evidence, the following is our anticipation: According to relative purchasing power parity (RPPP), higher inflation of China promotes the expectation of RMB appreciation which leads to a higher share price than its implied value. (positive in β_1); The relationship among ADR discount, ADR-A discount, H-A discount and dividend yield depends on the preference of known investors. (β_2 is unknown); When one market has lower liquidity than other markets, investors are reluctant to invest and induce the price to be lower than the implied value (negative in β_3); The higher market sentiment represents that investors in this market are optimistic or this market is in good prospect. Investors will be willing to invest and lead to a price premium (positive in β_4). Higher company sentiment represents that the companies or industries have good performance. Investors who focus on company performance will be willing to invest and lead to a higher share price (β_5 is unknown).

[27] For example, the result should find a positive correlation between ADR-H discount and relative market sentiment, and a positive correlation between ADR-H discount and changes of the expected exchange rate.

We further expand the cross-sectional panel model to 2012, the testing results show that the capability of explanation of models decrease, and several outcomes are different from hypotheses; for example, ADR-A discount and H-A discount should be negatively related to relative illiquidity, and ADR-H discount should be positively related to relative market sentiment between 1996 to 2012. We also revise the cross-sectional panel model to examine the data from 2007 to 2012 while China's security market became more liberal after 2007[28]. The testing result also shows that the capability of explanation of models decrease, and several outcomes are different to hypothesis[29].

IV. The effects of non-pricing factors on discounts

Previous literatures on China focus on the relationship between pricing factors (liquidity, dividend taxes, *etc.*) and share prices in different markets (see. *e.g.*, Sun and Tong, 2000; Wang and Jiang, 2004). However, without considering the impact of non-pricing factors, such as government ownership, government policies, Five-Year Plans, and financial crises, there would have misinterpreted the impact estimation of

[28] There is lower investment restriction in the Chinese market after 2007 (restrictions on foreign investors' entry into the A-share, restrictions on Chinese investors' entry into the H-share market are liberated, there are lower non-tradable shares).

[29] For example, there should be a positive significant relation between ADR-A discount and changes of the expected exchange rate, so does ADR-H discount and H-A discount. The relationship between ADR-A discount and relative illiquidity should be negative. The result should find a positive and significant relationship between ADR-A discount and relative market sentiment.

share prices of Chinese companies in different markets. In order to comprehensively examine the effect of the Chinese market transferring from a planned economy market to a free economy market (gradually opening in the Chinese market), our research extends the model of Arquette *et al.* (2008) with those non-pricing factors respectively to investigate the effects on discounts.

Ⅳ.1 Empirical evidences of government ownership, government policies and financial crises on discounts

We add three key non-pricing factors, government policies, government ownership, and financial crises, into our models. The first key factor is China's government policies. China is a planned economy country and its policies relating to the financial market would affect prices of Chinese companies in the China market and in overseas markets. There are three Chinese financial policies which affect the China's securities market tremendously[30]. First, The China Securities Regulatory Commission (CSRC) announced three bailout policies in August 1994 to save the stock market decrease between 1992 to July 1994 (the first bailout policy in the China's securities market)[31]. Three bailout policies included that Chinese companies

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[30] Those financial policies and events are mainly summarized from annual Fact Book published by the SHSE, decrees enacted by the Chinese government and news and events which are related to China's securities market from 1991 to 2012. The impact of those financial policies to the China's securities market could refer to the price index of the SHSE in appendix 2.

[31] China tightening monetary and fiscal policies in 1993 , and the Shanghai Composite Index decline from 1558 in Feb. 1993 to 325 in Jul. 1994, more than 70%.

are suspended from initial public offering in the market, CSRC controlled the financing scale of existing listing companies, and introduce foreign funds into the A-share market gradually. The price index of the SHSE soared from 325 to 1050 (increased 323%) in a month after the announcement of three bailout policies. Second, Department of State announced that whenever the state-owned enterprises had initial public offering or capital raising, 10% of the financing amount should be sold to the public. After the announcement, prices in the SHSE and SZSE plunged by about 32% in four-month time. This policy was paused temporary in October 2001, and the stock market rose 10% in a single day, and later was terminated in June 2002. Third, A-shares include tradable and non-tradable shares[32]. Measures for the Administration of Initial Public Offering and listing of stocks promulgated by CRSC became effective, which heralded the resumption of shares following the non-tradable share reform in June 2005. Shareholders in government-owned enterprises (companies in A-share) can get compensation when a non-tradable share transfers to a tradable one. For example, shareholders in China Petroleum and Chemical got the dividend compensation, RMB 0.28 per share, after the non-tradable share reform. All companies completed the reform before 2007. Prices in the SHSE skyrocketed by about 500% during the period of the non-tradable shares reform. It clearly

[32] Non-tradable shares mainly refer state-owned shares and institutional shares that do not trade on the securities market, where state-owned shares are transferred when restructured into listed shares and institutional shares are a raising capital by company's promoters at the beginning of the listing.

demonstrates that even an announcement not the actual implementation can stir the A-shares market. We assimilate those policies into our research to investigate the impact of Chinese policies to the share prices of Chinese companies.

The second factor affecting price discounts is state-owned enterprise (SOE). Total 273 companies, namely 33.58% companies of all Chinese companies, have more than 50% of shares are state-owned in the SHSE and SZSE. Among them, 70% of companies have their company's share value over RMB 400 million and more than 50% company's shares are state-owned.[33] We suppose enterprises that have more state-owned shares would be affected less by investors sentiment, the price of enterprises that have more state-owned shares would be influenced closely by the government policies and be inefficient (see e.g., Dewenter and Malatesta, 1999; Chen, 2009). We add the proportion of state-owned shares, which is comparative to outstanding shares, into our model and examine this special factor.

The third factor that would affect price discounts is financial crises. The importance of financial crises to ADR-A, H-A, ADR-H discounts has already indicated in figure 2. During crises, we assume that herding behavior causes individual investors joining the crowd in a rush to get out of the market, the behavior of ADR and H-share investors tends to be more sentiment than A-share investors due

[33] The proportion of China's state-owned shares are going down with the gradual reduction of financial planning and policy, and therefore we cite the previous year (1998) to express the importance of state-owned shares of Chinese companies in the past.

to government control such as foreign currency exchange control, price limits, and limitation of transaction numbers. Therefore, there would be large price deviation between A-shares and H-shares or ADRs. Recent research has suggested that there is a large ADR discount during the financial crisis (see *e.g.*, Mitton, 2002; Mervin, 2003). Auguste *et al*. (2006) showed that Argentine and Venezuelan ADR discounts were 55 percent during the Argentina financial crisis, it indicated that investors are willing to pay significant price differences in order to move their funds abroad and to hedge the dollar value of their assets during the Argentina financial crisis. We also add financial crises into our research.

We extend equations (5), (6) and (7) by adding the proportion of state-owned shares and dummy variables of events and financial crises:

$$\begin{aligned} ER_{i,t}^{ADR-H} &= \alpha + \beta_1 \Delta S_t^{\$/HKD} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{ADR-H} + \beta_4 DSENT_t^{S\&P/HSI} \\ &+ \beta_5 SENT_{i,t}^{Com} + \beta_6 SOE\%_{i,t} + \beta_7 D_t^{EVENT2} + \beta_8 D_t^{EVENT3} + \beta_9 D_t^{CRISIS1} \\ &+ \beta_{10} D_t^{CRISIS2} + \beta_{11} D_t^{CRISIS3} + \varepsilon_{i,t} \end{aligned} \quad (15)$$

$$\begin{aligned} ER_{i,t}^{ADR-A} &= \alpha + \beta_1 \Delta S_t^{\$/RMB} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{ADR-A} + \beta_4 DSENT_t^{S\&P/SSECI} \\ &+ \beta_5 SENT_{i,t}^{Com} + \beta_6 SOE\%_{i,t} + \beta_7 D_t^{EVENT2} + \beta_8 D_t^{EVENT3} + \beta_9 D_t^{CRISIS1} \\ &+ \beta_{10} D_t^{CRISIS2} + \beta_{11} D_t^{CRISIS3} + v_{i,t} \end{aligned} \quad (16)$$

$$\begin{aligned} ER_{i,t}^{H-A} &= \alpha + \beta_1 \Delta S_t^{HKD/RMB} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{H-A} + \beta_4 DSENT_{i,t}^{HSI/SSECI} \\ &+ \beta_5 SENT_{i,t}^{Com} + \beta_6 SOE\%_{i,t} + \beta_7 D_t^{EVENT1} + \beta_8 D_t^{EVENT2} + \beta_9 D_t^{EVENT3} + \\ &\beta_{10} D_t^{CRISIS1} + \beta_{11} D_t^{CRISIS2} + \beta_{12} D_t^{CRISIS3} + \gamma_{i,t} \end{aligned} \quad (17)$$

where $SOE\%_{i,t}$ is the proportion of state-owned shares (relative to outstanding shares). $D^{EVENT1}{}_{t}$ is the three bailout policies in 1994. $D^{EVENT2}{}_{t}$ is the announcement of the sale of all sate shares in 2001. $D^{EVENT3}{}_{t}$ is the non-tradable share reform in 2005. $D^{CRISIS1}{}_{t}$ is the dummy variable for the 1997-1998 Asia financial crisis, $D^{CRISIS2}{}_{t}$ is the dummy variable for the 2000-2001 dotcom bubble. $D^{CRISIS3}{}_{t}$ is the dummy variable for 2007-to-2008 Subprime Mortgage Crisis (D_t= 1 during the crisis periods, otherwise=0). Other variables are defined above.

The results are shown in Table 3.

[Please insert Table 3 about here]

Evidence from Table 3 shows that after control variables are added, the capability of explanation of models rises. For example, the cross-section panel model of ADR-A discount can explain 17.38% of the total variation before control variables are added, but the cross-section panel model of ADR-A discount can explain 75.35% of the total variation after control variables are added.[34] It means that we can see effects of impact factors much more clearly and correctly, for example, the

[34] The cross-section panel model of ADR-H discount can explain 0.34% of the total variation before control variables be added, but the cross-section panel model of ADR-H discount can explain 0.55% of the total variation after control variables be added. The cross-section panel model of H-A discount can explain 24.21% of the total variation before control variables be added, but the cross-section panel model of H-A discount can explain 29.51% of the total variation after control variables be added.

relationship between H-A discount and relative illiquidity or relative market sentiment turns to be negative, and H-A discount has significant relation to state-owned shares. The relationship between ADR-H discount and relative market sentiment turns to be positive, and they are consistent with our hypotheses.

There are significant relations between all ADR-H discount, H-A discount, and ADR-A discount and China's government policies. There are significant relationship between all ADR-H discount, H-A discount, and ADR-A discount and the 2007-to-2008 Subprime Mortgage Crisis, except only ADR-A discount and H-A discount are related to the 1997-1998 Asia financial crisis. There are also significant relations between all ADR-H, H-A, and ADR-A discounts and the non-tradable reform in 2005, H-A discount are significant related to the three bailout policies in 1994, and only ADR-A discount and H-A discount are related to the sale of state-owned shares in 2001 for they related to the investors in the Chinese market.

Many relationship between variables and discounts turn to be non-significant after adding the proportion of state-owned shares (relative to outstanding shares) and controlling the impact of China's government policies and financial crises. There is only a positive and strong relationship between the ADR-H discount and dividend yield. It can be explained that investors in the U.S. market prefer dividend taxes compared to investors in Chinese market. All relationships between variables and

ADR-A discount turn to be non-significant. The result indicates that the discount occurs because of the impact of China's government policies and financial crises and not variables.

ADR-A discount and H-A discount are negative related to the proportion of state-owned shares (relative to outstanding shares), it is due to investors in the Chinese market are more confident in state-owned shares; investors in the Chinese market prefer to invest and induce the price to become higher than the implied value (see *e.g.*, Dewenter and Malatesta, 1999; Chen, 2009). The relationship between ADR-H discount and the proportion of state-owned shares (relative to outstanding shares) is non-significant, it is due to no direct relation to investors in China.

Ⅳ.2 Empirical evidences of China's Five-Year Plans on the discounts

Five-Year Plans of the China are a series of social and economic development guidelines. The Communist party plays a leading role in establishing the foundations and principles, they map out strategies for economic development, set growth targets, and launch reforms every five years. Our research contains from the eighth Five-Year Plan to the twelfth Five-Year Plan[35]. The eighth and ninth Five-Year Plans

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[35] In 1991, the National People's Congress (NPC) approve the State Council's Report entitled "The eighth Five-Year Plan." In 1996, NPC approve the ninth Five-Year Plan. In 2001, NPC approve the tenth Five-Year Plan. In 2006, NPC approve the eleventh Five-Year Plan. In 2011, NPC approve the twelfth Five-Year Plan.

(1991-2000) emphasized the needs to establish the security markets, and to lead the enterprises by plans and to regulate and adjust the market step by step and finally transform the market. To protect the China's stock market, China restricts its stock market on capital flows at the beginning of the establishment of security markets. This is because when the financial system and the financial institutions in a country are not strong enough to cope with capital flows of the liberalization on the capital accounts and cause financial instability and even lead to a crisis. The tenth Five-Year Plan (2001-2005) emphasized that the financial market needs to restructure and reform as the preparation of gradually transformation to free market. During the tenth Five-Year Plan period, the Chinese government accomplished the Qualified Foreign Institution Investor Program (QFII) which permits a limited number of qualified institutional investors, on an annual renewal basis, to participate directly in China's domestic stock markets in 2002 (Capital inflows). The Chinese government also prepared the Qualified Domestic Institutional Investing (QDII) which allows local institutions to exchange RMB into foreign currencies (Capital outflows). Chinese government also achieved the reform of currency exchange rate mechanism for; therefore, RMB exchange rate is no longer pegged to the U.S. dollar, instead it is a collective reflection to a basket of several major currencies. We could focus on the comprehension and research of gradual openness of China's capital market. The original eleventh Five-Year Plan (2006-2010) was named the eleventh Five-Year Program in Chinese, and it means that the planned economy is formally transformed into free market economy. The eleventh and twelfth Five-Year Plans (2006-2015) emphasized that China determined to build a global financing platform to allow large enterprises to list their shares in the SHSE. China introduced listing experiences from overseas markets to improve the quality of listing in the SHSE. For example, the Chinese government encouraged that shares, which were listed in the HKSE, returned to the SHSE and helped solve the problem of over-valuation in A-shares. Therefore, many Chinese companies which had initial public offering were listed as H-shares, and later were listed as ADRs with H-shares as underlying shares, and finally returned to China and listed A-share. We can find that China gradually open its security market by attracting international capital and international know-how under Five-Year Plans.

We can also find the effects of Five-Year Plans in figure 1. In the eighth and ninth Five-Year Plans, China's securities market just opened and there were many restrictions in order to protect China's securities markets. Therefore, there were large deviations between A-shares and H-shares or ADRs. In the tenth Five-Year Plans, we find the price deviations between A-shares and H-shares or ADRs were diminishing gradually because of the continuing openness of China's securities market. In the eleventh Five-Year Plans, China encouraged Chinese companies return to A-shares market for introducing international experience and the permission of big enterprises were listed in A-shares market, consequently, more companies listed in Chinese market and price deviations were volatile again. Five-Year Plans are too important to Chinese companies and Chinese markets, therefore we spilt our cross-sectional model by the timeframe of Five-Year Plans to estimate the impact of different price changes from the planned economy to free market economy.

The results are shown at Table 4, the positive coefficients indicate that the variables make the share price higher than its implied value. On the contrary, the negative coefficients indicate that the variables make the share price lower than its implied value.

[Please insert Table 4 about here]

The result in Table 4 shows that in the earliest period (1996-2000), there are too many restrictions in the Chinese market, therefore investors can only invest in a single market, under this circumstance, many results are significant but differ from our hypotheses, for example, ADR-H discount is significant and negative related to relative market sentiment. In the second period (2001-2005), while the Chinese market was globalizing, arbitragers led prices to converge in two markets. For ADR prices are always lower than their implied values calculated by their home market (the result illustrates in Figure 1), increasing in those coefficients can reduce the magnitude of the discount. In other words, coefficients should become larger to let discounts close to zero. Our statistic results are in agreement with this point. Our results show that most coefficients on ADR-A discount (5 of 6 variables) become larger while Chinese market keeps globalizing. We can also find some variables turn to be non-significant in the relationship between impact factors and discounts. In the last period (2006-2012), the Chinese market is more liberal than the pre-2007 period on foreign investors' entry into the A-share, Chinese investors' entry into the H-share market, and there are lower non-tradable shares. We find more variables turn to be non-significant in the relationship between impact factors and discounts, for example, half coefficients on ADR-H discount turn to be non-significant, most coefficients (5 of 6 variables) on ADR-A discount turn to be non-significant. It means that most ADR-A discounts, ADR-H discounts and H-A discounts are no longer affected by those variables. With the Chinese market keeps globalizing, investors can invest in their favorite market for their own purposes such as liquidity, tax purpose, and their risk attitude. It means that the relationship between impact factors and all discounts are getting close to our hypotheses. In the last period, all statistic results are consistent with our hypotheses. With the Chinese market keeps globalizing, arbitragers lead prices converge in two markets. In other words, all discounts should get close to zero. Our statistic results are in agreement with this point. Our results show that all coefficients on ADR-H discount get close to zero with the Chinese market keeps globalizing, most coefficients on ADR-A discount (5 of 6 variables) get close to zero with the Chinese market keeps globalizing, half coefficients on H-A discount (3 of 6 variables) get close to zero with the Chinese market keeps globalizing, and the other three variables which do not get close to zero are becoming larger. For ADRs are always lower than their implied value calculated by its home market (the result illustrates in Figure 1), increasing in those coefficients can reduce the magnitude of the discount. It is the affirmation to our hypothesis again. We further use Wald test to test the equality of coefficients in different periods, and find almost all coefficients are significant different in different periods. It indicates that the effects of each variable are different by Five-Year Plans.

IV.4 Further investigation by bivariate model

We conduct several cross-sectional panel models of returns to further investigate results in equation (5), (6), and (7), and the model is as follows:

Sample: listing in ADR and H-share in the same time

$$\begin{aligned} R_{i,t}^{ADR} &= \alpha + \beta_1 \Delta S_t^{\$/HKD} + \beta_2 DIV_{i,t} + \beta_3 ILLIQ_{i,t}^{ADR} + \beta_4 ILLIQ_{i,t}^{H} + \beta_5 SENT_t^{S\&P} \\ &+ \beta_6 SENT_t^{HSI} + \beta_7 SENT_{i,t} + \beta_8 SOE\%_{i,t} + \beta_9 D_t^{EVENT2} + \beta_{10} D_t^{EVENT3} \\ &+ \beta_{11} D_t^{CRISIS1} + \beta_{12} D_t^{CRISIS2} + \beta_{13} D_t^{CRISIS3} + \varepsilon_{i,t} \end{aligned} \quad ,(18)$$

$$\begin{aligned} R_{i,t}^{H} &= \alpha + \beta_1 \Delta S_t^{\$/HKD} + \beta_2 DIV_{i,t} + \beta_3 ILLIQ_{i,t}^{ADR} + \beta_4 ILLIQ_{i,t}^{H} + \beta_5 SENT_t^{S\&P} \\ &+ \beta_6 SENT_t^{HSI} + \beta_7 SENT_{i,t} + \beta_8 SOE\%_{i,t} + \beta_9 D_t^{EVENT2} + \beta_{10} D_t^{EVENT3} \\ &+ \beta_{11} D_t^{CRISIS1} + \beta_{12} D_t^{CRISIS2} + \beta_{13} D_t^{CRISIS3} + \mu_{i,t} \end{aligned} \quad , (19)$$

Sample: listing in ADR and A-share in the same time

$$\begin{aligned} R_{i,t}^{ADR} &= \alpha + \beta_1 \Delta S_t^{\$/RMB} + \beta_2 DIV_{i,t} + \beta_3 ILLIQ_{i,t}^{ADR} + \beta_4 ILLIQ_{i,t}^{A} + \beta_5 SENT_t^{S\&P} \\ &+ \beta_6 SENT_t^{SSECI} + \beta_7 SENT_{i,t} + \beta_8 SOE\%_{i,t} + \beta_9 D_t^{EVENT2} + \beta_{10} D_t^{EVENT3} \\ &+ \beta_{11} D_t^{CRISIS1} + \beta_{12} D_t^{CRISIS2} + \beta_{13} D_t^{CRISIS3} + \nu_{i,t} \end{aligned} \quad , (20)$$

$$\begin{aligned} R_{i,t}^{A} &= \alpha + \beta_1 \Delta S_t^{\$/RMB} + \beta_2 DIV_{i,t} + \beta_3 ILLIQ_{i,t}^{ADR} + \beta_4 ILLIQ_{i,t}^{A} + \beta_5 SENT_t^{S\&P} \\ &+ \beta_6 SENT_t^{SSECI} + \beta_7 SENT_{i,t} + \beta_8 SOE\%_{i,t} + \beta_9 D_t^{EVENT2} + \beta_{10} D_t^{EVENT3} \\ &+ \beta_{11} D_t^{CRISIS1} + \beta_{12} D_t^{CRISIS2} + \beta_{13} D_t^{CRISIS3} + \omega_{i,t} \end{aligned} \quad , (21)$$

Sample: listing in H-share and A-share in the same time

$$\begin{aligned} R_{i,t}^{H} &= \alpha + \beta_1 \Delta S_t^{HKD/RMB} + \beta_2 DIV_{i,t} + \beta_3 ILLIQ_{i,t}^{H} + \beta_4 ILLIQ_{i,t}^{A} + \beta_5 SENT_t^{HSI} \\ &+ \beta_6 SENT_t^{SSECI} + \beta_7 SENT_{i,t} + \beta_8 SOE\%_{i,t} + \beta_9 D_t^{EVENT1} + \beta_{10} D_t^{EVENT2} \\ &+ \beta_{11} D_t^{EVENT3} + \beta_{12} D_t^{CRISIS1} + \beta_{13} D_t^{CRISIS2} + \beta_{14} D_t^{CRISIS3} + \gamma_{i,t} \end{aligned} \quad , (22)$$

$$\begin{aligned} R_{i,t}^{A} &= \alpha + \beta_1 \Delta S_t^{HKD/RMB} + \beta_2 DIV_{i,t} + \beta_3 ILLIQ_{i,t}^{H} + \beta_4 ILLIQ_{i,t}^{A} + \beta_5 SENT_t^{HSI} \\ &+ \beta_6 SENT_t^{SSECI} + \beta_7 SENT_{i,t} + \beta_8 SOE\%_{i,t} + \beta_9 D_t^{EVENT1} + \beta_{10} D_t^{EVENT2} \\ &+ \beta_{11} D_t^{EVENT3} + \beta_{12} D_t^{CRISIS1} + \beta_{13} D_t^{CRISIS2} + \beta_{14} D_t^{CRISIS3} + \upsilon_{i,t} \end{aligned} \quad , (23)$$

where $R_{i,t}^{ADR}$ is the return for firm i on day t (calculated by price of ADRs). $R_{i,t}^{A}$ is the return for firm i on day t (calculated by price of A-Shares). $R_{i,t}^{H}$ is the return for firm i on day t (calculated by price of H-shares). $ILLIQ_{i,t}^{ADR}$, $ILLIQ_{i,t}^{A}$, and $ILLIQ_{i,t}^{H}$ are illiquidity for firm *i* on day *t*. $SENT_t^{S\&P}$, $SENT_t^{SSECI}$, and $SENT_t^{HSI}$ is the market sentiment on day *t*.[36] Other variables are defined above.

The results are shown at Table 5.

[Please insert Table 5 about here]

In Table 5, we find there is a significant relationship between China's government policies and the return of A-share; however, there is no significant relationship between China's government policies and the return of ADR. In addition, we also find that there is a significant relationship between the 1997-1998 Asia financial crisis and the return of A-share, and on the contrary, there is no significant relationship between the 1997-1998 Asia financial crisis and the return of ADR. There are significant relationship between the 2007-2008 Subprime Mortgage Crisis and the return of A-share and ADR, but the 2007-2008 Subprime Mortgage Crisis effect the return of ADR more than the return of A-share for investors in the Chinese market because of the protection of exchange rate mechanism during financial crises; there are significant relationship between financial crises and the return of A-share and H-share, but financial crises affect the return of H-share more than the return of

[36]Illiquidity and market sentiment variables are made by:

$ILLIQ_{i,t}^{ADR} = 1/D_{i,y}\sum_{t=1}^{Diy}\left|R_{i,y,t}^{ADR}\right|/Volume_{i,y,t}^{ADR}$, $ILLIQ_{i,t}^{A} = 1/D_{i,y}\sum_{t=1}^{Diy}\left|R_{i,y,t}^{A}\right|/Volume_{i,y,t}^{A}$, $ILLIQ_{i,t}^{H} = 1/D_{i,y}\sum_{t=1}^{Diy}\left|R_{i,y,t}^{H}\right|/Volume_{i,y,t}^{H}$.

$SENT_t^{S\&P} = \ln(P/E)_t^{S\&P}$, $SENT_t^{SSECI} = \ln(P/E)_t^{SSECI}$, $SENT_t^{HSI} = \ln(P/E)_t^{HSI}$.

A-share for investors in the Chinese market who were protected by exchange rate mechanism in Chinese market during financial crises. It supports that in the light of Figure 1, ADR-A discount and H-A discount become larger during the financial crises. We can also indicate that the capability of explanation of models rises after control variables are added.

V. Conclusions

We make several contributions in this paper. First, this study mainly inspects price discounts of Chinese public listed companies which have issued ADRs (overseas shares in the U.S. market), H-shares (shares traded in the Hong Kong market) and A-shares (shares traded in the China market). Our data are selected from the databases of the Bank of New York, Datastream, and compare with the SEC documents. We find that all underlying stocks of cross-listed level 2 and level 3 ADRs are H-shares, with no ADR can be converted to A-share (home market shares). It is due to A-shares and ADRs cannot transfer into each other. It can explain why there are a big price deviation between A-shares and ADRs before 2007. And because H-shares and ADRs can transfer into each other, the price of ADR gets close to the implied price of H-share by the law of one price.

Second, China is a planned economy country. For Chinese government wants to attract international capital, most Chinese companies are listed in the Hong Kong market first, and later, using H-shares as underlying shares to list ADRs. Chinese government want further Chinese companies to learn from international experience and to solidify the A-shares market, so most Chinese companies go back to list in the home market after listing in the foreign markets.

Third, long-term planning and government policies are important factors when we research on the China's securities market. Chinese Five-Year Plan is an important guidance of economic growth and helps establish principles and direction to the China's securities market. The timetable of the deregulation of the China's securities market can be separated into three periods. In the early limitation period (the eighth and ninth Five-Year Plan), the protection of the Chinese government to the fledgling China's securities market and the overexcited sentiment of Chinese investors have contributed to the much higher prices of A-shares to prices of H-shares and ADRs of the same Chinese company. In the period of the progressive openness of investment limitation (the tenth Five-Year Plan), the Chinese government gradually deregulate the China's securities market, and we could find that prices of A-shares, H-shares and ADRs of the Chinese companies tally in different markets. In the period of encouraging Chinese companies to list in the home market (the eleventh and twelfth Five-Year Plan), there were more listed companies in the China's securities market, and deviations between prices of Chinese companies in different markets are fluctuated again.

Fourth, previous studies focus on the relationship between pricing factors (liquidity, dividend taxes, *etc.*) and share prices in different markets, but without considering plans and regulations of China's government, the studies would have misinterpreted the impact estimation of share prices of Chinese companies in different markets. We collect important government policies through annual Fact Books from the SHSE and Chinese government's news releases published between 1991 and 2012, and factor the collective information into our research. And find that those policies are important factors to prices of the Chinese companies.

Fifth, for we can comprehensively interpret different prices of Chinese companies in different markets, our research also considers financial crises. We discover that price deviations are enlarged during financial crisis period for the Chinese government would protect the Chinese securities; for example, the limitation of the range of currency exchange rate volatility, price limit, *etc*.

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Table1 Summary statistics

Original data	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
A-share price	9.2011	6.1200	144.9900	0.8200	9.3788	3.8308	27.7591
H-share price	7.4376	3.1800	158.9000	0.1010	12.9721	4.2743	26.5536
ADR price	29.2288	20.5800	263.7000	0.6094	28.0672	2.1753	9.2609
Volume (A)	23340.5400	7280.7500	2789878.0000	0.5000	51822.5800	9.5589	228.8018
Volume (H)	31760.7600	6519.5000	18810420.0000	0.0000	118087.8000	57.9806	7352.1570
Volume (ADR)	340.7137	113.2000	32790.7000	0.0000	719.4491	12.2790	348.5890
market data	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Shaihai price index	2095.3570	1764.7460	6395.7540	661.8700	979.7870	1.5884	5.9815
Heng Seng price index	15747.7800	14776.7800	31638.2200	6660.4200	4820.4790	0.4836	2.3811
S&P 500 price index	1164.9760	1183.5000	1565.1500	626.6500	210.8992	-0.4396	2.4987
Shaihai price index (P/E ratio)	2.6621	2.4200	5.8400	0.8300	1.3328	0.4577	2.0844
Heng Seng price index (P/E ratio)	15.3073	15.3900	29.3100	6.5200	3.7852	0.4352	3.4887
S&P 500 price index (P/E ratio)	28.3743	22.1500	146.2700	13.4000	21.7394	3.8819	18.5646
US dollars to RMB ($/RMB)	0.1306	0.1208	0.1607	0.1195	0.0136	0.9361	2.2273
HK dollars to RMB (HKD/RMB)	1.0156	0.9428	1.2455	0.9283	0.1048	0.9289	2.2155
Forward rate ($/RMB)	0.1310	0.1219	0.1596	0.1205	0.0135	0.8740	2.1105
Forward rate (HKD/RMB)	1.0184	0.9482	1.2364	0.9328	0.1037	0.8789	2.1203
explanatory variables	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
Dividend yield	2.5568	1.8400	113.0200	0.0000	4.9934	12.3426	200.0832
Amihud illiquidity (A)	0.0011	0.0002	2.7075	0.0000	0.0129	153.5923	26896.8100
Amihud illiquidity (H)	0.0044	0.0003	7.6980	0.0000	0.0438	64.3682	8411.2740
Amihud illiquidity (ADR)	0.1175	0.0165	42.4052	0.0001	0.5812	23.3425	1007.3460
company sentiment	2.6017	2.4742	9.1479	0.8675	0.8306	2.5776	13.9539
ADR discount	0.0574	0.0028	0.9066	-0.4269	0.1608	2.3822	6.9011
ADR-A discount	-42.6532	-43.9185	98.7485	-89.1077	25.4717	0.5857	3.1410
H-A discount	-43.3636	-45.6731	149.5282	-97.6554	31.8173	0.3905	2.3460

Source: Datastream.
Volume is displayed in thousands. Amihud illiquidity are displayed in %. ADR discount is displayed in %. ADR-A discount is displayed in %. H-A discount is displayed in %.

Table 2 Relationship between ADR discount and impact factors

	1996-2006			1996-2012			2007-2012		
Dependent variable:	ADR-A	H-A	ADR-H	ADR-A	H-A	ADR-H	ADR-A	H-A	ADR-H
c	-90.8881***	-94.2483***	0.0556	-68.8885	-81.0114**	0.0361	-41.8989	-87.6220***	0.0364
	(0.0000)	(0.0003)	(0.4741)	(0.1370)	(0.0209)	(0.5815)	(0.1274)	(0.0004)	(0.3435)
ΔE(FX)	196.0227***	1.5102	-0.0089	41.2570**	1.5140*	0.0169	-21.5061***	2.0702***	0.0616***
	(0.0000)	(0.1348)	(0.6997)	(0.0136)	(0.0548)	(0.4209)	(0.0013)	(0.0000)	(0.0000)
Dividend yield	1.1751	-0.1969	0.0017***	-0.2942	-0.2043	0.0008***	0.4391	-0.3226	0.0000
	(0.2456)	(0.1735)	(0.0032)	(0.7219)	(0.1555)	(0.0149)	(0.6395)	(0.4384)	(0.9949)
Relative illiquidity	-3.2458***	-1.7175*	-4.03E-05	-1.0238	0.0342	2.21E-06	3.1217***	-0.2659	-0.0001
	(0.0006)	(0.0529)	(0.9405)	(0.2220)	(0.9615)	(0.9952)	(0.0001)	(0.5171)	(0.8095)
D(Market sentiment)	18.1128***	22.9186***	-0.0054***	12.6353***	23.4092***	-0.0007	-2.9597*	27.1037***	0.0008
	(0.0000)	(0.0000)	(0.0012)	(0.0008)	(0.0000)	(0.2868)	(0.0780)	(0.0000)	(0.0117)
Company sentiment	0.7687	-2.1546	0.0002	0.8550	-0.9443	0.0007*	-2.3015	0.7595	0.0001
	(0.6765)	(0.2939)	(0.7743)	(0.5983)	(0.4267)	(0.0503)	(0.2845)	(0.4367)	(0.7573)
Adjusted R-squared	0.6885	0.3127	0.0162	0.1738	0.2421	0.0034	0.1063	0.2460	0.0015

The estimates of this table are based on the following equations.

$$ER_{i,t}^{ADR-A} = \alpha + \beta_1 \Delta S_t^{\$/RMB} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{ADR-A} + \beta_4 DSENT_t^{S\&P/SSECI} + \beta_5 SENT_{i,t} + v_{i,t},$$

$$ER_{i,t}^{H-A} = \alpha + \beta_1 \Delta S_t^{HKD/RMB} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{H-A} + \beta_4 DSENT_{i,t}^{HSI/SSECI} + \beta_5 SENT_{i,t} + \gamma_{i,t},$$

$$ER_{i,t}^{ADR-H} = \alpha + \beta_1 \Delta S_t^{\$/HKD} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{ADR-H} + \beta_4 DSENT_t^{S\&P/HSI} + \beta_5 SENT_{i,t} + \varepsilon_{i,t},$$

where $ER_{i,t}^{ADR-A}$ is the ADR-A discount (premium) for firm i on day t. $ER_{i,t}^{H-A}$ is the H-A discount (premium) for firm i on day t. $ER_{i,t}^{ADR-H}$ is the ADR-H discount (premium) for firm i on day t. $\Delta S_t^{\$/RMB}$ is the change of expected exchange rate (US dollars to RMB) on day t. $\Delta S_t^{HKD/RMB}$ is the change of expected exchange rate (HK dollars to RMB) on day t. $\Delta S_t^{\$/HKD}$ is the change of expected exchange rate (US dollars to HKD) on day t. $DIV_{i,t}$ is the dividend yield for firm i on day t. $DILLIQ_{i,t}^{ADR-A}$, $DILLIQ_{i,t}^{H-A}$, and $DILLIQ_{i,t}^{ADR-H}$ are relative illiquidity for firm i on day t . $DSENT_t^{S\&P/SSECI}$, $DSENT_t^{HSI/SSECI}$, and $DSENT_t^{S\&P/HSI}$ is the relative market sentiment on day t. $SENT_{i,t}$ is the company sentiment for firm i on day t. ***, **, and * indicate significant at 1%, 5%, and 10% levels, respectively.

Table 3 Relationship between ADR discount and impact factors (with SOEs, China's government policies, and crises)

Dependent variable: ADR-H discount							
c	0.0384	0.0006	0.0013	0.0379	0.0377	0.0376	0.0338
	(0.6385)	(0.6609)	(0.5574)	(0.6349)	(0.5577)	(0.6761)	(0.5555)
ΔE(FX)	-0.0078						0.0013
	(0.6646)						(0.9526)
Dividend yield		0.0010**					0.0008***
		(0.0204)					(0.0087)
Relative illiquidity			0.0003				0.0002
			(0.3558)				(0.5772)
D(Market sentiment)				0.0009			-0.0002
				(0.2949)			(0.7694)
Company sentiment					0.0005		0.0007
					(0.1802)		(0.1238)
SOE%						0.0000	0.0000
						(0.1612)	(0.1528)
EVENT_STOCK	0.0012***	-0.0002**	-0.0024**	0.0013***	0.0017**	0.0011	0.0016**
	(0.0059)	(0.0398)	(0.0142)	(0.0065)	(0.0107)	(0.1404)	(0.0377)
EVENT_SOE	0.0005	0.0046	0.0018***	0.0002	-0.0021	-0.0013	-0.0028*
	(0.6692)	(0.8306)	(0.0003)	(0.8460)	(0.1879)	(0.1974)	(0.0551)
CRISIS_1997	0.0039	-0.0055	-0.0033	0.0043	-0.0047	0.0069***	0.0008
	(0.2070)	(0.2055)	(0.6763)	(0.2765)	(0.2843)	(0.0000)	(0.8645)
CRISIS_2000	-0.0052	0.0021*	0.0024	-0.0055*	-0.0019	-0.0024**	-0.0015
	(0.1026)	(0.0956)	(0.3818)	(0.0917)	(0.6580)	(0.0363)	(0.6571)
CRISIS_2007	0.0019*	0.0369**	0.0364**	0.0020*	0.0013**	0.0020***	0.0014*
	(0.0688)	(0.0335)	(0.0127)	(0.0899)	(0.0454)	(0.0039)	(0.0578)
Adjusted R-squared	0.0051	0.0071	0.0035	0.0052	0.0028	0.0042	0.0055
Dependent variable: ADR-A discount							
c	-38.1465	-37.7978	-33.9440	-38.6242***	-35.8602	-28.5339	-28.7910**
	(0.5471)	(0.5269)	(0.4337)	(0.0000)	(0.5592)	(0.3034)	(0.0007)
ΔE(FX)	8.8261						15.1263*
	(0.3074)						(0.0937)
Dividend yield		-0.0967					-0.9574
		(0.8894)					(0.1204)
Relative illiquidity			-0.7288				-1.6111***
			(0.3236)				(0.0057)
D(Market sentiment)				0.0026			4.0516*
				(0.9924)			(0.0980)
Company sentiment					-0.4051		-0.4420
					(0.7908)		(0.7454)
SOE%						-0.2247***	-0.2071***
						(0.0009)	(0.0012)
EVENT_STOCK	23.8622***	24.7555***	24.6916***	24.9890***	27.6563***	27.3298***	28.5618***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
EVENT_SOE	-21.7828***	-21.9107***	-21.6298***	-21.6495***	-22.1929***	-18.5350***	-16.6126***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
CRISIS_1997	-16.4977***	-16.5687***	-17.9636***	-16.5780***	-25.6762***	-11.4113***	-15.9919***
	(0.0005)	(0.0008)	(0.0005)	(0.0000)	(0.0000)	(0.0034)	(0.0028)
CRISIS_2000	-24.7291***	-24.9529***	-23.9648***	-24.8334***	-28.3353***	-22.8120***	-18.3486***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
CRISIS_2007	-10.9138***	-9.7593***	-10.5343***	-9.0750***	-8.6206***	-6.2575**	-5.4873**
	(0.0000)	(0.0005)	(0.0002)	(0.0000)	(0.0011)	(0.0207)	(0.0486)
Adjusted R-squared	0.4243	0.4220	0.4170	0.4355	0.4496	0.4717	0.7535
Dependent variable: H-A discount							
c	-6.7453	-31.2285	-31.1335	-70.5698*	-31.7568	-23.0244	-53.9793
	(0.3630)	(0.3751)	(0.3416)	(0.0587)	(0.3432)	(0.5722)	(0.1791)
ΔE(FX)	0.9095**						1.0087***
	(0.0310)						(0.0000)
Dividend yield		-0.2613**					-0.1459
		(0.0404)					(0.2161)
Relative illiquidity			-0.9251				-0.1681
			(0.1450)				(0.8316)
D(Market sentiment)				17.9088***			13.8220***
				(0.0000)			(0.0013)
Company sentiment					-1.3270		-0.0815
					(0.2398)		(0.9409)
SOE%						-0.2333***	-0.1953***
						(0.0000)	(0.0000)
EVENT_STOCK	18.3397***	18.7916***	18.9262***	10.3263***	20.7232***	22.4560***	15.9735***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
EVENT_SOE	-26.4858***	-26.7345***	-27.3343***	-19.7474***	-26.2062***	-21.2739***	-15.5304***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0006)
EVENT_3	37.1837***	39.6066***	39.5156***	48.7716***	36.6020***	45.8482***	46.5507***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
CRISIS_1997	-19.7271***	-19.1198***	-19.7304***	-3.4898***	-21.0811***	-16.1678***	-6.9844
	(0.0000)	(0.0000)	(0.0000)	(0.3967)	(0.0000)	(0.0000)	(0.1854)
CRISIS_2000	-31.0608***	-31.4162***	-31.1293***	-11.6584**	-31.0957***	-28.0135***	-12.6749
	(0.0000)	(0.0000)	(0.0000)	(0.0235)	(0.0000)	(0.0000)	(0.1378)
CRISIS_2007	-31.7801***	-6.1140***	-6.1947***	2.8495	-5.1629***	1.3240	6.5551**
	(0.0002)	(0.0006)	(0.0005)	(0.2299)	(0.0034)	(0.5836)	(0.0258)
Adjusted R-squared	0.2645	0.2638	0.2582	0.3110	0.2597	0.2753	0.2951

The estimates of this table are based on the following equations.

$$ER_{i,t}^{ADR-H} = \alpha + \beta_1 \Delta S_t^{\$/HKD} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{ADR-H} + \beta_4 DSENT_t^{S\&P/HSI} + \beta_5 SENT_{i,t} + \beta_6 SOE\%_{i,t},$$
$$+ \beta_7 D_t^{EVENT2} + \beta_8 D_t^{EVENT3} + \beta_9 D_t^{CRISIS1} + \beta_{10} D_t^{CRISIS2} + \beta_{11} D_t^{CRISIS3} + \varepsilon_{i,t}$$

$$ER_{i,t}^{ADR-A} = \alpha + \beta_1 \Delta S_t^{\$/RMB} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{ADR-A} + \beta_4 DSENT_t^{S\&P/SSECI} + \beta_5 SENT_{i,t} + \beta_6 SOE\%_{i,t},$$
$$+ \beta_7 D_t^{EVENT2} + \beta_8 D_t^{EVENT3} + \beta_9 D_t^{CRISIS1} + \beta_{10} D_t^{CRISIS2} + \beta_{11} D_t^{CRISIS3} + v_{i,t}$$

$$ER_{i,t}^{H-A} = \alpha + \beta_1 \Delta S_t^{HKD/RMB} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{H-A} + \beta_4 DSENT_{i,t}^{HSI/SSECI} + \beta_5 SENT_{i,t} + \beta_6 SOE\%_{i,t}, \\ + \beta_7 D_t^{EVENT1} + \beta_8 D_t^{EVENT2} + \beta_9 D_t^{EVENT3} + \beta_{10} D_t^{CRISIS1} + \beta_{11} D_t^{CRISIS2} + \beta_{12} D_t^{CRISIS3} + \gamma_{i,t}$$

where $ER_{i,t}^{ADR-H}$ is the ADR-H discount (premium) for firm *i* on day *t*. $ER_{i,t}^{ADR-A}$ is the ADR-A discount (premium) for firm *i* on day *t*. $ER_{i,t}^{H-A}$ is the H-A discount (premium) for firm *i* on day *t*. $\Delta S_t^{\$/HKD}$ is the change of expected exchange rate (US dollars to HKD) on day *t*. $\Delta S_t^{\$/RMB}$ is the change of expected exchange rate (US dollars to RMB) on day *t*. $\Delta S_t^{HKD/RMB}$ is the change of expected exchange rate (HK dollars to RMB) on day *t*. $DIV_{i,t}$ is the dividend yield for firm *i* on day *t*. $DILLIQ_{i,t}^{ADR-H}$, $DILLIQ_{i,t}^{ADR-A}$, and $DILLIQ_{i,t}^{H-A}$ are relative illiquidity for firm *i* on day *t*. $DSENT_t^{S\&P/HSI}$, $DSENT_t^{S\&P/SSECI}$, and $DSENT_t^{HSI/SSECI}$ is the relative market sentiment on day *t*. $SENT_{i,t}$ is the company sentiment for firm *i* on day *t*. $SOE\%_{i,t}$ is the proportion of state-owned shares (relative to outstanding shares). $D^{EVENT1}{}_t$ is the three bailout policies in 1994. $D^{EVENT2}{}_t$ is the announcement of the sale of all sate shares in 2001. $D^{EVENT3}{}_t$ is the non-tradable share reform in 2005. $D^{CRISIS1}{}_t$ is the dummy variable for the 1997-1998 Asia financial crisis, $D^{CRISIS2}{}_t$ is the dummy variable for the 2000-2001 dotcom bubble. $D^{CRISIS3}{}_t$ is the dummy variable for 2007-to-2008 Subprime Mortgage Crisis (D_t= 1 during the crisis periods, otherwise=0). ***, **, and * indicate significant at 1%, 5%, and 10% levels, respectively.

Table 4 Relationship between ADR discount and impact factors (Five-year program)

Dependent variable: ADR-H discount

	1996-2000	2001-2005	Wald test	2006-2012	Wald test
c	0.1558	-0.0414		0.0353	
	(0.5148)	(0.7313)		(0.4218)	
ΔE(FX)	-0.1344	0.1857		0.0361*	
	(0.1147)	(0.4576)	(0.4486)	(0.0527)	(0.4267)
Dividend yield	0.0061***	0.0308**		0.0001	
	(0.0000)	(0.0183)	(0.0000)***	(0.5929)	(0.0000)***
Relative illiquidity	0.0016*	0.0107		2.89E-05	
	(0.0650)	(0.5835)	(0.0007)***	(0.9287)	(0.0081)***
D(Market sentiment)	-0.0314***	-0.0014		0.0009***	
	(0.0097)	(0.9815)	(0.0000)***	(0.0092)	(0.1998)
Company sentiment	0.0063	0.0272		0.0002	
	(0.2780)	(0.3899)	(0.0000)***	(0.5720)	(0.0002)***
SOE%	0.0000	-0.0004		7.13E-06	
	(0.9945)	(0.8275)	(0.2323)	(0.5382)	(0.0000)***
EVENT_STOCK				0.0011	
				(0.2275)	
EVENT_SOE		0.0366			
		(0.4477)			
CRISIS_1997	-0.0005				
	(0.9234)				
CRISIS_2000	0.0052	0.0378			
	(0.5398)	(0.5362)			
CRISIS_2007				0.0016**	
				(0.0363)	
Adjusted R-squared	0.9795	0.1221		0.0030	

Dependent variable: ADR-A discount

	1996-2000	2001-2005	Wald test	2006-2012	Wald test
c	-1321.4980***	43.5584		-11.6686	
	(0.0000)	(0.4413)		(0.2887)	
ΔE(FX)	-206.3655***	106.8353***		-10.1848	
	(0.0001)	(0.0000)	(0.6328)	(0.1186)	(0.0000)***
Dividend yield	-2.1005*	0.0494		-0.0909	
	(0.0853)	(0.9610)	(0.0000)***	(0.9271)	(0.0000)***
Relative illiquidity	-0.6007***	-1.7715***		-1.0815	
	(0.0032)	(0.0001)	(0.0007)***	(0.2503)	(0.0000)***
D(Market sentiment)	6.7134	19.7300***		-0.9578	
	(0.4783)	(0.0001)	(0.0000)***	(0.6776)	(0.0000)***
Company sentiment	1.0604	1.6440		-3.6753***	
	(0.6265)	(0.1911)	(0.0000)***	(0.0265)	(0.0000)***
SOE%	21.0995***	-2.2275***		-0.1784***	
	(0.0000)	(0.0065)	(0.0000)***	(0.0115)	(0.0000)***
EVENT_STOCK				31.8648***	
				(0.0000)	
EVENT_SOE		-11.3913***			
		(0.0000)			
CRISIS_1997	-3.6176				
	(0.4541)				
CRISIS_2000	-5.2850	8.0552			
	(0.2461)	(0.1921)			
CRISIS_2007				-5.3960	
				(0.1215)	
Adjusted R-squared	0.6848	0.8526		0.3785	

Dependent variable: H-A discount

	1993-2000	2001-2005	Wald test	2006-2012	Wald test
c	-77.2156***	38.3166		-95.2129***	
	(0.0000)	(0.5609)		(0.0057)	
ΔE(FX)	1.1228***	7.4536***		1.3741***	
	(0.0000)	(0.0000)	(0.0000)***	(0.0048)	(0.0000)***
Dividend yield	-0.3015*	1.1791		-0.4853	
	(0.0875)	(0.1345)	(0.0000)***	(0.2967)	(0.0000)***
Relative illiquidity	-5.3507***	-1.0348***		0.4368	
	(0.0042)	(0.0010)	(0.0000)***	(0.2669)	(0.0000)***
D(Market sentiment)	16.1707**	27.6135**		30.7146***	
	(0.0439)	(0.0000)	(0.0000)***	(0.0000)	(0.0000)***
Company sentiment	0.3961	1.0720		1.0581	
	(0.8866)	(0.5806)	(0.0000)***	(0.3380)	(0.7916)
SOE%	0.1377	-3.1209***		-0.0004	
	(0.5892)	(0.0074)	(0.0000)***	(0.9920)	(0.0417)**
EVENT_STOCK				6.2213*	
				(0.0554)	
EVENT_SOE		1.2860			
		(0.6288)			
EVENT_3	41.5648***				
	(0.0000)				
CRISIS_1997	-15.8871**				
	(0.0473)				
CRISIS_2000	-22.2166**	16.8718***			
	(0.0246)	(0.0005)			
CRISIS_2007				6.9038***	
				(0.0000)	
Adjusted R-squared	0.4791	0.6819		0.2875	

The estimates of this table are based on the following equations.

$$ER_{i,t}^{ADR-H} = \alpha + \beta_1 \Delta S_t^{\$/HKD} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{ADR-H} + \beta_4 DSENT_t^{S\&P/HSI} + \beta_5 SENT_{i,t} + \beta_6 SOE\%_{i,t},$$
$$+ \beta_7 D_t^{EVENT2} + \beta_8 D_t^{EVENT3} + \beta_9 D_t^{CRISIS1} + \beta_{10} D_t^{CRISIS2} + \beta_{11} D_t^{CRISIS3} + \varepsilon_{i,t}$$

$$ER_{i,t}^{ADR-A} = \alpha + \beta_1 \Delta S_t^{\$/RMB} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{ADR-A} + \beta_4 DSENT_t^{S\&P/SSECI} + \beta_5 SENT_{i,t} + \beta_6 SOE\%_{i,t},$$
$$+ \beta_7 D_t^{EVENT2} + \beta_8 D_t^{EVENT3} + \beta_9 D_t^{CRISIS1} + \beta_{10} D_t^{CRISIS2} + \beta_{11} D_t^{CRISIS3} + v_{i,t}$$

$$ER_{i,t}^{H-A} = \alpha + \beta_1 \Delta S_t^{HKD/RMB} + \beta_2 DIV_{i,t} + \beta_3 DILLIQ_{i,t}^{H-A} + \beta_4 DSENT_{i,t}^{HSI/SSECI} + \beta_5 SENT_{i,t} + \beta_6 SOE\%_{i,t},$$
$$+ \beta_7 D_t^{EVENT1} + \beta_8 D_t^{EVENT2} + \beta_9 D_t^{EVENT3} + \beta_{10} D_t^{CRISIS1} + \beta_{11} D_t^{CRISIS2} + \beta_{12} D_t^{CRISIS3} + \gamma_{i,t}$$

where $ER_{i,t}^{ADR-H}$ is the ADR-H discount (premium) for firm i on day t. $ER_{i,t}^{ADR-A}$ is the ADR-A discount (premium) for firm i on day t. $ER_{i,t}^{H-A}$ is the H-A discount (premium) for firm i on day t. $\Delta S_t^{\$/HKD}$ is the change of expected exchange rate (US dollars to HKD) on day t. $\Delta S_t^{\$/RMB}$ is the change of expected exchange rate (US dollars to RMB) on day *t*. $\Delta S_t^{HKD/RMB}$ is the change of expected exchange rate (HK dollars to RMB) on day *t*. $DIV_{i,t}$ is the dividend yield for firm *i* on day *t*. $DILLIQ_{i,t}^{ADR-H}$, $DILLIQ_{i,t}^{ADR-A}$, and $DILLIQ_{i,t}^{H-A}$ are relative illiquidity for firm *i* on day *t*. $DSENT_t^{S\&P-HSI}$, $DSENT_t^{S\&P-SSECI}$, and $DSENT_t^{HSI-SSECI}$ is the relative market sentiment on day *t*. $SENT_{i,t}$ is the company sentiment for firm *i* on day *t*. $SOE\%_{i,t}$ is the proportion of state-owned shares (relative to outstanding shares). $D^{EVENT1}{}_t$ is the three bailout policies in 1994. $D^{EVENT2}{}_t$ is the announcement of the sale of all sate shares in 2001. $D^{EVENT3}{}_t$ is the non-tradable shares reform in 2005. $D^{CRISIS1}{}_t$ is the dummy variable for the 1997-1998 Asia financial crisis, $D^{CRISIS2}{}_t$ is the dummy variable for the 2000-2001 dotcom bubble. $D^{CRISIS3}{}_t$ is the dummy variable for 2007-to-2008 Subprime Mortgage Crisis (D_t= 1 during the crisis periods, otherwise=0). ***, **, and * indicate significant at 1%, 5%, and 10% levels, respectively.

Table 5 relationship between return and impact factors

	1996-2012				2007-2012			
	ADR	ADR	H	H	ADR	ADR	H	H
c	-0.1719	0.0065	-0.3597***	-0.1759	-0.1954	-0.2333*	-0.4346***	-0.5005***
	(0.1557)	(0.9584)	(0.0025)	(0.1805)	(0.1244)	(0.0845)	(0.0017)	(0.0008)
ΔE(FX)	1.6740**	1.7946*	1.3518*	2.1221**	0.7130	3.6757	0.3236	5.8192***
	(0.0245)	(0.0543)	(0.0504)	(0.0282)	(0.6956)	(0.1093)	(0.8598)	(0.0067)
Dividend yield	0.0000	-0.0323**	-0.0063	-0.0380**	0.0169	0.0146	-0.0003	-0.0045
	(0.9985)	(0.0310)	(0.6131)	(0.0234)	(0.3482)	(0.4139)	(0.9874)	(0.8142)
illiquidity_ADR	-0.0872**	-0.0800**	-0.1111***	-0.1084***	-0.3607	-0.4291	-0.2731	-0.3954
	(0.0139)	(0.0493)	(0.0018)	(0.0065)	(0.2901)	(0.2069)	(0.4306)	(0.2463)
illiquidity_H	-1.0798	-1.2567	-0.1569	-0.2941	-204.0639*	-177.2499*	-198.5823*	-152.0889
	(0.3877)	(0.3170)	(0.8535)	(0.7214)	(0.0537)	(0.0936)	(0.0529)	(0.1480)
Market sentiment_US	0.0015**	0.0009	0.0011	0.0007	0.0011*	0.0005	0.0003	-0.0007
	(0.0434)	(0.2275)	(0.1219)	(0.3487)	(0.0643)	(0.4520)	(0.5573)	(0.2133)
Market sentiment_HK	0.0087	0.0034	0.0248***	0.0213****	0.0114	0.0148*	0.0368***	0.0427***
	(0.2388)	(0.6358)	(0.0006)	(0.0047)	(0.1022)	(0.0560)	(0.0000)	(0.0000)
Company sentiment	-0.0280	-0.0095	-0.0400*	-0.0300	0.0022	0.0081	-0.0233	-0.0150
	(0.1966)	(0.7201)	(0.0759)	(0.2977)	(0.9466)	(0.7982)	(0.5268)	(0.6648)
SOE%	-0.0002	0.0004	-0.0004	-0.0011	-0.0015*	-0.0010	-0.0020**	-0.0011
	(0.7911)	(0.6285)	(0.5785)	(0.2045)	(0.0717)	(0.2263)	(0.0383)	(0.2290)
EVENT_STOCK		0.0170		0.0050		0.0104		-0.1135
		(0.6020)		(0.8862)		(0.9053)		(0.2142)
EVENT_SOE		-0.1364		-0.0761				
		(0.1099)		(0.4341)				
CRISIS_1997		-0.0765		0.1483				
		(0.6753)		(0.3842)				
CRISIS_2000		0.1181		0.0864				
		(0.4755)		(0.5562)				
CRISIS_2007		-0.1841***		-0.1733***		-0.1655**		-0.2858***
		(0.0003)		(0.0018)		(0.0370)		(0.0006)
Adjusted R-squared	0.0005	0.0011	0.0018	0.0023	0.0002	0.0003	0.0022	0.0031

	1996-2012				2007-2012			
	ADR	ADR	A	A	ADR	ADR	A	A
c	-0.0094	0.0614	0.0012	0.0013	-0.0017	-0.0007	-0.0019	0.0006
	(0.9460)	(0.6943)	(0.4328)	(0.4259)	(0.3295)	(0.7496)	(0.4212)	(0.8160)
ΔE(FX)	-0.2973	-0.1784	-0.0055**	-0.0084***	-0.0054	-0.0053	-0.0163***	-0.0186***
	(0.1714)	(0.5196)	(0.0259)	(0.0031)	(0.1779)	(0.1808)	(0.0001)	(0.0000)
Dividend yield	-0.0061	-0.0386*	-0.0003**	-0.0007***	0.0002	1.26E-05	2.70E-05	-0.0002
	(0.7248)	(0.0293)	(0.0920)	(0.0005)	(0.2511)	(0.9532)	(0.9188)	(0.3270)
illiquidity_ADR	-0.0921**	-0.0953**	-0.0007***	-0.0007**	-0.0028	-0.0029	-0.0008	-0.0015
	(0.0193)	(0.0281)	(0.0062)	(0.0153)	(0.4634)	(0.4504)	(0.8295)	(0.4596)
illiquidity_A	-1.5138	-1.3732	-0.0088	-0.0073	-11.8620***	-16.2542***	-17.7430***	-24.2391***
	(0.4908)	(0.5410)	(0.1951)	(0.3080)	(0.0001)	(0.0000)	(0.0000)	(0.0000)
Market sentiment_US	0.0013	0.0003	9.10E-06**	-4.80E-06	6.20E-07	-4.20E-06	-1.25E-05*	-2.37E-05***
	(0.1058)	(0.7459)	(0.0469)	(0.4684)	(0.9276)	(0.5463)	(0.0600)	(0.0024)
Market sentiment_CN	0.0032	0.0260	0.0005***	0.0017***	0.0006	0.0007	0.0024***	0.0035***
	(0.8341)	(0.4227)	(0.0009)	(0.0004)	(0.1991)	(0.2094)	(0.0000)	(0.0000)
Company sentiment	-0.0300	-0.0153	-0.0009**	-0.0009**	0.0003	0.0005	-0.0003	-0.0007
	(0.3555)	(0.6854)	(0.0154)	(0.0155)	(0.5546)	(0.4161)	(0.5974)	(0.2226)
SOE%	0.0013	0.0012	1.10E-05	3.06E-06	8.01E-06	-1.32E-06	1.04E-05	-2.94E-06
	(0.1445)	(0.2056)	(0.2346)	(0.7135)	(0.4195)	(0.8921)	(0.4628)	(0.7889)
EVENT_STOCK		0.0201		0.0031***		-0.0014		0.0037***
		(0.7164)		(0.0000)		(0.1469)		(0.0002)
EVENT_SOE		-0.0969		-0.0015				
		(0.1451)		(0.1920)				
CRISIS_1997		-0.3691		-0.0048**				
		(0.1947)		(0.0231)				
CRISIS_2000		0.1674		-0.0038**				
		(0.2896)		(0.0322)				
CRISIS_2007		-0.2357**		-0.0034***		-0.0006		-0.0030***
		(0.0116)		(0.0001)		(0.5459)		(0.0056)
Adjusted R-squared	0.0001	0.0010	0.0015	0.0046	0.0023	0.0031	0.0111	0.0176

	1996-2012				2007-2012			
	H	H	A	A	H	H	A	A
c	-0.1123	-0.1443	-0.2388***	-0.2279***	0.0832	0.1743	-0.2830***	-0.2005***
	(0.2135)	(0.1327)	(0.0000)	(0.0000)	(0.5431)	(0.2015)	(0.0020)	(0.0010)
ΔE(FX)	-0.1172***	-0.1940***	-0.0251	-0.0352	-0.2780***	-0.3250***	-0.2349***	-0.2756***
	(0.0000)	(0.0000)	(0.1512)	(0.1105)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Dividend yield	0.0019	-0.0012	-0.0014	-0.0026	-0.0813***	-0.0778***	-0.0434***	-0.0405***
	(0.7015)	(0.7383)	(0.4365)	(0.1576)	(0.0001)	(0.0001)	(0.0000)	(0.0000)
illiquidity_H	-0.6312	-0.7381	-0.6695**	-0.7663**	-1.5272	-1.6307	-1.2447***	-1.3490**
	(0.1769)	(0.1071)	(0.0321)	(0.0145)	(0.2435)	(0.2142)	(0.0000)	(0.0499)
illiquidity_A	-3.4175**	-3.1457*	-6.0098**	-6.0377**	-55.9327	-33.9744	-101.7883*	-78.7081**
	(0.0475)	(0.0603)	(0.0320)	(0.0348)	(0.2350)	(0.4043)	(0.0714)	(0.0229)
Market sentiment_HK	-0.0001	-0.0200**	0.0140***	0.0029	-0.0232**	-0.0703***	0.0013**	-0.0412***
	(0.9866)	(0.0115)	(0.0000)	(0.4227)	(0.0124)	(0.0000)	(0.0133)	(0.0000)
Market sentiment_CN	0.0754***	0.2745***	0.0280***	0.1190***	0.2646***	0.6253***	0.2442	0.5683***
	(0.0009)	(0.0000)	(0.0010)	(0.0000)	(0.0000)	(0.0000)	(0.7984)	(0.0000)
Company sentiment	-0.0204	-0.0381	-0.0058	-0.0141	-0.1757***	-0.1832***	-0.0520***	-0.0592***
	(0.5647)	(0.2595)	(0.6185)	(0.2756)	(0.0012)	(0.0007)	(0.0000)	(0.0029)
SOE%	-0.0002	-0.0009	-0.0004	-0.0009**	-0.0007	-0.0002	-0.0017***	-0.0012***
	(0.8088)	(0.2796)	(0.2992)	(0.0120)	(0.5229)	(0.8894)	(0.0098)	(0.0082)
EVENT_STOCK		0.5185***		0.3572***		1.3895***		1.2099***
		(0.0000)		(0.0000)		(0.0000)		(0.0000)
EVENT_SOE		-0.2913**		-0.1614***				
		(0.0137)		(0.0015)				
EVENT_3		3.0742***		2.8583***				
		(0.0000)		(0.0000)				
CRISIS_1997		-0.4115***		-0.1606**				
		(0.0007)		(0.0180)				
CRISIS_2000		-1.0437***		-0.2974**				
		(0.0000)		(0.0147)				
CRISIS_2007		-0.2991***		-0.2086***		-0.6600***		-0.5941***
		(0.0006)		(0.0000)		(0.0000)		(0.0000)
Adjusted R-squared	0.0001	0.0006	0.0007	0.0031	0.0009	0.0020	0.0041	0.0087

The estimates of this table are based on the following equations:

Sample: listing in ADR and H-share in the same time

$$\begin{aligned} R_{i,t}^{ADR} = {} & \alpha + \beta_1 \Delta S_t^{\$/HKD} + \beta_2 DIV_{i,t} + \beta_3 ILLIQ_{i,t}^{ADR} + \beta_4 ILLIQ_{i,t}^{H} + \beta_5 SENT_t^{S\&P} + \beta_6 SENT_t^{HSI} + \beta_7 SENT_{i,t} + \beta_8 SOE\%_{i,t}, \\ & + \beta_9 D_t^{EVENT2} + \beta_{10} D_t^{EVENT3} + \beta_{11} D_t^{CRISIS1} + \beta_{12} D_t^{CRISIS2} + \beta_{13} D_t^{CRISIS3} + \varepsilon_{i,t} \end{aligned}$$

$$\begin{aligned} R_{i,t}^{H} = {} & \alpha + \beta_1 \Delta S_t^{\$/HKD} + \beta_2 DIV_{i,t} + \beta_3 ILLIQ_{i,t}^{ADR} + \beta_4 ILLIQ_{i,t}^{H} + \beta_5 SENT_t^{S\&P} + \beta_6 SENT_t^{HSI} + \beta_7 SENT_{i,t} + \beta_8 SOE\%_{i,t}, \\ & + \beta_9 D_t^{EVENT2} + \beta_{10} D_t^{EVENT3} + \beta_{11} D_t^{CRISIS1} + \beta_{12} D_t^{CRISIS2} + \beta_{13} D_t^{CRISIS3} + \mu_{i,t} \end{aligned}$$

Sample: listing in ADR and A-share in the same time

$$\begin{aligned} R_{i,t}^{ADR} = {} & \alpha + \beta_1 \Delta S_t^{\$/RMB} + \beta_2 DIV_{i,t} + \beta_3 ILLIQ_{i,t}^{ADR} + \beta_4 ILLIQ_{i,t}^{A} + \beta_5 SENT_t^{S\&P} + \beta_6 SENT_t^{SSECI} + \beta_7 SENT_{i,t} + \beta_8 SOE\%_{i,t}, \\ & + \beta_9 D_t^{EVENT2} + \beta_{10} D_t^{EVENT3} + \beta_{11} D_t^{CRISIS1} + \beta_{12} D_t^{CRISIS2} + \beta_{13} D_t^{CRISIS3} + \nu_{i,t} \end{aligned}$$

$$\begin{aligned} R_{i,t}^{A} = {} & \alpha + \beta_1 \Delta S_t^{\$/RMB} + \beta_2 DIV_{i,t} + \beta_3 ILLIQ_{i,t}^{ADR} + \beta_4 ILLIQ_{i,t}^{A} + \beta_5 SENT_t^{S\&P} + \beta_6 SENT_t^{SSECI} + \beta_7 SENT_{i,t} + \beta_8 SOE\%_{i,t}, \\ & + \beta_9 D_t^{EVENT2} + \beta_{10} D_t^{EVENT3} + \beta_{11} D_t^{CRISIS1} + \beta_{12} D_t^{CRISIS2} + \beta_{13} D_t^{CRISIS3} + \omega_{i,t} \end{aligned}$$

Sample: listing in H-share and A-share in the same time

$$\begin{aligned} R_{i,t}^{H} = {} & \alpha + \beta_1 \Delta S_t^{HKD/RMB} + \beta_2 DIV_{i,t} + \beta_3 ILLIQ_{i,t}^{H} + \beta_4 ILLIQ_{i,t}^{A} + \beta_5 SENT_t^{HSI} + \beta_6 SENT_t^{SSECI} + \beta_7 SENT_{i,t} + \beta_8 SOE\%_{i,t}, \\ & + \beta_9 D_t^{EVENT1} + \beta_{10} D_t^{EVENT2} + \beta_{11} D_t^{EVENT3} + \beta_{12} D_t^{CRISIS1} + \beta_{13} D_t^{CRISIS2} + \beta_{14} D_t^{CRISIS3} + \gamma_{i,t} \end{aligned}$$

$$\begin{aligned} R_{i,t}^{A} = {} & \alpha + \beta_1 \Delta S_t^{HKD/RMB} + \beta_2 DIV_{i,t} + \beta_3 ILLIQ_{i,t}^{H} + \beta_4 ILLIQ_{i,t}^{A} + \beta_5 SENT_t^{HSI} + \beta_6 SENT_t^{SSECI} + \beta_7 SENT_{i,t} + \beta_8 SOE\%_{i,t}, \\ & + \beta_9 D_t^{EVENT1} + \beta_{10} D_t^{EVENT2} + \beta_{11} D_t^{EVENT3} + \beta_{12} D_t^{CRISIS1} + \beta_{13} D_t^{CRISIS2} + \beta_{14} D_t^{CRISIS3} + \upsilon_{i,t} \end{aligned}$$

where $R_{i,t}^{ADR}$ is the return for firm i on day t (calculated by price of ADRs). $R_{i,t}^{A}$ is the return for firm i on day t (calculated by price of A-Shares). $R_{i,t}^{H}$ is the return for firm i on day t (calculated by price of H-shares). $\Delta S_t^{\$/HKD}$ is the change of expected exchange rate (US dollars to HKD) on day *t*. $\Delta S_t^{\$/RMB}$ is the change of expected exchange rate (US dollars to RMB) on day *t*. $\Delta S_t^{HKD/RMB}$ is the change of expected exchange rate (HK dollars to RMB) on day *t*. $DIV_{i,t}$ is the dividend yield for firm *i* on day t. $ILLIQ_{i,t}^{ADR}, ILLIQ_{i,t}^{A}$, and $ILLIQ_{i,t}^{H}$ are illiquidity for firm *i* on day *t*. $SENT_t^{S\&P}, SENT_t^{SSECI}$, and $SENT_t^{HSI}$ is the market sentiment on day *t*. $SENT_{i,t}$ is the company sentiment for firm *i* on day *t*. $SOE\%_{i,t}$ is the proportion of state-owned shares (relative to outstanding shares). ${D^{EVENT1}}_t$ is the three bailout policies in 1994. ${D^{EVENT2}}_t$ is the announcement of the sale of all sate shares in 2001. ${D^{EVENT3}}_t$ is the non-tradable shares reform in 2005. ${D^{CRISIS1}}_t$ is the dummy variable for the 1997-1998 Asia financial crisis, ${D^{CRISIS2}}_t$ is the dummy variable for the 2000-2001 dotcom bubble. ${D^{CRISIS3}}_t$ is the dummy variable for 2007-to-2008 Subprime Mortgage Crisis (D_t= 1 during the crisis periods, otherwise=0). ***, **, and * indicate significant at 1%, 5%, and 10% levels, respectively.

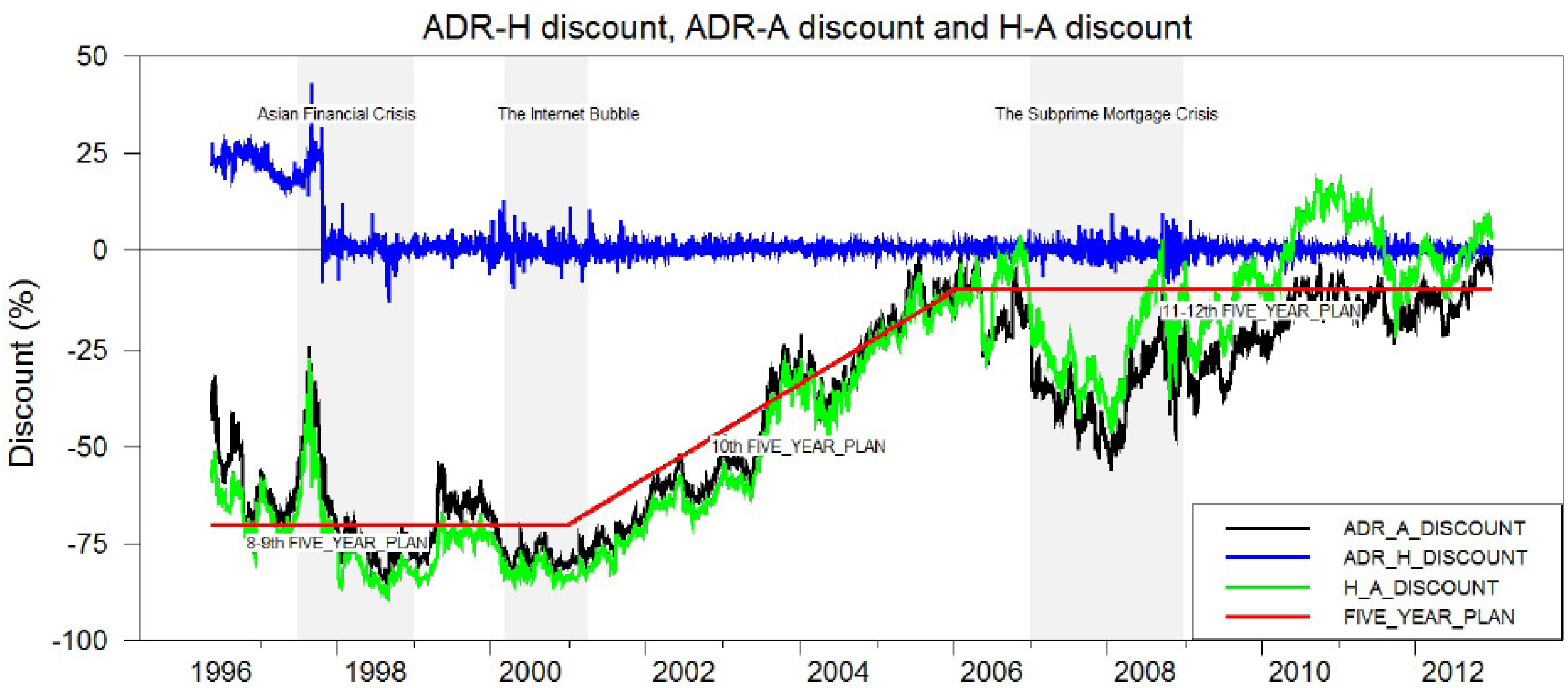

Fig. 1 ADR-H discount, ADR-A discount and H-A discount

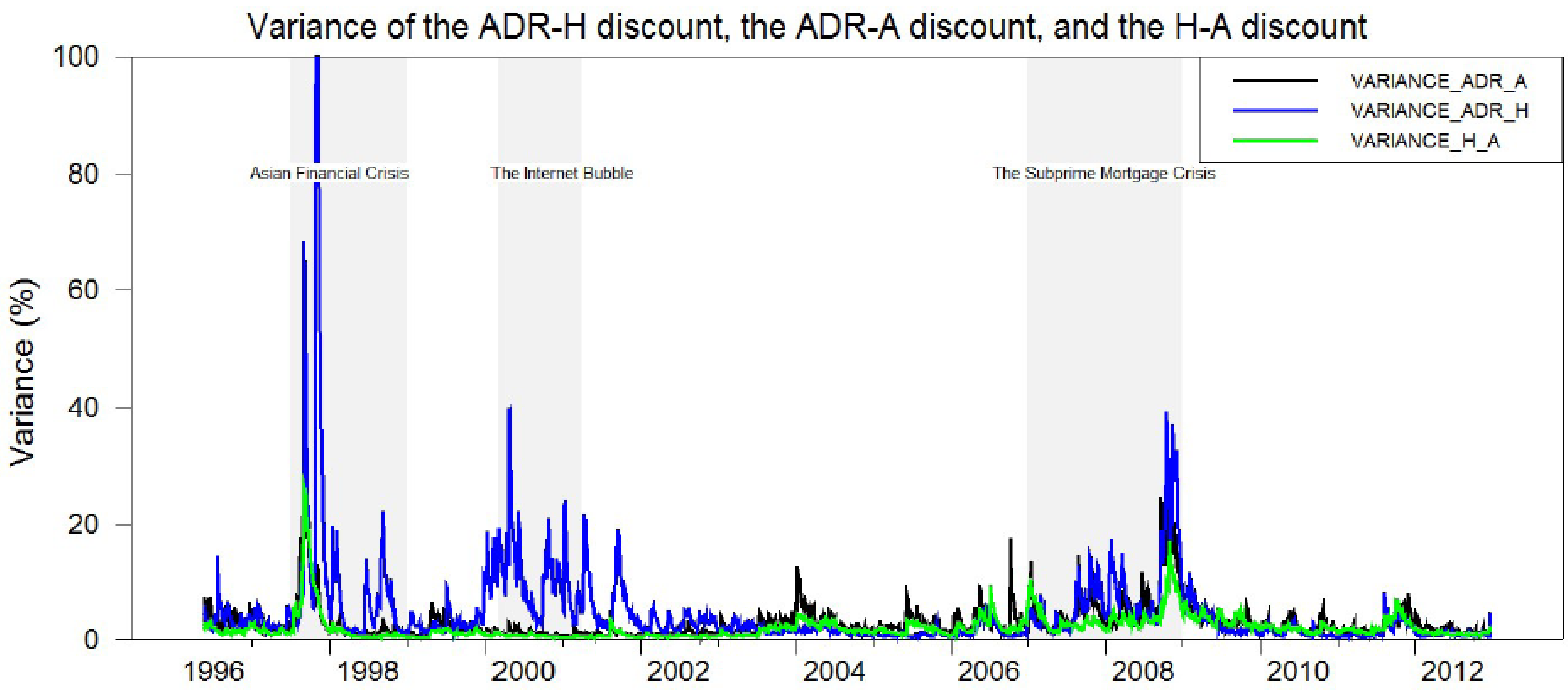

Fig. 2 Variance of the ADR-H discount, ADR-A discount and the H-A discount

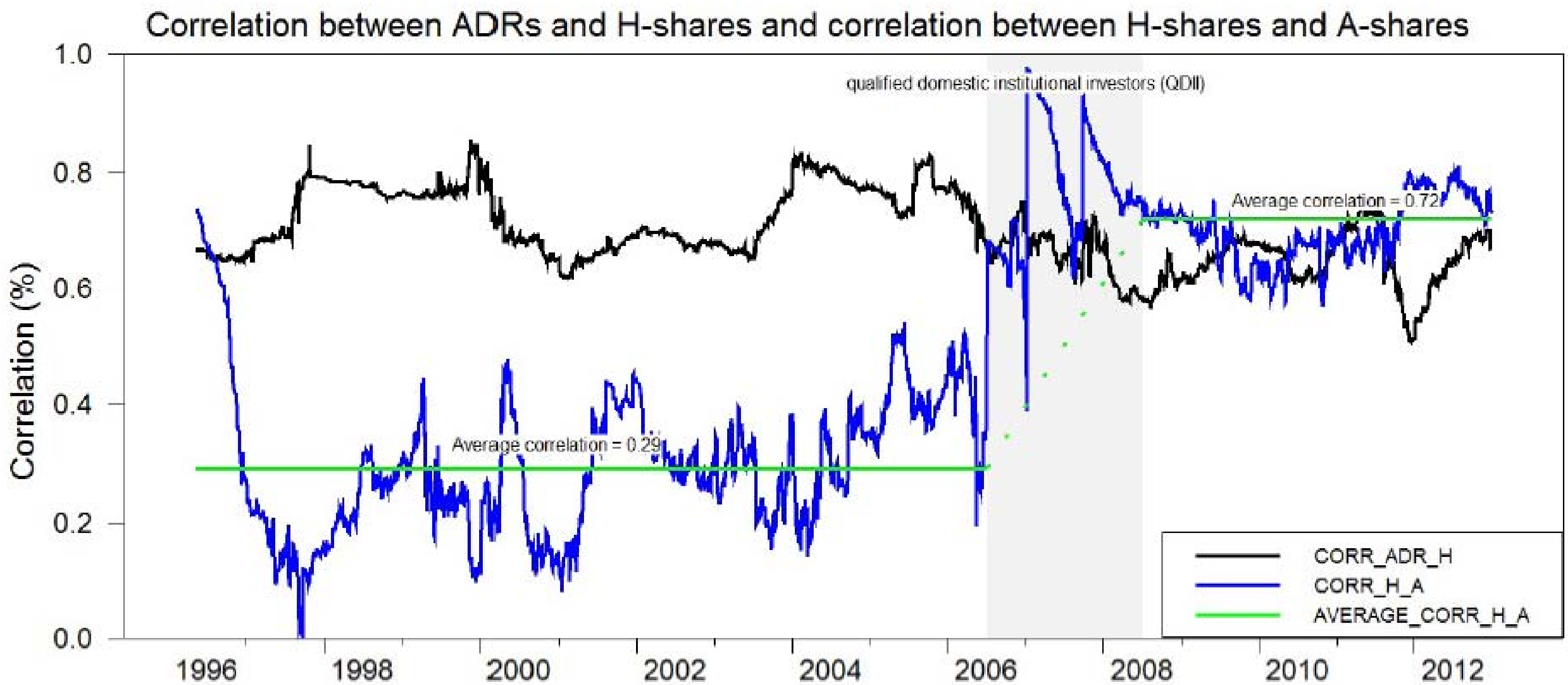

Fig. 3 Correlation between ADRs and H-shares and correlation between H-shares and A-shares

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Value at Risk for Portfolio with High-frequency Trading: A Wavelet Adaptive Approach for DJIA

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The risk measures (such as VaR and CVaR) often rely an assumption about the return distribution of the underlying risky assets. Different distributional assumption may produce widely different computed VaR values. When measuring risk for intra-daily equity returns, the question arises as to what assumption should be made about the return distribution due to the huge amount of market microstructure noise. Because of the difficulty of decom- posing such noise, it is very hard to measure high-frequency market risk. In this paper, we circumvent the inefficiency of distributional assumption of intra-daily market fluctuations, by specifying approaching the issue using wavelet based adaptive separation method. With this approach, we can deconstruct optimally the data into the true efficient information and the noise. Using this approach, we forecast VaR and CVaR and implement them in portfolio selection using high frequency data of the US DJIA stocks. Our results suggest that the performance of the wavelet approach in VaR computation and portfolio selection dominates that of the competitive models investigated in this study.
Keywords: DWT, High-frequency data, Portfolio, Value at Risk, Wavelet.

JEL Classifications: C02, C10, C63

1 Introduction

The standard VaR computation (e.g., delta-normal VaR) requires that the underlying return-generating processes for the risky assets be normally distributed, where the moments are time invariant and can be estimated with historical data. Despite the increased use of the VaR methodology, it does have well-known drawbacks. VaR is not a coherent risk measure and does not provide insight into the risk beyond the quantile.[1] The empirical work by Beder (1995) clearly demonstrates how different VaR models can lead to dramatically different VaR estimates. More- over, when employing the VaR methodology, it is possible for a decision maker, unintentionally or not, to decrease portfolio VaR while simultaneously increasing the expected losses beyond the VaR (i.e., by increasing the "tail risk" of a portfolio or position).[2] There are superior measures to VaR for measuring market risk, such as average value at risk (AVaR). This risk measure – also called conditional value at risk (CVaR) and, for continuous distributions called expected tail loss (ETL) – is a coherent risk measure that overcomes the conceptual deficiencies of VaR.[3] Even with these well-known limitations, however, VaR remains the most popular measure of market risk employed by risk managers [4].

Different arguments about the distributional assumption of the underlying risky assets have been proposed in the literature. Neftci (2000) points out that extreme events are structurally different from the return-generating process under normal market conditions. Höchstötter et al. (2005) and Rachev et al. (2005, 2007) make the same argument, focusing on the stylized fact that returns are heavy tailed. Brooks et al. (2005) argue that heavy tailedness might lead to an underprediction of both the size of extreme market movements and the frequency with which they occur. Sun et al. (2009) propose a methodology for computing VaR based on the fractional stable model.

With the development of algorithmic trading techniques, increasingly financial institutions have implemented high frequency trading. High-frequency trading narrows spreads and improves market liquidity. As a consequence, the market volatility changes instantaneously. As a result, fi- nancial institutions require a methodology that can be easily applied to monitoring instantaneous market risk. With the availability of real-time tick-by-tick data (i.e., high-frequency data), risk managers can measure market risk at a high-frequency level. For example, hedge funds with large position involving high frequency trading can measure their market risk every minute. When performing risk management with high-frequency data, one has to take into account that the high-frequency data are known to exhibit the complex structure of irregularities and roughness that have been described as multifractal phenomena, that is, different fragments of the data have different fractal properties (see ?). The major characteristic of high-frequency data is that they

[1]See Artzner et al. (1999).
[2]See Martin et al. (2003) and the references therein.
[3]See, for example, Acerbi and Tasche (2002) and Rachev et al. (2005a).
[4]See Dowd (2002) for the characteristics of VaR that make it appealing to risk managers

exhibit erratic arrival that contains several distinct types of market microstructure noise. Such noises reflect the trading behavior and information flows in the market. Due to the difficulty of decomposing the different types of noises, an intelligent pattern recognition method is desired.

Wavelet method has been shown as one of a multifractal spectrum computing methods and proven to be a reliable tool in econometric analysis, (see, for example, Fan and Gençay (2010), Fan and Wang (2007), and Hong and Kao (2004)). Particularly, it is suitable for time series analysis, for example, smoothing, denoising, and jump detection (see, for example, Gençay et al. (2010), In et al. (2011), Donoho and Johnstone (1998), and Sun and Meinl (2012), among others). The advantage of wavelet method is that it performs a multiresolution analysis, that is, it allows us to analyze the data at different scales (each one associated with a particular frequency passband) at the same time. In this way, wavelets enable us to identify single events truncated in one frequency range as well as coherent structures across different scales. Several studies have applied wavelet methods in mining financial data, for example, Ramsey and Lampart (1998) and Kim and In (2008) apply wavelets to analyze relationships and dependencies among key macroeconomic and financial variables. Laukaitis (2008) applies wavelet transforms for high frequency data denoising in the study of credit card intraday cash flow and intensity of transactions. Sun et al. (2011) propose a wavelet method for analyzing currency market with high-frequency data. Meinl and Sun (2012) investigate the local linear scaling approximation (LLSA) in denoising high-frequency data and show its robustness in empirical application under statistical goodness-of-fit tests.

A classic assumption for data mining is that the data is generated by certain systematic patterns plus random noise. Denoising big data provides a fundamental tool to extract the systematic patterns conveyed in the data. As Sun and Meinl (2012) point out a specific problem arises when trend component exhibits occasional jumps that are in contrast to the slow evolving long-term trend. These occasional jumps are often caused by, for example, unexpected large transaction or extreme prices and should not be contributed to the normal short-term variations (since jumps are often considered as noises) but indeed to the long-run trend. Traditional linear denoising methods (e.g., moving average) usually fail to capture this information accurately as these linear methods tend to blur out jumps, while nonlinear filters are not appropriate to smooth out high-frequency fluctuations sufficiently since the trends extracted by these methods are not smooth enough (i.e., usually with kicks) to present the long-run dynamic information (see Sun and Meinl (2012) and references therein).

Several works have been done to overcome the above-mentioned problem. For example, Con- nor and Rossiter (2005) estimate the wavelet variance by using non-decimated wavelet transforms. Haven et al. (2012) show the efficiency of wavelet method in dnoising option price data. Studies of applying wavelets in denoising data and coefficient construction can be found in Gençay et al. (2002), Keinert (2004), Mallat and Hwang (1992), and Percival and Walden (2006) among oth- ers. Ramsey (2002) highlights some research areas where wavelet analysis might be applied in economics and Crowley (2007) provides a survey about how wavelet methods have been used in

the economics and finance literature. Gençay et al. (2003) propose a method based on a wavelet multiscaling approach for decomposing time series data. Lada and Wilson (2006) develop a wavelet-based spectral method for steady-state simulation analysis. Gençay and Gradojevic (2011) introduce a wavelet approach to estimate the parameters of a linear regression model. Among these methods, both DWT and MODWT need to decide the wavelet function, level of decomposition, and thresholding rule. A common approach in choosing the wavelet function is to use the shortest wavelet filter which can provide reasonable results, see Percival and Walden (2006). The level of decomposition leads to the choice which considers "the higher the better" in general. The thresholding rule, which is a function identifying the wavelet coefficients to be deleted, has also been investigated in academic research, see, for example Gençay et al. (2002). The remaining challenge is how to determine the combination of wavelet function, level of de- composition, and thresholding rule to reach an optimal smoothness that generally improve the performance of classic models after denoising the data.

The algorithm (named GOWDA) proposed in this paper can optimally determine the wavelet function, level of decomposition, and thresholding rule by using smoothness as a regularization variable. The goal of our method is to denoise the data and obtain the trend that (1) contains as much information as possible, (2) exhibits a certain degree of smoothness which can utilize the classic model, and (3) preserves as less artifact (i.e., undesired structures, like oscillating nature, generated through the denoising process) as possible. In our method, we define measures for smoothness. Intuitively, these measures for smoothness describe the characteristics of the denoised data with wavelet transform that optimally provide output for further analysis with classical model. We show the resulting difference sequence between the denoised data and the original signal must converge in probability at a predetermined confidence level. This requires
(1) the structural change (e.g., jumps) of the denoised data and the original signal should be synchronous, (2) there is no outliers in the denoised data, and (3) the local extremum in the denoised data should be bounded. We show that the method we proposed leads to an optimal choice with respect to these requirements.

We investigate the performance of GOWDA with numerical simulations that consider some typical patterns often observed in big financial market data, e.g., excessive volatility and regime switching. With comparison, GOWDA results in better performance than the alternative meth- ods and the numerical results coincide with the analytical properties we have shown. From the results in this paper, we see that GOWDA maintains the original wavelet transform's compu- tational complexity and its approximation errors are bounded. In order to confirm the compu- tational reliability and consistency that we have shown in the simulations, we further perform an empirical investigation by applying GOWDA with 5-minute data of German DAX 30 stocks. The results we obtained from such large sample investigation coincide with the previous sim- ulation results. When using the denoised data generated by GOWDA for forecasting with the high-frequency data, we find that the performance (i.e., accuracy of forecasting) of classic models e.g., AR, ARMA, and ARMA-GARCH, has been significantly improved which confirms the robustness of GOWDA.

We then apply GODWA for two financial implementations, i.e., market risk assessment and portfolio selection for day trading. We compute the Value at Risk (VaR) and conditional Value at Risk (CVaR) measures with GOWDA based on our big financial market data. We found when using the data denoised by GOWDA, we can improve the accuracy of VaR and CVaR measures significantly. In this paper, we formulate three day trading strategies, i. e., first, sorting stocks with Sharpe ratio and risk-reward ratio with VaR and CVaR; second, ranking them as the top and bottom groups, then conduct long-short strategy for buying the top and shorting the bottom group at hourly frequency and keep the position only for one day. We estimate the transaction cost at tick-by-tick level and formulate a index (market) portfolio as the benchmark. The annualized return of the trading strategy based on ranking with GOWDA denoised data is overwhelmingly larger than that with ranking of original data.

We organized the paper as follows. In Section 2, we describe the methodology in details, summarize it with an algorithm chart. In Section 3, we show the analytical properties of our algorithm. In Section 4, we do an empirical study of applying our method for measuring risk and portfolio selection. We summarize our conclusions in Section 5.

2 The Methodology

In this section, we describe the wavelet based adaptive seperation algorithm (WASA) and analytically show its computational properties.

2.1 Wavelet and wavelet transform

Assume that the observed data X can be decomposed as follows:

$$X_t = S_t + N_t,$$

where S_t is the true signal and $\tilde{S}$ is its estimation. N_t is the additive noise sampled at time t.

Let $W(\cdot;\omega,\zeta)$ denote the wavelet transform operators with certain wavelet function ω for ζ level of decomposion. $W^{-1}(\cdot)$ denotes the inverse wavelet transform. Let $D(\cdot;\gamma)$ denotes the denoising operator with thresholding rule γ. We intend to wavelet denoise $X(t)$ in order to recover $\tilde{S}(t)$ as an estimate of $S(t)$. Then the procedure is summarized as follows:

$$\begin{aligned} Y &= W(X;\omega,\zeta), \\ Z &= D(Y;\gamma), \\ \tilde{S} &= W^{-1}(Z). \end{aligned}$$

This summary of procedure does not reveal the details involving implementation of the operators

$W(\cdot)$, $D(\cdot)$, and selection of ω, ζ, and γ. Donoho et al. (1994, 1995) address details about implementation of the operators and selection of thresholding rules.

Wavelets are bases of $L^2(\mathrm{R})$ first developed to analyze geophysical signals (see Morlet (1983)). In contrast to Fourier transformation they enable a localized time-frequency analysis with wavelet

functions that usually have either compact support or decay exponentially fast to zero. In ad- dition, wavelets provide a multiresolution of a signal that allows to analyze the signal simulta- neously on different (usually dyadic) scales. To achieve these desirable properties, the wavelet transformation is subject to the following conditions, i.e., the admissibility condition and or- thonormality,

$$\sum_{l=0}^{L-1} h_l = 0, \qquad \sum_{l=0}^{L-1} h_l^2 = 1 \quad \text{and} \quad \sum_{l=0}^{L-1} h_l h_{l+2n} = 0$$

for all $n \in \mathrm{N}^*$, where $h_l = (h_0, h_1, \cdots, h_{L-1})$ be a finite length discrete wavelet filter.

The idea of the wavelet transform W is to translate and dilate a single function (the mother wavelet) $\psi(t)$:

$$\psi_{a,b}(t) = \frac{1}{\sqrt{|a|}}\,\psi\left(\frac{t-b}{a}\right), a, b \in \mathrm{R}, a \neq 0. \tag{1}$$

The degree of compression is determined by a and the time location of the wavelet is set by b, where a is said the scaling parameter and b the translation parameter. $|a| < 1$ leads to compression and therefore to higher frequencies. The opposite (lower frequencies) is true for $|a| > 1$, leading to time-widths adapted to their frequencies, see Percival and Walden (2006).

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In this paper, we focus on the discrete wavelet transform (DWT). A discrete wavelet transform (DWT) is an orthogonal transform of a vector (discrete signal or time series data) X of length N (which must be a multiple of 2^J) into J wavelet coefficient vectors $W_j \in \mathbb{R}^{N/2^j}$, $1 \leq j \leq J$ and one scaling coefficient vector $V_J \in \mathbb{R}^{N/2^J}$, that is,

$$[W_1, \ldots, W_J, V_J] = WX, \tag{2}$$

with the transformation matrix W determined by the wavelet filter banks h, it is more convenient to use the pyramid algorithm developed by Mallat (1989), with a computational complexity of $O(N)$. Applying the inverse transform on these vectors yield

$$[W_1, \ldots, W_J, V_J]W^T = S_J + \sum_{j=1}^{J} D_j = X, \tag{3}$$

that is, an additive decomposition of the original signal. As

$$S_{j_0-1} = S_J + \sum_{j=j_0}^{J} D_j \tag{4}$$

holds, S_j, approximations (i. e., moving weighted averages) of X at different dyadic scales, and D_j, the detail vectors which are the details we loose at each approximation level, result in a multiscale decomposition. For each scale j we can separate the signal into high and low frequencies by a wavelet filter with the bandwidth determined by j.

Wavelet denoising might result in different outcomes due to different choice of input variables. As we pointed out, wavelets are oscillating functions and transform the signal orthogonally in the Hilbert space, consequently we do not have any trouble from reconstruction based on wavelet transform. However, there are many wavelet functions that can suffice the requirement for transform. In practice, different wavelets are used for different reasons. For example, the Haar wavelet has very small support and wavelets of higher orders such as Daubechies ($D4$) and least asymmetric (LA) have also bigger support. Bigger support can ensure a smoother shape of S_j, $1 \leq j \leq J$ with each wavelet and scaling coefficient carrying more information due to the increased filter width. The optimal band-pass filter which dictates the capacity to isolate features to specific frequency intervals is determined by the length of a wavelet function in approximation. In addition, the wavelet function must be able to mimic the features contained in the signal of interest in order to optimally represent the conveyed information. Therefore, the choice of wavelet basis function turns to be important when analyzing a given signal.

After choosing the wavelet, we can then decompose the signal into several levels. In general, we use the pyramid algorithm to accomplish this, see Gençay et al. (2002). This algorithm decomposes the signal into detail and approximation coefficients in its first iteration. Each following iteration applies the same procedure on the approximation coefficients from the iteration one step ahead.[5] We can do this at a maximum $\log_2(N)$ times (N is the number of observations). The quality of the denoising process varies with the number of iterations. The resulting outcome also critically depends on the thresholding rule which decides all wavelet coefficients less than a fixed constant in magnitude to be zero. The coefficients obtained in each iteration are subject to the thresholding rule before we reconstruct the denoised signal. This rule identifies the coefficients that represent noise.

Therefore, we have three factors that influence the quality of denoising based on wavelet transform: wavelet function (or mother wavelet), number of maximal iterations (or level of decomposition), and thresholding rule. However, there is no straight-forward method to determine these three factors simultaneously. In this paper, we propose a new method that can optimally determine the choice of wavelet function, number of maximal iterations, and thresholding.

2.2 Wavelet based adaptive seperation algorithm (WASA)

In order to evaluate the DWT performance, i.e., to see how close $\tilde{S}_t$ toward S_t, we introduce the wavelet adaptive seperation algorithm (WASA) as follows. First, we name a seperation factor

[5] For DWT, we down sample the coefficients, i. e., in each iteration we halve the number of detail coefficients.

θ that is the combination of wavelet function, number of maximal iterations, and thresholding rule and a factor space $\Theta \subseteq \mathbb{R}^p$, $p \geq 0$, then $\theta \in \Theta$. Different θ will lead to different DWT performance. We then define a random variable X and $X = S - \tilde{S}$. X is in fact the approximation error and determined by a real value approximating function $m(X, \theta) \in R$ and $E(m(X, \theta)) = 0$.

Definition 1. *Let $X_t \in \mathbb{R}^d$ be i.i.d. random vectors, and given $\theta \in \mathbb{R}^p$ that is uniquely determined by $E(m(X, \theta)) = 0$, where $m(X, \theta)$ is called the approximating function and takes values in $\mathbb{R}^{p+q}$ for $q \geq 0$. WASA determines $\tilde{\theta}$ such that $\tilde{\theta} = \operatorname{argmax}_\theta R(\theta)$, where*

$$R(\theta) = \min \left\{ \prod_{i=1}^{n} n\omega_i \,\middle|\, \sum_{i=1}^{n} \omega_i m(X, \theta),\ \omega_i \geq 0, \sum_{i=1}^{n} = 1 \right\}.$$

In other words, WASA is to minimize the resulting difference sequence between $\tilde{S}_t$ and S_t based on choosing an optimal combination of approximating functions $m(\cdot)$. Therefore, WASA needs to determine the approximating function $m(\cdot)$ and its corresponding weight. If we only use one type of approximation, that is, a single criterion, then the weight is one. If we need to apply multivariate criteria for approximation, we need to determine the associated weight for each approximating function.

2.2.1 Model selection criteria

In this paper, for WASA we suggest six model selection criteria (i.e., $m_1, \ldots, m_6$) to evaluate $m(\cdot)$. The first one is the traditional root mean square error, such that,

$$m_1 = \sqrt{\frac{\sum_{t=1}^{T} \left(S_t - \tilde{S}_t\right)^2}{T}}, \tag{5}$$

where T is the data length.

Then we use the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC):

$$m_2 = \ln\left(\frac{\sum_{t=1}^{T} \left(S_t - \tilde{S}_t\right)^2}{T}\right) + \frac{2p}{T}, \tag{6}$$

$$m_3 = \ln\left(\frac{\sum_{t=1}^{T} \left(S_t - \tilde{S}_t\right)^2}{T}\right) + \frac{p \ln T}{T}, \tag{7}$$

where p is the number of parameters and T is the data length.

We use two measures suggested by Sun and Yu (2013) to detect artifacts and jumps: one considers artifacts (m_4, based on an outliers test) and the other considers jumps (m_5, based on local extrema). In other words, we use m_4 to detect the global extrema and m_5 the local extrema. Both of them have ability to detect boundary problems, that is, inefficient approximation at the beginning and end of the signal.

We suggest to apply Grubbs test for identifying artifacts, which is an iterative test for outliers based on an approximately normal distributed sample, see Grubbs (1969). Let $\mu = \frac{1}{T}\sum_{t=1}^{T} X_t$ be the sample mean of vector X and $s^2 = \frac{1}{T-1}\sum_{t=1}^{T}(X_t-\mu)^2$ its sample variance. The test statistics is then given by

$$G = \frac{\max |X_i-\mu|}{s}.$$

G can be assumed to be t-distributed and a test for outliers with significant level α (e.g. $\alpha = 0.05$) can easily be performed by rejecting the null hypothesis of no outliers if

$$G > z_\alpha = \frac{T-1}{\sqrt{T}} \times \sqrt{\frac{t^2_{\frac{\alpha}{2\times T},T-2}}{T-2+t^2_{\frac{\alpha}{2\times T},T-2}}}.$$

When an outlier (i.e., the global extremum) is detected, it is removed from the data and the test will proceed. As a measure of the amount of artifacts (or jumps of high magnitude), we can identify the number of iterations to run the test until it confirms there is no outlier. We apply the test until $g(x) = 0$ and count the number of outliers as a measure of structure.

Let $C(x)$ be a function determining whether there is one outlier in vector X:

$$C(x) = \begin{cases} 1, & if \quad G > z_\alpha \\ 0, & if \quad otherwise \end{cases}$$

$$m_4 = \frac{1}{T}\sum_{t=1}^{T} 1 \times *_{C(x)=1}, \tag{8}$$

where T is the data length.

In order to control all structural changes to be bounded, our proposed method investigates the local extrema (maxima or minima, respectively) at certain magnitude. In order to avoid redundant computation (since τ_1 controls the outlier detection), we can only run the test procedure for the output data after wavelet transform. The local extrema here we referred to, are the largest and smallest values that a function takes at a point within a given neighborhood.

If there exists a $\Lambda \in \mathrm{R}$, such that $\lim\sup_{n\to N} x_n < \Lambda$ and there exists a subsequence x_{k_n} of x_n for which we have that $x_{k_n} < \Lambda$, $\forall n$, then Λ is the local maxima. If there exists a $\lambda \in !R$, such that $\lim\inf_{n\to N} x_n > \lambda$, and there exists a subsequence x_{k_n} of x_n for which we have that $x_{k_n} > \lambda$, $\forall n$, then λ is the local minima.

Let $D(x)$ be a function that detects local maxima

$$D(x) = \begin{cases} 1, & if \quad x_i = \Lambda \\ 0, & if \quad otherwise, \end{cases}$$

and $D^*(x)$ detects local minima.

$$D^*(x) = \begin{cases} 1, & if \quad x_i = \lambda \\ 0, & if \quad otherwise. \end{cases}$$

$$m_5 = \frac{1}{T} \sum_{t=1}^{T} 1 \times \left(\mathbb{1}_{D(x)=1} + \mathbb{1}_{D^*(x)=1} \right), \tag{9}$$

where T is the sample size.

Let $A(x)$ be a function that detects comovement

$$A(x) = \begin{cases} 1, & if \quad (S_{t+1} - S_t)(\tilde{S}_{t+1} - S_1) > 0 \\ 0, & if \quad otherwise, \end{cases}$$

$$m_6 = \frac{1}{T} \sum_{t=1}^{T} 1 \times \mathbb{1}_{A(x)=1}, \tag{10}$$

2.2.2 Determining the factor scores

The algorithm we proposed in this paper is then to solve and optimal problem to determine the weights ω_i, that is,

$$\min \sum_{i=1}^{6} \omega_i m_i, \text{ s.t. } \omega_i \geq 0, \quad \sum_{i=1}^{6} \omega_i = 1.$$

2.2.3 The algorithm: summary

Given a set of wavelet functions F, a set of maximal levels of decomposition L, a set of thresholding rules S, and a input data vector X_t as input variables, $W(F, L, S, X_t)$ determines the output of wavelet transform. We define a score function $T(\tau_1, \tau_2)$ as the criterion to determine the combination of denoising factors (i.e., F, L, and S). The function $\min\{T(\tau_1, \tau_2)\}$ will lead to the optimal combination of denoising factors when its score value is minimized. If two parameter sets $\{F(i), L(i), S(i)\}$ and $\{F(j), L(j), S(j)\}$, $(i < j)$, yield the same score value of $\min\{T(\tau_1, \tau_2)\}$, the algorithm determines the first set (i.e., i) as the optimal one. After the optimal combination of denoising factors has been determined, our algorithm applies the denoising approach based on wavelet transform $W(\cdot)$ to generate the final output vector $\hat{X}_t$. Pseudo code for this smoothness-oriented wavelet denoising algorithm is provided in Algorithm chart 1.

3 Computational Properties of WASA

3.1 Complexity

The wavelet based adaptive seperation algorithm (WASA) can implement DWT and the computational complexity critically depends on the implemented algorithms of DWT.

Algorithm 1 *Generalized Optimal Wavelet Decomposing Algorithm (GOWDA)*

```
X ← input data vector
F ← a set of wavelet functions
L ← a set of maximal levels of decomposition
S ← a set of thresholding rules
W(·) ← wavelet transform
η_H ← upper tail synchronousness defined by Eq.(5)
η_L ← lower tail synchronousness defined by Eq.(??)
for F ← i do
    for L ← j do
        for S ← k do
            Apply W(·) using {F(i),L(j),S(k)} : X → X̃      (see Eq.(2) - Eq.(5))
            if η_L /= η_H then
                Compute T(τ1,τ2) (see Eq.(??))
            else
                Compute T(τ1,τ2) = τ1 + τ2 (see Eq.(??) and Eq.(??))
            end if
        end for
    end for
end for
for run(l) ← l do
    Compute T(τ1,τ2)
end for
Evaluate W(F(l),L(l),S(l)) ← arg min T(τ1,τ2)
Decompose X based on W(F(l),L(l),S(l)): X → X̃.
Reconstruct X̂  from X̃ with W^-1(·)
Output X̂  for X
```

Corollary 1. *The computational complexity of WASA is $O(n)$ when applied with DWT.*

Proof. Percival and Walden (2006) show that the computational complexity of DWT is $O(N)$. WASA computes DWT $(i \times j \times k) + 1$ times, where i stands for the number of wavelet functions, j the number of maximal levels of decomposition, and k the number of thresholding rules. For $i \times j \times k << T$ and the quantity of $i \times j \times k$ is countable, therefore we preserve the computational complexity of DWT. □

When executing WASA, several measures are computed. It is easy to see that the time complexity of τ_2 and η is $O(N)$. For τ_2, we need n times to go through a vector X_n to evaluate the local extrema condition. To compute η, we count changes of tails in vector X_n then have a complexity of $O(N)$ as well. τ_1 implements the Grubbs test for outliers. For each run, we have to compute the new test statistic of the t-distribution. That is, we have n runs, each of complexity $O(N)$. For $n << T$, leads to $O(N)$.

3.2 Consistency

The following theorem provides an upper bound for the error of the estimated trend to the real one. We now show the asymptotic convergence of the proposed method towards DWT.

Theorem 1. *Given any signal X of length N with the trend $\vartheta(X)$, the error generated by WASA approximation S^{WASA} is bounded, that is, for any choice of (F, L, S) there exists a constant $c > 0$ such that*

$$\sum_{t=1}^{N} |\vartheta_t(X) - S_J^{\text{WASA}}| < c \tag{11}$$

holds. Furthermore, for F fixed and $N \to \infty$ we have

$$\lim_{N\to\infty} \frac{1}{N} \sum_{t=1}^{N} |S_J^{\text{DWT}} - S_J^{\text{WASA}}| = 0. \tag{12}$$

i. e., WASA converges asymptotically towards the estimated trend of the DWT.

Proof. Let (F, L) be fixed, we can directly obtain $S_J^{\text{WASA}} = S_J^{\text{DWT}}$. For any other choice of (F, L, S), more details will be added to the estimator S^{WASA}, according to $T(\tau_1, \tau_2)$. After the reconstruction (see Eq. (5)) these additional details correspond to the estimator S_J^{DWT} are therefore bounded as well. For the refinement process, several wavelet coefficients are set to zero by S, this match only holds approximately, i. e., no exact description of $S_{J,t}^{\text{WASA}}$ is available, as this procedure causes the information carried by the wavelet coefficients at different levels to be intermixed. However, knowing that the DWT approximation of any level is bounded by the signal itself, we can set up an ε-tube around the initially estimated trend by

$$\varepsilon := |\max_t X_t - \min_t X_t|. \tag{13}$$

As we have

$$\min_t X_t \leq S^{\mathrm{DWT}}_{J,t} \leq \max_t X_t,$$

for all $1 \leq j \leq J$. It follows that

$$|\vartheta_t(X) - S^{\mathrm{DWT}}_{J,t}| \leq \varepsilon.$$

This must also hold for WASA, i. e.,

$$\min_t X_t \leq S^{\mathrm{WASA}}_{J,t} \leq \max_t X_t, \qquad \text{and} \quad |\vartheta_t(X) - S^{\mathrm{WASA}}_{J,t}| \leq \varepsilon.$$

We then can estimate an upper bound for the error by $c = N \cdot \varepsilon$, which suffices Eq.(11). To prove the asymptotic consistency we assume that for fixed F and L the wavelet coefficients $\Omega^{W}_{j,k}$ are ordered in time, that is

$$\omega_{j,k+1} \geq \omega_{j,k}$$

for all $1 \leq j \leq J$ and $1 \leq k \leq K-1$. With

$$t_K := \max_{t_j}\{t \in \Omega^{S}_{j,K}\}$$

we have $S^{\mathrm{WASA}}_{J,t} = S^{\mathrm{DWT}}_{J,t}$ for all $t > t_K$. As the prior deviations between both estimators were bounded, e. g., by the same ε as in Eq.(13). We then obtain,

$$\sum_{t=1}^{N} |S^{\mathrm{DWT}}_{J} - S^{\mathrm{WASA}}_{J}| = \sum_{t=1}^{t_K} |S^{\mathrm{DWT}}_{J} - S^{\mathrm{WASA}}_{J}| \leq t_K \cdot \varepsilon.$$

for all N, which lead to Eq.(11) and Eq.(12).

4 Empirical Study

In this empirical study, we investigate the performance of our proposed algorithm (WASA) working with a big financial data of US DJIA 30 component stocks. In this study, we are going to conduct three tasks: (1) use WASA to improve the performance of some classic models (i.e., AR, ARMA, and ARMA-GARCH) for in-sample estimation and out-of-sample forecasting; (2) use WASA for market risk management, i.e., assessment of Value at Risk (VaR) and conditional Value at Risk (CVaR) ; and (3) use WASA to improve the performance of portfolio selection based on risk-reward ranking.

4.1 The data

The analysis is performed based on the high-frequency German DAX 30 component stock prices from January to December 2005. In our empirical study, the homogeneous (i. e., equally spaced) time series data is aggregated at 5-minute level by the linear interpolation method (see Meinl and Sun (2012)). That is, the inhomogeneous series with times t_i is given by $x(t_i)$, while fixed. As every regular τ_j is bounded by two times of the irregularly spaced series, i. e.,

$$t_{I_j} \le \tau_j < t_{I_j+1},$$

with

$$I_j := \max\{i \mid t_i \le \tau_j\},$$

data point τ_j is interpolated between t_{I_j} and t_{I_j+1} by

$$\underline{x}(\tau_j) = x_{I_j} + \frac{\tau_j - t_{I_j}}{t_{I_j+1} - t_{I_j}}(x_{I_j+1} - x_{I_j}).$$

In our sample, the 5-minute data contains 26,686 data points for each DAX stock in 2005.

4.2 The methodology

In our simulation study we choose Haar, Daubechies (DB), Symlet (LA) and Coiflets (Coif) as wavelet functions (see Percival and Walden (2006)). We apply the pyramid algorithm in our empirical study. With each iteration of the pyramid algorithm, we increase the scaling level. That is, given a signal of length $N = 2^J$, the j-th iteration computes detail coefficients associated with changes on a scale of length $\lambda_j = 2^{j-1}$, see Gençay et al. (2002).

In this simulation, we consider several thresholding rules. Donoho and Johnstone (1994) suggest the universal thresholding based on the following equation:

$$\vartheta^U = \hat{\sigma}_E \sqrt{2 \log n}.$$

The idea behind this selection rule is that for a sequence of n independently and identical distributed (i.i.d.) $N(0, \sigma^2)$ random variables it holds that the probability that the largest value in absolute terms is smaller than $\hat{\sigma}_E \sqrt{2 \log n}$ converges to one for large n. Donoho and Johnstone (1998) suggest the minimax. Donoho (1994) proposed a method based on minimizing Steins unbiased estimate of risk (i.e., SURE). Suppose there is a sequence of k i.i.d. random variables $z_i \sim N(\mu_i, 1)$. Let $\hat{\mu}$ be an estimator of $\mu = (\mu_1, ..., \mu_k)$. Given a weakly differentiable function g, an unbiased estimator of μ, $\hat{\mu} = z + g(z)$ is given by

$$E\|\hat{\mu} - \mu\|^2 = k + [E\|g(z)\|^2 + 2\nabla g(z)],$$

where $\nabla g(z) = \sum_i \partial g_i(z)$. With soft thresholding we obtain

$$SURE(z, \vartheta) = k - 2 \cdot \#(i : |z_i| \le \vartheta + \sum_{i=1}^{k} min^2(|z_i|, \vartheta).$$

where $\#S$ equals the cardinality of a given set S. The SURE thresholding is the one minimizing the estimated risk:

$$\vartheta^S = \arg min_{\vartheta \ge 0} SURE(z, \vartheta).$$

Donoho and Johnstone (1995) suggest the heuristic thresholding which applies the SURE thresholding rule to some levels of decomposition and universal thresholding to the others. The decision which rule to use on which level is made heuristically. Birgé and Massart (1998) suggest a thresholding rule based on the Birgé-Massart strategy using a penalized projection estimator

(PPE). For each level i, q_i is calculated as

$$q_i = m \cdot (j + 2 - i)^{\alpha},$$

where j is the maximal level of decomposition, m is a constant proposed to equal the length of the data (i.e., the number of observations) and α is a controlling constant. On each level i the q_i largest coefficients are kept. The larger the α value, the more coefficients remain. Typical choice for α value is 1.5 for compression and 3 for denoising.

Based on the above-mentioned thresholding rules, wavelet coefficients are thresholded term by term on the basis of their individual magnitudes. Information on other coefficients has no influence on the treatment of particular coefficients. Cai and Silverman (2001) propose a block thresholding method which is a shrinkage method capturing information on neighboring coef- ficients. When applying block thresholding rule, the coefficients are considered in overlapping blocks and the treatment of coefficients in the middle of each block depends on the data in the whole block.

The candidates of denoising factors of GOWDA in our simulation are:

- $F \in \{$Haar, DB(2), DB(4), DB(8), LA(2), LA(4), LA(8), Coiflet(4), Coiflet(6), Coiflet(8)$\}$;
- $L \in \{i : i = 1, 2, 3\}$;
- $S \in \{$ Block, Universal, SURE, heuristic Sure, Minimax, Birgé-Massart$\}$. The

linear score function $T(\cdot)$ of τ_1 and τ_2 has following form:

$$T(\tau_1, \tau_2) = 0.5 \times \tau_1 + 0.5 \times \tau_2.$$

When we compute τ_1, we set $\alpha = 0.05$ for the Grubbs t-statistic. When we compute τ_2, one- sigma rule is applied to detect the local extrema, that is, an observation is considered to be as

the local extrema (of a given sequence) if it lies in the region at a distance from its mathematical expectation of more than the standard deviation.

In this simulation, the alternative methods we compare with GOWDA are five single wavelet function, i.e., Haar, DB(4), DB(8), LA(8), and Coiflet(6), worked with DWT.

We run the simulation for the two different data patterns described in Section 3.1. We use our algorithm to identify the best denoising method that optimally combines wavelet function, level of decomposition, and thresholding rule. For each pattern, we conduction the simulation based on a moving window design following Sun and Meinl (2012). We investigate our algorithm for both in-sample approximation and out-of-sample forecasting. For the out-of-sample forecasting, we work for one-step and two-step forecasting. Since the true trend (for both in-sample and out-of-sample) of the simulated stylized data is known, we then use GOWDA and alternative methods to denoise the simulated data and compare the approximated trend and forecasted trend with their true counterparts. Obviously, the smaller the difference compared with the true trend, the better the performance of the underlying algorithm.

4.3 Computation of VaR and CVaR

We now present the GOWDA application related to the risk measures, i. e., Value at Risk (VaR) and conditional Value at Risk (CVaR). Let A_i be any asset that is assigned a synthetic return R_i and $r(A_i)$ a rating function. Defualt of an asset occurs if its synthetic return falls below (or equals) a threshold value of the rating function $\rho(r(A_i))$, that is, $R_i \leq \rho(r(A_i))$.

Let R be a random variable with a cumulative distribution function denoted by F_R, the VaR at confidence level $\alpha \in (0, 1]$, also referred as the α-quantile, is defined as

$$\mathrm{VaR}_\alpha(\mathrm{R}) = \inf\{\rho : \mathrm{F_R}(\rho) \geq \alpha\},$$

and the CVaR at confidence level α is defined as

$$\mathrm{CVaR}_\alpha(\mathrm{R}) = \sup\{\rho - \frac{1}{\alpha}\mathrm{E}([\rho - \mathrm{R}]_+)\},$$

where $[\rho - R]_+ = \max(\rho - R, 0)$ denotes the positive part of $\rho - R$. If $VaR_\alpha(R)$ is finite, the supremum in the above equation is attained at $\rho = VaR_\alpha(R)$. Then we have

$$\mathrm{CVaR}_\alpha(\mathrm{R}) = \mathrm{VaR}_\alpha(\mathrm{R}) - \frac{1}{\alpha}\mathrm{E}([\mathrm{VaR}_\alpha(\mathrm{R}) - \mathrm{R}]_+).$$

Following Sun et al. (2009), we apply both the nonparametric method and parametric method. For the nonparametric method, we use the bootstrapping to formulate the confi- dence interval. For the parametric method, we use the AR(2), ARMA(2,1), and ARMA(2,1)- GARCH(1,1). We report our results in Table 4 and Figure 3. As we know from the VaR and

CVaR definition given in Section 4.3, the ideal violation rate for VaR and CVaR is α, i. e., the confidence level. We see that the VaR measure based on the nonparametric method with original data turns to be more conservative as its violation rate is more less than 5%, the confidence level

α in our study. On the contrary, the parametric methods (i.e., AR, ARMA, and ARMA-GARCH models) provide more aggressive VaR measures based on the original data as they are far greater than 5%. For both the nonparametric and parametric methods, GOWDA denoised data can im- prove the performance of both nonparametric and parametric methods by driving the violation

rate close the confidence level α, i.e., 5%.

4.4 Portfolio Selection

Technological innovation has improved the trading capacity of financial assets. Many market participants are now employing algorithmic trading (AT) that uses computer algorithms to automatically complete the trading process that involves making trade decision, order submission, and order management after submission. High frequency trading (HFT) is a special class of al- gorithmic trading (AT) that uses computer algorithms making elaborate trading decision based on the electronically received information before human traders are capable of processing same information they observe. Much attention has, and continues to be, focused on the impact of high frequency trading, particularly due to the tremendous increases in volumes of HFT and the
U.S. May 6, 2010 flash crash.

One of the trading style of HFT is hourly trading that is buying and selling financial instru- ments within one hour, such that all positions are usually closed no longer than one hour after they have been established. In this section, we formulate an active portfolio trading strategy based on allocating asset with respect to the measure of reward to risk.

We consider three measures of reward to risk. The first one is the Sharpe ratio (see Sharpe (1994)), which is the ratio between the expected excess return and its standard deviation:

$$\text{Sharpe} = \frac{E[R - R_f]}{\sigma[R]}.$$

where R_f is the risk-free asset and $\sigma[R]$ is the standard deviation of R.

The second one is the VaR ratio, which is the ratio between the expected excess return and its value at risk:

$$\text{VaR Ratio} = \frac{E[R - R_f]}{\text{VaR}_{(1-\alpha)100\%}(R - R_f)}.$$

The third one is the CVaR ratio, also called STARR ratio (see Martin et al. (2003)), is the ratio between the expected excess return and its conditional value at risk:

$$\text{STARR} = \frac{E[R - R_f]}{\text{CVaR}_{(1-\alpha)100\%}(R - R_f)}.$$

We use the above three ratios as stock selection criteria to rank the DAX 30 stocks to the top (large ratio value) and bottom (small value) groups in our empirical data at the hourly base. We consider a intra-day momentum strategy that is implemented by simultaneously buying the top group and selling (or shorting) the bottom one at the end of the ranking period, and holding the portfolio over the training period. In our implementation, we consider the top and bottom group both have 5 stocks. The ranking period is from one day to ten day and the trading period is one hour.

We show the annualized performance of different portfolio trading strategies in Table 5. We see that when we use GODWA denoised data, the annualized returns of three risk-rewards based trading strategies are much higher than that based on the original data.

5 Conclusion

Identification of the optimal combination of wavelet function, level of decomposition, and thresholding rule challenges the efficiency of classic methods of denoising data based on wavelet transform (e.g., DWT). Inefficient decomposition of the systematic pattern (the trend) and noise of the target data will tremendously reduce the efficiency and effectiveness of any decision sup- port system. When working with high-frequency financial data, its irregularities and roughness reinforce the necessity of more efficient tools for data mining.

In this paper, we propose a new trend extraction method for high-frequency financial data named generalized optimal wavelet decomposing algorithm (GOWDA), which can optimally de- termine the combination of denoising factors (i.e., wavelet function, level of decomposition, and thresholding rule) based on a smoothness-oriented score function that is designed for detecting global and local extremum. The method can be applied with classic DWT approach. When work it with the big financial data, this algorithm is able to preserve a smooth trend and effectively displays the noise since all information can be contained in the wavelet multiresolution decom- position optimally after specifying the level of smoothness in reconstructing wavelet coefficients.

We define GOWDA's requirements and its input parameters and specify the smoothness score function. In order to show the reliability of GOWDA, we first conduct an experiment based on simulations. We consider two different stylized data patterns that are often observed in big financial market data. In all simulation settings we investigated, GOWDA illustrates its robustness independent of the input parameters. We then empirically show the potential application of GOWDA by fitting and forecasting the real high frequency data (aggregated at the 5 minute-frequency level) of the German DAX 30 component stock price data. The results confirm our conclusion that GOWDA can significantly improve the efficiency of data analysis.

We apply GOWDA to assess risk measures and select portfolio for day trading. We find that GOWDA can increase the accuracy of VaR and CVaR estimation. When applying GOWDA for portfolio selection, we show it can create profitability significantly to beat the market portfolio.

Based on these results, we conclude that GOWDA is a robust algorithm which enriches the class of intelligent denoising methods in big data mining. The proposed algorithm is expected to provide a significant improvement of the accuracy of modeling, forecasting, risk and portfolio management with big financial data . Since data denoising is fundamental for intelligent decision making, performing it efficiently and effectively will help us build more reliable decision support system.

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Panel 1: Nonparametric VaR and CVaR measues at 60-min level Panel 2: VaR and CVaR measures at 60-min level

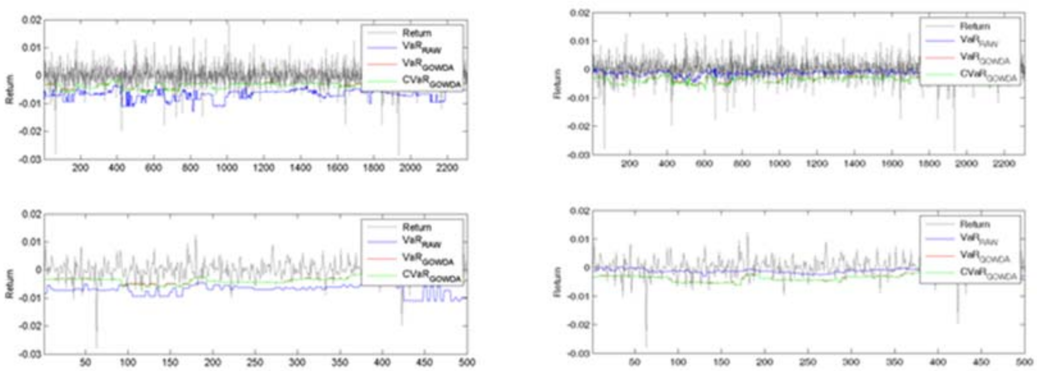

Figure 1: Value at Risk (VaR 95%) and conditional Value at Risk (CVaR 95%) measures. In Panel 1, we can see that the nonparametric method generates more conservative risk measures based on the original data, i.e., very low violation rate than 5%, while GOWDA denoised data make the VaR measure close to 5%. In Panel 2, we see that the parametric method (e.g., ARMA-GARCH model) generates more aggressive VaR measure based on the original data, i.e., very high violation rate more than 5%, while GOWDA denoised data shift the VaR measure close to 5%.

Short Selling and Buyback Strategies

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Corporate repurchases and insider buying are two ways that managers of heavily shorted companies can "draw a line in the sand that says that our stock goes this low and no lower." Although short sellers have a market power to punish a firm, managers are unlikely to be upcoming about this practice because it may be regarded as price manipulation. Managers' beliefs about equity valuation are therefore difficult to determine and only can be inferred indirectly. This study proposes to explore interrelationship between short-selling activity and manager repurchase to verify whether managers trade with short sellers to support an overvalued equity, or managers trade against shorts when they have private information that fundamentals will improve, or managers believe the shorts have made a mistake and the shares are fairly valued or even undervalued. We find corporate managers trade with short sellers regardless of big or small stocks, but insiders of big market-capitalization stocks trade against short sellers and insiders of small market-capitalization stocks trade with them in Taiwan stock market. We also investigate whether market frictions and type of short sellers affects this link. Furthermore, our sample spans a period, 2000 to 2014, in order to examine whether a high stock price has increased when buying back shares.

Keywords: Repurchase, buyback, short sale, insiders, informed trading.

JEL Classifications: D53, G13, G14, G15

1. Introduction

Although short sellers correctly predict future negative returns and keep prices closer to fundamental values (see Diether, Lee and Werner 2009, Karpoff and Lou 2010), research on how companies respond to short sellers is limited. To our knowledge, the only two prior studies investigating a relation between corporate share repurchases and short interest is by de Jong et al. (2011), who examine a specialized transaction involving issuance of convertible debt, and by Liu and Swanson (2012), which disclose managers trade against the shorts when shorts are mistaken. Jim Cramer, host of the CNBC show Mad Money, commented during July 23, 2010 episode, that corporate repurchases and insider buying are two ways that managers of heavily shorted companies can "draw a line in the sand that says that our stock goes this low and no lower." Although short sellers have a market power to punish a firm, managers are unlikely to be upcoming about this practice because it may be regarded as price manipulation. Since no academic evidence exists on whether the use of repurchase to trade against short seller is a common practice, we wonder the practice might not reasonably common or only sustain under a certain market structure. Owing to different repurchase law[1] and market mechanism between US and Taiwan, we suspect trading-against relationship between insiders and short sellers as in Liu and Swanson (2012) might not be the case in Taiwan. Size of firm associates with the supply of shares and might have an impact on manager's decision for repurchase and firm's goals to buyback. Firm size also indirectly relates to the extent and speed which short sellers can inflict on short sold stocks. Therefore, we explore whether type of firms (big-, medium-, or small-size) determines repurchase to trade against shorts to prevent, or at least delay, a decline in stock price or contrarily to trade with or trade with no relation to shorts. Furthermore, the type of shorts (e.g. individual or institution), the channel short sellers adopt, and its shorting cost produce additional sources of impact on the link between repurchase and short interest. Securities and Exchange Commission (SEC) of Taiwan regulate companies to report their buyback purpose which we believe somehow disclose manager's view for their stock as being undervalued, fairly valued or overvalued. In addition, officers, directors, managers and shareholders holding more than 10% shares outstanding have to report number of shares sold in advance if sold shares are over 10,000 per day and these stakeholders are not allowed to sell shares while company is buying shares back. The regulation might reverse the causality of above story that shorts might act to retreat, take no action or go forward to trade against repurchase when firms make an announcement to buy back shares. Finally, we look into how market friction (e.g. short-selling restriction or financial crisis) affects the link between repurchases and shorts.

Managers can easily monitor the aggregate short position in their company's stock because short interest is publicly reported by the stock exchange every day. However, the insiders' holding only needs to be reported once a month and is not necessary to report to authority before trading if the trade amount is less than 10000 shares per day. If trading amount is more than 10000 shares, the trader is obligated to report to the authority three days in advance in order to trade. Although the latter is the case, short sellers still do not have timely information.

Corporate share repurchases are expected to increase when the stock price drops. Expectations about the future price are also likely to influence share repurchases. If managers

[1] During the Asian financial crisis period, many firms in Taiwan experienced a big drop in stock price, but couldn't repurchase their own shares directly from the market because Taiwan corporations are not allowed to buy back shares until 2000.

expect a future price decline, they would reduce repurchases in the current quarter and buy at a lower price in the future. If short sellers have a similar expectation, they would increase their positions during the quarter to profit from a lower price in the later quarters. Then a negative association between repurchases and short interest is observed. On the contrary, a positive association would be observed if shorts and managers consistently (systematically) hold conflicting views about the future stock price. A third possibility is that repurchase and short sale is unrelated on average. However, a more plausible explanation for a positive association is managers either increase repurchase to counter an increase in shorts or decrease repurchase to go against an decrease in shorts.

Short sales constraints allow stocks to be substantially overpriced and any overpricing gets corrected only slowly. Lamont (2004) identifies a sample of 266 companies that took a variety of publicly stated actions to constrain short sellers[2] and concludes that firms are not just passively responding to market signals but are in fact actively trying to prop up their stock prices. Recent studies focus on short selling bans imposed by regulators in response to lobbying by corporate managers (see Beber and Pagano 2012, Boehmer et al. 2011). Liu and Swanson (2012) add to this literature by documenting that average stock price declines only modestly after corporate share repurchases increase in response to an increase in short interest. Lamont's sample firms experienced monthly abnormal returns by -2 percent on average over the next year, their efforts to support the stock price are not very successful.

Managers can influence market opinion by using their own funds to buy shares of the companies that employ them to silently wage war on shorts. To support this assertion, Liu and Swanson (2012) uncover evidence in stock prices, financial statements, and insider trading. This strategy can damage shorts especially those who are naked[3] because insider stock purchases are widely seen as a signal that a stock is underpriced. Nevertheless, this strategy only works if the market believes these purchases are a reliable price signal, yet it is weakened as share price rises. Even so, the sums that managers can invest are small relative to their companies' market capitalization and have little influence on shorts. Where managers can wield a powerful influence is in using their companies' money to buy back shares. However, an agency relationship exists when managers use corporate capital to repurchase shares. An especially interesting result would be if managers sell shares from their personal account while buying shares with corporate capital, as this would suggest repurchases are being used to support overvalued equity. On the contrary, if managers buy shares from their personal account while buying shares with corporate capital, this would suggest repurchases are being used to support undervalued equity and another agency problem arises.

Managers' beliefs about equity valuation are difficult to determine and only can be inferred indirectly. This study proposes an interrelationship between short selling and manager repurchase to verify Managers' beliefs. We find corporate managers trade with short sellers regardless of big or small stocks, but insiders of big market-capitalization stocks trade against short sellers and insiders of small market-capitalization stocks trade with them in Taiwan stock market. We also find market frictions and type of short sellers affects this link. Furthermore, we observe a high stock price has increased when buying back shares.

[2] For example, belligerent statements refuting or denouncing shorts for improper actions, lawsuits, appeals to authorities to investigate the shorts, requests to shareholders to withdraw their shares from the lending market.
[3] Short sellers did not borrow shares and sell them.

The remainder of the study proceeds as follows. The next section provides additional background about the regulation of corporate share repurchases and describes in more detail how our study relates to prior research. Section 3 presents research hypotheses, data collection and descriptive statistics. Section 4 reports empirical results on share repurchases, subsample analyses, and robustness tests, Section 5 extends to consider trading by insiders. The final section concludes and proposes additional research.

2. Literature review

Much of the past literature on corporate share repurchases considers program announcements and the stock returns that follow those announcements, rather than actual repurchase transactions. For example, Ikenberry, Lakonishok, and Vermaelen (1995) and Peyer and Vermaelen (2009) show that in the U.S. open market share repurchase announcements are accompanied by a positive short-term abnormal return of about 3% and long-run abnormal returns in the order of 30% over three to four years. Research on short term announcement returns (see Vermaelen 1981, Ikenberry et al 1995, Grullon and Michaely 2004) shows that these returns are higher when the percentage of shares repurchased is larger, when the firm has excess cash and is a value stock, and when the management states “undervaluation” as a motivation for the repurchase. These results are consistent with a variety of non-mutually exclusive explanations for the benefits from open market share buybacks: signaling, reduction in agency costs of equity, and corporate tax savings from increased leverage. Peyer and Vermaelen (2009) claim the results on long term returns imply that the U.S. market systematically underreacts to open market buyback announcements, especially for beaten up small firms, downgraded by analysts prior to the buyback announcement. Using robust data, McLean (2011) shows that a much stronger explanation is risk adverse. Prior to McLean (2011), the results are attributed to managers’ being able to time the market by taking advantage of market mistakes and buying back undervalued stock.

Manconi, Peyer and Vermaelen (2012) declare that share buybacks can be driven by non-value maximizing incentives such as fighting a takeover bid by repurchasing shares from “pessimistic” shareholders, stabilizing the stock price by buying shares above “fair” value, manipulating earnings per share, or acting in the interest of a majority stockholder at the expense of minority shareholders. The latter argument is particularly important in European firms, where Faccio and Lang (2002) find a minority of the publicly traded firms to be widely held. Manconi, Peyer and Vermaelen (2012) conclude that when corporate governance quality is high, markets do not expect that managers use buybacks to engage in these non-value maximizing activities. Likewise, McLean (2011) and Liu and Swanson (2012) illustrate how much share prices are influenced not by investors judging reported results and risks, but rather by insiders whose superior knowledge gives them an inherent advantage in the market for their companies' shares.

3. Data and markets

The data used in this study come from two sources: (1) the component stocks of Taiwan Stock Exchange Capitalization Weighted Stock Index (TAIEX) provided by the Taiwan Stock Exchange Co. Ltd (TWSE), and (2) the repurchased stock data and financial statement fundamentals, provided by the Taiwan Economic Journal (TEJ). For the present study, the unit of analysis for examining buybacks at the time of traders sold short is per trade data taken from August 10, 2000 to December 31, 2013, a sample period long enough to analyze all the managers' buyback against short sellers' trading in the Taiwan market, in particular around global financial crisis and the time periods during which short-selling price restrictions are lifted. Beginning from 7 August 2000, companies are allowed to buy back shares on open market and buyback should be completed within two months after announcement.

3.1. *Lifting of short-selling price constraints*

Phillips (2011) argues that since institutional investors are the primary source of borrowed stocks, institutional holding of stocks can be used as proxy for the level of short sale constraints. This study also serves to explore whether managers trade against /with /with no relation to short sellers will be different upon facing a lifting of short-selling price restriction. Our results should be more robust than the results in Phillips (2011) because the traits of our data allow us to directly evidence the hypotheses.

In May 2005, short-selling-price restriction on the 50 component stocks of Taiwan ETF 50 was removed for individual trader accounts only. In November 2007, the component stocks of the Taiwan Mid-cap 100 index exempts from the above-previous-closing price rule for both individual and institutional traders. On September 23, 2013, Taiwan Security Exchange Corporation lifted the restrictions of short-selling price that is not allowed to be lower than the previous closing on 1052 stocks. Furthermore, 200 stocks are allowed to be day traded since January 6, 2014.

3.2. *Global financial crisis*

The global financial crisis (GFC) or global economic crisis is commonly believed to have begun in July 2007 with the credit crunch and hit the world in 2008. The collapse of Lehman Brothers on September 14, 2008 marked the beginning of a new phase in the global financial crisis. From September 22, 2008 through October 3, 2008, short selling in Taiwan is completely prohibited for all stocks for the sake of worldwide financial crisis and reinstates afterwards, but short selling price is not allowed to be lower than the previous closing price without any exceptions until January 2009 with exemption of constituent stocks of Taiwan Top 50 and Taiwan Mid-cap 100. This study will follow the definition of TSEC's uptick rule in Lin, Lee and Wang (2013) and break the sample period into three subperiods: 1) September 14 to September 21 was the"preliminary"intervention period because during this window intervention on a small scale was taking place. 2) September 22 was the day of all-out stock market intervention. 3) September 23 to October 3, 2008, was the immediate aftermath of the intervention. The period allows an examination of the impact of government intervention before the reintroduction of restrictions on short selling of stocks on October 4. October 4 to 4 January, 2009 provides information on the net effect of the interplay between the fading of the effect of direct intervention and the impact of the reinstitution of the TSEC up-tick rule against short selling on Taiwan Top 50 and Taiwan Mid-cap 100.

4. Preliminary results

4.1. *Summary description*

The final sample consists of 1917 firm repurchase events. We drop firm events without full information including stock price, short sales, financial fundamental, insider trading, institutional holding, option granted, and so on. Table 1 presents descriptive statistics. Panel A reports summary statistics of stock and firm level characteristics by percentile, Panel B classifies Panel A by year to observe variation, and Panel C reports pair-wise correlation statistics. The average firm in the sample has a market capitalization of 1.30 billion NTD, a book-to-market ratio of 1.12, a quarterly stock price
17.44 NTD, repurchase 2%, short sale 0.8% and lending sale 0.05% of outstanding shares, and 36% institutional ownership. The figure in Panel B shows repurchase is negatively related to stock price and this pattern evidences an underpriced hypothesis.

The pair-wise correlation statistics reveal a negative relationship between Repurchase and Lending sale (and Institutional ownership) and also between lagged Repurchase and Short sale. Insider sale is positively correlated with short sale, but negatively correlated with return and insider holding.

4.2. *Hypotheses*

To test whether managers trade with short sellers to support an overvalued equity, or managers trade against shorts when they have private information that fundamentals will improve, or managers believe the shorts have made a mistake and the shares are fairly valued or even undervalued, we hypothesize:

H1: Is an increase in repurchases negatively / positively / non-relatively associated with an increase in short interest?

Short-selling constraints allow stocks to be substantially overpriced. Removal of short-selling price restriction may induce managers to react to short sellers oppositely. To support or retain a fair stock price, more buy bucks may be needed during a financial crisis or a downward market.

H2: Does the link between repurchases and shorts sale differ in firm size (type of short sellers, lifting of short-selling price restriction, or a global financial crisis) ?

We examine future stock prices, accounting fundamentals, insider trading and an overvaluation measure $OP_{i,t}$ in equation (1) for evidence of overvaluation.

$$OP_{i,t} = \frac{PE_{i,t} - PE_{pilot,t}}{PE_{pilot,t}} \tag{1}$$

where $PE_{pilot,t}$ is the price earning ratio of pilot stock and $PE_{i,t}$ is price earning ratio of matching stock i in the same industry as pilot stock. Pilot stocks are defined as those stocks which are lift of short-selling price restriction.

To examine whether managers use personal fund to support an overvalued equity or whether there is an agency problem when corporate repurchases shares, we hypothesize:

H3: Is an increase in insider's net selling negatively / positively / non-relatedly associated with an increase in short interest?

Inconsistent with other stock markets, Taiwan stock market disallow officers, directors, managers and shareholders holding more than 10% shares outstanding to sell shares while manager is buying back company stocks. This regulation leads to insider selling either unrelatedly or negatively associated with share repurchase, but how about the relation between short sale and insider sale? We also wonder whether this relationship will be enforced / reduced while corporate does not launch share repurchase.

In Taiwan market, short sale performs by individuals, but lending sale mostly conducts by institutional traders. Therefore, we also would like to test hypotheses H1 to H3 for lending sale to examine whether the result is different in trader type.

5. Main results

5.1. *The Repurchase model*

We follow Liu and Swanson (2012) and other studies in repurchase or short selling literature to model repurchases as

$$\begin{aligned} Rep_{i,t} = {} & \beta_0 + \beta_1 SI_{i,t} + \beta_2 SI_{i,t-1} + \beta_3 Rep_{i,t-1} + \beta_4 BTM_{i,t-1} + \beta_5 Ret_{i,t} + \beta_6 Cash_{i,t-1} + \beta_7 Debt_{i,t-1} + \beta_8 FCF_{i,t} \\ & + \beta_9 ROA_{i,t-1} + \beta_{10} Ins_{i,t} + \beta_{11} Size_{i,t-1} + \beta_{12} Div_{i,t-1} + \beta_{13} MOpt_{i,t} + \beta_{14} InsO_{i,t} \\ & + \beta_{15} Up_{i,t} + \beta_{16} Crsis_t + \beta_{17} Rep_{i,t-1} + \Sigma\beta_m Industry_m + \Sigma\beta_n Year\text{-}Qtr_n + e_{i,t} \end{aligned} \tag{2}$$

The dependent variable, $Rep_{i,t}$, is a company's repurchases of common stock in quarter t scaled by outstanding shares at the beginning of the quarter multiplied by 100 to present as a percentage. The explanatory variable of primary interest, $SI_{i,t}$, is short interest in quarter t and $SI_{i,t-1}$, is short interest in quarter t-1, where short interest is the number of shares sold short divided by common shares outstanding multiplied by 100. If managers use repurchases to trade against short sellers, the coefficient on $SI_{i,t}$ would be positive, indicating that firms increase their share repurchases concurrently with an increase in short interest. If managers instead trade with the shorts, which would occur if mispricing drives the trades of the shorts and both have similar views about the mispricing, the coefficient on $SI_{i,t}$ would be negative. The results of these arguments reveal in Table 3. In this study, we split the dataset into TSE50, TM 100, and the Rest according to the index-linked ETFs traded at the TWSE. Focusing first on the aggregate dataset, results show a significantly negative relation between repurchase and short interests. The negative relation also consistently reveals in TSE50, TM100, and the Rest splits with a waning degree by this order. Repurchase demonstrates a momentum effect in aggregate, TSE50, TM100, and the Rest splits.

To control for cross-sectional factors, we include several market and accounting variables from prior research on corporate share repurchases. $BTM_{i,t-1}$ equals the ratio of book value of equity to the market value of equity at the end of quarter t-1. $Ret_{i,t}$ is the raw stock return during quarter t. $Cash_{i,t-1}$ is calculated as cash and short term-investments at the end of quarter t-1, deflated by total assets at that time. $Debt_{i,t-1}$ is calculated as the ratio of current plus long term debt to total assets at the end of quarter t-1. $FCF_{i,t-1}$ is free cash flow (operating cash flow minus capital expenditures) in quarter t-1, scaled by total assets at the end of quarter t-1. $ROA_{i,t-1}$ is the ratio of earning before income tax, interest, and depreciation for quarter t-1, divided by total assets at the end of quarter t-1. $Ins_{i,t}$ is the shares hold by insiders (including board members and managers) during the last month of quarter t. $Size_{i,t-1}$ equals the natural log of total assets at the end of quarter t-1. $Div_{i,t-1}$ is dividends per share for quarter t-1 divided by stock price at the end of that quarter. $MOpt_t$ is the total number of stock options granted to managers in quarter t, scaled by common shares outstanding. $InsO_{i,t}$ is institutional ownership of stocks in quarter t. $Up_{i,t}$ /$SS_{i,t}$ is a dummy to control for stocks/regimes with / without TWSE-uptick-rules (see Lin, Lee, and Wang 2013)[4]. Crsist is a dummy variable, taking one to represent global financial crisis period, zero otherwise.

Book-to-market ratio has been used in the share repurchase literature to indicate whether the firm's stock is undervalued, but we find a significant and positive coefficient only in TM100 split. The coefficient on cash and short-term investments is positive in the Rest and aggregate splits because firms with more resources on hand more easily increase share repurchases. Debt servicing requires that firms keep cash on hand, and some debt covenants have strict limitations on payouts to shareholders. As Dittmar (2000) and Core et al. (2006), we find a significant and negative coefficient on debt in TSE50, TM100 and the Rest splits. Firms with increasing free cash flow are more able to increase share repurchases, but we observe an insignificantly positive coefficient on FCF, a finding inconsistent with Stephens and Weisbach (1998). Because profitable firms are not necessary to increase earnings per share by reducing outstanding shares, we find a strong and consistently negative sign on ROA in all sample splits with a decreasing degree in firm size. Insider holding is negatively associated with manager repurchase. There is less needs for managers to increase shares of control when the shares owned by mangers are high. Firm size is expected to be positively related to repurchases according to Dittmar (2000), Core et al. (2006), and Blouin and Krull (2009). Unlike Skinner (2008), dividend yield does not have a significantly negative coefficient assuming that share repurchases and dividends are substitutes in returning capital to shareholders. According to Phillips (2011), it is harder and more expensive to borrow a stock with lower institutional holding because short seller of this stock is more likely possess negative information of this firm. Institutional holding is negatively related to repurchases with a stronger effect to larger than smaller firms. If shorts are triggered by overpriced stock, lifting of short-selling price restriction would decrease the amount of shares sold or increase the amount of shares repurchased. Traders might behave differently from normal time during a depressed economy period, we thus control for global financial crisis and observe a positive coefficient on repurchase. Likewise, we find a negative/positive relation between $Up_{i,t}$ /$SS_{i,t}$ and share repurchase.

5.2. *The Netsell model*

[4] In Taiwan, short selling or lending selling is inhibited to execute at a price below the previous closing. We refer to this rule as the "TWSE uptick rule."

Insiders' superior knowledge gives them an inherent advantage in the market for their companies' shares. To provide additional information on whether managers use share repurchases to support overvalued equity, we would like to examine insiders' personal trades. We define insider as Cohen, Malloy and Pomorsky (2012) and Massa, Qian, Xu and Zhang (2015) to focus on officers and directors as our insiders in this study.

We use the following model:

$$\begin{aligned} NetSell_{i,t} = {} & \beta_0 + \beta_1 SI_{i,t} + \beta_2 Rep_{i,t} + \beta_3 BTM_{i,t-1} + \beta_4 AbRet_{i,t} + \beta_5 AbRet_{i,(t+1,t+4)} \\ & + \beta_6 MOpt_{i,t} + \beta_7 Size_{i,t-1} + \beta_8 Accrual_{i,t-1} + \beta_9 Crsis_t \\ & + \Sigma_m Industry_m + \Sigma_n Year\text{-}Qtr_n + e_{i,t} \end{aligned} \tag{3}$$

$NetSell_{i,t}$ is the amount of insider sales less insider purchases during quarter t, divided by the sum of those two amounts. We choose the sell version of the trading ratio because sales of stock by insiders are much more frequent than are purchases. Other studies that use variations of a trading ratio as the dependent variable, and use only periods with insider activity, include Rozeff and Zaman (1988), Lakonishok and Lee (2001), Frankel and Li (2004), Piotroski and Roulstone (2005), Rogers and Stockton (2005), and Core et al. (2006).

SI_t is short interest in quarter t. Although a greater amount of lendable shares increases the insiders' incentives to sell, particularly for the information-related insider sales, the more informed the insider is, the more they wish to pre-empt short sellers to exploit their informational advantage according to Massa, Qian, Xu and Zhang (2015). We do not predict a sign for SIt because short interest could be negatively related, positively related, or unrelated to insider net selling. The sign would be negative if managers trade against short sellers with their personal capital. Although their trades are too small by themselves to be effective in trading against shorts, their trades could influence outside investors to trade against the shorts. Recall that Cramer identifies insider trades as a way that managers of heavily shorted companies can draw "a line in the sand that says that our stock goes this low and no lower." A positive sign would be observed if managers, instead trade consistently with shorts. This could occur because prior research indicates that both short sellers (Drake et al. 2011) and insiders (Rozeff and Zaman 1988, Piotroski and Roulstone 2005) are value investors. To our knowledge, Liu and Swanson (2012) is the first to investigate if insiders and short sellers trade in a consistent or conflicting manner; however, they are not the first to investigate whether insider trading is related to corporate share repurchases. Core et al. (2006) find that when accruals are high, firms decrease repurchases and managers sell more shares. Griffin and Zhu (2010) find that CEO stock options influence the amount and timing of funds used for repurchasing stock.

The model includes several other variables that have been shown by prior research to influence insider trades. Rozeff and Zaman (1988) and Piotroski and Roulstone (2005) find that insider selling increases (decreases) in response to recent stock price increases (decreases). We extend their research by using quarterly, rather than annual, returns and we expect a positive association between insider net sales and AbReti,t. Prior research shows insiders tend to purchase value stocks, possibly because they are often undervalued based on fundamental information (Piotroski 2000). We therefore expect a negative coefficient, indicating less selling of firms with a high *Rank of BTM*. Consistent with Piotroski and Roulstone (2005), we include the one-year-ahead buy-and-hold return, $AbRet_{t+1 \text{ to } t+4}$, since insiders may have better information for predicting future returns than the market. All abnormal returns are characteristic-based and benchmark-adjusted as in Daniel et al. (1997). We expect a negative sign because insiders would reduce current selling when they expect positive future returns. We include stock option grants (*MOpt*) and expect a positive sign, reasoning that insiders receiving large option grants would sell shares to diversify their investment portfolio. We include *Size* and expect the coefficient to be positive, as prior research indicates that insiders of larger firms sell more stock than those of smaller firms (Seyhun 1986, Rozeff and Zaman 1988). Core et al. (2006) suggest that insiders sell more shares when accruals are high, which supports a positive sign on $Accrual_{i,t-1}$. Based on the recent study by Hafzalla et al. (2011) which shows accruals better predict future returns when deflated by earnings, we use the percent operating accrual (i.e., scaling accruals by the absolute value of net income). Finally, we control for global financial crisis period (*Crsist*).

6. Conclusions

In this study, we uncover whether managers trade against / with / with no relation to short sellers to support undervalued / overvalued shares during our sample period, and investigate whether the results differ in firm size and type of short sellers, and explore whether there are other factors drive firm size to obtain these results. We examine future stock prices, accounting fundamentals, and insider trading and also calculate an overvaluation measure to confirm evidence of undervaluation/overvaluation. We provide evidence whether the link between repurchases and shorts is different after removal of short-selling price restrictions and global financial crisis period.

We find that managers trade with shorts when they buck back shares to support an undervaluation hypothesis in Taiwan stock market. Also, we find small-size firms would have a different trading behavior from medium- and big-size firms regarding the association because of traits like higher insiders' holding and less liquidity. In addition, we expect there is a negative relation between insider's net sell and shorts, and also a negative relation between insider's net sell and corporate repurchase owing to the regulation of buyback act launched in 2000.

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Appendix : Variable Definitions

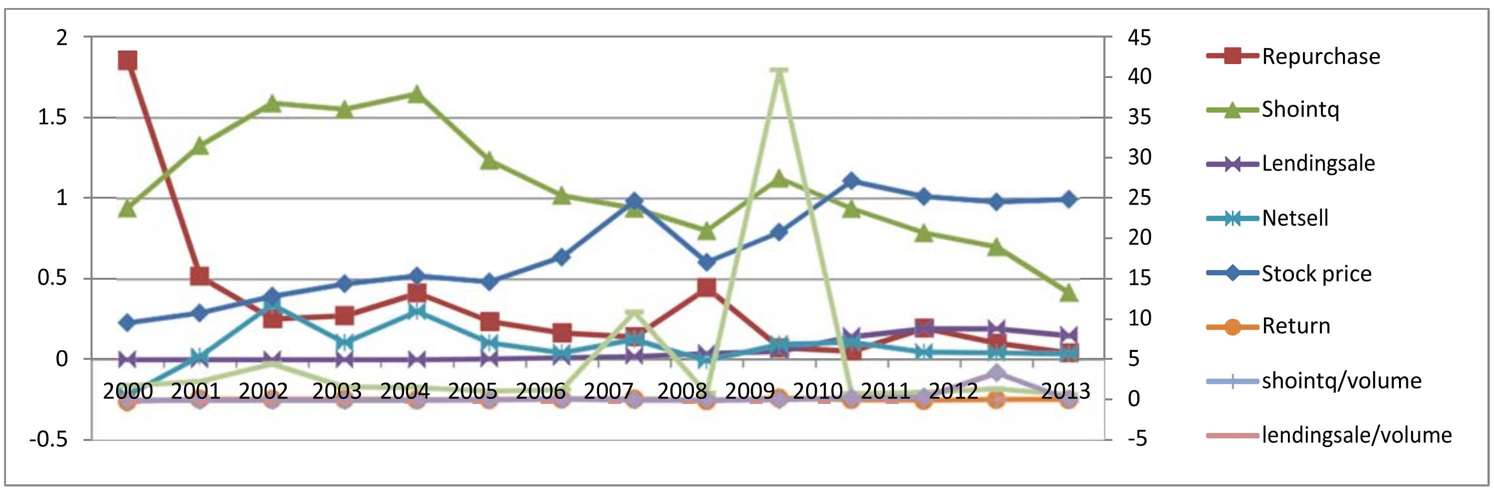
Variables	Definitions
Shointq	Number of shares sold short by individuals in quarter t scaled by shares outstanding multiplied by 100
Return	Return in quarter t calculated by stock price at end of quarter divided by the price at beginning of quarter minus one
Repurchase	Number of shares repurchased by corporation in quarter t scaled by shares outstanding multiplied by 100
Qopgnt	Number of stock options granted to managers in quarter t scaled by common shares outstanding multiplied by 100.
Qopgntdum	Dummy variable equals one if qopgnt>0 and zero otherewise
Netsell	Number of shares sold by officers and directors in quarter t
Netselldum	Dummy variable equals one if netsell>0 and zero otherewise
MV	Market value at the end of quarter t calculated by stock price multipled by shares outstanding
Lendingsale	Number of shares lent and sold by institutions (and less than 5% by individuals) in quarter t scaled by shares outstandii multiplied by 100
$Size_{t-1}$	Logarithm of total asset in quarter t-1
Roa_{t-1}	Lagged return on asset before interest, tax and depreciation
$Repurchase_{t-1}$	Lagged share repurchased
$Operaccrual_{t-1}$	Lagged operating Accrual computed by the difference between net income and operating cash flow scaled by the absolı of net income
$Lendingsale_{t-1}$	Lagged lent and sold shares
Fcf_{t-1}	Lagged free cash flow computed by sum of operating cash flow and purchased fixed asset scaled by total capital multip 100
Div_{t-1}	Lagged dividend yield computed by dividends per share divided by stock price at the end of quarter t-1
$Debt_{t-1}$	Lagged debt computed by sum of current debt and long term debt scaled by total asset
$Cash_{t-1}$	Lagged cash computed by sum of cash and short term-investments at the end of quarter t-1 scaled by total asset multipl
Btm_{t-1}	Lagged book to market value
Instiown	Institutional ownership, excluding repurchased shares, scaled by shares outsanding
Insider	Number of shares owned by officers and directors at the end of quarter t scaled by shares outsanding
Insiderdum	Dummy variable equals one if insider holding is euqal to or greater than the industrial median and zero otherwise
Illiquidity	Amihud (2002) illiquidity measure
Crisis	Dummy variable euqals one for date between July 1, 2007 and January 4, 2009 and zero otherwise
Abreturn	Abnormal return in quarter t is calculated by individual stock return minus group average return obtained by characteri sorting on Btm, previous quarter return, and size into five groups each (5x5x5).
Abreturn4	One-year-ahead buy-and-hold return computed by (1+abreturn_1)(1+abreturn_2)(1+abreturn_3)(1+abreturn_4)-1
UPss50	Dummy variable equals zero if firms belong to TSE50 and date is greater than 2005Q2 or among 2005Q2 or 2008Q4 a otherwise.
UPls50	Dummy variable equals zero if firms belong to TSE50 and date is greater than 2007Q2 or among 2007Q2 or 2008Q4 aı otherwise.
UPss100	Dummy variable equals zero if firms belong to TM 100 and date is greater than 2007Q4 or among 2007Q4 or 2008Q4 : otherwise.
UPls100	Dummy variable equal to zero if firms belong to TM 100 and date greater than 2007Q4 or among 2007Q4 or 2008Q4 : otherwise.
SS50	Dummy variable equals one if date is greater than 2005Q2 or among 2005Q2 or 2008Q4 and zero otherwise.
LS50	Dummy variable equals one if date is greater than 2007Q2 or among 2007Q2 or 2008Q4 and zero otherwise.
SS100	Dummy variable equals one if date is greater than 2007Q4 or among 2007Q4 or 2008Q4 and zero otherwise.
LS100	Dummy variable equals one if date is greater than 2007Q4 or among 2007Q4 or 2008Q4 and zero otherwise.

Table 1 Summary Statistics

Variable	N	Mean	Median	Variance	Skewness	Kurtosis	Min	Max	10th percentile	90th percentile
Panel A:										
Stock price	1917	17.44	10.42	1355.49	10.65	154	1.30	730	4.45	28.00
Repurchase	1917	2.00%	1.61%	0.03%	1.49	2.93	0.00	0.10	0.35%	4.20%
Shointq	1917	0.84%	0.18%	0.04%	4.97	31.97	0.00	0.23	0.01%	2.07%
Lendingsale	1917	5.0E-04	0.00	5.7E-06	8.58	89.76	0.00	0.04	0.00	7.7E-04
Btm_{t-1}	1917	1.12	1.02	0.43	2.44	20.10	0.07	10.00	0.44	1.92
Return	1917	(0.05)	-0.06	0.06	2.61	21.70	(0.60)	3.04	-0.31	0.20
$Cash_{t-1}$	1917	0.14	0.10	0	1.42	1.98	0.00	0.73	0.02	0.31
$Debt_{t-1}$	1917	0.32	0.32	0.02	0.22	(0.18)	0.00	0.87	0.11	0.52
Fcf_{t-1}	1917	0.02	0.01	0.00	0.50	8.77	(0.52)	0.61	-0.05	0.09
Roa_{t-1}	1917	4.77	3.62	27.54	1.53	4.31	(12.16)	40.08	0.19	11.20
MV	1917	1.E+07	5.E+06	1.E+15	11	176	2.E+05	7.E+08	1.E+06	3.E+07
Div_{t-1}	1917	4.39	4.13	14.56	0.95	1.56	0.00	26.42	0.00	9.08
$Operaccrual_{t-1}$	1917	(3.17)	(0.28)	6663	(29)	1098	(3092)	859	-6.88	2.99
Illiquidity	1917	10.03	1.56	1620	10.41	153.18	0.00	870	0.12	16.84
Insider	1917	20.13	17.63	131	1.21	1.49	2.45	67.26	7.71	36.02
Qopgntdum	1917	0.01	0.00	0.01	8.25	66.19	0.00	1.00	0.00	0.00
Instiown	1917	0.36	0.34	0.04	0.39	(0.55)	0.00	0.93	0.11	0.62
Netsell	1917	0.04	0.00	3.43	0.94	65.51	(26.77)	25.85	-0.70	0.48
Abreturn	1917	(0.01)	0.00	0.02	0.45	6.77	(0.60)	1.09	-0.15	0.13
Abreturn4	1773	0.01	-0.01	0.09	1.31	6.46	(1.15)	2.61	-0.31	0.36

Table 1 Summary Statistics

Variables	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Panel B:														
Repurchase Events	138	163	118	125	228	139	123	100	344	74	48	189	112	16
Stock price	9.54	10.76	12.85	14.37	15.37	14.61	17.68	24.62	17.04	20.75	27.11	25.19	24.51	24.82
Repurchase	1.85	0.51	0.26	0.27	0.41	0.24	0.17	0.14	0.44	0.08	0.05	0.20	0.10	0.04
Shointq	0.94	1.32	1.59	1.55	1.64	1.23	1.02	0.94	0.80	1.12	0.93	0.78	0.70	0.41
Lendingsale	0	0	0	0	0	0.01	0.01	0.02	0.04	0.06	0.15	0.19	0.19	0.15
Netsell	-0.22	0.02	0.34	0.10	0.30	0.10	0.04	0.12	-0.01	0.10	0.11	0.05	0.04	0.04
Return	-0.18	0.10	0.07	0.07	0.01	0.01	0.11	0.11	-0.13	0.23	0.03	-0.07	0.05	0.05
Shointq/volume (%)	1.09	1.02	1.30	1.25	1.67	1.37	0.97	0.88	0.01	0.99	0.96	1.25	1.26	0.78
Lendingsale/volume	0	0	0	0	0	0.02	0.04	0.07	0.10	0.11	0.29	0.53	0.68	0.61
Shointq/repurchase	1.73	2.24	4.41	1.57	1.52	1.07	1.26	10.88	0.80	40.86	0.76	0.91	1.34	0.66
Lendingsale/repurchase	0	0	0	0	0	0.08	0.15	0.04	0.03	0.07	0.30	0.40	3.38	0.09



Stock price (right Axis)

Table 1 Pearson Correlation

Prob > |r| under H0: Rho=0

Observations=2191

	Stock price	$Repurchase_t$	$Repurchase_{t-1}$	Shointq	$Shointq_{t-1}$	Lendingsale	$Lendingsale_{t-1}$	Return	$Return_{t-1}$	Insider	Instiown	Netsell
Panel C:												
Stock price	1											
Repurchase	0.1456	1										
	(0.0000)											
$Repurchase_{t-1}$	0.0267	0.0783	1									
	(0.2173)	(0.0003)										
Shointq	-0.0306	-0.0146	-0.0535	1								
	(0.1525)	(0.4945)	(0.0133)									
$Shointq_{t-1}$	-0.0424	-0.0019	-0.0652	0.5794	1							
	(0.0498)	(0.9308)	(0.0025)	(0.0000)								
$Lendingsale_t$	0.0479	-0.0428	-0.0405	0.1260	0.0608	1						
	(0.0250)	(0.0450)	(0.0610)	(0.0000)	(0.0049)							
$Lendingsale_{t-1}$	0.0293	-0.0605	-0.0183	0.0875	0.0658	0.6705	1					
	(0.1756)	(0.0051)	(0.3971)	(0.0000)	(0.0023)	(0.0000)						
Return	0.0174	0.0127	0.1000	0.0005	-0.0957	-0.0397	-0.0304	1				
	(0.2876)	(0.5532)	(0.0000)	(0.9803)	(0.0000)	(0.0629)	(0.1593)					
$Return_{t-1}$	0.0213	0.0167	0.0526	0.0357	0.0986	0.0184	-0.0044	0.0188	1			
	(0.1933)	(0.4344)	(0.0149)	(0.0956)	(0.0000)	(0.3904)	(0.8379)	(0.2506)				
Insider	-0.0990	-0.0164	-0.0217	-0.0832	-0.0923	-0.1296	-0.1191	0.0484	0.0055	1		
	(0.0000)	(0.4630)	(0.3355)	(0.0002)	(0.0000)	(0.0000)	(0.0000)	(0.0049)	(0.7486)			
Instiown	0.1817	-0.1800	-0.0304	-0.0488	-0.0688	0.1407	0.1442	0.0290	0.0530	0.2589	1	
	(0.0000)	(0.0000)	(0.1611)	(0.0228)	(0.0015)	(0.0000)	(0.0000)	(0.0870)	(0.0018)	(0.0000)		
Netsell	-0.0860	-0.0171	-0.0242	0.0246	0.0502	-0.0013	-0.0053	-0.0589	0.0124	-0.2092	0.0075	1
	(0.0000)	(0.4443)	(0.2822)	(0.2693)	(0.0259)	(0.9549)	(0.8154)	(0.0006)	(0.4724)	(0.0000)	(0.6697)	

Table 2

VARIABLES	TSE 50 Repurchase	TSE 50 Repurchase	TSE 50 Repurchase	Tm 100 Repurchase	Tm 100 Repurchase	Tm 100 Repurchase	The Rest Repurchase	The Rest Repurchase	Full Sample Repurchase	Full Sample Repurchase	Full Sample Repurchase
Panel A: Short Sale											
shointq	-10.07**	-9.738**	-9.617**	-1.326*	-1.258*	-1.321*	-0.0617	-0.0643*	-0.0674**	-0.181***	-0.0696***
	(0.0160)	(0.0320)	(0.0341)	(0.0751)	(0.0990)	(0.0870)	(0.104)	(0.0739)	(0.0124)	(0.000303)	(0.00794)
l_shointq	-0.0214	-0.0205	-0.0229	-0.00122	-0.00235	-0.00213	0.000444	0.000131	0.00156	0.00135	0.00109
	(0.412)	(0.423)	(0.367)	(0.940)	(0.885)	(0.896)	(0.976)	(0.993)	(0.905)	(0.918)	(0.934)
l_repurchase	0.106*	0.106*	0.104*	0.139***	0.139***	0.139***	0.0854***	0.0855***	0.0921***	0.0921***	0.0921***
	(0.0816)	(0.0796)	(0.0879)	(0.00773)	(0.00822)	(0.00822)	(0.000778)	(0.000764)	(0.000110)	(0.000111)	(0.000107)
insiderdum	-0.0419	-0.0397	-0.0358	-0.0408	-0.0412	-0.0412	-0.0685***	-0.0686***	-0.0631***	-0.0653***	-0.0632***
	(0.323)	(0.347)	(0.408)	(0.184)	(0.180)	(0.181)	(0.00148)	(0.00153)	(0.00145)	(0.00102)	(0.00154)
shointq_insiderdum	-0.00787	0.00286	0.0228	-0.0254	-0.0242	-0.0248	-0.00921	-0.00939	-0.0105	-0.0107	-0.0105
	(0.901)	(0.965)	(0.773)	(0.323)	(0.315)	(0.312)	(0.664)	(0.657)	(0.569)	(0.580)	(0.572)
instiown	-0.173*	-0.173*	-0.176*	-0.0337	-0.0342	-0.0342	-0.0180	-0.0179	-0.0330***	-0.0295***	-0.0331***
	(0.0626)	(0.0630)	(0.0551)	(0.194)	(0.192)	(0.193)	(0.101)	(0.104)	(0.00325)	(0.00381)	(0.00322)
shointq_instiown	0.0283	0.0214	0.0126	-0.00237	-0.00257	-0.00207	0.0131	0.0132	0.00573	0.00713	0.00557
	(0.244)	(0.279)	(0.574)	(0.801)	(0.779)	(0.829)	(0.218)	(0.213)	(0.493)	(0.450)	(0.519)
illiquidity	-15.69	-15.44	-16.75	-2.341	-2.214	-2.330	0.00148	0.00156	0.00309	0.00312	0.00314
	(0.357)	(0.365)	(0.355)	(0.121)	(0.150)	(0.138)	(0.913)	(0.909)	(0.823)	(0.823)	(0.821)
shointq_illiquidity	-51.16**	-49.50**	-48.58**	-6.819*	-6.478	-6.779*	0.0267*	0.0271	0.0288	0.0287	0.0291
	(0.0187)	(0.0354)	(0.0407)	(0.0816)	(0.105)	(0.0968)	(0.0969)	(0.108)	(0.101)	(0.102)	(0.112)
l_operaccrual	-0.0383	-0.0385	-0.0403	-0.0200	-0.0200	-0.0201	0.0122*	0.0123*	0.00585	0.00589	0.00589
	(0.129)	(0.120)	(0.101)	(0.236)	(0.233)	(0.234)	(0.0801)	(0.0795)	(0.218)	(0.215)	(0.217)
upss50		-0.510*	-0.0858			0.215***		-0.00373		0.0516*	0.0159
		(0.0557)	(0.583)			(0.00433)		(0.967)		(0.0524)	(0.836)
shointq_upss50		-0.0302	-0.0426			-0.0198		-0.0178		0.119**	-0.0188
		(0.664)	(0.729)			(0.340)		(0.388)		(0.0209)	(0.306)
upss100			0.598**		-0.878***	0.668***		-1.919***		0.0201	-1.718***
			(0.0123)		(0.000130)	(0.00212)		(1.58e-08)		(0.516)	(1.06e-06)
shointq_upss100			0.126		-0.0158	0.0241		0.0273		-0.00509	0.0250
			(0.422)		(0.410)	(0.285)		(0.225)		(0.771)	(0.174)
crisis	0.333**	-0.172	-0.159	0.729***	-0.151	-0.153	1.834***	1.834***	1.837***	1.839***	1.838***
	(0.0144)	(0.383)	(0.423)	(0)	(0.404)	(0.398)	(5.55e-08)	(5.55e-08)	(2.80e-08)	(2.86e-08)	(2.80e-08)
shointq_crisis	0.222*	0.227*	0.244*	0.0186	0.0216	0.0235	0.0357	0.0395	0.0403*	0.0403*	0.0444**
	(0.0562)	(0.0514)	(0.0565)	(0.389)	(0.317)	(0.289)	(0.277)	(0.175)	(0.0842)	(0.0770)	(0.0324)
l_btm	0.0603	0.0618	0.0613	0.0713**	0.0709**	0.0702**	-0.00146	-0.00154	0.00619	0.00629	0.00606
	(0.650)	(0.646)	(0.647)	(0.0130)	(0.0132)	(0.0140)	(0.951)	(0.949)	(0.793)	(0.790)	(0.798)
l_cash	0.0126	0.0123	0.00987	0.0321	0.0320	0.0320	0.0343**	0.0343**	0.0321***	0.0322***	0.0322***
	(0.687)	(0.691)	(0.758)	(0.157)	(0.161)	(0.161)	(0.0151)	(0.0151)	(0.00299)	(0.00366)	(0.00307)
l_fcf	0.0306	0.0305	0.0301	-0.00190	-0.00210	-0.00168	0.00792	0.00811	0.00675	0.00693	0.00690
	(0.298)	(0.297)	(0.299)	(0.895)	(0.884)	(0.906)	(0.316)	(0.304)	(0.306)	(0.300)	(0.299)
l_debt	-0.0743*	-0.0743*	-0.0727	0.0246*	0.0243*	0.0245*	-0.0316**	-0.0315**	-0.0223	-0.0219	-0.0221
	(0.0916)	(0.0910)	(0.106)	(0.0506)	(0.0555)	(0.0549)	(0.0434)	(0.0441)	(0.138)	(0.147)	(0.140)
l_div	0.0264	0.0262	0.0265	0.00941	0.00927	0.00912	0.00642	0.00656	0.00949	0.00919	0.00954
	(0.580)	(0.581)	(0.573)	(0.664)	(0.669)	(0.676)	(0.699)	(0.693)	(0.534)	(0.548)	(0.532)
l_roa	-0.0447*	-0.0441*	-0.0420*	0.0346**	0.0346**	0.0341**	-0.0434***	-0.0435***	-0.0320**	-0.0316**	-0.0321**
	(0.0678)	(0.0749)	(0.0673)	(0.0130)	(0.0129)	(0.0142)	(0.00441)	(0.00434)	(0.0106)	(0.0108)	(0.0106)
abreturn	-0.0120	-0.0118	-0.0109	0.00859	0.0101	0.0108	0.0129	0.0131	0.0110	0.0108	0.0114
	(0.543)	(0.544)	(0.589)	(0.374)	(0.313)	(0.288)	(0.324)	(0.318)	(0.355)	(0.369)	(0.337)
abreturn4	0.0130	0.0133	0.0129	0.0346	0.0344	0.0344	0.00932	0.00929	0.0119	0.0116	0.0118
	(0.437)	(0.431)	(0.436)	(0.104)	(0.106)	(0.107)	(0.467)	(0.468)	(0.286)	(0.302)	(0.290)
Constant	-2.890	-2.332	-3.093	-0.713**	0.195	-0.708**	-0.0981	-0.0986	-0.114	-0.185**	-0.114
	(0.366)	(0.484)	(0.363)	(0.0287)	(0.537)	(0.0365)	(0.252)	(0.249)	(0.114)	(0.0324)	(0.113)
Observations	1,103	1,103	1,103	1,832	1,832	1,832	12,111	12,111	15,046	15,046	15,046
Adjusted R-squared	0.109	0.108	0.108	0.116	0.115	0.115	0.106	0.106	0.108	0.108	0.108

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2

VARIABLES	TSE 50 Repurchase	TSE 50 Repurchase	TSE 50 Repurchase	Tm 100 Repurchase	Tm 100 Repurchase	Tm 100 Repurchase	The Rest Repurchase	The Rest Repurchase	Full Sample Repurchase	Full Sample Repurchase	Full Sample Repurchase
Panel B: Lending Sale											
lendingsale	-9.628**	-9.522**	-9.430**	1.031	1.006	1.099	-0.0358	-0.00196	-0.243	-0.305	-0.213
	(0.0296)	(0.0365)	(0.0385)	(0.429)	(0.427)	(0.355)	(0.919)	(0.996)	(0.349)	(0.207)	(0.425)
l_lendingsale	-0.00313	-0.00378	-0.00346	-0.00557	-0.00366	-0.00458	-0.00268	-0.00254	-0.00782	-0.00649	-0.00679
	(0.646)	(0.567)	(0.599)	(0.469)	(0.669)	(0.592)	(0.863)	(0.869)	(0.109)	(0.199)	(0.137)
l_repurchase	0.105*	0.105*	0.105*	0.139***	0.139***	0.138***	0.0868***	0.0868***	0.0938***	0.0937***	0.0938***
	(0.0794)	(0.0819)	(0.0822)	(0.00512)	(0.00517)	(0.00467)	(0.000575)	(0.000575)	(6.97e-05)	(7.07e-05)	(7.02e-05)
insiderdum	-0.0318	-0.0326	-0.0334	-0.0519**	-0.0521**	-0.0527**	-0.0639***	-0.0637***	-0.0605***	-0.0622***	-0.0608***
	(0.246)	(0.228)	(0.217)	(0.0457)	(0.0425)	(0.0421)	(0.000882)	(0.000911)	(0.00176)	(0.00126)	(0.00160)
lendingsale_insiderdum	0.00281	0.00359	0.000312	0.0148	0.000345	-0.00938	-0.00647	-0.00595	0.000543	-0.00501	-0.00135
	(0.928)	(0.909)	(0.992)	(0.687)	(0.989)	(0.678)	(0.813)	(0.831)	(0.975)	(0.782)	(0.934)
instiown	-0.178**	-0.179**	-0.179**	-0.0238	-0.0244	-0.0238	-0.0157	-0.0157	-0.0308**	-0.0289**	-0.0313***
	(0.0423)	(0.0407)	(0.0407)	(0.339)	(0.320)	(0.330)	(0.130)	(0.126)	(0.0102)	(0.0168)	(0.00795)
lendingsale_instiown	0.0772**	0.0763**	0.0754**	-0.00743	-0.00777	-0.00842	0.0160	0.0160	4.74e-05	0.00126	-0.000638
	(0.0129)	(0.0150)	(0.0161)	(0.388)	(0.387)	(0.360)	(0.433)	(0.443)	(0.997)	(0.916)	(0.957)
illiquidity	-10.51	-10.62	-10.32	1.683	1.679	1.554	-0.610	-0.612*	-0.319	-0.382	-0.320
	(0.595)	(0.590)	(0.598)	(0.358)	(0.342)	(0.372)	(0.104)	(0.0991)	(0.373)	(0.260)	(0.364)
lendingsale_illiquidity	-49.35**	-48.82**	-48.24**	5.352	5.309	4.857	-2.302	-2.308	-1.194	-1.436	-1.200
	(0.0328)	(0.0399)	(0.0432)	(0.442)	(0.430)	(0.464)	(0.107)	(0.103)	(0.382)	(0.268)	(0.374)
l_operaccrual	-0.0386	-0.0387	-0.0387	-0.0202	-0.0201	-0.0200	0.0121*	0.0121*	0.00579	0.00580	0.00579
	(0.198)	(0.196)	(0.200)	(0.247)	(0.249)	(0.251)	(0.0823)	(0.0824)	(0.219)	(0.217)	(0.219)
upls50		-0.522*	-0.0902			0.274***		-0.0516		0.0212	0.0274
		(0.0514)	(0.508)			(0.00170)		(0.604)		(0.542)	(0.726)
lendingsale_upls50		-0.0154	0.113			-0.187		-0.155		0.00543	0.0320
		(0.583)	(0.337)			(0.125)		(0.204)		(0.592)	(0.625)
upls100			0.617***		-0.865***	0.588***		-1.861***		0.0225	-1.732***
			(0.00629)		(0.000280)	(0.00732)		(5.10e-08)		(0.483)	(1.00e-06)
lendingsale_upls100			-0.102		0.112	0.0319		0.124		0.0201**	-0.0747
			(0.395)		(0.411)	(0.741)		(0.316)		(0.0206)	(0.229)
crisis	0.235*	-0.297	-0.307	0.775***	-0.0919	-0.0842	1.727***	1.726***	1.846***	1.847***	1.852***
	(0.0541)	(0.133)	(0.114)	(0)	(0.603)	(0.636)	(1.62e-07)	(1.70e-07)	(2.45e-08)	(2.43e-08)	(2.39e-08)
lendingsale_crisis	0.0645*	0.0621*	0.0715*	0.000863	0.0142	-0.00878	-0.411***	-0.415***	0.0143	0.0132	0.0250
	(0.0894)	(0.0866)	(0.0617)	(0.993)	(0.896)	(0.938)	(0.00542)	(0.00508)	(0.769)	(0.783)	(0.646)
l_btm	0.107	0.105	0.102	0.0868***	0.0874***	0.0894***	0.00681	0.00681	0.0154	0.0155	0.0155
	(0.394)	(0.397)	(0.410)	(0.000832)	(0.000669)	(0.000615)	(0.787)	(0.787)	(0.544)	(0.542)	(0.542)
l_cash	-0.000938	-0.00150	-0.00113	0.0311	0.0320	0.0319	0.0333**	0.0333**	0.0309***	0.0303***	0.0310***
	(0.968)	(0.949)	(0.961)	(0.132)	(0.110)	(0.118)	(0.0130)	(0.0130)	(0.00297)	(0.00381)	(0.00294)
l_fcf	0.0291	0.0290	0.0287	-0.000680	0.000457	0.00130	0.00942	0.00939	0.00848	0.00879	0.00850
	(0.330)	(0.333)	(0.337)	(0.962)	(0.973)	(0.922)	(0.204)	(0.205)	(0.170)	(0.163)	(0.170)
l_debt	-0.0939**	-0.0940**	-0.0931**	0.0220*	0.0217*	0.0224*	-0.0341**	-0.0341**	-0.0233	-0.0233	-0.0233
	(0.0201)	(0.0200)	(0.0213)	(0.0527)	(0.0604)	(0.0614)	(0.0289)	(0.0288)	(0.111)	(0.115)	(0.113)
l_div	0.0277	0.0278	0.0271	0.0149	0.0160	0.0159	0.0109	0.0109	0.0148	0.0148	0.0148
	(0.527)	(0.522)	(0.532)	(0.479)	(0.431)	(0.435)	(0.519)	(0.520)	(0.353)	(0.352)	(0.354)
l_roa	-0.0386	-0.0389	-0.0390	0.0321**	0.0312**	0.0314**	-0.0457***	-0.0457***	-0.0341**	-0.0341**	-0.0341**
	(0.122)	(0.124)	(0.118)	(0.0328)	(0.0409)	(0.0403)	(0.00432)	(0.00434)	(0.0119)	(0.0121)	(0.0122)
abreturn	-0.0167	-0.0168	-0.0160	0.00705	0.00436	0.00292	0.00514	0.00514	0.00337	0.00313	0.00336
	(0.262)	(0.259)	(0.273)	(0.445)	(0.651)	(0.771)	(0.686)	(0.686)	(0.769)	(0.786)	(0.769)
abreturn4	0.0253	0.0257	0.0265	0.0308	0.0313	0.0307	0.0128	0.0129	0.0151	0.0148	0.0151
	(0.270)	(0.257)	(0.238)	(0.138)	(0.128)	(0.139)	(0.331)	(0.329)	(0.187)	(0.196)	(0.187)
Constant	-1.797	-1.287	-1.744	0.00816	0.872*	-0.0190	-0.112	-0.103	-0.184*	-0.238**	-0.180*
	(0.627)	(0.739)	(0.634)	(0.980)	(0.0517)	(0.951)	(0.385)	(0.436)	(0.0568)	(0.0262)	(0.0628)
Observations	1,103	1,103	1,103	1,832	1,832	1,832	12,111	12,111	15,046	15,046	15,046
Adjusted R-squared	0.123	0.122	0.122	0.113	0.115	0.115	0.106	0.106	0.106	0.106	0.106

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3

VARIABLES	TSE 50 Netsell	TSE 50 Netsell	TSE 50 Netsell	Tm 100 Netsell	Tm 100 Netsell	Tm 100 Netsell	The Rest Netsell	The Rest Netsell	Full Sample Netsell	Full Sample Netsell	FullSample Netsell
Panel A: Short Sale											
shointq	-29.93***	-31.15***	-31.09***	1.083	0.919	1.030	0.0205	-0.0138	-0.00152	-0.173***	-0.0108
	(0.00420)	(0.00626)	(0.00689)	(0.241)	(0.347)	(0.303)	(0.573)	(0.729)	(0.945)	(0.00499)	(0.627)
l_shointq	0.0753	0.0720	0.0728	0.0114	0.0141	0.0138	0.0235**	0.0248**	0.0218**	0.0233**	0.0227**
	(0.393)	(0.395)	(0.407)	(0.516)	(0.431)	(0.427)	(0.0352)	(0.0281)	(0.0316)	(0.0234)	(0.0268)
repurchase	-0.0315	-0.0313	-0.0313	-0.00731	-0.00767	-0.00756	0.00294	0.00293	0.000233	0.000103	0.000214
	(0.190)	(0.199)	(0.200)	(0.707)	(0.689)	(0.695)	(0.732)	(0.733)	(0.974)	(0.988)	(0.976)
l_repurchase	0.0508	0.0527	0.0531	-0.0115	-0.0102	-0.0107	-0.0240***	-0.0244***	-0.0220***	-0.0219***	-0.0221***
	(0.280)	(0.272)	(0.278)	(0.470)	(0.508)	(0.488)	(0.000137)	(0.000116)	(0.00111)	(0.00118)	(0.00101)
insiderdum	-0.185**	-0.193**	-0.194**	-0.0947**	-0.0937**	-0.0937**	-0.145***	-0.144***	-0.128***	-0.127***	-0.127***
	(0.0156)	(0.0161)	(0.0218)	(0.0385)	(0.0395)	(0.0392)	(7.90e-11)	(6.57e-11)	(2.84e-10)	(1.21e-10)	(1.90e-10)
shointq_insiderdum	0.114	0.0742	0.0678	0.0694*	0.0664*	0.0673*	0.0591***	0.0633***	0.0601***	0.0545***	0.0620***
	(0.293)	(0.611)	(0.687)	(0.0829)	(0.0887)	(0.0961)	(0.00374)	(0.00137)	(0.00250)	(0.00470)	(0.00131)
instiown	0.151	0.153	0.154	0.0449	0.0460	0.0460	-0.00729	-0.00726	0.00368	0.00245	0.00390
	(0.109)	(0.112)	(0.109)	(0.328)	(0.325)	(0.327)	(0.558)	(0.556)	(0.688)	(0.798)	(0.671)
shointq_instiown	-0.267**	-0.242*	-0.239	0.0125	0.0129	0.0122	0.00698	0.00871	0.000433	0.00709	0.000497
	(0.0213)	(0.0991)	(0.103)	(0.534)	(0.521)	(0.552)	(0.613)	(0.506)	(0.970)	(0.551)	(0.965)
illiquidity	-29.78	-30.69	-30.26	2.100	1.794	1.973	0.0299**	0.0308**	0.0290**	0.0284**	0.0293**
	(0.108)	(0.116)	(0.109)	(0.266)	(0.368)	(0.344)	(0.0111)	(0.0101)	(0.0140)	(0.0150)	(0.0135)
shointq_illiquidity	-158.4***	-164.5***	-164.8***	5.740	4.921	5.386	0.0226	0.0265	0.0242	0.0218	0.0254
	(0.00361)	(0.00532)	(0.00619)	(0.239)	(0.340)	(0.319)	(0.196)	(0.146)	(0.176)	(0.212)	(0.163)
l_operaccrual	-0.102***	-0.101***	-0.101***	0.000189	0.000172	0.000242	-0.0128	-0.0129	-0.0115	-0.0115	-0.0116
	(0.00545)	(0.00522)	(0.00420)	(0.956)	(0.959)	(0.944)	(0.304)	(0.301)	(0.256)	(0.256)	(0.254)
upss50		-0.0755	0.0619			-0.191		0.249***		-0.00538	0.159**
		(0.378)	(0.624)			(0.224)		(0.00146)		(0.867)	(0.0238)
shointq_upss50		0.111	-0.0874			0.0306		0.0640**		0.139**	0.0467
		(0.458)	(0.682)			(0.738)		(0.0455)		(0.0126)	(0.132)
upss100			0.0130		0.162*	0.0199		-0.275***		-0.00153	-0.206***
			(0.871)		(0.0944)	(0.850)		(0.00244)		(0.946)	(0.00772)
shointq_upss100			-0.0406		0.0378	-0.0504		-0.0299		0.0576***	-0.0420
			(0.871)		(0.332)	(0.379)		(0.326)		(0.000127)	(0.129)
crisis	0.00883	-0.0857	-0.0899	-0.167	0.00166	0.00405	0.150***	0.151***	0.110**	0.110**	0.108**
	(0.901)	(0.100)	(0.151)	(0.102)	(0.981)	(0.952)	(0.00551)	(0.00467)	(0.0435)	(0.0481)	(0.0455)
shointq_crisis	-0.0678	-0.0873	-0.0929	0.00536	-0.00158	-0.00457	0.00459	0.0171	0.0272	0.00959	0.0253
	(0.537)	(0.339)	(0.332)	(0.781)	(0.925)	(0.783)	(0.896)	(0.629)	(0.231)	(0.664)	(0.275)
repurchase_crisis	0.0262	0.0264	0.0267	0.116*	0.118*	0.118*	-0.0133	-0.0132	-0.00868	-0.00857	-0.00845
	(0.509)	(0.511)	(0.523)	(0.0692)	(0.0686)	(0.0689)	(0.260)	(0.261)	(0.438)	(0.444)	(0.446)
l_btm	0.0971	0.0919	0.0920	-0.0272	-0.0263	-0.0252	0.0154	0.0151	0.00833	0.00895	0.00846
	(0.188)	(0.202)	(0.202)	(0.435)	(0.463)	(0.499)	(0.180)	(0.189)	(0.533)	(0.491)	(0.523)
l_cash	-0.0402	-0.0389	-0.0382	0.0201	0.0204	0.0204	0.0148	0.0142	0.0111	0.0128	0.0108
	(0.353)	(0.349)	(0.343)	(0.570)	(0.557)	(0.559)	(0.291)	(0.319)	(0.355)	(0.326)	(0.374)
l_fcf	-0.117***	-0.117***	-0.117***	-0.0341**	-0.0336**	-0.0343**	-0.0112	-0.0115	-0.0167**	-0.0166**	-0.0171**
	(1.49e-05)	(1.76e-05)	(1.65e-05)	(0.0195)	(0.0209)	(0.0153)	(0.282)	(0.270)	(0.0259)	(0.0298)	(0.0226)
l_debt	0.0265	0.0264	0.0259	-0.0450*	-0.0443*	-0.0445*	0.0231**	0.0221*	0.00777	0.00773	0.00734
	(0.134)	(0.130)	(0.133)	(0.0863)	(0.0923)	(0.0885)	(0.0457)	(0.0603)	(0.576)	(0.576)	(0.596)
l_div	-0.0656	-0.0650	-0.0651	0.0326	0.0330	0.0332	0.00849	0.00873	0.00975	0.00924	0.00979
	(0.342)	(0.347)	(0.348)	(0.288)	(0.283)	(0.275)	(0.551)	(0.541)	(0.472)	(0.505)	(0.471)
l_roa	0.121***	0.119***	0.118***	-0.0288	-0.0288	-0.0281	0.0435***	0.0433***	0.0360***	0.0357***	0.0362***
	(0.000213)	(0.000555)	(0.000249)	(0.172)	(0.174)	(0.209)	(0.000380)	(0.000344)	(0.000111)	(0.000137)	(8.92e-05)
abreturn	0.00679	0.00585	0.00558	0.0545*	0.0509*	0.0499*	0.00575	0.00365	0.0101	0.00911	0.00883
	(0.871)	(0.888)	(0.892)	(0.0582)	(0.0607)	(0.0545)	(0.691)	(0.800)	(0.432)	(0.482)	(0.492)
abreturn4	-0.0224	-0.0236	-0.0235	-0.00696	-0.00642	-0.00644	-0.00424	-0.00346	-0.00560	-0.00557	-0.00518
	(0.563)	(0.559)	(0.557)	(0.801)	(0.818)	(0.817)	(0.567)	(0.638)	(0.408)	(0.413)	(0.436)
Constant	-5.869	-5.967	-5.962	0.492	0.259	0.461	-0.0427	-0.0478	-0.0206	-0.0132	-0.0209
	(0.105)	(0.114)	(0.106)	(0.247)	(0.496)	(0.326)	(0.345)	(0.297)	(0.640)	(0.853)	(0.633)
Observations	1,103	1,103	1,103	1,832	1,832	1,832	12,111	12,111	15,046	15,046	15,046
Adjusted R-squared	0.077	0.077	0.076	0.015	0.015	0.014	0.014	0.015	0.014	0.014	0.014

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3

VARIABLES	TSE 50 Netsell	TSE 50 Netsell	TSE 50 Netsell	Tm 100 Netsell	Tm 100 Netsell	Tm 100 Netsell	The Rest Netsell	The Rest Netsell	Full Sampl Netsell	Full Sampl Netsell	Full Sample Netsell
Panel B: Lending Sale											
lendingsale	0.309	0.416	0.177	-0.0979	-0.160	0.156	0.853**	0.815**	0.655**	0.595	0.760**
	(0.877)	(0.848)	(0.939)	(0.920)	(0.882)	(0.881)	(0.0138)	(0.0125)	(0.0394)	(0.109)	(0.0223)
l_lendingsale	-0.0149*	-0.0156**	-0.0163**	-0.0178	-0.0120	-0.0135	-0.0316	-0.0318	-0.0181	-0.0193	-0.0160
	(0.0776)	(0.0466)	(0.0499)	(0.210)	(0.234)	(0.216)	(0.291)	(0.284)	(0.114)	(0.112)	(0.158)
repurchase	-0.00998	-0.0100	-0.00641	-0.0128	-0.0132	-0.0140	0.00197	0.00192	-0.000426	-0.000294	-0.000439
	(0.669)	(0.670)	(0.779)	(0.458)	(0.457)	(0.425)	(0.817)	(0.822)	(0.952)	(0.966)	(0.950)
l_repurchase	0.0335	0.0331	0.0326	-0.00877	-0.00929	-0.0107	-0.0261***	-0.0262***	-0.0244***	-0.0243***	-0.0242***
	(0.524)	(0.532)	(0.538)	(0.618)	(0.584)	(0.528)	(5.60e-05)	(5.44e-05)	(0.000414)	(0.000437)	(0.000431)
insiderdum	-0.166**	-0.167**	-0.165**	-0.0922**	-0.0932**	-0.0943**	-0.139***	-0.139***	-0.128***	-0.128***	-0.129***
	(0.0404)	(0.0378)	(0.0400)	(0.0338)	(0.0294)	(0.0299)	(3.25e-10)	(3.74e-10)	(4.06e-10)	(1.57e-10)	(4.14e-10)
lendingsale_insiderdu	0.0268	0.0275	0.0350	0.0657	0.0213	0.00467	0.0735***	0.0728***	0.0618**	0.0522***	0.0583**
	(0.234)	(0.214)	(0.225)	(0.203)	(0.536)	(0.900)	(0.00442)	(0.00549)	(0.0359)	(4.35e-05)	(0.0395)
instiown	0.0837	0.0832	0.0853	0.0365	0.0342	0.0351	-0.00250	-0.00201	0.00484	0.00300	0.00416
	(0.549)	(0.553)	(0.548)	(0.392)	(0.409)	(0.402)	(0.838)	(0.870)	(0.633)	(0.754)	(0.686)
lendingsale_instiown	-0.0269*	-0.0279*	-0.0259**	0.0168	0.0157	0.0146	0.0318	0.0339	0.0163**	0.0235	0.0153**
	(0.0829)	(0.0544)	(0.0422)	(0.207)	(0.110)	(0.107)	(0.245)	(0.247)	(0.0331)	(0.123)	(0.0343)
illiquidity	5.044	4.929	4.228	-0.120	-0.113	-0.322	1.148**	1.160**	0.971**	0.945**	0.961**
	(0.706)	(0.716)	(0.747)	(0.928)	(0.938)	(0.833)	(0.0150)	(0.0144)	(0.0289)	(0.0452)	(0.0322)
lendingsale_illiquidity	1.366	1.899	0.687	-0.0287	-0.0907	-0.850	4.314**	4.362**	3.644**	3.545**	3.603**
	(0.897)	(0.868)	(0.956)	(0.995)	(0.987)	(0.885)	(0.0164)	(0.0157)	(0.0312)	(0.0485)	(0.0349)
l_operaccrual	-0.0943**	-0.0945**	-0.0944**	-0.000450	-0.000221	-0.000150	-0.0129	-0.0129	-0.0117	-0.0117	-0.0117
	(0.0331)	(0.0324)	(0.0314)	(0.897)	(0.950)	(0.966)	(0.299)	(0.299)	(0.247)	(0.248)	(0.248)
upls50		0.00388	0.0619			-0.231		0.222***		-0.0563	0.113*
		(0.972)	(0.713)			(0.212)		(0.00568)		(0.461)	(0.0958)
lendingsale_upls50		-0.0156	-0.207**			-0.321		-0.0268		0.0366	-0.175*
		(0.638)	(0.0248)			(0.270)		(0.805)		(0.437)	(0.0878)
upls100			-0.0785		0.119	0.108		-0.254***		-0.0130	-0.199***
			(0.278)		(0.234)	(0.335)		(0.00865)		(0.541)	(0.00792)
lendingsale_upls100			0.232***		0.347	-0.100		0.0783		0.0115	0.0507
			(0.00377)		(0.135)	(0.190)		(0.294)		(0.806)	(0.180)
crisis	0.0139	0.00790	0.0305	-0.151	-0.0314	-0.0174	0.131**	0.130**	0.109**	0.110**	0.126**
	(0.868)	(0.824)	(0.373)	(0.122)	(0.635)	(0.779)	(0.0140)	(0.0159)	(0.0307)	(0.0304)	(0.0145)
lendingsale_crisis	-0.0114	-0.0138	-0.0352	0.0899	0.131*	0.0920*	-0.0582	-0.0615	0.0246	0.0302	0.0336
	(0.573)	(0.506)	(0.307)	(0.133)	(0.0576)	(0.0718)	(0.211)	(0.181)	(0.239)	(0.180)	(0.224)
repurchase_crisis	-0.00825	-0.00835	-0.0103	0.118*	0.105*	0.103*	-0.0148	-0.0147	-0.0108	-0.0110	-0.0110
	(0.876)	(0.874)	(0.843)	(0.0540)	(0.0509)	(0.0538)	(0.206)	(0.209)	(0.340)	(0.335)	(0.338)
l_btm	-0.0626	-0.0648	-0.0597	-0.0563	-0.0538	-0.0501	-0.000823	-0.000856	-0.00839	-0.00832	-0.00756
	(0.501)	(0.499)	(0.546)	(0.127)	(0.142)	(0.198)	(0.954)	(0.953)	(0.611)	(0.613)	(0.641)
l_cash	-0.0664**	-0.0670***	-0.0679**	0.0208	0.0238	0.0237	0.0157	0.0157	0.0122	0.0132	0.0125
	(0.0112)	(0.00993)	(0.0148)	(0.546)	(0.464)	(0.463)	(0.246)	(0.245)	(0.265)	(0.273)	(0.242)
l_fcf	-0.120***	-0.120***	-0.119***	-0.0372**	-0.0337**	-0.0323**	-0.0151	-0.0150	-0.0198**	-0.0199**	-0.0197**
	(1.78e-06)	(1.55e-06)	(1.62e-06)	(0.0162)	(0.0269)	(0.0408)	(0.171)	(0.172)	(0.0134)	(0.0167)	(0.0134)
l_debt	0.0300	0.0299	0.0282	-0.0402	-0.0409	-0.0397	0.0257**	0.0258**	0.0113	0.0110	0.0114
	(0.127)	(0.129)	(0.134)	(0.127)	(0.112)	(0.125)	(0.0356)	(0.0358)	(0.438)	(0.446)	(0.430)
l_div	-0.0658	-0.0657	-0.0641	0.0268	0.0301	0.0299	-0.000512	-0.000525	0.000674	0.000623	0.000906
	(0.367)	(0.369)	(0.391)	(0.403)	(0.342)	(0.348)	(0.971)	(0.970)	(0.959)	(0.963)	(0.945)
l_roa	0.115***	0.115***	0.116***	-0.0252	-0.0278	-0.0273	0.0490***	0.0489***	0.0402***	0.0395***	0.0402***
	(8.44e-05)	(8.41e-05)	(6.77e-05)	(0.216)	(0.162)	(0.169)	(3.74e-05)	(3.63e-05)	(1.36e-05)	(1.19e-05)	(1.31e-05)
abreturn	0.00131	0.00123	-0.000452	0.0556*	0.0473*	0.0449*	0.0147	0.0147	0.0181	0.0181	0.0179
	(0.979)	(0.981)	(0.993)	(0.0645)	(0.0848)	(0.0916)	(0.267)	(0.267)	(0.129)	(0.128)	(0.133)
abreturn4	-0.0248	-0.0244	-0.0265	-0.00493	-0.00351	-0.00448	-0.00770	-0.00766	-0.00913	-0.00895	-0.00931
	(0.437)	(0.453)	(0.412)	(0.855)	(0.897)	(0.868)	(0.350)	(0.353)	(0.206)	(0.217)	(0.196)
Constant	0.847	0.831	0.685	0.102	-0.0170	0.0574	0.181	0.171	0.161	0.224	0.175*
	(0.730)	(0.742)	(0.774)	(0.673)	(0.944)	(0.853)	(0.108)	(0.103)	(0.117)	(0.143)	(0.0908)
Observations	1,103	1,103	1,103	1,832	1,832	1,832	12,111	12,111	15,046	15,046	15,046
Adjusted R-squared	0.027	0.026	0.027	0.014	0.023	0.024	0.011	0.010	0.011	0.010	0.011

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4

	TSE 50	TSE 50	TSE 50	Tm 100	Tm 100	Tm 100	The Rest	The Rest	Full Sample	Full Sample	Full Sample
VARIABLES	Netsell	Netsell	Netsell	Netsell	Netsell	Netsell	Netsell	Netsell	Netsell	Netsell	Netsell
Panel A: Short Sale											
shointq	-19.29***	-19.90***	-19.80***	1.075	0.900	0.803	0.0324	-0.00574	0.00720	-0.167***	-0.000900
	(0.00106)	(0.000412)	(0.000604)	(0.267)	(0.388)	(0.483)	(0.387)	(0.895)	(0.750)	(0.00406)	(0.969)
l_shointq	0.0707	0.0694	0.0671	0.00169	0.00476	0.00212	0.0148	0.0162	0.0124	0.0140	0.0133
	(0.439)	(0.447)	(0.478)	(0.925)	(0.794)	(0.912)	(0.184)	(0.148)	(0.212)	(0.166)	(0.180)
repurchase	0	0	0	0	0	0	0	0	0	0	0
l_repurchase	0.0426	0.0438	0.0431	-0.00750	-0.00591	-0.00499	-0.0227***	-0.0229***	-0.0215***	-0.0215***	-0.0216***
	(0.380)	(0.360)	(0.382)	(0.690)	(0.751)	(0.767)	(0.000851)	(0.000762)	(0.00100)	(0.00103)	(0.000882)
insiderdum	-0.169***	-0.174***	-0.171***	-0.0908*	-0.0896*	-0.0890*	-0.151***	-0.149***	-0.130***	-0.129***	-0.129***
	(0.000429)	(0.000246)	(0.000731)	(0.0522)	(0.0529)	(0.0529)	(6.09e-10)	(4.89e-10)	(7.43e-10)	(4.51e-10)	(5.00e-10)
shointq_insiderdum	0.275***	0.254*	0.265**	0.0691*	0.0663*	0.0670*	0.0557***	0.0597***	0.0601***	0.0537***	0.0617***
	(0.00578)	(0.0501)	(0.0343)	(0.0754)	(0.0832)	(0.0952)	(0.00617)	(0.00294)	(0.00224)	(0.00498)	(0.00164)
instiown	0.0895	0.0907	0.0886	0.0369	0.0381	0.0379	0.00102	0.00104	0.00809	0.00685	0.00827
	(0.190)	(0.194)	(0.181)	(0.399)	(0.394)	(0.397)	(0.934)	(0.932)	(0.425)	(0.503)	(0.415)
shointq_instiown	-0.331**	-0.317*	-0.321**	0.0101	0.0103	0.00947	0.00318	0.00490	-0.00536	0.00178	-0.00527
	(0.0117)	(0.0536)	(0.0368)	(0.618)	(0.612)	(0.635)	(0.837)	(0.733)	(0.666)	(0.886)	(0.661)
illiquidity	9.115	8.679	7.798	2.381	2.100	1.729	0.0322**	0.0324**	0.0315**	0.0309**	0.0315**
	(0.730)	(0.745)	(0.780)	(0.291)	(0.372)	(0.513)	(0.0157)	(0.0160)	(0.0181)	(0.0187)	(0.0178)
shointq_illiquidity	-103.1***	-106.2***	-105.9***	5.644	4.776	3.765	0.0269	0.0289	0.0284	0.0262	0.0289
	(0.00101)	(0.000385)	(0.000561)	(0.270)	(0.384)	(0.554)	(0.198)	(0.179)	(0.180)	(0.204)	(0.173)
l_operaccrual	-0.107***	-0.106***	-0.107***	-4.98e-06	0.000325	0.000409	-0.0193	-0.0195	-0.0170	-0.0169	-0.0171
	(5.01e-05)	(7.44e-05)	(9.59e-05)	(0.999)	(0.933)	(0.915)	(0.313)	(0.310)	(0.247)	(0.249)	(0.245)
upss50		-0.0593	0.0821			-0.00622		0.256***		-0.00254	0.181**
		(0.233)	(0.565)			(0.952)		(0.00749)		(0.943)	(0.0161)
shointq_upss50		0.0623	-0.0985			-0.0261		0.0571*		0.141***	0.0399
		(0.700)	(0.712)			(0.852)		(0.0890)		(0.00665)	(0.210)
upss100			-0.0206		0.176	0.160		-0.258***		-0.00524	-0.175**
			(0.852)		(0.121)	(0.303)		(0.00421)		(0.807)	(0.0249)
shointq_upss100			0.0604		0.0404	-0.0637		-0.0231		0.0605***	-0.0368
			(0.790)		(0.311)	(0.300)		(0.445)		(3.88e-05)	(0.178)
crisis	-0.0141	-0.0838	-0.0180	-0.126	0.0598	-0.139	0.146***	0.142**	0.0835	0.0901*	0.0881*
	(0.810)	(0.121)	(0.753)	(0.225)	(0.365)	(0.184)	(0.00455)	(0.0215)	(0.115)	(0.0654)	(0.0873)
shointq_crisis	-0.140	-0.152	-0.149	0.00637	-0.000326	-0.0157	0.00294	0.0193	0.0267	0.00826	0.0250
	(0.244)	(0.136)	(0.206)	(0.735)	(0.984)	(0.375)	(0.935)	(0.609)	(0.262)	(0.715)	(0.289)
o.repurchase_crisis	0	0	0	0	0	0	0	0	0	0	0
l_btm	-0.0182	-0.0208	-0.0217	-0.0365	-0.0352	-0.0378	0.0146	0.0144	0.00693	0.00764	0.00707
	(0.775)	(0.747)	(0.734)	(0.376)	(0.411)	(0.402)	(0.263)	(0.273)	(0.653)	(0.612)	(0.644)
l_cash	-0.0384	-0.0378	-0.0390	0.0241	0.0245	0.0247	0.0111	0.0104	0.00779	0.00949	0.00755
	(0.316)	(0.310)	(0.283)	(0.483)	(0.468)	(0.462)	(0.486)	(0.515)	(0.570)	(0.520)	(0.585)
l_fcf	-0.103***	-0.103***	-0.103***	-0.0415***	-0.0409***	-0.0410***	-0.0127	-0.0131	-0.0178**	-0.0176**	-0.0181**
	(4.00e-05)	(5.04e-05)	(4.57e-05)	(0.00734)	(0.00770)	(0.00578)	(0.276)	(0.263)	(0.0378)	(0.0428)	(0.0333)
l_debt	-0.000789	-0.00101	-0.000154	-0.0436*	-0.0428*	-0.0422*	0.0232*	0.0222*	0.00732	0.00719	0.00696
	(0.973)	(0.965)	(0.995)	(0.0853)	(0.0911)	(0.0918)	(0.0545)	(0.0683)	(0.599)	(0.607)	(0.616)
l_div	-0.0336	-0.0332	-0.0328	0.0442	0.0447	0.0460	0.0110	0.0113	0.0128	0.0122	0.0128
	(0.618)	(0.623)	(0.626)	(0.212)	(0.207)	(0.197)	(0.306)	(0.298)	(0.266)	(0.295)	(0.267)
l_roa	0.111***	0.109***	0.110***	-0.0274	-0.0274	-0.0276	0.0435***	0.0434***	0.0358***	0.0355***	0.0360***
	(0.00145)	(0.00373)	(0.00221)	(0.247)	(0.249)	(0.279)	(0.00262)	(0.00259)	(0.00243)	(0.00302)	(0.00215)
abreturn	0.0217	0.0210	0.0217	0.0496*	0.0457*	0.0446*	0.00520	0.00318	0.00992	0.00867	0.00877
	(0.745)	(0.755)	(0.744)	(0.0898)	(0.0977)	(0.0926)	(0.738)	(0.839)	(0.479)	(0.539)	(0.530)
abreturn4	-0.00778	-0.00851	-0.00864	-0.00331	-0.00279	-0.00220	-0.00567	-0.00490	-0.00580	-0.00578	-0.00548
	(0.860)	(0.852)	(0.851)	(0.895)	(0.912)	(0.931)	(0.504)	(0.559)	(0.468)	(0.472)	(0.487)
Constant	1.637	1.612	1.324	0.550	0.306	0.277	-0.0443	-0.0420	-0.0224	-0.0148	-0.0286
	(0.747)	(0.752)	(0.803)	(0.270)	(0.484)	(0.591)	(0.409)	(0.522)	(0.656)	(0.865)	(0.592)
Observations	981	981	981	1,689	1,689	1,689	10,603	10,603	13,273	13,273	13,273
Adjusted R-squared	0.085	0.085	0.084	0.017	0.017	0.017	0.014	0.014	0.014	0.014	0.014

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4

VARIABLES	TSE 50 Netsell	TSE 50 Netsell	TSE 50 Netsell	Tm 100 Netsell	Tm 100 Netsell	Tm 100 Netsell	The Rest Netsell	The Rest Netsell	Full Sampl Netsell	Full Sampl Netsell	Full Sample Netsell
Panel B: Lending Sale											
lendingsale	1.575	1.356	1.795	0.123	0.304	0.768	1.012***	1.123***	0.729**	0.654*	0.888***
	(0.510)	(0.619)	(0.488)	(0.913)	(0.789)	(0.502)	(0.00917)	(0.00124)	(0.0208)	(0.0690)	(0.00974)
l_lendingsale	-0.0192*	-0.0197*	-0.0205*	-0.0169	-0.0118	-0.0136	-0.0261	-0.0263	-0.0161	-0.0170	-0.0143
	(0.0883)	(0.0676)	(0.0548)	(0.291)	(0.307)	(0.290)	(0.342)	(0.340)	(0.141)	(0.126)	(0.156)
repurchase	0	0	0	0	0	0	0	0	0	0	0
l_repurchase	0.0274	0.0269	0.0268	-0.00738	-0.00978	-0.00686	-0.0247***	-0.0247***	-0.0239***	-0.0238***	-0.0237***
	(0.565)	(0.580)	(0.578)	(0.733)	(0.640)	(0.781)	(0.000330)	(0.000331)	(0.000325)	(0.000356)	(0.000393)
insiderdum	-0.171**	-0.169**	-0.173**	-0.0819*	-0.0824*	-0.0849*	-0.141***	-0.141***	-0.129***	-0.128***	-0.129***
	(0.0215)	(0.0212)	(0.0190)	(0.0657)	(0.0581)	(0.0551)	(5.99e-09)	(6.58e-09)	(2.56e-09)	(1.73e-09)	(2.59e-09)
lendingsale_insiderdum	0.0305	0.0370	0.0322*	0.0431	-0.00209	-0.0245	0.0849***	0.0857***	0.0674***	0.0552***	0.0651***
	(0.104)	(0.114)	(0.0885)	(0.411)	(0.953)	(0.566)	(0.00410)	(0.00393)	(0.00830)	(5.49e-06)	(0.00761)
instiown	0.00799	0.0106	0.00732	0.0250	0.0238	0.0269	0.00499	0.00521	0.00913	0.00708	0.00824
	(0.951)	(0.936)	(0.955)	(0.530)	(0.545)	(0.509)	(0.688)	(0.673)	(0.402)	(0.482)	(0.468)
lendingsale_instiown	-0.0296**	-0.0270**	-0.0318**	0.0253	0.0227**	0.0190**	0.0301	0.0310	0.0178**	0.0269	0.0165**
	(0.0495)	(0.0145)	(0.0180)	(0.120)	(0.0408)	(0.0399)	(0.341)	(0.322)	(0.0325)	(0.126)	(0.0233)
illiquidity	24.37	24.05	24.22	0.316	0.807	0.613	1.214**	1.217**	1.077**	1.045**	1.068**
	(0.437)	(0.436)	(0.440)	(0.845)	(0.610)	(0.705)	(0.0111)	(0.0106)	(0.0153)	(0.0235)	(0.0166)
lendingsale_illiquidity	7.980	6.811	9.076	1.165	2.572	1.856	4.563**	4.574**	4.043**	3.920**	4.007**
	(0.526)	(0.639)	(0.503)	(0.844)	(0.663)	(0.762)	(0.0122)	(0.0116)	(0.0167)	(0.0255)	(0.0182)
l_operaccrual	-0.116***	-0.115***	-0.116***	-0.00153	-0.000949	-0.00149	-0.0194	-0.0194	-0.0174	-0.0173	-0.0175
	(0.000231)	(0.000247)	(0.000213)	(0.665)	(0.802)	(0.679)	(0.311)	(0.310)	(0.238)	(0.240)	(0.235)
upls50		0.0370	0.0390			-0.140		0.134		-0.0595	0.0840
		(0.712)	(0.685)			(0.267)		(0.135)		(0.487)	(0.276)
lendingsale_upls50		-0.201**	-0.0283			-0.378		-0.234		0.0437	-0.210
		(0.0318)	(0.386)			(0.340)		(0.231)		(0.359)	(0.153)
upls100		-0.0539			0.127	0.197		-0.207**		-0.0164	-0.149**
		(0.675)			(0.263)	(0.232)		(0.0310)		(0.472)	(0.0455)
lendingsale_upls100		0.211***			0.377	-0.138		0.142		0.0177	0.0516
		(0.00385)			(0.192)	(0.169)		(0.239)		(0.710)	(0.187)
crisis	-0.00149	0.0145	0.0171	-0.120	0.00449	-0.109	0.127	0.0732	0.103**	0.115**	0.0815*
	(0.984)	(0.862)	(0.696)	(0.272)	(0.939)	(0.325)	(0.134)	(0.388)	(0.0484)	(0.0128)	(0.0656)
lendingsale_crisis	-0.00662	-0.0253	-0.0110	0.0938	0.176	0.0933	-0.174	-0.192	0.0225	0.0286	0.0136
	(0.719)	(0.440)	(0.555)	(0.228)	(0.122)	(0.111)	(0.474)	(0.447)	(0.355)	(0.272)	(0.532)
o.repurchase_crisis	0	0	0	0	0	0	0	0	0	0	0
l_btm	-0.192**	-0.186**	-0.196**	-0.0648	-0.0634	-0.0596	-0.00189	-0.00190	-0.00972	-0.00958	-0.00901
	(0.0300)	(0.0375)	(0.0298)	(0.141)	(0.139)	(0.193)	(0.908)	(0.907)	(0.604)	(0.608)	(0.627)
l_cash	-0.0844***	-0.0858***	-0.0855***	0.0252	0.0274	0.0263	0.0127	0.0127	0.00900	0.0103	0.00923
	(0.000944)	(0.00144)	(0.000711)	(0.450)	(0.386)	(0.403)	(0.402)	(0.402)	(0.468)	(0.450)	(0.451)
l_fcf	-0.114***	-0.113***	-0.114***	-0.0450***	-0.0421***	-0.0419**	-0.0158	-0.0159	-0.0203**	-0.0204**	-0.0204**
	(0.000466)	(0.000478)	(0.000409)	(0.00657)	(0.00787)	(0.0110)	(0.199)	(0.198)	(0.0248)	(0.0298)	(0.0231)
l_debt	-0.000234	-0.00245	-0.000470	-0.0380	-0.0384	-0.0372	0.0255**	0.0255**	0.0107	0.0104	0.0109
	(0.993)	(0.929)	(0.986)	(0.131)	(0.123)	(0.139)	(0.0423)	(0.0433)	(0.460)	(0.474)	(0.450)
l_div	-0.0246	-0.0229	-0.0243	0.0363	0.0395	0.0403	0.00179	0.00180	0.00358	0.00355	0.00373
	(0.744)	(0.769)	(0.748)	(0.318)	(0.272)	(0.266)	(0.861)	(0.861)	(0.737)	(0.747)	(0.728)
l_roa	0.113***	0.113***	0.112***	-0.0229	-0.0256	-0.0247	0.0486***	0.0485***	0.0396***	0.0388***	0.0398***
	(0.00283)	(0.00236)	(0.00278)	(0.314)	(0.246)	(0.257)	(0.000477)	(0.000499)	(0.000577)	(0.000572)	(0.000586)
abreturn	0.0181	0.0164	0.0180	0.0528*	0.0447*	0.0424	0.0170	0.0170	0.0205	0.0205	0.0203
	(0.812)	(0.828)	(0.813)	(0.0803)	(0.0964)	(0.112)	(0.241)	(0.240)	(0.124)	(0.124)	(0.128)
abreturn4	-0.00569	-0.00815	-0.00490	-0.00137	0.000613	-0.000448	-0.00927	-0.00922	-0.00961	-0.00935	-0.00973
	(0.879)	(0.828)	(0.897)	(0.956)	(0.981)	(0.986)	(0.315)	(0.319)	(0.249)	(0.264)	(0.242)
Constant	4.617	4.548	4.566	0.198	0.160	0.191	0.222*	0.300***	0.180*	0.249	0.243**
	(0.435)	(0.434)	(0.441)	(0.524)	(0.567)	(0.517)	(0.0737)	(0.00967)	(0.0836)	(0.134)	(0.0369)
Observations	981	981	981	1,689	1,689	1,689	10,603	10,603	13,273	13,273	13,273
Adjusted R-squared	0.026	0.025	0.025	0.016	0.025	0.027	0.010	0.010	0.010	0.010	0.011

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

□ □ □ □ □ □ A study of Companies' Expenditures in Pollution Prevention and their Corporate Social Responsibility Reports

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In this study, we empirically investigate the information content of the spending on pollution prevention reported in the companies' corporate social responsibility (CSR) reports. The findings are mixed. Companies' expenditures on long-term assets are associated with economic benefits. Nevertheless, pollution prevention expenses are not associated with economic benefits. We also find that companies' CSR reports are value relevant on stock returns and cash flows. Overall, the findings support that non-for- profit expenditures are consistent with shareholders wealth maximization. Several caveats are noticed.

Keywords: corporate social responsibility; economic benefit; value relevance.

JEL Classifications: F31, F37, F47

1. Introduction

In recent years, the global community has called for companies' close attention to corporate social responsibility (CSR). Some companies have responded to this vocal by allocating more resources to CSR. Other companies' managers have been hastate and argued that additional expenditure of CSR is inconsistent with their missions to pursue profit maximization for shareholders.

The resulting controversy has induced the academics to investigate the relationship between investment in CSR and financial performance. However, a major weakness of using profit-based measures lies in that these measures do not truly reflect the wealth that has been created. In addition to accounting profits, shareholders should also gain wealth from economic profit created by a company. This is extremely important for the evaluation of the CSR performance because the benefits from the actions that appear to further some social good may not be fully captured by financial performance. Therefore, this paper mainly aims to examine whether companies' CSR expenditure is associated with future economic benefit.

As early as early 2000s, the Taiwanese government embarked on a series of actions to encourage companies to undertake additional investments in CSR. These actions include the incorporation of CSR into national policy, the establishment of CSR indices, and the enactment of "CSR Best Practice Principles". To date, a growing number of Taiwanese publicly held companies have responded to the government's requirement by specifying what they have achieved for environment and global climate change in the CSR report in accordance with the Global Reporting Initiative (GRI) certified by independent institutes.

In this paper, we have two purposes. The first purpose is to examine whether companies' CSR costs are related to future economic benefit. Tobins'Q and EVA are used to capture a company's economic benefit. The second purpose is to investigate whether CSR report can be considered as part of accounting information which is consistent with shareholders' wealth maximization.

We utilize Taiwanese semiconductor companies as our sample firms for two reasons. First, some Taiwanese companies disclose environmental protection expenditures in their CSR reports. In addition, we can reduce potential differences among industries by shedding light on single industry.

By focusing on a sample of Taiwanese publicly held semiconductor companies during 2006 and 2013, we show that the investments in capitalized environment protection assets are accompanied with future economic benefits. However, environment protection costs that are recognized as an expense in the income statement fail to produce future economic benefits. In addition, we find that CSR ports convey incremental value relevance to semiconductor companies' stock returns and cash flows, excepted for stock price. The findings are consistent with GRI who attempts to provide guidelines as regard to what non-for profit activities a company has taken and how those activities benefit the society. Several caveats are mentioned in the concluding remarks.

The remainder of the paper is organized as follows: The next section reviews CSR in Taiwan and related research. Section Three explains the data selection and research design. The empirical results are presented and discussed in Section Four, while value relevance of CSR report are provided in Section Five. The final section offers conclusions.

2. A brief discussion about gri and literature review

2.1. *Taiwan's Efforts on CSR*

GRI, established in 1997, is an international not-for-profit organization belonging to the Coalition for Environmentally Responsible Economies (CERES). Its mission is to make sustainability reporting standard practice for all companies and organizations. GRI contains members from several companies in different areas, NGOs and the United Nations Environment Program (UNEP). To make sure that the guidelines are serving its purpose, GRI continuously evaluates and revises the CSR reporting frameworks.

Up to date there are four generations of GRI's Guidance. The first generation, known as G1, was released in 2000 and tested on a number of pilot companies worldwide. Subsequently, GRI revised and released generations G2, G3, G3.1, and G4 of guidelines in 2002, 2006, 2011, and 2013. Among the guidelines, G3.1 is the one that is commonly followed by Taiwanese companies. It is made up of two parts. Part 1 features guidance on how to report. Part 2 features guidance on what should be reported, in the form of Disclosures on Management Approach and Performance Indicators. G3.1's Performance Indicators are organized into categories: Economic, Environment and Social. The Social category is broken down further by Labor, Human Rights, Society and Product Responsibility sub-categories. Indicator Protocols are the 'recipe' behind the Performance Indicators; they define key terms in the Indicator, compilation methodologies, the intended scope and relevance of the Indicator, and technical references. Indicator Protocols provide guidance on how Disclosures on Management Approach and Performance Indicators should be reported.

2.2. *Literature Review*

2.2.1. *CSR and Financial Performance*

There are two streams of empirical studies investigating the relationship between CSR and financial performance. One stream of studies addresses the impact of companies' CSR acts on short-term financial performance.[1] The results of these studies have been mixed. For instance, Wright and Ferris (1997) found a negative impact of CSR on short-term stock prices when examining divestitures from South Africa during the Apartheid controversy. Teoh et al. (1999) found no relationship between CSR and financial performances. Posnikoff (1997) and Tang et al. (2012) reported a positive impact of CSR on financial performance. Other studies concerning the relationship between CSR and short run financial performances, discussed in McWilliams and Siegel (1997), are similarly inconsistent. The evidences on the relationship between CSR and long-term financial performance are also mixed (e.g. Aupperle et al. 1985; McGuire et al. 1988; and Waddock and Graves, 1997; Hillman and Keim 2001). Aupperle et al. (1985) found no relationship between CSP and long term performance. McGuire et al. (1988) found that prior performance was more closely related to

[1] E. g. Clinebell and Clinebell, (1994); Hannon and Milkovich, (1996); Posnikoff, (1997); Teoh, Welch and Wazzan, (1999); Worrell et al., (1991); Wright and Ferris, (1997); Brammer et al., (2006); Tang et al., (2012).

CSR than was subsequent performance. Waddock and Graves (1997) and Hillman and Keim (2001) found that the increased CSR leads to enhanced financial performance.

2.2.2. formation Content of CSR Reports

Prior studies exploring the information content of CSR reports mainly focus on qualitative analyses (Grayet al., 1988; Deegan 2002; Hedberg, and von Malmborg, 2003; Idowu and Towler, 2004; Wanderley et al. 2008; Du et al. 2010; Burritt and Schaltegger, 2010). For example, Wanderley et al. (2008) analyze the websites of 127 companies from emerging countries and addressed whether CSR information disclosure on these companies' websites is influenced by country of origin and industry sector. They concluded that country of origin has a stronger influence over CSR information disclosure on the web than industry sector.

3. Data and methodology

3.1. *Data*

The sample contains Taiwanese publicly held semiconductor companies during the period of 2006-2013. The sample period begins from 2006 because 2007 is the earliest year semiconductor companies released their CSR reports. Financial data and stock returns are retrieved from Taiwan Economic Journal (TEJ) database. Environment protection costs are manually collected from the companies' CSR reports, and are crossly checked with the companies' annual financial reports if available. Most of the companies disclose both capitalized environment protection costs and expensed environment protection costs. Environment protection cost are assumed to be expensed if they are unidentifiable.

The preliminary sample contains 21 semiconductor companies that released CSR reports, corresponding to 60 firm-years. We exclude 10 companies because they did not report environment protection costs in their CSR reports and because they have missing values required for the regression analysis. The final sample contains 11 semiconductor companies that released CSR reports, corresponding to 32 firm-years.

3.2. *Research Methodology*

3.2.1. *Measurement of Economic Benefits*

We use Tobins'Q and Economic Value Added (EVA) to capture a company's economic benefits. Tobins'Q is calculated as the sum of market value of equity and book value of total liabilities divided by the firm's total assets at the end of the year. We estimate EVA by following Palliam (2006), expressed by Equation (1).

$$EVA_{it} = (ROE_{it} - r_e) \times BV_{it-1} \tag{1}$$

where EVA_{it} represents Economic Value Added for firm *i* in year *t*[2]. ROE_{it} represents net income for firm *i* in year *t* divided by beginning total shareholder's equity, multiplied by 100. r_e represents cost of capital. It is risk-free rate, plus the expected market risk premium estimated from Capital Assets Pricing Model. We use one year certified of deposit rate in Bank of Taiwan as the risk-free rate. In the estimation of market risk premium, we use annualized monthly stock returns. BV_{it-1} represents total shareholder's equity for firm *i* in year *t-1*.

3.2.2. *Regression Model*

We then conduct regression analysis. Because companies' efforts on CSR may not be converted immediately into outcomes, we regress future economic benefits on capitalized environment protection cost, expensed environment protection cost, and several control variables that control for size, risk, R&D intensity, year-specific effects, following prior studies (McWilliams and Siegel 2000; Inoue and Lee, 2011). In addition, we include an indicator variable that equals one if the company is traded over-the counter. We mainly focus on capitalized environment protection cost and expensed environment protection cost. We expect a positive relation between capitalized environment protection cost and future economic benefits because expenditures that are capitalized as assets are more likely to produce potential economic benefits. We expect a negative or insignificant relation between expensed environment protection cost and future economic benefits because expenditures that are recognized as expenses are expected not to generate potential economic benefits. The regression model is expressed by Equation (2).

$$EcoBenefit_{it+1} = \alpha_0 + \alpha_1 CapCSR_{it} + \alpha_2 ExCSR_{it} + \alpha_3 Log\ (Rev)_{it} + \alpha_4 Risk_{it} + \alpha_5 R\&D_{it} + \alpha_5 OTC_{it} + \alpha_6 \sum year + \varepsilon \tag{2}$$

where $EcoBenefit_{it+1}$ represents either Tobins'Q or EVA estimated from Equation (1) for firm *i* in year *t+1*. $CapCSR_{it}$ represents capitalized environment protection cost for firm *i* in year *t*, deflated by beginning total assets. $ExCSR_{it}$ represents expensed environment protection cost for firm *i* in year *t*, deflated by beginning total assets. $Log(Rev)_{it}$ represents the natural logarithm of net sales for firm *i* in year *t*. $Risk_{it}$ represents total debt-to-total asset ratio for firm *i* in year *t*. $R\&D_{it}$ represents R&D expenses divided by net sales for firm *i* in year *t*. OTC_{it} represents an indicator variable that equals one if the company is traded over-the counter, and zero otherwise. $\Sigma year$ represents a set of indicator variables that control for year-specific effects.

4. Empirical results

4.1. *Descriptive Statistics*

[2] EVA is multiplied by 1,000 in order to make the coefficients readable.

Table 1 reports descriptive statistics. The sample firms on average spent 0.3% of the total assets on capitalized environment protection cost (*CapCSR*), and the corresponding expenditures on environment protection expense (*ExCSR*) is 59.9%. The sample companies on average have debts 34.8% of the total assets (*Risk*). The sample companies on average spent 22.7% of revenues on R&D. The mean and median values of *Tobins'Q* are 0.173 and 0.014, respectively, exhibiting right-skewed distributions.

[Insert Table 1 here]

Table 2 reports the cross-sectional Pearson correlation coefficients among the variables. The sample firms' environment protection expense is negatively correlated with current *EVA* (-0.339; p=0.07). The sample firms' capitalized environment protection cost is not correlated with *Tobins'Q* in the current year. In addition, bothcapitalized environment protection cost and expensed environment protection cost are not correlated with EVA in the current year. This implies that the sample firms' CSR efforts are not associated with current-year economic benefits.

[Insert Table 2 here]

4.2. *Regression Analysis*

Table 3 shows the results of regression analysis. The coefficients on $CapCSR_{it}$ in Columns (1) and (2) are 1.380 and 0.874, respectively, and are all statistically significant at 5% significance level. This indicates that investments in environment protection assets are related to future economic profits. However, the coefficients on $ExCSR_{it}$ in Columns (1) and (2) are statistically insignificant, suggesting that environment protection expense does not produce future benefits.

Overall, the findings suggest a positive relationship between capitalized CSR expenditure and future economic benefits and an insignificant link between CSR expenses and future economic benefits.

[Insert Table 3 here]

5. Value relevance of CSR report

In this section, we further investigate whether CSR report can be considered as part of accounting information which conveys a goal consistent with shareholders' wealth maximization. Although the non-for-profit efforts listed in the CSR report might not bring sure gains, they transmit a positive massage to shareholders with respect to what the companies have contributed to the social good. Investors might consider CSR report as valuable information if they believe the companies are doing things that are consistent with their interests. However, it is also likely that investors consider CSR report ambiguous because the companies are not required to state non-for-profit efforts in a formal format.

Therefore, we empirically examine the value relevance of CSR reports. To do this, we compare semiconductor companies providing CSR reports with those not providing CSR reports. There are totally 138 semiconductor companies with data available for the regression analysis, of which 21 companies released CSR reports.

Following previous studies,[3] we use three value relevance metrics: stock price metric, stock return metric, and cash flow metric. For each value relevance metric, we focus on the difference in R-squared from the regression models between those two groups. Equation (3), (4), and (5) express the value relevance metrics. We estimate significance levels for all comparisons of R-squared following Harris et al. (1994)[4].

$$P_{it} = \beta_0 + \beta_1 BVE_{it} + \beta_2 EPS_{it} + \varepsilon_{it}, \tag{3}$$

$$Return_{it} = \beta_0 + \beta_1 \frac{EPS_{it}}{P_{it-1}} + \beta_2 \frac{\Delta EPS_{it}}{P_{it-1}} + \beta_3 LOSS_{it} + \beta_4 LOSS_{it} \times \frac{EPS_{it}}{P_{it-1}} + \beta_5 LOSS_{it} \times \frac{\Delta EPS_{it}}{P_{it-1}} + \varepsilon_{it}, \tag{4}$$

$$\frac{CF_{it+1}}{TA_{it}} = \beta_0 + \beta_1 \frac{NI_{it}}{TA_{it-1}} + \varepsilon_{it}, \tag{5}$$

where P_{it} is the mean value of twelve-moth stock price three months after the beginning of the fiscal year. BVE_{it} is book value of equity per share of the ith firm in year t. EPS_{it} is net income before extraordinary items per share of the ith firm in year t. $Return_{it}$ is annualized monthly stock returns three months after the beginning of the fiscal year. $LOSS_{it}$ is a dummy variable that equals one if the EPS of the ith firm in year t is negative, and zero otherwise. CF_{it+1} is net cash flow from operations of the ith firm in year $t+1$. NI_{it} is net income of the ith firm in year t. TA_{it-1} is total assets of the ith firm in year $t-1$.

Table 4 reports the results. For the stock price metric, the R-squared for semiconductor companies providing CSR reports is 0.54, which is lower than those without CSR reports (0.56) by 2% (Z=-1.96). This indicates that CSR reports fail to convey incremental value relevant information for the explanation of share price. By contrast, semiconductor companies providing CSR reports have significantly higher R- squared value (0.42) for the return matric than those without CSR reports (0.34). Similarly, semiconductor companies providing CSR reports have significantly higher R-squared values (0.66) for the cash flow matric than those without CSR reports (0.16).These results indicate that CSR reports contain incremental value relevant information for the explanations of stock returns and cash flows.

Collectively, the findings in Table 4 suggest that CSR reports convey incremental value relevance to the users regarding the semiconductor companies' stock returns and cash flows. Not surprisingly, these findings are consistent with GRI who attempts to provide guidelines

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[3] Amir and Lev. (1996), Collins et al. (1997), Harris and Muller (1999), and Song et al. (2010).

[4] Z-statistics are computed as: $\dfrac{R_1^2 - R_2^2}{\sqrt{\sigma^2\left(R_1^2\right) - \sigma^2\left(R_2^2\right)}}$

as regard to what non-for profit activities a company has taken and how those activities benefit the society.

[Insert Table 4 here]

6. Concluding remarks

In this paper, we have two missions. The first mission is to examine whether companies' CSR expenditures are associated with future economic benefit. Tobins'Q and EVA are used to capture a company's economic benefit. By focusing on a sample of Taiwanese publicly held semiconductor companies during 2006 and 2013, we show that the investments in capitalized environment protection assets are associated with future economic benefits. However, environment protection costs that are recognized as an expense in the income statement do not produce future economic benefits.

The second mission is to investigate whether CSR report can be considered as part of accounting information which conveys a goal consistent with shareholders' wealth maximization. Three value relevance metrics, stock price metric, stock return metric, and cash flow metric are used to measure value relevance. Our findings suggest that CSR ports convey incremental value relevance to semiconductor companies' stock returns and cash flows, excepted for stock price. The findings are consistent with GRI who attempts to provide guidelines as regard to what non-for profit activities a company has taken and how those activities benefit the society.

There are several caveats and suggestions. First, CSR reports may vary with industries although GRI provide systemic guidance, so our findings might not be generalized to other industries. Future studies are encouraged to extend this study by expending the sample to other industries. Secondly, while GRI guidelines provide a good framework for companies to comply with, some companies selectively and unsystematically report the items. This may reduce the value relevance conveyed to the users. As a result, we suggest the authorities to ask companies to report CSR activities in a more systematic manner.

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Table 1 Descriptive Statistics

Variable	N	Mean	Standard Deviation	Median
CapCSR	32	0.003	0.008	0.000
ExCSR	32	0.599	0.899	0.005
Log(Rev)	32	17.719	1.613	17.338
Risk	32	0.348	0.193	0.345
R&D	32	0.227	0.723	0.021
Tobins'Q	32	0.173	0.007	0.014
EVA	32	-0.001	0.004	-0.000

Notes: The sample contains 32 firm-years from 2006 to 2013. $CapCSR_{it}$ represents capitalized environment protection cost for firm *i* in year *t*, deflated by beginning total assets. $ExCSR_{it}$ represents expensed environment protection cost for firm *i* in year *t*, deflated by beginning total assets. $Log(Rev)_{it}$ represents the natural logarithm of net sales for firm *i* in year *t*. $Risk_{it}$ represents total debt-to-total asset ratio for firm *i* in year *t*. $R\&D_{it}$ represents R&D expenses divided by revenues for firm *i* in year *t*. *Tobins'Q* represents the sum of market value of equity and book value of total liabilities divided by the firm's total assets at the end of the year. *EVA* represents Economic Value Added estimated from Equation (1), multiplied by 1,000.

Table 2 Mean Correlations among Variables

Variable	*CapCSR*	*ExCSR*	*Log(Rev)*	*Risk*	*R&D*	*Tobins'Q*	*EVA*
CapCSR	1						
ExCSR	-0.237						
	(0.21)	1					
Log(Rev)	-0.012	-0.693					
	(0.95)	(<0.01)	1				
Risk	0.074	-0.331*	0.013				
	(0.70)	(0.07)	(0.94)	1			
R&D	0.836	-0.188	-0.273	0.189			
	(<0.01)	(0.32)	(0.15)	(0.32)	1		
Tobins'Q	0.057	-0.339*	0.521***	-0.397**	-0.148		
	(0.76)	(0.07)	(<0.01)	(0.03)	(0.44)	1	
EVA	-0.356*	-0.120	0.344*	-0.033	0.408**	-0.144	
	(0.05)	(0.53)	(0.06)	(0.36)	(0.02)	(0.45)	1

Notes: *, **, *** Significant at 10%, 5%, and 1% levels, respectively. The number in the parenthesis refers to p-value. The sample contains 33 firm-years from 2006 to 2013. $CapCSR_{it}$ represents capitalized environment protection cost for firm *i* in year *t*, deflated by beginning total assets. $ExCSR_{it}$ represents expensed environment protection cost for firm *i* in year *t*, deflated by beginning total assets. $Log(Rev)_{it}$ represents the natural logarithm of net sales for firm *i* in year *t*. $Risk_{it}$ represents total debt- to-total asset ratio for firm *i* in year *t*. $R\&D_{it}$ represents R&D expenses divided by revenues for firm *i* in year *t*. *Tobins'Q* represents the sum of market value of equity and book value of total liabilities divided by the firm's total assets at the end of the year. *EVA* represents Economic Value Added estimated from Equation (1), multiplied by 1,000.

Table 3: Regression Analysis for the relation between CSR Costs and Future Benefits

	(1) Tobins'Q$_{it+1}$		(2) EVA$_{it+1}$	
Independent Variables	Coefficients	t-value	Coefficients	t-value
Intercept	-0.001	[-0.05]	0.024*	[1.85]
CapCSR$_{it}$	1.380**	[2.76]	0.874**	[2.47]
ExCSR$_{it}$	-0.002	[-1.26]	-0.001	[-1.15]
Log(Rev)$_{it}$	0.001	[1.17]	-0.002*	[-2.14]
Risk$_{it}$	-0.016***	[-3.29]	0.010**	[2.75]
R&D$_{it}$	-0.038*	[-1.84]	-0.009	[-0.63]
OTC$_{it}$	-0.001	[-0.15]	-0.004	[-1.56]
Year	YES		YES	
Adjusted R^2	92.4%		45.2%	

Notes: *, **, and *** represent significance levels of 0.10, 0.05, and 0.01, respectively. The number in the parenthesis refers to p-value. The sample contains 33 firm-years from 2006 to 2013. *CapCSR$_{it}$* represents capitalized environment protection cost for firm *i* in year *t*, deflated by beginning total assets. *ExCSR$_{it}$* represents expensed environment protection cost for firm *i* in year *t*, deflated by beginning total assets. *Log(Rev)$_{it}$* represents the natural logarithm of revenues for firm *i* in year *t*. *Risk$_{it}$* represents total debt-to-total asset ratio for firm *i* in year *t*. *R&D$_{it}$* represents R&D expenses divided by net sales for firm *i* in year *t*. *Tobins'Q* represents the sum of market value of equity and book value of total liabilities divided by the firm's total assets at the end of the year. *EVA* represents Economic Value Added estimated from Equation (1), multiplied by 1,000.

Table 4 Value relevance Matrices

$$P_{it} = \beta_0 + \beta_1 BVE_{it} + \beta_2 EPS_{it} + \varepsilon_{it}, \tag{3}$$

$$Return_{it} = \beta_0 + \beta_1 \frac{EPS_{it}}{P_{it-1}} + \beta_2 \frac{\Delta EPS_{it}}{P_{it-1}} + \beta_3 LOSS_{it} + \beta_4 LOSS_{it} \times \frac{EPS_{it}}{P_{it-1}} + \beta_5 LOSS_{it} \times \frac{\Delta EPS_{it}}{P_{it-1}} + \varepsilon_{it}, \tag{4}$$

$$\frac{CF_{it+1}}{TA_{it}} = \beta_0 + \beta_1 \frac{NI_{it}}{TA_{it-1}} + \varepsilon_{it}, \tag{5}$$

	β_0	β_1	β_2	β_3	β_4	β_5	Adj.R^2	Z-Stat.
Price:								
Providing CSR reports	3.010 [0.64]	1.215*** [5.04]	3.066** [3.62]				0.54	-1.96*
Without CSR reports	12.270*** [6.10]	0.881*** [9.19]	3.066** [16.66]				0.56	
Return:								
Providing CSR reports	-0.175 [-1.33]	2.817 [1.53]	11.557*** [4.22]	-0.086 [-0.28]	4.313 [0.66]	-52.838* [-1.83]	0.42	4.13***
Without CSR reports	-0.258*** [-4.49]	6.245*** [11.36]	2.391 [1.05]	0.203** [2.03]	-6.512*** [-8.27]	-4.694 [-1.29]	0.34	
Cash Flow:								
Providing CSR reports	0.108*** [6.50]	0.001*** [7.04]					0.66	9.42***
Without CSR reports	0.060*** [6.14]	0.603*** [11.86]					0.16	

Notes: *refers to significant at the 10% level; ** refers to significant at the 5% level; *** refers to significant at the 1% level. P-values are given in brackets.

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