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5 The Effectiveness of Foreign-Exchange Intervention: Recent Experience, 1985–1988

Maurice Obstfeld

But ultimately there are limits to what can be achieved by a pure intervention policy. The monetary crises under the Bretton Woods system showed that powerful market trends cannot be suppressed through exchange market interventions by central banks, and more recent monetary history has reaffirmed this.

Deutsche Bundesbank (1982, 25)

5.1 Introduction

In a report published in July 1985, economic policymakers from ten industrial countries reviewed the performance of floating exchange rates to date and concluded that "the key elements of the current international monetary system require no major institutional change."[1] Within three months, however, finance ministers and central bank governors from five of the largest industrial countries announced their readiness for concerted action to reduce the U.S. dollar's foreign-exchange value. The Group of Five's announcement, made at the Plaza Hotel in New York on Sunday, September 22, initiated a series of international accords centered around the management of key dollar exchange rates.[2] Understandings concerning joint intervention in foreign-exchange markets have figured prominently in these accords, which thus represent a clear modification of the U.S. distaste for intervention that prevailed during the first half of the Reagan administration.

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This paper focuses on the practice and effects of foreign-exchange intervention during the years 1985–88 by the three largest industrial economies, the Federal Republic of Germany, Japan, and the United States. A wide variety of economic policy tools—monetary, fiscal, and commercial, to name just three—can be used to influence exchange rates. To isolate the "pure" effects of intervention on exchange rates, the discussion below distinguishes between sterilized interventions, whose monetary effects are neutralized by offsetting domestic liquidity measures, and nonsterilized interventions, which alter money supplies and therefore involve the joint exercise of monetary policy and exchange market policy. If effective in achieving significant and sustained exchange rate changes, sterilized intervention could give governments an additional policy tool helpful in resolving conflicts between the monetary policies appropriate for internal balance and those appropriate for external balance.

In June 1982, participants at the Versailles Economic Summit commissioned an official Working Group on Exchange Market Intervention to study the efficacy of government interventions in exchange markets. The Working Group's April 1983 report concluded that sterilized intervention is a relatively weak instrument of exchange-rate policy, with little apparent effectiveness beyond the very short run. This finding is in accord with the statement by the Bundesbank given above, as well as with academic research on the subject, which reaches conclusions that are at least as negative.[3] In the months since the Plaza meeting, however, a substantial realignment of industrial country currency values has been achieved and exchange market intervention (much of it sterilized) has been conducted on a scale not seen since the early 1970s. A fresh look at intervention experience may yield new conclusions, conclusions relevant for evaluating the recent experience of international policy coordination and the prospects for its future success.

The paper is organized as follows. Section 5.2 reviews the recent evolution of key macroeconomic fundamentals, other than intervention, that are likely to have influenced exchange rates. This narrative sets out the macroeconomic context in which intervention has been conducted, and also provides information needed for assessing the independent role of intervention in currency market developments.

Section 5.3 then sets out the mechanics of both sterilized and nonsterilized intervention, emphasizing the effects on asset supplies of alternative intervention strategies. Portfolio-balance theories of effective sterilized intervention are reviewed in this section, which also presents some econometric evidence on foreign currency risk premiums.

Section 5.4 considers an alternative to the portfolio-balance rationale for sterilized intervention, the "signaling" theory. According to this view, official portfolio shifts between nonmoney assets can influence exchange rates, independently of any resulting need for private portfolio rebalancing, by

credibly signaling future policy intentions or information not widely appreciated by the market. A simple but limited model of effective signaling, driven by the government's concern about capital losses on its net assets, is outlined and evaluated. Alternative signaling models driven by asymmetric information also receive brief attention.

Section 5.5 reports approximate data on foreign-exchange interventions carried out since the first half of the 1980s, and evaluates the likelihood that portfolio effects associated with those interventions have had a major influence on exchange rates. The conclusion reached is that monetary and fiscal policies, and not intervention per se, have been the main policy determinants of exchange rates in recent years. Pure intervention seems to have played an effective signaling role, in the sense of speeding desired exchange rate movements or impeding undesired ones, when promptly backed up by other, more substantive policy adjustments. But the portfolio effects of pure intervention have generally been elusive enough that intervention cannot be regarded as a macroeconomic policy tool in its own right, with an impact somehow independent of short-term decisions on monetary and fiscal policy. Even in 1987, when massive sterilized interventions were carried out by Germany and Japan, any associated portfolio effects failed to stop sharp appreciations of both the mark and the yen against the dollar. Recent experience does not justify the view that sterilized intervention offers much help in resolving open-economy policy dilemmas.

5.2 After the Strong Dollar: Macroeconomic Adjustment in the Federal Republic of Germany, Japan, and the United States

The dollar reached its most recent peak in the first quarter of 1985 amid a pattern of large and growing external imbalances in the main industrial countries.[4] By 1987, the current account deficit of the United States stood at $154 billion, or 3.4 percent of U.S. gross national product; the current-account surplus of Japan was $87 billion, or 3.6 percent of GNP; and that of Germany was $45 billion, or 4.0 percent of GNP.[5] The size and persistence of these imbalances is unprecedented in the postwar period; to reduce them to sustainable levels, without compromising the goal of noninflationary growth, was the immediate objective of the international policy coordination efforts mounted in the second half of the 1980s.

5.2.1 The Evolution of Cooperative Exchange Rate Management

A substantial realignment of the principal currencies' real exchange rates appeared to be a precondition for a return to a sustainable configuration of current accounts. Between December 1978 and February 1985, the dollar had appreciated (in nominal terms) by 45 percent against the German mark and by 25 percent against the Japanese yen; by the end of August 1985, having depreciated from February levels by 19.4 percent against the mark and by

9.4 percent against the yen, the dollar seemed set on the necessary downward adjustment path.[6] (See figs. 5.1 and 5.2, which show bilateral nominal exchange rates from the end of 1978 and from the start of 1985, respectively.) A sharp dollar upswing in the first week of September 1985, occurring against a backdrop of rising protectionism in the U.S. Congress, was the catalyst for the Group of Five (G-5) Plaza announcement and the approach to exchange rate management it initiated.[7]

Significant milestones in the ongoing evolution of this approach include the following:

Plaza Agreement (September 22, 1985). Participants agreed that "exchange rates should better reflect fundamental economic conditions than has been the case," that "in view of the present and prospective changes in fundamentals, some further orderly appreciation of the main non-dollar currencies against the dollar is desirable," and that G-5 governments would "stand ready to cooperate more closely to encourage this when to do so would be helpful." Funabashi (1988) has given an account of the meeting based, in part, on interviews with unnamed participants. According to this account, an understanding was reached to conduct simultaneous sales of up to $18 billion, with the goal of

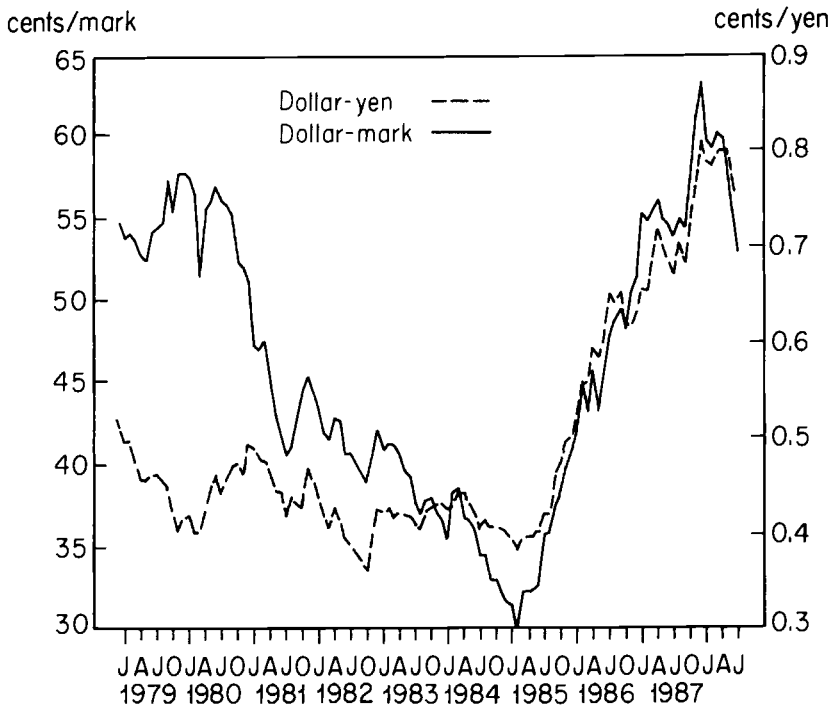

Fig. 5.1 Dollar-mark and dollar-yen nominal exchange rates, 1978–1988

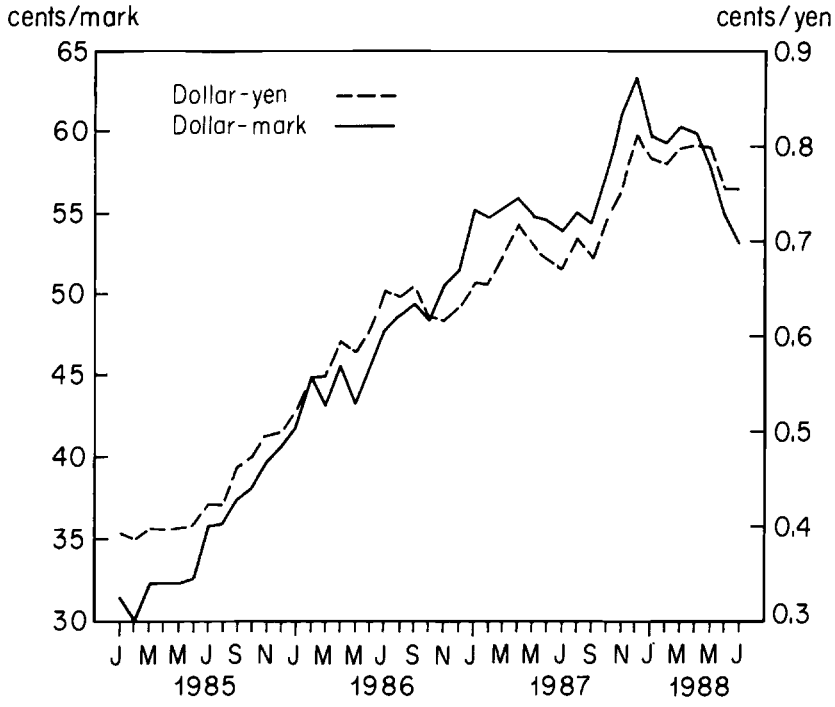

Fig. 5.2 Dollar-mark and dollar-yen nominal exchange rates, 1985–1988

lowering the dollar's value by 10 to 12 percent over a period of six weeks. The implications of this intervention for national monetary policies and interest rates—and, in particular, the question of sterilization—were apparently not discussed. Pledges on fiscal policy were made, however, including a U.S. pledge to pursue tax reform and government deficit reduction.

Coordinated interest rate reductions (March-April 1986). On March 6 and 7, the central banks of France, Germany, Japan, and the United States all lowered their discount rates, hoping to stimulate global growth without upsetting the exchange rate realignment process. On April 21 the monetary authorities of Japan and the United States both lowered their discount rates again.

Tokyo Summit (May 4–5, 1986). The Group of Seven heads of state set up the Group of Seven Finance Ministers to review the "mutual compatibility" of members' policies between the annual summit meetings. These multilateral surveillance exercises, to be conducted in cooperation with the International Monetary Fund, were to consider a number of "indicators" of economic performance, including exchange rates, international reserves, current account and trade balances, and fiscal deficits. The summit declaration seemed to back off a bit from the more vigorous interventionism of the Plaza announcement:

it recommended that "remedial efforts focus first and foremost on underlying policy fundamentals," and reaffirmed the 1983 Williamsburg Summit commitment "to intervene in exchange markets when to do so would be helpful."

First meeting of the G-7 finance ministers (September 27, 1986). A year after the Plaza Agreement, the G-7 finance ministers agreed that members should adopt macroeconomic policies to reduce external imbalances to sustainable levels "without further significant exchange rate adjustment." In other words, even though major effects of the exchange rate realignment on current accounts remained to be seen, realignment had proceeded far enough over the past year to allow countries to stabilize currency values. Nonetheless, between October 1986 and February 1987, the dollar depreciated roughly 13.0 percent further against the mark and 5.5 percent further against the yen. (See fig. 5.2.)

Louvre Accord (February 22, 1987). The G-7 finance ministers and central bank governors (except Italy) made their strongest statement yet on the need to hold nominal exchange rates near existing levels, but did not reveal to the public exact reference levels or allowable ranges of variation around them:

> The Ministers and Governors agreed that the substantial exchange rate changes since the Plaza Agreement will increasingly contribute to reducing external imbalances and have now brought their currencies within ranges broadly consistent with underlying economic fundamentals, given the policy commitments summarized in this statement. Further substantial exchange rate shifts among their currencies could damage growth and adjustment prospects in their countries. In current circumstances, therefore, they agreed to cooperate closely to foster stability of exchange rates around current levels.

The published "policy commitments" included a German promise of tax cuts, Japanese assurances of fiscal stimulus and tax reform, and a U.S. pledge to cut the federal deficit to 2.3 percent of GNP in 1988. According to Funabashi (1988, 186–87), the participants also agreed to spend as much as $4 billion intervening over the period ending in April. Their goal, he reports, was to stabilize the mark and the yen within ± 5 percent ranges of 1.8250 marks/dollar and 153.50 yen/dollar, respectively. Intervention would occur "on a voluntary basis" within a ± 2.5 percent band of these central rates, was "expected to intensify" between the 2.5 and 5 percent limits, and would be supplemented by mandatory "consultation on policy adjustment" at the 5 percent limit. A 7 percent appreciation of the yen relative to its Louvre parity was, however, ratified at a G-7 meeting in April 1987, where it was agreed, once again, that "around current levels" member currencies "are within ranges broadly consistent with economic fundamentals and the basic policy intentions outlined at the Louvre meeting." A similar favorable assessment of the appropriateness of current exchange rate levels was offered by the G-7 after their September 26, 1987 meeting. This last announcement, however, followed nearly six months of relative stability of mutual G-7 exchange rates.

The G-7 response to the stock market crash (December 22, 1987). After the stock market collapse of October 19, 1987, the dollar depreciated sharply against foreign currencies. The subsequent G-7 communiqué refrained from any direct pronouncement on the appropriateness of current exchange rate levels. A warning to the foreign-exchange markets was, however, issued:

> The Ministers and Governors agreed that either excessive fluctuation of exchange rates, a further decline of the dollar, or a rise in the dollar to an extent that becomes destabilizing to the adjustment process could be counterproductive by damaging growth prospects in the world economy. They re-emphasized their common interest in more stable exchange rates among their currencies and agreed to continue to cooperate closely in monitoring and implementing policies to strengthen underlying economic fundamentals to foster stability of exchange rates. In addition, they agreed to cooperate closely on exchange markets.

(This warning was repeated, in almost identical words, after the April 1988 G-7 meeting.) The communiqué praised the period of exchange rate stability from the Louvre to the September G-7 meeting, as well as "the basic objectives and economic policy directions agreed in the Louvre Accord. . . ." Policy pledges included greater fiscal stimulus in Germany, continued stimulus in Japan, and further fiscal consolidation in the United States.[8] This G-7 declaration followed disappointing news on the U.S. trade deficit in the first half of December; the declaration, perhaps because of its vagueness, did nothing to dispel the ensuing selling pressure on the dollar, which only abated in early January after concerted intervention.[9]

Toronto Summit (June 19–21, 1988). After another, nearly six months of relative exchange rate stability, the seven heads of state repeated the now familiar ban on further dollar depreciation or "destabilizing" appreciation. Around the same time, however, positive news on the U.S. foreign deficit, rising dollar interest rates, and official remarks seemingly favorable to the possibility of some dollar appreciation set off a two-month slide of the mark and yen against the dollar.

G-7 Berlin statement (September 24, 1988). In the wake of the previous summer's dollar appreciation, the participants endorsed exchange rate stability in general terms but did not repeat their earlier formula, which had labeled as "counterproductive" any significant change in the dollar's value. After the G-7 meeting, however, individual statements by the G-5 foreign ministers expressed satisfaction with the prevailing levels of exchange rates. Their assessment contradicted that of the IMF's managing director, who, in widely publicized remarks, deplored the dollar's appreciation since the Toronto Summit.

5.2.2 Exchange Rate Fundamentals: Monetary Policies

In evaluating the role played by pure intervention in recent years, it is useful to have some perspective on the behavior of other fundamental determinants

of exchange rates, and on the ability of these fundamentals to explain exchange market developments. Because of the close link between intervention and monetary policy, a natural focus is an account of money-market conditions in Germany, Japan, and the United States. In recent years, the often erratic behavior of money demand and of individual monetary aggregates has made it perilous to use any one as an indicator of the stance of monetary policy. Some inferences about monetary tightness can, however, be based on the behavior of short-term nominal interest rates. In sticky price exchange rate models, these rates tend to fall (rise) in the short run, reinforcing the home currency's depreciation (appreciation), when monetary policy is expansionary (contractionary) or when the money demand function shifts downward (upward).[10] The peril in relying even on short-term nominal interest rates as indicators of monetary ease is, of course, that these rates are influenced by other factors, notably the price level and output. It is therefore advisable to consider additional relevant information, when it is available, in assessing the stance of monetary policy.

Figure 5.3 shows short-term nominal interest rates on mark, yen, and dollar deposits since 1978; interest differentials (dollar less mark and dollar less yen) are shown in figure 5.4. The figures suggest that the foundation for the

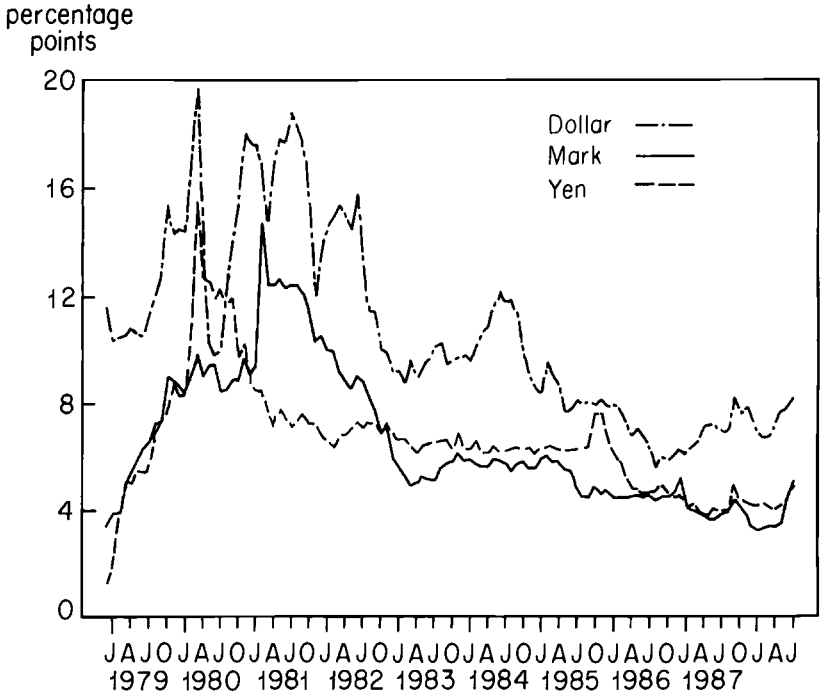

Fig. 5.3 Nominal short-term interest rate levels for dollar, mark, and yen assets, 1978–1988

downward trend of the dollar after the first quarter of 1985 was a falling trend in dollar interest rates from a local peak reached early in the summer of 1984. As dollar interest fell through the late spring of 1985, yen and mark interest fluctuated in narrow ranges. Accordingly, the interest differential in favor of dollars dropped precipitously over the period. Apparently behind this drop was a sharp shift in U.S. monetary policy: as dollar interest rates began to fall, M2 growth, which had been in the lower portion of its 6–9 percent 1984 target range, jumped sufficiently to finish the year around the top.[11] In addition, the Federal Reserve made ½ percent cuts in its discount rate in November and December of 1984. In subsequent testimony before Congress, Federal Reserve Chairman Paul Volcker included the disruptive effects of the dollar's continuing strength among the factors that motivated this easing of monetary policy.[12]

The effects of looser money did not show up immediately in exchange markets; indeed, during the fall of 1984, the dollar appreciated against the mark and yen, and then jumped upward between December 1984 and February 1985 as the pace of U.S. interest rate reduction slowed and (in February) temporarily reversed. The dollar began to decline from its peak, however, as a renewed narrowing of the interest differentials favoring dollars began in

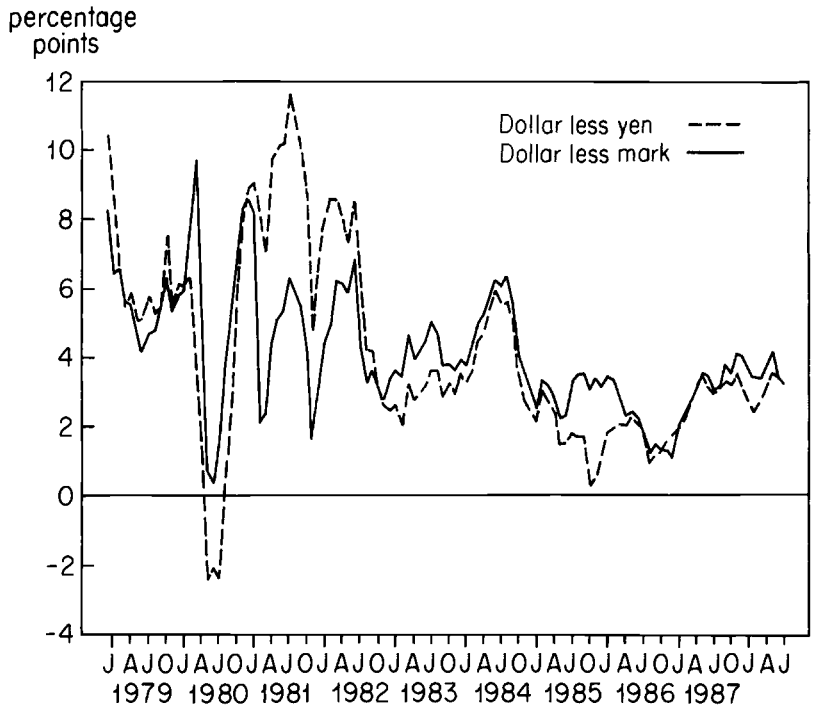

Fig. 5.4 Nominal short-term interest rate differentials, 1978–1988

March. Fueling this development was U.S. M2 growth around the top of its range, another ½ percent discount rate cut in May, and progress on the Gramm-Rudman-Hollings deficit reduction legislation, which President Reagan signed at the end of 1985. Falling interest rates in Germany probably slowed, but did not prevent, the dollar's very sharp depreciation against the mark.

A firming of U.S. interest rates in the summer of 1985 helped set the stage for the September dollar rally that preceded the Plaza announcement. The announcement was not accompanied by an immediate change in international interest differentials; however, it occasioned an immediate fall in the dollar, even before any official intervention occurred. The exchange markets' response represented, in part, a reassessment of the likely permanence of the expansionary monetary tack pursued by the Federal Reserve in previous months. As an official U.S. account put it:

> In part, the exchange market reaction reflected the fact that the announcement was unexpected. More importantly, market participants noted that the initiative had come from the United States and viewed it as a change in the U.S. government's previously perceived attitude of accepting or even welcoming the strong dollar. In addition, the agreement was interpreted as eliminating the likelihood that the Federal Reserve would tighten reserve conditions in response to rapid U.S. monetary growth.[13]

Faced with selling pressure on the yen, the Bank of Japan pushed yen interest sharply higher in October; mark interest rates rose only slightly in that month. Over the course of 1986, dollar interest first rose, then declined, and then rose relative to yen interest, while falling more or less steadily relative to mark interest. The dollar's depreciation against the yen from end-September 1985 to end-December 1986, 36.4 percent, was about the same as its depreciation against the mark, 37.6 percent, in contrast to the dollar's greater fall vis-à-vis the mark in the months before the Plaza Agreement. During this period, U.S. M2 growth remained strong; in addition to the coordinated discount-rate cuts mentioned above, which brought the U.S. rate down to 6.5 percent by the end of April, the Federal Reserve carried out two unilateral ½ percent cuts in July and August.

Already by mid-1986, some policymakers in the United States, notably Chairman Volcker, and many abroad, worried that further dollar depreciation might have adverse effects on U.S. inflation and on the world economy. In September, the G-7 issued the above-mentioned declaration that current exchange rate levels were broadly consistent with "fundamentals." On October 31, 1986, U.S. Treasury Secretary James A. Baker and Japanese Finance Minister Kiichi Miyazawa reiterated that "the exchange rate realignment achieved between the yen and the dollar since the Plaza Agreement is now broadly consistent with the underlying fundamentals. . . ." The Bank of Japan cut its discount rate, and Miyazawa pledged to stimulate the Japanese

economy further through tax reform and additional public spending.[14] In November, short-term dollar interest rates began to edge upward.

Disappointing news on the U.S. trade balance, disappointing implementation of the Japanese fiscal undertakings in the Baker-Miyazawa accord, and hints from U.S. officials that the dollar might need to depreciate further led to a renewed bout of dollar weakness in December and January. On January 21, Baker and Miyazawa issued a second communiqué characterizing the dollar-yen rate as "broadly consistent with fundamentals," despite a dollar depreciation against the yen of close to 6 percent since the earlier Baker-Miyazawa declaration.[15] In later attempts to relieve the upward pressure on their currencies, the Bundesbank and the Bank of Japan lowered their discount rates, reinforcing an ongoing widening of the dollar's interest advantage. The Bundesbank's action followed a year in which, partly as a result of interventions connected with European Monetary System (EMS) pressures and partly as a result of dollar interventions, the central bank money stock had finished far above the top of its target range. (The mark was revalued within the EMS on January 12, 1987.) The Louvre Accord, the first concerted attempt to stabilize currency values since the dollar turnaround of early 1985, was announced on February 22, 1987.

The Louvre Accord resulted in a period, about eight months long, of approximate stability for the main industrial country exchange rates. This broad stabilization was achieved despite continuing pressure for further dollar depreciation due, in part, to the persistence of a large U.S. current account deficit. The dollar-mark exchange rate basically remained within a 5 percent band during this period, while the dollar-yen rate fluctuated within a 10 percent band. The dollar exchange rates of the pound sterling, the French franc, the Canadian dollar, and the lira were also unusually stable.

It seems apparent in retrospect that the relative exchange rate stability that followed the Louvre meeting was enforced with the help of restrictive monetary policy in the United States and relatively expansionary policies in Germany and Japan. Short-term mark and yen interest rates moved downward after the Louvre, remaining near, and mostly below, 4 percent until September 1987. Germany's central bank money stock was allowed to overshoot its 1987 target growth range of 3–6 percent by a considerable margin; as a result, German M1 and M3 both grew at exceptionally rapid rates over the year. Japan's money supply—whether measured as M1 or as M2 plus the stock of certificates of deposit—grew at its fastest rate of the decade (in both cases well above 10 percent per year). In the United States, meanwhile, short-term interest rates moved to a higher range and the growth rate of M2 was held below the bottom of its target interval;[16] in early September the Federal Reserve raised its discount rate from 5.5 to 6 percent.

Interest rate increases in all three countries, and a widening of the U.S.-foreign short-term interest differential, preceded the stock market crash

of October 19, 1987. This generalized rise in interest rates is sometimes identified as a catalyst of the crash. The stock market plunge was immediately followed by a worldwide *fall* in interest rates as investors shifted from stocks into bonds and as central banks acted to head off any incipient liquidity crisis; in the process, the interest differential in favor of dollars declined. By the end of 1987, the dollar had registered another decisive external decline, shattering the lower limit specified by the Louvre Accord. The dollar's fall was heavily influenced by adverse U.S. trade news, and it occurred in spite of an interest rate reduction in Japan and an even deeper reduction in Europe. The December G-7 meeting, as noted earlier, reaffirmed the goal of exchange rate stability and warned against further dollar depreciation, to no great immediate effect.

After the dollar, buttressed by favorable trade news and more intervention, recovered some of its losses in January, the currency's exchange rates against the yen and the mark remained in relatively narrow bands through the middle of June—another period, nearly six months long, of approximate stability. A new phase of dollar appreciation began after mid-June, sparked, as noted above, by evidence of U.S. trade balance improvement, firming dollar interest rates, and official intimations that some dollar appreciation might now be tolerated. The surprising magnitude and duration of the dollar's summer-time rise raised the worrisome possibility that progress in external adjustment might be slowed or even reversed. By September, however, the dollar upswing had moderated with the aid of sharply higher short-term interest rates in Germany.

5.2.3 Exchange Rate Fundamentals: Government and Private Demand

A brief look at events impinging more directly than monetary policy on output markets will complete this survey of macroeconomic developments in the recent period of exchange rate realignment. Table 5.1 reports data on central-government fiscal deficits (general-government deficits are given in parentheses) and real domestic demand growth in the three largest economies.[17]

Important changes in fiscal positions are evident in the data. Over the course of the early 1980s, U.S. government deficits—central and general alike—rose sharply relative to GNP; starting in 1986, a leveling off and possible reversal of this trend appears. Both Germany and Japan, however, display declining deficit ratios over the early 1980s. In the German case, this downward trend seems to end in 1985–86, while in the Japanese case, the trend continues through the time of this writing.

In retrospect, the stabilizing of the American and German fiscal deficit ratios around the mid-1980s stands out as a key factor behind the dollar-mark realignment that began late in the first quarter of 1985. Although Japan's fiscal deficits have continued to decline throughout the 1980s, U.S. fiscal consolidation has contributed to dollar-yen realignment as well. Before 1985, market participants may have expected the then-divergent trends in national fiscal positions to continue for some time; these expectations would have contributed, in turn, to the dollar's appreciation against the mark and yen. Thus, the

Table 5.1 **Fiscal Policy and Domestic Demand in Japan, the Federal Republic of Germany, and the United States, 1980–1988**

	Germany	Japan	United States
	Central (General) Government Fiscal Balance (% of nominal GNP/GDP)		
1980	−1.9 (−2.9)	−6.2 (−4.4)	−2.3 (−1.3)
1981	−2.5 (−3.7)	−5.9 (−3.8)	−2.4 (−1.0)
1982	−2.4 (−3.3)	−5.9 (−3.6)	−4.1 (−3.5)
1983	−1.9 (−2.5)	−5.6 (−3.7)	−5.6 (−3.8)
1984	−1.6 (−1.9)	−4.7 (−2.1)	−5.1 (−2.8)
1985	−1.3 (−1.1)	−3.9 (−0.8)	−5.3 (−3.3)
1986	−1.2 (−1.3)	−3.4 (−0.9)	−4.8 (−3.4)
1987	−1.4 (−1.8)	−2.7 (0.6)	−3.4 (−2.3)
1988	−1.7 (−2.0)	−2.1 (1.1)	−3.3 (−1.8)
	Annual Growth of Total Real Domestic Demand (%)		
1980	1.1	0.8	−1.8
1981	−2.7	2.1	2.2
1982	−2.0	2.8	−1.9
1983	2.3	1.8	5.1
1984	2.0	3.8	8.7
1985	0.8	4.0	3.8
1986	3.6	4.1	3.7
1987	3.1	5.2	3.0
1988	3.5	7.7	3.0

Source: IMF, *World Economic Outlook* (October 1988 and April 1989): tables A13, A17, and A2 in both issues.

impact of fiscal policy on exchange rates in the late 1980s should not be judged by the sizes of *actual* fiscal adjustments alone. To the extent that fiscal policy actions from 1985 on signaled changes in the trends of the decade's first half, they would have been accompanied by changes in *expected future* deficit ratios that have an effect on exchange rates independent of current fiscal moves. Branson (1988) has insisted on the importance of such expectations effects in arguing that the anticipated enactment of the Gramm-Rudman-Hollings legislation contributed to the dollar's 1985 depreciation.

Lacking the benefits of hindsight, market participants were able to discern changes in national fiscal trends only over time. A growing perception that American and German fiscal trends had been altered probably contributed to steady downward pressure on the dollar relative to the mark and yen in 1986 and 1987.

Given the likely importance of fiscal policy expectations, little can be gained from attempts to correlate even year-to-year movements in currency values with ex post changes in fiscal stance. Possibly, more can be learned from divergent movements in real domestic demand, which are less likely than fiscal

deficit changes to have been associated with large shifts in long-term expectations. It is difficult in practice, however, to disentangle the "pure" exchange rate effect of a demand shift—which alters the terms of trade at constant money price levels—from the expectations about future monetary policy reactions that the shift creates. Thus, an acceleration of demand growth in the United States can cause nominal dollar appreciation for two reasons: it signals the possible need for a rise in the relative price of U.S. traded goods, and, if the economy is running near full capacity, it also raises the likelihood that the Federal Reserve will restrict monetary growth in the future.

Since 1985, cumulative demand growth has been strongest in Japan; from 1986, demand growth has been comparable in the United States and Germany. Overall demand factors are therefore likely contributors to the yen's appreciation against both the dollar and the mark over the 1985–88 period. The very high rate of U.S. demand growth in 1984 (8.7 percent) is noteworthy. A plausible hypothesis is that the buoyant business environment associated with this exceptional growth, perhaps coupled with expectations that monetary tightness would be needed later to discourage inflation, kept the dollar high in 1984 and early 1985 even after U.S. monetary policy loosened.

5.3 Sterilized Intervention as a Policy Instrument

After 1985, monetary policies in the three main industrial countries have operated in a setting of relatively inflexible fiscal policies, first to amplify the dollar's real depreciation in the hope of hastening current account adjustment, then to stabilize currencies at levels supposedly consistent with external equilibrium in the long run. At the same time, each country has used monetary means to pursue the additional domestic goal of growth with low inflation. In a world of N countries and N policy tools (the individual countries' monetary policies), it is only by accident that N domestic objectives and $N - 1$ exchange rate targets can simultaneously be attained in the short run. Unless $N - 1$ additional policy instruments are available, conflicts between internal and external balance are bound to arise, as they have done continually in recent years.

Sterilized foreign-exchange intervention furnishes $N - 1$ additional policy tools with the potential to be useful complements to monetary policies. These $N - 1$ additional tools are pure changes in the *relative* stocks of national currency bonds held in private portfolios. A major difficulty in evaluating intervention is to identify empirically the channels, if any, through which intervention has significant, lasting effects on exchange rates.

5.3.1 The Mechanics of Intervention and Sterilization

Official intervention in the foreign-exchange market has the direct effect of altering the balance sheet of the central bank, and possibly of other government agencies. U.S. intervention, for example, is carried out by both the Federal Reserve and by the Exchange Stabilization Fund (ESF) of the U.S. Treasury.

When foreign-exchange intervention is not sterilized, it can affect exchange rates by changing the stock of high-powered (or base) money, a change that leads to adjustments in broader monetary aggregates, in interest rates, and in market expectations about future price level inflation. A stylized balance sheet for the German Bundesbank would show its net asset holdings—consisting of net foreign assets (NFA) and net domestic assets (NDA)—equal to its monetary liabilities, the German monetary base (B):[18]

$$\text{NFA} + \text{NDA} = \text{B}.$$

A nonsterilized Bundesbank purchase of a $1 million bank deposit at DM 2 per dollar, say, alters the central bank's balance sheet by raising NFA (on the asset side) and B (on the liability side), both by DM 2 million. The corresponding change in the private sector's balance sheet is the mirror image of this one: a DM 2 million rise in German high-powered money holdings, and a DM 2 million decline in holdings of dollar deposits.

The Bundesbank could sterilize this intervention's expansionary effect on the monetary base through several types of offsetting operation, for example, a DM 2 million open market sale of mark-denominated domestic government securities. This additional operation would reduce the Bundesbank's net domestic assets and its monetary liabilities, both by DM 2 million. Taken together, the two Bundesbank actions—intervention plus sterilization—would leave the public with unchanged holdings of high-powered money, but with a higher stock of interest-bearing mark assets and a correspondingly lower stock of interest-bearing dollar assets. In this sense, sterilized intervention is a "pure" change in the relative stocks of national currency bonds held by the public, that is, a change that is not accompanied by a change in the monetary base.[19]

As noted above, sterilized interventions can take many forms. Consider, for example, a hypothetical forward exchange market intervention in which the Bundesbank sells three-month forward marks for forward dollars. This operation is essentially the same as the sterilized intervention just described, in that it increases the net stock of mark bonds held by the private sector (the private sector's net claims on future delivery of marks), decreases the net stock of dollar bonds, but does not change the German base.[20] Operations by non–central bank government agencies, such as the U.S. ESF, are automatically sterilized if the balances drawn on for intervention purposes are held in the private banking system, say, or in the form of government securities purchased and sold in the open market. If some of these balances are held at central banks, however, the agencies' interventions may have monetary effects.

Certain central bank transactions are automatically sterilized, after some time lag. Imagine that the Bundesbank lends DM 1 million to the Bank of France for intramarginal franc purchases under the EMS very short-term financing facility. At an exchange rate of Ffr 3.5 per mark, say, these transactions change the two central banks' balance sheets as follows:

Balance Sheet of the Bundesbank

Change in Net Assets	Change in Monetary Liabilities
ΔNFA = + DM 1 million	ΔB = + DM 1 million

Balance Sheet of the Bank of France

Change in Net Assets	Change in Monetary Liabilities
ΔNFA = − Ffr 3.5 million	ΔB = − Ffr 3.5 million

As a result of this coordinated intervention, there is a symmetric monetary adjustment (absent immediate sterilization), because Germany's high-powered money stock rises as France's falls. Under EMS rules, however, the increase in German money may be automatically sterilized if, after the statutory three and a half months, the Bundesbank requests repayment of its loan in marks. Since repayment leaves the French central bank's *net* foreign assets the same—a liability to the Bundesbank is settled through an equal depletion of mark reserves—the French monetary base can remain at its lower level. The German base falls, however, if the Bank of France discharges its debt to the Bundesbank by drawing on French official holdings of marketable mark securities:

Balance Sheet of the Bundesbank

Change in Net Assets	Change in Monetary Liabilities
ΔNFA = − DM 1 million	ΔB = − DM 1 million

In effect, the Bank of France automatically sterilizes the increase in the German base when it repays its loan using marketable mark reserves; the initial symmetry of the intervention unwinds. Such automatic sterilization would not occur if France repaid Germany in dollars or, say, in European Currency Units.[21]

5.3.2 International Portfolio Balance and Exchange Rates

Since sterilized intervention operates by changing the currency denomination of bonds held by the public, such changes must affect asset market equilibrium if any exchange rate change is to result. As a matter of theory, the link between government asset swaps and equilibrium is not immediate: a government exchange of foreign for domestic assets with domestic residents may wash out if private agents fully capitalize, as part of their own wealth, all future net taxes levied by the government. In this extreme case of Ricardian

equivalence between debt issue and taxes, the government cannot systematically affect the relevant "outside" bond supplies, that is the net supply of claims on governments that the public must hold. The evidence on Ricardian equivalence is ambiguous, so in what follows, I will assume that government asset operations do indeed move outside asset supplies in the intended directions, though not necessarily on a one-for-one basis.[22]

How should changes in outside supplies of national currency debt affect asset markets? Portfolio-balance theories of exchange rate determination link relative expected nominal rates of return on bonds of different currency denomination to outside asset supplies. According to these theories, a wealth owner cares about the riskiness of a portfolio as well as the expected return that it offers. Since bonds of different currency denomination are perfect substitutes for risk averters only under very unlikely circumstances, a change in outside asset supplies generally alters the risk characteristics of the market portfolio and thus requires an equilibrating adjustment in currencies' relative expected returns.

More precisely, let R_t be the one-period risk-free nominal interest rate on domestic currency, R_t^* the corresponding rate on foreign currency, S_t the (spot) price of foreign currency in terms of domestic, and $E_t(\cdot)$ a conditional expectation, given information as of date t. Then the domestic currency payoff on a domestic currency bond held for one period is $1 + R_t$, while the expected domestic currency payoff on the same investment in a one-period foreign bond is $(1 + R_t^*)E_t(S_{t+1})/S_t$. The portfolio-balance view posits that the return differential or (relative) *risk premium* on foreign currency,

$$(1) \qquad (1 + R_t^*)E_t(S_{t+1})/S_t - (1 + R_t) \equiv \rho_t ,$$

is a function of the outside supplies of assets denominated in domestic and foreign currency. An implication is that changes in outside asset supplies, such as those caused by sterilized intervention, can alter asset market prices, including exchange rates. The general presumption is that, all else equal, an increase in the stock of domestic currency debt that the public must hold will raise the domestic currency interest rate, lower the foreign currency interest rate, and depreciate the domestic currency in the foreign-exchange market (see Branson and Henderson 1985). As note 22 above warns, however, the exchange rate effect of a sterilized intervention is impossible to evaluate in *general* equilibrium without a complete model of how future macroeconomic policies of all kinds adjust to keep the government within its intertemporal budget constraint.

There is a large body of evidence contradicting the hypothesis that ρ_t in equation (1) is identically zero, or even constant over time; Hodrick (1987) presents a thorough review of this evidence and of its interpretation by various authors. The risk premium ρ_t could be identically zero if investors were risk neutral (and certain other conditions held); in this case, bonds differing in

currency of denomination would be perfect substitutes, implying that changes in their relative outside supplies do not necessarily call for equilibrating changes in relative asset returns. Under perfect substitution, there is no meaningful distinction (leaving aside the incentive effects to be discussed in sec. 5.4) between monetary changes brought about by transactions in foreign-exchange markets and changes of equal magnitude brought about by measures such as open market trades of domestic securities. The condition $\rho_t \equiv 0$ is often called the uncovered interest parity condition.[23]

The statement that uncovered interest parity fails to hold is not the same as the statement that sterilized intervention is effective in moving exchange rates.[24] The latter statement would be supported, however, by econometric evidence that government debt supplies play a systematic role in determining ρ_t. Evidence of this sort has not, however, been forthcoming. Define

$$v_{t+1} \equiv (1 + R_t^*)\,[S_{t+1} - E_t(S_{t+1})]/S_t,$$

so that v_{t+1} is uncorrelated with time-t information. Most studies proceed by regressing

$$(1 + R_t^*)S_{t+1}/S_t - (1 + R_t) = \rho_t + v_{t+1}, \tag{2}$$

on time-t government debt supplies, which are assumed to be correlated with the relevant outside asset supplies. Hodrick (1987, 119–28) documents the failure of such tests to produce significant evidence that asset supplies affect risk premiums.

Some of the tests discussed by Hodrick impose added structure on the problem of relating the ex post excess return, equation (2), to outside asset supplies by assuming that international investors are mean-variance optimizers. The resulting capital asset pricing model (CAPM) implies that the coefficient in the regression equation depends on the degree of investor risk aversion and the covariance matrix of unexpected asset returns, which is assumed not to change over time. Evidence that the covariance matrix does indeed change over time (see Cumby and Obstfeld 1984) has led some researchers to postulate explicitly time-varying covariance matrices in estimation. Engel and Rodrigues (1987), Giovannini and Jorion (1989), and Mark (1988) take this approach; the first two papers find evidence against versions of the CAPM with time-varying covariances, while the last is more favorable. It seems fair to say, however, that none of these models can explain more than a small fraction of the volatility in the ex post excess return defined by equation (2). Allowing for time-varying covariances in the CAPM does little if anything to support the view that shifts in outside asset supplies, per se, have significant exchange rate effects.[25]

5.3.3 Consumption-Based Asset Pricing Models

An alternative approach to modeling the risk premium views consumption risk as a major determinant of asset returns. On this view, the mechanisms that

might underlie any effects of sterilized intervention are somewhat less direct than those driving portfolio-balance models. Presumably, sterilized intervention could affect exchange rates by altering the composition of private wealth, and thereby altering the covariance of wealth, and hence of consumption, with the returns on various currencies.

The consumption-based theory builds on the intertemporal efficiency condition for an individual who derives utility $u(c_t)$ from consuming c_t in period t, has a subjective discount factor β, and faces the home price level P_t in addition to home and foreign nominal interest rates R_t and R_t^* and a nominal price of foreign currency S_t. The efficiency condition is

$$E_t(S_{t+1}/S_t) - \frac{1 + R_t}{1 + R_t^*} = -\frac{\text{cov}_t(Q_{t+1}, S_{t+1}/S_t)}{E_t(Q_{t+1})}, \tag{3}$$

where

$$Q_{t+1} \equiv \beta u'(c_{t+1})/P_{t+1} \div u'(c_t)/P_t$$

and $\text{cov}_t(\cdot)$ is a conditional covariance.[26] The term on the right-hand side of equation (3) is (up to a discount factor) the risk premium ρ_t defined in equation (1); if it is identically zero, equation (3) becomes the uncovered interest parity condition

$$\frac{1 + R_t}{1 + R_t^*} = E_t(S_{t+1}/S_t). \tag{4}$$

As noted earlier, condition (4) has been tested extensively, for example, by testing whether the interest factor ratio is an unbiased predictor of future spot rate changes. Table 5.2 presents estimates of the equation

$$S_{t+1}/S_t = a + b(1 + R_t)/(1 + R_t^*) + \epsilon_{t+1},$$

Table 5.2 Tests Based on $S_{t+1}/S_t = a + b\,(1 + R_t)/(1 + R_t^*) + \epsilon_{t+1}$

Currency	a	b	$Q(18)$	F-stat	Significance
Mark	2.383	−1.364	15.76	1.036	0.363
	(1.742)	(1.726)			
Yen	4.013	−2.967	19.43	6.333	0.004
	(1.152)	(1.141)			
Pound	2.289	−1.304	32.74	3.165	0.052
	(0.935)	(0.939)			

Note: Quarterly data, three-month interest rates. Exchange and interest rates are end-of-quarter quotations. Sample period for yen is 76:2 to 86:3; for other currencies, 75:2 to 86:3. The Q-statistic tests for serial correlation at lags up to 18 and is distributed $\chi^2(18)$ if equation errors are white noise. The F-statistic tests the null hypothesis $a = 0$, $b = 1$. Its significance is the probability of finding the estimated coefficients under the null.

along with F-tests of the null hypothesis of unbiasedness, $a = 0$, $b = 1$. (The time interval is three months, and the data are nonoverlapping.) Included are results for the exchange rates of the mark, the yen, and the pound sterling against the dollar. The results are rather negative, and indicate that interest rate differences have tended to mispredict the direction of subsequent exchange rate change in recent years.

To assess the possibility that the results of table 5.2 are explained by a time-varying consumption-based risk premium, it is useful to write equation (3) in a form that is comparable to equation (4). This can be done by observing that $E_t(Q_{t+1}) = (1 + R_t)^{-1}$, which implies

$$\frac{1 + R_t}{1 + R_t^*} = E_t[(S_{t+1}/S_t)Q_{t+1}(1 + R_t)]. \tag{5}$$

Equation (5) shows how depreciation, adjusted for consumption risk, is related to the international interest differential. The prediction of this equation is that the ordinary least-squares regression $(S_{t+1}/S_t)Q_{t+1}(1 + R_t) = a + b(1 + R_t)/(1 + R_t^*) + \mu_{t+1}$ should yield estimated coefficients of $a = 0$ and $b = 1$; table 5.3 reports the results of empirical tests. For the purpose of these tests, it was assumed that (1) utility is separable in consumption of services, nondurables, and durables; (2) the utility derived from any consumption category can be measured by a function that is isoelastic with elasticity 2 (so that $u'[c]$ is a constant times c^{-2}); and (3) $\beta = 0.985$ (per quarter).[27]

Table 5.3 Tests Based on $(S_{t+1}/S_t)\ Q_{t+1}(1+R_t)=a+b(1+R_t)/(1+R_t^*)+\mu_{t+1}$

Currency	a	b	$Q(18)$	F-stat	Significance
		Consumption Data: Services			
Mark	−0.347	1.325	14.97	1.992	0.148
	(1.855)	(1.837)			
Yen	2.585	−1.567	15.81	2.571	0.089
	(1.208)	(1.196)			
Pound	0.963	0.014	30.73	2.699	0.078
	(1.071)	(1.076)			
		Consumption Data: Nondurables			
Mark	0.804	0.193	14.40	0.792	0.459
	(1.817)	(1.780)			
Yen	3.069	−2.037	17.80	2.542	0.091
	(1.365)	(1.352)			
Pound	1.421	−0.438	16.39	1.464	0.242
	(1.131)	(1.136)			

Note: See footnote to table 5.2. The appendix describes the consumption data underlying the results reported above.

While the results of table 5.3 do make the consumption-based model look marginally better than the simple uncovered interest parity model, they do not justify a large shift in priors. Figure 5.5 illustrates why the consumption-based model cannot go very far in explaining the risk premium; it compares the ex post values of the right-hand sides of equations (4) and (5), using data for the first regression reported in table 5.3. (This is a completely representative picture, however.) The correlation between these two variables is extremely high: price levels are not very variable compared with exchange rates, and except at implausibly high levels of risk aversion, aggregate consumption variability is insufficient to help much in explaining excess returns in the foreign-exchange market.

Hodrick (1987) reviews a largely negative body of evidence on consumption based international asset pricing models.[28] Slightly more favorable results have been reported recently by Cumby (1988), Hodrick (1989), and Obstfeld (1989a). Nonetheless, the low explanatory power of these models precludes any strong inferences about the validity of a portfolio-balance rationale for sterilized intervention. Perhaps the point to take home is that ex post exchange rate variability is so high relative to that of other variables in all of the models reviewed that only the weakest conclusions can be drawn from the econometric record.

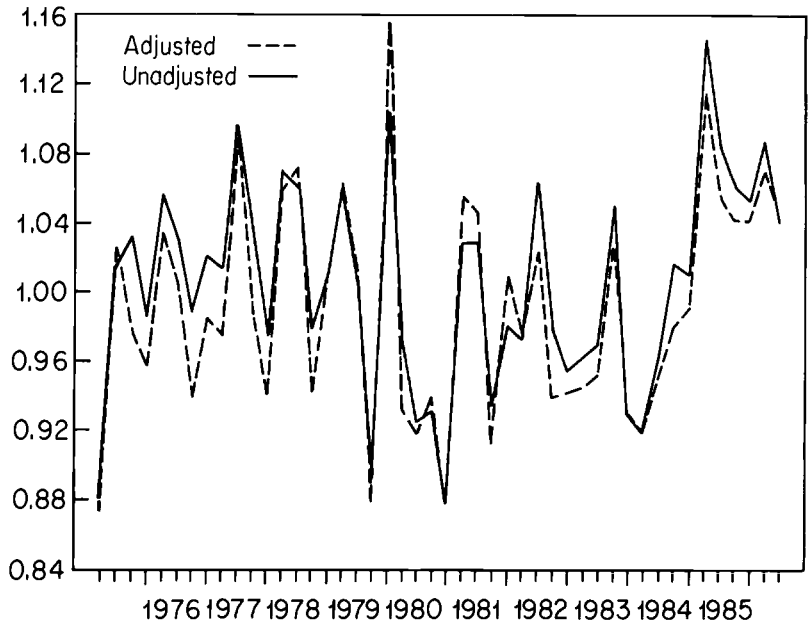

Fig. 5.5 Depreciation versus consumption-adjusted depreciation: The dollar-mark exchange rate, 1975–1986

5.4 Intervention as a Signal to Exchange Markets

The failure of risk models to explain the apparent deviations from uncovered interest parity has led some researchers to conclude that participants in exchange markets ignore easily available information about exchange rates and make biased exchange rate forecasts.[29] Other researchers interpret the negative results as evidence of weaknesses in the econometric methods and the empirical risk models that have been applied.[30]

Members of both schools agree, however, that there is a channel through which sterilized intervention can move exchange rates even when bonds of different currency denomination are perfect substitutes. That channel is the new information about economic conditions and future economic policies that the volume and direction of intervention may signal to the market independently of any other current policy changes. Marston (1988) provides an interesting comparative discussion of two episodes—the Carter administration's dollar support operations of late 1978, and the Plaza declaration—in which sterilized intervention accompanied explicit policy announcements aimed at changing the course of exchange markets.

Notice that the *signaling effect* of intervention might not be detectable by means of econometric tests such as those discussed in section 5.3 because forward-rate forecast errors can be uncorrelated with lagged intervention despite being correlated with contemporaneous intervention. This correlation pattern could occur if, for example, currency-denominated bonds were perfect substitutes, expectations were rational, and sterilized intervention helped significantly in predicting future monetary policies. While the results of section 5.3 thus allow no direct inferences about the signaling effect, alternative econometric tests of signaling can be designed. In a study covering the period 1977–81, Dominguez (1988) provides empirical support for the proposition that Federal Reserve intervention has at times communicated information useful for predicting future monetary policies.[31] Humpage (1988), who uses a different methodology, cites evidence suggesting a signaling effect over the recent period from August 1984 to August 1987.

It must be emphasized, however, that if intervention affects exchange rates *only* through the signals it sends, then it is not a macroeconomic policy instrument in the same sense that monetary and fiscal policies are. Intervention may alter the way that monetary policy announcements affect the exchange rate, for example, but it derives its power in this case entirely from its ability to influence market perceptions or expectations about other economic factors.

Consideration of episodes such as those described by Marston (1988) raises three fundamental (and closely connected) questions about the hypothesis that sterilized intervention affects exchange rates through a signaling mechanism. First, what information is contained in interventions that is not contained in the verbal policy announcements that frequently complement intervention and sometimes substitute for it? Second, why should sterilized foreign-exchange

intervention, rather than other reallocations of the government's asset portfolio, be particularly effective in signaling official intentions or information? For example, would it not be equally effective to signal that currency depreciation is desired through open market sales of domestic bonds that are subsequently "sterilized" by an offsetting increase in commercial banks' rediscount quotas? Third, what, if anything, assures the market that the signals sterilized intervention conveys are credible? In other words, are there costs that discourage governments from sending deceptive signals in attempts to obtain short-term advantages?

An obvious advantage of foreign-exchange intervention as a signaling device is that it can be deployed rapidly and around the clock, with immediate impact in the markets where exchange rates are set. The difficulties one faces in taking the analysis of intervention signals beyond this observation were well summarized by Tobin (1971, 408) in a discussion of the role of discount rate changes in monetary management:

> For many students of central bank policy the psychology of the announcement is the most important and perhaps the only important aspect of the discount rate. Unfortunately there is little of a systematic character that can be said about it. Will the public conclude from the announcement of a fall in the discount rate that predictions of recession are now confirmed by the expert economic intelligence of the central bank, and therefore regard the announcement as a deflationary portent? Or will the market judge that the authorities have thus indicated their resolute intention of preventing deflation, arresting and reversing the recession, and accordingly interpret the announcement as an inflationary sign? What do the authorities themselves regard as the likely psychological effects of their announcements? Clearly it is easy to become enmeshed in a game of infinite regress between the central bank and the market.

In the decades since this passage first was published, some progress has been made in systematically modeling the announcement effects of sterilized intervention. It is fair to say, however, that the models put forward so far are not close to representing the full range of government concerns that motivate intervention.

One reason sterilized intervention may send more informative and more credible signals than announcements or other public debt management policies centers on the effect of unanticipated exchange rate changes on the government's net worth. (Mussa 1981 discusses the relevance of this effect.) For example, a government that buys foreign exchange on a sterilized basis—thereby going long in foreign currency and short in domestic—will lose more money than it otherwise would have lost if its own currency subsequently appreciates by a percentage amount greater than the nominal interest differential. Public finance considerations thus lend credibility to a government that uses sterilized purchases of foreign exchange to signal a future depreciation of the domestic currency; conversely, sterilized sales of foreign currency may

communicate a credible signal that policies to appreciate the domestic currency will be pursued. The expectations created when a policy authority "puts its money where its mouth is" in this way can move exchange rates even under perfect asset substitutability.

As an illustration, suppose that the U.S. Treasury's ESF decides to intervene in marks to support the dollar's exchange rate against the German currency. A hypothetical possibility is that the ESF draws on a mark credit line with the Bundesbank (borrowing DM 10 million, say) and purchases dollar securities on the open market (say, $5 million in U.S. Treasury bills at an exchange rate of DM 2 per dollar). The effect on the U.S. government's balance sheet is:

Balance Sheet of the U.S. Government

Change in Assets	Change in Liabilities
+ $5 million	+ DM 10 million

This intervention has no effect on the U.S. monetary base. Although its monetary effects in the United States are therefore sterilized, the intervention does alter U.S. incentives: having gone long in dollars and short in marks, the Treasury is now more vulnerable to an unanticipated rise in the mark's dollar price. Foreign-exchange traders may therefore view the Treasury's action as a signal that American policies consistent with dollar appreciation are in store.[32]

In November 1978, the announcement that the U.S. Treasury would sell "Carter bonds" denominated in nondollar currencies may initially have altered market forecasts by appearing to reduce the U.S. government's incentive to inflate. (The rapid unwinding of the initial favorable market response to the Carter package illustrates the perils of intervention signals that are not backed up promptly by concrete policy changes.) Similarly, recent proposals that the U.S. government borrow yen rather than dollars, put forward by the *Economist* magazine and others, build on the idea of stabilizing currency markets by reducing the U.S. temptation to default partially on external dollar debts through an inflation of dollar prices.

The foregoing ideas can be formalized in the context of recent research on dynamic optimal taxation. Work by Lucas and Stokey (1983), Persson, Persson, and Svensson (1987), Calvo and Obstfeld (1990), and Obstfeld (1989c) has shown how government debt management policies, such as changes in the maturity structure of government debt or in the mix between real and nominal public liabilities, can enhance the credibility (technically speaking, the dynamic consistency) of optimal government plans. More generally, alternative debt strategies can alter the economy's equilibrium path, even when the expectations theory of the term structure holds and the Fisher equation links the own returns on real and nominal bonds.

The basic setup assumed in this literature is one in which the government must finance expenditures and debt repayments via distorting taxes, including the inflation tax on monetary balances. Since the real present value of its debt repayments depends on policies, potential asset revaluations affect the net marginal benefit to the government of any contemplated policy change. Realizing this linkage, the public uses government portfolio shifts, which change marginal government incentives, to predict future policy shifts. As a result, government asset swaps such as sterilized intervention, which might appear pointless at first glance, can alter expectations systematically, and can be analyzed by methods analogous to those that have been used to analyze the expectational effects of other types of official portfolio shift.

As suggested above, a government that buys home currency bonds and sells foreign bonds may reduce its own future incentives to create surprise inflation, and thereby lead traders to infer that the home currency will be stronger in the future than they had previously believed. Given current money supplies, the sterilized sale of foreign currency will thus cause a spot appreciation of the home currency. Bohn (1988) develops a model of the type described above to examine the incentive effects of government operations in foreign exchange.[33]

Such models could be useful in understanding the apparently stronger effects of *concerted*, as opposed to unilateral, intervention. If the Japanese authorities coordinate their dollar purchases with official American sales of yen, the Japanese government's gains from yen appreciation, and the U.S. government's gains from dollar depreciation, *both* decline. The positive effect on the dollar's value would be smaller if Japan intervened alone and the American government's incentives didn't change.

How powerful in practice are the budgetary incentives underlying these ideas? In testimony before Congress shortly after the Plaza Agreement, Stephen H. Axilrod, then Federal Reserve Staff Director for Monetary and Financial Policy, felt it necessary to comment on the budgetary implications of recent U.S. purchases of foreign currencies. After pointing out that lower interest earnings on those investments might be offset by an appreciation of foreign currencies against the dollar, he concluded that any net effect "would be very small absolutely and relative to Treasury receipts."[34] Economic theory implies, however, that the cost to the government of foreign exchange losses should be measured as the product of the amount of the loss and a shadow price reflecting the difficulty the government would encounter in replacing the lost resources. A government that is already running a large deficit will view a given loss as more costly than would a government with a balanced budget.

This is not to say that public sector losses on exchange markets have not been large in some years. Germany lost more than DM 9 billion on its reserves in 1987 as a result of the dollar's depreciation (see table 5.6, below). This loss had a substantial impact on the country's public sector deficit and caused the German government considerable domestic embarrassment.

Interesting as they are, the public finance models are quite specialized; they capture only one aspect of government behavior and probably not the most important one. In reality, governments pursue many goals not present in these models, such as high employment, and respond to purely political events, such as sectoral pressures for protection. Furthermore, the observability assumptions of these models, which require full public knowledge of government preferences, constraints, and information, are inadequate for addressing some issues.

Stein (1989) presents a simple incomplete information model in which the market cannot directly observe the authorities' utility trade-off between an exchange rate target and a domestic policy target. Uncertainty over official preferences prevents the market from accurately forecasting future monetary policy. Because of the temptation to manipulate the *current* exchange rate through a time-inconsistent policy, the authorities cannot credibly announce the future level of the money supply. Surprisingly, however, the authorities can credibly communicate some of their private information to the market, and in a way that favorably affects the current exchange rate. Specifically, the authorities can credibly announce a *range* of future exchange rate targets, even though the announcement of any precise policy target is not credible. Aside from rationalizing the recent G-7 practice of indicating only broad target ranges for exchange rates, Stein's model suggests that intervention itself could provide a noisy but credible message about policymakers' private information.

Intervention may be costly for a government, as noted earlier, with costs that depend on the private information the government has. While such signaling costs play no role in Stein's analysis, they may allow the market to use observed interventions for more precise inferences about that data available to the authorities. Asymmetric information thus provides an additional mechanism through which intervention costs can lend credence to intervention signals.

Uncertainty has additional implications for intervention that any realistic analysis must recognize. Policymakers have imperfect information about market fundamentals; for example, they usually are unable to observe directly shifts in comparative advantage or the location of new international investment opportunities. By "testing the market" through intervention, authorities may gain a better idea of whether particular exchange rate movements represent transitory factors that ought to be offset—such as erroneous rumors about future policies—or permanent developments that it would be unwise to resist through monetary adjustments. Government agencies may well lose money in carrying out such exploratory intervention operations, but at least part of this cost can be viewed as a price paid for insight into market conditions. Generally, individual market actors will also gain information by observing the effects of official interventions.

Economics is still far from a full account of the signals conveyed by intervention or of the factors that might make those signals believable. In

analyzing the signaling effects of intervention, practical analysis currently has no choice but to rely on an informal weighing of the myriad factors entering government preferences and information sets and influencing government constraints.

5.5 Recent Foreign-Exchange Intervention: An Assessment

Earlier sections of this paper documented the macroeconomic adjustments that accompanied the dollar's decline from its peak in early 1985, and reviewed the theory and econometric evidence concerning the use of sterilized intervention as an additional instrument of macroeconomic policy alongside conventional monetary and fiscal policy. The econometric evidence is consistent with the 1983 finding of the Working Group on Exchange Market Intervention, cited in the introduction, that the portfolio effects of sterilized intervention are weak except, possibly, in the very short run. As the Working Group also recognized, however, the signaling effect of exchange market intervention is of potential importance. Unfortunately, it is difficult, except within models too stylized to be immediately useful to policymakers, to design signals to the exchange market that are credible and therefore effective.

Intervention, often sterilized and often concerted, has nonetheless loomed large in recent currency experience, so it is important to ask whether and through what channels intervention aided in promoting the 1985–88 realignment. In this section I try to answer this question by examining the timing and magnitudes of interventions by the three largest industrial countries. The message in the data appears to be that monetary and fiscal actions, rather than sterilized interventions, have been the dominant policy determinants of the broad exchange rate movements of recent years. On several occasions, however, intervention seems to have been effective in signaling to exchange markets the major governments' resolve to adjust other macroeconomic policies, if necessary, to achieve exchange-rate goals. On other occasions, authorities have been convinced by exchange market pressures to modify these goals rather than to make fully accommodating monetary or fiscal changes. Sterilized intervention has not helped governments resolve conflicts between internal and external balance in any fundamental way.

5.5.1 Intervention Data for the United States, the Federal Republic of Germany, and Japan, 1985–88

Table 5.4 reports the dollar value of net U.S. open market purchases of foreign currencies, both by the Federal Reserve and the ESF. For reasons to be discussed in a moment, these data do not completely capture quarterly changes in the U.S. official foreign asset position, which might be more relevant for assessing the portfolio effects of intervention. Given its small size relative to the global supply of dollar assets, however, the most interesting

Table 5.4 **United States: Open Market Purchases of Foreign Exchange**

	Quarterly Purchase			
	1	2	3	4
1985	0.7	0.0	0.2	3.1
1986	0.0	0.0	0.0	0.0
1987	−1.5	−3.4	0.3	−3.9
1988	−1.0	2.4*	2.1**	—

Source: Data for 1985–87 from IMF, *World Economic Outlook* (April 1988): table 22; 1988 data from *Federal Reserve Bulletin* (April 1988, July 1988, October 1988, and February 1989).

Note: Purchases (+) and sales (−) in billions of U.S. dollars.

*Includes intervention purchases of foreign exchange during July.

**August and September only.

aspect of U.S. intervention is its possible signaling effect, which is well captured by the data on market transactions reported in table 5.4.

Table 5.5 reports changes in the dollar values of German and Japanese foreign-exchange reserves. The numbers in table 5.5 include, along with changes in central-bank reserve holdings, changes in the net foreign claims of other government agencies that intervene in financial markets. Also included

Table 5.5 **The Federal Republic of Germany and Japan: Increase in Dollar Value of Foreign Exchange Reserves**

Yearly Quarter	Germany	Japan
1985		
1	−2.9	0.2
2	2.3	0.9
3	3.1	−0.3
4	1.5	−0.8
1986		
1	0.8	1.2
2	−0.9	5.9
3	4.3	7.5
4	2.6	0.7
1987		
1	8.2	15.8
2	2.3	10.5
3	1.5	2.8
4	15.0	8.9
1988		
1	−5.7	3.2
2	−7.8	2.4
3	−6.7	3.1
4	0.6	6.1

Source: IMF, *World Economic Outlook* (April 1988): table 23; and IMF, *International Financial Statistics* (March 1989): line 1d.*d*.

Note: In billions of U.S. dollars.

are fluctuations in the dollar value of existing nondollar reserves that are induced entirely by exchange rate changes; but despite this valuation discrepancy, the numbers in table 5.5 are reasonably well correlated with the dollar value of actual foreign-exchange acquisitions by the two countries' authorities. Because of German EMS interventions, the reported series is significantly more reliable as an indicator of dollar acquisitions for Japan than for Germany.

The intervention series probably most useful in assessing the pressure of intervention on domestic financial markets is the domestic currency value of official foreign asset acquisitions—essentially, the balance of payments in domestic currency. This variable captures the incipient addition to domestic base money resulting from intervention. Table 5.6 reports quarterly data on the mark value of Bundesbank acquisitions of reserve assets. Capital gains on existing reserves, which are excluded from the acquisition data, appear in the second column.[35] Such capital gains do not put direct pressure on domestic financial markets, but they can have significant consequences for the government's finances.

Some caveats applying to all of the data are in order. Even in the absence of valuation changes, the figures in tables 5.5 and 5.6 may differ considerably from outright official purchases of foreign exchange in the open market.

Table 5.6 **The Federal Republic of Germany: Bundesbank Foreign Asset Acquisitions and Capital Gains**

Yearly Quarter	Asset Acquisitions	Capital Gains
1985		
1	−12.6	4.2
2	6.0	−2.7
3	5.7	−2.3
4	2.8	−2.3
1986		
1	2.2	−1.0
2	−8.1	1.1
3	8.9	−1.0
4	3.0	−2.2
1987		
1	14.2	−0.1
2	5.8	−0.3
3	−1.5	0.1
4	22.7	−9.1
1988		
1	−2.9	−0.1
2	−10.0	1.1
3	−22.3	1.9
4	0.6	−0.7

Note: Acquisitions and gains (+) in billions of marks.

Source: Monthly Report of the Deutsche Bundesbank (April 1989): table IX.1. For a more precise description of "capital gains," see footnote 6 to table IX.1. Asset acquisitions are "Change in the Bundesbank's net external assets" (from table IX.1) less capital gains.

Interest earnings on the Bundesbank's dollar assets, for example, when reinvested in dollars, swell the bank's net foreign assets, even though no transaction in the foreign-exchange market is directly involved. As argued by Adams and Henderson (1983), however, such reinvestment is correctly thought of as intervention, since the German government could have used dollar interest earnings to reduce the flow of mark-denominated government debt into private portfolios, simultaneously leaving more dollar bonds for the private market to hold. There are, in addition, some problems of measurement related to off-balance-sheet items, end-of-quarter "window dressing" of balance sheets, and so on.

5.5.2 Intervention and the Exchange Markets

An informal review of tables 5.4–5.6 in the light of the narrative of section 5.2 provides a vantage from which to evaluate recent intervention experience.

Pre-Plaza period (January–September 1985). Table 5.6 shows that the Bundesbank intervened heavily in the first quarter of 1985 to stop the dollar's rise to its peak; the United States intervened at the same time, but on a much smaller scale. The Bundesbank sterilized its intervention—in the Bundesbank's published monetary survey, the reduction in central bank money due to foreign-exchange flows in the first quarter of 1985 (DM 12.2 billion) is accompanied by an unusually large domestic open-market purchase under repurchase agreement (DM 12.1 billion). Short-term mark interest rates showed only a temporary and relatively small increase in this quarter.[36] In the two subsequent quarters, the German authorities purchased dollars as the dollar depreciated, and took advantage of the mark's relative strength to lower interest rates in the face of a weak domestic economy. Japan's foreign reserves (measured in dollars) show a net rise over these two quarters (table 5.5); the United States, for the most part, stayed on the sidelines (table 5.4). All told, the period shows no sustained, coordinated attempt to drive the dollar down through intervention.

Plaza to Louvre (September 1985–February 1987). In the last quarter of 1985 the United States and Japan, backing up the Plaza Agreement, both intervened to push the dollar down. Germany also carried out open market dollar sales, but once nonmarket transactions are taken into account, its foreign reserves show a net *increase* for the quarter (tables 5.5 and 5.6). Intervention clearly did little to promote the dollar's depreciation over 1986; U.S. activity was insignificant, and Japan bought dollars to counteract yen appreciation. Indeed, by the second half of 1986, the Bundesbank had joined Japan in trying to brake the dollar's fall through dollar purchases, but the resulting interventions were allowed to have no substantial effect on interest rates in either country and were ineffective.[37] Only after Germany and Japan decisively lowered interest rates in January 1987, and the United States intervened at month's end, did the dollar stabilize briefly; from end-October 1986 to end-January 1987, the dollar price of marks had risen by 14.3 percent and that

of yen by 5.9 percent. The Bundesbank has summarized the experience of intervention in the months before the Louvre accord as follows:

> These [intervention] efforts were in vain, not least because statements by U.S. officials repeatedly aroused the impression on the markets that the U.S. authorities wanted the dollar to depreciate further. Moreover, until then [late January 1987] the Americans hardly participated in the operations to support their currency. Nor did the Federal Reserve counteract the downward trend in the dollar through monetary policy measures, despite the risks to price stability which it clearly perceived.[38]

Evidently, pure intervention by Japan and Germany had little effect compared with concrete monetary policy actions, favorable news on the U.S. trade balance, a pointedly visible reentry of the United States into the foreign-exchange market, and a more straightforward American acknowledgment that the time for dollar stabilization had come.[39]

From the Louvre to the crash (February–October 1987). After the Louvre Accord, the yen appreciated substantially in spite of heavy Japanese dollar purchases in the first half of 1987 (table 5.5). (Germany's sizable intervention in the first quarter of 1987 was motivated largely by an EMS realignment episode.) On March 11, the United States bought $30 million in marks to counteract heavy private sales of the German currency. Pressure on the mark rapidly subsided, but then the yen began to appreciate. Between March 23 and April 6, the Federal Reserve intervened daily and purchased a total of $3.0 billion with yen; between April 7 and 17, the Federal Reserve intervened on three occasions, buying $532 million.[40] These operations marked the first major U.S. intervention in foreign-exchange markets since the Plaza period in late 1985, but intervention now aimed at supporting the dollar, not bringing it down. The Bundesbank and other European central banks also participated in these dollar support operations. Pressure on the yen eased only after the dollar-yen interest differential widened substantially (see fig. 5.4), and industrial country exchange rates remained roughly stable until the worldwide stock market crash in October. As noted above, this stability owed much to monetary policies.

From the crash to the Toronto Summit (October 1987–June 1988). Concerted official purchases of dollars began at the end of October and continued through January. All three countries intervened heavily to support the dollar, and as a result of these and earlier operations, the overall increases in German and Japanese foreign reserves over 1987 are remarkably large. In spite of this heavy intervention, the dollar depreciated by 16.2 percent against the mark, and by 18.5 percent against the yen, between end-September and end-December 1987, before partially recovering and stabilizing in the last part of January 1988. From then until mid-June, the dollar-mark and dollar-yen exchange rates fluctuated within relatively narrow ranges. The United States conducted moderate dollar support operations in March and April of 1988, while Japan intervened more heavily to discourage yen appreciation. Germany,

however, allowed its reserves to fall during the period, presumably to help counteract a perceived weakness of the mark. Short-term mark interest rates also drifted upward after the end of January. Until the second half of June, however, the interest differential favoring dollar over mark assets increased.

Toronto to Berlin (June–September 1988). Several developments, already reviewed above, led to a sharp appreciation of the dollar in June. The U.S. began intervening to discourage the dollar's rise on June 27; foreign-exchange operations by the U.S. and foreign authorities, sometimes on a large scale, continued through the summer. (Japan's dollar reserves rose in this period despite the dollar's strength, but the Bundesbank sold DM 22.3 billion in reserves in the third quarter of 1988 alone.) By early September the dollar appeared once again to have stabilized; but from end-May to end-August, the U.S. currency had appreciated by 7.9 percent against the mark and by 7.2 percent against the yen, despite forceful intervention efforts by the Federal Reserve and foreign central banks.

5.5.3 How Effective Has Intervention Been?

International currency experience since 1985 lends little support to the idea that sterilized intervention has been an important determinant of exchange rates. Anecdotal as well as econometric evidence suggests that intervention has been useful as a device for signaling to exchange markets official views on currency values. The signals sent by intervention have been effective, however, only when they have been backed up by the prompt adjustment of monetary policies, or when events such as unexpected trade balance news have coincidentally altered market sentiment. Concerted intervention operations have naturally been the most convincing, since international agreement on exchange rate objectives ensures that national authorities will not act at cross-purposes, as they did around the end of 1986.

Except possibly in 1987 and 1988, the scale of intervention was simply too small to have had significant portfolio effects. Between the Plaza Agreement on September 22 and the end of October 1985, the G-10 countries as a group sold around $7 billion in the market, hardly enough to make a major difference to global asset supplies.[41] The Plaza Agreement seems, however, to have sent an important signal that derived some of its credibility from the rapid progress of protectionist legislation through the U.S. Congress. Despite the dollar's fall, protectionist pressures remained strong over the next three years, and these may have *reduced* the credibility of later attempts to stabilize exchange rates in the face of slow trade balance adjustment.

Intervention totals for 1987–88 are much higher than for 1985 or 1986, but even so, the intervention provided at best a partial brake on exchange market pressures. Germany's official external asset acquisitions in 1987 were DM 41.2 billion (table 5.6), equal to roughly one-third of its year-end currency stock. Most of this reserve inflow was sterilized through domestic open market operations, however, and Germany's stock of high-powered central bank

money rose by only DM 15.5 billion in 1987. In 1986, when reserve inflows were much lower, central bank money rose by DM 13.1 billion. How large were the effects of this DM 41.2 billion inflow on the supply of mark-denominated bonds? The IMF estimates that the net stock of German general government debt was 21.8 percent of GNP, or DM 440.4 billion, in 1987. The year's reserve inflow thus represented 9.4 percent of Germany's net public debt—a large number, but not large enough to prevent a sharp mark appreciation against the dollar.[42] It is doubtful that sterilized interventions on this scale could be the norm in a viable target-zone system. As noted above, the interventions had an adverse effect on Germany's public finances serious enough to spark political debate.

Japan, too, sterilized much of the massive reserve inflow it experienced as a result of its own 1987 interventions. Foreign assets of the Japanese monetary authorities increased by ¥ 5.1 trillion in that year, yet high-powered money rose by only ¥ 2.8 trillion, compared with a rise of ¥ 2.4 trillion in 1986.[43] IMF estimates put Japan's 1987 net general government debt at 21.7 percent of GNP, or ¥ 74.8 trillion.[44] So Japan's ¥ 5.1 trillion 1987 reserve increase amounted to 6.8 percent of the net public debt. (And this figure understates the effect on yen-denominated asset supplies because it includes yen capital losses on official Japanese foreign reserves, suffered as a result of the dollar's 1987 depreciation.) Although too large and costly to become a way of life for the Japanese government, the intervention of 1987 still did not prevent a substantial yen appreciation over the course of that year.

Shifting fiscal trends contributed to the dollar's fall from its peak of early 1985, but it is monetary policy that has been the more important instrument of medium-term exchange rate management. On several occasions, officials chose to adjust their exchange rate objectives in the face of market pressure, rather than compromise domestic policy goals. Substantial departures from internationally agreed exchange rate targets occurred, in spite of heavy intervention, in the three months after the Louvre Accord, in the three months following the October 1987 stock market crash, and in the summer of 1988.

Outcomes such as those described above could occur in a world where the portfolio effects of sterilized intervention are very potent: it is at least a logical possibility that the mark and yen would have appreciated far more against the dollar than they did in 1987 had the massive interventions of that year not been carried out. To settle the question definitively, economists would need a generally acceptable structural exchange rate model in which a counterfactual scenario with no intervention could be simulated. After many fruitless attempts to pin down econometrically significant portfolio effects due to intervention, however, it seems more reasonable to take governments' repeated failures to keep exchange rates within agreed ranges at face value: portfolio effects either are absent or are so small and uncertain that only unacceptably high intervention levels would have succeeded in maintaining exchange rate targets.[45] The limited econometric evidence on the most recent experience

appears to support this face-value interpretation. For example, Humpage's (1988) study of daily data on intervention and exchange rates concludes that "frequent or otherwise systematic intervention that does not provide new information to the market will not affect exchange rates," and that beyond any signaling effect, "exchange-market intervention has no apparent influence on day-to-day exchange-rate movements" (15).

With a reliably significant and sustained portfolio effect on exchange markets, sterilized intervention could ease international policy cooperation by giving each country an additional policy instrument that might help it attain external as well as internal targets. In the absence of this additional instrument, however, authorities inevitably encounter dilemmas as a result of attempts to gear monetary policy to exchange rate stabilization alone. A nominal exchange rate fixed by monetary means provides an efficient automatic offset to purely monetary disturbances, but a monetary policy that steadies the nominal exchange rate when real exchange rate adjustment is still necessary can be counterproductive. It causes some combination of unnecessary deflation at home and inflation abroad when a real depreciation of home currency is needed, and it causes some combination of unnecessary inflation at home and deflation abroad when real appreciation is needed.[46] The "black Monday" of October 1987 has often been attributed to fears that the Federal Reserve would raise interest rates further to keep the dollar within its Louvre limits, despite the apparent incompatibility of the prevailing real exchange rate with external balance.[47] Had the Federal Reserve taken this course, the real dollar depreciation that occurred after the stock-market crash would have been brought about, not by a relatively painless fall in the dollar's nominal value, but by a recession originating in the United States.

Appendix

The following data were used in the econometric work of section 5.3 and in constructing figures 5.1–5.5.

Nominal interest rates (R, R^*): Three-month Eurocurrency rates, observed at month's end, from Data Resources, Inc. (DRI).

Spot exchange rates (S): End-of-month observations from OECD, *Main Economic Indicators,* various issues.

Real per capita U.S. consumption (c) and price level (P): Separate seasonally unadjusted series on nominal consumption of services and of nondurables were deflated by seasonally unadjusted price indexes for consumption of services and of nondurables, then divided by seasonally unadjusted data on the civilian noninstitutional population of the United States. The resulting per capita real consumption data were deseasonalized by log-linear

regression. Population data from *Economic Report of the President,* February 1988, and from U.S. Department of Labor, Bureau of Labor Statistics, *Employment and Earnings.* Consumption and price data from DRI.

Notes

1. See "Report of the Deputies: The Functioning of the International Monetary System," Supplement on the Group of Ten Deputies' Report, *IMF Survey* (July 1985): 2–14.

2. The Group of Five (G-5) countries are France, the Federal Republic of Germany, Japan, the United Kingdom, and the United States. The Group of Seven (G-7) consists of the G-5 plus Canada and Italy; the Group of Ten (G-10), of the G-7 plus Belgium, the Netherlands, and Sweden.

3. A recent survey of research on sterilized intervention is found in Weber (1986). The conclusions of Federal Reserve participants in the Versailles Working Group are summarized by Henderson and Sampson (1983).

4. Throughout this paper, a currency is said, synonymously, to appreciate, rise, strengthen, or increase in value against a foreign currency when its price in terms of the foreign currency rises. When that price falls, the currency is said to depreciate, fall, weaken, or decline in value against the foreign currency.

5. IMF, *World Economic Outlook* (April 1989): table A31.

6. The cited changes are based on end-of-month exchange rates, expressed as dollars per foreign currency unit. Between December 1978 and August 1985, the U.S. price level had risen by a greater percentage than Japan's or Germany's had, so even a complete reversal of the nominal exchange rate movements up to February 1985 would not have restored the *real* exchange rates prevailing at the period's start.

7. The dollar's September surge is not visible in the end-of-month data plotted in figures 5.1 and 5.2.

8. See "Group of Seven Countries Agrees to Intensify Policy Coordination," *IMF Survey* (11 January 1988): 8–10; and "Ministers Stress Exchange Rate Stability, Oppose Global Debt-Forgiveness Plans," *IMF Survey* (18 April 1988): 116. Earlier communiqués are reproduced in full in Funabashi (1988).

9. The important role of trade balance reports in explaining recent exchange rate behavior does not contradict the asset market theory of exchange rates. It is *unanticipated* trade balance movements and trade balance data *revisions* that have had the greatest effects on currencies because such surprises change market assessments of the long-run real and nominal exchange rates consistent with external balance. For a formal model, see Mussa (1979). The effects on current exchange rates of shifts in expected long-run equilibrium exchange rates often are amplified by anticipated policy responses to the news. For example, a market belief that the Federal Reserve is likely to ease monetary policy following an unexpectedly negative trade balance report increases the dollar's tendency to depreciate immediately afterward.

10. See, for example, Dornbusch (1976). In Dornbusch's model, monetary expansion could cause an immediate *rise* in the short-term nominal interest rate if output were to respond immediately and strongly to monetary expansion. This possibility does not seem very relevant to the three main industrial countries. Central bankers seem confident of their ability to lower short-term interest rates in the short run, and some formal econometric tests (such as tests based on money announcements) support their view.

11. See IMF, *World Economic Outlook* (April 1988): 63, chart 19.

12. Volcker's February 20, 1985, testimony before the Senate Committee on Banking, Housing, and Urban Affairs is reproduced in *Federal Reserve Bulletin* 71 (April 1985): 211–21.

13. See "Treasury and Federal Reserve Foreign Exchange Operations: Interim Report," *Federal Reserve Bulletin* 72 (February 1986): 110.

14. Funabashi (1988, 274–75).

15. Funabashi (1988, 161–63) suggests that Japanese authorities manipulated the Tokyo foreign-exchange market to bring about the yen depreciation that occurred between the conclusion of the first Baker-Miyazawa deal in September 1986 and its announcement a month later.

16. IMF, *World Economic Outlook* (April 1988): 63, chart 19. The money growth rates cited in this paragraph are changes in annual averages (table A14, 125). Since the October 1987 stock market crash caused some easing of monetary policies, a measure of money growth more relevant for assessing the domestic policy impact of the Louvre Agreement may be the growth rate of money for the year ending in September 1987. (A year-long interval is chosen to correct for money-supply seasonality.) From end-September 1986 through the same time in 1987, growth rates of Japan's monetary aggregates and of German M1 are not very different from the figures cited; growth of German M3 is 6.4 percent, which is, however, higher than the upper limit for 1988 M3 growth (6 percent) set by the Bundesbank in January of that year.

17. Domestic demand is the sum of domestic consumption and investment demand, both private and public. Domestic demand growth rather than output growth is reported because the former variable is a more direct measure of pressure on the exchange rate. In the Mundell-Fleming model, for example, an increase in domestic demand can cause the home currency to appreciate even though output does not change. (See Mundell 1968; a more recent analytical discussion of the effects of demand factors on real and nominal exchange rates is in Obstfeld 1985.) The movements in government deficits reported above, though not cyclically or inflation adjusted, are broadly consistent (in recent years) with changes in the IMF's fiscal impulse measures.

18. Central bank net worth is ignored for simplicity of exposition. See Adams and Henderson (1983) for a more detailed discussion of intervention practices. Kenen (1988, ch. 5) discusses some asymmetries in current intervention arrangements.

19. My discussion draws a perhaps artificially sharp distinction between "money" and "bonds," and lumps all interest-bearing assets together under the latter category. As a practical matter, financial authorities have available a rich menu of financial operations, across liquidity categories, maturities, and currencies. I judge an intervention to be sterilized when it has no effect on the monetary base, defined as the stock of reservable central bank liabilities, including currency; and I exclude from the definition of "bonds" any interest-bearing reserves of the domestic banking system held at the central bank.

20. I leave maturity issues aside for the purpose of this example.

21. For simplicity, this example has abstracted entirely from interest payments. Of course, the intervention's effects would be reversed entirely if the Bank of France went to the open market to purchase the needed marks with high-powered francs.

22. Pure intervention has no effect on exchange rates in a Ricardian setting for the same reason that private firms' decisions on the currency of denomination of their borrowing may have no effect. (See Froot, ch. 8 in this volume.) Stockman (1979) and Obstfeld (1982) discuss the relation between Ricardian equivalence and intervention effects. As illustrated in those papers, and as stressed more recently by Backus and Kehoe (1989), the analysis of intervention cannot be conducted independently of an analysis of the resulting effects on the government's intertemporal budget constraint.

Thus, if pure intervention disturbs asset market equilibrium because taxes are distorting, the effect of intervention would depend heavily on which taxes (if any) need to be adjusted afterward to ensure government solvency. In principle, it is easy to imagine that a given intervention could have a wide variety of effects, depending on how its budgetary impact is accommodated. (The same point naturally applies to the evaluation of any other policy.) Section 5.4 below discusses the linkage between intervention and government budget constraints from the perspective of policy credibility.

23. Engel and Flood (1985, 314) argue that "certain types of sterilized intervention can be effective in temporarily altering exchange rates, even in the presence of uncovered interest parity." They give as an example a (nonsterilized) sale of foreign bonds by the central bank, accompanied by a temporary rise in monetary transfer payments that holds the money supply constant and simultaneously raises private net wealth at the initial money price level. A key feature of this policy package is, however, the *fiscal policy* change that accompanies the central bank's foreign-exchange intervention. It is not surprising that a fiscal change accompanied by a nonsterilized intervention disturbs equilibrium, even when the money supply remains constant as a result of the combined policy actions.

24. The implication of Ricardian equivalence, that the government does not change outside asset supplies when it conducts sterilized intervention, has already been mentioned. Backus and Kehoe (1989), in a non-Ricardian model with risk-averse investors, present other examples of sterilized interventions that have no effects. Suppose that the dollar-mark rate will be $\$S(\omega)$ per mark next period if the state of nature ω occurs, and imagine two bonds with respective payoffs of DM 1 and $\$S(\omega)$ in state ω, and with a common payoff of zero in other states. These securities are perfect substitutes because they have the same payoff in every state of nature; intervention operations that change their relative supplies thus have no effects, in spite of the fact that the bonds' face values differ in currency of denomination. Backus and Kehoe present further examples, all of which involve operations in securities which are perfect substitutes (despite private risk aversion) because of their identical state-contingent payoffs. These examples are of limited practical relevance for evaluating sterilized intervention, since the securities traded in reality do not have identical payoffs across states of nature, and therefore are not generally perfect substitutes for investors.

25. The work just reviewed relies on some version of the ARCH specification proposed by Engle (1982) to model time variation in covariances. Pagan and Hong (1988) question the adequacy of the ARCH specification on empirical grounds.

26. See Hodrick (1987) for a derivation.

27. Consumption of durables is not considered in the tests for reasons outlined by Grossman and Laroque (1990). Because of the deseasonalization I performed in constructing the consumption-adjusted depreciation series used in table 5.3, the reported standard errors are subject to a (hopefully minor) asymptotic inconsistency. See the appendix for a description of the seasonal adjustment procedure used.

28. For some additional negative evidence, see Kaminsky and Peruga (1987).

29. Froot and Frankel (1989) suggest this as one possible explanation (among others) for the results of their study of survey data on exchange rate expectations.

30. One type of econometric problem, which arises when large infrequent interventions can disturb the data-generating process, is the "peso problem." (See Lewis 1988 and Obstfeld 1989b for discussions.) Peso problems are clearly of potential relevance in analyzing recent exchange market data.

31. Dominguez shows that in the period from the Federal Reserve's monetary-targeting shift in October 1979 until the following spring, there is a significant positive relationship between money surprises (defined as Federal Reserve money announcements less Money Market Survey forecasts) and official U.S. purchases of foreign currencies carried out in the interval between forecast and announcement. Her

interpretation is that the Federal Reserve used intervention to signal information about monetary policy not reflected in the prior market forecast.

32. The intervention does raise Germany's monetary base by DM 10 million (assuming the Bundesbank doesn't sterilize), but the currency composition of the Bundesbank's balance sheet is not changed.

33. Backus and Kehoe (1989) also mention the possible strategic effects of sterilized intervention, but do not suggest a particular model. Bohn's account stresses that a nationalistic government will be motivated not only by its own budgetary needs but by its potential ability to alter the net real foreign asset position of the domestic *private* sector. For example, if domestic nationals have a net foreign debt denominated in home currency, the government has an added incentive to inflate. The welfare effects of policy-induced wealth redistributions from foreigners to domestic residents are likely to be large compared with the costs of tax distortions (which determine the welfare value of wealth transfers from the domestic public to the government). If bonds are perfect substitutes, however, individual portfolio composition is indeterminate in equilibrium, as is the direction of the wealth redistribution associated with an exchange rate change. In this setting, the government might well lack sufficient information to calculate the effect on net foreign wealth various actions. Even if U.S. Treasury bonds were initially placed with Japanese investors, say, there is nothing to prevent the original buyers from quickly selling the bonds to Americans in the secondary market and investing the proceeds in, say, sterling. Watson et al. (1986, 39) note that "it is not possible to obtain information on the ownership of new or outstanding international bonds."

34. *Federal Reserve Bulletin* (January 1986): 17.

35. The coverage of table 5.6 is potentially broader than that of table 5.5 because table 5.5 excludes foreign assets other than those classified by the IMF as foreign-exchange reserves, for example, SDRs and the IMF reserve position. Notice that the capital gains reported in table 5.6 are changes in the mark (not dollar) value of reserves; in some quarters, these data measure capital gains inexactly because they include SDR allocations.

36. See *Monthly Report of the Deutsche Bundesbank* (December 1986): table I.3.

37. On Bundesbank dollar purchases over 1986, see *Report of the Deutsche Bundesbank for the Year 1987,* 29.

38. *Report of the Deutsche Bundesbank for the Year 1986,* 63.

39. The U.S. intervention, however, amounted to a mere $50 million in yen sold on January 28, 1987 (*Federal Reserve Bulletin* [May 1987]: 333). This intervention was intended to underscore the second Baker-Miyazawa statement, issued January 21 (see above).

40. See *Federal Reserve Bulletin* (July 1987): 553–55.

41. See *Federal Reserve Bulletin* (February 1986): 112. As noted earlier, this figure may overstate the true extent of intervention because it omits such factors as interest earnings on dollar reserves. Feldstein (1986) argues that the intervention that followed the Plaza Agreement had little effect on exchange rates.

42. See *Monthly Report of the Deutsche Bundesbank* (April 1989): table I.3; IMF, *World Economic Outlook* (April 1989): table 22. To assess the intervention's effect on relative bond supplies, the entire foreign reserve inflow (and not just the sterilized portion) is counted as an addition to the stock of outstanding mark debt, because monetary-base growth not brought about by foreign asset purchases would otherwise have been brought about by purchases of mark assets.

43. See IMF, *International Financial Statistics* (October 1988), lines 11 and 14. As noted below, the dollar depreciated over 1987, so the ¥ 5.1 billion figure understates the expansionary pressure on Japan's money supply: it includes the negative effect of

capital losses on official dollar reserves measured in yen. Such capital losses do not directly reduce the high-powered money supply.

44. See IMF, *World Economic Outlook* (April 1989): table 22.

45. If intervention has some small but reliable portfolio effect, why don't governments exploit it to the maximum extent to hit exchange rate targets? In principle, nothing prevents governments from taking unlimited open positions in foreign exchange. Surely part of the answer is that governments themselves regard the effects of intervention as being unreliable. If a government is not confident that it can control the exchange rate by intervening, a large open foreign-exchange position would seriously restrict other macroeconomic policy choices by placing budgetary stability at risk. In addition, governments wish to keep the option of changing exchange rate targets.

46. The responses of alternative exchange rate regimes to various shocks are analyzed in Obstfeld (1985). Controls on cross-border capital movements are a possible way out of the dilemma of instrument insufficiency, but it is fanciful to think that a reversal of the trend toward more global financial markets is fully enforceable or, at the moment, politically feasible.

47. See, for example, Feldstein (1988).

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Comment J. S. Flemming

Maurice Obstfeld's survey is thorough in its treatment of intervention by the G-3 countries, and in its discussion of their changing attitudes toward intervention during the period since the Versailles Summit of June 1982—from which the Jurgensen group emerged. He looks at the theory of and econometric tests of effectiveness, as well as at the historical narrative, and concludes that (sterilized) intervention is not a very effective supplement to monetary and fiscal policies affecting exchange rates—a judicious conclusion from which I would not wish to dissent. I do however have six comments.

1. In section 5.2.1 attention is drawn to the fact that, although in September 1986 G-7 finance ministers saw no need for "further significant exchange rate adjustment," within six months the dollar had fallen 5–15 percent.

One strand running through the whole process of bringing the dollar down to earth has been a disjunction between the implication of ex ante statements ("the present rate is about right") and action when the rate changes (very little)

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and satisfaction is again expressed at the new level. Despite all the talk of credible commitment to published (monetary) targets, the aim seems to be to prevent interest rate differentials reflecting exchange adjustments which are (at least with hindsight) recognized as (having been) necessary.

Given the implications for the U.S. bond market of the interest rate rise required in early 1985, had the subsequent decline in the dollar been anticipated, ambivalence may have been warranted. The strategy was certainly successful; as time passes, however, one would expect the trick to be more difficult to repeat and the attempt to be perceived to become more costly.

2. In his discussion of sterilization, Obstfeld refers to the sharpness of the distinction between "money" and "bonds," where the latter includes all interest-bearing assets. In the first half of the period under review, we in the United Kingdom used a technique of debt management to control a broad monetary aggregate (including interest-bearing ["bond"?] elements) which almost certainly worked by twisting the yield curve. We had a great deal of inconclusive discussion of the exchange rate effect of this policy of "overfunding." Could one say something about the differing degrees of substitutability at different maturities and infer from that the direction of exchange rate pressure generated by the policy?

3. Obstfeld mentions the possibility of bonds in different currencies being perfect substitutes. That would imply not only that overfunding did not affect the exchange rate but also that it could not have affected the growth of the money supply either—which is rejected by our evidence.

In any case, I find the hypothesis profoundly unattractive for its implications that portfolios of a heterogeneous population will typically be undiversified and liable to jump from one corner to another.

4. As far as models of this area are concerned, Obstfeld mentions the failure of the consumption-based CAPM, despite its theoretical attractions. There are a number of possible reasons for this. A paper by Attanasio and Weber (UCL 87–33) suggests that the use of aggregate rather than cohort consumption data may be to blame.

5. Obstfeld discusses at some length a rational signaling effect related to the effects of the portfolio shift of sterilized intervention on the cost to the authorities of subsequent exchange rate changes. This is ingenious stuff but not, I think, very convincing especially given the secrecy of most central banks about their operations and the untimeliness and obscurity of most of their accounting statements. The restriction to fully rational models precludes another role, related to that of signaling, which is dear to the hearts of many central bankers.

The failure of economists to model exchange rates, the remarkable performance of the random-walk model (see Charles Goodhart's 1987 inaugural lecture) the extent of chartist influence on traders, and the documented failure of traders to follow the advice even of in-house economists, together with the observed volatility of exchange rates, all suggest the possibility of "giving the

market a lead." With no other rocks to cling to, might evidence that the authorities were prepared to "defend" a rate increase its plausibility in market eyes at least when the chosen rate fell within the zone of the market's apparent indeterminacy? The testing of this suggestion is made more difficult by the tendency of authorities to attempt from time to time to defend the indefensible.

6. Although I have said that I would not dissent from Obstfeld's conclusion about the effectiveness of intervention, I am less happy with his apparent rejection of any kind of nominal exchange rate targeting when real exchange rate adjustment is necessary. In an economy with a rapidly changing financial structure, velocity of any monetary aggregate may become even less stable than PPP-type relationships. Nominal exchange rate targets or management do not mean fixity. Other people's inflation rates (at least in the aggregate) are fairly easy to forecast. Thus a target path for the domestic price level can be combined with a target path for the real exchange rate and converted into a target path for the nominal rate. Nor do I believe that confusion on these issues could account for the stock market crash of last October. The incompatibility of prevailing rates with prevailing hopes meant something had to give—but not that it had to be, or naturally could be, resolved by a crash.

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Comment Hans Genberg

Obstfeld's paper reviews and reexamines the evidence on the effectiveness of official interventions in the foreign-exchange markets that has become available since the 1983 study of the Versailles Working Group. The rationale for the undertaking is that we have observed such interventions on a much larger scale in the past four to five years than before. Therefore, recent data ought to be particularly useful for detecting any exchange rate response to these interventions.

The main points of the paper can be summarized by four statements: First, based on a review of exchange rate behavior and macroeconomic policy since late 1984, the conclusion is reached that the major movements in exchange rates since that time can be explained by economic fundamentals. Second, an examination of the available empirical evidence suggests that sterilized interventions do not influence exchange rate movements, at least as far as

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channels that operate via portfolio-balance effects are concerned. Third, data show that interventions have been large and frequent in recent years, and that most of them have been sterilized. Fourth, the fact that substantial amounts of foreign exchange have been used for sterilized intervention in spite of the evidence that such interventions have no effect on the exchange rate represents a puzzle. Assuming that governments also believe that interventions do not influence exchange rates, why do they engage in them? Obstfeld suggests that one possibility might be that interventions operate via signaling effects rather than through portfolio-balance channels.

As this brief synopsis suggests, the paper contains a nice blend of factual information (about exchange rate movements, interventions in the foreign-exchange markets, and macroeconomic policies in general), theory, and empirical evidence. I have no major disagreement with Obstfeld about his interpretation of the facts or of the empirical evidence, nor about the theoretical possibility of signaling effects. In my comments I will first elaborate on the points raised in the paper. I then raise some doubts about the desirability of using intervention and exchange rate announcements as a way to signal other policy changes. I conclude by arguing that we do not yet seem to have a satisfactory explanation of why central banks engage in sterilized interventions in view of the evidence showing that they are largely ineffective as an instrument for exchange rate management. Before proceeding I would like to draw attention to the fact that Obstfeld tells a convincing story about exchange rate movements since 1984 based on the evolution of monetary and fiscal policies. There is no need to refer to such elusive concepts as unwinding of speculative bubbles, and consequently one common argument for exchange rate targeting as a policy goal is undermined.

The data presented in figure 5.5 of the paper indicate why econometric evidence on the effectiveness of sterilized interventions is not likely to detect any links between exchange rate movements and relative asset stocks as in the portfolio-balance models. These data show that ex post yield differentials can be as large as 10–15 percentage points on a quarterly basis (mainly due to exchange rate effects). Suppose that the portfolio-balance model were correct in predicting that changes in asset stocks resulting from sterilized interventions do require changes in ex ante yields. Suppose further that, for the modification in asset stocks actually achieved by interventions, the required variation in yields is on the order of 2–3 percentage points on an annual basis. In this case one should not expect interventions to be able to account for more than between 2 and 5 percent of observed ex post yield differentials. Other sources of exchange rate fluctuations are evidently so large that they swamp any reasonable portfolio-balance effects of sterilized interventions.

Why then do central banks engage in these types of interventions to such a large extent? Obstfeld suggests one possibility, namely that the authorities use interventions as a signal of future changes in monetary, fiscal, and trade policies that ultimately will move the exchange rate in the desired direction. Currencies will reflect the information contained in the signals immediately as

market participants act on these signals. A number of questions are raised by this view of the role of interventions: Why, for instance, is a mere statement of the reorientation of the fundamental policies not sufficient to provide the signal? Also, does signaling intervention provide an extra policy instrument, and is signaling a reliable way to influence markets?

To deal with some of these questions, Obstfeld outlines a theory that is basically a version of the "putting the money where your mouth is" argument. By buying foreign assets to prevent an appreciation of the domestic currency, the central bank creates incentives for itself to pursue monetary and fiscal policies that are consistent with the intervention. The reason is that such policies would prevent capital losses on the acquired foreign assets. But creating the incentive to pursue a specific set of policies is presumably not enough. It is also necessary actually to carry out these policies. Otherwise the effect of the initial announcement is reversed and the credibility of future announcements endangered. So to be effective, an announced exchange rate target must be followed by the required adjustment in economic policies. Intervening in the foreign-exchange market to bolster credibility does not alter this fact. As already noted, such intervention "only" makes it costlier (in terms of capital losses on foreign-exchange holdings) for central banks to deviate from the required policies. But as table 5.6 in the paper illustrates, central banks appear not to be greatly influenced by such incentives since they seem to have lost substantial amounts of money on their intervention activities. The quantitative importance of the incentive effects of interventions is thus questionable.

What this discussion shows me is, first of all, that signals by means of policy announcements and interventions in the foreign-exchange market are no substitutes for genuine changes in economic policies. There are no additional degrees of freedom to be had this way. Furthermore, it is questionable how much additional mileage the authorities can get from interventions compared with straightforward policy announcements relating to basic macroeconomic policies. Add to this the danger that signals stated in terms of desired exchange rate movements are not always easy to interpret and may therefore constitute a source of uncertainty in the economy, and we end up, in my judgement, with a rather weak case for the use of sterilized interventions as a tool for exchange rate management.

If this assessment is correct, the question remains why there has been so much sterilized intervention in the foreign-exchange markets. I can think of two possible reasons, neither of which is entirely satisfactory. One is that the authorities are really concerned only with very short term exchange rate fluctuations, and that interventions do have an effect on these. The main problem with this explanation is that governments have not provided a rationale for adopting such a short-term perspective.

The other reason is that governments want to be seen as "doing something" about exchange rate misalignments and volatility, but they are unwilling to alter underlying policies. Interventions in the foreign-exchange market constitute a placebo for public opinion. The difficulty here, of course, is that the private sector may not be fooled indefinitely by such a placebo.

This then leaves me with the impression that we do not yet have an entirely satisfactory explanation for the reasons behind central banks' interventions in the foreign-exchange markets. Obstfeld's thorough and comprehensive paper has provided a definitive assessment of the effects of interventions. A further analysis of the reasons that motivate governments to conduct these policies should be next on the research agenda in this field.

Comment

Shuntaro Namba

We have experienced dramatic volatility in foreign-exchange markets especially after the so-called Plaza Agreement. On the other hand, the importance of international policy coordination among the major industrialized countries has been reaffirmed and put into practice. Under these circumstances, Professor Maurice Obstfeld's paper is a valuable attempt to evaluate the recent effects of foreign-exchange intervention.

The paper is well-balanced in its contents, containing both theoretical analyses and detailed case studies based upon recent developments in the foreign-exchange market. Also, it is an excellent survey, summarizing the theoretical and empirical studies on the effectiveness of intervention.

I would like to note one important point first. The effects of a certain limited amount of foreign-exchange intervention will depend largely on the outstanding net asset holdings of the private sector and their currency composition. For example, it is a well-known fact that large-scale current account imbalance has been persistent between the United States and Japan at present. As a result, the outstanding net asset holdings of the private sector have also been subject to change in their value and contents. In order empirically to evaluate the effects of intervention, we need to pay the closest attention to this aspect.

Fundamental Views on Intervention

The most significant finding of Obstfeld's paper—one based both on empirical analyses and on recent experience—is summarized in section 5.1 as follows: "The conclusion reached is that monetary and fiscal policies, and not intervention per se, have been the main policy determinants of exchange rates in recent years."

This is harmonious with our view of intervention as a policy measure. We recognize that intervention is a measure which can be flexibly adopted to prevent erratic movements in the exchange rate caused by abrupt changes of market sentiments, without committing ourselves to set certain market levels.

According to our knowledge of economic theories, real foreign-exchange rates can be determined by the following four factors: (1) the purchasing power

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parity based on relative price levels among countries; (2) real interest rate differentials; (3) risk premiums based on accumulated current account imbalances or other related factors; and (4) market expectations.

Monetary and fiscal policy management will influence these four factors. On the other hand, effects that are drawn only from sterilized intervention are not clear, or else are rather limited.

Consequently, we aim at preventing excessive volatility in foreign-exchange markets by controlling the market determinants, especially real interest differentials and accumulated current account imbalances, through internationally coordinated monetary and fiscal policy management.

Effects of Intervention

In Obstfeld's paper, the effects of intervention are evaluated as follows: nonsterilized interventions are regarded as effective, while according to empirical analyses, sterilized interventions have limited effect. Obstfeld states "the portfolio effects of pure intervention have generally been elusive enough that intervention cannot be regarded as a macroeconomic policy tool in its own right" (sec. 5.1).

When interventions are nonsterilized, for example in cases when the Japanese monetary authority buys dollars and sells yen, high-powered money in the economy will increase, reflecting the rise in foreign reserves; this increase will then result in lower interest rates and an expanded money supply. Therefore, in addition to the rise in dollar demand due to interventions, lower interest rates and deteriorating balances of payments caused by easier monetary conditions will eventually cause high dollar/low yen ratios.

The effectiveness of nonsterilized intervention is broadly recognized in academic circles, and we also support this view. However, I would like to add another point: we cannot be certain in advance whether or not the intervention is going to be sterilized. For example, in the case of a policy of intervention in buying the dollar, we determine the volume of money which should be absorbed in the money market in consideration of the overall monetary situation. In other words, we cannot conduct monetary policy presupposing the effectiveness of the nonsterilized intervention.

A sterilized intervention can work effectively through the following two channels: (1) if it changes the amount of foreign-currency–denominated bonds and of home-currency–denominated bonds, and then changes risk premiums arising from foreign-exchange volatility; and (2) if it influences market participants' expectations.

Generally, the effectiveness of sterilized interventions depends largely on the conditions of the foreign-exchange market. Two aspects of those market conditions are considered below.

Substitutability between Domestic-Currency– and Foreign-Currency–Denominated Assets

How many changes in the foreign-exchange rate are needed to absorb changes in the private sector's foreign-currency–denominated positions? If the

market is risk neutral and the substitutability of assets between currencies is perfect, then the risk premium will be zero. In that case, changes in foreign-currency–denominated positions will be absorbed in the market without affecting the foreign-exchange rate (therefore, the first channel for a sterilized intervention does not work).

On the other hand, if the market is risk-averse and the substitutability between domestic and foreign currencies is not perfect, changes in foreign-currency positions will result in an increase or decrease in risk premiums. These changes cannot be absorbed without changes in the foreign-exchange rate (so, the first channel does work).

Market Efficiency

Do the foreign-exchange rates effectively reflect various sources of market information, such as interest rates, rates of inflation, price levels, balances of payments, and each government's policy stance?

If the market is completely efficient, official interventions cannot change investors' expectations since investors are already well informed about the market (therefore, the second channel does not work).

So, intervention will be perfectly ineffective when (a) the substitutability between foreign-currency– and home-currency–denominated assets is perfect and (b) the market is completely efficient at the same time. However, according to the various empirical analyses conducted to date, there seems to be some truth to the claim that the current foreign-exchange market is in no such condition. However, it is not clear whether this is because of the imperfectness of the substitutability between assets, or because of the inefficiency of the market.

In either case, we cannot determine a priori whether these two channels would work. Future developments of empirical studies in this field are awaited.

In section 5.3, Obstfeld also presents econometric analyses of the existence of risk premiums and discusses whether or not they can change. He summarizes: "There is a large body of evidence contradicting the hypothesis that ρ_t in equation (1) [the risk premium] is identically zero, or even constant over time."(sec. 5.3.2)

We confirmed through our econometric analyses that intervention can affect risk premiums and that, consequently, sterilized interventions can have some effect. At the same time, however, we get the result that the effects of a certain limited amount of intervention are decreasing recently (see below).

In section 5.4, Obstfeld indicates that sterilized intervention can affect the foreign-exchange market through the so-called "signaling effect," through which information on future policy stances of the monetary authority is conveyed.

Obstfeld also points out that sterilized intervention has the signaling effect since markets can learn from the monetary authority's move to avoid the estimated loss in its foreign-currency–denominated assets caused by exchange

rate fluctuations. This is quite an interesting point, since the idea is related to the "profitability criterion" concerning the effectiveness of intervention.

Concerted intervention is often regarded as more effective than unilateral intervention. One reason for this is that the monetary authorities of involved countries sometimes offer a kind of collateral as a pledge of exchange rate stability. Therefore, the signaling effects of concerted intervention have a higher credibility to the market than those of unilateral intervention.

Also, the foreign-exchange market is counted as the most efficient one among all financial markets as it fairly quickly reacts to all information on the policy stances of various governments and monetary authorities. So, in addition to the signaling effect that Obstfeld pointed out, I would like to add that an unanticipated intervention also plays an important role in conveying a signaling effect in a fairly efficient market.

Our Recent Econometric Result

Recently, Mitsuhiro Fukao, a member of the staff of our institute, estimated an equation of real foreign-exchange rates explained by real interest rate differentials between the United States and Japan and risk premium factors. The regression was conducted through the period from the first quarter of 1973 to the end of 1987.

$$e_t = \alpha + \beta_t (r_t^j - r_t^u) + \gamma_t (M^{jj}B_t^j + M^{jg}B_t^g) + \epsilon_t ,$$

where e_t is the real exchange rate of yen against the dollar (dollar/yen, indexed); r^j and r^u are the long-term real interest rates for Japan and the United States, respectively; M^{jj} is the variance for rates of change in yen-dollar real exchange rates as compared to the previous term (unchanged throughout the observed period); M^{jg} is the covariance between rates of change in yen-dollar real exchange rates and those in mark-dollar real exchange rates as compared to the previous term (unchanged throughout the observed period); B^j and B^g are accumulated current account imbalances for Japan and for the total of all EMS participant countries, respectively (standardized by the total of nominal GNP for major countries); α is a constant; β_t is the coefficient for real interest rates; and γ_t is the coefficient for accumulated current account imbalances.

This equation is basically the same as Obstfeld's equation (1). Here, γ_t $(M^{jj}B_t^j + M^{jg}B_t^g)$ is the risk premium. For this regression, Fukao used the Kalman filter which allows the coefficients β_t and γ_t to vary during the observed period.

The result of the estimation is as follows: while real interest rate coefficient (β_t) increased largely, risk premium coefficient (γ_t) has decreased but not reached zero in this regression period.

This reflects the financial globalization in which real interest rate differentials become as important as a real foreign-exchange determinant. Also the

effects of the change of the risk premium explained by the change in the external net asset are seen to have decreased.

From this empirical result, we can get the following implications concerning the effectiveness of sterilized intervention: risk premium factors are apparent ($\gamma_t \neq 0$); therefore, sterilized intervention can be effective to some degree. But the effects of sterilized intervention recently have been weakened.

According to our estimation, if an additional \$10 billion of sterilized intervention had been conducted, it would have changed the yen rate from the actual level by 7.7 percent in the fourth quarter of 1974 and by 1.7 percent in the last quarter of 1987.