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ARE BANKS MARKET TIMERS OR MARKET MAKERS? EXPLAINING FOREIGN EXCHANGE TRADING PROFITS

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ABSTRACT

We analyze the foreign exchange trading earnings of large U.S commercial banks over the past several years. In particular, we use several approaches to try to determine to what extent these profits can be attributed either to position-taking by banks or to the provision of intermediation services to bank customers. The results can be summarized as follows. First, banks appear to generate a substantial portion of their foreign exchange earnings from making markets in conventional spot and forward foreign exchange contracts. In addition, some indirect evidence supports anecdotal reports that intermediation in volatility-related products (e.g., options contracts) has been a significantly profitable activity. Finally, on average, positions in currencies do not appear to contribute to profits. Tests applied to monthly and daily data on banks' portfolio positions suggest that banks cannot accurately forecast changes in exchange rates, and that these currency positions account for only a small fraction (if any) of the banks' foreign exchange earnings.

Are Banks Market Timers or Market Makers? Explaining Foreign Exchange Trading Profits

John Ammer and Allan D. Brunner[1]

1. Introduction

This paper examines the sources of foreign exchange trading profits at several large U.S commercial banks over the past several years. Foreign exchange trading profits at seven of the largest foreign exchange players among U.S. commercial banks grew at a 17 percent annual rate between 1984 and 1993 (see Figure 1) and accounted for about 60 percent of all trading profits for those years and about 20 percent of total bank earnings. A natural question to ask is whether these revenues were the result of banks taking profitable positions or, rather, were they derived from an increasing level of intermediation services? The answer to this question has several important implications.

First, if positions were a major source of profits, it would imply a failure of several forms of the efficient market hypothesis (EMH). As stated by Malkiel (1987), the semi-strong form of the EMH asserts that all publicly available information relevant to a particular exchange rate must be fully incorporated in the market rate, while the strong form further requires that the market rate include all information known to any market participant. Therefore, these versions of the EMH rule out the possibility that banks may have earned abnormal economic profits from taking positions in foreign exchange. Although the general

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tenets of the EMH are widely accepted on theoretical grounds, a few recent empirical studies have found evidence that some professional portfolio managers may be able to persistently outperform market benchmarks.[2]

Second, the source of foreign exchange trading profits also has implications for the sustainability of earnings. Although the persistence of intermediation earnings depends on aggregate volume, market share, and either bid-ask spreads (for generic instruments) or mark-ups (for customized products), they likely have longer-lasting effects on the bottom line than do profits from positions that may have been merely a temporary windfall. Equity securities of large U.S. commercial banks tended to trade in the early 1990s at significantly lower multiples of current earnings than the U.S. stock market as a whole, suggesting that investors were relatively pessimistic about the likely stream of future bank earnings.[3] Moreover, articles in the popular financial press reported some misgivings on the part of investors concerning bank trading activities, indicating that at least part of the weakness in bank stock prices in the early 1990s can be attributed to investors' concerns regarding the sustainability of trading profits.[4]

Finally, the source of trading profits has implications for the variability of earnings and, consequently, for the riskiness of bank capital. It is possible that banks are devoting significant resources to proprietary trading activities without appropriate increases in economic

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[2] For example, see Grinblatt and Titman (1992).

[3] Based on information extracted from the Value Line Investment Survey, we found that for the period 1990-1994, the average P/E ratio for the ten largest U.S. commercial bank players in foreign exchange markets was typically about 60 percent of the average P/E ratio for the U.S. stock market as a whole.

[4] See, for example, The Economist, April 10, 1993.

profits. Such circumstances would tend to increase the volatility of earnings and possibly reduce the value of the banking firm.[5]

In this paper, we examine four possible sources of foreign exchange trading profits -- outright positions in spot and forward exchange contracts, outright positions in derivative securities, market-making services in spot and forward exchange contracts, and market-making services in derivative securities. The first two sources are associated with position-taking activity, and the last two sources are related to intermediation. We take several approaches to identify which sources can account for foreign exchange trading profits. We first test whether banks' foreign exchange positions predict future changes in exchange rates, which is a necessary condition for banks to generate position-taking profits. We then undertake some direct calculations of intermediation profits using available spread and volume data on spot and forward contracts. Finally, we indirectly examine whether these sources can actually account for observed bank earnings by regressing bank profits on data proxies for each of the four possible sources of foreign exchange profits.

The remainder of the paper is organized as follows. Section 2 offers a conceptual decomposition of foreign exchange trading profits, and section 3 describes the survey data on banks' portfolio positions that we use. Section 4 presents the results of regressing bank positions on future changes in exchange rates. Section 5 discusses our direct calculation of intermediation earnings. Section 6 presents the results of regressing foreign exchange profits

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[5] Azarchs (1994) found that the trading income of a few large U.S. institutions accounted for less of the variance of total earnings than their did traditional lines of business. However, without accounting for the relative magnitude of the two activities, one cannot determine from these which activity tends to produce more volatile earnings.

on proxies for several sources of profits. The final section summarizes our conclusions.

2. Sources of Foreign Exchange Revenues

For the purposes of this paper, we assume that banks' foreign exchange trading profits are derived from four identifiable sources. Banks could profit from outright positions (long or short) either in exchange rates themselves via spot and forward foreign exchange contracts or in the *second* moments of exchange rates (volatility) through derivative securities. For example, if a bank has a short yen position over a period during which the yen depreciates against the dollar, then the bank profits from its yen position.[6]

Note that it is also possible for a bank to take a position in the volatility of a currency while maintaining a zero position in the level of the currency. Suppose a bank writes (sells) both put and call options on the Swiss franc. The sold puts constitute a long position in the franc, and the sold calls are a short position. It is possible for the bank to arrange for these two holdings to balance to a net zero exposure to the level of the $/SFr exchange rate (although maintaining the neutral position over time would require dynamic hedging). Nevertheless, the bank is taking a short position in the volatility of the dollar-franc exchange rate, because the value of both the put and the call options are increasing in the volatility of the underlying assets. Ceteris paribus, this bank would profit from a decrease in volatility.

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[6] This conclusion ignores the complication that the bank is a net payer of yen interest and a net receiver of dollar interest over the period in question. If Japanese interest rates sufficiently exceeded U.S. interest rates over the period in question, a short yen position could be a losing position even if the yen depreciates. Because of data constraints that are mentioned below, we will not consider the effects of differentials between domestic and foreign interest rates.

In addition, banks can profit from providing market-making services to their customers by intermediating in either spot and forward foreign exchange markets or in volatility-related markets, including the sale of customized derivative products. For example, if a bank stands ready to buy British pounds at $1.6415 and sell them at $1.6425, it will earn $1,000 from each "round trip" transaction (given a contract size of one million pounds). Similarly, a bank may profit from selling an option to a customer, if it can hedge its consequent exposure at a lower cost than the option premium.

Let $\pi_{b,t+1}$ denote the trading profits earned by bank "b" between time t and t+1. The four components can be written as:

$$\begin{aligned} \pi_{b,t+1} &= \sum_{c=1}^{C} \Delta e_{c,t+1} \cdot N_{bc,t} + \sum_{c=1}^{C} \frac{1}{2} \cdot S_{c,t+1} \cdot Q_{bc,t+1} \\ &+ \sum_{c=1}^{C} \Delta \rho_{c,t+1} \cdot NV_{bc,t} + \sum_{c=1}^{C} \frac{1}{2} \cdot SV_{c,t+1} \cdot QV_{bc,t+1} \end{aligned} \tag{1}$$

where $\Delta e_{c,t+1}$ denotes the change in the exchange rate of the US$ relative to currency "c" between time t and t+1; $N_{bc,t}$ is the net position taken by bank b at time t in currency c; $S_{c,t+1}$ represents the average bid-ask spread for currency c between t and t+1; $Q_{bc,t+1}$ denotes the volume of spot and forward foreign exchange trades in currency c by bank b with customer counterparties; $\Delta\rho_{c,t+1}$ denotes the change in value of a unit position in volatility for currency "c" between time t and t+1; $NV_{bc,t}$ is the net position in volatility by bank b in currency c; $SV_{c,t+1}$ represents the average rate of profit for volatility-related intermediation in currency c between t and t+1; and $QV_{bc,t+1}$ denotes the volume of volatility-related activity by bank b for

currency c.

If sufficiently high frequency data (i.e., transactions level) were available for all components in equation (1), it would be a straightforward accounting exercise to determine the proportion of bank trading profits that fell into each of our four categories. We will have to make do with lower frequency data and proxies for some of the variables. The next section of the paper describes survey data that regulatory institutions have collected on banks' trading positions.

3. Survey Data on Bank Portfolio Positions

Our empirical analysis uses survey data that has been collected by federal agencies.[7] Since 1990, federal financial regulators have required banks that undertake a significant volume of trading in foreign exchange and related instruments to file FFIEC form number 035, a fairly comprehensive monthly report on foreign currency portfolio positions.[8] Respondents to this survey report details of their foreign exchange trading positions, including their gross open (i.e., unsettled) foreign exchange contracts (spot, forward, and futures) and their "net dealing position" in each of six major foreign currencies -- Deutsche marks, yen,

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[7] These data are also examined in a recent Federal Reserve Board staff study by Michael Leahy, "FFIEC 035 Data and Exchange Rate Movements".

[8] Generally banks that have had gross foreign exchange trading volume of at least $1 billion in the most recent third quarter are required to file the 035 report. Other banks with "significant foreign exchange activities" may be specifically requested to file the 035 report by their primary federal regulator.

sterling, Swiss francs, Canadian dollars, and Australian dollars.[9] The gross futures positions are reported separately, but forward and spot positions are lumped together as a single category. This last feature of the data is unfortunate, because it makes it impossible to determine the contribution of interest rate differentials to profits. For example, suppose a bank has a net short position in yen of $10 million. This position might be comprised, in part, of a $20 million short position in forward yen. In this case, the bank would likely be earning (positive) net income on yen-denominated assets. Alternatively, the forward yen position might be neutral, in which case the bank would probably be a net payer of yen interest.

There are also some data on options positions. For each currency, the banks report the number of call options purchased, the number of calls written, the number of put options purchased, and the number of puts written. In addition, banks are asked to provide the consequent ("delta equivalent") position in each currency as a result of options contracts. However, no information is requested in the survey about the strike prices or the maturities of the options in the respondent bank's portfolio.

From among the respondents to the 035 survey, data limitations led us to focus on seven banks. Each of these banks was among the ten U.S. banks with the highest level of foreign exchange trading activity in April 1992, according to a joint central bank survey.

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[9] Through 1992, the survey applied to close of business on the second Wednesday of the month. Since the beginning of 1993, it has been on a month-end basis. The net dealing position is the "actively managed" position in the currency that is used for internal risk monitoring of the bank's traders. This figure would generally account for Euro-deposits and derivatives positions as well as unsettled spot and forward currency commitments. The implicit underlying concept of this measure is the exposure of the bank to exchange rate fluctuations as a consequence of positions taken by its traders.

Figure 2 depicts the gross positions (both long and short) for our sample of seven banks in unsettled spot, forward, and futures transactions in the aggregate of the six major currencies mentioned above. This rough measure of market activity (which may include long-term forward contracts entered into in previous years) has risen by about half since the summer of 1991 to approximately $3-1/2 trillion. The path of this variable over the past three years suggests that it is positively correlated with both domestic and foreign business cycles.

Figure 3 shows the aggregate of the net foreign currency dealing positions of these banks in the above-mentioned currencies expressed as a percentage of the aggregate gross position. The fact that the magnitude of this ratio has never exceeded 0.2 percent -- so that open long positions are almost exactly balanced by open short positions -- suggests that the scope of the banks' intermediation operations vastly exceeds that of their position-taking activities, at least to the extent that positions are held overnight.[10] It is also worth pointing out that the net foreign currency position of these banks has sometimes been short in the aggregate. As shown in Figure 4, these banks often had short positions in the Deutsche mark and Swiss franc which were offset by long positions in the yen and Australian dollar.

To our surprise, the net dealing positions of the seven banks in our sample seem to be somewhat persistent over time, although they do appear to be mean-reverting. Table 1 shows that the first-order autocorrelations of the reported positions are nearly always positive, are

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[10] This inference is further supported by the fact that the magnitude of this net-gross ratio is also consistently very small for individual bank positions in each currency. However, the need to respect the confidentiality of the individual banks' 035 responses precludes us from showing this ratio on a disaggregated basis.

positive with 95 percent confidence in 24 out of 42 cases, and run as high as 0.89.[11] For each of the six currencies, the sum of the positions of the seven banks exhibits a positive first-order autocorrelation (see the bottom row of table) that is significant at the 95 percent level. Overall, the results in Table 1 suggest that at least some of the positions are being taken with a view as to how markets will move over a period of several weeks or more. This implication is puzzling, given that one would expect any advantage that traders might have in forecasting to be for shorter horizons and associated with private information about order flow and market liquidity.[12] Similar time series properties are evident in a short span of daily net position data that were available for one of the banks.

4. Foreign Currency Positions and Associated Profits

If banks have some ability to forecast future changes in exchange rates, then they ought to be able to earn significant profits by actively seeking long and short positions in foreign currencies. That is, any predictive powers would be reflected in their foreign exchange positions. For example, one would expect a bank to be long in yen if it was forecasting a yen appreciation in the near future. Conversely, without any forecasting ability, they should reap zero profits, on average, from taking positions. In this case, banks' foreign exchange positions should have no predictive power for future exchange rate movements.

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[11] Individual bank position autocorrelations have been suppressed because the position data are confidential.

[12] Of course, it may be the case that most of the positions taken by these banks are unwound within the trading day. The 035 data give no hint of the typical magnitudes of intraday positions.

In this section, we explore this possibility using net dealing position data from the 035 survey. Figure 5 shows the total net position of the banks along with a trade-weighted index of the exchange value of the U.S. dollar. If the banks are typically taking what turn out to be profitable positions in foreign currencies, one would expect short positions to be followed by dollar appreciation and long positions to presage depreciation. It is difficult to discern such a pattern from the figure.

We pursue the question of whether positions predict exchange rates somewhat more systematically by estimating the following regression equation:

$$\Delta e_{c,t+1} = \mu_{bc} + \psi_{bc} N_{bc,t} + \epsilon_{bc,t+1} \qquad (2)$$

for each bank (b) and currency (c). Here, Δe_c denotes the percent change in the (spot) exchange value of foreign currency c (e.g., dollar per yen), N_{bc} is the net dealing position of bank b in currency c, and the μ and ψ are parameters to be estimated. Positive estimates for the ψ would imply that the banks are profitably predicting exchange rate movements.[13]

Note that equation (2) provides a direct test of the strong form of the efficient market hypothesis, which states that exchange rates should reflect all fundamental information known by any market participant. This test is somewhat stronger than the usual tests of whether publicly-available information can be used to forecast future exchange rate changes. These

[13] Note that we use only the spot exchange rate to judge profits, although the net positions (N) include open forward contracts and futures positions. If, for example, the interest rate differential changed during our measurement period, the forward exchange rate would not move one-for-one with the spot rate. However, in practice, changes in spot and forward exchange rates among major currencies have been highly correlated.

weaker tests have provided somewhat mixed results. Meese and Rogoff (1983a, 1983b) and others have found that random-walk models out-perform other models of exchange rates, indicating that all publicly-available information is incorporated in market rates. On the other hand, studies that have examined survey measures of exchange rate expectations reject that those data follow a random walk; see, for example, Frankel and Froot (1987).

One remaining procedural issue is the length of the time period over which to measure the change in the exchange rate; we report estimates for several time horizons. Results for each bank are summarized in Table 2 for an overnight horizon -- from 4 pm (the New York close) on the day of the 035 survey until 9 am on the next business day.[14] Because it uses the shortest possible horizon, this specification has the advantage that the banks' positions are measured relatively accurately over the evaluation period. Because the New York market is closed, many of the traders will not be changing their positions until the next morning.[15] The drawback is that we are only assessing the performance of the banks' foreign exchange positions for seventeen hours per month over our four-year sample. Note that roughly half (22 out of 42) of the estimates of ψ are negative and that only about 5 percent of the estimates (two out of 42) are significant at the 5 percent level. This evidence is consistent with the notion that the banks are not able to predict overnight changes in exchange rates.

The bottom row of the table shows estimates of ψ for the aggregate of the seven banks. Only three out of six are positive, and none of the estimates are statistically

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[14] Note that this period runs over the weekend in a few cases. The confidential nature of the 035 data precluded reporting the regression coefficients.

[15] However, because these banks can also trade in the European and Asian markets, their net dealing positions do not stay fixed even overnight.

significant.

The first six columns of Table 2 suggest that overall, the banks were as likely to lose as to profit from their positions in individual currencies. A natural question to ask is whether the banks made or lost money on their overall foreign exchange positions. To address this issue, we define a bank's overall net foreign exchange position as the sum of its positions in each currency:

$$N_{b,t} = \sum_{c=1}^{C} N_{bc,t} \tag{3}$$

We also define an exchange rate index for each bank for each time period. The percent change in the exchange rate index for a bank is computed using the bank's foreign exchange positions as weights:

$$\Delta e_{b,t+1} = \frac{\sum_{c=1}^{C} N_{bc,t} \, \Delta e_{c,t+1}}{N_{b,t}} \tag{4}$$

A bank's profit from its overall foreign exchange position in a period is given by the product:

$$\pi_{b,t+1} = \Delta e_{b,t+1} \, N_{b,t} \tag{5}$$

Thus we can investigate whether banks' overall positions predict changes in the relevant exchange rate index by estimating:

$$\Delta e_{b,t+1} = \mu_b + \psi_b N_{b,t} + \epsilon_{b,t+1} \quad (6)$$

The rightmost column of Table 2 reports that there were positive estimates of ψ for three of the seven banks and negative estimates for four, although none of the banks exhibited a statistically significant correlation between its overall position and the subsequent change in the relevant exchange rate index. The overall position of the aggregate of the banks seems to have been only minimally profitable on average, as indicated by the small and insignificant value (.02) in the lower right corner of the table -- which is the estimate of ψ when equation (6) is estimated for the aggregate of the banks.

Table 3 summarizes estimates of equations (2) and (6) for exchange rate changes over the twenty business days following each 035 survey date. This specification has the advantage of assessing the positions relative to most of the exchange rate movements during the three-year sample period. The disadvantage is that the banks' positions are not measured accurately, as they evolve over the twenty days. However, the persistence in positions implied by Tables 1 suggests that foreign exchange positions often bear some resemblance to where they stood a month earlier. The 20-day results are similar to those of the overnight exercise in that roughly half of the ψ estimates are negative and that only one is statistically significant. The table implies that if positions were maintained for this horizon, four of the banks lost money on their foreign exchange positions as did the banks as a group.

Table 4 reports estimates for an intermediate horizon of five business days. These results are similar to those of Tables 2 and 3 -- again, roughly half of the ψ estimates are negative and few are statistically significant. As at the overnight horizon, the seven banks appear to have made a small profit on their total position in foreign currencies, although the

positive parameter estimate in the lower right corner of the table is still not statistically significant.

An issue that naturally arises is how much profit is associated with the positive coefficients in the lower right corner of Tables 2 and 4. Before answering this question, it is useful to decompose position-taking profits as follows:

$$\Delta e_{bc,t+1} N_{bc,t} = \Delta e_{bc,t+1} \overline{N}_{bc} + \Delta e_{bc,t+1} \tilde{N}_{bc,t} \quad (7)$$

where $\overline{N}_{bc}$ denotes the average position over time of bank b in currency c, and $\tilde{N}_{bc,t}$ is the deviation in month t of N from its mean. Because our prediction regressions included an intercept term, the results reported in Tables 2 through 4 only pertain to the contribution (or lack thereof) of the second component of equation (7). Positive entries in those tables were engendered whenever a longer-than-average position (even if it may still be a short position) in a foreign currency portended a stronger-than-average move in that currency (even if it were still depreciating against the dollar). Estimates of this second component, under the assumption that the 035 positions were held for five days, yield $18 million per quarter in profits for the seven banks combined, less than 5 percent of the average foreign exchange profits of these banks. Applying the same calculation to an overnight holding period yielded even smaller quarterly position earnings, and the calculation for the 20-day horizon resulted, of course, in a negative profit estimate.

In addition, the first component of equation (7) seems to have contributed about $7

million per quarter, or less than 2 percent, to the foreign exchange earnings of these banks.[16] The banks were fortunate in that, on average, they were long in yen over the whole period. The yen was the only one of these currencies to appreciate significantly on balance over the fifteen-quarter sample period, rising about 55 percent, more than enough to produce quarterly earnings of $7 million on the average long yen position of the banks.

We also estimated equations (2) and (6) with the short span of daily data that was available for one bank. Our results were similar to those reported in Tables 2, 3, and 4.

Our analysis suggests that the banks' end-of-day positions accounted for less than 10 percent of their foreign exchange income during 1990-1994, and may have made a negative contribution. Nevertheless, it is possible that these banks are systematically earning profits on intraday positions that we cannot observe. However, the taking of positions in currency is essentially a zero-sum game, at least in money terms (but not necessarily utility). If the banks are making money, someone must be losing.[17] Because random trading would tend to lead to zero profits (net of transactions costs, including the bid-ask spread), the notion of a systematic loser is somewhat paradoxical. Perhaps the most plausible candidate is central banks, the only market participants not pursuing a goal of profit maximization. Occasionally circumstances have arisen, such as the faltering of the Exchange Rate Mechanism (ERM) in Europe in August and September 1992, that appear to offer an ex-ante profit opportunity to

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[16] The assumption implicit in this calculation is that the means of the net positions in the 035 survey results equal the mean net positions over the period.

[17] However, to the extent that, with a single transaction, banks may be both taking a position and providing intermediation services to a customer, such a transaction would not be purely of a zero-sum nature.

anyone in a position to trade foreign exchange.

5. Direct Calculations of Foreign Exchange Intermediation Returns

In this section, we attempt to measure intermediation earnings directly. If complete data were available on every foreign exchange trade that a bank made -- including the transaction price, the quantity traded, and the prevailing bid and ask prices in the market at the time of the trade -- it would be possible to construct a fairly precise measure of the returns to market-making. For example, for each trade, one might multiply the quantity traded by the difference between the transaction price and the prevailing mid-market price (i.e., the midpoint between the bid and ask prices).

It is also possible to estimate intermediation earnings with less comprehensive price and volume data. Turnover data for the seven most important foreign exchange markets (ranked by the trading volume involving U.S. counterparties) in April 1992 were collected from the seven banks in our sample, among other financial institutions, in a survey compiled by the Bank for International Settlements (BIS).[18] The survey distinguished between trades among foreign exchange dealers and trades between a dealer and a non-dealer. The latter transactions are those in which we expect our banks to be compensated for providing liquidity services.

A rough estimate of the portion of the foreign exchange earnings of our seven banks that can be attributed to intermediation in these currency markets can be obtained by

[18] The seven markets are the U.S. dollar markets for yen, DM, sterling, Swiss francs, Canadian dollars, Australian dollars, and French francs.

multiplying their volume of trade in these markets with non-dealer counterparties by half of the average market bid-ask spread during April 1992.[19] (These seven markets, defined to include both spot and forward transactions, account for about 85 percent of the foreign exchange trading of the seven banks.) This measure amounted to $115 million (at a quarterly rate) for the aggregate of the seven banks, about 30 percent of both 1992 Q2 foreign exchange earnings and of the average for these banks between 1990 Q3 and 1994 Q1.

For several reasons, the above measure likely understates banks' earnings from providing liquidity services in foreign exchange markets. Perhaps the most obvious is that the estimate does not take account of all of the currencies in which the banks trade. Furthermore, minor currency markets are less liquid, and the spreads are wider in those markets, so that a given volume of trading will be more profitable to a market-making bank.

Second, the measure does not include any measure of the banks' trading in foreign exchange derivatives markets, including customized over-the-counter products. These activities have grown rapidly in magnitude and may contribute significantly to profits. Anecdotal evidence suggests that banks may earn more from providing liquidity to a customer who wishes to take or hedge a position in the second moment of a price (e.g., exchange rate risk) than from servicing a customer concerned with the first moment (e.g., taking a position in the level of an exchange rate).

Third, spreads in forward currency markets are almost invariably wider than in the

[19] Only about a quarter of the trading volume was with non-dealer counterparties.

spot market.[20] About half of the trading volume of the six banks was in forward contracts. A casual inspection of wire service quotes undertaken recently suggested that 12-month forward spreads could be up to twice as much as spot spreads, even in heavily-traded currencies. In addition, Bessembinder (1994) reports average spreads for 6-month forwards that are 1-1/2 to 2 times as large as spot spreads. Lacking proper data on forward spreads, we used the spot spread on forward contracts in the above calculation.[21]

Fourth, our calculation was based on market spreads -- the difference between the highest bid and the lowest ask. This is merely a lower bound on an individual bank's bid-ask spread. Some non-dealer customers may face a spread that is wider than the market spread.

Fifth, April 1992 was almost certainly a below-average month for intermediation profits. The mean spread was about 20 percent below its 1985-1993 average in all of the currencies except the Canadian dollar. Second, a proxy for exchange market activity drawn from the 035 data (the same that was shown in figure 2) was 3 percent below trend in the April 8 survey.

Finally, intermediation earnings may be further understated because of a positive correlation between volume and spreads that is masked by time aggregation of the data. Both trading volume and bid-ask spreads are thought to increase during episodes of market volatility, spreads because market makers are believed to require compensation for increased

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[20] The manner in which forwards are quoted -- as add-ons to the spot rate -- practically ensures that forward spreads will be wider than spot spreads.

[21] Nor did we have a comprehensive breakdown of forward contracts by maturity.

risk.[22] If trading tends to be concentrated when the spread is highest, the product of total monthly volume by an unweighted average of the spread will fall short of a (more accurate) higher frequency calculation.

Given that all of these sources of error bias our calculation in the same direction, it seems plausible that intermediation earnings could be understated by as much as a factor of three or four, enough so that if they were correctly measured, they could completely account for mean foreign exchange earnings.

6. A Regression Approach to Explaining Observed Profits

In the two previous sections, we examined two possible sources of foreign exchange trading profits -- position-taking and intermediation activity in spot and forward foreign exchange rate markets. This section uses an indirect method to determine the importance of these and other sources of profits for which data are not available, by regressing quarterly bank profits on proxies for the unobserved data.

Although the 035 data provide banks' net positions in several currencies, these data provide only proxies for intermediation volumes, net positions in volatility, and volatility-related activity for those currencies. In addition, although we were able to obtain bid and ask exchange rates for several currencies, we were not able to obtain either the changes in value of net positions in volatility or bid and ask rates for volatility-related

[22] Bessembinder (1994) found that spreads in four major currency markets were increasing in both conditional exchange rate volatility and innovations to trading volume. In the model of Tauchen and Pitts (1983), asset market trading volume is associated with the rate of information arrival.

activity, both of which are required to decompose profits as described in equation (1).

As a consequence, we made several assumptions about those missing variables. First, we assume that the volume of customer-related activity of a bank is proportional to the gross sum of all purchased and sold foreign exchange spot and forward contracts. Second, we assume that a bank's net position in volatility is proportional to the number of put and calls purchased less those sold; and we assume that the change in the value of these positions for a particular currency is a linear function of the change in the volatility of that currency. Also, we assumed that a bank's volume of volatility-related intermediation activity is proportional to the number of put and calls written and that the bid-ask spreads on these activities are linear functions of the currency volatility. Finally, we assumed that, for each variable reported by a bank on the 035, a simple average of the three numbers in any given quarter equalled the appropriately weighted mean value of the variable in that quarter.

Using these assumptions, the profits decomposition in equation (1) can be rewritten as a panel regression equation:

$$\begin{aligned} \pi_{b,t+1} &= \mu_b + \sum_{c=1}^{C} \alpha_c \cdot \Delta e_{c,t+1} \cdot N_{bc,t} + \sum_{c=1}^{C} \beta_c \cdot S_{c,t+1} \cdot Q_{bc,t+1} \\ &+ \sum_{c=1}^{C} \gamma_c \cdot \Delta \sigma^2_{c,t+1} \cdot NV_{bc,t} + \sum_{c=1}^{C} \delta_c \cdot \sigma^2_{c,t+1} \cdot QV_{bc,t+1} + \epsilon_{b,t+1} \end{aligned} \tag{8}$$

where μ_b represents a bank-specific constant; where α_c, β_c, γ_c and δ_c are expected to be positive; and where the remaining components have been described above. The change in each exchange rate is measured over the whole quarter, and volatility is computed as the

variance of daily log changes. The change in volatility in the third summation term is the difference between this measure and the value for the previous quarter. Also note that, except for bank-specific intercepts, we restrict the coefficients to be the same across banks. These restrictions are motivated by a desire to conserve degrees of freedom.

Figures 6, 7, and 8 present some of our exchange rate variables. Figure 6 demonstrates significant comovement among the European currencies. Not surprisingly, all of the exchange rate volatility measures in Figure 7 are also positively correlated. Figure 8 shows monthly averages of 10 am bid-ask spreads for U.S. dollars in terms of seven foreign currencies.[23] Note that these are highly liquid markets -- the spreads seldom exceed 0.1 percent of the midpoint price.[24]

The panel regression in equation (8) was estimated using quarterly data from 1990:Q3 through 1994:Q1. Estimated coefficients are presented in Table 5. The adjusted R^2 indicates that about 60 percent of the variance in profits can be explained by the model variables, but about a third of the coefficients have the "wrong" sign.

It is conceivable that a component of profits, such as position-taking, could account for a significant amount of the time series variation in profits but, on average, add nothing to the *level* of profits. Table 6 provides some information about the extent to which different types of regressors account for average foreign exchange earnings at each bank. The contribution

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[23] The Australian dollar spread is measured at 9 am.

[24] Interestingly, although the quoted spreads are constrained by a discrete tick size (one "pip"), the relative spreads (measured as a percent of the midpoint exchange rates) appear to be uncorrelated with the exchange rates (the denominator in the definition of the relative spread).

of a right-hand-side variable to the mean is computed as the product of the estimated coefficient and the sample mean of the regressor. We report these contributions as a proportion of average foreign exchange earnings for the bank. The table indicates that about 50 percent of average profits can be accounted for by the variables that represent our four sources of foreign exchange earnings.

Note that the parameter estimates and the profits decomposition for position-taking and intermediation activity in currencies are roughly consistent with the results obtained in the previous two sections. All of the parameter estimates for position-taking variables (the αs in Table 5) are insignificant from zero, and the contribution of these variables to average profits is negligible. Intermediation activity in currencies appear to account for only 17 percent of average profits, largely associated with two banks and activity in the Japanese yen.

Although parameter estimates for positions in volatility variables (the γs) are often significant, these variables account for about 2 percent of average profits. This is likely because the banks in our sample write nearly as many options as they buy. In contrast, two of the parameters for intermediation in volatility variables (the δs) are significant from zero, and these variables account for nearly 30 percent of average explained profits.

In summary, our cross-sectional regression suggests that about 50 percent of banks' foreign exchange earnings are associated with some type of financial intermediation, and the profit contribution of their position-taking activities is close to zero, on average. As before, there are numerous caveats to these results. First, there are very few degrees of freedom in the regression. In addition, these estimates could be contaminated for several reasons, including problems with the proxies for unobservables, omitted currencies, time aggregation,

and correlation among the regressors.

7. Conclusions

All told, our evidence does not support the notion that position-taking was, on average, a major source of foreign exchange trading earnings for the banks in our sample; this result is consistent with the efficient markets hypothesis. To the extent that these earnings derive from conventional market-making, they ought to be fairly stable and persistent over time. However, if volatility-related intermediation services are an important component of profits, the outlook is somewhat murkier. Foreign exchange option products are still relatively new, and the competitive structure of these markets may still be rapidly evolving.

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Table 1
First-order Autocorrelations of Foreign Exchange Positions, June 1990 - March 1994

summary of results for 7 banks

	DM	SFr	£	¥	A$	C$
number positive	7	7	7	6	6	6
with 95% confidence	6	3	4	4	4	3
number negative	0	0	0	1	1	1
with 95% confidence	0	0	0	0	0	0
maximum estimate	0.54	0.64	0.88	0.74	0.69	0.89
estimate for aggregate (7 banks)*	0.48	0.57	0.48	0.34	0.63	0.30

* Underlined coefficients are significant at the 95 percent confidence level.

Table 2
Do 035 FX Positions (5/90-3/94) Predict Exchange Rate Changes?

Overnight Horizon

Summary matrix of regression coefficients for net dealing position (in $US billions); dependent variable is % change in exchange rate

	DM	SFr	£	¥	A$	C$	Total Position
number positive	2	5	5	3	3	2	3
with 95% confidence	0	0	1	0	0	0	0
number negative	5	2	2	4	4	5	4
with 95% confidence	0	1	0	0	0	0	0
estimate for aggregate (7 banks)*	-0.04 (-0.64)	0.26 (1.14)	0.05 (0.34)	0.05 (0.42)	-0.05 -0.43	-0.18 (-1.50)	0.02 (0.10)

* The numbers in parentheses are t-statistics for the estimates for a null hypothesis of ψ=0.

Table 3
Do 035 FX Positions (5/90-3/94) Predict Exchange Rate Changes?

Horizon of 20 Business Days

Summary matrix of regression coefficients for net dealing position (in $US billions); dependent variable is % change in exchange rate

	DM	SFr	£	¥	A$	C$	Total Position
number positive	3	4	2	2	5	1	3
with 95% confidence	1	0	0	0	0	0	0
number negative	4	3	5	5	2	6	4
with 95% confidence	0	0	0	0	0	0	0
estimate for aggregate (7 banks)*	0.16 (0.37)	1.25 (0.67)	-1.26 (-1.13)	-1.04 (-1.57)	-0.04 (-0.09)	-1.26 (-1.78)	-0.31 (-0.19)

* The numbers in parentheses are t-statistics for the estimates for a null hypothesis of $\psi=0$.

Table 4
Do 035 FX Positions (5/90-3/94) Predict Exchange Rate Changes?

Horizon of 5 Business Days

Summary matrix of regression coefficients for net dealing position (in $US billions); dependent variable is % change in exchange rate

	DM	SFr	£	¥	A$	C$	Total Position
number positive	5	3	1	1	3	0	2
with 95% confidence	2	0	0	0	0	0	0
number negative	2	4	6	6	4	7	5
with 95% confidence	0	0	0	1	0	0	0
estimate for aggregate (7 banks)*	0.27 (1.01)	0.67 (0.66)	-0.96 (-1.46)	-0.35 (-1.13)	-0.19 (-0.69)	-0.71 (-1.69)	0.54 (0.64)

* The numbers in parentheses are t-statistics for the estimates for a null hypothesis of $\psi=0$.

Table 5
Explaining 1990-1994 Quarterly Foreign Exchange Trading Profits at 7 U.S. Commercial Banks

Parameter	Parameter Estimate	t-Statistic
α_{DM}	-.08	-0.54
α_{SFr}	.23	0.74
$\alpha_{£}$	-.12	-1.08
$\alpha_{¥}$	-.10	-0.33
$\alpha_{A\$}$	.05	0.18
$\alpha_{C\$}$	1.02	0.84
β_{DM}	.000	0.17
β_{SFr}	-.012	-2.14
$\beta_{£}$	.001	0.12
$\beta_{¥}$	.003	2.18
$\beta_{A\$}$	.031	0.76
$\beta_{C\$}$	.005	0.18
γ_{DM}	.002	0.20
γ_{SFr}	.040	3.92
$\gamma_{£}$	.007	0.43
$\gamma_{¥}$	.122	2.18
$\gamma_{A\$}$	.141	1.67
$\gamma_{C\$}$	-.209	-2.97
δ_{DM}	.000	0.24
δ_{SFr}	.003	2.53
$\delta_{£}$	-.001	-0.49
$\delta_{¥}$	.005	2.43
$\delta_{A\$}$	-.009	-1.29
$\delta_{C\$}$	-.029	-1.25
R^2		.60
Number of Banks		7
Number of Observations		15
Degrees of Freedom		74

Table 6
Explaining 1990-1994 Average Quarterly Foreign Exchange Trading Profits

	Percent of Average Profits Attributable to:				
	Constant	Positions in Currencies	Intermediation in Currencies	Positions in Volatility	Intermediation in Volatility
Bank A	87	-2	5	0	10
Bank B	69	0	0	8	23
Bank C	14	4	27	11	46
Bank D	88	0	-15	1	27
Bank E	71	0	4	-1	26
Bank F	82	0	9	9	0
Bank G	-21	0	77	3	42
Total	51	0	17	2	29

Figure 1. Foreign Exchange Trading Revenues of Seven U.S. Commercial Banks

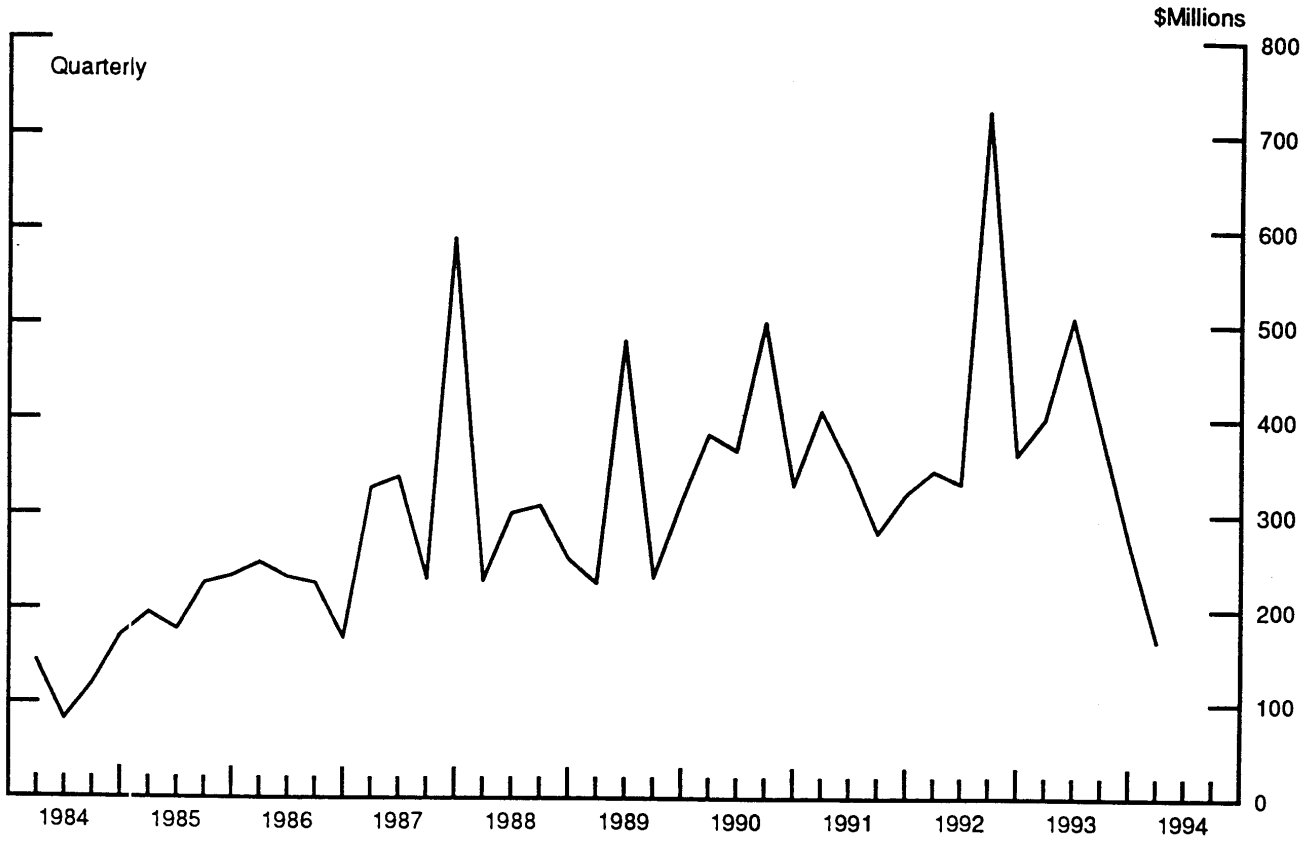


Figure 2. Gross Foreign Currency Dealing Activity
(spot, forward, and futures contracts in six currencies)

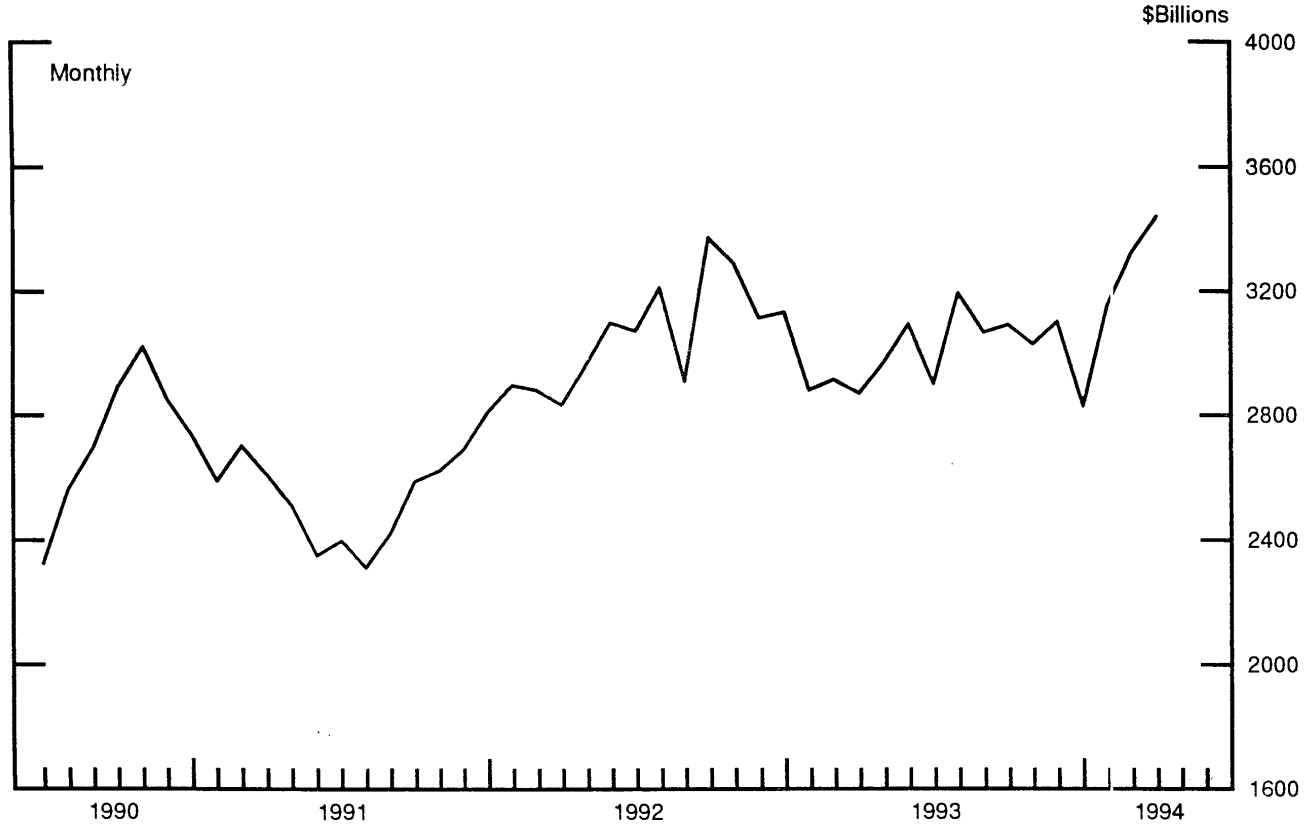


Figure 3. Net Foreign Currency Dealing Position

(as a percentage of dealing activity, in six currencies)

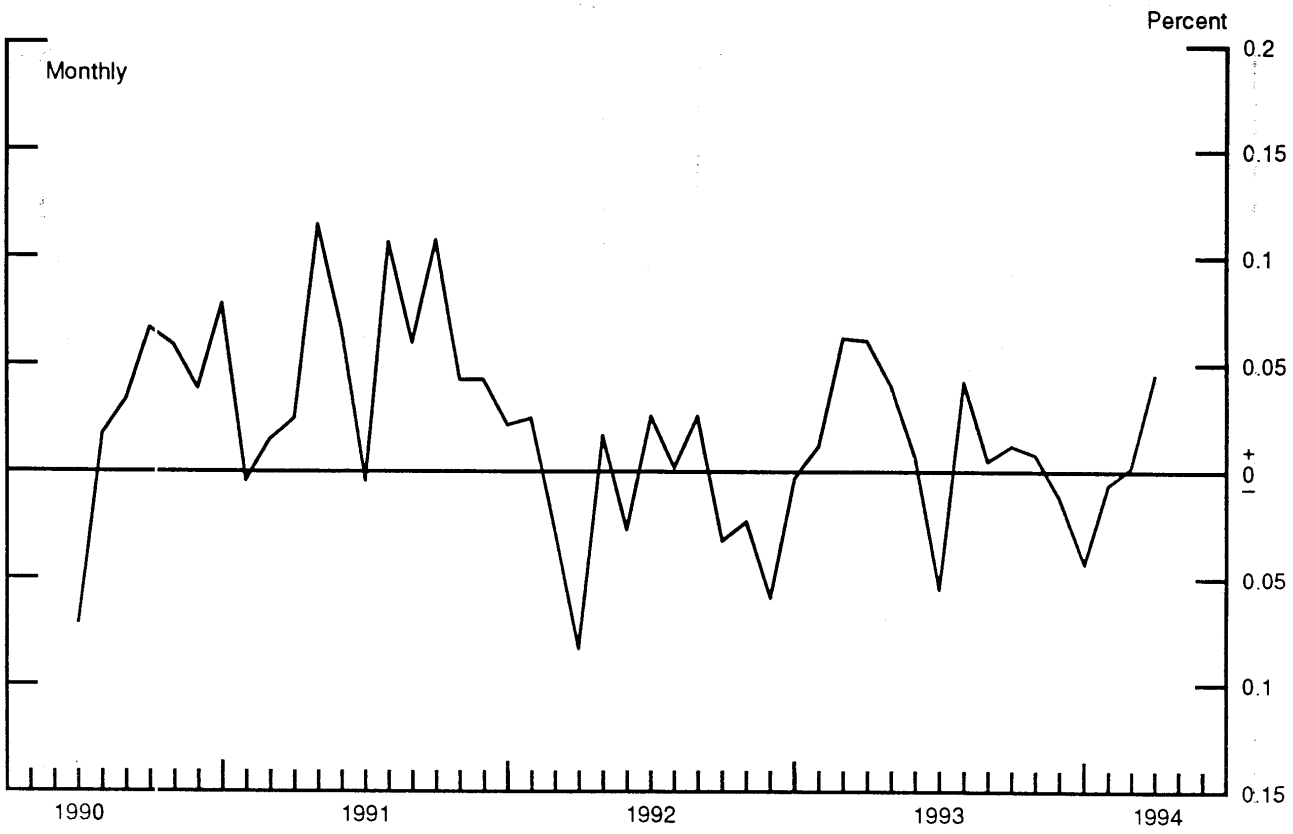
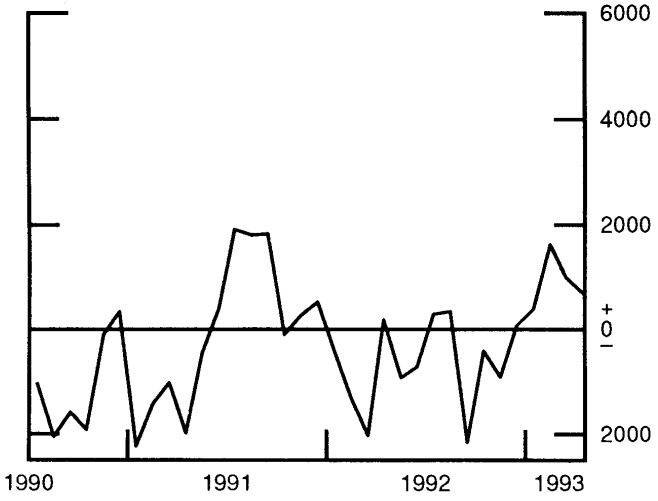


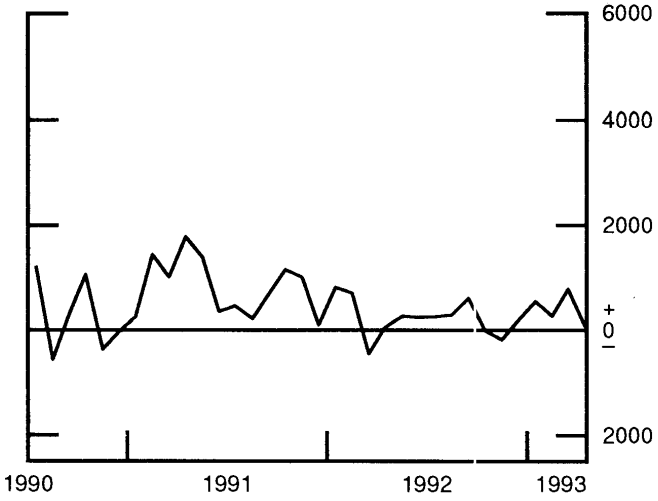
Figure 4. Net Dealing Positions of Banks by Currency

(End of Day Positions, in Millions of US$)

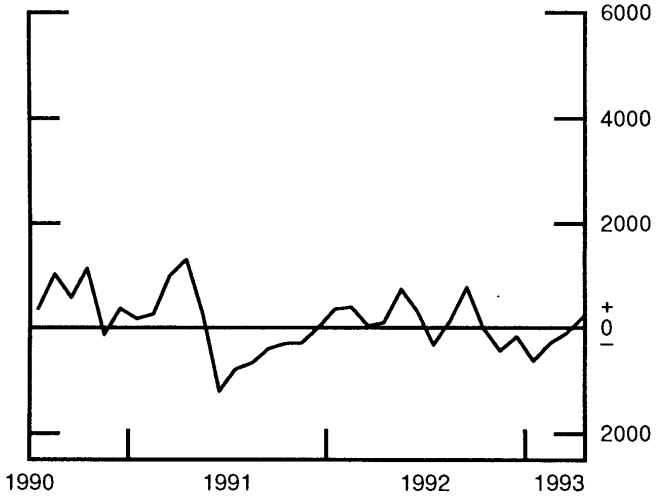
Deutsche Mark



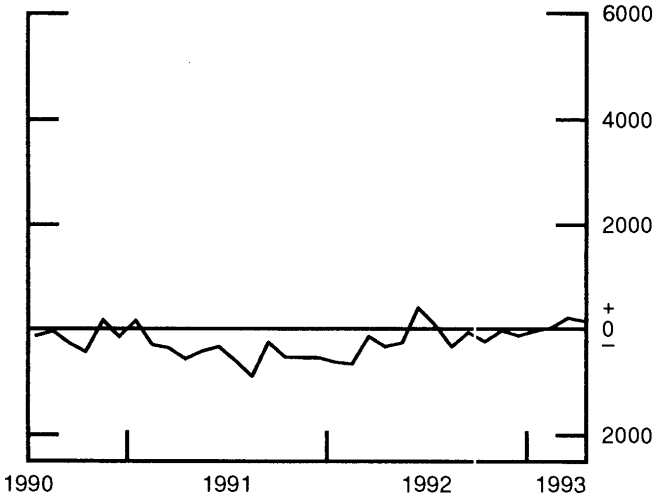
Yen



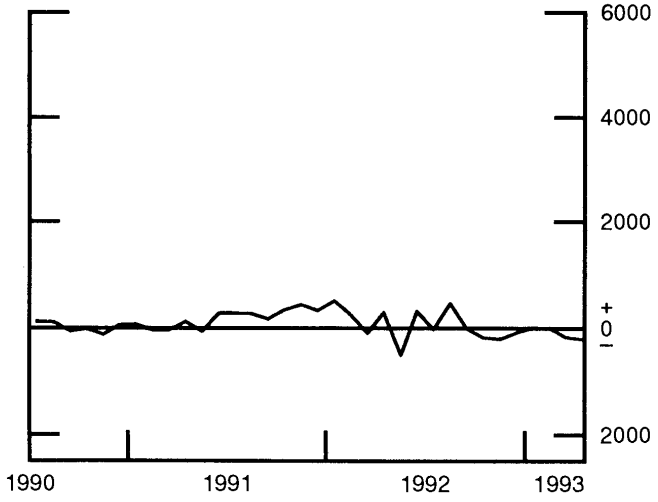
Sterling



Swiss Franc



Canadian Dollar



Australian Dollar

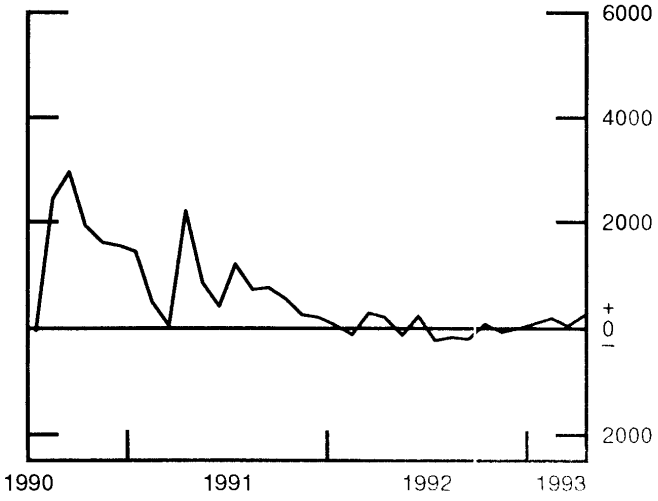


Figure 5. Net Foreign Dealing Position of Banks

(includes positions in six currencies)

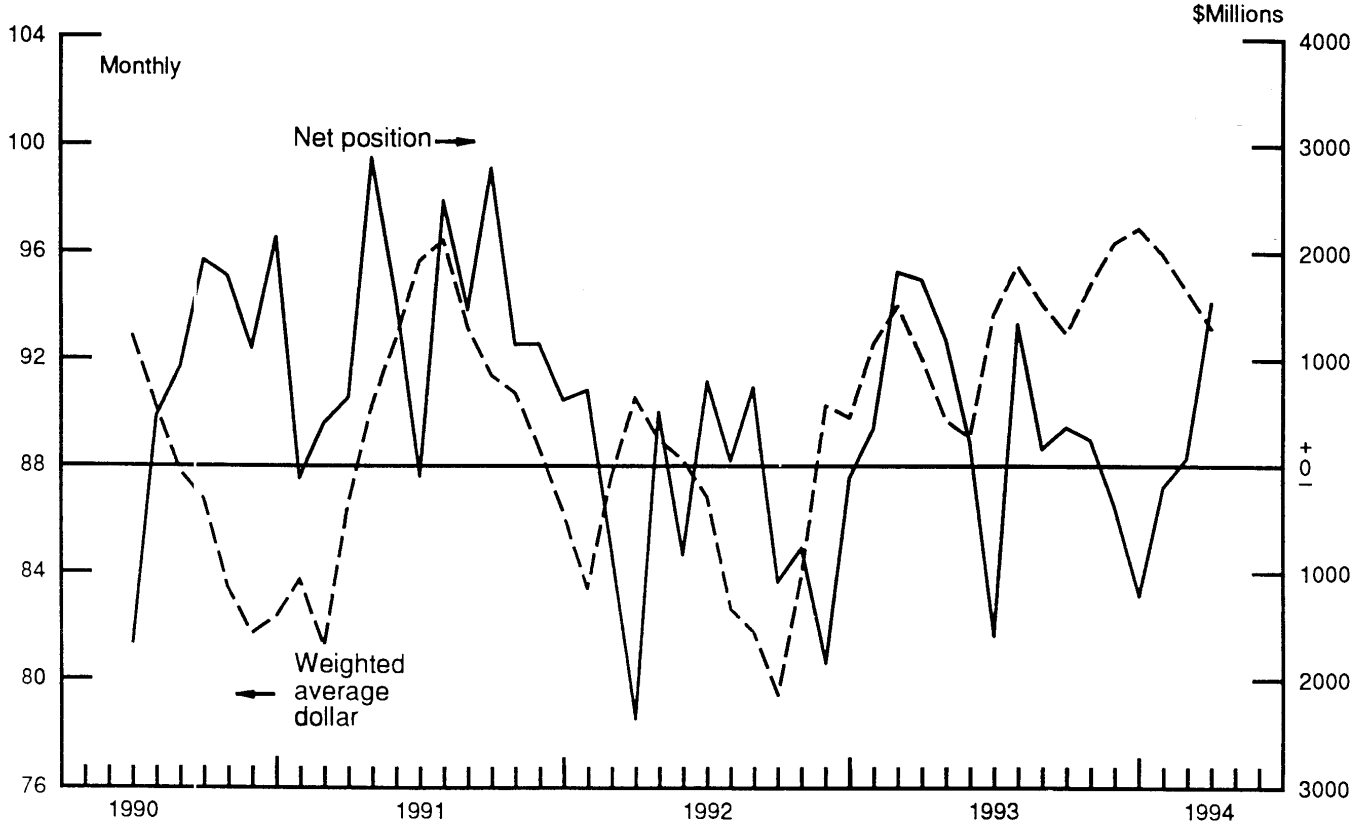
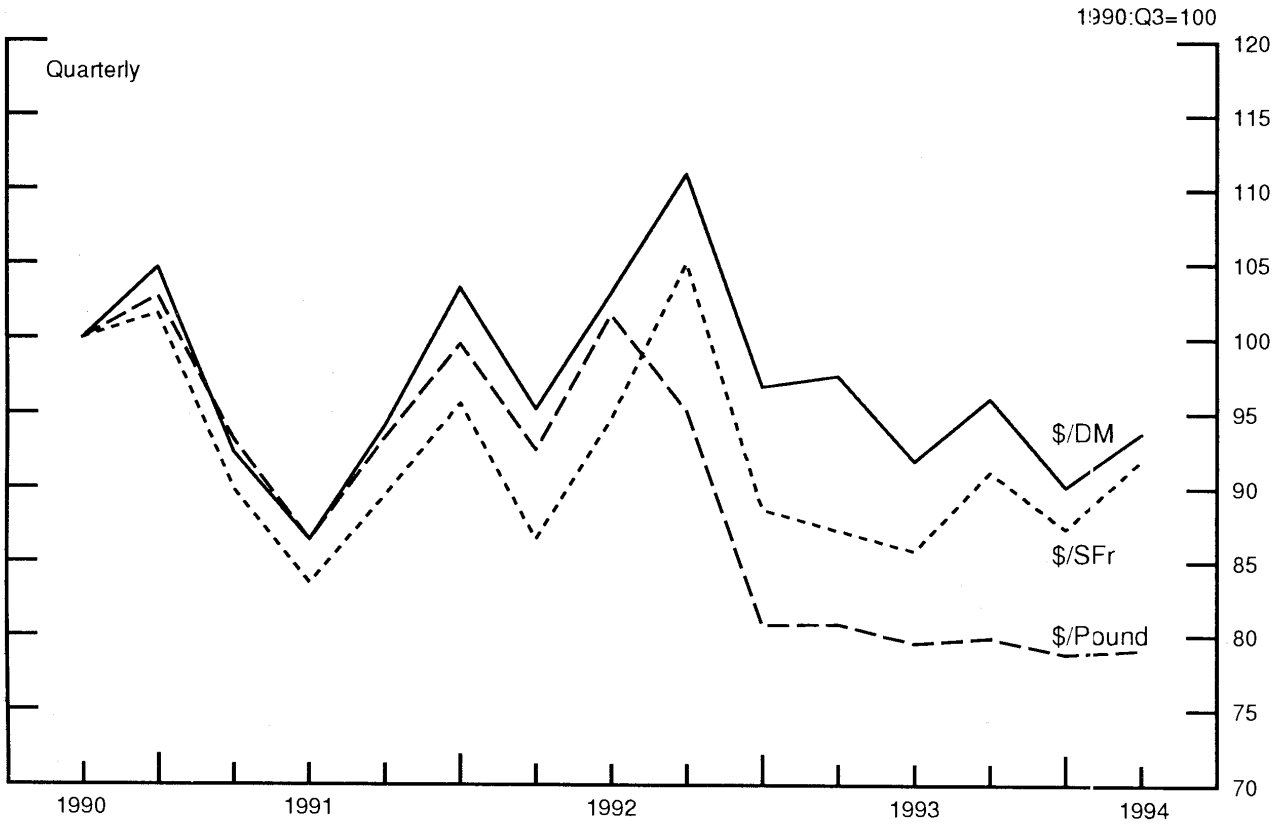


Figure 6. Exchange Rates



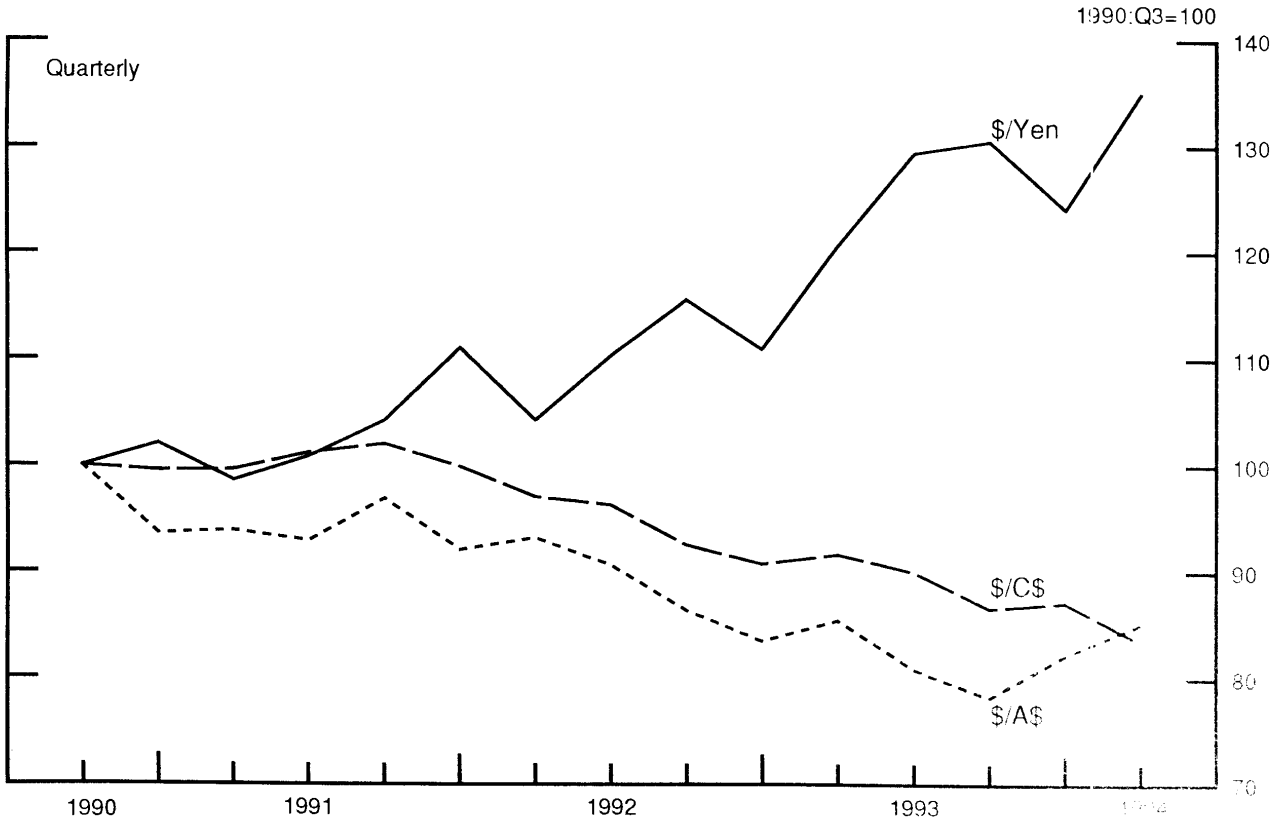
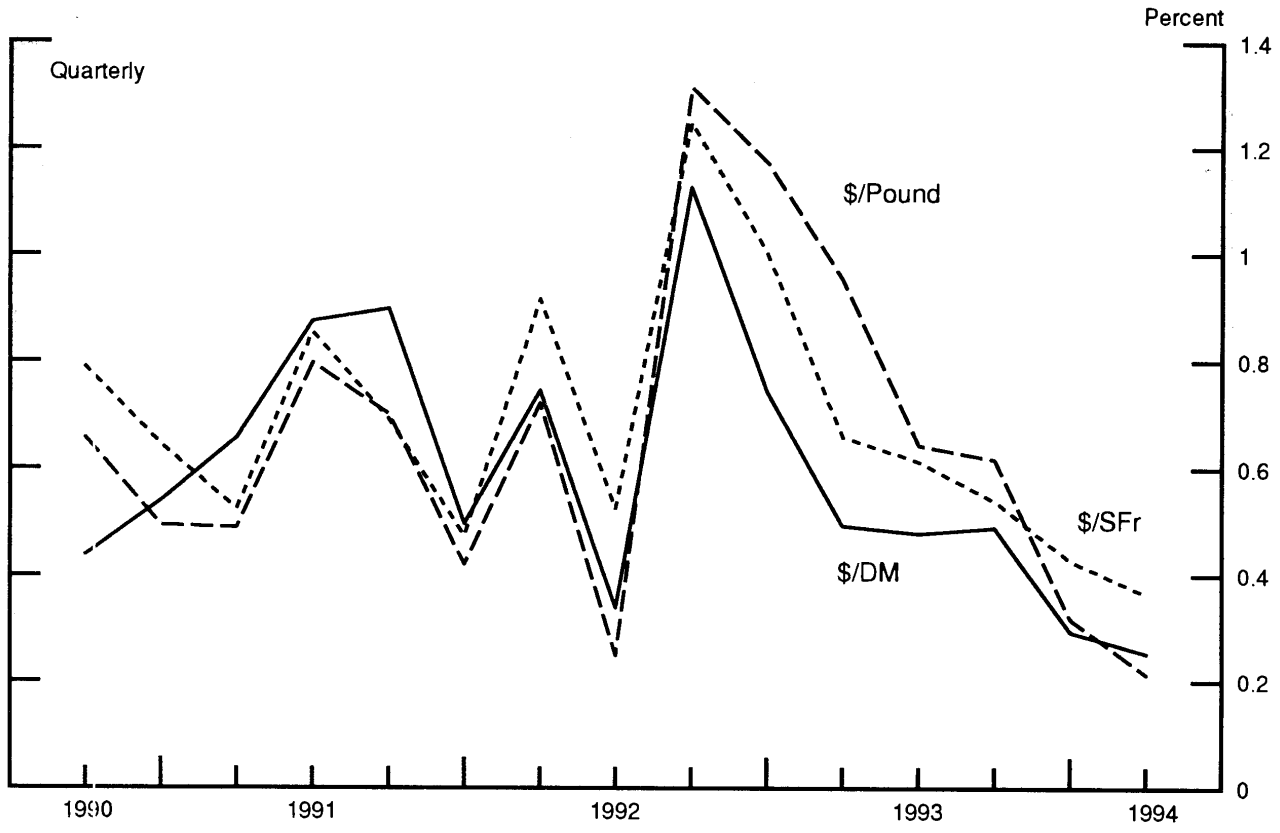


Figure 7. Standard Deviation of Exchange Rates



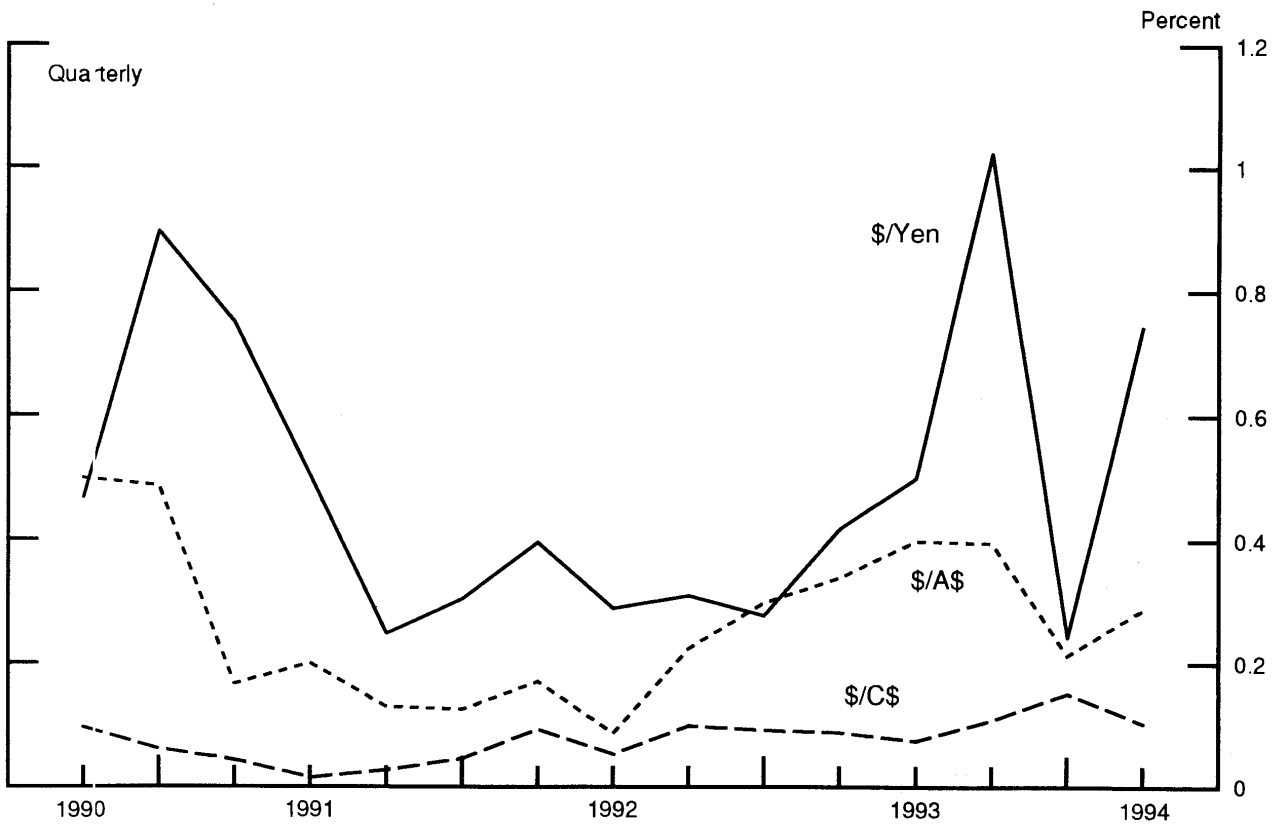
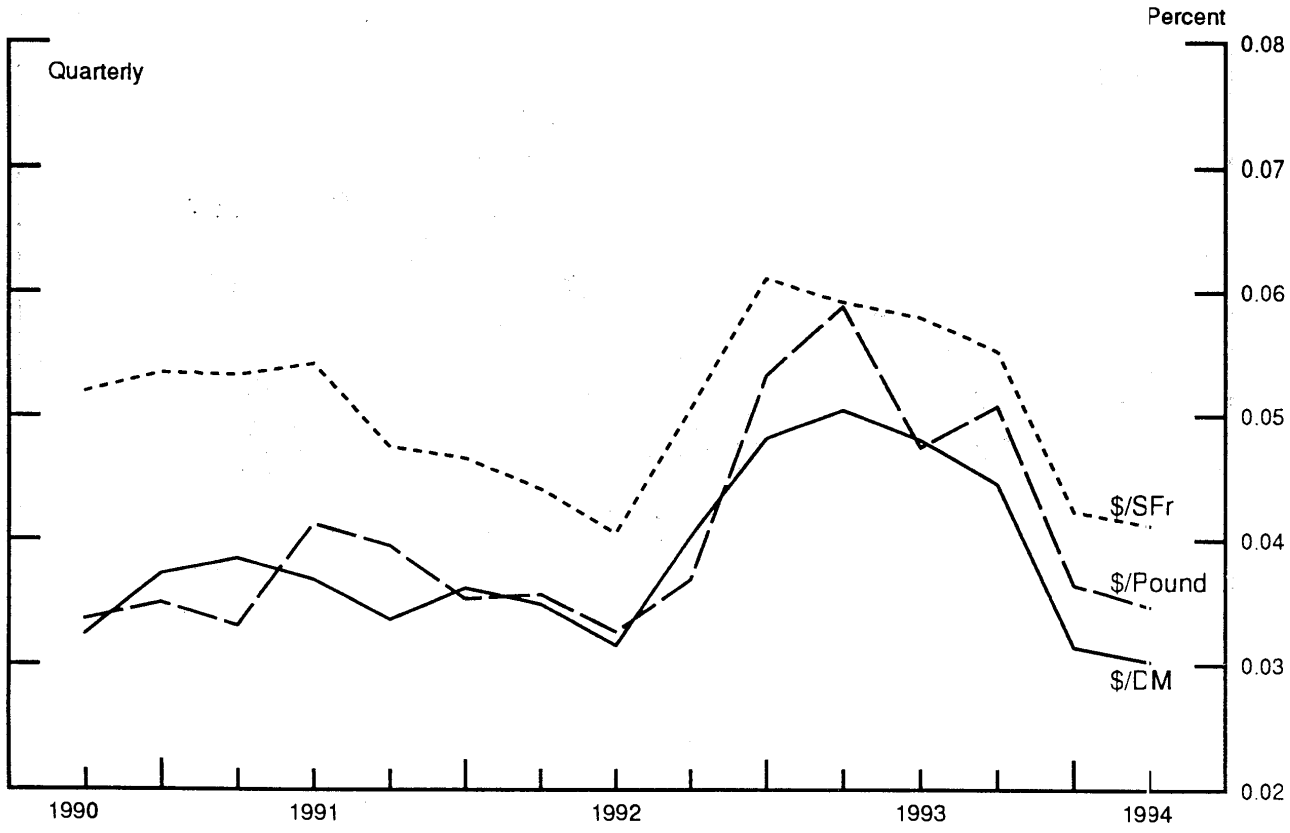
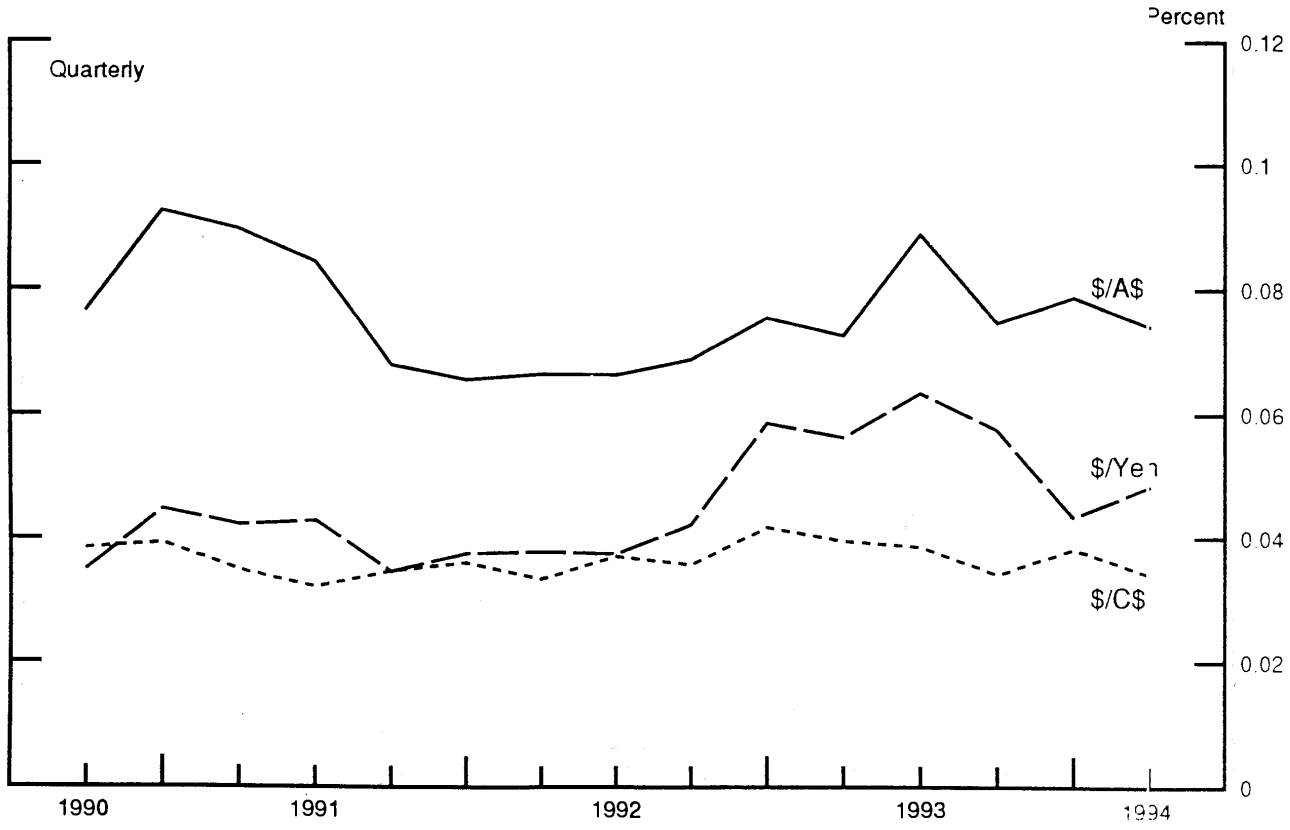


Figure 8. 10am Bid–Ask Spreads in N.Y. Foreign Exchange Market

(as a percent of mid–point price; monthly average)





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