International Variation in the Benefits of Feasible Diversification Strategies

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ABSTRACT

This paper investigates which countries and/or regions are potential markets for global portfolio management services by displaying how the benefits of international diversification differ from country to country. The impact of the well-recognized phenomenon of home bias and short-sales on international investments is also modeled in our analysis. The empirical results of our study suggest that investors in less developed countries, particularly those in East Asia and South Asia, receive greater benefits from international diversification than investors in the rest of the world. These benefits are particularly noticeable in the reduction in volatility. Sub-period and inter-temporal analyses show that the benefits of global diversification decrease slightly. This is consistent with the finding of previous studies regarding the increasing integration of the world financial market. Our results are especially useful for financial professionals as they identify target clients for global wealth management services.

I. INTRODUCTION

Incomes generated by business lines of global wealth management provide key revenue for many major financial institutions across the globe, particularly during economic downturns. This was especially shown to be true in 2008, when the top banks in the U.S. posted earnings from global wealth management services despite facing huge losses in other business lines. Therefore, identifying the potential target clients to generate such fee incomes is a critical issue for financial institutions. Previous research examines the methods of creating optimal portfolios as well as confirms the benefits of international diversification for domestic investors[1]. The increase in the idiosyncratic volatility of asset prices in recent years highlights this effectiveness (e.g., Ang, Hodrick, Xing, Zhang, [2009]; Bekaert, Hodrick, and Zhang, [2010], Koedijk, Kool, Schotman, and van Dijk [2003]). Current literature on this topic, while evaluating the performance of internationally diversified portfolios from investor's perspective, rarely analyzes the issue from a perspective that would benefit the marketers in the asset management industry. In addition, early studies fail to model the home-biased investing behavior when evaluating the diversification benefits. A study from the angle of the service providers assists in discovering possible clients of global wealth management services. In this paper, we customize the optimal asset strategies in each country and compare the economic value of international diversification across 73 countries while considering home-bias investments and no short-sales in portfolios.

This study differs from previous studies in two major aspects. First, this paper synthesizes the major concepts and/or *modi operandi* that generate feasible investing strategies.

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[1] For more detailed discussion, please see Bekaert and Urias (1996); Chiou, Lee, and Chang (2009); De Roon, Nijman, and Werker (2001); Driessen and Laeven (2007); Errunza, Hogan, and Hung (1999); Harvey (1995); and Li, Sarkar, and Wang (2003).

We estimate the benefits of optimal asset allocations in a wide range of countries while taking into account home-bias investments and no-short sales in designing the empirical framework. We consider the impact of the well-recognized phenomenon of home-biased investments on the benefits of diversification to provide practical results for asset management professionals.[2] The nonnegative-weighting optimal strategies are frequently considered in previous empirical research, particularly as they are related to developing countries (De Roon, Nijman, and Werker, [2001]; Li, Sarkar, and Wang, [2003]). However, the short-sale constraints should be extended to analyses involving developed economies since such limits might be imposed, temporarily or permanently, by rich countries, such as what took place in Australia and the U.S. during the 2008 financial crisis. Furthermore, although literature has documented that investors tend to allocate larger amounts of their fund than they should in their domestic assets (e.g., French and Poterba [1991], Grinblatt and Keloharju [2001], Hau and Rey [2008], Huberman [2001]), previous empirical studies do not directly model investing home biases in their estimations of diversification benefits. Therefore, our study focuses on this second issue from a perspective of risk management. Imposing investment constraints on efficient frontiers is equivalent to constructing the optimal portfolio with shrinkage in estimating covariances, which leads to a decrease in a portfolio's volatility (Green and Hollifield [1992], and Jagannathan and Ma [2003]). For local investors in different countries, the efficiency frontiers do not relapse analogously in proportion to a decrease in Sharpe ratio as the investments become more home-biased. Because of this, comparing the gains of international diversification under upper- and lower-bound investment constraints across the world is a critical issue to international investors.

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[2] For more detailed discussion, please see Coval and Moskowitz (1999) and Parwada (2008) for intranational empirical finding, and Chan, Covrig, and Ng (2005); Cooper and Kaplanis (1994); Errunza, Hogan, and Hung (1999); French and Poterba (1991); and Hau and Rey (2008) for the international result.

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This paper also differs from previous studies by examining the cross-nation variation in the gains of global diversification over various periods. The rapid growth of developing economies in the recent decade, such as so-called the BRIC (Brazil, Russia, India, and China), not only provides investing opportunities but also creates clients who seek advice to help diversify their portfolios internationally. An expansion of investment opportunities brought by foreign assets may be much more attainable for investors in less developed markets than those in rich countries. The countries in which domestic investors receive comparatively higher benefits from international diversification imply stronger demand for global asset management service. Finally, this paper examines the effectiveness of international diversification to domestic investors over various business cycle periods. This over-time analysis provides insights for investors about diversification benefits in an increasingly liberalized and integrated world financial market.

Detecting the target market for international asset management services is critical for financial institutions for several reasons. First, the revenue generated by related wealth management means stable cash flows for financial institutions. Such fee incomes are particularly important for financial industries in rich economies where profit margins earned from domestic clients is narrowing. Second, for investors in countries with a poorly performing market, it is possible to seek investing opportunities overseas that outperform the menu at home. Due to cross-country heterogeneities of institutional systems, cultural backgrounds, and natural endowments, the nonsynchronous movements of security prices across markets provide diversification (e.g., Beck, Demirgüç-Kunt, and Levine [2003a], Bekaert, Harvey, and Ng [2005], and Stulz [2005]). Third, a substantial and continuing growth of income and an accumulation of wealth in certain emerging economies create domestic demand for international

investments (World Bank [2008]). This opens a niche for service providers in developed countries, as local financial institutions in developing countries may not possess enough expertise, exposure, or investment vehicles to manage global portfolios. Fourth, the liberalization and integration of financial markets in the past decades has removed or decreased the barriers that deter cross-country investing, particularly for investments in and by emerging markets (Aizenman [2004]; Bekaert, Harvey, and Lundblad [2005, 2006], Lothian [2006]). The trend of market openings triggered by international treaties/organizations, such as the World Trade Organization (WTO), provides both overseas and native investors alternative mixtures of asset allocation to enhance their welfare.

The empirical results of our analysis of 73 countries suggest that domestic investors in emerging markets, particularly those in East Asia and South Asia, benefit the most from international diversification. This finding is particularly noticeable in the reduction of risk. However, during certain periods, local investors in developed countries also can obtain significant mean-variance efficiency benefits, both economically and statistically. The inter-temporal analysis shows that the benefits of global diversification benefits slightly decrease with the increasing integration of the world financial market.

The paper is organized as follows. Section II describes the estimate of the benefits of international diversification. Section III describes the data used in this study. Section IV reports the major empirical results found through the international comparison of diversification benefits. We check the robustness of our findings by conducting sub-period and over-time analyses in Section V. Section VI presents conclusions and discusses relevant issues.

II. BENEFITS OF HOME-BIASED INTERNATIONAL DIVERSIFICATION

The increase in risk-adjusted performance and the reduction in volatility brought by the international diversification are used to estimate the benefits of such diversification in each country. Suppose international equity investments can be characterized as a vector of multivariate returns of N assets, $\mathbf{R}^{\mathrm{T}}$. The risk premiums and variance-covariance of asset returns can be expressed as a vector $\boldsymbol{\mu}$ and a positive definite matrix $\mathbf{V}$, respectively. Let Ω be the set of all real vectors $\mathbf{w}$ that define the weights such that $\mathbf{w}^{\mathrm{T}}\mathbf{1} = 1$, where $\mathbf{1}$ is an N-vector of ones. Following the method of Markowitz (1952), a representative investor maximizes the return of her portfolio, given the same volatility, by allocating funds internationally. The global efficient frontier can be then expressed as a Lagrangian function:

$$\min_{\{\mathbf{w},\phi,\eta\}} \Xi = \frac{1}{2}\mathbf{w}^{\mathrm{T}}\mathbf{V}\mathbf{w} + \phi(\mu_p - \mathbf{w}^{\mathrm{T}}\boldsymbol{\mu}) + \eta(1 - \mathbf{w}^{\mathrm{T}}\mathbf{1}), \tag{1}$$

where μ_p denotes the expected return on the portfolio, and the shadow prices ϕ and η are two positive constants. The quadratic programming solution for asset spanning is $\mathbf{w_p}$.

The effect of short-sales (SS) constraints and home bias (HB) investing behavior is considered in our analysis. This is because in some developing countries, short-selling is not allowed for foreign investors.[3] Furthermore, it has been well documented that investors tend to invest in domestic securities above the optimal level. Though home bias is not a constraint in investing, such behavior can be modeled as upper bounds in the optimal portfolio. Given the multiple bounds described above, the Kuhn-Tucker conditions are then applied to solve the

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[3] See De Roon, Nijman, and Werker (2001); Harvey (1995); Li, Sarkar, and Wang (2003); and Pástor and Stambaugh (2000).

multiple-constraint optimization. The subset of portfolio weights $P_{L,D}$ with short-sales constraints and home-biased investments (SS+HB(L)) in country D can be described as:

$$P_{L,D} = \{\mathbf{w_p} \in \mathbf{\Omega} : 0 \leq w_i \leq 1, \ w_D \geq L, \ i=1,2,...,N\}, \ 0<L<1, \tag{2}$$

where w_D is the proportion of the domestic assets, and L is the minimum portfolio weight that the investor places in the home market. A greater L implies a stronger home-bias tendency when the investor forms a portfolio strategy. The constrained optimal weights can be solved by applying the Kuhn-Tucker conditions when the complementary slackness conditions, primal constraints, and gradient equations are fulfilled.

The benefits of diversification can be measured in two ways. The first is the maximum increase in mean-variance efficiency caused by diversifying a portfolio internationally while still holding a certain portion of domestic assets. Since the incentives of diversification are not only to seek higher yields but also to reduce a portfolio's volatility, the maximum Sharpe ratio (MSR) represents the highest mean-variance efficiency that can be achieved by the international efficient frontier. Specifically,

$$MSR_{L,D} = \max_{\{\mathbf{w_p}\}} [(\mathbf{w_p^T \mu}) / (\mathbf{w_p^T V w_p})^{\frac{1}{2}} | \mathbf{w_p^T} \in P_L]. \tag{3}$$

For the domestic investor, therefore, the greatest improvement in unit-risk return brought by global diversification is

$$\delta_{SS+HB(L),D} = \mathrm{MSR}_{L,D} - \mathrm{SR}_D, \tag{4}$$

where SR_D is the Sharpe ratio for the domestic portfolio in country D.

The second assessment of diversification benefits is shown by the reduction in volatility that results from international investing. Elton, Gruber, Brown, and Goetzmann (2007) suggest that investors may choose to minimize the risk of a portfolio due to the unpredictability of the expected returns. Thus, investors may want to construct a minimum-variance portfolio (MVP). Let σ_D and $\sigma_{MVP,SS+HB(\,L),D}$ represent the standard deviations of a domestic portfolio and the MVP under different scenarios of home bias for investors in country D, respectively. The maximum decline in volatility achieved by diversifying a portfolio internationally is

$$\varepsilon_{SS+HB(L),D} = \sigma_D - \sigma_{MVP,SS+HB(\,L),D} \ . \tag{5}$$

III. DATA

This study uses the returns of the market indices for 23 developed countries and 50 developing countries from January 1997 to November 2010[4]. The data of market values and gross domestic products (GDP) used in this study are obtained from the World Development Indicators and Global Financial Data. Table 1 summarizes the U.S. dollar-denominated stock return in each country. The equity securities in emerging markets are, in general, shown to be more volatile but not necessarily less mean-variance efficient than those in the developed countries. From 1997 to 2006, the total weight of market capitalization of emerging markets increased from 11% to 23%, although industrial countries, such as the U.S., Japan, the U.K., and France, still make up the largest stock markets in the world. The average value-weighted growth rate of market capitalization for all countries during the sample period is 10.1%. China, Bulgaria,

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[4]The term "developed" or "developing" is used as defined by the World Bank Atlas. In 2007, high-income countries are classified as having an annual gross national income (GNI) per capita of $11,456 or more. In this study, the data of the 51 countries with an asterisk are collected from 1988 to 2010 for a time-series analysis.

Poland, Malta, Iceland, the UAE, Zambia, and Turkey experienced the largest growth in market value during the sample period. It also must be noted that there are comparable disparities within each group of countries at different developmental stages and in various areas.

[INSERT TABLE 1 ABOUT HERE]

The market capitalization of stocks listed on the stock exchange as a portion of the gross domestic product (Cap/GDP) is a measure of the development of the equity market in each country (e.g., Beck, Demirgüç-Kunt, and Levine [2003a, b], Levine and Zervos [1998], and Beck and Levine [2003]). As demonstrated in Table 1, a considerable variation in this ratio indicates that the development of a country's stock market does not necessarily correlate with the scale of a country's economy or the stage of its economic development. The countries with largest Cap/GDP ratio are Hong Kong, Switzerland, Malaysia, Singapore, and South Africa. The fact that, in the majority of countries, this ratio is higher at the end of 2006 than the average from 1991 to 2006 suggests that equity markets have substantially expanded over the sample period. This trend is particularly evident in countries of low- or mid-level income.

IV. MAJOR EMPIRICAL RESULTS

Table 2 reports the weights of the global optimal portfolio without home bias and the benefits of international diversification with different degrees of home-bias in each country. In the sample period, Bangladesh, Philippines, Thailand, Malaysia, Japan, Paraguay, Indonesia,

Taiwan, Venezuela, Ecuador, Lebanon, and Kenya are the countries in which domestic investors gain the highest mean-variance efficiency from investing internationally. On average, investors in the developing countries enjoy greater improvements in mean-variance efficiency than those in developed countries. Following global MVP strategies, domestic investors can effectively decrease annualized volatility of portfolios from 2% (Panama) to 15.4% (Turkey). Similar to the result of the Sharpe ratio benefit, these findings show that investors in emerging markets can decrease the volatility of their portfolios more substantially by investing globally, as compared to those in developed countries.

[INSERT Table 2 ABOUT HERE]

The resulting disproportional distribution of funds leads to a challenge to the feasibility of optimal asset allocation that only considers short-sales. As shown in Table 2, there are only fifteen and twenty-three nations selected in the MSR portfolio (MSRP) and the MVP, respectively, during the period of January 1997 to November 2010. Furthermore, the results of the MSRP indicate that investors should place 98% of their funds in low- and middle-income countries. For investments in small capital markets, such as Trinidad and Tobago (26.5%), Panama (12.9%), Malta (11.4%) and Bermuda (9.5%), which totally represents less than 1% of global market value, this optimal investing strategy is hardly executable. On the other hand, the weights on the major financial markets are either negligible or zero. A similar phenomenon can also be found in the weights of the MVP. Such investments in small markets may be infeasible in reality since they imply that no domestic investments are made in most countries, particularly in

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developed nations. The "corner solutions" may result in investor concern on the illiquidity of the optimal portfolios as well as volatility in asset values triggered by the excessive foreign capital in- and outflows..

Our measures of the benefits of international diversification also consider the effect of home bias. The disproportional distribution of funds may cause an investor to hesitate to implement no-short-selling global diversification strategies. Investors, particularly those in industrial countries, may want to overweigh the securities in their home markets when they consider international diversifying strategies. Table 2 shows that the gains of international diversification with various degrees of home bias to local investors in low- and middle-income countries, both measured by the increase in risk-adjusted return and the reduction in volatility, are still greater than those in developed countries. This finding holds for the various scenarios of home-bias (HB) investments, though the proportion of decrease varies from country to country. Diversification benefits erode considerably when asset allocation becomes more home-biased. However, on average, domestic investors can still slightly improve mean-variance efficiency and reduce volatility through diversification strategies that include a 5% investment in the global market.

Figure 1 shows the impact of home bias on the mean-variance efficiency of the global portfolios. We use the U.S. portfolio as an example. The Sharpe ratio curve with least constraints, no HB, is evidently the most mean-variance efficient. When the investments become increasingly home-biased, the economic value of diversification decreases, as displayed by the downward-moving curve. However, the finding also suggests that, for an investor in the U.S., the globally-diversified portfolios with any level of home bias are still preferable to holding only a domestic portfolio. This fact also holds true for investors in the other countries.

[INSERT FIGURE 1 ABOUT HERE]

The impact of home-biased investments on the change in the shapes of the efficient

frontiers varies from country to country. In Figure 2, we select 8 countries as an example and

demonstrate their efficient frontiers with various degrees of home bias. The domains of the

optimal portfolio shrink and mean-variance efficiencies decline as domestic investors allocate

increasing amounts of funds in their home securities. However, the shape transformation and

transfer of frontiers diverge due to deviations in the mean-variance efficiency and

interdependences among countries. For instance, the efficient frontiers of the U.S. and the U.K.

are nearly identical under the situation SS+HB(40%), but they gradually separate as the portfolio

becomes more home-biased. Conversely, home-bias causes investment sets of Argentina and

Bulgaria, primarily, to be of a higher variance while those of Japan have a lower return. The

relative magnitude of a country's diversification benefits is determined by (1) the marginal

contribution in mean-variance brought by portfolios in other countries, and (2) lower correlations

between domestic markets and foreign assets. The impact of home bias on the optimal portfolio

selection differs from country to country. This implies that investors in various countries need

professional wealth allocation services to customize international portfolios that will bring

optimal results.

[INSERT FIGURE 2 ABOUT HERE]

Figure 3 shows that the benefits of ranks of diversification benefits for all countries are not constant across different scenarios, particularly for the increase in Sharpe ratio. The emerging markets, on average, are concentrated on the columns to the left, indicating that investors in these countries benefit the most out of all countries in the sample group. In Panel A, a high δ under short-sales constraints does not necessarily imply a high δ under home bias constraints. The benefits with various degrees of home-bias decrease but not proportionally in size as the investments become more home-biased. This is associated with the difference in the effect of correlations and marginal contribution of mean-variance efficiency brought by other markets to each country. Though the portfolios consist of 95% of home assets, the fact that both δ and ε benefits are non-negative suggest the value of international diversification to the local investor.

[INSERT FIGURE 3 ABOUT HERE]

Table 3 reports a measure of diversification benefits across various groups of countries. Domestic investors in less developed countries benefit more than those in richer economies with different investment constraints, measured by both an increase in Sharpe ratio and a reduction in volatility. We test the null hypothesis that there is no statistically significant difference between the countries in the tested group and the rest in the world. Since there is no sound theory supporting Gaussian distribution of diversification benefits, statistics for the truncated t-test

suggested by Bagnoli and Bergstrom (2005) and the non-parametric Mann-Whitney test are

implemented to minimize the possible departure from normality. All statistics are presented in

absolute values. Both tests suggest that investors in developing economies benefit more than

those in developed countries in all situations, particularly in the reduction of volatility. The

differences are significant both economically and statistically. Differing from Driessen and

Laeven (2007) using parametric statistics, our empirical results also are shown to be robust by

applying non-parametric method.

[INSERT Table 3 ABOUT HERE]

Table 3 also shows that the comparative advantages of diversification differ from area to

area. To deepen our analysis of this variation among countries, we classify emerging markets

into following regions: Africa (9), Latin America (11), East Asia (10), South Asia (4), Middle

East (8), and European emerging markets (8). The rich economies, except Japan and two city

states in East Asia, Hong Kong and Singapore, include North America (2), industrial European

countries (16), and Oceania (2). In general, when diversifying portfolios internationally, local

investors in East Asia and South Asia enjoy the most significant improvements in risk-adjusted

premiums and the greatest reduction in volatility. For domestic investors in European emerging

markets and Latin America, the primary benefit of incorporating overseas stocks in their

portfolios is to reduce volatility. The benefits of mean-variance efficiency for investors in

European industrial countries are relatively trivial as compared to those in the rest of world. The

decrease in risk for all three high-income regions is also significantly lower than that of the other

regions. The comparison of magnitudes of HB diversification benefits among regions is similar to that of no-short-selling portfolios although the statistical significance varies among various circumstances.

V. ROBUSTNESS ANALYSIS

5.1. Sub-period analysis

To evaluate the effectiveness of diversification, we divide our sample period into three according to the market situation. Following the method described in Section III, we form the optimal portfolios under various scenarios in each country by using sub-sample data. The periods of 97:01-00:03 and 03:02-07:07 are bullish, and the periods of 00:01-03:04 and 07:05-09:12 are bearish.

Table 4 shows sub-period analyses of the benefits of international diversification under different constraints in various groups of countries. In general, the benefits of mean-variance efficiency from diversification are greater in bullish periods than in bearish periods. However, the absolute value of reduction in volatility seems to have no relation to business cycle. In these sub-periods, investors in middle- and low-income countries benefit more than those in high-income countries. The differences in δ and ε between countries at various developmental stages are both economically and statistically significant under all constraints.

[INSERT Table 4 ABOUT HERE]

Regional differences vary in sub-periods. The business cycle may affect diversification benefits because of the dynamics of the co-movement of asset returns, idiosyncratic risk, and mean-variance efficiency. Investors in East Asia still benefit more from diversifying portfolios internationally than investors in the rest of the world. The economic value of the mean-variance benefits decreases but their statistical significance increases during bullish periods. For the areas in which investors benefit less than the rest of the world over a long term, such as European developed countries and North America, the absolute values of the mean-variance benefits decrease during bullish periods while their relative economic value becomes significant. For investors in Australia and New Zealand, diversification benefits are insignificant only during the period of 03:02-07:07. In general, for Africa, Latin America, Middle East, and European emerging markets, their difference from the rest of the world is statistically insignificant. The above findings suggest that investors in richer economies can still use international investments as an option of enhancing risk-adjusted return during recession.

5.2. Inter-temporal analysis

As the world market becomes increasingly integrated, and due to recent international financial trends—lower domestic asset returns, stronger co-movement of prices, and time-varying idiosyncratic risk—investors may question effectiveness of international diversification. Table 5 shows the time-rolling results of diversification benefits of developed countries and emerging markets. As shown in Panel A, local investors in emerging markets, on average, generate higher benefits over the sample period than those in developed countries, particularly in terms of reduction in volatility. However, local investors in developed countries can generate

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higher risk-adjusted return than investors in developing countries during about 14% of the sample period.

[INSERT Table 5 ABOUT HERE]

Panel B displays the over-time results with short-sales constraints in sub-periods that are divided by the market condition of major industrial countries. Though the value of risk-adjusted performance is associated with business cycle, the relative magnitude is time-varying. For investors in less developed countries, the benefits of mean-variance efficiency are statistically greater than the rich economies in early years, both in bullish and bearish market. After 2003, investors in developed countries do not receive lower improvements in Sharpe ratio than those in the emerging markets, particularly during the bullish market 03:02-07:07. For investors in emerging markets over the sample period, the benefits of volatility reduction are constantly more significant than developed countries.

Figure 4 demonstrates the time series of the maximum improvement in mean-variance efficiency under short-sales constraints for local investors across the world. Panel A shows that the time-series of δ fluctuates considerably over time while also demonstrating a substantial cross-sectional variation. The steadily positive minima of δ over the period suggest that a local can always improve her portfolio's performance by investing overseas *optimally*. The 1st and 3rd quartiles show that the distribution of δ in the same period is not centralized. Panel B displays that the mean of δ in developed countries is lower in most of periods than that of developing

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countries. This confirms the finding that investors in lower-income countries benefit the most from international diversification.

[INSERT Figure 4 ABOUT HERE]

Figure 5 shows that the international disparity of the benefit of reduction in volatility decreases over time. In Panel A, the mean of ε over the sample period is between 0.02 and 0.045, but the maximum gradually reduces from 0.23 to 0.08. The fact that the mean of the reduction in volatility slightly decreases during this period suggests the increasing integration of the global financial market. Panel B demonstrates moderate inter-temporal alterations in the cross-country averages of ε. Nevertheless, the consistently positive minimum during the period suggests that international diversification can eliminate volatility in all countries.

[INSERT Figure 5 ABOUT HERE]

The inter-temporal evaluation of diversification benefits seemingly supports the idea of integration of international financial markets. Figures 4 and 5 show that both the increase in risk-return and the decrease in volatility brought by global diversification slightly shrink over time. This trend is particularly evident for δ during the financial crises in 1998 and 2008-09. This indicates that as the international markets become more integrated, the gains of international

diversification decrease. Though the improvement of mean-variance efficiency and reduction in portfolio volatility for domestic investors are quite volatile, the persistently positive values suggest that diversifying globally is still desirable by domestic investors.

VI. CONCLUSION

This paper investigates the economic value of diversification from a perspective of providers of global wealth management services. The empirical findings suggest that investors in less developed countries, particularly those in East Asia and South Asia, benefit more from international diversification than investors in developed countries. This result holds even when short-selling constraints are included and asset allocation is home-biased. Financial institutions, especially those in developed countries, should consider placing more effort in promoting their international portfolio management services in the countries and/or regions that benefit most from diversification, especially in the reduction in volatility. As the world market becomes increasingly integrated, investors in developed countries do not receive lower risk-adjusted return than those in the emerging markets. This is consistent with the finding of previous studies regarding the increasing integration of the world financial market (e.g., Aizenman [2004]; Bekaert, Harvey, and Lundblad [2005, 2006], Lothian [2006]).

Our analyses of the benefits of international diversification contribute to the existing literature in two ways. First, international diversification benefits are assiduously investigated from a domestic perspective in a large cross-section of countries. The results are useful to Wall Street to help determine target markets. For finance academia, we evaluate the economic value of diversification from local prospective while considering feasibility of the strategies. Second, to

accommodate real-world situations, this research takes into account the home bias and short-selling constraints in global portfolio management. These results are useful for professionals of asset management in determining target markets for their services. Our finding of the evident benefits of international investments for locals in less developed countries also yields meaningful policy implications regarding international investment, particularly for investors in emerging markets. Future research may investigate the impact of the changing economic and financial environments on international diversification benefits.

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Table 1. Sample Countries

Table 1 presents the standard deviation (SD) and Sharpe ratio (SR) of the return of market index in the sample countries. The weight of global market capitalization at the end of 1997 and at the end of 2006, the growth rate of market capitalization between 1988 and 2006 (*g*), the ratio of market capitalization to gross domestic product (Cap/GDP) at the end of 2006, and its average between 1991 and 2007 for each country are reported. The data from January 1988 to November 2010 in 51 countries (indicated with an asterisk) are used for time-series analysis.

Country	Market Index	SD	SR	Weight (%)		*g* (%)	Cap/GDP (%)	
				1997	2006		2006	1991-2006
Argentina [*]	Buenos Aires SE General Index	0.344	0.183	0.256	0.147	21.88	37.22	31.84
Australia [*]	ASX All-Ordinaries	0.177	0.532	1.280	2.022	12.20	140.40	85.53
Austria [*]	Wiener Boersekammer Share Index	0.169	0.875	0.155	0.353	18.61	59.41	19.80
Bahrain	Bahrain BSE Composite Index	0.127	0.658	0.028	0.039	9.85	108.25	99.35
Bangladesh [*]	Dhaka SE Index	0.282	-0.361	0.007	0.007	12.55	5.83	3.52
Barbados	Barbardos SE Local Stock Index	0.181	0.564	0.005	0.009	19.62	144.42	81.66
Belgium	Brussels All-Share Price Index	0.176	0.607	0.593	0.731	11.17	100.55	59.23
Bermuda	Bermuda SE Index	0.175	0.949	0.006	0.005	7.50	61.23	61.97
Botswana	Botswana SE Domestic Companies Index	0.178	0.941	0.003	0.007	21.50	37.24	16.66
Brazil [*]	Brazil Bolsa de Valores de Sao Paulo	0.468	0.262	1.105	1.312	18.78	66.62	32.35
Bulgaria	Bulgaria SE SOFIX Index	0.447	0.211	0.001	0.019	63.21	32.80	8.23
Canada [*]	Canada S&P/TSX 300 Composite	0.201	0.496	2.456	3.138	11.44	133.75	88.67
Chile [*]	Santiago SE Indice General de Precios de	0.205	0.403	0.312	0.322	19.71	119.69	93.92
China	Shanghai SE A Shares	0.253	0.581	0.893	4.477	65.17	91.74	27.31
Colombia [*]	Colombia IGBC General Index	0.334	0.490	0.084	0.104	24.18	36.64	17.90
Costa Rica	Costa Rica Bolsa Nacional de Valores Index	0.183	0.360	0.004	0.004	10.59	8.75	10.42
Cote D'Ivoire	Cote d'Ivoire Stock Market Index	0.198	0.351	0.006	0.008	13.33	23.67	10.52
Cyprus [*]	Cyprus CSE All Share Composite	0.427	0.335	0.009	0.029	18.23	86.55	37.23
Czech Republic	Prague SE PX Index	0.269	0.536	0.055	0.090	21.34	33.98	23.17
Denmark [*]	OMX Copenhagen All-Share Price Index	0.168	0.785	0.406	0.426	11.97	83.89	50.02
Ecuador [*]	Ecuador Bolsa de Valores de Guayaquil	0.258	0.093	0.009	0.007	25.75	9.76	7.57
Egypt	Cairo SE EFG General Index	0.306	0.451	0.090	0.172	24.69	86.97	31.12
Finland [*]	OMX Helsinki All-Share Price Index	0.310	0.478	0.317	0.490	12.84	126.03	96.57
France [*]	France SBF-250 Index	0.188	0.555	2.917	4.481	13.59	108.03	63.31
Germany [*]	Germany DAX Price Index	0.242	0.334	3.570	3.022	10.96	56.54	39.70
Ghana	Ghana SE Databank Index	0.249	0.379	0.005	0.006	24.02	25.05	15.87
Greece [*]	Athens SE General Index	0.314	0.529	0.148	0.384	24.09	67.53	41.32
Hong Kong [*]	Hong Kong Hang Seng Composite Index	0.270	0.144	1.788	3.164	19.04	903.56	346.94
Iceland	OMX Iceland All-Share Price Index	0.215	0.954	0.008	0.067	43.24	221.94	72.24
India [*]	Bombay SE Sensitive Index	0.271	0.488	0.556	1.511	21.78	89.81	39.11
Indonesia [*]	Jakarta SE Composite Index	0.500	-0.039	0.126	0.256	41.97	38.07	23.82
Ireland [*]	Ireland ISEQ Overall Price Index	0.178	0.688	0.214	0.301	18.25	74.21	62.25

Table 1. (cont.)

Country	Market Index	SD	SR	Weight (%) 1997	Weight (%) 2006	g (%)	Cap/GDP (%) 2006	Cap/GDP (%) 1991-2006
Israel [*]	Israel All-Share Index	0.198	0.807	0.196	0.320	21.18	123.39	56.30
Italy [*]	Banca Commerciale Italiana Index	0.213	0.559	1.491	1.894	11.93	55.47	35.82
Jamaica [*]	Jamaica SE All-Share Composite Index	0.258	0.386	0.009	0.023	16.42	122.48	63.18
Japan [*]	Japan Nikkei 225 Stock Average	0.219	-0.060	9.589	8.721	1.06	108.19	75.01
Jordan [*]	Jordan AFM General Index	0.183	0.712	0.024	0.055	15.48	210.83	101.25
Kenya [*]	Nairobi SE Index	0.213	0.136	0.008	0.021	19.31	49.95	19.65
Korea [*]	Korea SE Stock Price Index	0.418	0.177	0.199	1.541	12.22	94.05	47.95
Kuwait	Kuwait SE Index	0.182	0.935	0.113	0.238	14.21	161.03	79.24
Lebanon	Beirut Stock Exchange Index	0.296	0.114	0.013	0.015	14.10	36.44	13.57
Luxembourg [*]	Luxembourg SE LUXX Index	0.224	0.538	0.147	0.147	3.24	191.77	143.23
Malaysia [*]	Malaysia KLSE Composite	0.357	-0.064	0.405	0.434	13.71	156.20	177.65
Malta	Malta SE Index	0.199	0.846	0.002	0.008	45.03	70.64	35.22
Mexico [*]	Mexico SE Indice de Precios y Cotizaciones	0.313	0.564	0.677	0.643	19.65	41.51	30.08
Morocco [*]	Casablanca Financial Group 25 Share Index	0.192	0.685	0.053	0.091	29.88	75.47	28.47
Namibia	Namibia SE Overall Index	0.307	0.328	0.003	0.001	26.36	8.25	8.49
Netherlands [*]	Netherlands All-Share Price Index	0.197	0.344	2.028	1.439	11.27	117.72	100.04
New Zealand [*]	New Zealand SE All-Share Capital Index	0.199	0.189	0.132	0.083	7.04	43.00	43.98
Nigeria	Lagos SE Index	0.215	0.628	0.016	0.061	21.68	28.45	11.81
Norway [*]	Oslo SE OBX-25 Stock Index	0.241	0.458	0.288	0.519	17.99	83.92	38.86
Pakistan [*]	Pakistan Karachi SE-100 Index	0.363	0.483	0.047	0.084	17.60	35.89	19.10
Panama	Panama SE Index	0.118	1.108	0.010	0.011	25.95	33.43	21.11
Paraguay	Asuncion SE PDV General Index	0.139	-0.052	0.002	0.001	24.38	4.41	3.31
Peru [*]	Lima SE General Index	0.277	0.863	0.076	0.110	30.09	64.55	24.52
Philippines [*]	Manila SE Composite Index	0.340	-0.159	0.136	0.126	16.64	58.17	52.89
Poland	Warsaw SE 20-Share Composite	0.348	0.263	0.052	0.275	57.54	44.00	13.71
Portugal [*]	Oporto PSI-20 Index	0.217	0.411	0.169	0.192	16.03	53.51	32.78
Singapore [*]	Singapore SES All-Share Index	0.259	0.169	0.460	0.510	14.54	209.09	177.19
South Africa [*]	FTSE/JSE All-Share Index	0.288	0.377	1.004	1.319	10.13	280.23	167.18
Spain [*]	Madrid SE General Index	0.197	0.658	1.256	2.441	16.03	108.04	59.55
Sri Lanka [*]	Colombo SE All-Share Index	0.264	0.320	0.009	0.014	16.85	28.81	16.25
Sweden [*]	Sweden Affarsvarlden General Index	0.232	0.460	1.180	1.058	10.19	149.36	93.43
Switzerland [*]	Switzerland Price Index	0.163	0.619	2.489	2.237	12.70	318.74	198.65
Taiwan [*]	Taiwan SE Capitalization Weighted Index	0.295	-0.021	1.245	1.097	9.30	162.95	101.18
Thailand [*]	Thailand SET General Index	0.399	-0.101	0.102	0.260	16.66	68.38	56.65
Trinidad & Tobago [*]	Trinidad and Tobago SE Composite	0.129	1.287	0.013	0.029	25.32	85.85	55.26
Turkey [*]	Istanbul SE IMKB-100 Price Index	0.581	0.214	0.264	0.300	31.72	40.33	26.53
UAE	United Arab Emirates SE Index	0.271	0.495	0.000	0.256	42.85	173.91	46.82
United Kingdom [*]	UK FTSE All-Share Index	0.135	0.478	8.636	7.001	9.26	159.63	138.44
USA [*]	S&P 500 Composite Price Index	0.153	0.440	48.921	35.844	11.38	147.57	119.95
Venezuela [*]	Caracas SE General Index	0.446	0.061	0.063	0.015	8.76	4.54	8.91
Zambia	Zambia Lu SE Index	0.330	0.577	0.003	0.002	41.12	11.04	9.47
World	MSCI World Price Index	0.144	0.439	100.00	100.00	10.01	113.91	80.68

Table 2. Diversification Benefits: 1997:01 – 2010:11

This table indicates the portfolio weights of the maximum Sharpe ratio (MSR) and the minimum-variance (MV) for each country during January 1997 and November 2010 when short-sales are not allowed. The benefits of international diversification for each country with different degrees of home-bias are also reported.

Country	$w_i(MSR)$	δ_{SS}	$\delta_{SS+HB(40\%)}$	$\delta_{SS+HB(60\%)}$	$\delta_{SS+HB(80\%)}$	$\delta_{SS+HB(95\%)}$	$w_i(MV)$	ε_{SS}	$\varepsilon_{SS+HB(40\%)}$	$\varepsilon_{SS+HB(60\%)}$	$\delta_{SS+HB(80\%)}$	$\delta_{SS+HB(95\%)}$
Argentina	0.0000	0.5228	0.1338	0.0540	0.0195	0.0056	0.0000	0.0854	0.0589	0.0402	0.0204	0.0052
Australia	0.0000	0.4219	0.2123	0.0889	0.0312	0.0080	0.0000	0.0373	0.0292	0.0209	0.0111	0.0029
Austria	0.0000	0.3230	0.1548	0.0635	0.0214	0.0036	0.0000	0.0348	0.0256	0.0184	0.0098	0.0026
Bahrain	0.0000	0.3856	0.1943	0.0863	0.0302	0.0061	0.0000	0.0228	0.0181	0.0134	0.0077	0.0023
Bangladesh	0.0000	0.6798	0.2021	0.1025	0.0378	0.0127	0.0532	0.0675	0.0508	0.0350	0.0180	0.0046
Barbados	0.0000	0.4126	0.2060	0.0957	0.0350	0.0100	0.0306	0.0385	0.0304	0.0219	0.0118	0.0033
Belgium	0.0000	0.4003	0.1684	0.0689	0.0237	0.0049	0.0000	0.0370	0.0271	0.0192	0.0103	0.0028
Bermuda	0.0948	0.3017	0.1935	0.0901	0.0321	0.0086	0.0306	0.0367	0.0286	0.0203	0.0108	0.0029
Botswana	0.0687	0.3039	0.1802	0.0790	0.0280	0.0068	0.0617	0.0373	0.0305	0.0223	0.0125	0.0037
Brazil	0.0000	0.4999	0.0978	0.0374	0.0133	0.0037	0.0000	0.1212	0.0807	0.0546	0.0277	0.0070
Bulgaria	0.0000	0.5147	0.1143	0.0510	0.0186	0.0058	0.0000	0.1150	0.0773	0.0522	0.0264	0.0067
Canada	0.0000	0.4323	0.1824	0.0724	0.0252	0.0060	0.0000	0.0440	0.0328	0.0232	0.0121	0.0031
Chile	0.0000	0.4593	0.1836	0.0717	0.0252	0.0062	0.0000	0.0453	0.0334	0.0234	0.0123	0.0032
China	0.0174	0.4078	0.1588	0.0614	0.0218	0.0056	0.0311	0.0591	0.0446	0.0315	0.0166	0.0043
Colombia	0.0000	0.4342	0.1191	0.0436	0.0152	0.0037	0.0000	0.0825	0.0566	0.0385	0.0195	0.0049
Costa Rica	0.0363	0.4718	0.2403	0.1079	0.0393	0.0117	0.0932	0.0389	0.0321	0.0232	0.0124	0.0033
Cote D'Ivoire	0.0000	0.4744	0.1984	0.0845	0.0307	0.0086	0.0000	0.0431	0.0325	0.0230	0.0121	0.0032
Cyprus	0.0000	0.4789	0.1124	0.0474	0.0172	0.0051	0.0000	0.1092	0.0740	0.0500	0.0255	0.0066
Czech Republic	0.0000	0.4209	0.1471	0.0565	0.0199	0.0050	0.0000	0.0637	0.0448	0.0311	0.0161	0.0042
Denmark	0.0000	0.3489	0.1594	0.0647	0.0219	0.0040	0.0000	0.0346	0.0255	0.0181	0.0097	0.0025
Ecuador	0.0117	0.5487	0.1969	0.0873	0.0413	0.0136	0.0432	0.0605	0.0454	0.0316	0.0166	0.0043
Egypt	0.0000	0.4454	0.1387	0.0530	0.0198	0.0054	0.0000	0.0745	0.0520	0.0356	0.0183	0.0047
Finland	0.0000	0.4375	0.1422	0.0567	0.0222	0.0064	0.0000	0.0757	0.0535	0.0368	0.0190	0.0049
France	0.0000	0.4155	0.1704	0.0711	0.0190	0.0035	0.0000	0.0404	0.0291	0.0203	0.0106	0.0028
Germany	0.0000	0.4791	0.1542	0.0639	0.0247	0.0067	0.0000	0.0560	0.0386	0.0266	0.0137	0.0036
Ghana	0.0000	0.4662	0.1652	0.0743	0.0303	0.0091	0.0000	0.0580	0.0421	0.0297	0.0162	0.0044
Greece	0.0000	0.4230	0.1242	0.0464	0.0062	0.0004	0.0000	0.0768	0.0525	0.0358	0.0182	0.0047
Hong Kong	0.0000	0.5341	0.1666	0.0691	0.0471	0.0162	0.0000	0.0640	0.0473	0.0333	0.0178	0.0047
Iceland	0.0101	0.3003	0.1371	0.0547	0.0058	0.0004	0.0000	0.0480	0.0350	0.0244	0.0128	0.0034
India	0.0000	0.4346	0.1429	0.0541	0.0046	0.0006	0.0000	0.0644	0.0451	0.0312	0.0160	0.0041
Indonesia	0.0000	0.5869	0.1085	0.0496	0.0380	0.0138	0.0000	0.1305	0.0896	0.0609	0.0310	0.0079
Ireland	0.0000	0.3769	0.1668	0.0688	0.0269	0.0062	0.0000	0.0376	0.0276	0.0194	0.0102	0.0027
Israel	0.0000	0.3428	0.1472	0.0574	0.0129	0.0010	0.0000	0.0432	0.0312	0.0219	0.0115	0.0030
Italy	0.0000	0.4141	0.1546	0.0615	0.0178	0.0034	0.0000	0.0475	0.0334	0.0230	0.0119	0.0030
Jamaica	0.0000	0.4642	0.1679	0.0782	0.0164	0.0038	0.0000	0.0606	0.0438	0.0305	0.0160	0.0043
Japan	0.0000	0.5931	0.2070	0.0959	0.0564	0.0193	0.0000	0.0492	0.0370	0.0260	0.0135	0.0035
Jordan	0.0403	0.3700	0.1939	0.0811	0.0134	0.0012	0.0377	0.0389	0.0307	0.0220	0.0121	0.0034
Kenya	0.0000	0.5362	0.2081	0.0898	0.0333	0.0099	0.0056	0.0476	0.0361	0.0255	0.0135	0.0035
Korea	0.0000	0.5245	0.1218	0.0497	0.0388	0.0138	0.0000	0.1068	0.0742	0.0505	0.0256	0.0065
Kuwait	0.0660	0.3057	0.1638	0.0655	0.0005	0.0000	0.0406	0.0388	0.0309	0.0221	0.0119	0.0032
Lebanon	0.0000	0.5426	0.1643	0.0751	0.0385	0.0130	0.0000	0.0716	0.0507	0.0347	0.0178	0.0045
Luxembourg	0.0000	0.4203	0.1481	0.0602	0.0049	0.0000	0.0000	0.0507	0.0359	0.0249	0.0129	0.0034
Malaysia	0.0000	0.5942	0.1462	0.0671	0.0502	0.0181	0.0000	0.0891	0.0648	0.0445	0.0227	0.0058
Malta	0.1144	0.3315	0.1902	0.0798	0.0199	0.0042	0.0709	0.0435	0.0345	0.0244	0.0130	0.0036
Mexico	0.0000	0.4128	0.1340	0.0506	0.0211	0.0059	0.0000	0.0766	0.0543	0.0374	0.0194	0.0050
Morocco	0.0000	0.3780	0.1594	0.0640	0.0124	0.0009	0.0135	0.0415	0.0323	0.0234	0.0126	0.0034
Namibia	0.0000	0.4808	0.1497	0.0551	0.0202	0.0055	0.0000	0.0746	0.0539	0.0376	0.0197	0.0051

Table 2. (cont.)

Country	$w_i(MSR)$	δ_{SS}	$\delta_{SS+HB(40\%)}$	$\delta_{SS+HB(60\%)}$	$\delta_{SS+HB(80\%)}$	$\delta_{SS+HB(95\%)}$	$w_i(MV)$	ε_{SS}	$\varepsilon_{SS+HB(40\%)}$	$\varepsilon_{SS+HB(60\%)}$	$\delta_{SS+HB(80\%)}$	$\delta_{SS+HB(95\%)}$
Netherlands	0.0000	0.4762	0.1729	0.0725	0.0219	0.0048	0.0000	0.0430	0.0306	0.0213	0.0111	0.0029
New Zealand	0.0000	0.5211	0.2029	0.0811	0.0415	0.0128	0.0000	0.0437	0.0334	0.0236	0.0123	0.0032
Nigeria	0.0568	0.3943	0.1880	0.0753	0.0216	0.0050	0.0284	0.0481	0.0370	0.0259	0.0135	0.0036
Norway	0.0000	0.4434	0.1532	0.0609	0.0223	0.0056	0.0000	0.0556	0.0391	0.0272	0.0141	0.0037
Pakistan	0.0182	0.4361	0.1219	0.0451	0.0330	0.0110	0.0121	0.0908	0.0635	0.0432	0.0219	0.0056
Panama	0.1292	0.2557	0.1887	0.0884	0.0002	0.0000	0.0996	0.0201	0.0175	0.0131	0.0074	0.0021
Paraguay	0.0000	0.5906	0.2793	0.1316	0.0724	0.0238	0.1018	0.0261	0.0219	0.0158	0.0085	0.0023
Peru	0.0471	0.3264	0.1449	0.0553	0.0054	0.0000	0.0000	0.0660	0.0472	0.0327	0.0169	0.0043
Philippines	0.0000	0.6214	0.1549	0.0752	0.0390	0.0136	0.0093	0.0842	0.0620	0.0428	0.0218	0.0055
Poland	0.0000	0.4997	0.1341	0.0535	0.0233	0.0071	0.0000	0.0867	0.0597	0.0409	0.0210	0.0054
Portugal	0.0000	0.4571	0.1578	0.0646	0.0165	0.0030	0.0000	0.0488	0.0342	0.0237	0.0123	0.0032
Singapore	0.0000	0.5267	0.1835	0.0699	0.0307	0.0094	0.0000	0.0609	0.0458	0.0321	0.0167	0.0044
South Africa	0.0000	0.4669	0.1563	0.0583	0.0282	0.0086	0.0000	0.0694	0.0505	0.0350	0.0181	0.0047
Spain	0.0000	0.3856	0.1573	0.0615	0.0123	0.0008	0.0000	0.0430	0.0308	0.0214	0.0111	0.0029
Sri Lanka	0.0000	0.4833	0.1634	0.0797	0.0321	0.0099	0.0108	0.0623	0.0460	0.0250	0.0165	0.0042
Sweden	0.0000	0.4429	0.1489	0.0602	0.0254	0.0068	0.0000	0.0531	0.0370	0.0257	0.0133	0.0035
Switzerland	0.0000	0.3968	0.1830	0.0753	0.0093	0.0000	0.0000	0.0331	0.0249	0.0178	0.0096	0.0025
Taiwan	0.0000	0.5816	0.1594	0.0747	0.0250	0.0076	0.0000	0.0712	0.0501	0.0345	0.0178	0.0046
Thailand	0.0000	0.6049	0.1359	0.0640	0.0646	0.0241	0.0119	0.1012	0.0725	0.0496	0.0251	0.0063
Trinidad	0.2648	0.2040	0.1851	0.1156	0.0099	0.0000	0.1688	0.0232	0.0211	0.0164	0.0098	0.0032
Turkey	0.0000	0.5137	0.0831	0.0340	0.0214	0.0073	0.0000	0.1539	0.1007	0.0679	0.0344	0.0087
UAE	0.0000	0.4327	0.1669	0.0748	0.0256	0.0076	0.0148	0.0644	0.0480	0.0342	0.0184	0.0050
UK	0.0000	0.4375	0.2042	0.0893	0.0306	0.0064	0.0000	0.0250	0.0192	0.0139	0.0075	0.0021
USA	0.0000	0.4486	0.2197	0.0952	0.0232	0.0042	0.0202	0.0302	0.0242	0.0176	0.0095	0.0025
Venezuela	0.0002	0.5579	0.1188	0.0506	0.0328	0.0115	0.0104	0.1149	0.0803	0.0547	0.0278	0.0071
Zambia	0.0238	0.4089	0.1309	0.0508	0.0163	0.0042	0.0000	0.0813	0.0578	0.0397	0.0203	0.0052

Table 3. Benefits of Home-biased Diversification

Table 3 reports the benefits of mean-variance efficiency, δ, and risk reduction, ε, generated by international diversification in different countries under various no-short-sale and home bias (HB) strategies. This table also displays the parametric truncated *t*-test and non-parametric Mann-Whitney test of the difference of diversification benefits between the groups of countries.

	δ					ε (%)				
	SS	SS+ HB(40%)	SS+ HB(60%)	SS+ HB(80%)	SS+ HB(95%)	SS	SS+ HB(40%)	SS+ HB(60%)	SS+ HB(80%)	SS+ HB(95%)
All Countries	0.449	0.163	0.069	0.037	0.023	6.055	4.370	3.028	1.581	0.413
Developmental Stage										
High Income	0.424	0.161	0.069	0.031	0.018	4.527	3.283	2.297	1.203	0.315
Low and Mid Income	0.459	0.169	0.074	0.040	0.027	6.714	4.839	3.343	1.745	0.456
Mann-Whitney test	1.86	1.42	2.03	2.78	3.52	3.29	3.57	3.67	3.92	4.34
t test	2.58	2.52	2.76	2.89	5.32	7.90	8.72	8.89	9.38	9.78
Area										
Africa	0.434	0.171	0.070	0.033	0.023	5.566	4.141	2.912	1.540	0.410
t test	1.71	1.96	1.13	1.41	1.27	1.01	1.73	1.55	1.40	1.12
Mann-Whitney test	1.45	1.87	1.45	1.10	1.07	1.18	1.07	1.27	1.49	1.74
Latin America	0.462	0.167	0.073	0.037	0.023	6.704	4.802	3.320	1.717	0.444
t test	1.50	1.25	1.18	1.17	1.13	1.96	1.90	1.92	1.78	1.70
Mann-Whitney test	1.85	1.45	1.60	1.45	1.65	1.83	1.98	1.91	1.89	1.69
East Asia	0.558	0.194	0.078	0.049	0.030	8.162	5.880	4.057	2.086	0.535
t test	6.31	2.16	2.47	4.65	6.06	3.02	3.34	3.46	3.47	3.43
Mann-Whitney test	3.93	2.90	2.18	3.67	3.13	2.81	2.95	3.03	3.05	3.00
South Asia	0.508	0.158	0.070	0.025	0.026	7.125	5.135	3.360	1.808	0.461
t test	2.08	0.36	0.08	0.26	1.51	1.71	1.91	0.92	1.77	1.51
Mann-Whitney test	2.07	0.41	0.07	0.70	1.38	1.41	1.41	1.09	1.19	1.09
Middle East	0.419	0.163	0.068	0.035	0.018	5.922	4.232	2.942	1.539	0.404
t test	1.14	0.07	0.19	1.18	0.76	0.06	0.13	0.12	0.11	0.09
Mann-Whitney test	0.99	0.32	0.18	1.06	1.02	0.90	0.88	0.94	0.97	0.85
European Emerging Markets	0.456	0.138	0.058	0.030	0.015	8.564	5.915	4.056	2.091	0.541
t test	0.38	2.31	2.49	0.30	2.94	3.08	2.08	2.11	2.12	2.19
Mann-Whitney test	0.44	2.00	1.85	0.09	2.21	2.28	2.21	2.23	2.24	2.28
European Industrial Countries	0.407	0.159	0.065	0.031	0.018	4.657	3.327	2.318	1.212	0.319
t test	4.39	1.28	2.57	3.54	3.71	5.17	5.90	6.07	6.41	6.61
Mann-Whitney test	3.08	1.09	1.55	2.75	3.31	3.08	3.43	3.56	3.76	4.00
North America	0.440	0.201	0.068	0.025	0.017	3.708	2.853	2.040	1.079	0.282
t test	1.04	2.08	1.30	1.19	2.44	3.49	3.64	3.61	3.87	4.32
Mann-Whitney test	0.14	1.62	1.25	1.15	1.59	1.39	1.45	1.45	1.59	1.72
Oceania	0.471	0.208	0.085	0.033	0.019	4.049	3.127	2.226	1.172	0.302
t test	0.47	9.68	4.08	0.94	2.22	6.50	6.05	6.27	7.35	8.32
Mann-Whitney test	0.37	2.06	2.55	0.78	1.18	1.22	1.12	1.08	1.12	1.39

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Table 4. Sub-period Analysis

Panel A. 97:01-00:03   (Bullish)

	δ					$\mathcal{E}$ (%)				
	SS	SS+ HB(40%)	SS+ HB(60%)	SS+ HB(80%)	SS+ HB(95%)	SS	SS+ HB(40%)	SS+ HB(60%)	SS+ HB(80%)	SS+ HB(95%)
Mean	1.061	0.414	0.216	0.060	0.036	0.078	0.057	0.040	0.022	0.006
St. Dev.	0.213	0.127	0.109	0.033	0.027	0.043	0.028	0.019	0.010	0.002
Developmental Stage										
High-income	0.947	0.401	0.211	0.051	0.026	0.054	0.040	0.028	0.017	0.004
Mid and Low income	1.110	0.446	0.218	0.064	0.085	0.089	0.064	0.045	0.024	0.007
M-W test	3.234	1.851	0.854	0.902	2.392	3.066	3.438	3.787	3.811	4.989
t test	4.755	2.531	0.643	2.440	3.350	9.641	10.657	11.200	3.898	13.915
Area										
Africa	1.153	0.441	0.235	0.076	0.152	0.073	0.054	0.039	0.021	0.006
M-W test	1.594	0.856	1.091	1.577	1.225	0.034	0.151	0.352	0.587	0.789
t-test	1.687	0.767	0.815	1.798	2.029	0.610	0.533	0.358	0.331	0.367
Latin America	1.145	0.425	0.255	0.070	0.165	0.085	0.061	0.042	0.022	0.006
M-W test	1.311	0.308	0.170	0.509	0.971	0.571	0.648	0.617	0.401	0.308
t-test	1.324	0.218	0.678	0.758	1.468	0.569	0.604	0.326	0.272	0.253
East Asia	1.163	0.313	0.147	0.073	0.156	0.125	0.090	0.062	0.032	0.008
M-W test	1.781	2.840	3.048	2.102	1.957	3.449	3.578	3.562	3.385	3.289
t-test	2.830	3.993	6.722	5.822	2.402	3.641	4.011	4.023	3.712	3.551
South Asia	1.251	0.380	0.219	0.059	0.173	0.093	0.068	0.050	0.024	0.006
M-W test	1.503	0.606	0.170	0.218	0.848	1.260	1.357	1.454	1.139	1.018
t-test	1.806	0.867	0.077	0.132	1.430	1.145	1.238	1.401	0.912	0.892
Middle East	1.033	0.478	0.251	0.075	0.015	0.065	0.047	0.034	0.019	0.006
M-W test	0.300	1.536	1.395	1.448	0.159	1.466	1.395	1.307	1.236	0.424
t-test	0.356	1.208	1.097	1.412	0.214	0.856	0.920	0.833	0.792	0.150
European Emerging Markets	1.033	0.333	0.165	0.045	0.025	0.110	0.077	0.054	0.028	0.008
M-W test	0.406	1.960	1.801	1.766	0.759	2.119	2.119	2.119	1.978	2.031
t-test	0.416	2.133	2.317	2.286	0.708	1.996	1.966	2.012	1.914	2.029
DC-Europe	0.915	0.423	0.203	0.044	0.128	0.054	0.039	0.028	0.017	0.004
M-W test	4.040	0.107	0.427	2.387	2.507	3.214	3.747	4.080	3.867	5.000
t-test	5.688	0.599	1.518	3.190	4.134	6.771	7.938	8.465	2.563	10.498
DC-North America	0.880	0.529	0.253	0.065	0.020	0.051	0.039	0.028	0.015	0.004
M-W test	1.318	1.453	1.048	0.574	0.473	1.014	0.946	0.946	1.149	1.149
t-test	1.818	1.669	0.808	0.368	1.061	3.262	3.398	3.139	3.688	6.764
Oceania	1.227	0.532	0.248	0.085	0.224	0.055	0.042	0.030	0.016	0.004
M-W test	1.217	1.521	1.149	1.554	1.081	0.642	0.541	0.642	0.946	1.386
t-test	1.028	1.019	1.553	1.246	1.016	0.688	1.403	1.673	1.071	2.296

Panel B. 00:01-03:04   (Bearish)

	δ					ε (%)				
	SS	SS+ HB(40%)	SS+ HB(60%)	SS+ HB(80%)	SS+ HB(95%)	SS	SS+ HB(40%)	SS+ HB(60%)	SS+ HB(80%)	SS+ HB(95%)
Mean	0.623	0.293	0.164	0.058	0.024	0.066	0.047	0.032	0.017	0.004
St. Dev.	0.171	0.094	0.069	0.072	0.011	0.029	0.021	0.012	0.006	0.001
Developmental Stage										
High-income	0.597	0.292	0.163	0.052	0.022	0.063	0.044	0.030	0.016	0.004
Mid and Low income	0.682	0.295	0.167	0.061	0.025	0.067	0.049	0.033	0.017	0.005
M-W test	2.092	0.721	1.046	1.443	0.156	0.252	0.505	0.625	0.649	1.142
t test	3.510	0.353	0.473	2.701	0.399	1.275	2.139	1.860	2.000	2.507
Area										
Africa	0.556	0.291	0.162	0.050	0.027	0.054	0.040	0.028	0.015	0.004
M-W test	1.544	0.235	0.050	0.268	1.594	1.393	1.359	1.326	1.191	1.091
t-test	1.600	0.020	0.106	0.152	1.238	2.569	2.686	2.190	1.934	1.682
Latin America	0.631	0.322	0.190	0.063	0.026	0.071	0.050	0.035	0.019	0.005
M-W test	0.509	0.586	0.694	0.771	0.154	0.385	0.432	0.555	0.786	0.941
t-test	0.155	0.632	0.722	0.306	0.650	0.453	0.393	0.674	0.956	1.139
East Asia	0.717	0.295	0.163	0.049	0.017	0.077	0.053	0.037	0.019	0.005
M-W test	2.070	0.369	0.257	0.160	2.631	1.701	1.636	1.717	1.909	1.781
t-test	2.866	0.115	0.060	1.819	5.596	1.939	1.579	1.831	1.949	1.707
South Asia	0.542	0.280	0.152	0.042	0.022	0.067	0.047	0.033	0.018	0.005
M-W test	1.188	0.121	0.242	0.485	0.024	0.218	0.339	0.364	0.533	0.703
t-test	1.096	0.342	0.510	2.112	0.354	0.051	0.023	0.179	0.315	0.384
Middle East	0.622	0.311	0.168	0.121	0.028	0.066	0.046	0.032	0.015	0.004
M-W test	0.583	1.007	0.795	0.936	1.289	1.183	1.218	1.271	2.013	1.536
t-test	0.079	0.406	0.129	0.991	1.018	0.036	0.146	0.125	0.442	0.234
European Emerging Markets	0.614	0.254	0.139	0.041	0.020	0.089	0.069	0.042	0.021	0.006
M-W test	0.106	1.007	1.113	1.466	1.642	1.466	1.519	1.501	1.519	1.377
t-test	0.084	1.383	1.377	1.930	1.005	1.421	1.553	1.423	1.441	1.364
DC-Europe	0.681	0.289	0.163	0.051	0.021	0.065	0.046	0.031	0.016	0.004
M-W test	1.493	0.213	0.160	0.427	0.253	0.107	0.333	0.480	0.600	1.027
t-test	2.991	0.421	0.140	2.509	2.278	0.214	0.856	0.687	0.854	1.240
DC-North America	0.692	0.334	0.188	0.061	0.025	0.052	0.038	0.027	0.014	0.004
M-W test	0.642	1.014	0.879	1.183	0.845	0.879	0.845	0.879	0.777	0.980
t-test	1.132	1.134	0.738	0.292	0.942	3.180	3.681	3.472	2.994	3.232
Oceania	0.560	0.256	0.139	0.043	0.025	0.054	0.038	0.026	0.014	0.004
M-W test	0.946	0.743	0.608	0.270	0.946	0.811	0.946	0.912	0.845	0.946
t-test	1.233	1.556	1.280	1.285	1.372	1.383	1.651	1.522	1.523	0.990

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Panel C. 03:02-07:07   (Bullish)

	δ					ε (%)				
	SS	SS+ HB(40%)	SS+ HB(60%)	SS+ HB(80%)	SS+ HB(95%)	SS	SS+ HB(40%)	SS+ HB(60%)	SS+ HB(80%)	SS+ HB(95%)
Mean	1.499	0.609	0.347	0.140	0.013	0.047	0.034	0.024	0.013	0.003
St. Dev.	0.150	0.164	0.109	0.060	0.032	0.020	0.013	0.009	0.009	0.001
Developmental Stage										
High-income	1.431	0.608	0.345	0.134	0.008	0.034	0.025	0.018	0.009	0.002
Mid and Low income	1.529	0.609	0.351	0.154	0.018	0.053	0.039	0.027	0.015	0.003
M-W test	2.452	0.757	0.998	1.875	2.044	3.883	4.160	4.304	4.484	3.559
t test	4.002	0.052	0.316	1.875	2.420	9.874	10.400	10.778	13.724	6.158
Area										
Africa	1.514	0.619	0.354	0.133	0.010	0.050	0.037	0.026	0.014	0.003
M-W test	0.772	0.470	0.520	0.151	0.218	0.873	0.990	0.990	1.258	0.973
t-test	0.575	0.202	0.215	0.673	0.739	1.133	1.440	1.620	0.440	0.920
Latin America	1.500	0.616	0.343	0.138	0.002	0.056	0.040	0.028	0.015	0.004
M-W test	0.031	0.848	0.971	0.833	0.262	1.295	1.527	1.665	1.712	1.635
t-test	0.004	0.099	0.099	0.072	0.571	1.359	1.467	1.566	1.050	1.361
East Asia	1.534	0.621	0.345	0.122	0.028	0.045	0.033	0.023	0.012	0.003
M-W test	1.027	0.754	0.369	0.786	2.695	0.257	0.128	0.016	0.064	0.898
t-test	1.016	0.389	0.103	1.450	3.862	0.784	0.656	0.476	0.919	0.868
South Asia	1.619	0.542	0.312	0.124	0.006	0.064	0.046	0.032	0.016	0.004
M-W test	1.430	1.018	0.630	0.339	0.339	2.230	2.182	2.182	2.060	1.382
t-test	1.695	1.747	1.333	0.936	0.550	7.434	5.569	5.053	3.148	1.204
Middle East	1.527	0.589	0.345	0.143	0.005	0.057	0.040	0.028	0.014	0.003
M-W test	0.459	0.159	0.371	0.247	0.035	0.759	0.777	0.671	0.706	0.477
t-test	0.701	0.470	0.172	0.047	0.235	1.040	1.007	0.978	0.495	0.126
European Emerging Markets	1.502	0.485	0.265	0.097	0.012	0.063	0.044	0.030	0.015	0.003
M-W test	0.000	2.561	2.649	2.402	1.024	2.013	1.731	1.572	1.289	0.230
t-test	0.024	3.370	3.372	2.848	1.285	1.784	1.690	1.605	0.967	0.063
DC-Europe	1.415	0.591	0.342	0.151	0.014	0.035	0.026	0.018	0.010	0.002
M-W test	3.227	0.307	0.053	1.160	1.853	3.347	3.587	3.734	3.934	3.307
t-test	4.041	1.277	0.468	1.408	2.789	6.697	7.226	7.509	9.561	4.135
DC-North America	1.466	0.717	0.412	0.186	0.001	0.024	0.019	0.014	0.008	0.003
M-W test	0.135	0.980	0.743	0.608	0.135	1.791	1.757	1.723	1.622	0.034
t-test	0.528	0.757	0.583	0.562	0.106	3.213	3.176	3.241	3.736	1.155
Oceania	1.437	0.572	0.322	0.124	0.026	0.029	0.021	0.015	0.008	0.002
M-W test	0.507	0.203	0.169	0.338	1.014	1.588	1.859	1.926	1.892	2.061
t-test	0.539	0.926	0.518	0.402	0.958	1.716	1.951	1.707	2.144	3.490

Panel D. 07:05-09:12   (Bearish)

	δ					ε (%)				
	SS	SS+ HB(40%)	SS+ HB(60%)	SS+ HB(80%)	SS+ HB(95%)	SS	SS+ HB(40%)	SS+ HB(60%)	SS+ HB(80%)	SS+ HB(95%)
Mean	0.835	0.363	0.210	0.078	0.031	0.072	0.052	0.035	0.018	0.005
St. Dev.	0.190	0.110	0.076	0.081	0.013	0.033	0.025	0.013	0.007	0.002
Developmental Stage										
High-income	0.801	0.367	0.209	0.070	0.028	0.084	0.056	0.039	0.021	0.005
Mid and Low income	0.913	0.361	0.214	0.082	0.033	0.090	0.060	0.042	0.023	0.006
M-W test	2.322	0.801	1.161	1.601	0.203	0.280	0.560	0.694	0.721	1.268
t test	3.896	0.391	0.525	2.998	0.519	1.415	2.375	2.065	2.220	2.782
Area										
Africa	0.746	0.361	0.207	0.067	0.035	0.055	0.040	0.029	0.015	0.004
M-W test	1.713	0.274	0.056	0.303	1.833	1.546	1.509	1.471	1.322	1.211
t-test	1.776	0.022	0.125	0.169	1.388	2.852	3.062	2.584	2.151	1.885
Latin America	0.846	0.399	0.244	0.085	0.034	0.076	0.053	0.038	0.020	0.005
M-W test	0.565	0.684	0.770	0.871	0.177	0.428	0.504	0.616	0.889	1.082
t-test	0.172	0.721	0.852	0.340	0.728	0.502	0.448	0.795	1.063	1.277
East Asia	0.960	0.365	0.209	0.066	0.022	0.088	0.060	0.041	0.021	0.005
M-W test	2.297	0.431	0.285	0.181	3.026	1.888	1.910	1.906	2.157	2.048
t-test	3.182	0.131	0.071	2.022	6.273	2.152	1.800	2.160	2.168	1.914
South Asia	0.727	0.347	0.194	0.056	0.029	0.068	0.048	0.034	0.018	0.005
M-W test	1.318	0.141	0.269	0.548	0.028	0.242	0.396	0.404	0.603	0.808
t-test	1.217	0.390	0.601	2.349	0.396	0.056	0.026	0.212	0.350	0.430
Middle East	0.833	0.386	0.215	0.162	0.036	0.069	0.048	0.033	0.016	0.005
M-W test	0.647	1.175	0.882	1.058	1.482	1.313	1.353	1.411	2.235	1.705
t-test	0.088	0.463	0.153	1.102	1.141	0.040	0.167	0.147	0.492	0.263
European Emerging Markets	0.822	0.315	0.178	0.056	0.026	0.098	0.077	0.045	0.024	0.006
M-W test	0.118	1.175	1.235	1.656	1.889	1.627	1.772	1.666	1.716	1.584
t-test	0.094	1.576	1.625	2.146	1.126	1.577	1.771	1.679	1.603	1.529
DC-Europe	0.912	0.358	0.209	0.068	0.027	0.076	0.052	0.036	0.018	0.005
M-W test	1.658	0.249	0.178	0.482	0.291	0.118	0.370	0.533	0.666	1.140
t-test	3.320	0.480	0.166	2.790	2.553	0.238	0.976	0.811	0.950	1.390
DC-North America	0.927	0.415	0.241	0.082	0.032	0.062	0.045	0.031	0.016	0.004
M-W test	0.713	1.183	0.975	1.337	0.972	0.975	0.938	0.975	0.863	1.088
t-test	1.256	1.293	0.871	0.325	1.056	3.529	4.196	4.097	3.329	3.623
Oceania	0.751	0.317	0.179	0.058	0.033	0.062	0.044	0.030	0.016	0.004
M-W test	1.050	0.868	0.675	0.305	1.088	0.900	1.050	1.013	0.938	1.050
t-test	2.588	2.054	1.871	1.652	1.659	1.085	1.002	1.595	0.374	0.160

Table 5. Intertemporal Analysis

Panel A shows the summary of the over-time benefits of mean-variance efficiency, δ, and risk reduction, ε, as generated by international diversification without short-sale in bullish and bearish periods. Panel B reports the percentages that difference of diversification benefits between high-income countries and mid/low income countries are statistically significant. The parametric truncated t-test and non-parametric Mann-Whitney (M-W) test of difference of diversification benefits are applied. Finally, the mean and the standard deviation of the benefits of international diversification with short-sale constraints in high-income and mid/low-income countries are also reported.

Panel A. Over-time Summary

			Prob. (significantly higher benefit)	
	Mean	SD	M-W test	t-test
δ				
High-income countries	0.510	0.238	14.65%	13.79%
Mid/ Low income countries	0.530	0.241	41.86%	41.28%
ε				
High-income countries	1.74%	1.03%	0.00%	0.00%
Mid/ Low income countries	6.33%	6.78%	100.00%	94.67%

Period	δ		ε	
	High-income	Mid / Low income	High-income	Mid / Low income
Bullish				
93:01-00:03	0.559	0.597	0.019	0.101
03:02-07:07	0.587	0.534	0.015	0.038
Bearish				
00:01-03:04	0.384	0.433	0.018	0.057
07:05-09:12	0.307	0.368	0.014	0.046

Panel B. The Percentages

	δ		ε	
Period/Statistics	M-W test	Truncated t-Test	M-W test	Truncated t-Test
93:01-00:03 (bullish)				
Prob (EMs benefit more significantly)	48.28%	49.43%	100.00%	100.00%
Prob (CDs benefit more significantly)	2.30%	5.63%	0.00%	0.00%
03:02-07:07 (bullish)				
Prob (EMs benefit more significantly)	0.00%	0.00%	100.00%	92.16%
Prob (CDs benefit more significantly)	11.76%	11.67%	0.00%	0.00%
Bearish				
00:01-03:04 (bearish)				
Prob (EMs benefit more significantly)	82.50%	77.50%	100.00%	100.00%
Prob (CDs benefit more significantly)	0.00%	0.00%	0.00%	0.00%
07:05-09:12 (bearish)				
Prob (EMs benefit more significantly)	22.30%	18.90%	100.00%	100.00%
Prob (CDs benefit more significantly)	16.00%	17.20%	0.00%	0.00%

Figure 1. Sharpe Ratio Curves

This graph demonstrates the Sharpe ratio curves under a certain percentage of home-biased (HB) investments as well as the U.S. domestic portfolio for the period of January 1997 to November 2010.
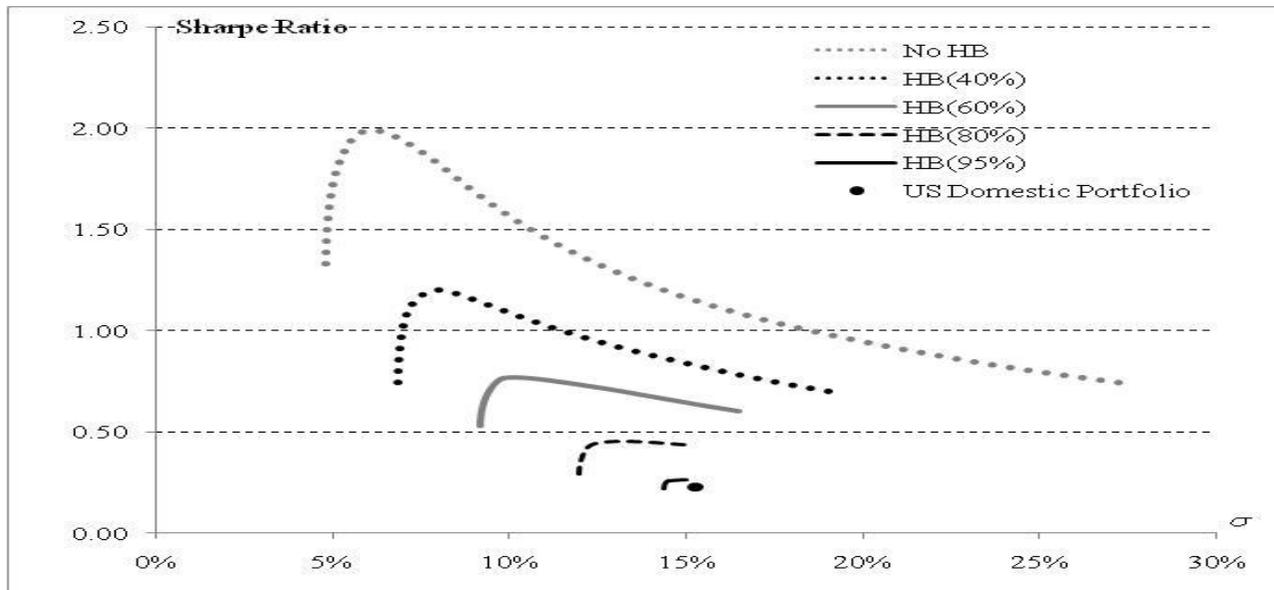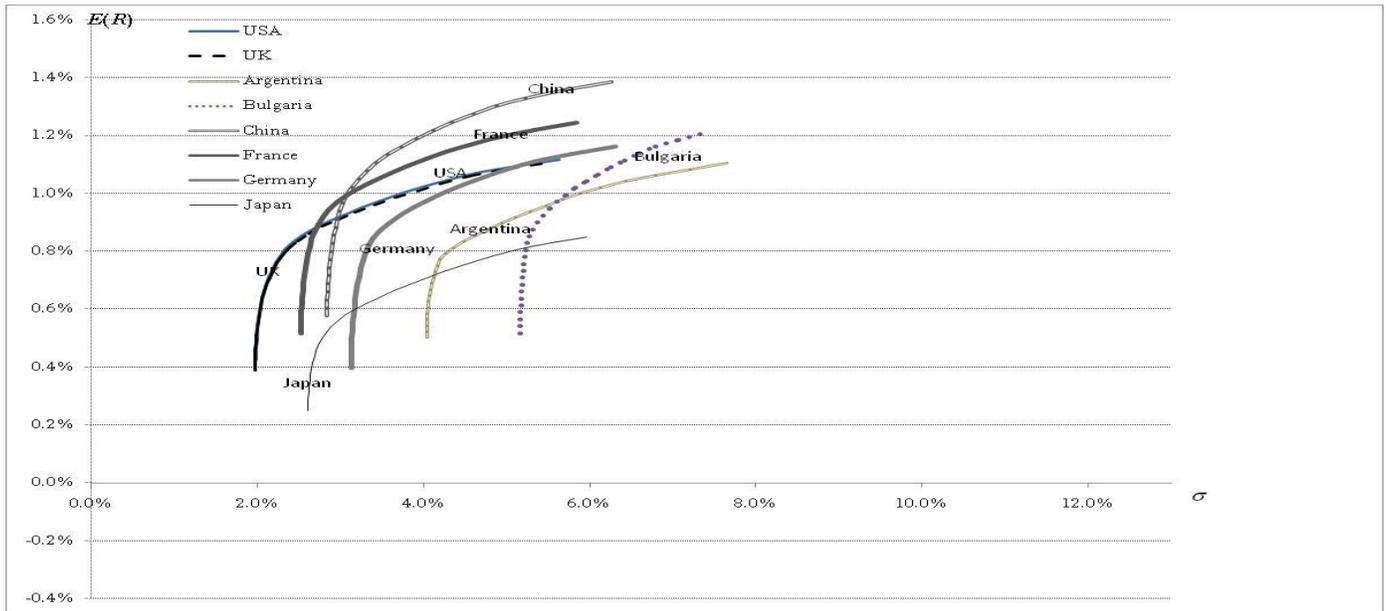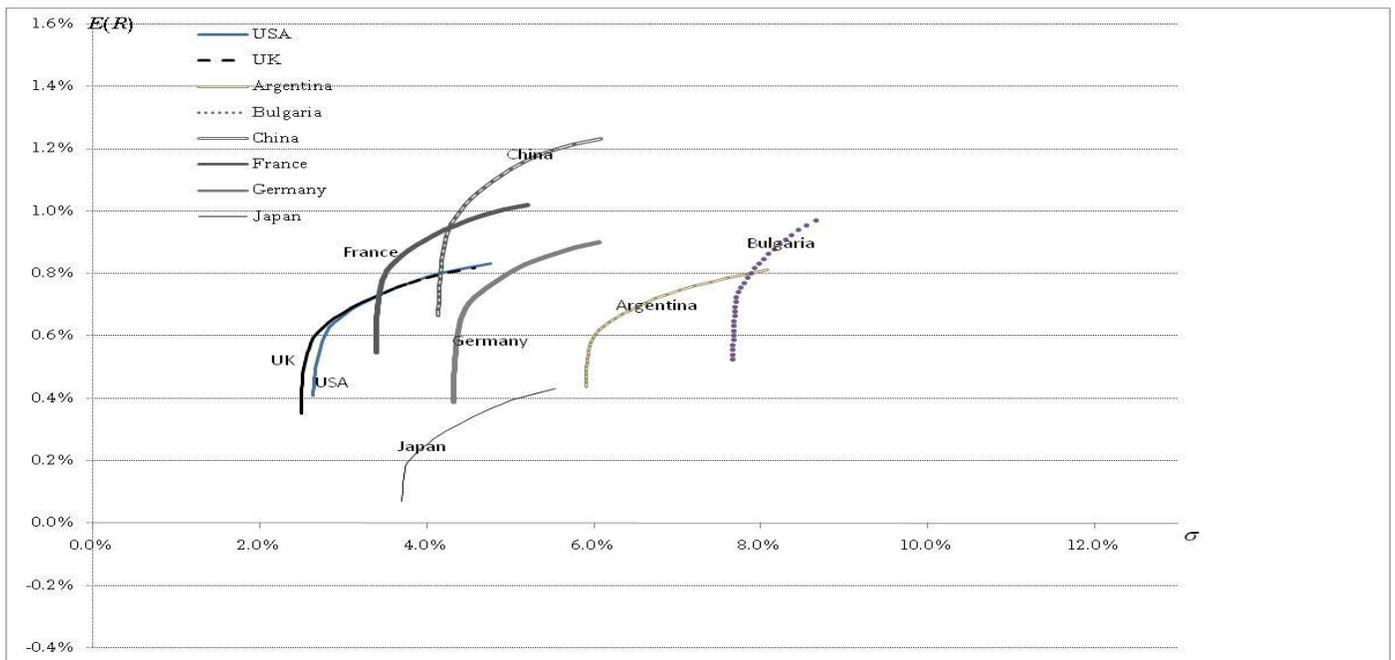
Figure 2. Efficient Frontiers with Home-biased Investments

Figure 2 presents the efficient frontiers with short-selling constraints and various levels of home-biased investments in selected countries.
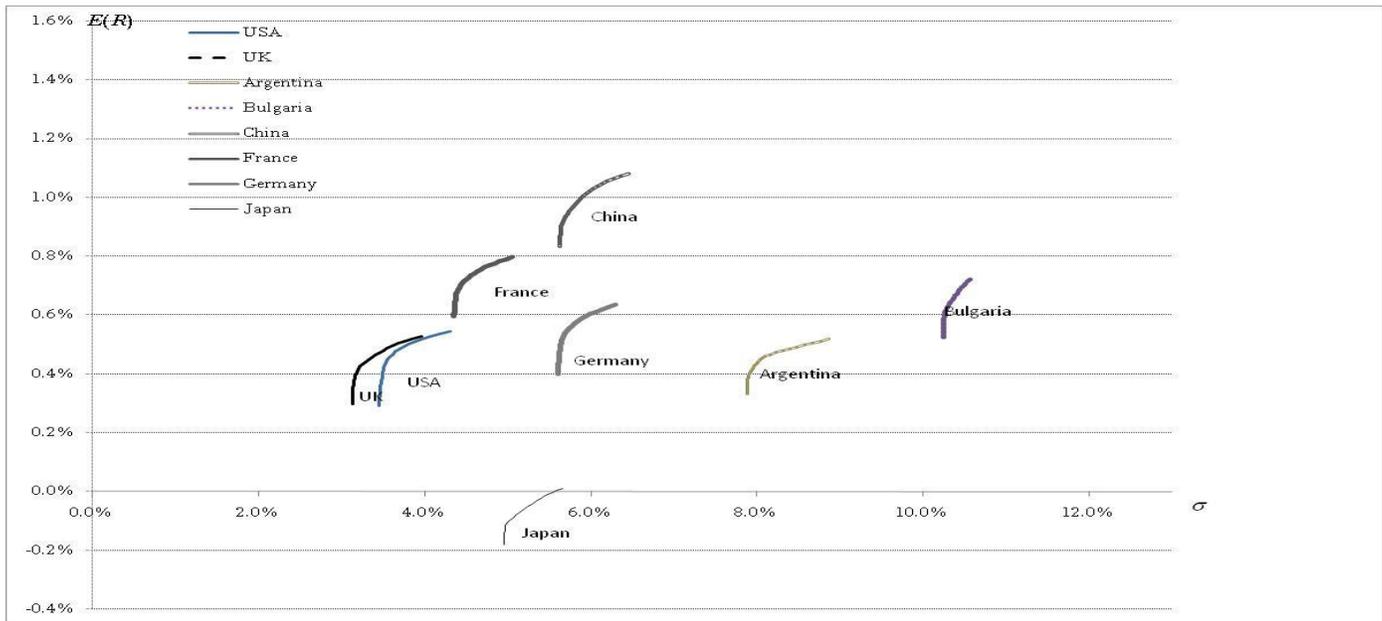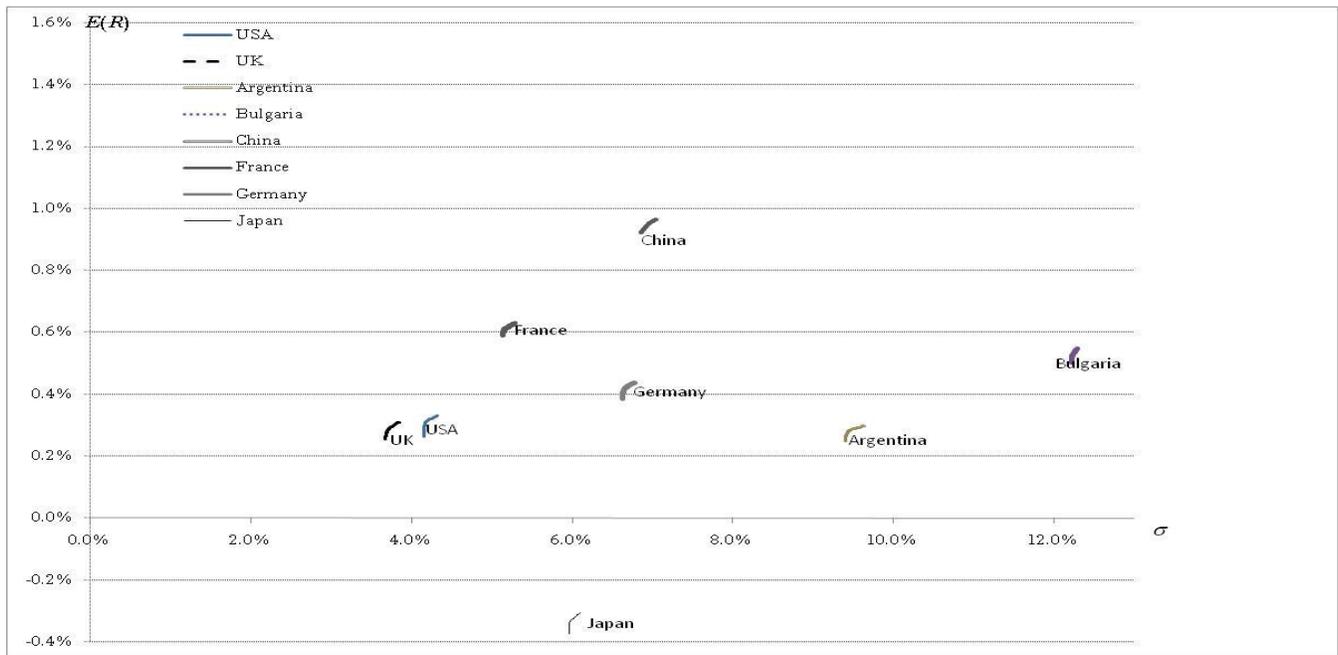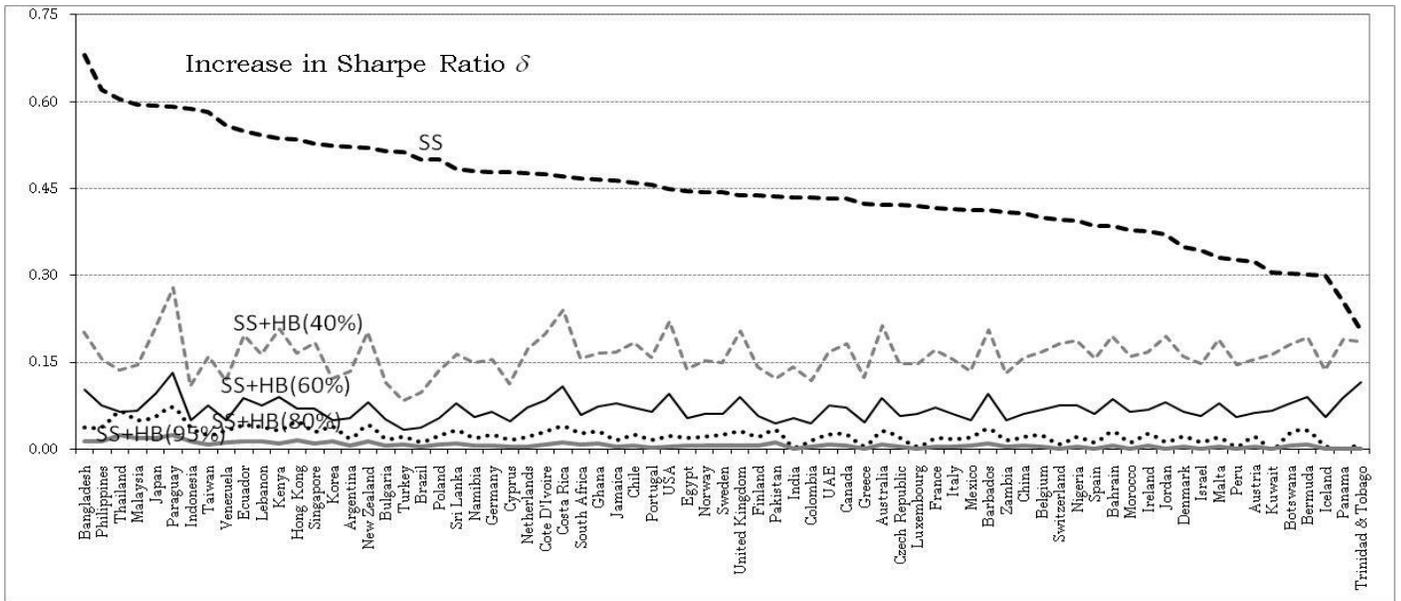
A. SS+HB(40%)

B. SS+HB(60%)

C. SS+HB(80%)

D.   SS+HB(95%)

Figure 3. Benefits of International Diversification

A. Sharpe Ratio Benefits

B. Reduction in Risk Benefits
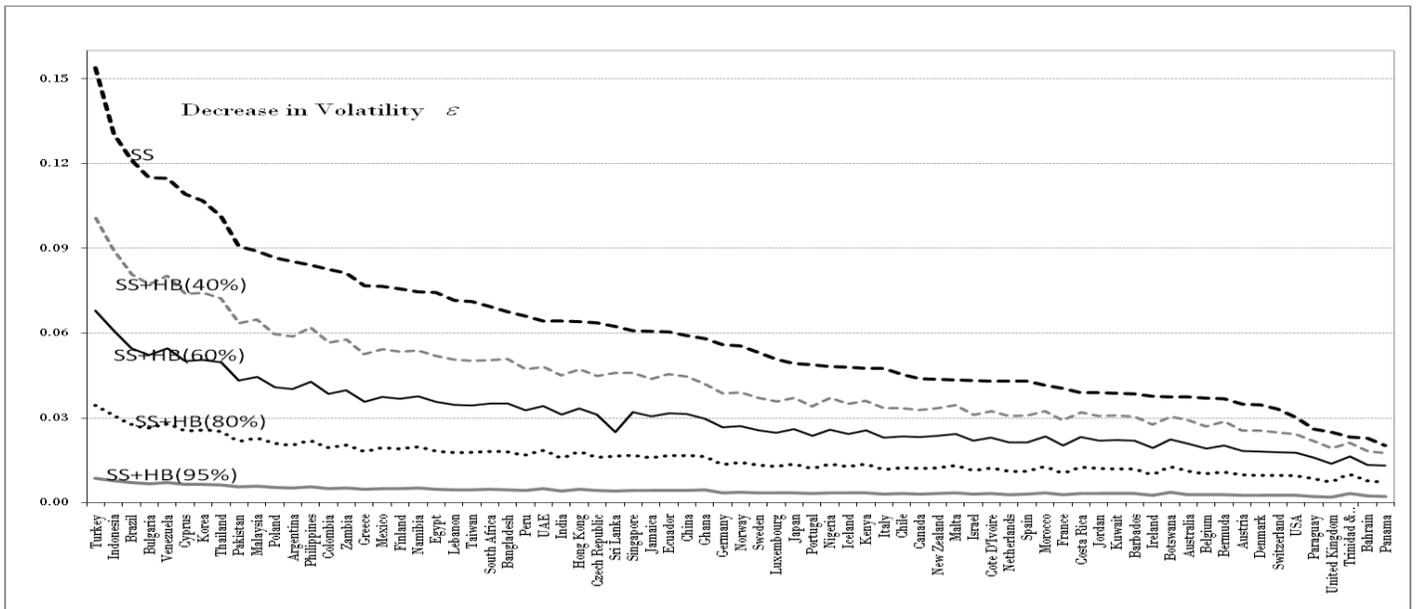
Figure 4. Time-Variation in the Sharpe Ratio Benefits of International Diversification

Panel A shows the range, the mean, and the first and third quartiles of the Sharpe ratio benefits of short-sales constrained (SS) international diversification. In Panel B presents the benefits for investors in high-income countries and in mid- and low- income countries over the sample period.
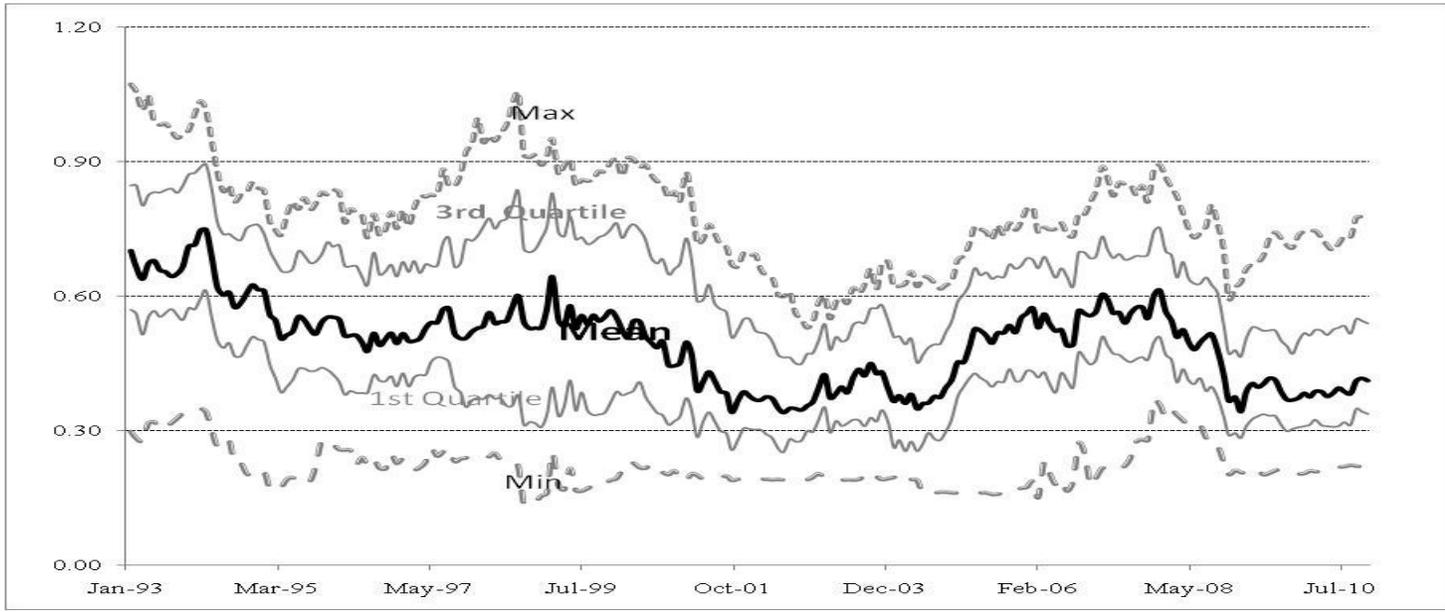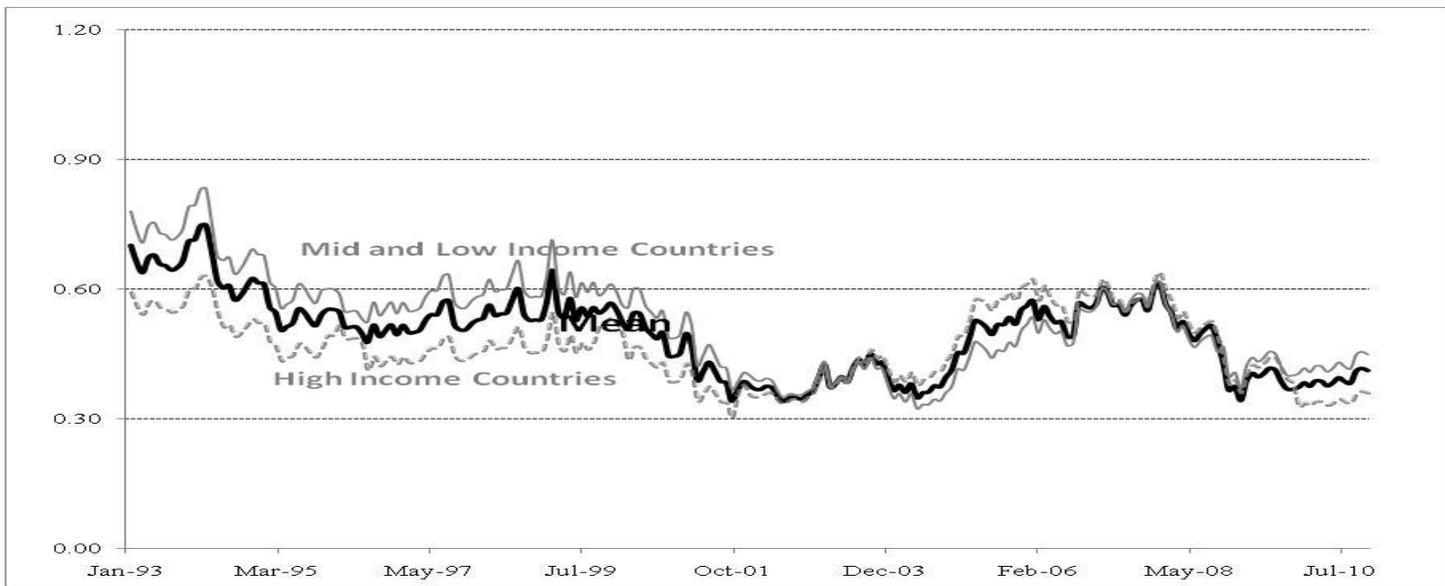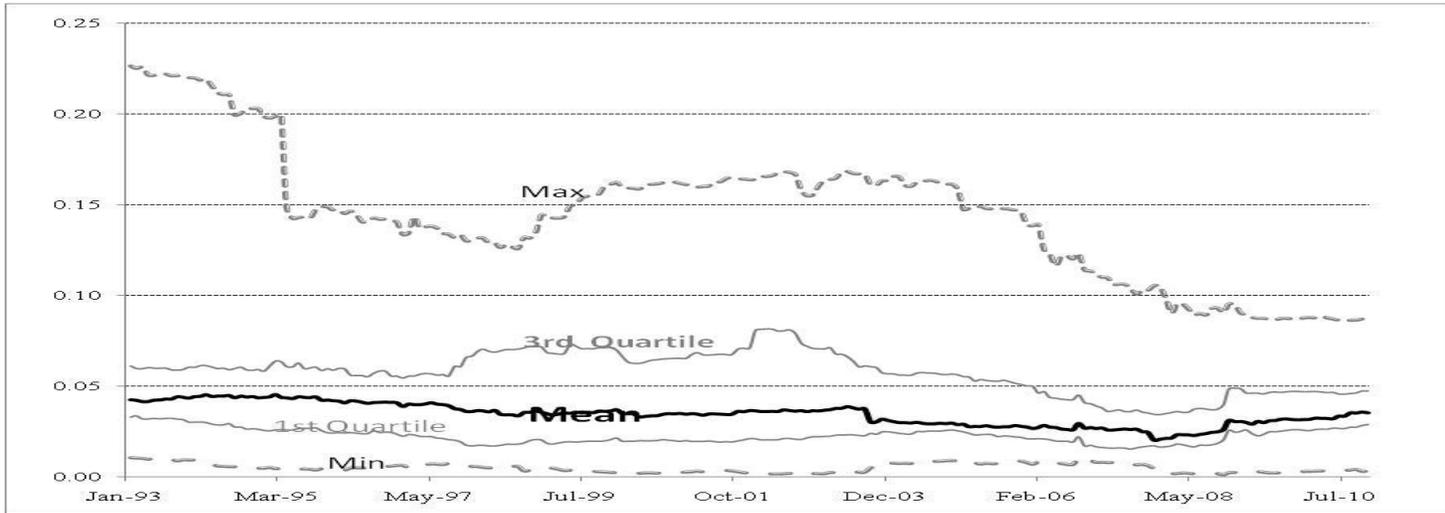
Panel A.

Panel B.

Figure 5. Time-Variation in the Reduction of Volatility Due to International Diversification

Panel A shows the range, the mean, and the first and third quartiles of the volatility reduction benefits of short-sales constrained (SS) international diversification. Panel B presents the benefits for investors in high-income countries and mid- and low-income countries over the sample period.

Panel A.

Panel B.