THE BIG PLAYERS IN THE FOREIGN EXCHANGE MARKET: DO THEY TRADE ON INFORMATION OR NOISE?

Shang-Jin Wei
Jungshik Kim

Working Paper **6256**

NBER WORKING PAPER SERIES

THE BIG PLAYERS IN THE FOREIGN EXCHANGE MARKET: DO THEY TRADE ON INFORMATION OR NOISE?

Shang-Jin Wei
Jungshik Kim

Working Paper 6256
http://www.nber.org/papers/w6256

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
November 1997

We would like to thank Greg Dorchak for efficient editorial assistance. The views in the paper represent those of the authors and not those of their affiliated institutions. This paper is part of NBER's research program in International Finance and Macroeconomics. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

The Big Players in the Foreign Exchange
Market: Do They Trade on Information or Noise?
Shang-Jin Wei and Jungshik Kim
NBER Working Paper No. 6256
November 1997
JEL No. F31
International Finance and Macroeconomics

ABSTRACT

This paper studies whether there exists private information in the foreign exchange market, and whether speculation reduces or exacerbates volatility. It makes use of a recent data set on foreign currency positions by large market participants that include positions on options and other derivatives. This is the first data set that describes comprehensive currency positions of market participants. There are two main findings. First, not only the absolute value of the options position but also that of spot, forward and futures positions by large participants Granger-causes exchange rate volatility. This suggests that the large participants' currency speculation does not stabilize exchange rate volatility. Second, regression analyses do not find any positive association between large participants' position in a foreign currency with its subsequent appreciation. A non-parametric approach finds some weak support for a positive association but not on a systematic level. This casts into doubt the view that large participants have better information about the future movement of exchange rates. It further strengthens the case that the large players trade on noise rather than on information.

Shang-Jin Wei
Kennedy School of Government
Harvard University
79 John F. Kennedy Street
Cambridge, MA 02138
and NBER
shang-jin_wei@harvard.edu

Jungshik Kim
Kennedy School of Government
Harvard University
79 John F. Kennedy Street
Cambridge, MA 02138

"The market mechanism fails to bring currencies back into alignment. On the contrary, speculation tends to exaggerate currency moves. ... [T]he system of freely floating currencies is cumulatively destabilizing."

George Soros, The Alchemy of Finance, p328

1. Introduction

With one trillion dollars per day, the weekly trading volume in the foreign exchange market is five times larger than the annual volume of the world goods trade.[1] This gigantic asset market also has enormous volatility. Contrary to the predictions of the monetary approach to exchange rate determination, Flood and Rose (1995) showed that the floating exchange rate system after 1973 is associated with substantially higher exchange rate volatility than the pre-1970 period, without any discernible difference in the volatility of economic and policy fundamentals. This suggests, though does not prove, that the trading process itself may generate unnecessary volatility that is not based on real information. Even George Soros, who is known to have made a penny or two speculating in the foreign exchange market, thinks that the answer is affirmative, as shown by the opening quote of this paper.

Another nagging question about this market is whether there exists asymmetric information among traders that may be price relevant. The conventional answer has been no even though there may be asymmetry between a central bank and traders. A recent paper by Lyons, Ito and Melvin (1997) found that the intra-day pattern of exchange rate volatility changes after the Tokyo market lifted its lunch-hour trading restrictions. The authors interpreted the changes as a reflection of asymmetric information in the market.[2] This question is important because the existence of informational asymmetry would suggest that we should begin to focus more attention on exchange rate models in which traders are optimizing agents. Such models are still rare in the international finance literature.

In this paper, we study the behavior of very large market participants. We aim to shed light on

[1] Calculated based on information in Levich (1998), p69.

[2] This interpretation, however, met some challenge during the Workshop on Microstructure at the 1997 NBER Summer Institute.

two questions. First, does the trading/speculation by these very large participants tend to stabilize or exacerbate exchange rate volatility? Second, if any traders have better information, these large participants likely do. Does the data indicate that they actually have better information? The two questions are of course related: if the large players do not have better information about future levels of exchange rate than the general public, it would be difficult for their trading positions to stabilize the exchange rate.

We are not aware of any study of the first question on the foreign exchange market. Lyons (1997) provided an interesting model of large trading volume in the foreign exchange market, but does not deal with its effect on volatility directly. On the second questions, there were a number of studies with inconclusive answers. VanBelle (1975, 1977), Eaker (1977), Mahajan and Mehta (1986, 1984) and So (1994) found that banks' currency positions in spot and swaps seem to demonstrate some ability to make correct predictions of the exchange rate. Using monthly data, Fieleke (1981) found that both bank and nonbank positions performed poorly as forecasters of exchange rates. He found that the position takers in his study generally failed to earn even a gross return on their positions. The problem with these studies is that their data did not include certain important derivative products, namely options. In other words, an important part of the market participants' overall currency positions was missing. For the large players in our sample, for example, the net options positions over 1994-96 were over 25% of the total positions in spot, forward and futures. And this missing part has grown rapidly in importance relative to other currency products. A data set that covers options and thus provides a more comprehensive description of currency positions should offer more reliable inferences.

We make use of a data set recently collected and released by the U.S. Treasury. This data set has two important advantages over those in the earlier papers. First, it gives a more complete description of the market participants' positions by including information on options and other derivatives positions in addition to spot trading. Second, it is of relatively higher frequency (i.e., weekly positions).

On the first question, we note first that speculation, ex ante, is just as likely to reduce as to increase volatility. Friedman (1953) provided the classic argument for stabilizing speculation. His logic is (maybe deceptively) simple: destabilizing speculators lose money on average and would be driven out of the market eventually. On the other hand, recent models of noise trading (Kyle, 1985; Delong, Shleifer, Summers and Waldman, 1990a and 1990b) provided a host of reasons why non-rational noise traders may not disappear from the market (i.e., they could earn higher expected returns for unknowingly bearing extra risk, and new generations of noise traders come to market continuously). Furthermore, rational speculators may take destabilizing positions in the presence of noise traders using feedback rules.

The rapid development of the derivatives markets, particularly that of currency options, coincides with an increase in the volatility. Of course, the direction of causality can, in principle, go either way. However, many people seem convinced that the use of derivatives has contributed to the increased volatility. As a former central banker told the Wall Street Journal,[3] "most foreign-exchange traders now take it for granted that once in a while you will get a little extra kick in the price movement from a large number of options in the market." George Soros was reported to have compared the destabilizing effects of currency options to 'crack' cocaine and called for greater regulation of currency derivatives.[4]

Empirical work on the effect of currency derivatives on exchange rate volatility is lacking, in part, because of unavailability of data on derivatives usage. Studies of this question for other financial markets have reached apparently conflicting conclusions. We will later list these studies and offer a possibly unifying interpretation. Due to the same data availability problem, empirical studies of asymmetric information in the foreign exchange market are rare.[5]

---

[3] "Economy: Treasurers of Many Multinational Firms Took Risks to Profit from Falling Dollars," by Fred R. Bleakley, The Wall Street Journal, April 17, 1995, Section A, page 2.

[4] "Do Knock-Out Options Need to be Knocked Out?" by Michael R. Sesit and Laura Jereski, The Wall Street Journal, May 5, 1995, Section C, page 1.

[5] Richard Lyons (1995) made headway in studying the microstructure of the market by obtaining the order flow information of one trader for a week. Norman Fieleke (1981) made the first study of the forecasting ability of large U.S. firms by using their monthly currency positions released by the U.S. Treasury. His data set did not include positions in options and other derivatives.

We organize the paper in the following way. Section 2 explains the data. Section 3 investigates whether large participants' positions in foreign exchange are systematically associated with subsequent change in exchange rate volatility, and if so, what a plausible causality story should be. Section 4 turns attention to whether large participants' positions reflect their superior ability to forecast the level of exchange rate, using both parametric and non-parametric approaches. Section 5 provides concluding remarks.

2. Data

Large participants' foreign exchange position

Data on the foreign exchange positions by large market participants come from the *Treasury Bulletin*, which, in September 1994, began publishing weekly time-series data on aggregate currency holdings by major foreign exchange market participants in the U.S.

Major foreign exchange participants are defined as those with more than $50 billion equivalent in foreign exchange contracts on the last business day of any calendar quarter during the previous year. According to authors' phone conversations with Treasury officials in charge of the data collection, in 1996, there were thirty-six entities that qualified as major participants. Of them, twenty-nine were commercial banks and the remaining seven were other forms of financial institutions. In accordance with law (31 U.S.C. 5315; 31 C.F.R. 128, Subpart C), weekly and monthly reports must be filed throughout the calendar year by these participants.

An important feature of these filings is that they include the derivative positions, specifically, the outstanding amounts of foreign exchange forward, futures and swaps contracts bought and sold, and one half the notional amount of foreign exchange options, in addition to spot contracts. Previous Treasury data released not only were of lower (i.e., monthly) frequency, but also omitted derivative positions which have become increasingly important over time.

The data are disaggregated by currencies but not by participants. The currencies covered include the British Sterling, Swiss Franc, Japanese Yen, German Deutschemark and Canadian Dollar.

Weekly position data is available only since January 5, 1994. Thus, the sample period of this paper is from that day through December 25, 1996. A shortcoming of the data set is that it only reports net but not gross positions.

Table 1 presents summary statistics. Suppose that a corporate customer asks a major participant (say a commercial bank) to buy 100 million D-marks, and the bank turns around to buy the foreign currency from the foreign exchange market. This bank will report two transactions to the Treasury: a purchase of 100 million D-marks from the market, and a sale of 100 million D-marks to the corporate customer. Table 1 indicates that the major participants buy and sell a large amount with relatively small net positions. This could reflect a combination of two things: they act as intermediaries in the market; and they close out most of the speculative positions within a week (if not by the end of a day).

Exchange rates and volatility

Daily exchange rate data used for this study was obtained from the DRI database (FACS). We use offer rates at the close of the London market. For the purpose of this paper, using the middle point of the bid-ask rates, or using rates at a different time of the day would not make a difference.

Volatility measures were calculated by taking the standard deviation of daily returns (i.e., first difference in log exchange rates) over various time horizons (1, 2, 4, and 12-weeks).

3. Position-Taking by Large Participants and Volatility of Exchange Rates

In this section, we investigate the relationship between position-taking by large participants and exchange rate volatility. Since options have been singled out as a particularly menacing culprit as discussed in the introductory section of the paper, we start with large participants' positions in options. Because options are only reported in terms of delta equivalent values,[6] we will examine only the relationship between the absolute value of the net delta equivalents and exchange rate volatility.

[6] The delta equivalent value is the product of the first derivative of the option value with respect to the spot

The effect of options trading on the volatility of underlying spot market has been an obsession in studies of other financial market. The results appear to be conflicting and confusing. Those who studied the effect of listing of individual stock options generally found that they are associated with a reduction in subsequent stock price volatility (e.g., Hayes and Tennenbaum, 1979; Ma and Rao, 1988; Bansal, Pruitt and Wei, 1989; Skinner, 1989; Conrad, 1989; Nabar and Park, 1989; and Damodaran and Lim, 1991a). Those who studied the listing of individual commodity options also found a reduction in subsequent commodity price volatility (Working, 1960, in onion markets; Powers, 1970, in pork belly and live beef; and Cox, 1976, in a number of commodity markets). On the other hand, those who studied the effect of stock index options usually found an increase in the underlying stock price volatility (e.g., Stoll, 1987; Harris, 1989b; Damodaran, 1990; and Blume, MacKinlay and Terker, 1989). Similarly, studies of the GNMA market found that the options tend to either increase the volatility of the underlying prices (Figlewski, 1981; and Edwards, 1988a) or have no (statistically significant) effect (Simpson and Ireland, 1982; Corgel and Gay, 1984; and Moriarty and Tosini, 1985).

These apparently conflicting findings have a possible unifying interpretation. In those markets (e.g., individual stocks and commodities) where asymmetric information is prevalent (between insiders and uninformed traders), introduction of options can bring out new information more quickly and, if this effect dominates, it can reduce the volatility of the underlying prices. In those markets where asymmetric information is negligible such as stock index or GNMA, options trading tends to mainly augment the speculative positions of noise traders or other uninformed traders, and hence raise the underlying price volatility. If we accept the conventional view that asymmetric information is negligible among foreign exchange traders, this interpretation would suggest that options trading may exacerbate foreign exchange volatility. On the other hand, if we subscribe to the alternative view as advocated by Lyons, Ito and Melvin (1997), we may expect a negative association between options and volatility in the foreign exchange market.

---

exchange rate (according to the Black-Scholes formula) multiplied by the notional principal of the contract.

Options Positions and Exchange Rate Volatility

We employ Granger-causality tests to examine the relationship between the absolute value of the options positions by large participants and exchange rate volatility. The tests are conducted on the pooled-sample as well as on five individual currencies, and for four different horizons (one, two, four and twelve weeks).

A typical specification is the following linear vector autoregression (VAR):

$$VOL_t = A_L\, OPT_t + B_L\, VOL_t + \epsilon_{vol,t}$$

$$OPT_t = C_L\, OPT_t + D_L\, VOL_t + \epsilon_{fcp,t}$$

where OPT, the absolute value of the delta equivalent of the net outstanding foreign currency options contracts at the time of the survey (subsequently referred to as "options positions" for short); VOL is exchange rate volatility over a relevant time horizon; and A_L, B_L, C_L, and D_L are one-sided lag polynomials.

To test for Granger causality from options position (OPT) to volatility (VOL), in this framework, a standard joint test of exclusion restrictions (F-test) is used to determine whether lagged OPT has significant predictive power for current VOL. The null hypothesis that OPT does not Granger-cause VOL is rejected if the coefficients on A_L are jointly significantly different from zero. We test for Granger causality from VOL to OPT in a similar manner. To determine the appropriate lag lengths for the lag polynomials, we minimize the Schwarz Bayesian Information Criterion (SBIC).

Table 2 reports the results of the Granger tests. Lag lengths and computed F-statistics with their significance levels are reported as well. For the pooled sample on top of the table, we can reject the null of non-causality from options positions to subsequent exchange rate volatility at the five percent level for all four horizons (the middle column). On the other hand, we cannot reject the null of non-causality in the reverse direction at the five percent level for all four horizons (the right column). With somewhat weaker power, this same pattern carries over to four out of five currencies and for one, two and four week horizons.

It is useful to stress that Granger-causality is not the same thing as economic causality. Table 2 has not established that the options trading by large participants causes more volatility in the foreign exchange rate. It does establish that the option trading tends to lead to, in a time sequence sense, a subsequent increase in volatility.

Could this finding simply reflect the possibility that large traders have good information about the subsequent movement in the exchange rate volatility, and they adjust their options positions in anticipation of the movement? While it is difficult to give a definitive answer, we make a few observations. First, if the large participants truly have good information about future exchange rate volatility, they can in principle take advantage of it without any change in the net delta value of the options, for example, by simultaneously buying and selling calls and puts with the strike price equal to the current spot price (known as a straddle). Thus, options trading based on good information about future volatility may not necessarily induce a positive correlation between options positions and subsequent volatility.

Second, if options trading is executed to take advantage of information about future volatility, there is no reason that positions in the spot, forward and futures contracts should be positively related to subsequent exchange rate volatility. On the other hand, if both derivatives and spot contracts are employed to speculate on the level of the exchange rate movement, and if the trading is based on noises rather than information, it is possible to find a positive correlation between positions in spot, forward and futures, and subsequent exchange rate volatility. For this reason, we take a look at the association between these two variables.

Positions in Spot, Futures and Forward and Exchange Rate Volatility

Table 3 presents the results of bivariate Granger-causality tests between positions in spot, futures and forward (which we shall call "spot positions" in this subsection for short) and exchange rate volatility. In the pooled sample, we can reject, at the five percent level, the null hypothesis of no causality from spot positions to exchange rate volatility at the one, two and four week horizons (the middle column). But we cannot reject no-causality from exchange rate volatility to spot positions. This pattern is broadly repeated for each of the five individual currencies. Thus, the data reveals that increases in the absolute value of the positions in spot, forward and futures are associated with increases in the subsequent exchange rate volatility, but not the other way around.

We also conduct Granger-causality tests between the absolute value of positions in all products (spot, futures, forward and options) and exchange rate volatility (reported in Table 4). Naturally, we find exactly the same pattern as in Tables 2 and 3. This similarity in patterns across positions in different currency products suggests that the options positions (together with positions in other products) cannot be entirely taken because of good information about future volatility. They are likely taken, at least in part, to speculate on the level of exchange rate movements.

4. Large Participants' Ability to Forecast the Level (First Moment) of Exchange Rate

The last paragraph naturally leads to the following question: Do large market participants have better abilities to forecast the level (the first moment) of exchange rates? We investigate this question using two methods: a regression and a non-parametric approaches.

It is useful to point out that all we can hope to test is a union of two observationally equivalent hypotheses: (a) Large participants have superior information about exchange rate movement so that they buy (sell) on average when they anticipate a subsequent rise (fall) in the value of foreign currency; and (b) Large participants have sufficient market power so that their action of purchase (sale) on average generates a rise (fall) in the value of foreign currency. In other words, if we find that subsequent appreciation of the exchange rate is predicted by large participants' current net purchase of the foreign currency, either or both hypothesis can be true. On the other hand, if we fail to find the positive correlation, neither can be true.

We should also note that given the nature of our data, we cannot test if the large participants have superior ability to forecast exchange rate movement within a day. Nor can we test if a subset of the participants in our sample have superior forecasting ability.

Parametric Approach: Regression Analysis

We begin with the following regression specification:

$$S(t+1) - S(t) = \alpha + \beta\ FCP(t) + \epsilon(t+1).$$

where S(t) is the exchange rate (value of foreign currency in units of domestic currency) at the end of week t, and FCP(t) is defined as the net foreign currency position (purchase) of the large participants at the end of week t. Either the better information hypothesis or the market power hypothesis would imply that $\beta > 0$.

The results are given in Table 5. The regressions on a pooled sample of all five currencies (top panel) show that, over almost all horizons (1 day, 2 days, 5 days, 1 week, 2 weeks, and 4 weeks), we cannot reject the null hypothesis that the coefficient on the foreign currency variable is zero even at the ten percent level. The only exception is for the 12-week horizon where the slope estimate has a wrong sign.

Disaggregating by currency, essentially the same pattern prevails for four out of the five currencies. The only exception is Japanese yen where a positive slope coefficient is observed for most of the horizons.

The overall results demonstrate that, at least for four out of the five currencies, the large participants as a group do not have better information on a systematic basis about the movement in the level of exchange rate, nor do they appear to possess a significant market power that alters the movement of the exchange rates to make their expectations self-fulfilling.

Non-parametric Approach: The Henriksson-Merton Test

The regression analysis in the last subsection examines the correlation between the magnitude of exchange rate appreciation with the size of foreign currency positions. Now we turn to a non-parametric approach developed by Henriksson and Merton (1981). There are two reasons for this approach. First, the inference in the regression analysis assumed that exchange rate changes follow a normal distribution. This assumption is not supported by evidence (McFarland, Pettit, and Sung, 1982;

So, 1987). The non-parametric approach relieves us of the need to make the normality assumption. Second, if we maintain the normality assumption, we may view the hypothesis tested by the non-parametric approach as a weaker one: the direction (not magnitude) of currency appreciation may be correlated with a buy decision (regardless of the size of the buy).

Let R(t) denote the return on an investment from week t to week t+1, R(t) = S(t+1) - S(t), then, define

$$p_1(t) = \text{prob}\ [FCP(t) \leq 0 \mid R(t) \leq 0] \quad \text{and}$$

$$p_2(t) = \text{prob}\ [FCP(t) > 0 \mid R(t) > 0].$$

Thus, $p_1(t)$and $p_2(t)$ describe the conditional probabilities of a correct position given that the currency in question decreases or increases subsequently in value, relative to the U.S. dollar. Henriksson and Merton (1981) show that a necessary and sufficient condition for a forecast (or in this case, large participants' position) to have predictive value, is that the sum of conditional probabilities $p_1(t) + p_2(t)$ must be significantly greater than 1. The position has no predictive value if actual and predicted returns are distributed independently, resulting in $p_1(t) + p_2(t) = 1$.

The test is implemented by classifying a sample of N observed positions and outcomes in the following manner:

		Actual Returns	
		$R(t) \leq 0$	$R(t) > 0$
Predicted Returns	$BP_i(t) \leq 0$	n_1	$N_2 - n_2$
	$BP_i(t) > 0$	$N_1 - n_1$	n_2
		N_1	N_2

where

N_1 = total number of outcomes with $R(t) \leq 0$;
N_2 = total number of outcomes with $R(t) > 0$;
n_1 = number of correct forecasts given $R(t) \leq 0$;
n_2 = number of correct forecasts given $R(t) > 0$;

and defining

n = number of times forecaster predicts that $R(t) \leq 0$, or $n = n_1 + N_2 - n_2$;

$N = N_1 + N_2$ = total number of observations.

Then, under the null hypothesis that position takers do not have superior forecasting abilities (or do not act in a stabilizing manner), the probability distribution of n_1 (the number of correct forecasts given that $R(t) \leq 0$) is characterized by the following hypergeometric distribution and is independent of both $p_1(t)$and $p_2(t)$:

$$P(\hat{n}1 = n1 \mid N1, N2, n) = \frac{\binom{N1}{n1}\binom{N2}{n-n1}}{\binom{N}{n}}$$

Therefore, to test the null hypothesis, it is unnecessary to directly estimate either of the conditional probabilities, $p_1(t)$and $p_2(t)$. Provided that N_1, N_2 and n are observable, the distribution of n_1 is given above, with the feasible range for n_1 given by:

$$\underline{n1} \equiv \max\ \{0,\ n\ -\ N2\ \}\ \leq\ n1\ \leq\ \min\ \{N1,\ n\ \}\ \equiv\ \overline{n1}$$

Using the above equations to establish confidence intervals for testing the null hypothesis, a one-tail test (or at least one that weights the right-hand tail much more heavily than the left) is more appropriate than a two-tail test: if the market participants (i.e., forecasters) are rational, then it should not be true that $p_1(t)+ p_2(t) < 1$. Thus, given a confidence level of C, one could reject the null hypothesis of no forecasting ability if $n_1 \geq x^*(C)$ where $x^*(C)$ is the solution to:

$$\frac{\sum_{x=x^*}^{n1} \binom{N1}{n1} \binom{N2}{n-n1}}{\binom{N}{n}} = 1-C$$

For large sample sizes, it may be cumbersome to do the factorial computations, particularly when N1 ≈ N2. Fortunately, it is for precisely these cases where N1 ≈ N2 and where the sample sizes are large, that the hypergeometric distribution can be accurately approximated by a normal distribution. In these cases, we can use the following hypergeometric means and variances as parameters to the normal approximation:

$E(n_1) = n^*N_1/N$,

$\sigma^2 (n_1) = [n^*N_1^*(N - n_1)^*(N - n)] / [N_2^*(N - 1)]$.

We apply the non-parametric test to our data. And the results are presented in Table 7. In the pooled-sample (top panel), we found that we can reject the hypothesis of no predictive power at the five percent level for 1-day, 2-day and 2-week horizons, but fail to reject for the 5-day, 1 week, 2-week, 4-week and 12-week horizons. When we go into disaggregated samples (i.e., currency by currency), the rejections are less frequent. There is no single currency for which we can reject the hypothesis of no predictive power at the five percent level for more than one horizon. Neither is there a horizon for which we can reject the hypothesis for more than one currency.

Thus, even for the less demanding task of forecasting the direction of exchange rate changes, not their magnitude, large participants' positions have at most some weak power.

One may imagine that if the currency positions of the large participants do not forecast subsequent direction of the foreign currency appreciation, maybe their adjustment, i.e., changes in the currency positions, does. Table 7 reports the results of such tests. If anything, the results are even less favorable to the large participants' forecasting ability.

5. Conclusion

Using a newly released data set by the U.S. Treasury, we investigate the relationship between foreign currency positions, including those of the derivatives, taken by very large market participants, and exchange rate movement.

There are several important findings. First, both the absolute value of the options positions and the absolute value of the spot, forward and futures positions are positively correlated with a subsequent increase in exchange rate volatility. This suggests that position-taking by large market participants is likely to have contributed to an increase in the exchange rate volatility.

Second, a regression analysis suggests that position-taking by large participants does not help to forecast subsequent appreciation of the exchange rate. A non-parametric approach indicates that large participants are not likely to have a systematic ability to forecast even the direction, let alone the magnitude, of the exchange rate movement. These findings are inconsistent either with the hypothesis that large participants have superior information about exchange rate movement, or with the hypothesis that they have market power so that their purchases of foreign currencies tend to raise their value.

References

Anthony, J. 1988. "The Interrelation of Stock and Options Market Trading - Volume Data." *Journal of Finance* v. 43: 949-964.

Bansal, V.K., S W Pruitt and K.C. John Wei. 1989. "An Empirical Reexamination of the Impact of CBOE Option Initiation on the Volatility and Trading Volume of the Underlying Equities: 1973-1986." *The Financial Review* v.24: 19-29.

Black, Fischer, and Myron Scholes 1973. "The Pricing of Options and Corporate Liabilities," *Journal of Political Economy*, v. 81: 637-54.

Blume, Marshall E., Craig A. MacKinley and Bruce Terker. 1989. "Order Imbalances and Stock Price Movements on October 19 and 20, 1987," *Journal of Finance* 44, (Sept.), pp. 827-48.

Conrad, Jennifer. 1989. "The Price Effect of Options Introduction," *Journal of Finance* 44 (2), June, pp. 487-98.

Corgel, John B. and Gerald D. Gay. 1984. "The Impact of GNMA Futures Trading on Cash Market Volatility," *Journal of the American Real Estate and Urban Economics Association*, v.12: 176-190.

Cox, Charles C. 1976. "Futures Trading and Market Information," *Journal of Political Economy* 84(6), December, pp. 1215-37.

Damodaran, Aswath. 1990. "Index Futures and Stock Market Volatility," *The Review of Futures Markets*. Vol. 9. No. 2: p. 443+.

Damodaran, Aswath, and J. Lim. 1991a. "The Effects of Option Listing on the Underlying Stocks' Return Processes." *Journal of Banking and Finance*. v.15: 647-664.

Damodaran, Aswath, and J. Lim. 1991b. "Put Listing, Short Sales and Return Processes." Working Paper, Stern School of Business, New York University.

Damodaran, Aswath, and Marti G. Subrahmanyam.1992. "The Effects of Derivative Securities on the Markets for the Underlying Assets in the United States: A Survey," *Financial Markets, Institutions, and Instruments*, v. 1 (5): 1-22.

DeLong, James, Andrei Shleifer, Lawrence Summers, and Robert Waldmann. 1990a.

"Positive Feedback Investment Strategies and Destabilizing Rational Speculation," *The Journal of Finance* 45, (June), pp. 379-395.

DeLong, James, Andrei Shleifer, Lawrence Summers, and Robert Waldmann. 1990b. "Noise Trader Risk in Financial Markets," *The Journal of Political Economy*, Vol. 98, no.2: pp. 703-738.

DeTemple, J. and L. Selden. 1988. "Option Listing and Stock Returns." First Boston Working Paper Series, Columbia University.

Eaker, M.R. 1977. "A Note on the Test of Stein's Theory of Foreign Exchange Markets: A Comment," *Journal of Money, Credit and Banking* 9, (February), pp. 103-104.

Edwards, Franklin R. et. al. 1988a. *Financial Market Volatility: A Symposium Sponsored by the Federal Reserve Bank of Kansas City, Wyoming, August 17-19, 1988*. Kansas City, MO: Federal Reserve Bank of Kansas City.

Edwards, Frankin. 1988b. "Futures Trading and Cash Market Volatility: Stock Index and Interest Rate Futures," *Journal of Futures Markets* 8 (4), August, pp. 421-39.

Fieleke, Norman S. 1981. "Foreign-Currency Positioning by U.S. Firms: Some New Evidence," *Review of Economics and Statistics* LXIII, No.1, pp. 35-42.

Figlewski, Stephen. 1981. "Futures Trading and Volatility in the GNMA Market," *Journal of Finance* 36 (2), May, pp. 445-56.

Flood, Robert, and Andrew Rose, 1995, "Fixing Exchange Rates: A Virtual Quest for Fundamentals," Journal of Monetary Economics, 36(1): 3-37, December.

Frankel, Jeffrey. 1992. "Monetary and Portfolio-Balance Models of Exchange Rate Determination." in Letiche, John, *International Economic Policies and Their Theoretical Foundations - A Sourcebook*. Academic Press Inc. 1992. pp. 793-832.

Friedman, Milton. 1953. *Essays in Positive Economics*. Chicago: University of Chicago Press. pp. 162-189.

Grossman, S.J. 1988. "An Analysis of the Implications for Stock and Futures Price Volatility of Program Trading and Dynamic Hedging Strategies." *Journal of Business*. v.61:275-298.

Harris, Lawrence. 1989a. "The October 1987 S&P 500 Stock-Futures Basis," *Journal of*

Finance 44(1), March, pp. 77-99.

Harris, Lawrence. 1989b. "S&P 500 Cash Stock Price Volatilities," *Journal of Finance* 44(5), December, pp. 1155-75.

Hayes, S.I. and M.E. Tennenbaum. 1979. "The Impact of Listed Options on the Underlying Shares." *Financial Management*. 72-76.

Henriksson, R. and R. Merton. 1981. "On Market Timing and Investment Performance: II. Statistical Procedures for Evaluating Forecasting Skills." *Journal of Business* 54 (Oct.), pp. 513-533.

Kwast, Myron L. "An Overview of Financial Futures and Options in the U.S. Economy" in *Financial Futures and Options in the US Economy*, Federal Reserve System, p. 1-38.

Kyle, Albert, 1985, "Continuous Auctions and Insider Trading," *Econometrica* 53:1315-35.

Levich, Richard M., 1998, *International Financial Markets: Prices and Policies*, McGraw-Hill.

Lyons, Richard, 1995, "Tests of Microstructure Hypotheses in the Foreign Exchange Market." *Journal of Financial Economics* 39: 321-51.

Lyons, Richard, Takatoshi Ito and Michael Melvin, 1997, "The Tokyo Experiment: Is There Private Information in the Foreign Exchange Market?" Paper presented at the NBER Summer Institute, July, 1997.

Ma, C.K. and R.P. Rao. 1988. "Information Asymmetry and Options Trading." *The Financial Review* v. 23: 39-51.

Mahajan, A. and D. Mehta. 1984. "Strong Form Efficiency of the Foreign Exchange Market and Bank Positions," *Journal of Financial Research* 3 (fall), pp.197-207.

Mahajan, A. and D. Mehta. 1986. "Swaps, Expectations, and Exchange Rates," *Journal of Banking and Finance*. pp. 7-20.

McFarland, J; R. Pettit, and S. Sung. 1982. "The Distribution of Foreign Exchange Prices: Trading Day Effects and Risk Measurement," *Journal of Finance* (June), pp. 693-715.

Moriarty, Eugene J. and Paula Tosini. 1985. "Futures Trading and the Price Volatility of GNMA Certificates - Further Evidence," *Journal of Futures Markets* 5(4), Winter, pp. 633-41.

Nabar, P. and S. Park. 1988. "Options Trading and Stock Price Volatility." Working Paper, Salomon Brothers Center, New York University.

Powers, Mark J. 1970. "Does Futures Trading Reduce Price Fluctuations in the Cash Markets?" *American Economic Review* 60 (3), June, pp. 460-64.

Simpson, Gary W. and Timothy C. Ireland. 1982. "The Effect of Futures Trading on the Price Volatility of GNMA Securities," *Journal of Futures Markets*, v.2: 357-66.

Skinner, Douglas J. 1989. "Options Markets and Stock Return Volatility," *Journal of Financial Economics* 23 (1), pp. 61-78.

So, Jacky C. 1987. "The Distribution of Foreign Exchange Price Changes: Trading Day Effects and Risk Management - A Comment." *Journal of Finance* (March), pp. 181-188.

So, Jacky C. 1994. "The Speculative Behavior of Commercial Banks and Foreign Exchange Rates: An Empirical Analysis," *Research in International Business and Finance* 11A, pp.107-130.

Stoll, Hans. 1987. "Effects of Options on Underlying Assets," *Aussenwirtschaft* 42. (September), pp. 199-212.

U.S. Treasury Department, *Treasury Bulletin*, various issues.

Van Belle, J. 1975. "The Behavior of Professional Risk-Bearers: Test of a Theory," *Journal of Money, Credit and Banking* 7, (May) pp. 253-257.

Van Belle, J. 1977. "The Relevance of an Aggregate Benchmark for Testing Stein's Theory," *Journal of Money, Credit and Banking* 9, (February), pp. 105-106.

Whiteside, M.M., W.P. Dukes and P.M. Dunne. 1983. "Short Term Impact of Option Trading on Underlying Securities." *Journal of Financial Research* 6: 313-321.

Table 1 - Summary Statistics: Foreign Currency Positions of Major Market Participants
(weekly data - Jan. 5, 1994 through Dec. 25, 1996)

	1994				1995				1996				1994-1996			
	Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max	Mean	Std Dev	Min	Max
British Sterling																
Purchased	405,572	42,275	340,047	502,539	514,590	39,623	443,259	594,596	480,951	51,466	421,112	631,782	467,038	63,774	340,047	631,782
Sold	404,338	40,158	339,643	497,642	510,039	39,575	440,035	588,774	476,022	49,649	418,732	623,446	463,466	61,729	339,643	623,446
Net Options Position	539	621	-819	2,122	828	774	-870	2,285	1,344	1,261	-1,638	3,190	904	979	-1,638	3,190
Net Foreign Curr. Pos.	1,773	2,536	-3,844	8,778	5,380	1,735	2,197	10,879	6,273	2,438	2,904	12,829	4,475	2,978	-3,844	12,829
Swiss Franc																
Purchased	278,729	13,277	248,045	310,557	292,266	16,075	255,308	346,499	346,149	46,457	266,064	449,494	304,816	40,826	248,045	449,494
Sold	281,308	13,984	250,315	313,851	297,591	16,091	260,540	350,581	355,847	49,227	271,383	458,437	310,588	43,957	250,315	458,437
Net Options Position	1,844	938	588	4,120	4,259	1,504	1,642	6,530	6,801	1,591	4,134	10,378	4,236	2,441	588	10,378
Net Foreign Curr. Pos.	-735	1,544	-3,079	4,551	-1,065	1,341	-3,950	1,096	-2,897	4,562	-28,254	3,730	-1,537	2,978	-28,254	4,551
Japanese Yen																
Purchased	1,174,884	129,819	862,888	1,337,054	1,312,536	58,531	1,199,145	1,468,428	1,271,913	45,341	1,199,114	1,399,273	1,253,111	103,465	862,888	1,468,428
Sold	1,191,411	134,236	874,875	1,365,093	1,336,203	57,870	1,224,818	1,490,934	1,296,519	47,154	1,216,101	1,417,403	1,274,711	107,324	874,875	1,490,934
Net Options Position	6,911	3,193	2,817	13,502	10,577	1,492	7,271	13,510	7,637	1,889	3,178	11,570	8,375	2,791	2,817	13,510
Net Foreign Curr. Pos.	-9,617	4,426	-19,010	-1,063	-13,090	3,328	-22,279	-3,708	-16,970	5,400	-26,547	-7,961	-13,226	5,363	-26,547	-1,063
GermanDeutschemark																
Purchased	1,232,485	98,380	1,067,557	1,437,706	1,258,810	101,758	1,034,980	1,550,656	1,147,923	73,983	1,026,553	1,306,086	1,213,073	103,173	1,026,553	1,550,656
Sold	1,240,520	98,152	1,076,488	1,444,947	1,248,017	101,838	1,025,430	1,540,893	1,152,835	73,145	1,030,836	1,309,379	1,213,791	101,103	1,025,430	1,540,893
Net Options Position	7,420	1,454	4,011	10,187	6,670	2,158	2,391	9,855	4,560	2,544	-1,731	9,856	6,217	2,415	-1,731	10,187
Net Foreign Curr. Pos.	-615	3,391	-6,499	8,726	17,463	3,610	11,528	25,362	-353	4,134	-7,607	10,780	5,499	9,260	-7,607	25,362
Canadian Dollar																
Purchased	119,390	10,986	98,309	131,709	157,294	19,529	125,835	204,780	143,738	8,775	130,058	161,527	144,295	20,009	98,309	204,780
Sold	116,396	11,377	94,216	129,758	152,145	18,955	123,918	198,939	139,770	8,285	125,667	156,359	140,047	19,193	94,216	198,939
Net Options Position	-1,307	606	-2,206	201	-1,642	629	-2,557	-103	-2,384	439	-3,211	-1,638	-1,868	704	-3,211	201
Net Foreign Curr. Pos.	1,687	679	261	2,823	3,507	1,490	956	6,462	1,583	1,138	-956	3,668	2,380	1,532	-956	6,462

Notes:

Purchased and Sold refers to spot, forward, and future contracts purchased and sold, respectively, in that currency.

Net Options Position is the net delta-equivalent value of the total options position. The delta-equivalent value is defined as the product of the first partial derivative of an option valuation formula times the notional principle of contract.

Net foreign currency position is defined as Purchased - Sold + Net Options Position.

All values above are in millions of U.S. dollars.

Table 2 - Currency Options Positions and Exchange Rate Volatility: Granger Causality Tests.
(major market participants, weekly, 1/5/94 - 12/25/96)

			H_0: Foreign Currency Options Positions Do Not Cause Exchange Rate Volatility.			H_0: Exchange Rate Volatility Does Not Cause Foreign Currency Options Positions.		
	# Obs.	Lag Length	Sum of Coeff.	F-stat	Level of Sig.	Sum of Coeff.	F-stat	Level of Sig.
Pooled Sample								
1 - week	726	3	2.22**	20.60	0.00	0.99	1.51	0.21
2 - weeks	712	5	0.92**	6.67	0.00	0.99	1.06	0.38
4 - weeks	712	5	0.42**	3.21	0.01	0.99	0.82	0.54
12 - weeks	641	13	0.11*	1.75	0.05	0.99	0.64	0.82
UK Sterling Pound								
1 - week	154	2	2.79**	13.66	0.00	0.95#	2.85	0.06
2 - weeks	153	3	1.14**	4.19	0.01	0.96*	3.30	0.02
4 - weeks	154	2	0.71*	4.29	0.02	0.96	1.58	0.21
12 - weeks	151	2	0.14	1.05	0.35	0.95#	2.80	0.06
Swiss Franc								
1 - week	142	4	3.20**	4.44	0.00	1.00	0.93	0.45
2 - weeks	142	4	2.20**	3.70	0.01	0.99	0.57	0.69
4 - weeks	140	5	0.66	0.96	0.45	0.99	1.00	0.42
12 - weeks	145	1	0.20	1.59	0.21	0.99	2.23	0.14
Japanese Yen								
1 - week	155	1	4.63**	63.40	0.00	1.00	0.36	0.55
2 - weeks	155	1	2.06**	22.87	0.00	1.00	0.00	0.97
4 - weeks	155	1	0.82**	8.29	0.01	1.00	0.04	0.84
12 - weeks	152	1	0.19	1.75	0.19	1.00	0.06	0.81
German D-mark								
1 - week	154	2	3.66**	16.91	0.00	1.00	0.26	0.77
2 - weeks	154	2	2.19**	13.41	0.00	1.00	0.48	0.62
4 - weeks	154	2	0.92**	5.67	0.00	1.00	0.07	0.93
12 - weeks	151	2	0.17	0.90	0.41	0.99	0.34	0.71
Canadian Dollar								
1 - week	127	1	1.94**	42.47	0.00	0.99	1.03	0.31
2 - weeks	125	2	1.32**	14.24	0.00	0.99	1.45	0.24
4 - weeks	127	1	0.38**	7.46	0.01	1.00	0.25	0.62
12 - weeks	122	2	0.09	2.03	0.14	0.99#	2.87	0.06

Notes:
1) **, *, # denote significance at one, five, and ten percent levels, respectively.
2) Lag lengths are determined by minimizing Schwartz-Bayes Information Criterion (SBIC).
3) Sum of coefficients in column 4 are multiplied by 10^4.

Table 3 - Spot, Forward & Futures Positions and Exchange Rate Volatility: Granger Causality Tests.
(major market participants, weekly, 1/5/94 - 12/25/96)

			H_0: Spot, Forward & Futures Positions Do Not Cause Exchange Rate Volatility.			H_0: Exchange Rate Volatility Does Not Cause Spot, Forward, & Futures Positions.		
	# Obs.	Lag Length	Sum of Coeff.	F-stat	Level of Sig.	Sum of Coeff.	F-stat	Level of Sig.
Pooled Sample								
1 - week	740	8	1.15**	2.57	0.01	1.00	0.60	0.78
2 - weeks	745	7	0.72**	3.44	0.00	1.00	0.70	0.67
4 - weeks	745	7	0.41**	3.20	0.00	1.00	0.29	0.96
12 - weeks	700	13	0.09	1.20	0.27	1.00	0.75	0.71
UK Sterling Pound								
1 - week	154	2	3.24**	19.23	0.00	0.99	0.46	0.63
2 - weeks	153	3	1.54**	5.43	0.00	0.98	0.84	0.48
4 - weeks	149	7	0.66#	1.78	0.10	1.00	0.41	0.90
12 - weeks	151	2	0.19	1.65	0.20	0.96	1.50	0.23
Swiss Franc								
1 - week	154	2	4.32**	15.41	0.00	1.00	0.06	0.94
2 - weeks	154	2	2.65**	12.90	0.00	1.00	0.11	0.89
4 - weeks	151	5	0.74	1.60	0.17	1.00	0.14	0.98
12 - weeks	151	2	0.22	1.08	0.34	0.99	0.43	0.65
Japanese Yen								
1 - week	154	2	3.25**	14.33	0.00	1.00	1.88	0.16
2 - weeks	153	3	1.24*	3.01	0.03	1.00	1.78	0.15
4 - weeks	154	2	0.75*	4.15	0.02	1.00	0.85	0.43
12 - weeks	151	2	0.17	1.03	0.36	1.00	0.34	0.71
German D-mark								
1 - week	154	2	3.60**	16.10	0.00	0.99	0.58	0.56
2 - weeks	154	2	2.06**	11.06	0.00	0.99	0.13	0.88
4 - weeks	155	1	0.76**	7.93	0.01	0.97	2.02	0.16
12 - weeks	152	1	0.09	0.62	0.43	0.97	2.73	0.10
Canadian Dollar								
1 - week	154	2	2.03**	20.78	0.00	1.00	0.59	0.56
2 - weeks	154	2	1.44**	21.70	0.00	1.00	0.29	0.75
4 - weeks	154	2	0.51**	6.87	0.00	0.99	0.39	0.68
12 - weeks	151	2	0.10	1.65	0.20	0.99	0.33	0.72

Notes:
1) **, *, # denote significance at one, five, and ten percent levels, respectively.
2) Lag lengths are determined by minimizing Schwartz-Bayes Information Criterion (SBIC).
3) Sum of coefficients in column 4 are multiplied by 10^4.

Table 4 - Total Currency Positions and Exchange Rate Volatility: Granger Causality Tests.
(major market participants, weekly, 1/5/94 - 12/25/96)

			H_0: Total Currency Positions Do Not Cause Exchange Rate Volatility.			H_0: Exchange Rate Volatility Does Not Cause Total Currency Position.		
	# Obs.	Lag Length	Sum of Coeff.	F-stat	Level of Sig.	Sum of Coeff.	F-stat	Level of Sig.
Pooled Sample								
1 - week	712	5	1.91**	7.92	0.00	1.00	1.06	0.38
2 - weeks	712	5	0.89**	5.26	0.00	1.00	0.20	0.96
4 - weeks	712	5	0.42**	3.20	0.01	1.00	0.67	0.65
12 - weeks	641	13	0.09	1.38	0.16	1.00	1.55	0.09
UK Sterling Pound								
1 - week	152	4	2.79**	7.26	0.00	0.99	1.00	0.41
2 - weeks	153	3	1.35**	7.35	0.00	0.98	1.09	0.35
4 - weeks	151	5	0.52	1.26	0.29	0.99	0.25	0.94
12 - weeks	150	3	0.16	1.96	0.12	0.97	0.72	0.54
Swiss Franc								
1 - week	144	3	3.92**	5.49	0.00	1.00	1.87	0.14
2 - weeks	144	3	2.43**	4.80	0.00	0.99	0.55	0.65
4 - weeks	140	5	1.29#	1.99	0.08	1.04	0.74	0.59
12 - weeks	141	3	0.45	1.65	0.18	0.95	1.92	0.13
Japanese Yen								
1 - week	154	2	3.35**	14.23	0.00	0.99	1.64	0.20
2 - weeks	151	5	0.90	1.59	0.17	1.00	1.70	0.14
4 - weeks	151	5	0.50	1.02	0.41	1.00	0.82	0.54
12 - weeks	151	2	0.17	0.85	0.43	1.00	0.32	0.73
German D-mark								
1 - week	154	2	4.11**	19.67	0.00	0.97	1.49	0.23
2 - weeks	154	2	2.60**	14.93	0.00	0.96	1.32	0.27
4 - weeks	151	5	0.77#	1.91	0.10	0.98	0.45	0.81
12 - weeks	151	2	0.21	1.02	0.36	0.93	2.11	0.13
Canadian Dollar								
1 - week	123	3	1.99**	7.18	0.00	1.01	0.30	0.83
2 - weeks	123	3	1.20**	5.52	0.00	1.00	0.41	0.75
4 - weeks	119	5	0.37	1.03	0.41	0.99	0.11	0.99
12 - weeks	120	3	0.15	1.19	0.32	0.98	0.74	0.53

Notes:

1) **, *, # denote significance at one, five, and ten percent levels, respectively.

2) Lag lengths are determined by minimizing Schwartz-Bayes Information Criterion (SBIC).

Sum of coefficients in column 4 are multiplied by 10^4.

Table 5 - Parametric Test: Foreign Exchange Rate Returns and Net Foreign Currency Position

(major market participants, weekly, 1/5/94 - 12/25/96)

Dependent Variable: ln(Spot $_{t+1}$) - ln(Spot $_t$)

	1-day	2-days	5-days	1-week	2-weeks	4-weeks	12-weeks
Pooled Sample							
Intercept	-33.1	-14.8	-13.3	24.1	41.5	-40.2	-2624.1
	(18.2)	(9.5)	(8.4)	(40.5)	(61.0)	(57.6)	(3092.1)
Net Foreign Currency Position	-0.04	0.01	-0.1	-0.01	0.1	1.4	-9.4
	(0.2)	(0.3)	(0.4)	(0.5)	(0.7)	(1.1)	(5.6)
# Obs.	736	728	681	737	732	732	729
Std. Err. Of Reg.	0.004	0.006	0.007	0.008	0.011	0.016	0.094
Adj. R^2	0.33	0.33	0.33	0.33	0.35	0.35	-0.03
British Pound							
Intercept	17.0	14.8	24.5	26.7	39.1	38.9	407.1**
	(9.5)	(14.5)	(18.8)	(22.7)	(30.6)	(40.3)	(129.8)
Net Foreign Currency Position	-1.9	-0.8	-2.5	-3.3	-3.9	1.7	-111.0*
	(1.7)	(2.6)	(3.5)	(4.7)	(6.7)	(9.3)	(50.7)
# Obs.	155	152	141	154	153	153	153
Std. Err. Of Reg.	0.007	0.010	0.013	0.015	0.021	0.028	0.140
Adj. R^2	0.0002	-0.006	-0.004	-0.003	-0.004	-0.006	0.043
Swiss Franc							
Intercept	-2.0	6.3	11.5	11.6	24.0	40.5	51.5
	(5.2)	(7.7)	(9.2)	(10.5)	(15.3)	(21.0)	(67.9)
Net Foreign Currency Position	0.9	1.8	3.1	2.7	6.0	9.2	108.2
	(0.9)	(1.3)	(1.9)	(2.8)	(4.9)	(5.3)	(57.0)
# Obs.	146	146	138	148	147	147	147
Std. Err. Of Reg.	0.006	0.009	0.010	0.012	0.017	0.025	0.112
Adj. R^2	-0.005	-0.003	0.002	-0.003	0.004	0.005	0.069
Japanese Yen							
Intercept	0.02	0.2	0.6*	0.8**	1.4**	2.8**	-53.1
	(0.1)	(0.2)	(0.2)	(0.3)	(0.4)	(0.6)	(45.6)
Net Foreign Currency Position	0.002	0.02	0.04*	0.1**	0.1**	0.2**	-12.5
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)	(7.8)
# Obs.	155	152	142	154	153	153	153
Std. Err. Of Reg.	0.0001	0.0001	0.0001	0.0002	0.0002	0.0003	0.079
Adj. R^2	-0.006	-0.0005	0.018	0.036	0.059	0.100	0.001
German D-mark							
Intercept	-2.6	-0.05	2.2	2.0	4.3	11.2	72.9*
	(2.6)	(4.3)	(5.8)	(6.7)	(9.4)	(13.0)	(31.3)
Net Foreign Currency Position	0.4	0.6	0.6	0.4	0.8	1.1	-2.5
	(0.4)	(0.6)	(0.7)	(0.8)	(1.1)	(1.9)	(2.8)
# Obs.	153	152	142	154	153	153	153
Std. Err. Of Reg.	0.004	0.006	0.007	0.009	0.012	0.018	0.035
Adj. R^2	0.001	0.001	-0.001	-0.004	-0.003	-0.004	-0.002
Canadian Dollar							
Intercept	-0.1	3.1	0.8	0.7	8.6	7.2	44.1*
	(2.3)	(3.4)	(5.1)	(6.0)	(8.5)	(13.5)	(21.2)
Net Foreign Currency Position	-0.9	-1.5	-0.8	0.2	-2.6	-0.3	-13.6*
	(1.0)	(1.3)	(2.4)	(2.7)	(3.5)	(4.5)	(6.8)
# Obs.	127	126	118	127	126	126	123
Std. Err. Of Reg.	0.002	0.002	0.004	0.004	0.006	0.009	0.013
Adj. R^2	-0.002	0.001	-0.007	-0.008	-0.004	-0.008	0.017

Notes:

1) ** and * denote significance at one and five percent levels, respectively.
2) Coefficients for Intercept and Net Foreign Currency Position are multiplied by 10^4 and 10^7, respectively.
3) Panel regression includes currency and time (week) dummy variables, not reported here.

Table 6 - Non-Parametric Tests: Conditional Probability of a Correct Net Foreign Currency Position.

Currency	Time Horizon (# of days)	N	N_1	N_2	$P_1(t)$	+	$P_2(t)$	=	P(t)
All Currencies									
	1	736	379	357	0.51		0.55		1.06*
	2	728	373	355	0.53		0.57		1.10**
	5	681	343	338	0.48		0.52		1.01
	7 (1-week)	737	365	372	0.47		0.52		0.99
	14 (2-weeks)	732	351	381	0.52		0.56		1.08*
	28 (4-weeks)	732	346	386	0.51		0.55		1.05
	84 (12-weeks)	729	368	361	0.47		0.51		0.98
British Pound									
	1	155	65	90	0.12		0.96		1.08*
	2	152	68	84	0.09		0.93		1.02
	5	141	68	73	0.07		0.90		0.98
	7 (1-week)	154	64	90	0.06		0.91		0.97
	14 (2-weeks)	153	63	90	0.08		0.92		1.00
	28 (4-weeks)	153	68	85	0.09		0.93		1.02
	84 (12-weeks)	153	69	84	0.03		0.88		0.91
Swiss Franc									
	1	146	83	63	0.82		0.19		1.01
	2	146	77	69	0.87		0.26		1.13*
	5	138	66	72	0.80		0.19		1.00
	7 (1-week)	148	70	78	0.81		0.21		1.02
	14 (2-weeks)	147	67	80	0.85		0.24		1.09
	28 (4-weeks)	147	63	84	0.86		0.24		1.10
	84 (12-weeks)	147	72	75	0.83		0.23		1.06
Japanese Yen									
	1	155	78	77	1.00		0.00		1.00
	2	152	88	64	1.00		0.00		1.00
	5	142	75	67	1.00		0.00		1.00
	7 (1-week)	154	81	73	1.00		0.00		1.00
	14 (2-weeks)	153	88	65	1.00		0.00		1.00
	28 (4-weeks)	153	85	68	1.00		0.00		1.00
	84 (12-weeks)	153	90	63	1.00		0.00		1.00
German Deutschemark									
	1	153	83	70	0.45		0.64		1.09
	2	152	74	78	0.47		0.64		1.11
	5	142	73	69	0.44		0.62		1.06
	7 (1-week)	154	82	72	0.35		0.54		0.90
	14 (2-weeks)	153	68	85	0.44		0.62		1.07
	28 (4-weeks)	153	68	85	0.44		0.62		1.07
	84 (12-weeks)	153	79	74	0.28		0.45		0.72
Canadian Dollar									
	1	127	70	57	0.03		0.95		0.98
	2	126	66	60	0.03		0.95		0.98
	5	118	61	57	0.02		0.95		0.96
	7 (1-week)	127	68	59	0.01		0.93		0.95
	14 (2-weeks)	126	65	61	0.03		0.95		0.98
	28 (4-weeks)	126	62	64	0.00		0.92		0.92
	84 (12-weeks)	123	58	65	0.00		0.92		0.92

Notes:

1) ** and * denote confidence levels of 1 percent and 5 percent, respectively, using a one-tailed test.

2) Null hypothesis is that the combined conditional probabilities equals one, $H_0 : P_1(t) + P_2(t) = 1.00$.

3) N = total number of observations; N_1 = number of observations where $S(t+1) - S(t) \leq 0$; N_2 = number of observations where $S(t+1) - S(t) > 0$; $P_1(t)$ is the conditional probability of a correct position given $S(t+1) - S(t) \leq 0$; $P_2(t)$ is the conditional probability of a correct position given $S(t+1) - S(t) > 0$.

Table 7 - Non-Parametric Tests: Conditional Probability of a Correct Change in Net Foreign Currency Position

Currency	Time Horizon (# of days)	N	N_1	N_2	$P_1(t)$	+ $P_2(t)$	= P(t)
All Currencies							
	1	729	374	355	0.50	0.44	0.94
	2	721	370	351	0.49	0.43	0.92
	5	674	341	333	0.52	0.47	0.98
	7 (1-week)	730	364	366	0.51	0.45	0.96
	14 (2-weeks)	725	349	376	0.54	0.48	1.02
	28 (4-weeks)	725	344	381	0.54	0.48	1.01
	84 (12-weeks)	722	366	356	0.54	0.48	1.02
British Pound							
	1	154	64	90.00	0.44	0.44	0.88
	2	151	68	83	0.52	0.52	1.03
	5	140	68	72	0.53	0.53	1.06
	7 (1-week)	153	64	89	0.48	0.47	0.96
	14 (2-weeks)	152	63	89	0.44	0.45	0.89
	28 (4-weeks)	152	68	84	0.53	0.50	1.03
	84 (12-weeks)	152	68	84	0.50	0.49	0.99
Swiss Franc							
	1	144	82	62	0.57	0.44	1.01
	2	144	76	68	0.50	0.34	0.84
	5	136	66	70	0.55	0.43	0.97
	7 (1-week)	146	70	76	0.53	0.38	0.91
	14 (2-weeks)	145	67	78	0.61	0.45	1.06
	28 (4-weeks)	145	63	82	0.54	0.40	0.94
	84 (12-weeks)	145	71	74	0.61	0.45	1.05
Japanese Yen							
	1	154	78	76	0.44	0.46	0.90
	2	151	88	63	0.43	0.43	0.86
	5	141	75	66	0.39	0.41	0.80
	7 (1-week)	153	81	72	0.46	0.47	0.93
	14 (2-weeks)	152	88	64	0.51	0.55	1.06
	28 (4-weeks)	152	85	67	0.49	0.54	1.03
	84 (12-weeks)	152	90	62	0.48	0.52	0.99
German Deutschemark							
	1	152	82	70	0.57	0.40	0.97
	2	151	74	77	0.55	0.38	0.93
	5	141	73	68	0.62	0.43	1.04
	7 (1-week)	153	82	71	0.59	0.41	0.99
	14 (2-weeks)	152	67	85	0.67	0.47	1.14*
	28 (4-weeks)	152	68	84	0.62	0.44	1.06
	84 (12-weeks)	152	79	73	0.61	0.43	1.03
Canadian Dollar							
	1	125	68	57	0.46	0.46	0.91
	2	124	64	60	0.45	0.48	0.94
	5	116	59	57	0.51	0.54	1.05
	7 (1-week)	125	67	58	0.51	0.52	1.03
	14 (2-weeks)	124	64	60	0.48	0.50	0.98
	28 (4-weeks)	124	60	64	0.50	0.52	1.02
	84 (12-weeks)	121	58	63	0.50	0.52	1.02

Notes:

1) ** and * denote confidence levels of 1 percent and 5 percent, respectively, using a one-tailed test.

2) Null hypothesis is that the combined conditional probabilities equals one, $H_0 : P_1(t) + P_2(t) = 1.00$.

3) N = total number of observations; N_1 = number of observations where $S(t+1) - S(t) \leq 0$; N_2 = number of observations where $S(t+1) - S(t) > 0$; $P_1(t)$ is the conditional probability of a correct position given $S(t+1) - S(t) \leq 0$; $P_2(t)$ is the conditional probability of a correct position given $S(t+1) - S(t) > 0$.