NBER WORKING PAPER SERIES

DOES FOREIGN EXCHANGE INTERVENTION MATTER? DISENTANGLING THE PORTFOLIO AND EXPECTATIONS EFFECTS FOR THE MARK

Kathryn Dominguez

Jeffrey Frankel

Working Paper No. 3299

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 1990

We wish to thank Julia Marsh and Julia Lowell for research assistance, and Dr. Franz Scholl of the Bundesbank for making the daily intervention data available. This paper is part of NBER's research program in International Studies. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

NBER Working Paper #3299
March 1990

DOES FOREIGN EXCHANGE INTERVENTION MATTER? DISENTANGLING THE PORTFOLIO AND EXPECTATIONS EFFECTS FOR THE MARK

ABSTRACT

The time is ripe for a re-examination of the question whether foreign exchange intervention can affect the exchange rate. We attempt to isolate two distinct effects: the portfolio effect, whereby an increase in the supply of marks must reduce the dollar/mark rate (for given expected rates of return) and the additional expectations effect, whereby intervention that is publically known may alter investors' expectations of the future exchange rate, which will feed back to the current equilibrium price. We estimate a system consisting of two equations, one describing investors' portfolio behavior and the other their formation of expectations, where the two endogenous variables are the current spot rate and investors' expectation of the future spot rate. We use relatively new data sources: actual daily data on intervention by the Bundesbank, newspaper stories on known intervention, and survey data on investors' expectations. We find evidence of both an expectations effect and a portfolio effect. The statistical significance of the portfolio effect suggests that even sterilized intervention may have had positive effects during the sample period. (It tends to be significant only during the later of our two sample periods, October 1984 to December 1987. That intervention appears less significant statistically during the earlier period, November 1982 to October 1984, could be attributed to the fact that little intervention was undertaken until 1985.) For the magnitude of the effects to be large requires that intervention be publically known. Our (still preliminary) estimates suggest that a typical $100 million of "secret" intervention has an effect of less than 0.1 per cent on the exchange rate, but that the effect of news reports of intervention can be as large as an additional 4 per cent.

Kathryn Dominguez
Kennedy School of Government
Harvard University
Cambridge, MA 02138

Jeffrey Frankel
Department of Economics
University of California
Berkeley, CA 94720

Introduction

Until recently, there was an unusual degree of consensus among economists, and among policy-makers and participants in the financial markets as well, that intervention by central banks in the foreign exchange market did not offer an effective or lasting instrument for affecting the exchange rate, at least not independently of monetary policy. The 1982 G-7 economic summit at Versailles commissioned a study of intervention, known as the Jurgenson report, which found that the effects were small and transitory at most.[2]

We think that the time is ripe for new statistical testing of the question. Many policy-makers and foreign exchange traders believe that the intervention operations that have taken place since the Plaza Agreement of September 1985 have had an effect. Moreover, the theoretical case against the effectiveness of intervention is not as clear as a reading of the economics literature might suggest.

The academic literature is predicated on the distinction between intervention operations that are sterilized and those that are not sterilized. Intervention operations that change the supplies of domestic and foreign money are considered nonsterilized. Sterilized intervention operations, in contrast, are accompanied by offsetting open-market operations which return the relevant money supply to its original level. In this paper we do not concentrate on this distinction. We study the intervention operations that actually took place between 1982 and 1987,

---

[2] Many of the econometric results, finding little or no effect, were reported in Rogoff (1984) and Henderson and Sampson (1983).

regardless of whether they were sterilized. But we do begin in section II with a review of the issues involved.[3]

In this paper we examine the two possible channels through which intervention (whether sterilized or not) can influence the foreign exchange rate: the portfolio and the expectations channels. Intervention can, even if sterilized, influence exchange rates through the portfolio channel provided foreign and domestic bonds are considered imperfect substitutes in investor's portfolios. Intervention operations that, for example, increase the current relative supply of mark to dollar assets that private investors are obliged to accept into their portfolios, will force a decrease in the relative price of mark assets.[4] Intervention can also influence exchange rates, regardless of whether foreign and domestic bonds are imperfect substitutes, through the expectations channel. The public information that central banks are intervening in support of a currency (or are planning to intervene in the future) may, under certain conditions, cause speculators to expect an increase in the price of that currency in the future. Speculators react to this information by buying the currency today, bringing about the change in the exchange rate today.

While some previous empirical studies of foreign exchange intervention operations have found evidence from daily data that central banks have had a statistically significant effect on exchange rates (Loopesko (1984) and Dominguez (1987,1989)), the studies were not able to distinguish whether the effect was coming through the portfolio or the

---

[3] For authoritative statements, see Henderson (1984) or Obstfeld (1988).

[4] The exchange rate reaction to an increase in the relative supply of outside foreign assets may be reduced by an increase in their expected rate of return that induces a corresponding increase in demand.

expectations channel. The goal of this study is to disentangle the influence of the two potential channels during the most recent experience with central bank intervention operations. The empirical work was made possible by an agreement with the German Bundesbank allowing use of confidential daily intervention data over the period 1982-1987.[5] While the Fed did not grant us official access to their daily intervention data over this period, we constructed a daily intervention series for the U.S. (including both Federal Reserve and Treasury initiated operations) from descriptions of foreign exchange desk operations published in the Federal Reserve Bank of New York Quarterly Review (FNYQR) and other Federal Reserve publications.

The present study brings three distinct sources of information [related to past work by the authors] to bear on the effects of intervention. First, we measure expectations of the future spot exchange rate by means of survey data on the forecasts of market participants. These data were introduced in another context by Frankel and Froot (1987) and Dominguez (1986).[6] Second, we use daily newspaper reports of intervention and related news to distinguish public awareness of intervention operations, a prerequisite for the expectations channel to be operative, from actual intervention operations, a prerequisite for the portfolio channel to be operative. Third, in the relationship connecting asset supplies to the risk premium, we impose the constraint that the coefficient is

---

[5] With the understanding that it be used under certain restrictions.

[6] Subsequent studies using such survey data include Frankel and Froot (1988), Froot and Frankel (1989), Froot and Ito (1988) and Ito (1989).

proportionate to the time-varying variance of the exchange rate, as it should be if investors choose their portfolios to diversify optimally.

These additional sources of information allow us to estimate a two-equation system: an expectations-formation equation and a portfolio-diversification equation. Our novel conclusion, based on our findings for the dollar/mark exchange rate, is that both the portfolio and expectations channels were effective during the sample period.

II. The Standard Theory: Sterilized vs. Nonsterilized Intervention

There are three standard arguments as to why the effects of intervention should be very small: the small size of intervention relative to the total market, Ricardian equivalence, and high international asset substitutability. The latter two, if valid, imply that the effects of sterilized intervention should be small or zero. The first implies that the effects of intervention should be relatively small even if nonsterilized.

While the scale of intervention operations in recent years is unprecedented, it remains small relative to the stocks or flows in the foreign exchange market. A census of the volume of foreign exchange trading recently released by the New York Fed reported a total of $129 billion per day (eliminating double-counting) in the United States in April 1989. Adding in London and Tokyo, the total exceeds $430 billion. Daily _net_ positions taken by banks and other individual institutions are much smaller than the gross positions. However, the total net _stocks_ of currencies that could in theory be brought into the market at any time are considerably larger. U.S. M2, for example, currently exceeds $3,000 billion. By comparison the average coordinated intervention operation in support of the dollar during the period January 1985 to December 1987 involved \$256 million, while the average coordinated sale of dollars involved \$208 million (Dominguez (1989), p.34).

Standard models of exchange rate determination at least allow non-sterilized intervention to have an effect on the exchange rate in proportion to the change in the relative supplies of domestic and foreign money, just as any other form of monetary policy does. The idea that sterilized intervention operations, on the other hand, have any effect at all, is less accepted. Those that conclude that sterilized intervention can have no effect, base their arguments on either "Ricardian equivalence" or the high substitutability between foreign and domestic bonds. We consider these two arguments in turn.

If government bonds imply the public liability of future taxation to service them, and if investors look far into the future, optimize intertemporally, and internalize the welfare of future generations, then government bonds are not true "outside" assets; they have no more effect on market equilibrium than the issue of an IOU by one private citizen to another. If government bonds are not true outside assets, it follows that swaps in their currency composition have no effect on the foreign exchange market equilibrium.[7]

There are many arguments against Ricardian equivalence, both theoretical and empirical; it is the sort of proposition that one would like to test rather than impose. In any case, in recent years the lines of distinction between "money" and "bonds" have become increasingly blurred. It is not clear that the creation of a Money Market Deposit Account --

---

[7] For example, Frankel (1979) and Backus and Kehoe (1988).

which is part of M2, but is the liability of a privately-owned financial institution rather than of the government -- should have a fully proportionate effect on the exchange rate, while the issue of a Treasury Bill has no effect.

Even if it is granted that government bonds are "outside" assets, the second line of argument against the effectiveness of sterilized intervention is that domestic and foreign bonds are perfect substitutes, so that changes in their relative supply have no effect.[8] A less extreme version of the argument is that substitutability is very high, even if not literally infinite, so that intervention (in the relevant magnitudes) can have very little effect quantitatively. One point that is often missed is that, even if it is true that the effect of sterilized intervention on the differential in rates of return is very close to zero, the effect on the <u>level</u> of the exchange rate may be relatively large. As long as changes in bond supplies matter, they should have a proportionate effect on the exchange rate (which is the relative price of foreign bonds, in the portfolio model, not just the relative price of money) in the absence of changes in the risk premium, no matter how high the degree of substitutability.[9]

Even for those who hold either to Ricardian equivalence or to the assumption that foreign and domestic bonds are perfect substitutes, there remains a channel whereby sterilized intervention can have an effect on

---

[8] In terms of equation (1) below, it is argued that b is infinite, or, in terms of equation (4), that rv is zero.

[9] Frankel (1985, 213-215). Once effects on the expected future rate of change in the exchange rate are taken into account, the exchange-rate effect of a one percent change in the relative supply of foreign assets could be either more or less than one percent.

exchange rates. Intervention operations can effect exchange rates through the *signalling channel* if they are used by central banks as a means of conveying (or signalling) to the market inside information about future monetary policy. If market participants believe central bank intervention signals, then even though today's money supply has not changed, expectations of future monetary policy will change. When the market revises its expectations of future money supplies, it also revises its expectations of the future spot exchange rate, which brings about a change in the current rate. The signalling channel is thus one example of the expectations channel mentioned in the preceding section.[10]

It is known that daily intervention by the Federal Reserve Bank of New York is fully and automatically sterilized: the foreign exchange trading room immediately reports its dollar sales to the open market trading room, which then buys that many fewer bonds, so that the daily money supply is precisely what it would have been if no intervention had occurred. This leaves open the possibility that a Federal Reserve Board decision to try to influence the exchange rate will result in both intervention and a different money supply, say on a monthly basis. To the extent that the market learns about such decisions by observing intervention, that is a case of the signalling hypothesis. Trying to test the signalling hypothesis by observing what happens to the money supply *ex post*, in finite samples, would be a dubious way of approaching the question. Intervention is at best but one of many factors relevant for determining the future money supply; in finite samples the relationship might not be detectable. This is especially true of one particular argument why an increase in the

[10] An influential statement is Mussa (1981). See also Kenen (1981).

supply of government debt today implies an increase in the money supply in the future. The Sargent-Wallace "unpleasant monetarist arithmetic," which says that an increase in debt may be explosive if it is not eventually monetized, might not take effect until far after the end of the sample period.

The Bundesbank and other smaller central banks are less prone to complete sterilization than are the U.S. authorities; during periods of undesired dollar weakness, the Bundesbank often buys dollars for marks, and to some extent allows the increase in reserves to swell the German money supply. In this study, we do not prejudge the sterilization question. To summarize, the expectations channel may or may not require that intervention be allowed to affect future money supplies. The portfolio channel presumably would require that sterilized intervention be effective, but we allow the data to tell us whether this channel is in fact operative.

III. The Standard Econometrics

The portfolio-balance theory says that investors diversify their holdings among domestic and foreign assets -- including bonds, if we do not rule them out *a priori* on the grounds of Ricardian equivalence -- as functions of expected rates of return. Measuring the expected rates of return requires both data on interest rates, which is easy, and data on investors' expectations of exchange rate changes, which is very hard. Some early tests assumed away this problem by setting expected depreciation equal to zero, and simply looking for a relationship between the level of the exchange rate and the supplies of domestic and foreign assets.[11] But,

[11] For example, Branson, Haltunnen and Masson (1977). A more recent attempt, with better measures of asset supplies, is Golub (1989).

even aside from the expectations problem, these studies were plagued by a second econometric difficulty: simultaneity.[12]

A regression specification that avoids this simultaneity problem takes the dependent variable to be the differential in expected _rates of return_ between domestic and foreign assets, rather than the _level_ of the exchange rate, and uses _ex post_ changes in the exchange rate to measure investors' expectations by invoking the methodology of rational expectations.[13] Begin by considering the asset-demand function that determines the portfolio share x that is allocated to mark assets, as a function of the risk premium rp:

$$x = a + b\ rp \tag{1}$$

where $rp = i^{DM} - i^{\$} + \Delta s^{e}$, i^{DM} is the euroDM interest rate, $i^{\$}$ is the eurodollar interest rate, and Δs^{e} is the expected change in the dollar/mark spot exchange rate. Now invert the equation to express the risk premium as a function of the aggregate supplies of assets that must be held in market equilibrium:

$$rp = -ab^{-1} + b^{-1}x. \tag{2}$$

The special case where domestic and foreign assets are perfect substitutes is the special case where b is infinite, the coefficient b^{-1} in equation (2) is zero, and changes in assets supplies have no effect on the risk premium. According to the rational expectations methodology, the _ex post_ change in the exchange rate, Δs, can be substituted for the expected

[12] Coefficients on asset supplies often appeared statistically significant, but with the wrong signs. When the Bundesbank reacts to an increase in the dollar/mark rate by buying dollar assets and selling mark assets, an apparent perverse relationship between the exchange rate and the supply of dollar assets results.

[13] See Dooley and Isard (1983) and Frankel (1982a).

change, Δs^e, because the only difference is a forecast error e that is independent of x (and all other variables that are contemporaneously observable). So we can run a regression on the resulting equation.

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta s_{t+k} = -ab^{-1} + b^{-1}x_t + e_{t+k}. \quad (3)$$

The regression estimate of the coefficient b^{-1} in equation (3) is generally found to be insignificantly different from zero, a failure to reject the null hypothesis of perfect substitutability.[14] One possible explanation for this result is that there is insufficient power in the test. One way of bringing additional information to bear is to assume that investors choose their portfolio allocation, x, to optimize a function of the mean and variance of end-of-period wealth, from which it follows that equation (1) holds with a constraint imposed: the coefficient is inversely proportionate to v, the variance of the return differential.[15] In the case where goods prices are nonstochastic, v is simply the variance of the exchange rate, and a, the minimum-variance portfolio, is closely related to the share of German goods in the consumption basket of the investor. The inverted form, equation (3), becomes:

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta s_{t+k} = -a(rv_t) + (rv_t)x_t + e_{t+k}, \quad (4)$$

[14] At least that is what studies find when assets supplies x are computed to include not only foreign exchange intervention, but also government budget deficits, and other forms of asset creation that usually dwarf intervention in magnitude. [E.g., Dooley and Isard (1983), Frankel (1982a), and Boothe, Clinton, Cote, and Longworth (1985).] Studies that focus more narrowly on daily changes in asset supplies through foreign exchange intervention do sometimes find an effect on the differential in rates of return: Loopesko (1984) and Dominguez (1989).

[15] References include Kouri and de Macedo (1978), Dornbusch (1983), Frankel (1982b), Adler and Dumas (1983), and Branson and Henderson (1985).

where we have defined r to be the constant of proportionality, which is the coefficient of relative risk-aversion.[16]

The rational expectations methodology assumes that the regression error and forecast error are identical, so that the equation can be estimated subject to the constraint that the coefficient is proportionate to the variance of the error term. Despite the presumed increase in power, the empirical literature generally fails to reject the null hypothesis of perfect substitutability, which is now interpreted as risk-neutrality ($r=0$).[17] This finding is the same when the variance v is allowed to vary over time, as in the popular ARCH models.[18]

Notwithstanding the elegance of the rational expectations methodology, several econometric problems remain in the estimation of an equation like (4), and they may be responsible for the results. First, the asset supplies x may be measured with error, or the asset demand equation (1) may hold only subject to an error term. In theory, either source of error would be fairly easy to handle, provided that the error (like investors' forecast error e) were independent of x.[19] But it seems likely that simultaneity bias has been a problem in practice, particularly since the

---

[16] This is the simplified form of the equation in Dornbusch (1983), where a is interpreted as equal to the share of German goods in the consumption basket of the investor in question. Krugman (1981) pointed out that a correct treatment of the convexity term that arises from Jensen's Inequality makes the constant term $-(ra - a + 1/2)v$, instead of $-a(rv)$. In what follows, the variable in the regression is v in either case, and it is only the interpretation of its coefficient that is affected.

[17] Frankel (1982b).

[18] For example, Engel and Rodrigues (1989), Attanasio and Edey (1987), and Giovannini and Jorion (1989).

[19] See Lewis (1988) and Engel and Rodrigues (1989).

definition of the righthandside variable, the asset share, includes the spot exchange rate s as part of its computation:

$$x = (S\ DM / W), \quad (5)$$

where DM is the quantity of deutschemark assets supplied to the public, and W is total wealth expressed in dollars. Addressing this possible source of simultaneity bias in the estimation of portfolio-balance equations is one of the several goals of this study.[20]

IV. Expectations, and Our Two-Equation System

The second set of econometric difficulties with estimating equation (4) concern the measurement of the expectations variable in the risk premium. Even if the rational expectations methodology is valid, i.e, the forecast error e is uncorrelated in-sample with all other contemporaneous variables, there is the undeniable problem that the magnitude of the error term is extremely large. This could lead to low power: a failure to reject risk-neutrality even though the coefficient of risk-aversion is in reality greater than zero. Furthermore, there is reason to think that *ex post* changes in the exchange rate are a particularly bad measure of what investors expected *ex ante*. Independent estimates of market forecasts of exchange rates, drawn from survey data, suggest that expected depreciation varies closely with the forward discount, while *ex post* changes in the exchange rate do not, and tend if anything to lie in precisely the opposite direction.[21] We choose to measure expectations by using the survey data rather than *ex post* changes, on the grounds that (a) the evidence of bias

---

20 In terms of the identification problem, the excluded exogenous variable that will help us estimate the equation is the one that captures public news.

21 Froot and Frankel (1989).

is damaging for the latter, and (b) the magnitude of the measurement error is almost certainly larger for *ex post* changes than for the survey data.

Thus the equation now becomes:

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta\hat{s}^{e}_{t+k} = -a(rv_t) + (rv_t)x_t + u_{t+k}, \quad (6)$$

where the error term **u** is now meant to reflect any measurement error in the data, rather than investors' forecasting errors. In light of the many studies concluding that exchange rate changes have variances that are autocorrelated over time, we choose to estimate the variance v as the daily variance of exchange rate changes over the preceding week. To our knowledge, despite the incipient spread of the use of the survey data, they have not been used together with data on asset supplies and variances to estimate a risk premium equation.

Equation (6), which captures the portfolio channel through which intervention may have an effect, is only one of two equations in the system we estimate. The other is an equation of expectations formation, where the dependent variable, investors' forecast of the expected future spot rate, is measured using the survey data.

Past work with the survey data shows clearly that the expected future spot rate, in general, fluctuates roughly one-for-one in proportion to the most recent realized spot rate. But other factors enter the equation as well. Frankel and Froot (1987,1988) considered in turn three possible alternative candidates for the other factor: (1) the lagged spot rate, in which case the specification is extrapolative expectations, (2) the lagged expectation, in which case the specification is adaptive expectations, and (3) a long-run equilibrium measured by Purchasing Power Parity, in which case the specification is regressive expectations. In each case, the variable in question entered with statistical significance.[22]

Although a number of different surveys at different horizons are available, we use here the 1-week and 4-week ahead survey forecasts conducted by Money Market Services, International, for the period October 24, 1984 to December 18, 1987. Unlike some other surveys, it is conducted on a weekly basis (since July 1985; before that it was conducted every two weeks). Longer horizons do not seem relevant for the majority of trading in the foreign exchange market.[23]

In addition, we report results for the earlier period November 17, 1982, to October 10, 1984, when the survey was conducted every two weeks and pertains to 3-month ahead forecasts. One might expect that intervention would have a greater effect in the later period, since the Reagan Administration's firm commitment to free-floating began to change when Don Regan and Beryl Sprinkel were succeeded at the Treasury by James Baker and Richard Darman in January 1985 and when the Plaza Agreement followed in September.[24]

---

[22] Its coefficient is only positive, with a slightly less-than-unit coefficient on the contemporaneous spot rate, when the forecast horizon is 3 months or longer.

[23] There is evidence that most foreign exchange trading takes place among banks, with rapid turnover and correspondingly short investment horizons. The recent New York Fed census of foreign exchange trading found that in April 1989 only 4.9 per cent of banks' trading was with a nonfinancial firm. In other words, banks trade with each other much more than with ultimate customers. See Goodhart (1988) and Frankel and Froot (1988) for more on this theme.

[24] The Germans began to intervene seriously to try to push the dollar down in February 1985 (Funabashi (1988)).

The specification we choose here is general in that it allows for both extrapolative and adaptive expectations. At the 4-week horizon, respondents have been observed to put negative weight on the lagged spot rate and more-than-unit weight on the contemporaneous spot rate, so that they are extrapolating the recent trend into the future to get their forecast.[25] Previous work has also found evidence that respondents form their predictions adaptively, putting positive weight on the lagged survey prediction (Frankel and Froot (1987)). Finally, we also include a constant term in the expectations equation, to represent the long-term equilibrium toward which investors may expect the spot rate to regress (or away from which investors may expect the spot rate to explode, as the case may be).

The fourth variable in our expectations equation is a NEWS variable meant to capture information appearing in the newspaper about the central bank's exchange rate policy. NEWS is set equal to +1 if there were reports of central bank action in support of the dollar, -1 if there were reports of action against the dollar, and 0 if there were no such reports. Thus we expect NEWS to have a negative effect on expectations of the future dollar/mark rate. The NEWS variable included not only reports of actual intervention but also, for example, official statements by Treasury and Central Bank officials that they would like the exchange rate to go in a

---

[25] Frankel and Froot (1988). Models based on technical analysis (which often essentially extrapolate past trends) are more widely-used by professional forecasting services, especially at short horizons, than models based on macroeconomic fundamentals (which could be viewed as regressive expectations). Euromoney magazine runs a yearly review of foreign exchange forecasting services; of 27 firms covered in 1988, 12 used only technical models, only 1 relied exclusively on fundamentals models, and 12 used a combination of the two techniques.

particular direction, or that a G-7 meeting may be scheduled in response to exchange rate worries.

We also include a variable for "reported intervention" equal to a dummy variable for newspaper reports of intervention (a subset of the reports captured by the NEWS variable) multiplied by the amount of true intervention. This variable allows us to quantify the difference between publically known intervention of a given size and discrete (so-called "stealth," or secret) intervention.

The second equation in our system is thus:

$$\hat{s}^e_{t+k}-s_t = \alpha_0 + \alpha_1(s_{t-j}-s_t) + \alpha_2(\hat{s}^e_{t-1+k}-s_t) + \alpha_3 NEWS_t + \alpha_4 REPI_t + \epsilon_t \quad (7)$$

where $\hat{s}^e_{t+k}$ is log of the MMS survey prediction of the spot rate in period t+k, s_t is the log of the contemporaneous spot rate, s_{t-j} is the log of the spot rate on the day of the last MMS survey, $NEWS_t$ is a (1,0,-1) dummy variable which captures reports of exchange rate policy news, and $REPI_t$ is reported Bundesbank and Fed intervention measured in dollars. We choose to date the "contemporaneous" spot rate at 7:00 a.m. EST, so that we can be sure that it is known to market participants when they formulate the forecasts that they report to MMS International the next morning. Nevertheless simultaneity may be a problem: if demand for dollars relative to marks at 7:00 a.m. EST is in part determined by expectations reflected in the next morning's survey, then the contemporaneous spot rate s_t is endogenous. But our set-up is designed to deal with precisely this problem: we have two endogenous variables, s and s^e, and two equations to be estimated simultaneously. In terms of the identification problem, the exogenous variables that are excluded from equation (7) and that can serve as instrumental variables for s are the variance v and the total quantity of marks sold in foreign exchange intervention (measured in marks) IDM.

V. The Estimation Results

The regression results for the expectation equation (7) and the portfolio equation (6) are presented in six pairs of tables. All tables with the "A" suffix present regression results over the period November 1982 through October 1984 using 3-month-ahead survey expectations of the dollar/mark exchange rate. Tables with the "B" suffix present results over the period October 1984 through December 1987 using 1-month-ahead survey expectations. [Results using 1-week-ahead survey expectations also over the latter period are presented in the Appendix.] Further, in the first three pairs of tables we present single-equation estimates to provide a basis for comparison. The instrumental variable estimates for the two equations are presented in the second three pairs of tables. Finally, in all of the tables we present results for three measures of the intervention variable. "1-day" intervention is Fed and Bundesbank purchases of dollars on the day before the survey. "14-day" or "7-day" intervention is cumulated between survey dates, so that it measures total Fed and Bundesbank dollar purchases since the last survey. "Total" intervention is cumulated from the beginning of the sample period and therefore measures the relative stock supplies of outside assets denominated in dollar and mark currencies.

We begin with the expectations equation (7), reported in Tables 1A,B and 4A,B. When equation (7) is estimated by OLS allowing for a serial correlation correction (Tables 1A,B), the coefficient on the difference between the lagged and contemporaneous spot rate is always negative, as in the destabilizing extrapolative model.[26] The estimated extrapolative coefficient tends to be larger in magnitude when the regression is estimated using instrumental variables to correct for endogeneity of the spot rate (Tables 4A,B). The coefficient on the adaptive term (the difference between the lagged survey prediction and contemporaneous spot rate) is, in contrast, always positive indicating that expectations are stabilizing. Again, the estimated adaptive coefficient tends to be larger in magnitude in the instrumented regressions. The absolute values of the estimated coefficients on the extrapolative and adaptive terms in the regressions are similar in magnitude making it difficult to access whether expectations are, on net, destabilizing or stabilizing; but the former seem to dominate during the key 1985-87 period.

The more interesting finding in the context of the signalling hypothesis is that the coefficient on the NEWS variable usually appears statistically significant for the one- and three-month horizon expectations, and of the correct sign: newspaper reports of prospective intervention in support of the dollar and related stories tend to lower expectations of the future dollar/mark exchange rate. The average news effect on the 1-month ahead expectations of the dollar mark exchange rate is on the order of .005 to .007 per cent. This is true both for the OLS estimates (Table 1B) and for the instrumental variables estimates (Table 4B). The reported intervention variable is significant in two of the three instrumented regressions for the latter sample period (table 4B).

We now turn to the risk-premium, the portfolio equation (6). We present OLS regression results for (6) in Tables 2A,B and 3A,B and

---

[26] These are similar to estimates in Frankel and Froot (1988).

instrumental variable results in Tables 5A,B and 6A,B. The intervention variable (defined as x in the text) is expressed in each of two alternative possible ways: in terms of millions of dollars' in Tables 2A,B and 5A,B, and as a percent of total wealth W in Tables 3A,B and 6A,B. (Wealth, W, is measured as the total supply of U.S. and German federal government debt that has been issued and so must be held in investors' portfolios.) The first alternative is the approach of Loopesko (1984) and Dominguez (1987,1989). In the case when the intervention variable is simply expressed in number of dollars bought on the foreign exchange market (times the variance), its coefficient should be interpreted as r/W, rather than simply as r. The second alternative -- which is the approach of Dooley and Isard (1982,1983), Frankel (1982a,1982b), and Boothe, Clinton, Cote and Longworth (1985) -- is more in accordance with the asset-market theory of exchange rate determination; but it has in the past turned out less likely to give "good" results: intervention is in practice dwarfed by government deficits and other sources of changes in asset supplies. Finally, in the regressions where intervention is expressed as percent of wealth, we further disaggregate the data by including Bundesbank and Fed intervention separately. The three separate sets of regressions, therefore, include intervention measured as the sum of Bundesbank and Fed intervention I_t, intervention by the Bundesbank IBB_t, and intervention by the Fed $IFED_t$.[27]

[27] While the magnitudes of the coefficient estimates on the intervention variable (however defined) of course change dramatically depending on whether intervention is expressed in millions of dollars or as a percent of wealth, the statistical significance of the coefficient is consistent across the two definitions. We therefore, in the interest of space, do not include regression results for Fed and Bundesbank intervention, separately, expressed in millions of dollars.

Begin with the OLS estimates [tables 2 and 3]. When intervention is measured either between surveys or on the day before the survey in the latter sample period, the effect of the variance of spot changes on the risk premium is generally statistically significant at the 95 per cent level. This finding is itself of interest.[28] But our primary focus here is on the effect of intervention, and it is not statistically significant for the October 1982 - October 1984 sample period. Again, this is not surprising, as the sample size is small and this was the period when there was no official U.S. support for intervention.[29] But even for the later sample period, the OLS regressions show significance only for the effects of 1-day intervention on the 1-month-term risk premium.

As discussed earlier, the single equation estimates of the portfolio regression are vulnerable to concerns of simultaneity bias due to the endogeneity of the spot exchange rate, used to translate the marks sold in intervention into dollar terms so as to be able to divide by wealth expressed in dollars. That is why we report simultaneous-equation estimates of equation (6) in tables 5A,B and 6A,B, using as instruments: last week's spot rate, the NEWS variable, and the reported component of Bundesbank and Fed intervention. During the later period, October 1984 to December 1987, the coefficient on intervention estimated by instrumental variables is generally statistically significant, regardless of whether it

---

[28] Domowitz and Hakkio (1985) test for a relationship between the variance and the risk premium, with the latter defined using the conventional rational expectations methodology.

[29] Indeed, what little U.S. intervention there was shows up with a high standard error and the wrong sign when Bundesbank and Fed intervention are included separately in the regressions.

is expressed in millions of dollars (Table 5B) or as a percent of wealth (Table 6B).[30]

Tables 7 and 8 present OLS and instrumental variable estimates, respectively, over the latter sample period for an unconstrained version of the portfolio equation (equation (3)) that enters the variance and asset supplies linearly, rather than constraining them to enter in multiplicative form.[31] The OLS results in Table 7 are similar in terms of statistical significance to the analogous constrained version results presented in Table 2B. Likewise, the instrumental variable results in Table 8 are similar to those presented in Table 5B. These results suggest that even using the simple linear specification, we can generally reject perfect asset substitutability in the latter sample period.

The finding that the instrumented coefficients on the intervention variable are generally statistically significant in equations 3 and 6 (for the latter sample period) implies that intervention has an effect, even if sterilized. The reason is that if mark and dollar assets were perfect substitutes, then the coefficient should be zero: changes in asset supplies would have no effect on the risk premium.

---

[30] Recall that, in theory, the coefficient of the product of the intervention variable and the variance is the coefficient of relative risk-aversion. When intervention is defined as percent of wealth the estimates of the coefficient of risk aversion implicit in the Tables are extremely large. This result is an artifact, not of the particular estimation technique, but of the optimal-diversification theory, as has been noted before: e.g., Krugman (1981). It follows from equation (4) that for intervention to have a non-negligible effect on the risk premium, either the coefficient of risk-aversion r must be much higher than 2, or the proper denominator for x must be much smaller than the total stock supply of marks and dollars.

[31] Analogous unconstrained regression results using the one-week-ahead expectations survey data are presented in Appendix Tables A7 and A8.

VI. A Summary of the Quantitative Effects

For purposes of illustration, we now try out some sample parameter estimates in calculations of the effect of intervention on the exchange rate. We assume in these experiments that interest rates in Germany and the United States are held constant (which, for some readers, might mean that we are talking about sterilized intervention). If interest rates were allowed to vary, then the effects in a general portfolio-balance model might be either smaller or larger than those reported here, depending on whether the intervention were sterilized or not sterilized.

First, consider the effect of intervention on the exchange rate if it is not known publically. [Recall that this experiment precludes any effects that run via expectations of future asset supplies.] We begin with the baseline case where expectations are assumed to be neither extrapolative nor adaptive. If one wants to take the extrapolative and adaptive parameters to be non-zero, the baseline case is still relevant as a description of the long-run equilibrium (where $s_t - s_{t-1}$ and $s_t - s_t^e$ are zero). Under these assumptions, the intervention has no effect at all on the risk premium.

It follows from equation (6) that the effect of the intervention on the spot exchange rate is simply in proportion to the change in the supply of mark assets. What is the proportion represented by, say, $100 million dollars of intervention? If we are thinking of the case where only non-sterilized intervention matters, then the denominator is relatively clear: total reserve money supplied to the banking system by the Bundesbank, which, as of the end of 1987, was $ 126.3 billion [= DM 199.7 billion / 1.5815]. Thus the effect is only .079 per cent. If we are thinking of sterilized intervention, then the effect of $ 100 million will be even smaller, because the denominator is the total supply of mark-denominated bonds, rather than just money. (But it is worth recalling again that this effect, even if small, is nonetheless not zero, according to our rejection of perfect substitutability between mark and dollar bonds.)

To get large effects on the exchange rate, we need the public to hear the news of the intervention. Our second experiment considers the effect of such information in isolation, as reflected in the coefficient on our NEWS variable, even if such intervention is in fact not taking place. [If intervention actually takes place <u>and</u> is publically reported, then its total effect would be the sum of the (small) effect reported in the preceding paragraph, plus the (much larger) effect reported in this paragraph, plus the effect implied by the coefficient on the REPI variable when significant.] Under our baseline case [no change in interest rates and no extrapolative or adaptive expectations], the risk premium simply changes by the coefficient of NEWS in the expectation equation: .007, to take an INST estimate for one-month-ahead expectations in Table 4B. Such a change in the risk premium will have a large effect on the demand for mark versus dollar assets.

The effect of the change on the exchange rate is simply proportional to the effect on $x_t/1-x_t$, the ratio of the portfolio demand for marks to the portfolio demand for dollars. Our preferred estimate of the coefficient on $v_t x_t$ from equation (6), for Federal Reserve 1-day intervention, is 168,903 (this is from the third row of Table 6B: for the period October 1984 to December 1987, using the one-month risk premium and the simultaneous-equation estimate). The average value of v_t during this period was .0000115. It follows that the average effect of the news was to lower the portfolio demand for marks x_t by .0036 [=.007/(168,903 x .0000115)], and to raise $1-x_t$ by the same amount. The average value of x_t during the period (measured as total debt issued by the German government, divided by the total of German and U.S. debt) was .0994, and so the average value of $1-x_t$ was .9006. Thus the average effect of a news report was to change $x_t/1-x_t$, the ratio of the portfolio demand for marks to the portfolio demand for dollars, from .110 [=.099/.901] to .106 [= .096/.904]. This represents a 4 per cent decline in $x_t/1-x_t$, and therefore in the exchange rate.

At the end of the sample period, the value of x_t was .121 (because the value of the mark was much higher [\$.613 as compared to \$.437]), and so $1-x_t$ was .879. Thus the effect of a news report at that time would have been to change $x_t/1-x_t$, the ratio of the portfolio demand for marks to the portfolio demand for dollars, from .138 [=.121/.879] to .133 [=.117/.883], an effect of 3 per cent on the exchange rate.

These effects seem rather high (and they would be considerably higher if the estimate was taken from the coefficient on Bundesbank intervention, rather than that on Federal Reserve intervention). One's intuition that the effect should in reality be smaller can easily be fit into any of several categories. First, it is possible, even if we are talking about intervention that is sterilized in the sense that there is no change in the money supply, that the interest rates will absorb some of the impact of the decreased demand for mark assets (the German interest rate rising and the U.S. interest rate falling), so that the depreciation of the mark will be smaller. One would need to specify a complete portfolio balance model to answer how big the changes in the interest rates would be. But the effect on the nominal interest differential would only have to be 35 basis points to wipe out half of the reported effect on the spot rate.

Second, if one wishes to deviate from the baseline case to consider the possibility of extrapolative expectations, then the effects reported above obtain only in the long-run equilibrium in which $s_t - s_{t-1}$ is zero. The short-run impact effect could be smaller.[32] For some readers an intuitively appealing implication of extrapolative expectations is that, after the first-week impact of the news, market forecasters react further to the observed change in the exchange rate by jumping on the bandwagon, so that the effect grows in subsequent weeks.[33] Others may prefer to believe that expectations are regressive rather than extrapolative; or that newspaper reports or other random disturbances to the level of the spot rate, to the extent that they are not confirmed subsequently by actual observed changes in macroeconomic fundamentals, will gradually lose their effect on the spot rate as time passes, and that this "unwinding factor" is not adequately captured in our equations. This last possibility would

---

[32] On the other hand, if market participants are believed to have adaptive or regressive expectations, then the impact in short-run equilibrium will be <u>higher</u> than in long-run equilibrium, the familiar overshooting hypothesis. Estimates in Frankel and Froot (1988) show that expectations are extrapolative at the short-term horizons, but turn regressive at 6-month and 1-year horizons. [We did not try these horizons in our estimates here, partly because they are only available (from the <u>Financial Report</u>) at six-week intervals.]

[33] C.Fred Bergsten, for example, has urged that Central Banks intervene by "leaning into the wind," which could be interpreted as getting a bandwagon or snow-balling effect going.

constitute a third factor that could reduce the effect on the spot rate in long-run equilibrium below that reported above.[34]

Our own inclination is to believe that expectations only tend to be extrapolative in occasional periods: "speculative bubble" environments, when the foreign exchange market "loses its moorings" and forecasters forget about fundamentals. Of course, these are precisely the periods in which Central Bankers might be most interested in using the tool of intervention.[35]

The last circumstance in which the effect on the spot rate would be less than that estimated here is if the event occurs during a period when the variance is higher than it is on average. Again, these might be the precisely periods in which Central Bankers would be most interested in using intervention as a short-term tool, to smooth "disorderly markets."[36]

---

[34] A related point concerns the famous "Lucas critique." If the Central Bank adopted a policy of routinely making public announcements of its intervention -- which is not its practice now -- each announcement would not continue to have the same impact as in our estimates (unless, perhaps, it was sufficiently backed up by a correspondingly greater degree of actual changes in asset supplies). Our estimates only purport to say what the effect was during the regime actually in effect during the sample period.

[35] References include Krugman (1985), Frankel (1985), Marris (1985), Frankel and Froot (1988), and Williamson and Miller (1987).

[36] On the other hand, the financial press often talks of central bankers' intervention operations as seeking to have an effect on market behavior precisely by <u>creating</u> extra volatility, and thereby "punishing" nasty speculators. Our estimates imply that a change in volatility can indeed have a significant impact on investors' asset demands. But, aside from the difficulty of driving out nasty destabilizing speculators without also driving out good stabilizing speculators, and aside from the general undesirability of creating needless volatility, there is another problem with this theory. If the supply of dollar assets in the market exceeds the share in the minimum-variance portfolio, then an increase in the variance will work to <u>depreciate</u> the dollar (for a given risk premium), which may not be the direction desired by the authorities.

Our results cannot be viewed as definitive. We plan to extend the framework in several directions, such as including other currencies. Nevertheless, to sum up, the findings for the dollar/mark rate during our mid-1980s sample period are generally favorable for the effectiveness of intervention. There appear to be statistically significant effects both through the expectations channel and through the portfolio channel. The quantitative effects can vary, depending both on the particular estimates chosen for the key parameters and on the precise experiment that one wishes to consider. But we hope that the statistical significance of the effects that we find will contribute to a re-evaluation of the conventional wisdom as to the ineffectiveness of intervention.

DATA SOURCES AND VARIABLE DEFINITIONS

s_t: log of the \$/DM spot exchange rate (DRI)

$\hat{s}^e_{t,k}$: log of Money Market Services (MMS) median k-period-ahead expectation for the \$/DM rate.

$NEWS_t$: +1 for reports of central bank purchases, etc., in support of dollar
-1 for reports of central bank purchases, etc., in support of mark
0 for no relevant newspaper reports
(Newspapers: Wall Street Journal, London Financial Times)

$REPI^*_t$: actual Bundesbank and Fed intervention, in millions of \$s, when reports of intervention appeared in the newspaper

v_t: daily variance of \$/DM exchange rate changes over the preceding week

$i^{DM}_{t,k}$: euroDM k-period-ahead interest rate (DRI)

$i^{\$}_{t,k}$: euro\$ k-period-ahead interest rate (DRI)

$\Delta\hat{s}^e_{t,k}$: log of the MMS k-period-ahead \$/DM exchange rate minus the log of the time t \$/DM exchange rate.

I_t: sum of Bundesbank and Fed intervention, in millions of \$

IDM_t: sum of Bundesbank and Fed intervention, in millions of DM

IBB_t: Bundesbank intervention, in millions of \$

$IFED_t$: Fed intervention, in millions of \$

* All intervention variables are known at time t (purchases and sales through the end of day t-1) and are defined in terms of number of dollars purchased.

Table 1A

ESTIMATION TECHNIQUE: OLS

SAMPLE: November 1982 - October 1984

$$\hat{s}^e_{t+k}-s_t = \alpha_0 + \alpha_1(s_{t-j}-s_t) + \alpha_2(\hat{s}^e_{t-1+k}-s_t) + \alpha_3 NEWS_t + \alpha_4 REPI_t + \epsilon_t$$

BI-WEEKLY THREE-MONTH-AHEAD SURVEY EXPECTATION EQUATION

(OBS=51, k=90, j=14)

INTERVENTION	α_0	α_1	α_2	α_3	α_4	RHO	R^2	D.W.
1-DAY[a]	.003	-.628**	.669**	-.007**	-.374-04	-.349**	.28	1.55
	(.003)	(.133)	(.131)	(.002)	(.501-04)	(.162)		
14-DAY[b]	.006	-.551**	.661**	-.007**	.655-05	-.392**	.31	1.60
	(.003)	(.140)	(.129)	(.002)	(.447-05)	(.158)		
TOTAL[c]	.008**	-.435**	.597**	-.008**	.113-05**	-.439**	.39	1.64
	(.003)	(.139)	(.123)	(.002)	(.395-06)	(.155)		
Table 1B .								
SAMPLE: October 1984 - December 1987								
WEEKLY ONE-MONTH-AHEAD SURVEY EXPECTATION EQUATION								
(OBS=133, k=30, j=7)								
1-DAY	.008**	-.043	.031	-.005**	.245-06	.327**	.12	2.06
	(.002)	(.115)	(.086)	(.003)	(.138-04)	(.114)		
7-DAY	.007**	-.268**	.201**	-.006**	.104-04**	.101	.17	1.98
	(.002)	(.113)	(.082)	(.003)	(.338-05)	(.126)		
TOTAL	.008**	-.079	.049	-.005*	.214.06	.304**	.13	2.05
	(.002)	(.115)	(.086)	(.003)	(.241-06)	(.116)		

a) Intervention variable (REPI) is an end-of-day before the survey measure.

b) Intervention variable is an accumulated measure between survey forecasts.

c) Intervention variable is an accumulated measure from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table 2A

ESTIMATION TECHNIQUE: OLS

SAMPLE: November 1982 - October 1984

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta \hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 v_t {*} I_t + u_{t+k}$$

BI-WEEKLY THREE-MONTH-AHEAD RISK PREMIUM EQUATION

(OBS=51, k=90)

(Intervention in millions of $)

INTERV-ENTION	β_0	β_1	β_2	RHO	R^2	D.W.
1-DAY[a]	.006	116.90	-.0139	.754**	.44	2.24
	(.005)	(132.49)	(3.0396)	(.122)		
14-DAY[b]	.005	93.26	-.1664	.774**	.45	2.29
	(.006)	(131.19)	(.2277)	(.118)		
TOTAL[c]	.006	88.59	-.0087	.769**	.44	2.26
	(.005)	(161.81)	(.0300)	(.122)		

Table 2B

SAMPLE: October 1984 - December 1987

WEEKLY ONE-MONTH-AHEAD RISK PREMIUM EQUATION

(OBS=153, k=7)

1-DAY	.002	204.99**	.6229*	.429**	.24	2.16
	(.002)	(74.91)	(.3317)	(.080)		
7-DAY	.002	159.10**	.0645	.436**	.22	2.17
	(.002)	(73.19)	(.1205)	(.081)		
TOTAL	.002	-346.83	-.0278	.436**	.23	2.16
	(.002)	(465.62)	(.0251)	(.080)		

a) Intervention variable (I) is an end-of-day before the survey measure.

b) Intervention variable is an accumulated measure between survey forecasts.

c) Intervention variable is an accumulated measure from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table 3A

ESTIMATION TECHNIQUE: OLS

SAMPLE: November 1982 - October 1984

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta \hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 v_t * x_t + u_{t+k}$$

BI-WEEKLY THREE-MONTH-AHEAD RISK PREMIUM EQUATION

(OBS= 51, k=90)

(Intervention expressed as percent of wealth.)

INTERV-ENTION	β_0	β_1	β_2(x=I)	β_2(x=IBB)	β_2(x=IFED)	RHO	R^2	D.W.
1-DAY[a]	.006	118.17	1459.91			.755**	.45	2.25
	(.005)	(132.08)	(38646.69)			(.122)		
	.006	113.42		-4666.69		.756**	.45	2.25
	(.005)	(134.04)		(48288.90)		(.122)		
	.006	116.70			56559.85	.759**	.45	2.25
	(.005)	(128.21)			(137063.70)	(.122)		
14-DAY[b]	.006	92.46	-2400.69			.774**	.45	2.30
	(.006)	(130.61)	(3011.58)			(.118)		
	.006	91.57		-2691.11		.775**	.45	2.30
	(.006)	(130.87)		(3384.62)		(.117)		
	.006	106.79			-13169.65	.760**	.45	2.29
	(.005)	(128.91)			(21040.87)	(.122)		
TOTAL[c]	.006	83.74	-141.02			.771**	.45	2.27
	(.006)	(163.52)	(425.31)			(.121)		

a) Intervention variables (I, IBB, IFED) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table 3B

ESTIMATION TECHNIQUE: OLS

SAMPLE: October 1984 - December 1987

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta \hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 v_t * x_t + u_{t+k}$$

WEEKLY ONE-MONTH-AHEAD RISK PREMIUM EQUATION

(OBS= 133, k=30)

(Intervention expressed as percent of wealth.)

INTERV-ENTION	β_0	β_1	β_2(x=I)	β_2(x=IBB)	β_2(x=IFED)	RHO	R^2	D.W.
1-DAY[a]	.002 (.002)	202.81** (74.68)	9351.99* (5067.35)			.431** (.080)	.24	2.16
	.002 (.002)	201.34** (75.07)		9154.76* (5410.92)		.433** (.080)	.24	2.16
	.002 (.002)	175.42** (70.88)			134188.70** (51228.66)	.433** (.080)	.26	2.15
7-DAY[b]	.002 (.002)	161.79** (72.67)	1282.98 (2367.96)			.435** (.081)	.22	2.17
	.002 (.002)	138.59* (77.64)		3891.16 (4184.79)		.420** (.083)	.23	2.16
	.002 (.002)	166.63** (75.25)			376.55 (4664.66)	.448** (.080)	.22	2.17
TOTAL[c]	.002 (.002)	262.80 (385.00)	96.75 (373.51)			.445** (.079)	.22	2.16

a) Intervention variables (I, IBB, IFED) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table 4A

ESTIMATION TECHNIQUE: INSTRUMENTAL VARIABLES

SAMPLE: November 1982 - October 1984

$$\hat{s}^e_{t+k} - s_t = \alpha_0 + \alpha_1(s_{t-j} - s_t) + \alpha_2(\hat{s}^e_{t-1+k} - s_t) + \alpha_3 NEWS_t + \alpha_4 REPI_t + \epsilon_t$$

BI-WEEKLY THREE-MONTH-AHEAD SURVEY EXPECTATION EQUATION

(OBS= 51, k=90, j=14)

INSTRUMENTS: v_t, IDM_t

INTERV-ENTION	α_0	α_1	α_2	α_3	α_4	RHO	D.W.
1-DAY[a]	-.006	-1.050**	1.158**	-.007**	.516-04	-.416	1.73
	(.011)	(.373)	(.527)	(.003)	(.131-03)	(1.256)	
14-DAY[b]	-.008	-1.093**	1.218**	-.007**	.494-07	-.434	1.73
	(.013)	(0.489)	(0.536)	(.003)	(.830-05)	(1.046)	
TOTAL[c]	.008	-.352	.582	-.006**	.117-05	-.420	1.65
	(.012)	(.499)	(.489)	(.003)	(.753-06)	(.998)	

Table 4B

SAMPLE: October 1984 - December 1987

WEEKLY ONE-MONTH-AHEAD SURVEY EXPECTATION EQUATION

(OBS= 133, k=30, j=7)

1-DAY	.003	-1.175**	.942**	-.005	.579-05	-.270	2.02
	(.002)	(.368)	(.223)	(.003)	(.202-04)	(2.536)	
7-DAY	.003	-1.113**	.732**	-.007**	.104-04**	-.269	2.02
	(.002)	(.379)	(.205)	(.003)	(.386-05)	(5.291)	
TOTAL	.003	-1.628**	.981**	-.005	.484-06*	-.292	1.99
	(.002)	(.429)	(.238)	(.003)	(.281-06)	(15.773)	

a) Intervention variables (REPI, IDM) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table 5A

ESTIMATION TECHNIQUE: INSTRUMENTAL VARIABLES

SAMPLE: November 1982 - October 1984

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta \hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 v_t * I_t + u_{t+k}$$

BI-WEEKLY THREE-MONTH-AHEAD RISK PREMIUM EQUATION

(OBS= 51, k=90)

INSTRUMENTS: s_{t-j}, $NEWS_t$, $REPI_t$

(Intervention in millions of $)

INTERV-ENTION	β_0	β_1	β_2	RHO	D.W.
1-DAY[a]	.007	-39.84	-4.0687	.740**	2.33
	(.005)	(179.06)	(4.3537)	(.246)	
14-DAY[b]	.007	-79.31	-.3150	.773**	2.38
	(.006)	(177.95)	(.3158)	(.213)	
TOTAL[c]	.012**	521.52*	.1831**	.287	1.83
	(.003)	(277.09)	(.0640)	(.639)	

Table 5B

SAMPLE: October 1984 - December 1987

WEEKLY ONE-MONTH-AHEAD RISK PREMIUM EQUATION

(OBS= 133, k=30)

1-DAY	.002	184.19**	.7521**	.421**	2.15
	(.002)	(82.25)	(.3666)	(.182)	
7-DAY	.003	79.01	.6001**	.307	2.09
	(.002)	(86.92)	(.2658)	(.272)	
TOTAL	.002	-1103.98	-.0678	.419**	2.13
	(.002)	(1701.42)	(.0926)	(.165)	

a) Intervention variables (I, REPI) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table 6A

ESTIMATION TECHNIQUE: INSTRUMENTAL VARIABLES

SAMPLE: November 1982 - October 1984

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta\hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 v_t * I_t + u_{t+k}$$

BI-WEEKLY THREE-MONTH-AHEAD RISK PREMIUM EQUATION

(OBS= 51, k=90)

INSTRUMENTS: s_{t-j}, $NEWS_t$, $REPI_t$

(Intervention expressed as percent of wealth.)

INTERV-ENTION	β_0	β_1	β_2(x=I)	β_2(x=IBB)	β_2(x=IFED)	RHO	D.W.
1-DAY[a]	.007	-36.37	-51026.15			.736**	2.32
	(.005)	(177.93)	(54546.04)			(.248)	
	.007	-62.38		-78031.25		.739**	2.35
	(.005)	(184.89)		(73981.73)		(.249)	
	.007	-5.57			-79153.85	.734**	2.27
	(.005)	(170.96)			(172108.60)	(.272)	
14-DAY[b]	.007	-76.79	-4246.85			.770**	2.38
	(.006)	(176.54)	(4126.61)			(.214)	
	.007	-57.67		-3593.72		.769**	2.35
	(.006)	(177.81)		(4854.12)		(.234)	
	.007	-60.04			-33076.56	.744**	2.37
	(.005)	(172.87)			(27170.84)	(.252)	
TOTAL[c]	.012**	533.51*	2577.16**			.308	1.83
	(.003)	(288.02)	(943.12)			(.633)	

a) Intervention variables (I, IBB, IFED, REPI) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table 6B

ESTIMATION TECHNIQUE: INSTRUMENTAL VARIABLES

SAMPLE: October 1984 - December 1987

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta \hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 v_t * I_t + u_{t+k}$$

WEEKLY ONE-MONTH-AHEAD RISK PREMIUM EQUATION

(OBS= 133, k=30)

INSTRUMENTS: s_{t-j}, $NEWS_t$, $REPI_t$

(Intervention expressed as percent of wealth.)

INTERV-ENTION	β_0	β_1	β_2(x=I)	β_2(x=IBB)	β_2(x=IFED)	RHO	D.W.
1-DAY[a]	.002	181.17**	11231.26**			.423**	2.16
	(.002)	(82.01)	(5576.69)			(.181)	
	.002	181.32**		11435.18*		.424**	2.16
	(.002)	(82.49)		(5961.83)		(.179)	
	.002	150.09*			168903.80*	.424**	2.15
	(.002)	(78.31)			(88580.14)	(.190)	
7-DAY[b]	.002	110.48	10229.34**			.315	2.10
	(.002)	(82.54)	(4714.61)			(.268)	
	.003	56.69		12518.91*		.346	2.12
	(.002)	(92.89)		(7334.16)		(.251)	
	.001	214.76**			20012.59*	.354	2.11
	(.002)	(93.63)			(10607.68)	(.223)	
TOTAL[c]	.003	1847.76*	1684.77*			.378	2.14
	(.002)	(994.83)	(978.64)			(.264)	

a) Intervention variables (I, IBB, IFED, REPI) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table 7

ESTIMATION TECHNIQUE: OLS

SAMPLE: October 1984 - December 1987

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta\hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 x_t + u_{t+k}$$

WEEKLY UNCONSTRAINED ONE-MONTH-AHEAD RISK PREMIUM EQUATION

(OBS= 133, k=30)

(Intervention expressed in millions of $.)

INTERV-ENTION	β_0	β_1	β_2(x=I)	β_2(x=IBB)	β_2(x=IFED)	RHO	R^2	D.W.
1-DAY[a]	.001	200.42**	.280-04**			.412**	.26	2.15
	(.002)	(72.26)	(.103-04)			(.081)		
	.002	199.88**		.292-04**		.426**	.25	2.16
	(.002)	(72.79)		(.123-04)		(.080)		
	.002	167.49**			.345-04	.433**	.24	2.16
	(.002)	(72.01)			(.227-04)	(.079)		
7-DAY[b]	.002	153.53**	.422-05			.403**	.23	2.14
	(.002)	(72.87)	(.277-05)			(.083)		
	.002	151.77**		.378-05		.421**	.23	2.16
	(.002)	(74.33)		(.478-05)		(.083)		
	.002	170.24**			.674-05	.428**	.24	2.15
	(.002)	(72.18)			(.442-05)	(.080)		
TOTAL[c]	-.009	165.78**	-.572-06			.438**	.23	2.16
	(.011)	(72.25)	(.579-06)			(.079)		

a) Intervention variables (I, IBB, IFED) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table 8

ESTIMATION TECHNIQUE: INSTRUMENTAL VARIABLES

SAMPLE: October 1984 - December 1987

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta\hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 I_t + u_{t+k}$$

WEEKLY <u>UNCONSTRAINED</u> ONE-MONTH-AHEAD RISK PREMIUM EQUATION

(OBS= 133, k=30)

INSTRUMENTS: s_{t-j}, $NEWS_t$, $REPI_t$

(Intervention expressed in millions of $.)

INTERV-ENTION	β_0	β_1	β_2(x=I)	β_2(x=IBB)	β_2(x=IFED)	RHO	D.W.
1-DAY[a]	.002	173.25**	.283-04**			.409**	2.15
	(.002)	(78.86)	(.113-04)			(.194)	
	.002	169.04**		.271-04**		.427**	2.16
	(.002)	(79.98)		(.136-04)		(.181)	
	.002	138.83*			.405-04	.429**	2.16
	(.002)	(79.26)			(.249-04)	(.179)	
7-DAY[b]	.002	85.22	.230-04**			.218	2.03
	(.002)	(89.01)	(.666-05)			(.425)	
	.003	115.96		.579-05		.404*	2.15
	(.002)	(81.59)		(.529-05)		(.211)	
	.002	139.22*			.747-05	.423**	2.15
	(.002)	(79.11)			(.486-05)	(.187)	
TOTAL[c]	.014	138.42*	.638-06			.481**	2.20
	(.029)	(81.19)	(.155-05)			(.179)	

a) Intervention variables (I, IBB, IFED, REPI) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table A1

ESTIMATION TECHNIQUE: OLS

SAMPLE: October 1984 - December 1987

$$\hat{s}^e_{t+k} - s_t = \alpha_0 + \alpha_1(s_{t-j} - s_t) + \alpha_2(\hat{s}^e_{t-1+k} - s_t) + \alpha_3 NEWS_t + \alpha_4 REPI_t + \epsilon_t$$

WEEKLY ONE-WEEK-AHEAD SURVEY EXPECTATION EQUATION

(OBS=153, k=7, j=7)

INTERV-ENTION	α_0	α_1	α_2	α_3	α_4	RHO	R^2	D.W.
1-DAY[a]	.004**	-.165	.046	-.002	-.155-04	.154	.05	1.98
	(.001)	(.101)	(.113)	(.002)	(.122-04)	(.108)		
7-DAY[b]	.004**	-.132	.038	-.004*	.619-05**	.109	.07	1.98
	(.001)	(.101)	(.112)	(.002)	(.298-05)	(.112)		
TOTAL[c]	.004**	-.147	.036	-.003	.381-06	.137	.04	1.98
	(.001)	(.102)	(.115)	(.002)	(.603-06)	(.108)		

Table A2

ESTIMATION TECHNIQUE: INSTRUMENTAL VARIABLES

INSTRUMENTS: v_t, IDM_t

	α_0	α_1	α_2	α_3	α_4	RHO	D.W.
1-DAY	.001	1.611*	-1.505*	-.005	-.121-04	-.207	2.07
	(.002)	(.908)	(.796)	(.004)	(.215-04)	(2.931)	
7-DAY	.002	1.091	-1.118*	-.005*	.611-05	-.218	2.07
	(.002)	(.691)	(.630)	(.003)	(.431-05)	(1.162)	
TOTAL	.002	1.292*	-1.429**	-.004	.106-05	-.211	2.06
	(.002)	(.738)	(.639)	(.003)	(.862-06)	(2.661)	

a) Intervention variables (REPI, IDM) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table A3

ESTIMATION TECHNIQUE: OLS

SAMPLE: October 1984 - December 1987

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta\hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 v_t * I_t + u_{t+k}$$

WEEKLY ONE-WEEK-AHEAD RISK PREMIUM EQUATION

(OBS=153, k=7)

(Intervention in millions of $)

INTERV-ENTION	β_0	β_1	β_2	RHO	R^2	D.W.
1-DAY[a]	.0007	139.20**	.2978	.132	.06	2.00
	(.001)	(59.14)	(.4177)	(.083)		
7-DAY[b]	.0008	121.47**	.0281	.141*	.06	2.00
	(.001)	(57.15)	(.0922)	(.085)		
TOTAL[c]	.0008	155.68	.0054	.150*	.06	2.01
	(.001)	(117.12)	(.0173)	(.083)		

Table A4

ESTIMATION TECHNIQUE: INSTRUMENTAL VARIABLES

INSTRUMENTS: s_{t-j}, $NEWS_t$, $REPI_t$

	β_0	β_1	β_2	RHO	D.W.
1-DAY	.0007	144.63**	.3717	.128	2.00
	(.001)	(59.94)	(.4452)	(.525)	
7-DAY	.0008	96.78	.3149*	.088	1.99
	(.001)	(62.28)	(.1948)	(.766)	
TOTAL	.0004	-375.63	-.0846	.174	2.03
	(.001)	(390.81)	(.0652)	(.394)	

a) Intervention variables (I, REPI) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table A5

ESTIMATION TECHNIQUE: OLS

SAMPLE: October 1984 - December 1987

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta\hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 v_t{*}x_t + u_{t+k}$$

WEEKLY ONE-WEEK-AHEAD RISK PREMIUM EQUATION

(OBS= 153, k=7)

(Intervention expressed as percent of wealth.)

INTERV-ENTION	β_0	β_1	β_2(x=I)	β_2(x=IBB)	β_2(x=IFED)	RHO	R^2	D.W.
1-DAY[a]	.0007	135.95**	3795.20			.135	.07	2.00
	(.001)	(58.93)	(6463.70)			(.083)		
	.0008	128.67**		1559.10		.142*	.06	2.01
	(.001)	(59.39)		(6920.63)		(.084)		
	.0006	124.59**			108418.90**	.149*	.10	2.00
	(.001)	(55.13)			(43646.26)	(.083)		
7-DAY[b]	.0008	122.86**	520.10			.141*	.06	2.00
	(.001)	(56.56)	(1855.86)			(.085)		
	.0009	112.08*		1958.37		.135	.07	2.00
	(.001)	(61.40)		(3604.52)		(.086)		
	.0008	123.73**			21.89	.147*	.06	2.01
	(.001)	(57.65)			(3473.89)	(.085)		
TOTAL[c]	.0008	152.23	88.86			.148*	.06	2.01
	(.001)	(120.18)	(329.60)			(.083)		

a) Intervention variables (I, IBB, IFED) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table A6

ESTIMATION TECHNIQUE: INSTRUMENTAL VARIABLES

SAMPLE: October 1984 - December 1987

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta\hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 v_t * I_t + u_{t+k}$$

WEEKLY ONE-WEEK-AHEAD RISK PREMIUM EQUATION

(OBS= 153, k=7)

INSTRUMENTS: s_{t-j}, $NEWS_t$, $REPI_t$

(Intervention expressed as percent of wealth.)

INTERV-ENTION	β_0	β_1	β_2(x=I)	β_2(x=IBB)	β_2(x=IFED)	RHO	D.W.
1-DAY[a]	.0007	142.59**	5350.09			.129	2.01
	(.001)	(59.64)	(6810.90)			(.517)	
	.0007	141.66**		5124.03		.130	2.00
	(.001)	(60.15)		(7305.55)		(.522)	
	.0007	126.34**			71641.36	.146	2.00
	(.001)	(55.98)			(62224.98)	(.465)	
7-DAY[b]	.0007	112.21*	6158.61*			.084	1.99
	(.001)	(59.26)	(3661.81)			(.808)	
	.001	26.92		16098.73**		.053	2.00
	(.001)	(80.25)		(7950.05)		(.995)	
	.0005	152.69**			6761.66	.114	2.00
	(.001)	(61.01)			(6265.92)	(.707)	
TOTAL[c]	.0006	-169.28	-913.98			.168	2.02
	(.001)	(370.13)	(1131.86)			(.423)	

a) Intervention variables (I, IBB, IFED, REPI) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table A7

ESTIMATION TECHNIQUE: OLS

SAMPLE: October 1984 - December 1987

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta \hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 x_t + u_{t+k}$$

WEEKLY <u>UNCONSTRAINED</u> ONE-WEEK-AHEAD RISK PREMIUM EQUATION

(OBS= 153, k=7)

(Intervention in millions of $.)

INTERV-ENTION	β_0	β_1	β_2(x=I)	β_2(x=IBB)	β_2(x=IFED)	RHO	R^2	D.W.
1-DAY[a]	.0007	140.67**	.165-04**			.123	.09	2.00
	(.001)	(55.70)	(.776-05)			(.083)		
	.0007	135.65**		.118-04		.125	.07	2.01
	(.001)	(56.39)		(.973-05)		(.083)		
	.0006	122.67**			.373-04**	.170**	.10	2.01
	(.001)	(55.30)			(.157-04)	(.082)		
7-DAY[b]	.0008	116.44**	.371-05*			.123	.09	2.00
	(.001)	(55.79)	(.193-05)			(.083)		
	.001	106.21*		.769-05**		.107	.09	2.00
	(.001)	(56.15)		(.338-05)		(.083)		
	.0007	125.06**			.307-05	.141*	.07	2.01
	(.001)	(56.06)			(.304-05)	(.083)		
TOTAL[c]	-.0009	121.62**	-.296-06			.138*	.07	2.01
	(.001)	(56.08)	(.261-06)			(.083)		

a) Intervention variables (I, IBB, IFED) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

Table A8

ESTIMATION TECHNIQUE: INSTRUMENTAL VARIABLES

SAMPLE: October 1984 - December 1987

$$i^{DM}_{t+k} - i^{\$}_{t+k} + \Delta\hat{s}^{e}_{t+k} = \beta_0 + \beta_1 v_t + \beta_2 I_t + u_{t+k}$$

WEEKLY <u>UNCONSTRAINED</u> ONE-WEEK-AHEAD RISK PREMIUM EQUATION

(OBS= 153, k=7)

INSTRUMENTS: s_{t-j}, $NEWS_t$, $REPI_t$

(Intervention in millions of $.)

INTERV-ENTION	β_0	β_1	β_2(x=I)	β_2(x=IBB)	β_2(x=IFED)	RHO	D.W.
1-DAY[a]	.0007 (.001)	134.40** (56.44)	.881-05 (.803-05)			.134 (.504)	2.01
	.0008 (.001)	132.56** (56.99)		.722-05 (.100-04)		.134 (.523)	2.01
	.0007 (.001)	125.59** (56.24)			.168-04 (.163-04)	.154 (.459)	2.01
7-DAY[b]	.0008 (.001)	119.14** (56.26)	.330-05* (.200-05)			.125 (.827)	2.00
	.0009 (.001)	109.63* (56.63)		.682-05* (.352-05)		.112 (.822)	2.00
	.0007 (.001)	126.41** (56.61)			.274-05 (.318-05)	.141 (.585)	2.01
TOTAL[c]	-.006 (.005)	107.07* (60.02)	-.111-05 (.875-06)			.207 (.374)	2.03

a) Intervention variables (I, IBB, IFED, REPI) are end-of-day before the survey measures.

b) Intervention variables are accumulated measures between survey forecasts.

c) Intervention variables are accumulated measures from the beginning of the sample period.

* significant at the 90% level; ** significant at the 95% level.

References

Adler, Michael, and Bernard Dumas, 1983, "International Portfolio Choice and Corporation Finance: A Survey," Journal of Finance 38, 925-984.

Attanasio, O.P., and M.L. Edey, 1987, "Time-Varying Volatility and Foreign Exchange Risk: An Empirical Study," Manuscript, London School of Economics.

Backus, David, and Patrick Kehoe, 1988, "On the Denomination of the Government Debt: A Critique of the Portfolio Balance Approach," Federal Reserve Bank of Minneapolis, June.

Boothe, P., K.Clinton, A.Cote and D.Longworth, 1985, International Asset Substitutability: Theory and Evidence for Canada, Ottawa: Bank of Canada, February.

Branson, William, Hannu Halttunen and Paul Masson, 1977, "Exchange Rates in the Short Run: The Dollar-Deutschemark Rate," European Economic Review 10, no.3, 303-24.

Branson, William, and Dale Henderson, 1985, "The Specification and Influence of Asset Markets," in Handbook of International Economics, vol.2, Ronald Jones and Peter Kenen, eds., North Holland: Amsterdam.

Dominguez, Kathryn, 1986, "Are Foreign Exchange Forecasts Rational?: New Evidence from Survey Data," Economic Letters 21, 277-82.

Dominguez, Kathryn, 1987, "The Informational Role of Official Foreign Exchange Intervention Operations: An Empirical Investigation," Harvard University.

Dominguez, Kathryn, 1989, "Market Responses to Coordinated Central Bank Intervention," August; forthcoming in Carnegie-Rochester Series on Public Policy, vol. 32.

Domowitz, Ian, and Craig Hakkio, 1985, "Conditional Variance and the Risk Premium in the Foreign Exchange Market," Journal of International Economics, August, 19, 47-66.

Dooley, Michael, and Peter Isard, 1982, "A Portfolio-Balance Rational-Expectations Model of the Dollar-Mark Rate," Journal of International Economics, 12, 257-76.

Dooley, Michael, and Peter Isard, 1983, "The Portfolio Balance Model of Exchange Rates and Some Structural Estimates of the Risk Premium," IMF Staff Papers, 683-702.

Dornbusch, Rudiger, 1983, "Exchange Risk and the Macroeconomics of Exchange Rate Determination," in The Internationalization of Financial Markets and National Economic Policy," R.Hawkins, R.Levich and C.Wihlborg, eds., JAI Press: Greenwhich, CT.

Engel, Charles and Anthony Rodrigues, 1989, "Tests of International CAPM with Time-Varying Covariances," Journal of Applied Econometrics.

Frankel, Jeffrey, 1979, "The Diversifiability of Exchange Risk," Journal of International Economics, 9, August.

Frankel, Jeffrey, 1982a. "A Test of Perfect Substitutability in the Foreign Exchange Market," Southern Economic Journal 46, no. 4, April.

Frankel, Jeffrey, 1982b, "In Search of the Exchange Risk Premium: A Six-Currency Test Assuming Mean-Variance Optimization:" Journal of International Money and Finance 1, December.

Frankel, Jeffrey, 1985, "The Dazzling Dollar," Brookings Papers on Economic Activity 1, 199-217.

Frankel, Jeffrey, and Kenneth Froot, 1987, "Using Survey Data to Test Standard Propositions Regarding Exchange Rate Expectations," American Economic Review, 77, 1, 133-153.

Frankel, Jeffrey, and Kenneth Froot, 1988, "Chartists, Fundamentalists, and the Demand for Dollars" NBER Working Paper 1854 and Greek Economic Review, 10, 1, June. Also forthcoming in Policy Issues for Interdependent Economies, edited by T. Courakis and M. Taylor, MacMillan Press: London.

Froot, Kenneth, and Jeffrey Frankel, 1989, "Forward Discount Bias: Is it an Exchange Risk Premium?" Quarterly Journal of Economics 104, no.1, February.

Froot, Kenneth and Takatoshi Ito, 1988, "On the Consistency of Short-run and Long-run Exchange Rate Expectations," NBER Working Paper no. 2577, May; Journal of International Money and Finance, forthcoming.

Funabashi, Yoichi, 1988, Managing the Dollar: From the Plaza to the Lourve, Institute for International Economics, Washington, D.C..

Giovannini, Alberto, and Philippe Jorion, 1989, "The Time-Variation of Risk and Return in the Foreign Exchange and Stock Markets," Journal of Finance, 44, no. 2, June, 307-324.

Golub, Stephen, 1989, "Foreign-Currency Government Debt, Asset Markets, and the Balance of Payments," Journal of International Money and Finance, 8, no.2, June, 285-294.

Goodhart, Charles, 1988, "The Foreign Exchange Market: A Random Walk with a Dragging Anchor," Economica 55, November, 437-60.

Henderson, Dale, 1984, "Exchange Market Intervention Operations: Their Role in Financial Policy and Their Effects," in Exchange Rate Theory and Practice, J.Bilson and R.Marston, eds., Chicago: University of Chicago Press.

Henderson, Dale, and Stephanie Sampson, 1983, "Intervention in Foreign Exchange Markets: A Summary of Ten Staff Studies," Federal Reserve Bulletin 69, Nov., 830-36

Ito, Takatoshi, 1989, "Foreign Exchange Rate Expectations: Micro Survey Data," May; forthcoming American Economic Review.

Kenen, Peter, 1981, "Comment on Mussa," in R.Cooper, J.de Macedo, P.Kenen, and J.van Ypersele, Essays in Honor of Robert Triffin.

Kouri, Pentti, and Jorge de Macedo, 1978, "Exchange Rates and the International Adjustment Process," Brookings Papers on Economic Activity, 1, 111-130.

Krugman, Paul, 1981, "Consumption Preferences, Asset Demands, and Distribution Effects in International Financial Markets," NBER Working Paper 651, March.

Krugman, Paul, 1985, "Is the Strong Dollar Sustainable?" In The U.S. Dollar -- Recent Developments, Outlook and Policy Options, Federal Reserve Bank of St.Louis, pp.103-133.

Lewis, Karen, 1988, "Inflation Risk and Asset Market Disturbances: The Mean-Variance Model Revisited", Journal of International Money and Finance, 7, 273-288.

Loopesko, Bonnie, 1984, "Relationships Among Exchange Rates, INtervention, and Interest Rates: An Empirical Investigation," Journal of International Money and Finance 3, 257-277.

Marris, Stephen, 1985, "Deficits and the Dollar: The World Economy at Risk," Policy Analyses in International Economics No. 14, December, Institute for International Economics, Washington, D.C.

Mussa, Michael, 1981, The Role of Official Intervention. Group of Thirty Occasional Papers, No. 6. New York: Group of Thirty.

Obstfeld, Maurice, 1988, "The Effectiveness of Foreign-Exchange Intervention: Recent Experience," NBER Working Paper No. 2796.

Rogoff, Kenneth, 1984, "On the Effects of Sterilized Intervention: An Analysis of Weekly Data," Journal of Monetary Economics 14, 133-150.

Williamson, John, and Marcus Miller, 1987, "Targets and Indicators: A Blueprint for the International Coordination of Economic Policy," Policy Analyses in International Economics No. 22, September, Institute for International Economics, Washington, D.C.

</ref_section>