

Intervention in Foreign Exchange Markets

A Summary of Ten Staff Studies

The staffs of the Federal Reserve System and the U.S. Department of the Treasury have recently completed a set of ten studies on intervention in foreign exchange markets that the Federal Reserve has released as Staff Studies 126–35. The following article summarizes the results of these studies. It was prepared by Dale Henderson and Stephanie Sampson, with the assistance of the authors of the studies.

The analyses and conclusions set forth in the staff studies and in this summary article are those of the authors and do not necessarily reflect the views of the Working Group on Exchange Market Intervention, the Board of Governors of the Federal Reserve System, the Federal Reserve Banks, the U.S. Department of the Treasury, or other members of their staffs.

Fluctuations in exchange rates have concerned economic policymakers since the transition to widespread floating in 1973. There has been much debate about the feasibility and desirability of using intervention in foreign exchange markets to limit movements in exchange rates.

Participants at the Versailles summit in June 1982 accepted a U.S. proposal to study their experience with intervention. A special Working Group on Exchange Market Intervention (the Working Group) was commissioned to carry out the study. Entirely retrospective, the study examined the motives, methods, and effects of intervention operations by the various countries. The Working Group devoted much of its effort to analyzing the effects of intervention. It addressed the important question of whether sterilized intervention (which does not affect any monetary base) can have significant effects on exchange rates.

The April 1983 Report of the Working Group on Exchange Market Intervention draws no explicit conclusions. The analysis in the report seems to suggest that (1) sterilized intervention

has a much smaller impact on exchange rates than does unsterilized intervention; (2) sterilized intervention can have some short-run impact on exchange rates and may therefore be effective in achieving some short-run exchange market objectives; (3) sterilized intervention does not appear to have much long-run impact, and its effects are often swamped by those of other macroeconomic policies; and (4) coordinated intervention is more effective than intervention by a single country, although the conditions for successful coordination are exacting.

The Working Group based its report on three types of background papers: case studies examining episodes of intervention of special interest; surveys of the literature on intervention; and more formal econometric analyses. The staffs of the Federal Reserve System and the U.S. Department of the Treasury produced ten of these papers, and the Federal Reserve has released these as a series of Staff Studies. This article summarizes the objectives, methodologies, and conclusions of each of these Staff Studies.

DEFINING INTERVENTION

In their study, Donald Adams and Dale Henderson argue that, in attempting to isolate the effects of intervention as an independent policy tool, the analyst will find it is useful to view intervention as sterilized intervention—operations in the exchange market that leave unchanged the monetary liabilities of both the home and foreign authorities. From this perspective, an intervention operation is the analytical equivalent of a trade between the authorities and the public of securities denominated in one currency for those denominated in another.

The authors list a wide range of actions that alter the relative supplies of securities denominated in different currencies that are available to

the public. One such action is the purchase or sale by central banks of foreign exchange for domestic currency in the interbank market; this is the only type of transaction included in the narrow, traditional definition of intervention. A somewhat broader definition might include transactions in foreign currency directly with entities that otherwise would have dealt with market agents. These so-called customer transactions can be dealings with nonbank entities, central banks in other countries, or the central bank's own government (supplying the foreign exchange needed by the government to make interest payments on foreign debt, for example). An even broader definition might include borrowings of foreign currency by public sector enterprises or by commercial banks when those borrowings are induced or directed by the monetary authority.

U.S. EXPERIENCE WITH INTERVENTION

The series includes three in-depth case studies analyzing the experience of the United States with its intervention operations. In particular, these studies discuss the objectives and effects of U.S. intervention operations for several important episodes during the period of floating dollar rates in terms of the perceptions and motivations of U.S. monetary authorities at the time. These operations are then evaluated from the present perspective of the U.S. authorities.

In the first study, which covers January through March 1975, Margaret Greene describes U.S. efforts to check the sharp day-to-day declines in the dollar rate against the deutsche mark and the Swiss franc. Concerned that these declines would cumulate, U.S. authorities changed their intervention strategy, deciding to be prepared to commit larger amounts of funds and to enter the market earlier than they had on previous occasions during the floating rate period. U.S. authorities also sought closer cooperation from major central banks abroad. In February 1975, the first large-scale concerted intervention began. These operations appear to have met the objectives of the U.S. authorities because the pattern of virtually continuous daily declines ended, and intra-day variability declined somewhat. They did not reverse the trend in the value

of the dollar, however; after a brief rise, dollar rates fell back during most of the rest of February. The trend of dollar movements appears not to have been reversed until the market became convinced that U.S. economic performance was improving relative to performance in other countries.

In her second case history, Greene studies a much longer period of sustained pressure on the dollar, the two years between September 1977 and October 1979. The United States moved throughout this period to halt declines in the dollar, but when the U.S. authorities did not soon follow up their intervention operations with consistent and effective measures to deal with the underlying causes of the dollar's weakness, any positive short-run impact of the intervention faded.

Complicating U.S. intervention operations at the beginning of the period was the market's impression that the United States welcomed a depreciation of the dollar. In addition, the divergence between the domestic economic paths followed by the United States and its trading partners had a significant impact on exchange rates. The United States tried to induce other countries with strong external positions to join it in a coordinated expansion, but in general the policies of those countries were less expansionary and less inflationary. A relatively slow adjustment by the United States to higher oil prices also contributed to a decline in the dollar.

The domestic policy changes in the United States and Japan in late 1978, which were accompanied by joint intervention operations, proved sufficient to strengthen the dollar substantially against the yen. Against the major European currencies, in which intervention operations were larger, the dollar's decline came to a halt and the dollar stayed above its lows of the fall of 1978. But new concerns about the U.S. economy developed during the summer of 1979, and large joint intervention operations did not prevent a renewed decline in the dollar. Near the end of the period, convergence of economic fundamentals, including economic policies, helped to reverse the decline in the dollar. The change in Federal Reserve operating procedures in October 1979 and the subsequent tightening of money market conditions pushed the yen down vis-à-vis the dollar and helped turn around the dollar-

deutsche mark rate, although the dollar did not appreciate significantly until early 1980.

The third study covers the period from October 1980 to October 1981, in roughly the middle of which came the announcement of a change in the implementation of U.S. intervention policy. Greene divides this period into two subperiods, October 1980 to February 1981 and February to October 1981.

In each subperiod examined by Greene, the dollar appreciated 23 percent against the deutsche mark. U.S. authorities intervened during the earlier rise in the dollar to counter disorderly market conditions by limiting fluctuations in the dollar–deutsche mark rate and to rebuild its foreign-currency reserves. Data compiled by the U.S. authorities during the period distinguish between these two types of operations, and this distinction frequently held in practice. However, it would be a mistake to infer that the distinction was clear-cut. At the margin, the willingness of the U.S. authorities to operate on the scale they did in countering disorderly market conditions was influenced by their desire to accumulate net foreign-currency balances. The U.S. and the German authorities intervened heavily between October 1980 and February 1981, but the objectives of the two countries were not always the same. Thus, although regular and close communication was maintained, it would not be entirely accurate to characterize these operations as coordinated intervention.

After February 1981, U.S. intervention ceased, and the Bundesbank increased its own intervention activity for a time. It is not evident that the two decisions were related, or that these changes had a demonstrable impact on the extent of appreciation of the dollar. Variability in all major bilateral dollar exchange rates increased slightly after February, especially after mid-August when the dollar was depreciating and intervention by both the German and U.S. authorities was negligible.

EXAMINING THE EFFECTS OF EXCHANGE RATE VARIABILITY

Three economists from the U.S. Treasury—Victoria Farrell with Dean DeRosa and T. Ashby

McCown—review the theoretical and empirical literature on the effects of exchange rate variability on international trade and other economic variables. The empirical tests they review use data from the floating-rate period through 1977. Although the results of these tests do not support a clear-cut conclusion about the effects of exchange rate variability on the volume of trade, they indicate that such variability has had no generalized effect on inflation. The authors conclude that instability in national economies causes variability in exchange rates, and not the other way around.

The authors highlight the problems in trying to model precisely how exchange rate variability affects the behavior of firms and therefore how it influences the demand for and supply of internationally traded goods. For example, one should account for the ability of firms to hold assets and liabilities denominated in various currencies, thereby reducing their exposure to exchange rate risk, and for the way movements in the exchange rate are related to those in other economic variables.

Empirical evidence on the relationship between the volume of trade and exchange rate variability is mixed. Most analyses of data from cross-sections made up of a number of countries conclude that the volume of a country's trade is not affected by the variability of short-term changes in nominal and real exchange rates. However, analyses of time-series data on trade of individual countries, bilateral trade flows, and trade of several Brazilian industries present a somewhat different picture; four of six of these analyses find that variability in nominal or real exchange rates has had a significant, on average negative, effect on some trade flows. The Treasury economists suggest that future work examine measures of real risk relevant for highly diversified firms and the effects of variability of longer-term changes in exchange rates.

Some evidence across countries shows a negative relationship between growth rates in real gross fixed-capital formation between 1973 and 1976 and measures of variability in nominal exchange rates. The authors suggest that increased uncertainty about future rates of inflation may cause both exchange rate volatility and cutbacks in investment plans.

CALCULATING THE PROFITABILITY OF INTERVENTION

Laurence Jacobson begins his study by reviewing the literature that analyzes profitability as a criterion of the effectiveness of intervention in stabilizing exchange rates. According to this criterion, intervention stabilizes exchange rates if and only if the intervention is profitable. Apparently, if the monetary authorities bought low and sold high, they would reduce variability in exchange rates as well as earn a profit. However, Jacobson cites papers that call into question this proposition; profits can be associated with increased variability and losses with reduced variability. Significantly, if the monetary authorities prevent any fluctuation in the exchange rate, they earn zero profits.

After summarizing the theoretical issues, Jacobson points out the substantial practical problems that beset attempts to calculate profits made from intervening in exchange markets. One must choose the sample period and decide how to value initial and ending stocks of reserve assets. Also, profits should include a measure of net interest earnings on foreign-currency reserves derived from a relevant interest rate differential or the forward discount.

The author first calculates the profits on U.S. dollar–deutsche mark intervention, varying the beginning and ending point of the sample period. His measure of profits includes an inventory adjustment for accumulated stocks of foreign currency. Evaluation of the profitability of cumulated intervention from 1973 to 1979 shows a loss of \$500 million, a consequence of revaluing large net dollar purchases at the dollar's historic low. However, the appreciation of the dollar and substantial dollar sales over the next two years made cumulated intervention activity from 1973 to 1981 moderately profitable.

Jacobson then calculates profits for eight subperiods (one of which is the entire period) in which net intervention was near zero. This exercise is interesting because inventory valuation problems are virtually eliminated. Profits are positive for all but one subperiod when the differential between the U.S. Treasury bill rate and the German interbank rate is used to calculate net interest earnings; and they are positive

for all subperiods when the forward discount is used.

Including net interest earnings increases measured profits significantly. Almost 90 percent of gross daily intervention occurred during one subperiod, October 1977 to January 1981. Profits calculated for this episode are close to the total calculated for the entire period. Moreover, net interest earnings in this subperiod constitute more than half the total profit figure: the United States gained by issuing its mark debt at interest rates substantially lower than dollar interest rates.

ISOLATING THE EFFECTS OF STERILIZED INTERVENTION

The last four studies—two literature surveys and two econometric analyses—focus on the important question of whether sterilized intervention is an independent policy instrument. A sterilized purchase of deutsche marks against dollars, for example, results in a larger supply of dollar-denominated government debt and a smaller supply of mark-denominated government debt available to the public. If investors require an inducement to switch their mark assets for dollar assets—that is, if dollar debt and mark debt are imperfect substitutes in the portfolios of private agents—then the expected return on mark securities falls relative to that on dollar securities, and the mark appreciates against the dollar. However, if securities denominated in different currencies are perfect substitutes, then sterilized intervention has no direct effect on the exchange rate. Sterilized intervention is an independent policy instrument if securities denominated in different currencies are not perfect substitutes.

Even if sterilized intervention is not an independent policy instrument, it may be a signaling device. For example, by conveying otherwise unavailable information about the future course of monetary policy, sterilized intervention may have an indirect effect on the exchange rate.

Analysis of Daily Data

Because the effect of sterilized intervention may be relatively short-lived, the Working Group on

Exchange Market Intervention decided it was important to analyze daily data. Unfortunately, formidable difficulties hamper attempts to draw conclusions from these data.

Kenneth Rogoff explores whether nonstructural time-series techniques, especially vector autoregressions, can be used to examine the impact of intervention in the short run. A vector autoregression system seems to have an advantage for analyzing the relationship among economic variables using limited daily data: no structural model needs to be imposed to estimate the coefficients of the system. However, that advantage is more apparent than real. The researcher must impose such a structural model to interpret the coefficients of a vector autoregression. Thus the vector autoregression technique is not a way of escaping the severe problem of omitted variables presented by daily data. The money supply is not available daily, and one can reasonably assume that changes in the money supply are correlated with sterilized intervention and changes in the exchange rate. This correlation clouds the interpretation of the vector autoregression. Even if daily data on the money supply were available, the presence of contemporaneous correlation between intervention and movements in exchange rates would continue to confound interpretation of the autoregression coefficients. Also, the number of variables included in a vector autoregression system has to be limited to attain computational tractability.

Turning to a review of current literature, Rogoff reports on two time-series investigations of the effectiveness of exchange market intervention. One uses daily data on exchange rates and intervention to analyze the Canadian experience with floating exchange rates. It concludes that official intervention did play an important role in stabilizing the Canadian dollar from 1952 to 1960. However, as Rogoff points out, this investigation was not concerned with the distinction between sterilized and nonsterilized intervention. The other investigation does make this important distinction. It contains estimates of separate six-variable vector autoregressions for the United States, the United Kingdom, Germany, and Japan using quarterly data. Unfortunately, the presence of contemporaneous correlation makes it very difficult to use these vector autoregressions to analyze the relationship between ex-

change rates and intervention while holding the current and expected future path of the money supply constant.

To extract as much information as possible from daily intervention data, Bonnie Loopesko adopts a widely used empirical approach that has minimal data requirements. She tests a joint hypothesis composed of two underlying hypotheses: (1) securities denominated in different currencies are perfect substitutes, and (2) exchange markets are "efficient" in the sense that market participants use all relevant information in forecasting spot exchange rates. Realized profits from speculating in the foreign exchange market will reflect any expected risk premium and any error in forecasting the spot rate. If perfect asset substitutability holds, then the expected risk premium should always be zero. Realized profits therefore result only from forecasting errors. And, if markets are efficient, the public makes no systematic forecasting errors; thus realized profits (measured as the interest differential in favor of a currency minus its actual rate of depreciation) should be random.

If the joint hypothesis does not hold, then systematic realized profits may be attributable either to a risk premium, or to a systematic error in forecasting the spot rate, or to both. The first would imply that assets denominated in different currencies were not perfect substitutes, while the second would indicate that speculators consistently ignored some relevant information in making their forecasts.

Loopesko tests to see whether realized profits are indeed random, using exchange rates for six currencies (the Canadian dollar, the French franc, the deutsche mark, the yen, the lira, and the pound sterling) against the U.S. dollar. The joint hypothesis is soundly rejected, but this conclusion leaves open the question of which of the underlying hypotheses is false. To address this question, the author considers whether predictions of realized profits are improved by the use of data on cumulated intervention. For almost half the subsamples examined, cumulated intervention does help predict realized profits. These findings provide limited support for the view that securities denominated in different currencies are not perfect substitutes and thus sterilized intervention can have at least a short-run effect on exchange rates.

This study also includes tests for whether coordinated intervention has a different effect (but not necessarily a stronger one) on exchange rates than does noncoordinated intervention. Only in the case of dollar–deutsche mark intervention are there clearly enough instances of coordinated intervention in the sample period from which to obtain statistically significant results. In one set of tests, coordinated intervention has a different effect, but in another it does not.

Analysis of Monthly and Quarterly Data

Economists have more hope of isolating the effects of sterilized intervention in empirical analyses of monthly and quarterly data because data on more variables are available at these intervals than at daily ones. Ralph Tryon describes the theoretical underpinnings of existing empirical analyses of this type and summarizes their findings.

Tests for the imperfect substitutability of securities denominated in different currencies are based on the portfolio-balance model of international financial markets. In this model, market participants in each country allocate their wealth among domestic money and securities denominated in both the home and foreign currencies. The return on foreign-currency securities is risky because the future exchange rate is uncertain. Because they are averse to risk, investors diversify their holdings of securities instead of holding the single security with the highest expected rate of return; the share allocated to each security is an increasing function of the expected return on that security. If securities are imperfect substitutes, one expects to find a statistically significant relationship between the holdings of securities and rates of return.

Two important problems are encountered in empirical estimation of the portfolio-balance model. First, data on the bond holdings of residents of each country are not generally available by currency. To get around this problem, investigators have estimated either a capital flow equation using data from the balance of payments accounts, or an equation representing the aggregate demand by residents of all countries for bonds denominated in a given currency. Second,

because the expected future exchange rate is unobservable, one must make an assumption about how expectations are formed. In early empirical work, investigators imposed static expectations—that is, the expected future exchange rate was assumed to be equal to the current rate. In more recent research, analysts have postulated rational expectations—that is, market participants were assumed to make no systematic errors in forecasting the exchange rate.

Tryon concludes that the empirical analyses he reviews do not resolve the question of whether securities denominated in different currencies are imperfect substitutes and thus sterilized intervention can have significant effects on exchange rates. Earlier analyses, most of which are based on capital flow equations, provide some support for the view that securities are imperfect substitutes. More recent analyses, most of which are based on bond demand equations and the hypothesis of rational expectations, provide almost no support for this view. Instead, they suggest that securities are such close substitutes that sterilized intervention is unlikely to have significant effects on exchange rates.

Deborah Danker, Richard Haas, Dale Henderson, Steven Symansky, and Ralph Tryon provide new empirical evidence from monthly and quarterly data on the degree of asset substitutability. Their version of the theoretical portfolio-balance model is conventional, except that it includes a more complete specification of commercial bank behavior. Exchange rate expectations play an important role in the model; both static and rational expectations are included in the empirical analysis.

To test for imperfect substitutability, the authors investigate the relationship between realized profits from speculation (or the *ex post* risk premium) and other variables, including a stock of securities, obtained by rearranging the security demand function. Direct estimates of security demand functions are presented for completeness but are not emphasized because such estimates are probably unreliable when the degree of substitutability is high.

Tests are performed for Germany and Japan using monthly data and for Canada using quarterly data. For Germany and Japan, it was possible to obtain data on holdings of securities in the

domestic currency by both domestic and foreign residents. A recently developed technique is used to correct for a moving-average error problem that may arise in estimating rational expectations models.

To compare their results with those of other researchers, the authors test the joint hypothesis of perfect substitutability and market efficiency. As in some previous tests, the joint hypothesis is rejected for Canada and Germany but not for Japan. For Canada and Germany, realized profits from speculation are correlated with both lagged realized profits and the explanatory variables suggested by the portfolio-balance model. However, the results provide only limited support for imperfect substitutability. The estimated parameters of the portfolio-balance model are either insignificant, of the wrong sign, or both, in almost all cases.

Correlation among explanatory variables may make it difficult to determine whether the data are consistent with a particular theoretical relationship. A simple procedure for overcoming this problem is to exclude some explanatory variables. The authors report that they can obtain more estimated coefficients that have signs consistent with the portfolio-balance model when they follow this procedure than when they include all explanatory variables. These modified relationships are useful if one is confident that securities are imperfect substitutes and wants to obtain some estimate of the size of the effect of sterilized intervention. However, they are suspect because the explanatory variables are not precisely those implied by the portfolio-balance theory and because several alternatives were tried before one was selected. □

Listed below are the titles of the Staff Studies summarized in this article. Single copies of these studies as well as of the *Report of the Working Group on Exchange Market Intervention* are available free of charge from Publications Services, Board of Governors of the Federal Reserve System, Washington, D.C. 20551.¹

126. *Definition and Measurement of Exchange Market Intervention*, Donald B. Adams and Dale W. Henderson.

127. *U.S. Experience with Exchange Market Intervention: January–March 1975*, Margaret L. Greene.

128. *U.S. Experience with Exchange Market Intervention: September 1977–December 1979*, Margaret L. Greene.

129. *U.S. Experience with Exchange Market Intervention: October 1980–October 1981*, Margaret L. Greene.

1. Numbers 126, 131, 132, and 134 are currently available. The availability of the other studies will be announced in a forthcoming BULLETIN.

130. *Effects of Exchange Rate Variability on International Trade: A Review of the Literature*, Victoria S. Farrell with Dean A. DeRosa and T. Ashby McCown.

131. *Calculations of Profitability for U.S. Dollar–Deutsche Mark Intervention*, Laurence R. Jacobson.

132. *Time-Series Studies of the Relationship between Exchange Rates and Intervention: A Review of the Techniques and Literature*, Kenneth Rogoff.

133. *Relationships among Exchange Rates, Intervention, and Interest Rates: An Empirical Investigation*, Bonnie E. Loopesko.

134. *Small Empirical Models of Exchange Market Intervention: A Review of the Literature*, Ralph W. Tryon.

135. *Small Empirical Models of Exchange Market Intervention: Applications to Canada, Germany, and Japan*, Deborah J. Danker, Richard A. Haas, Dale W. Henderson, Steven A. Symansky, and Ralph W. Tryon.