Changes in the Structure of the Currency Futures Markets:

Who Trades and Where They Trade

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February 27, 2005

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Abstract

Changes in the structure of markets can have significant effects on how these markets operate. We examine how electronic trading, spreads, and different types of traders affect the operation of the currency futures markets. The movement toward electronic trading has created important changes, including who trades in these markets and the effect on the volatility-volume relationship. Each of these factors is examined from 1998 to 2002 to determine the importance of market structure on trading behavior.

I. Introduction

The field of market microstructure covers such diverse topics as the factors affecting the bid-ask spread to the investigation of volume relationships to how electronic markets impact trading decisions. Here we examine five issues in the market microstructure field, namely the impact of electronic trading on currency futures markets, the importance of spread trading in these markets, the effect of electronic and spread trading on the volume-volatility relation, who trades in these markets, and the change in these factors over time.

The new exchanges that have started trading since the early 1990s have almost exclusively been electronic markets. Electronic markets have overwhelming cost advantages, as well as fast access to traders and transparency benefits. The defining story for electronic markets for futures exchanges was the domination of the German bund futures by the electronic Eurex exchange starting in 1998, after Eurex extended their trading hours, and the subsequent closing of LIFFE's pit traded bund contract before the end of 1998. This rapid "destruction" of a very successful pit traded contract caused considerable anxiety within the Chicago futures exchanges, with "side-by-side" electronic and pit trading starting by late 1998 (Project A at the Chicago Board of Trade and Globex at the Chicago Mercantile Exchange). We examine how the introduction of electronic markets for currency futures have impacted this market.

Other issues are particularly important to the currency futures markets. Spreads between expiration months and between different futures are popular for currency futures, but the importance of spreads has received little attention. Spreads, in combination with electronic volume, could have an adverse effect on the volume-volatility relation, a popular research topic in the literature. Another related issue is what groups trade in currency futures and how does electronic trading impact on the trading behavior of these groups. In particular, changes in the trading pattern of the different types of traders, perhaps due to electronic trading, can significantly affect how these

markets operate. Finally, are there trends in these factors over time? Each of these issues are examined here.

We find that electronic trading contributed less than 20% of the speculative and hedging volume over the five year period of this study (1998-2002), but that electronic trading came to dominate the major currencies by the last year of the study. Spread trading is a major type of trading for most currency futures contracts, ranging from 35% to 43% of total volume for the major currencies. Both electronic and spread trading do have a different relation to volatility than does pit trading. Hence a volume-volatility study needs to consider the source of the volume being analyzed. Examining four types of traders (dealers, commercials, traders making trades for other pit traders, and the general public) finds that the general public dominates currency futures trading, and that dealers are almost non-existent in the electronic market, implying that the structure of trading in the currency futures market is significantly affected by the move towards electronic trading.

The remainder of this paper has the following organization: Part II discusses the issues related to this paper. Part III explains the data employed and how the volatility measures are calculated. Part IV discusses the relationships found in the results, and Part V provides observations concerning the results and the paper's conclusions.

II. Issues Relating to Electronic Trading and the Type of Trader

Electronic markets are an important issue for the structure of financial markets. They operate without a trading floor and often without much dealer interaction (if there is sufficient liquidity). An electronic market can be 1/30 the cost of a physical floor arrangement, and provides instant information on trade execution and (depending on the exchange) information on order transparency. For futures, and particularly options, electronic exchanges are beneficial for smaller

trades but larger orders need the expertise found with dealers on the floor. Similarly, floor dealers develop trading techniques that are linked to open pit activity and such traders often are not interested in participating in electronic trading. In particular, floor traders gauge potential supply and demand by both non-verbal and verbal (unintentional) "signals" of other traders. Volatility, short-term market direction, and the associated bid-ask spread, are easier to determine with the visual and auditory clues of pit trading. In fact, Coval and Shumway (2001) find that the noise level in the pits is directly related to market volatility. Daigler and Wiley (1999) associate trading advantages with proximity to the trading floor, finding that commercial traders on the floor often *reduce* volatility while the off-the-floor general public are strongly associated with greater volatility in the market. Ito, Lyons, and Melvin (1998) find evidence that some traders in foreign exchange possess semi-private fundamental information that they use to their benefit. Because of these advantages, the dealers on the floor (the scalpers), who own the exchange, traditionally were reticent to move to an electronic trading environment. Here we examine trader activity in electronic versus floor trading in terms of the volume of contracts traded and how electronic trading for currency futures has changed over time.

Spread trading consists of calendar trades where one buys one expiation month and sells another, and cross-spreading is where one buys one futures contract and sells another. Both are prevalent in currency futures. The risk in calendar spreads is limited to the variation in the basis between the expiration months, and hence the variation margin is substantially less compared to speculative margins. Cross-spreading using U.S. currency futures is undertaken to take a position in the currency trade of two countries that do have a direct liquid futures contract; the cross-trade with the U.S. dollar provides the equivalent currency hedge or speculation, with the cost of two bid-ask spreads and two commissions. Daigler (2005) shows that calendar spreads have a pronounced seasonal component but cross-spreads do not.

The volume-volatility relation is an important area of market structure research that has received a lot of attention in the past few years. Studies by Bessembinder and Seguin (1992,1993) on futures markets set the stage for later research. They find a significant relationship between volume and volatility, including an asymmetric component. Daigler and Wiley (1999) followed with type of trader volume to show that the general public is the cause of market volatility and that unexpected volume was more important than expected volume in the volume-volatility relation. The strength of the relationship varies substantially from one study to another. Potential issues affecting this strength include the measure of volatility used and the best method to measure volume. Daigler and Wiley show that the Garman-Klass volatility measure is superior to daily close-to-close measures. A volume measure that was restricted to "informed" volume would have the best association with price volatility. However, total futures volume includes spread volume and electronic exchange volume. Spreads are initiated for a different reason than speculative or hedging trades, and hence may not have as strong a relationship to volatility. Electronic trading occurs overnight (in the U.S.), as well as "side-by-side" with the pits during day trading hours, which means that typical measures of volatility will not include this overnight price effect but volume measures will include the electronic trading activity. Here we examine the effect of different types of volume on the volume-volatility relation, as well as investigating the effect of the type of trader on this relation.

III. Data and Volatility

Several new data sets were employed to generate the results in this study. The first data set is from The Commodity Research Bureau (CRB). The CRB data provides daily total volume for each futures contract and open/high/low/close prices. This total volume is the official exchange volume, which also appears in the Wall Street Journal. The OHLC data is used to generate the

Garman-Klass measure of volatility. The Garman-Klass variance is calculated as follows:

$$GK(v_t) = (u - d)^2 - [2LN2 - 1]\, c^2 \quad (1)$$

where u = the difference in the natural logarithms of the high and opening prices

d = the difference in the natural logarithms of the low and opening prices, and

c = the difference in the natural logarithms of the closing and opening prices.

The volatility is the square root of (1). Garman and Klass show that their popular range-based volatility measure is eight times more efficient than the daily squared return. The Garman-Klass estimator is biased when the number of transactions per day is less than 1000. Hence, the Garman-Klass volatility measure is adjusted for low liquidity, as given in Garman and Klass (undated), Table I.

The Chicago Mercantile Exchange (CME) provides a time and sales dataset which is employed to generate five-minute volatility values. Following Andersen, Bollerslev, Diebold and Labys (2003), we construct the five-minute realized variance series by accumulating the squared intraday five-minute returns, which are the logarithmic differences between the prices recorded at or immediately before the corresponding five-minute time stamps. The square root of this variance is the five-minute volatility.[1]

The CME also provides the "Volume by Type of Trader" dataset, which gives the volume by several types of categories. First, it separates the volume into pit, electronic (Globex), and spread trades. Second, it divides volume into four trader types, as described below:

[1] The selection of the sampling interval is a tradeoff between the cost of market microstructure biases and the desirability of approximate continuous-time models. We examine 15-minute, 30-minute, and 60-minute volatilities, but employ the five-minute measure because, theoretically, as the observation frequency increases the volatility converges to a genuine measurement of the latent volatility. Although Andersen, Bollerslev, Diebold and Ebens (2001) suggest to use the MA (1) to remove the negative serial correlation induced by the uneven spacing of the observed prices and the inherent bid-ask spread, we use the "raw" volatility series, consistent with Thomkas and Wang's (2003) evidence that the performance of the adjusted five-minute volatility is equivalent to the data adjusted with the MA(1) method.

CTI1: Volume for local marketmakers (scalpers) own accounts. A scalper provides short-term liquidity to the market by acting as a dealer.

CTI2: Volume for institutional clearing members house accounts (institutional or commercial traders). CTI2 consists of institutions trading for their own accounts; such trading can be based on hedging needs or speculative reasons.

CTI3: Volume for floor traders executing trades for other floor traders not in the pit.

CTI4: Volume for any other type of customer, called the general public.

The volatility, total volume, and CTI volume data are daily for 1998 through 2002.

IV. Relationships

This section examines the relationships that exist regarding volume traded in different venues and/or for different purposes, how these relationships changed over time, who trades in these markets, and the relationship between volatility and these volumes, all for the currency futures markets traded on the CME. Currency futures are perfect markets to examine these various relations, since there is trading over the entire 24 hour day, strategies such as spreads are important in these markets, currency futures are important for various types of traders, changes have occurred rapidly in similar markets, and some contracts have limited liquidity and market interest.

Table 1 provides our first insights to these markets. The second column shows the average daily volume from the CRB database per futures contract, while the remaining columns show the extent that the volume is broken into pit, electronic, and spread trading. Overall, for this time period, pit trading dominated electronic trading, implying that electronic trading is not a key force for currency futures; *however*, we need to examine the trend of electronic trading over time to completely understand the importance of electronic trading. More importantly, the volume of

spread trading for many of the currencies was approximately the same size as speculative plus hedging pit volume, except for the Mexican peso and Canadian dollar. The surprising size of spread trading illustrates a potential problem for volume-volatility studies, as well as other studies needing speculative and hedging volume for analysis, namely that using total futures volume includes a substantial amount of noise from non-price oriented spread trading. Hence, researchers need to separate volume into its components to appropriately analyze volume relationships.

TABLE 1

The trends over time are examined in Table 2. No apparent trend in total or spread volume exists over this time period, except for the increase in the euro's total volume in 2000 and 2001. However, there is a definite trend in the relationship between pit and electronic trading. Pit trading has noticeably declined, such that electronic trading became noticeably greater for the key currencies of the British pound, euro currency, and Japanese yen. Only the Mexican peso had substantially less electronic trading than pit trading. Obviously, a change in market structure from pit trading to electronic trading occurred in 2001 and 2002, with electronic trading becoming more dominant in 2002. This change in structure is consistent with the beginning of "side-by-side" electronic and pit trading in April of 2001 at the CME. Gradually traders started to use the electronic trading venue to execute trades, apparently believing that such a market provides advantages over pit trading, such as cheaper trading costs and more transparency, at least for smaller size lots. Such a radical change also is consistent with the significant interest in electronic e-mini contracts for stock index futures. However, changes in market structure create potential difficulties as well as opportunities. Namely, can scalpers (floor dealers) adapt to the change in trading venue? We shall explore this issue shortly.

TABLE 2

Another issue regarding trading volume is how the relationship between volume and volatility is affected by spread and electronic trading. Table 3 provides insight to this issue by examining the correlations between two measures of volatility and total, pit, electronic, and spread trading. The first two columns of results in Table 3 show the average daily volatility of the five-minute and Garman-Klass volatility measures. Although calculated in different ways, the two measures give very similar values for the average volatilities. Note that the less liquid Mexican peso and Australian dollar are also the most volatile when the five-minute volatility measure is employed. The correlations between the volatility measures and total and pit volume support the extensive research that a significant relationship exists. However, pit volume almost always possesses a higher correlation with volatility than does total volume. The lower total volume-volatility correlation is obviously due to the somewhat surprisingly low correlation between electronic trading and volatility. To the extent that electronic trading reflects overnight trading in the U.S., when markets in Europe and Asia are open and reacting to home country news, such a lack of a relationship has merit since both measures of volatility used here are based only on the U.S. futures market intraday price changes. Hence, the link between volume and volatility is limited to certain types of volume, which complicates volume-volatility empirical studies. There is a higher relationship (in most cases) between spread volume and volatility (than for electronic volume and volatility), which is surprising given the purpose of calendar spreads. However, cross-spreads between currency futures could still reflect a speculative or hedging purpose and hence be related to price volatility. But the higher spread correlations with volatility are limited to the more important and active currency futures contracts. In conclusion, Table 3 clearly shows that the different types of volume have different characteristics, especially with volatility.

TABLE 3

Any possible changing relationships between volume and volatility over time are examined in Table 4. Panel A presents the volatilities for the five-minute and Garman-Klass measures for each of the five years examined in this study. While the volatilities do change over time, such changes are reasonable in size. As with the overall totals, the vast majority of years for most contracts have reasonably similar values for the two measures of volatility. The superiority of pit volume over total volume when examining the correlation with volatility often is much stronger for the individual year data than with the combined data of Table 3. The volume-volatility relation for electronic volume fluctuates substantially, being stronger in 1998 and 2002, but being weak in the remaining years. The spread volume-volatility correlations weaken for the last three years for the more important currencies, and remain weak for the Canadian dollar, Mexican peso, and Australian dollar. These results provide even stronger evidence that the volume-volatility relation is concentrated in reported pit trading, which coincides with the U.S. trading day and excludes spread trading.

TABLE 4

The breakdown of volume into different types of trades is presented in Table 5 for the entire five year period as well as annual subperiods. The dominance of the CTI4 general public is obvious. Such a dominance is unusual for futures markets, as the CTI1 dealers often trade as much or more than the general public. For some other futures markets the CTI2 commercial institutions are a more important group than they are for these currency markets, although note the relatively large amount of activity of the commercial traders for the deutschmark/euro futures. For the key European currencies and the Asian currencies the commercials have similar or more activity than the CTI1 dealers. The relative participation by the different types of traders does not vary much over time for most currencies, despite the movement towards the electronic market.

TABLE 5

Table 6 explicitly breaks out the volume into who is trading, what type of trading they are making (pit, electronic, spreading), and how this trading changes over the five years of the study. The percentages for any one currency all add to 100% for the totals and for each specific year. An important observation from Table 6 is the total lack of trading by the CTI1 dealers in the electronic and spread markets. In fact, as electronic trading becomes more important in the last two years of the study, the proportion of total volume associated with dealers in the pits declined noticeably. These results confirm our earlier suspicion, namely the changing market structure of the currency futures market has made dealing on the floor less active, and hence less profitable. While a small increase in electronic trading by dealers is evident in 2002 in all futures, it is evident that the floor dealers are either not comfortable trading electronically or they do not possess the advantages on the electronic platform that they enjoy on the floor.

TABLE 6

Finally, Table 7 provides the correlations of the volatilities with the CTI volumes for the entire time period and for each annual time period. There is a substantial change in correlations for a given CTI trader from one year to another, and the correlations tend to be lower for the last two years for the less important currencies. Interestingly, the CTI1 dealer correlations between volume and volatility tend to be larger than the correlations with other CTI traders, even though dealer trades often are in response to other trades rather than initiated by the dealers.[2] The correlations generally remain high for the CTI1 group in the last two years for the European and Japanese currencies, even though the dealers trade less due to the movement toward electronic trading. However, the correlations for the Australian dollar and Mexican peso are low for all CTI groups for the last two years. Unlike the regression results of Daigler and Wiley (1999), the

[2] In very active markets, such as major stock index futures, large block trades are often resold into smaller size trades by floor traders to spread the price risk of a large inventory. However, currency futures are smaller in size and such “re-trading” among dealers is less frequent.

correlations shown here for the CTI2 and CTI4 groups with volatility are very similar in size to one another.

TABLE 7

V. Observations and Conclusions

The importance of market structure is an elusive but important element in the behavior of financial markets. We examine the change from pit trading to the introduction of electronic trading for currency futures, finding that this change can have important effects on trading structure. We also examine the importance of spread trading, which groups trade in this market, and how the volume-volatility relation is impacted by electronic trading and type of trader.

The movement from pit dominated trading to electronic trading over the five years of this study did have important consequences for market structure. First and foremost, the CTI1 dealers are not an important factor in the electronic market. Hence, the electronic market operates based on outside participants, without the need for intermediaries. The remaining pit trading could be useful for larger trading sizes. Second, the participation of pit spread trading fell less than speculative/hedging pit trading, suggesting that it is difficult to implement spread trades effectively on the electronic market. Third, the volume-volatility relation for electronic trading is low overall, but actually higher than pit volume in some of the latter annual results, which is a strange result since overnight electronic trading is not associated in time with the measured intraday volatility.

We also find that the general public and the dealers are the two most important groups of traders in the currency futures markets, although the commercial traders are unusually strong traders for the deutschmark/euro currency. It is not surprising that commercial traders are not very active in the currency futures markets, since the money center banks run their own cash currency dealer markets, allowing them to manage risk in other ways. The almost nil participation by CTI3

traders shows that floor traders do not generate spread transactions in these markets, rather spreads are generated almost exclusively by the off-the-floor general public.

The results in this paper show that changes in market structure can create important changes in trading activity by different types of traders and affect volume-volatility relationships. Additional study on the effect of electronic markets on market structure should bring other insights to the market structure literature.

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Table 1: Trading Activity by Currency and Market

Currency	Total Volume	Pit (%)	Electronic (%)	Spread (%)
Canadian dollar	10748	61.3%	12.4%	26.2%
Mexican peso	4806	82.8%	3.5%	13.7%
British pound	9279	43.3%	19.3%	37.4%
Swiss franc	13567	44.9%	12.3%	42.8%
Deutschmark/euro	23022	46.1%	18.8%	35.1%
Japanese yen	21222	43.7%	18.0%	38.3%
Australian dollar	3306	35.5%	13.7%	50.8%

Table 2: Trading Activity by Market over Time

		1998	1999	2000	2001	2002
Canadian dollar	Total Volume	9556	10269	9659	11779	12465
	Pit	76.7%	68.3%	67.2%	55.1%	39.7%
	Electronic	3.5%	2.8%	3.9%	16.5%	35.2%
	Spread	19.8%	29.0%	28.9%	28.4%	25.1%
Mexican peso	Total Volume	5396	4540	4459	4276	5375
	Pit	89.6%	91.3%	84.3%	77.6%	71.3%
	Electronic	0.1%	0.0%	0.0%	5.4%	12.0%
	Spread	10.3%	8.7%	15.6%	17.1%	16.6%
British pound	Total Volume	10573	10892	8049	8305	8601
	Pit	58.1%	50.8%	49.4%	35.5%	22.8%
	Electronic	7.1%	6.9%	10.5%	27.2%	44.7%
	Spread	34.7%	42.3%	40.2%	37.4%	32.5%
Swiss franc	Total Volume	15928	16375	12818	11486	11262
	Pit	63.1%	51.0%	44.6%	36.2%	29.8%
	Electronic	6.0%	5.1%	5.7%	15.4%	29.2%
	Spread	30.9%	43.9%	49.8%	48.5%	41.0%
Deutschmark/euro	Total Volume	27477	13265	16897	24347	33330
	Pit	59.3%	52.6%	49.7%	41.0%	28.4%
	Electronic	6.8%	6.7%	11.1%	24.0%	45.1%
	Spread	33.9%	40.8%	39.2%	35.0%	26.5%
Japanese yen	Total Volume	28154	23605	15833	18480	20215
	Pit	54.7%	50.3%	47.4%	37.1%	29.1%
	Electronic	9.9%	10.2%	10.6%	19.0%	40.1%
	Spread	35.3%	39.4%	42.0%	43.9%	30.8%
Australian dollar	Total Volume	2662	3419	2953	3299	4183
	Pit	44.8%	40.7%	38.4%	31.5%	22.2%
	Electronic	7.3%	5.5%	9.4%	15.4%	30.7%
	Spread	47.9%	53.8%	52.2%	53.1%	47.1%

Table 3: Volatilities and Volume-Volatility Correlations

	Volatilities		Volatility-Volume Correlations Using Pit, Electronic, and Spread Volumes							
			Using the 5 minute Volatility				Using the Garman-Klass Volatility			
Currency	5 minute	Garman-Klass	Total	Pit	Electronic	Spread	Total	Pit	Electronic	Spread
Canadian dollar	0.410	0.386	0.372	0.468	0.093	0.185	0.270	0.447	0.162	0.043
Mexican peso	0.672	0.681	0.262	0.368	-0.081	0.008	0.197	0.291	0.063	0.003
British pound	0.457	0.520	0.446	0.344	0.058	0.384	0.305	0.310	0.160	0.194
Swiss franc	0.638	0.703	0.406	0.403	0.043	0.298	0.351	0.322	0.203	0.251
Deutschmark/euro	0.578	0.653	0.278	0.382	0.011	0.267	0.191	0.280	0.062	0.186
Japanese yen	0.577	0.732	0.482	0.649	0.154	0.294	0.452	0.575	0.312	0.263
Australian dollar	0.715	0.847	0.174	0.328	0.034	0.137	0.155	0.296	0.079	0.106

Table 4: Volatilities and Correlations for Yearly Currency Futures

	CD	CD	MP	MP	BP	BP	SF	SF	DME	DME	JY	JY	AD	AD
Volatilities:	5 min	GK	5 min	GK	5 min	GK	5 min	GK	5 min	GK	5 min	GK	5 min	GK
Panel A: Five-Minute and Garman-Klass Volatilities														
1998	0.442	0.411	0.835	0.740	0.462	0.503	0.627	0.671	0.541	0.581	0.739	0.960	0.751	0.989
1999	0.411	0.401	0.702	0.703	0.410	0.470	0.624	0.670	0.526	0.625	0.615	0.805	0.604	0.711
2000	0.385	0.353	0.619	0.562	0.505	0.585	0.722	0.773	0.692	0.786	0.522	0.621	0.754	0.880
2001	0.408	0.363	0.627	0.662	0.490	0.554	0.639	0.736	0.619	0.702	0.509	0.626	0.842	0.946
2002	0.406	0.405	0.576	0.741	0.423	0.488	0.578	0.665	0.513	0.571	0.498	0.655	0.635	0.713
Panel B: Correlations between Volatility and Volume														
1998														
Total	0.408	0.297	0.330	0.294	0.572	0.440	0.545	0.427	0.613	0.443	0.529	0.484	0.351	0.315
Pit	0.547	0.455	0.351	0.364	0.525	0.520	0.577	0.454	0.570	0.411	0.570	0.480	0.512	0.488
Electronic	0.364	0.341	0.045	0.074	0.343	0.448	0.453	0.551	0.333	0.473	0.638	0.749	0.257	0.512
Spread	0.124	0.038	0.105	0.038	0.472	0.301	0.360	0.273	0.467	0.324	0.345	0.324	0.305	0.277
1999														
Total	0.489	0.342	0.209	0.246	0.528	0.385	0.439	0.422	0.447	0.430	0.408	0.382	0.210	0.233
Pit	0.577	0.559	0.264	0.294	0.520	0.502	0.587	0.553	0.444	0.434	0.609	0.509	0.430	0.307
Electronic	0.210	0.296	0.167	0.367	0.193	0.352	0.331	0.395	0.163	0.262	0.428	0.621	0.047	0.232
Spread	0.283	0.101	-0.025	0.032	0.418	0.228	0.270	0.256	0.316	0.293	0.239	0.238	0.107	0.120
2000														
Total	0.390	0.339	0.490	0.319	0.412	0.335	0.365	0.388	0.385	0.393	0.484	0.449	0.272	0.199
Pit	0.420	0.509	0.545	0.455	0.370	0.266	0.542	0.476	0.585	0.481	0.661	0.595	0.432	0.362
Electronic	0.066	0.229	0.069	0.131	0.217	0.336	0.080	0.296	0.057	0.447	0.166	0.507	0.227	0.431
Spread	0.260	0.094	0.104	-0.018	0.318	0.265	0.234	0.268	0.220	0.216	0.314	0.254	0.210	0.123
2001														
Total	0.311	0.221	0.366	0.219	0.690	0.405	0.344	0.312	0.316	0.175	0.228	0.173	0.110	0.184
Pit	0.371	0.490	0.577	0.380	0.479	0.639	0.448	0.490	0.605	0.593	0.640	0.587	0.287	0.341
Electronic	-0.052	0.128	-0.030	0.213	0.086	0.267	0.126	0.294	0.039	0.102	0.257	0.401	0.114	0.259
Spread	0.184	0.014	0.053	-0.021	0.704	0.251	0.295	0.254	0.265	0.167	0.097	0.069	0.062	0.136
2002														
Total	0.402	0.244	0.128	0.076	0.338	0.219	0.444	0.374	0.468	0.381	0.473	0.440	0.169	0.099
Pit	0.368	0.418	0.399	0.310	0.299	0.306	0.362	0.435	0.611	0.535	0.487	0.563	0.368	0.303
Electronic	0.509	0.539	0.135	0.102	0.320	0.437	0.443	0.537	0.578	0.684	0.470	0.718	0.345	0.436
Spread	0.238	0.024	-0.058	-0.063	0.242	0.061	0.337	0.206	0.188	0.135	0.419	0.304	0.106	0.011

Table 5: CTI Participation in the Currency Futures Markets, by year

	Type of Trader	Totals	1998	1999	2000	2001	2002
Canadian dollar	CTI1	19.1%	23.7%	19.2%	19.4%	17.0%	16.0%
	CTI2	16.5%	11.8%	14.0%	14.9%	17.3%	24.1%
	CTI3	1.5%	2.4%	1.6%	1.0%	1.1%	1.3%
	CTI4	63.0%	62.1%	65.2%	64.7%	64.6%	58.6%
Mexican peso	CTI1	23.3%	28.0%	25.2%	22.0%	19.3%	21.8%
	CTI2	14.2%	14.0%	17.3%	14.6%	10.9%	14.3%
	CTI3	1.3%	1.2%	1.1%	1.0%	1.0%	2.0%
	CTI4	61.2%	56.8%	56.4%	62.4%	68.8%	61.9%
British pound	CTI1	17.0%	20.6%	19.2%	17.3%	14.4%	13.6%
	CTI2	19.2%	19.2%	18.6%	19.4%	18.8%	19.8%
	CTI3	1.0%	1.5%	1.0%	0.9%	0.9%	0.8%
	CTI4	62.8%	58.7%	61.2%	62.3%	65.9%	65.8%
Swiss franc	CTI1	19.1%	27.9%	20.6%	17.4%	14.8%	14.7%
	CTI2	17.9%	17.4%	18.2%	16.9%	16.7%	20.3%
	CTI3	1.0%	1.8%	1.0%	0.8%	0.6%	0.5%
	CTI4	62.1%	52.9%	60.2%	64.8%	67.9%	64.5%
Deutschmark/euro	CTI1	26.0%	32.2%	27.0%	26.1%	23.7%	20.9%
	CTI2	29.5%	28.2%	35.1%	29.8%	27.1%	27.1%
	CTI3	2.2%	3.5%	2.2%	1.8%	1.7%	1.6%
	CTI4	60.2%	55.0%	58.1%	62.2%	63.7%	61.9%
Japanese yen	CTI1	20.4%	24.9%	24.0%	21.4%	17.2%	14.5%
	CTI2	18.1%	19.4%	17.4%	17.1%	15.8%	20.9%
	CTI3	1.8%	2.8%	2.0%	1.4%	1.5%	1.6%
	CTI4	59.7%	52.9%	56.7%	60.1%	65.6%	63.0%
Australian dollar	CTI1	17.9%	20.9%	18.6%	16.6%	17.6%	15.8%
	CTI2	15.4%	17.3%	19.4%	14.4%	12.2%	13.7%
	CTI3	0.6%	0.8%	0.8%	0.4%	0.5%	0.8%
	CTI4	66.1%	61.0%	61.3%	68.6%	69.7%	69.7%

Table 6: CTI Volume by Type of Market

Currency	Trader/Market	Totals	1998	1999	2000	2001	2002
Canadian dollar	CTI1 pit	16.0%	21.4%	16.9%	17.0%	13.6%	11.2%
	CTI2 pit	6.6%	6.7%	6.2%	7.1%	7.2%	5.8%
	CTI3 pit	1.0%	1.8%	1.1%	0.7%	0.8%	0.6%
	CTI4 pit	37.6%	46.7%	43.8%	42.2%	33.3%	22.0%
	Elec CTI1	1.2%	0.2%	0.3%	0.5%	1.7%	3.2%
	Elec CTI2	3.5%	0.6%	0.5%	0.3%	3.5%	12.6%
	Elec CTI3	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Elec CTI4	7.7%	2.7%	2.0%	3.1%	11.3%	19.3%
	CTI1 spread	1.8%	2.1%	1.9%	1.9%	1.7%	1.6%
	CTI2 spread	6.4%	4.5%	7.3%	7.5%	6.7%	5.8%
	CTI3 spread	0.5%	0.6%	0.5%	0.4%	0.3%	0.6%
	CTI4 spread	17.8%	12.7%	19.4%	19.4%	19.9%	17.4%
Mexican peso	CTI1 pit	20.7%	24.8%	23.5%	20.4%	17.0%	17.5%
	CTI2 pit	11.1%	12.7%	15.5%	12.1%	7.5%	7.5%
	CTI3 pit	1.1%	1.0%	1.0%	0.9%	0.9%	1.9%
	CTI4 pit	49.7%	50.1%	51.2%	50.8%	52.0%	44.5%
	Elec CTI1	0.8%	0.0%	0.0%	0.0%	1.0%	3.1%
	Elec CTI2	1.3%	0.0%	0.0%	0.0%	1.7%	4.7%
	Elec CTI3	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Elec CTI4	1.4%	0.0%	0.0%	0.0%	2.9%	4.2%
	CTI1 spread	1.8%	3.2%	1.7%	1.6%	1.3%	1.2%
	CTI2 spread	1.9%	1.2%	1.7%	2.5%	1.8%	2.1%
	CTI3 spread	0.2%	0.3%	0.1%	0.1%	0.1%	0.1%
	CTI4 spread	10.1%	6.6%	5.2%	11.6%	14.0%	13.2%
British pound	CTI1 pit	14.3%	19.3%	17.8%	15.5%	10.6%	8.0%
	CTI2 pit	6.7%	7.8%	6.9%	8.7%	6.7%	3.2%
	CTI3 pit	0.8%	1.1%	0.8%	0.7%	0.6%	0.6%
	CTI4 pit	21.6%	29.9%	25.3%	24.5%	17.5%	11.0%
	Elec CTI1	1.8%	0.2%	0.3%	0.9%	2.9%	4.7%
	Elec CTI2	3.3%	1.4%	1.5%	1.0%	3.4%	8.9%
	Elec CTI3	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
	Elec CTI4	14.2%	5.6%	5.0%	8.5%	20.7%	31.0%
	CTI1 spread	0.9%	1.2%	1.0%	0.9%	0.8%	0.8%
	CTI2 spread	9.3%	10.0%	10.2%	9.8%	8.7%	7.7%
	CTI3 spread	0.2%	0.3%	0.2%	0.2%	0.2%	0.2%
	CTI4 spread	27.0%	23.2%	30.9%	29.3%	27.6%	23.9%
Swiss franc	CTI1 pit	17.1%	26.4%	19.3%	16.1%	12.6%	11.2%
	CTI2 pit	5.7%	7.6%	6.6%	5.6%	5.2%	3.6%
	CTI3 pit	0.8%	1.3%	0.9%	0.7%	0.5%	0.4%
	CTI4 pit	21.3%	27.8%	24.2%	22.2%	17.9%	14.7%
	Elec CTI1	1.1%	0.3%	0.4%	0.5%	1.5%	3.0%
	Elec CTI2	2.8%	2.0%	1.3%	0.8%	2.5%	7.4%
	Elec CTI3	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	Elec CTI4	8.3%	3.7%	3.3%	4.3%	11.4%	18.7%
	CTI1 spread	0.8%	1.2%	0.9%	0.7%	0.7%	0.5%
	CTI2 spread	9.4%	7.8%	10.2%	10.5%	9.0%	9.3%
	CTI3 spread	0.2%	0.5%	0.2%	0.1%	0.1%	0.0%
	CTI4 spread	32.4%	21.4%	32.6%	38.4%	38.6%	31.1%
Deutschmark/euro	CTI1 pit	21.8%	29.0%	23.8%	22.1%	18.9%	15.1%
	CTI2 pit	12.1%	13.6%	15.7%	14.3%	11.5%	5.6%
	CTI3 pit	1.8%	2.9%	1.8%	1.5%	1.3%	1.2%
	CTI4 pit	21.3%	26.9%	24.7%	24.5%	18.9%	11.8%

	Elec CTI1	1.2%	0.2%	0.3%	1.0%	1.6%	3.0%
	Elec CTI2	3.1%	1.6%	1.0%	0.8%	2.6%	9.4%
	Elec CTI3	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	Elec CTI4	10.8%	2.8%	2.4%	6.3%	15.3%	27.0%
	CTI1 spread	0.7%	0.9%	0.6%	0.7%	0.8%	0.7%
	CTI2 spread	6.0%	5.4%	6.0%	6.7%	6.5%	5.6%
	CTI3 spread	0.2%	0.3%	0.1%	0.1%	0.2%	0.2%
	CTI4 spread	16.4%	15.0%	15.1%	19.6%	18.6%	13.5%
Japanese yen	CTI1 pit	17.2%	22.4%	21.0%	18.2%	14.3%	10.2%
	CTI2 pit	5.5%	6.2%	5.9%	6.2%	5.1%	4.3%
	CTI3 pit	1.4%	2.1%	1.5%	1.2%	1.2%	1.1%
	CTI4 pit	19.5%	23.9%	21.9%	21.8%	16.5%	13.5%
	Elec CTI1	1.7%	0.5%	1.2%	1.6%	1.7%	3.3%
	Elec CTI2	3.9%	3.5%	2.3%	1.1%	2.7%	9.7%
	Elec CTI3	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
	Elec CTI4	12.5%	5.9%	6.7%	7.9%	14.6%	27.0%
	CTI1 spread	1.5%	2.0%	1.8%	1.6%	1.1%	0.9%
	CTI2 spread	8.7%	9.6%	9.2%	9.8%	8.0%	7.0%
	CTI3 spread	0.4%	0.7%	0.5%	0.2%	0.3%	0.4%
	CTI4 spread	27.7%	23.1%	28.0%	30.3%	34.5%	22.5%
Australian dollar	CTI1 pit	12.8%	17.4%	15.2%	12.0%	11.1%	8.4%
	CTI2 pit	1.4%	1.3%	2.3%	1.7%	1.0%	0.7%
	CTI3 pit	0.3%	0.5%	0.5%	0.2%	0.2%	0.3%
	CTI4 pit	21.3%	26.9%	23.3%	24.8%	19.1%	12.7%
	Elec CTI1	1.3%	0.5%	0.4%	0.7%	1.7%	3.3%
	Elec CTI2	1.8%	1.5%	0.7%	0.5%	1.9%	4.4%
	Elec CTI3	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%
	Elec CTI4	10.6%	5.5%	4.4%	8.3%	11.8%	22.6%
	CTI1 spread	3.7%	3.0%	3.0%	3.9%	4.7%	4.1%
	CTI2 spread	12.2%	14.5%	16.4%	12.2%	9.3%	8.7%
	CTI3 spread	0.2%	0.3%	0.3%	0.1%	0.2%	0.3%
	CTI4 spread	34.2%	28.6%	33.5%	35.5%	38.9%	34.4%

Table 7: Correlations between Volatility and CTI Volume

		CD 5 min	CD GK	MP 5 min	MP GK	BP 5 min	BP GK	SF 5 min	SF GK	DME 5 min	DME GK	JY 5 min	JY GK	AD 5 min	AD GK
1998-2002															
	CTI1	0.460	0.321	0.304	0.166	0.430	0.267	0.373	0.266	0.315	0.185	0.587	0.495	0.080	-0.005
	CTI2	0.281	0.237	0.293	0.245	0.398	0.295	0.344	0.333	0.315	0.265	0.488	0.501	0.178	0.202
	CTI3	0.293	0.160	0.010	0.010	0.265	0.109	0.244	0.183	0.226	0.135	0.480	0.411	-0.003	-0.013
	CTI4	0.333	0.237	0.176	0.173	0.416	0.299	0.382	0.348	0.321	0.257	0.417	0.405	0.184	0.151
1998															
	CTI1	0.486	0.352	0.302	0.275	0.633	0.501	0.609	0.458	0.566	0.398	0.525	0.423	0.170	0.115
	CTI2	0.258	0.185	0.414	0.389	0.499	0.423	0.507	0.394	0.608	0.481	0.509	0.507	0.372	0.376
	CTI3	0.354	0.221	-0.040	-0.049	0.435	0.240	0.462	0.416	0.513	0.391	0.411	0.346	0.162	0.111
	CTI4	0.375	0.268	0.259	0.245	0.539	0.421	0.461	0.375	0.568	0.402	0.509	0.483	0.383	0.364
1999															
	CTI1	0.561	0.379	0.209	0.131	0.501	0.349	0.532	0.472	0.351	0.282	0.455	0.372	0.031	-0.096
	CTI2	0.475	0.309	0.150	0.218	0.447	0.332	0.323	0.345	0.393	0.411	0.379	0.427	0.179	0.274
	CTI3	0.318	0.177	0.097	-0.059	0.205	0.082	0.313	0.232	0.144	0.224	0.326	0.251	-0.048	0.071
	CTI4	0.441	0.321	0.176	0.280	0.515	0.378	0.414	0.394	0.434	0.418	0.366	0.345	0.243	0.172
2000															
	CTI1	0.493	0.390	0.451	0.324	0.500	0.384	0.493	0.415	0.515	0.389	0.570	0.445	0.060	-0.027
	CTI2	0.307	0.227	0.487	0.393	0.324	0.302	0.376	0.356	0.393	0.385	0.463	0.438	0.307	0.215
	CTI3	0.269	0.056	0.031	0.060	0.270	0.203	0.097	0.098	0.364	0.331	0.315	0.248	0.075	-0.004
	CTI4	0.372	0.302	0.382	0.245	0.374	0.306	0.328	0.371	0.336	0.374	0.435	0.423	0.277	0.198
2001															
	CTI1	0.353	0.261	0.354	0.177	0.708	0.408	0.400	0.366	0.554	0.411	0.428	0.304	0.086	0.003
	CTI2	0.241	0.162	0.430	0.316	0.698	0.392	0.348	0.400	0.405	0.309	0.253	0.243	0.098	0.166
	CTI3	0.186	0.122	0.055	0.026	0.591	0.255	0.233	0.229	0.466	0.277	0.283	0.188	0.018	-0.081
	CTI4	0.263	0.212	0.300	0.181	0.652	0.407	0.344	0.332	0.320	0.289	0.167	0.168	0.103	0.221
2002															
	CTI1	0.374	0.215	0.159	0.074	0.388	0.182	0.505	0.387	0.637	0.533	0.589	0.518	0.109	-0.020
	CTI2	0.446	0.416	0.318	0.220	0.301	0.239	0.334	0.415	0.370	0.437	0.508	0.543	0.155	0.139
	CTI3	0.240	0.059	0.127	0.039	0.098	0.016	0.350	0.277	0.481	0.372	0.430	0.371	-0.022	-0.031
	CTI4	0.368	0.210	0.118	0.085	0.302	0.231	0.431	0.348	0.481	0.463	0.496	0.468	0.186	0.104