IV

THE USE OF INTERVENTION TO ACHIEVE DESIRED CURRENCY VALUES

10

Intervention When Exchange Rate Misalignments Are Large

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Recent developments in the foreign exchange markets have once again put the issue of exchange rate stability at the center of the policy arena. The continued fall of the dollar since February 2002 has potentially serious consequences for growth and recovery in Europe and Japan. In addition, the record levels of intervention in the foreign exchange markets by the Japanese authorities in 2003 have once again raised the issue of the controversial effects of foreign exchange intervention.

In particular, the issue of the effectiveness of sterilized intervention tends to polarize both policymakers and researchers into one of two distinct camps: those who believe that such interventions in the foreign exchange market are, to all intents and purposes, ineffective in influencing exchange rate movement; and those who take the view that they can play a substantial role in exchange rate management. Indeed, this division of views regarding intervention's effectiveness is reflected in the frequency of its use by the Group of Three (G-3) monetary authorities. Whereas the Japanese Ministry of Finance has intervened both massively and frequently in the foreign exchange markets during the past decade, intervention by the US and European authorities has been relatively rare since the later half of the 1990s.

This chapter makes the case that sterilized intervention can be an effective tool for managing exchange rates, but with some qualifications. In particular, it proposes that sterilized intervention is most effective when used to limit exchange rate misalignments, when the intervention is strong, and when it is conducted to address large misalignments of the exchange rate.

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The first section reviews the causes and episodes of exchange rate misalignment, with a focus on the role of "chartist" or technical trading strategies by market participants who extrapolate exchange rate trends. The second section briefly examines the evidence regarding the effects of sterilized intervention, and it discusses the various channels by which it may have an effect. A particular focus is the idea that intervention may affect market participants' expectations of the future path of the exchange rate. The third section lays out the analytical framework used to make these ideas more concrete. A key feature is the theory that traders select between destabilizing and stabilizing strategies on the basis of the relative profitability of chartist techniques.

The chapter's fourth section describes the role intervention can play in coordinating traders to become a force for the stabilization of exchange rates. Essentially, this can be achieved because sterilized intervention directly affects the profitability of competing strategies. Furthermore, it is shown how the processes by which long swings in exchange rates emerge imply that intervention is most effective when misalignments are large. Evidence on the importance of this effect is presented for the yen-dollar exchange rate in the 1990s. The fifth section discusses the implications for exchange rate policy, with a focus on the potential benefits of regimes based on exchange rate bands. The sixth section draws conclusions.

Market Participants and Exchange Rate Misalignments

The key justification for undertaking any sort of intervention in the foreign exchange markets lies in the observation that exchange rates do not always reflect underlying economic conditions. More precisely, it is the tendency for floating exchange rates to suffer from prolonged misalignments, which can have serious economic consequences. The proximate cause of misalignments is the tendency of asset market participants to herd: to buy overvalued assets or sell undervalued ones.

This kind of behavior is particularly prevalent at short forecasting horizons. There is growing evidence from foreign exchange markets the world over that, at least for horizons shorter than one month, exchange rate forecasts are not dominated by underlying economic conditions.[1] Rather, at short horizons, traders place more weight on "chartist" or technical trading strategies that effectively extrapolate recent trends. In addition to simple charts of past exchange rate behavior, a technical analyst may use a variety of trading rules based on statistical and mathematical techniques. Popular examples

1. See, inter alia, Allen and Taylor (1990) and Taylor and Allen (1992) for studies of the London markets; Menkhoff (1997, 1998) for the German markets; Lui and Mole (1998) for the Hong Kong markets; Cheung and Wong (1999, 2000) for the Hong Kong, Tokyo, and Singapore markets; and Cheung and Chinn (1999) for the US markets.

include the "head and shoulders" reversal pattern, and a variety of moving-average rules for predicting turning points. However, a common feature of all the rules is that their use adds a positive feedback into the exchange rate, tending to accentuate deviations from the equilibrium level implied by economic fundamentals. Because most trading in the foreign exchange market involves taking and unwinding positions at hourly horizons rather than months or years, these findings have potentially serious implications.

There are a number of well-documented periods in recent years when severe exchange rate misalignments have developed. Perhaps the best known is that of the dollar bubble of the mid-1980s. In a series of papers, Jeffrey Frankel and Kenneth Froot (1986a, 1986b, 1987) showed how the behavior of the dollar in this period could be understood as a bubble caused by the actions of portfolio managers basing their forecasts on technical analysis rather than macroeconomic fundamentals.

This was not an isolated event, however. The long swings observed in the value of the yen in the 1990s are striking. In particular, the appreciation of the yen-dollar rate to 80 in April 1995 was widely thought of as inconsistent with economic fundamentals. Takatoshi Ito (2002) suggests that possible causes of this were technical forces, such as the use of knockout options and delta hedge strategies, as well as trade conflicts over the United States–Japan automobile dispute. In addition, the initial undervaluation of the euro was only loosely connected to underlying economic factors.

Can Sterilized Intervention Influence Exchange Rates?

While monetary policy clearly can be used to moderate any destabilizing market behavior, a country may be understandably unwilling to sacrifice its use for domestic objectives. As a result, monetary authorities typically sterilize intervention so that there is no net effect on the domestic money supply.[2] Such intervention can produce an effect if domestic and foreign assets are imperfect substitutes—in which case the change in the relative supply of domestic and foreign assets leads to a change in the risk premium on foreign assets demanded by investors.

Though direct evidence for this "portfolio balance channel" of intervention is somewhat mixed,[3] there is increasing evidence that intervention

2. The two standard views of the channels by which sterilized intervention can influence the exchange rate are the portfolio balance channel and the signaling channel. The portfolio balance channel refers to the theory that sterilized intervention can influence the exchange rate by changing the relative outside supplies of domestic and foreign assets (normally government bonds), and hence the risk premium.

3. While Dominguez and Frankel (1993) provide evidence in support of a portfolio balance effect, both Jurgenson (1983) and Edison (1993) conclude sterilized intervention did not have much effect on exchange rates.

can substantially affect the exchange rate, at least in the short run. In particular, Kathryn Dominguez and Jeffrey Frankel (1993) found strong evidence that sterilized interventions in the G-3 currencies were successful in the 1980s, while further evidence that intervention in the 1990s was effective is provided by Dominguez (2003). A recent study by Ito (2002) found evidence that the characteristically large interventions conducted by the Japanese authorities in the latter half of the 1990s were largely successful in achieving their aims. Further evidence on the effectiveness of Japanese interventions is given by Ramaswamy and Hossein (2000) and Fatum and Hutchinson (2003), among others.

A common finding is that intervention can be particularly effective when conducted in concert by the authorities on both sides of the market. Examples include the interventions following the Plaza Accord and the Louvre Accord in the mid-1980s, and concerted interventions by the US and Japanese authorities in 1995. For example, Ito (2002) finds that during the second half of the 1990s, joint US-Japanese interventions were much more effective than unilateral interventions by the Japanese authorities. He estimates that while unilateral interventions by the Japanese authorities of ¥100 billion moved the yen-dollar rate by 0.1 percent, cooperative interventions of approximately the same size moved the yen by 5 percent.

A number of studies, most notably Dominguez and Frankel (1993), have concluded that this increase in potency is even more pronounced when interventions are announced. That the announcement of intervention plays an important role in eliciting a response from the market suggests that the impact of intervention on expectations is important in maximizing their efficiency. In addition to the portfolio balance view, there are two ways by which intervention may affect exchange rates through market expectations. First, intervention may act as a signal of the future course of monetary policy, in which case it clearly cannot be used as an independent policy tool. Second, it may directly affect the importance investors give to technical analysis in forecasting exchange rate movements. Indeed, if the proximate cause of misalignments is the use of such rules by market participants, then an analysis of the effects of intervention on the choice of forecasting technique can demonstrate how the efficiency of intervention can be improved.

The Analytical Framework

The traditional portfolio balance view of the effects of sterilized intervention implicitly assumes intervention attempts to influence the *equilibrium* level of the exchange rate. However, the authorities typically intervene when they view the exchange rate to be undervalued or overvalued. Thus interventions are carried out with the intent of reducing current *misalignments*, or indeed excessive volatility.

The view that intervention is most potent when aimed at influencing market expectations is best seen in the light of the use of technical analysis by traders discussed in the previous section. In practice, policymakers seem to be well aware of this. Sushil Wadhwani (2000) notes that "under some circumstances, intervention can give the fundamentals-based traders greater confidence to initiate positions during overshoots. Alternatively, in an overextended market, intervention can sometimes directly affect the behavior of the momentum-based traders." Similarly, the descriptions given by Eisuke Sakakibara (2000) of his experiences directing intervention operations at the Japanese Ministry of Finance frequently refer to the goal of changing market sentiment.

Although many studies find that the effects of intervention are typically short-lived, this is not necessarily problematic when the goal is a shift in expectations. The analogy employed by Dominguez and Frankel (1993) for intervention emphasizes this nicely. They liken the role of intervention to the role of herd dogs among cattle. Clearly, a small number of dogs cannot always sustain control of the steers. So when a stampede gets under way because each panicked steer is following its neighbors, the herd can wander off quite far from its initially desired direction. However, the dogs can be helpful in a stampede because, by turning a few steers around, they might induce the herd to follow.

To pin down how exactly intervention can exert this kind of influence over markets, it is important to be clear about the processes underlying market participants' selection of forecasting strategy. If intervention is undertaken with the specific aim of inducing traders to switch from destabilizing technical rules to forecasts based on fundamentals, a theoretical underpinning is paramount. Recent work by De Grauwe and Grimaldi (2004) has highlighted how the foreign exchange market is well characterized by "behavioral finance models," drawing particularly on the work of Brock and Hommes (1997).

The implications of this kind of model for the functioning of sterilized intervention are examined in Kubelec (2004). In that paper, traders are modeled as either paying a fixed cost to purchase a rule based on macroeconomic fundamentals,[4] or simply extrapolating recent trends in the exchange rate by using a "chartist" or "technical" rule. As described in box 10.1, at each point in time, traders choose whether to put their money on the exchange rate moving further from fundamentals (i.e., using the "chartist rule"), or moving back toward fundamentals (i.e., using the "fun-

4. This cost represents the information gathering cost necessary to correctly forecast the level of the equilibrium exchange rate, and may by no means be insignificant. E.g., De Grauwe and Embrechts (1994) note that in a world where authorities are bound by few commitments the number of possible future paths of debt and money is increased. This is due both to the move toward floating exchange rates and also to the dramatic increase in international capital mobility allowing for a much wider range of debt financing options than before. The net effect is that correct forecasting of the equilibrium exchange rate is more difficult, and hence more costly.

Box 10.1 A model of traders' strategy choice

This box summarizes the model of traders' strategy choice detailed in Kubelec (2004). In each period, given the level of the last period's exchange rate s_{t-1}, traders are assumed to select between a generic "chartist" forecasting rule:

$$f_{chart,t} = gs_{t-1} \quad g > 1 \tag{10.1}$$

and a generic "fundamentalist" forecasting rule:

$$f_{fund,t} = vs_{t-1} \quad 0 < v < 1 \tag{10.2}$$

The model of strategy choice extends work by Brock and Hommes (1997), so that traders select their strategy on the basis of an evolutionary "fitness measure"—a weighted function of past realized profits and expected profits for each strategy. For example, the fitness of the fundamentalist strategy is given by

$$U_{fund,t} = (1 - \delta)\, \rho_t\, z_{fund,t-1} + \delta\, E_{fund,t}\, [\rho_{t+1}\, z_{fund,t}] - C_h \tag{10.3}$$

where ρ_t is the excess return on, and $z_{fund,t}$ the demand for, foreign bonds; and δ is an exogenous parameter, giving the weight traders place on the expected component of the fitness function. The term C_h represents the cost of purchasing each strategy, and for the chartist strategy is assumed to be zero, so that $C_{chart} = 0$, and $C_{fund} = c$. The utility gained from employing the fundamentalist strategy is given by its fitness, plus a double exponentially distributed error term that captures random shifts in preferences:

$$U_{fund,t} = U_{fund,t} + \varepsilon_t \tag{10.4}$$

As the number of traders in the market tends to infinity, the probability that traders choose the fundamentalist strategy is given by the discrete choice model:

$$\omega_{fund,t} = \{1 + \exp\,[\beta(U_{chart,t-1} - U_{fund,t-1})]\}^{-1} \tag{10.5}$$

The parameter β measures how sensitive traders are to differences in the profitability of each strategy. Using the fact that the excess return from holding foreign bonds at time t is given by

$$\rho_t = (i^*_{t-1} - i_{t-1}) + (s_t - s_{t-1}) \tag{10.6}$$

The relative fitness of the chartist strategy may be expressed in terms of deviations from the fundamental level of the exchange rate, x_t, as

$$U_{chart,t-1} - U_{fund,t-1} = \left[(1 - \delta)x_{t-1} - \frac{(1 + \delta)(1 + \alpha)}{\alpha}\, x_{t-2} + \delta(g + v)x_{t-3} - \theta\right] \frac{q}{a\sigma^2}\, x_{t-3} + c \tag{10.7}$$

where α is the interest elasticity of money demand; $q = g - v$; a and σ^2 capture investors' degree of risk aversion and the variance of asset returns, respectively; and θ is a function of the relative private holdings of domestic over foreign bonds. Equations 10.5 and 10.7 provide the theoretical underpinning for the estimated transition function, equation 10.9 in box 10.2.

damentalist rule") by considering both the past realized profits and the expected profits from each market view.

This kind of strategy choice can explain the long swings in exchange rates so commonly observed in the data. When close to fundamentals, the cost of accurate forecasting of the future path of macroeconomic variables that influence the exchange rate leads the bulk of traders to rely on chartist, or extrapolative, techniques. Following a small shock to the exchange rate, trend chasing by traders leads the exchange rate to move further and further from equilibrium. However, as the size of the misalignment increases, the *expected* profit from adopting a view of exchange rate correction to levels in line with fundamentals also increases. The upshot is that, as the degree of misalignment grows, an increasing proportion of the market begins to sell overvalued currencies. Eventually, the proportion of the market selling the currency becomes large enough to reverse its rise. Once this occurs, the remaining traders who buy into the view of the currency as continuing to appreciate start to lose money, causing them to begin to sell, which rapidly returns the currency to levels in keeping with fundamentals.

A key feature of this story is the view that whether traders are stabilizing or destabilizing depends primarily on the relative profitability of alternative strategies. It is this that allows the monetary authorities to use sterilized intervention to coordinate traders to stabilize the exchange rate. For example, consider the scenario of the Japanese authorities conducting sterilized sales of yen because they view the yen as overvalued relative to the dollar. If identical classes of Japanese and US assets are imperfect substitutes, a dollar-supporting sterilized intervention results in traders requiring an increase in the excess return on yen-denominated bonds in order to willingly hold the increased supply. In this case, the effect of the increase in excess return on yen bonds will be to hit the profits of those traders who had been betting that the overvaluation of the yen would extend still further.

In other words, because sterilized intervention changes the excess return on foreign bonds, it also affects the realized profits from investing in them. In this way, it can be used by the authorities to reduce the profitability of destabilizing forecasting strategies.

Evidence consistent with this effect is provided by Neely (2002). He examines the temporal pattern of trading rule returns and interventions for Australian, German, Swiss, and US intervention series. His study demonstrates that, particularly in the German, Swiss, and US cases, high trading rule returns precede intervention. He concludes that intervention and trading rule returns are correlated because intervention responds to the exchange rate trends from which the trading rules profit.

The key message is this: When traders choose between trend chasing and stabilizing forecasting rules on the basis of the profitability of competing strategies, the authorities can use sterilized intervention to coordinate traders to stabilize the exchange rate.

Intervention When Misalignments Are Large

The interplay between the stabilizing and destabilizing behavior of traders has strong implications for the efficiency of intervention when misalignments are large. As was described above, as the size of the misalignment grows, the increase in expected profits from selling the overvalued currency leads fewer and fewer traders to forecast that the misalignment of the exchange rate will persist. A direct result of this is that, when misalignments are large, the authorities need to turn fewer traders to the fundamentalist strategy to facilitate the exchange rate's return to equilibrium.

Alternatively, *interventions become more effective the greater the size of misalignment.* Intuitively, if the long swings in exchange rates are "endogenous," in the sense that they are a direct result of the behavior of market participants, then policies aimed at encouraging stabilizing speculation must become more effective further from equilibrium because they are reinforced by the markets' own tendency to correct extreme misalignments.

To provide empirical evidence on the importance of this effect, in Kubelec (2004) I estimate a reduced form of the model of the foreign exchange market described in the previous section. Monthly data on the yen-dollar exchange rate from 1991 to 2003 are used, and the deviations from an equilibrium exchange rate based on monetary fundamentals are estimated.[5]

Although this measure of the equilibrium rate is not particularly sophisticated, it does give plausible figures—ranging from ¥111.2 in November 1992 to ¥119.4 in December 2002. The percentage deviations from this equilibrium are used to estimate the model.[6] The results indicate that, though intervention can play an important role in correcting misalignments, it has a negligible effect on the equilibrium rate (see box 10.2). Intuitively, given the enormous outstanding stock of US and Japanese assets, interventions are not large enough to have a sufficient effect on the equilibrium rate to be economically significant. However, this is not true of exchange rate misalignments.

This apparent paradox can be rationalized because market participants are highly sensitive to differences in profitability between alternative

5. Specifically, monetary fundamentals are calculated as relative monetary velocity, using monthly data for M1 from the United States and Japan, and industrial production indices as proxies for aggregate demand.

6. It is worth pointing out that the model provides a market-based rationale for the application of Smooth Transition Regression (STR) models suggested by Granger and Terasvirta (1993), which have recently become popular in modelling nonlinearities in exchange rates. The function $\Phi(\cdot)$ may be recognized as an (albeit complicated) form of logistic transition function used in LSTAR models.

Box 10.2 Model estimation results

The estimated model had the following specification:

$$x_t = \varphi_0 Int_t + \varphi_1 X_{t-1} - \varphi_2 X_{t-1} \ \Phi(\cdot) + \epsilon_\tau \tag{10.8}$$

where x_t gives the deviation from equilibrium in the exchange rate, Int_t the size of intervention at time t, and $\epsilon_t \sim iid(0,\sigma^2)$. The transition function, $\Phi(\cdot)$, is a reduced form of equation 10.5 and takes values from 0 to 1 (because the path of the exchange rate is explosive when a large enough proportion of traders employ the chartist strategy, standard t-statistics are invalid; reported bootstrapped confidence intervals are based on 1,000 replications of the model).

Equation 10.8 captures the estimated proportion of market participants using the fundamentalist forecasting rule. It may be written in reduced form as:

$$\Phi(\cdot) = \{1 + \exp[-(\beta_1 x_{t-1} - \beta_2 x_{t-2} - \beta_3 x_{t-3} + - \beta_4 Int_t)x_{t-3} - c]\}^{-1} \tag{10.9}$$

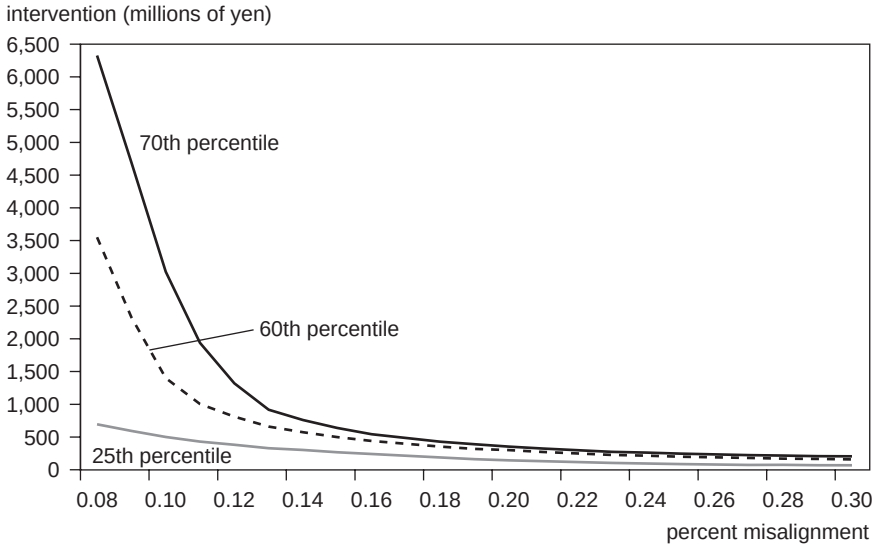
The final parameter estimates, together with bootstrapped confidence intervals, are given as follows:

Parameter	Estimate	95 percent confidence interval
φ_0	2.62×10^{-8}	$(-1.24 \times 10^{-5}, 1.08 \times 10^{-5})$
φ_1	1.1968	(1.1241, 1.2613)
φ_2	0.4650	(0.3821, 0.5577)
β_1	–8,474.2600	(–22 725.388, –7 299.812)
β_2	–10,767.3000	(–32 033.44, –10 043.96)
β_3	1,712.4700	(–1274.055, 3461.349)
β_4	–3.5227	(–7.7765, –1.8285)
c	–97.5961	(–256.49, –70.838)

The first term in equation 10.8 captures the effect of intervention on the equilibrium exchange rate. The confidence interval for the estimate of parameter φ_0 indicates that intervention has no detectable effect on the equilibrium rate. If the parameters φ_1 and φ_2 take the values of 1 and 0 respectively, this would imply that the exchange rate follows a random walk. However, with the estimate of φ_1 being 1.1968, when all traders employ a chartist strategy, that is, $\Phi(\cdot) = 0$, the exchange rate follows an explosive path moving away from equilibrium at a rate of 19.68 percent a month. When all traders employ the fundamentalist rule, so that $\Phi(\cdot) = 1$, the estimates of φ_1, and φ_2 imply that the exchange rate moves toward equilibrium at a rate of 26.82 percent a month.

The large estimated values of β_1, β_2, β_3, and β_4 in equation 10.9 indicate that traders are highly sensitive to differences in the relative profitability between strategies. The implication is that the behavior of the exchange rate can be approximated by a stochastic process that jumps between two limit cycles, one above and one below the equilibrium rate. The confidence interval of the parameter β_4 indicates that intervention has a significant effect on traders' strategy choice, while that for parameter c indicates there are significant costs to traders for pursuing the fundamentalist strategy.

Figure 10.1 Probability of an intervention effectively inducing a turning point



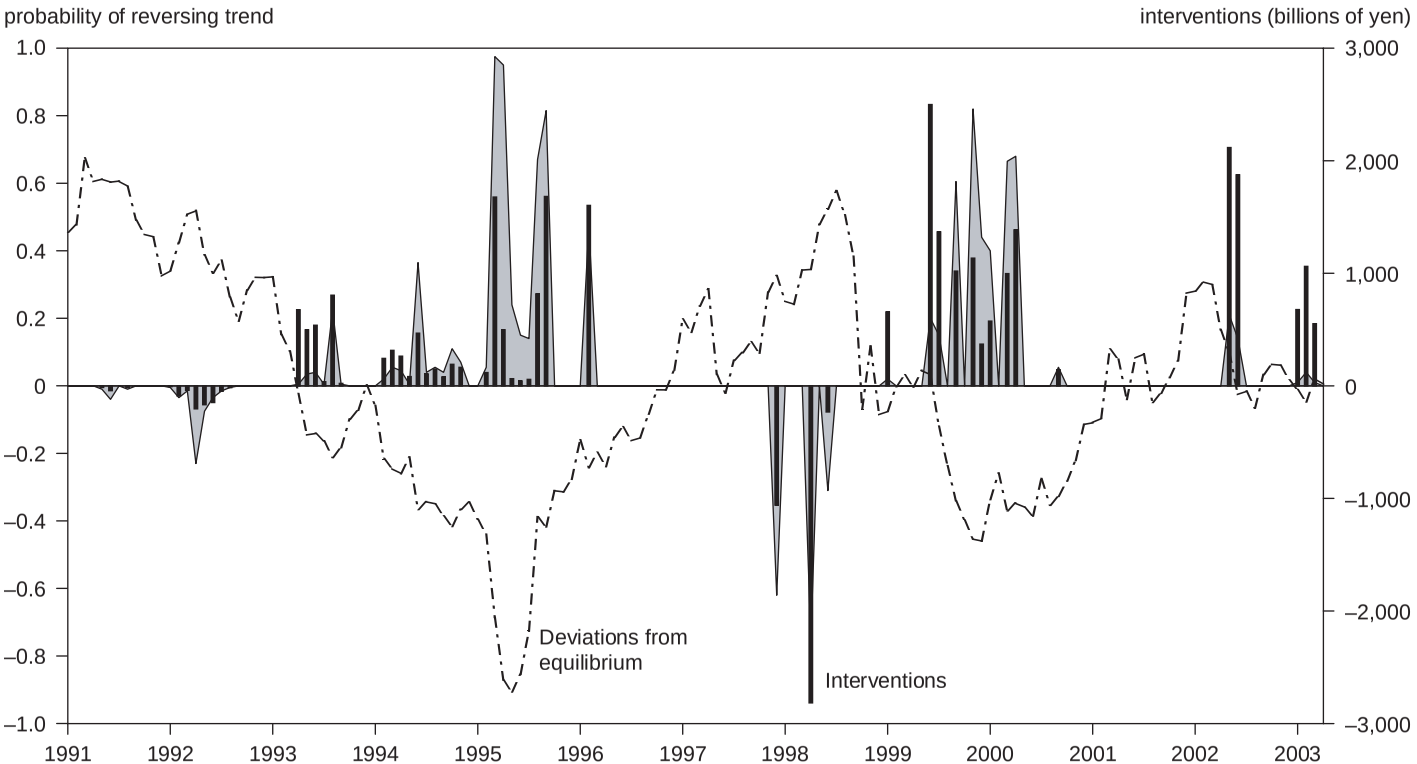
Note: The distributions illustrated in figure 10.1 may be used to calculate the ex ante probability that actual interventions by the Japanese authorities would result in a reversal of trend in the exchange rate. (However, many of the interventions by the Japanese during this period were not necessarily intended to reverse the trend in the exchange rate. Other possible goals include aiming only to slow the rise of the overvalued currency—smoothing intervention—and reinforcing movements toward equilibrium—"leaning with the wind" intervention. See Ito (2002) for details. Clearly, these types of interventions could be considerably smaller and yet still achieve their intended effects.) These probabilities are shown in figure 10.2, together with actual interventions and the estimated degree of misalignment when the intervention took place.
Source: Kubelec (2004).

strategies. Under the right circumstances, only a small change in the excess return on foreign assets is required to prompt traders to buy into a "fundamentalist" market view. Because such a change amounts to traders buying assets that they had been selling, this can lead to large changes in the exchange rate. On the basis of the estimated models, simulations are used to calculate the probability that intervention of a given size will reverse a destabilizing trend in the exchange rate at various sizes of misalignment.

The distributions illustrated in figure 10.1 may be used to calculate the ex ante probability that actual intervention operations by the Japanese authorities would result in a reversal of trend in the exchange rate.[7] These probabilities are illustrated in figure 10.2, together with actual interven-

7. In keeping with previous studies, instrumental variables estimation is used to avoid problems caused by simultaneous determination of intervention and the exchange rate, although nonlinear instrumental variables are used due to the cyclical dynamics predicted by the model.

Figure 10.2 Probability of an actual intervention inducing a turning point, 1991–2003



Note: Gray areas represent the probability of reversing trends.
Source: Kubelec (2004).

tion operations and the estimated degree of misalignment when the intervention took place.

Figure 10.1 shows the size of intervention in millions of yen necessary to have a 25 percent, 60 percent, and 70 percent chance of success as the percentage misalignment grows. For example, to have a 70 percent chance of moving the exchange rate toward fundamentals when the size of the misalignment is 13 percent, interventions of approximately ¥1 trillion per month are required. To achieve the same probability of mean reversion at a deviation from equilibrium of 9 percent requires interventions of about ¥5 trillion per month. However, within the sample there were only 13 months in which total interventions exceeded ¥1 trillion, and the largest total intervention in a single month was of the order of ¥2.8 trillion.

One may conclude from figure 10.1 that the degree of misalignment is of great importance to the likely efficiency of intervention. To have any reasonable chance of success, "leaning into the wind"–type intervention must be both determined and conducted only when the misalignment is substantial. In fact, the magnitude of intervention necessary to achieve a reasonable probability of success when closer to equilibrium than, say, 12 percent is so large as to be infeasible.

Figure 10.2 highlights how the efficiency of interventions by the Japanese monetary authorities has varied with the period in which they occurred. It further clarifies the importance of the degree of misalignment in determining interventions' success. For example, the Japanese authorities intervened with yen sales totaling approximately ¥1.4 trillion ($14 billion, at ¥100/$1) in both July 1999 and April 2000. However, the former intervention was conducted at a misalignment of approximately 4 percent, whereas for the latter the degree of misalignment was closer to 12 percent. As a result, though the probability of successfully engineering a yen depreciation was only 15 percent in July 1999, the intervention in April 2000 had a 70 percent chance of success.

These results also lend support to the findings of Ito (2002), who shows that interventions conducted when Eisuke Sakakibara was director general of the International Finance Bureau at the Japanese Ministry of Finance were particularly effective. Referring to his book (Sakakibara 2000), Ito details how Sakakibara's intervention policy was distinctively different from that of his predecessor. Specifically, interventions became much less frequent, and they were considerably larger than before. Ito's results indicate that, in contrast to his predecessor, intervention under Sakakibara was successful in producing the authorities' desired effects on the yen. Figure 10.2 illustrates a sharp contrast in the probability of intervention being effective between the period when Sakakibara was in office at the Ministry of Finance, from 1995 to 1999, and the periods before he took up his position and after he had left.

Up to this point, the discussion has focused on the efficiency of intervention aimed at reversing destabilizing market trends. However, intervention

can also be effective in preventing the development of severe misalignments, even when it fails to completely correct them. This is because even if the intervention fails to prompt enough traders to switch to strategies to bring about a market correction, it will nevertheless result in a reduction in the proportion of market participants using chartist techniques, thereby reducing the force of the trend away from equilibrium. Furthermore, even if the intervention fails to result in the exchange rate bubble bursting immediately, it may still prove effective in prompting a medium-run collapse of the bubble at significantly smaller misalignments of the exchange rate than would have been the case had the authorities not intervened.

To see why this is the case, recall that in the medium run the proportion of traders employing the chartist strategy inevitably falls as the exchange rate moves further from equilibrium. An intervention operation by the authorities has the effect of reducing still further the proportion of traders using the chartist rule. This will have two key consequences. First, the rate at which the exchange rate is moving away from equilibrium may be substantially reduced. Second, if the reduction in the mass of traders on the chartist strategy persists (i.e., traders who switched to the fundamentalist strategy following the intervention do not switch back to the chartist strategy once the authorities stop intervening), then, as the bubble grows larger, a relatively smaller proportion of traders is required to endogenously switch to the fundamentalist strategy for the bubble to burst. This implies that even if the intervention fails to reduce the misalignment in the short run, it may well prove effective in the medium run at substantially smaller deviations from fundamentals than would have been the case had the authorities failed to intervene.

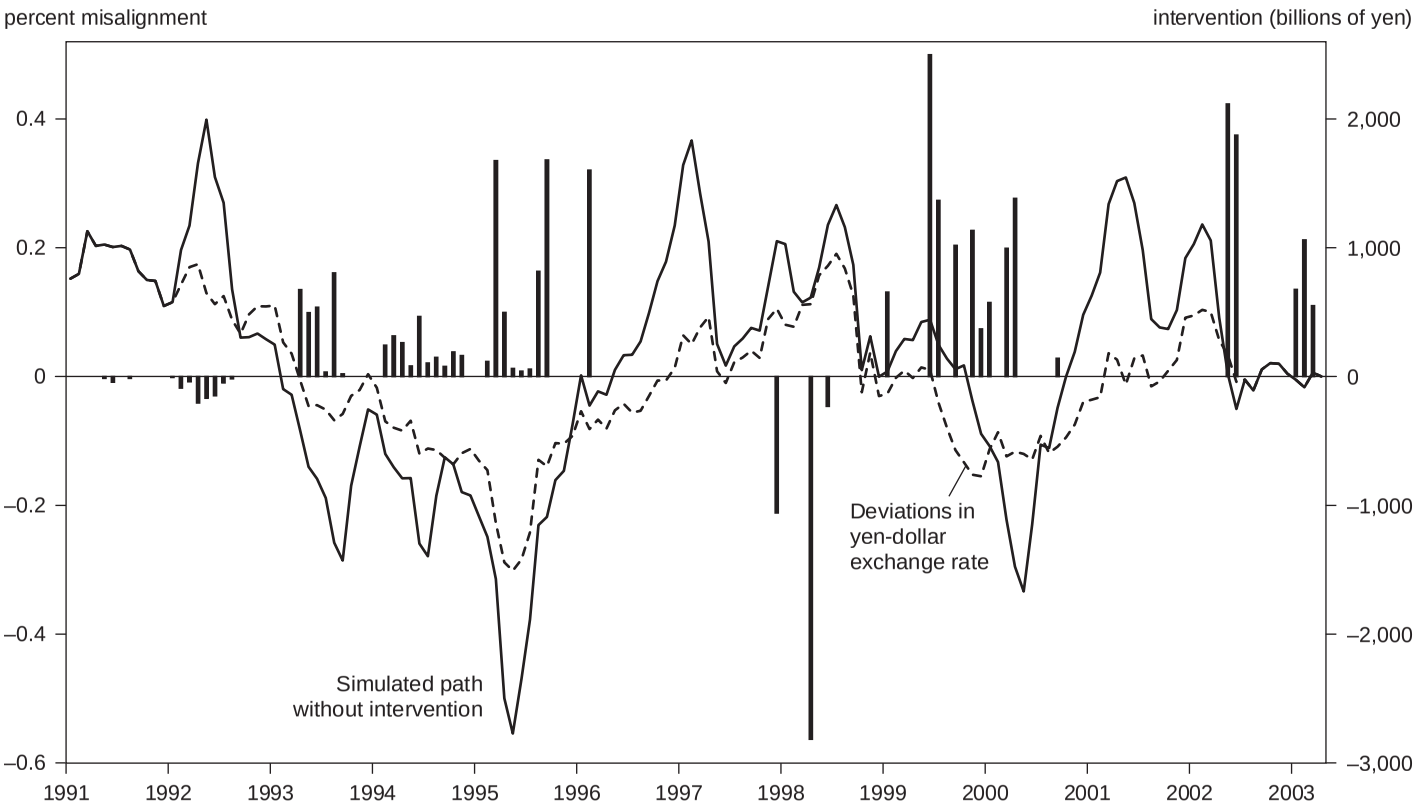
This delayed effect of intervention may be clarified, and a fuller picture of the actual effect of intervention operations gained, by using the estimated model to calculate the counterfactual exchange rate that would have prevailed if the exchange rate had been allowed to float freely. The simulated path of the exchange rate in the absence of intervention is compared with the actual path in figure 10.3.

Figure 10.3 clearly illustrates how intervention by the Japanese authorities has been successful in reducing medium-run volatility in the exchange rate. Though many interventions apparently failed to precipitate a movement toward equilibrium, the figure illustrates how they were effective in *reducing the strength* of the trend. Intervention by the authorities thus seems to have been highly successful in limiting erratic and persistent movements in the exchange rate created by herding behavior among market participants.

Policy Implications

The growing evidence that sterilized intervention can indeed be effective, together with the finding that intervention is much more successful when

Figure 10.3 Simulated path of the exchange rate in the absence of intervention, 1991–2003



Note: Bars represent interventions.

Source: Kubelec (2004).

misalignments are large, has at least two strong implications for exchange rate management regimes based on sterilized intervention in a world with free movement of capital. First, the finding that sterilized intervention can have strong effects on misalignments, but negligible effects on the equilibrium rate, is in keeping with the received wisdom that a country cannot maintain an exchange rate policy wholly independent of other policy choices. Instead, the role of intervention is likely limited to maintaining exchange rates at levels broadly in keeping with underlying economic conditions.

Second, the considerable gains in efficiency of intervention when misalignments are large provides further ammunition for basing intermediate exchange rate regimes on exchange rate bands. Clearly, the quantity of intervention required to keep the exchange rate within a band falls rapidly as the width of the band increases. More important, perhaps, the size of the intervention necessary to significantly influence the exchange rate when it is close to equilibrium is so large as to make such a policy unworkable in practice.

A key feature of much of the discussion surrounding the likely success of a target zone is the focus on the credibility of the authorities' commitment. For example, Paul Krugman and Marcus Miller (1993) argue that traders' speculation shifts from being destabilizing to stabilizing as long as they are assured that the target zone will be maintained. Their argument focuses on the role of stop-loss traders, who cover their exposure to large losses by selling their assets when prices fall below a certain level. If a target zone commands sufficient credibility to assure such traders that their stop-loss orders will not be triggered, it removes the fuel for destabilizing speculation. A similar case is put forward by Olivier Jeanne and Andrew Rose (2002), who suggest that a sufficiently credible commitment to keep the volatility of the exchange rate within a preannounced range can prevent destabilizing speculators from entering the market. This effect is achieved by lowering the risk premium on foreign bonds, which removes the high excess returns on foreign assets that lure destabilizing speculators in the first place.

Note, however, that the results discussed here suggest that an exchange rate band could still prove effective even when lacking full credibility. Though an even partially credible announcement to intervene does improve the effectiveness of intervention in the model presented here, it is not necessary to reduce the attractiveness of chartist strategies.[8] This is because, by its very nature, chartist behavior is backward looking. Intervention that reduces the profitability of technical rules in one period therefore affects the strategy choice the next.

8. An announcement by the authorities to intervene improves an intervention's effectiveness when market participants condition their choice of forecasting strategy on the likelihood of intervention. They do so because they are aware that intervention will reduce the profitability of chartist strategies.

What kind of exchange rate band would be most appropriate given these results? A key implication of the use of *sterilized* intervention is that even massive interventions may not be immediately successful in reversing destabilizing trends. Given this observation—and the well-documented susceptibility to speculative attack of target zones where the authorities are committed to defending the edges of the band—the most appropriate arrangement would seem to be the "monitoring exchange rate band" proposed by the Tarapore committee and discussed by John Williamson (1998). In a monitoring band, the authorities announce their intention to maintain the exchange rate within a band, but they are not committed to intervene when the edge of the band is reached. This allows for flexibility in the face of overwhelming market pressure, and it removes the threat of speculative attack.

This kind of regime would take full advantage of the increased efficiency of intervention at large misalignments. There is also no requirement for the announced band to be fully credible. Prolonged misalignments are generated when traders find forecasts based on past movements in the exchange rate more profitable than forecasts based on underlying economic conditions. Intervention can be successful because it reverses this situation. Indeed, this is exemplified by the experience of the Japanese authorities in the second half of the 1990s, when intervention proved quite successful despite the absence of an announced band for the exchange rate.

Conclusion

This chapter has put forward the case for sterilized intervention in foreign exchange markets when misalignments are large. The arguments used have been based on both a theoretical underpinning and empirical evidence from the yen-dollar exchange rate from 1991 to 2003. Work on the use of backward-looking, "technical" trading strategies in the foreign exchange market suggests that the large and persistent swings evident in G-3 exchange rates have little relation to movements in economic fundamentals. To limit the negative effects of these misalignments on competitiveness, inflation, and financial stability, foreign exchange intervention has successfully been used to reduce the severity of such swings. The central hypothesis of this chapter is that such interventions can succeed by reducing the profitability of destabilizing trading strategies, thereby inducing market participants to base their forecasts on economic fundamentals. It has been shown that even sporadic interventions can significantly alter the path of the exchange rate in the medium term, effectively controlling the development of exchange rate misalignments.

Drawing on 12 years of data on Japanese interventions, there is significant empirical support for this view. Even when intervention by the Japanese

authorities has apparently failed to correct misalignments in the short run, simulations of the model suggest that interventions have often led to a return to equilibrium somewhat earlier than would have otherwise been the case. Furthermore, estimates of the ex ante probability that interventions of a given size will be effective have been provided. For these results to constitute an operational guide to the authorities on the necessary size of an intervention clearly requires modeling at daily or higher frequencies. However, the results do provide an indication of the likely efficiency of interventions in the medium term. The key message of the results is that intervening when the exchange rate is close to fundamentals is unlikely to be effective, or at least that to be effective is likely to be prohibitively expensive.

More broadly, these results argue for the use of de facto monitoring bands to limit misalignments in G-3 exchange rates. Sterilized intervention would be sufficient to operate such a regime, allowing monetary policy to focus on domestic objectives.

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