Comment

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It is a pleasure to comment on chapters 10 and 11 by Christopher Kubelec and Marcel Fratzscher, respectively. Each chapter brings some new perspective to the long-standing question of whether sterilized intervention can be used to move exchange rates. To assess their contributions, I divide my discussion into three sections. First, I briefly summarize the textbook view of how intervention could potentially affect the exchange rate. Second, I extend this view to incorporate recent research on the role played by market makers and traders in the determination of exchange rates. This research has had notable success in accounting for the high frequency dynamics of exchange rates and so is clearly relevant in any discussion of intervention. Moreover, adding a role for market makers and traders also opens up some new channels for intervention to be effective. In the third section, I discuss how the empirical evidence presented by Fratzscher and Kubelec informs us about the efficacy of intervention via these channels.

A Textbook View of Intervention

A familiar textbook model of exchange rate determination starts with the difference equation $s_t = f_t + \lambda E_t[s_{t+1} - s_t]$ with $\lambda > 0$, where s_t is the log spot exchange rate (dollars/foreign exchange, or \$/FX), E_t is the conditional

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expectations operator, and f_t denotes macroeconomic fundamentals. Solving this equation forward (ruling out bubbles) gives

$$S_t = (1 - \theta)\sum_{i=0}^{\infty} \theta^i E_t[f_{t+i}], \qquad \text{(IV.1)}$$

where $\theta = \lambda/(1 + \lambda)$. This present-value equation for spot rates is consistent with a wide range of macroeconomic models, depending on how fundamentals are defined. In the well-known monetary model, for example, f_t is a linear combination of US and foreign log income and money supplies. In other models, the definition of fundamentals may include the real exchange rate, the risk premium of foreign exchange, and the international distribution of wealth. Aside from differences in the definition of fundamentals, macroeconomic models typically assume that all agents have access to the same information. Expectations of fundamentals, denoted by E_t, are therefore conditioned on common information known at time t.

To see how intervention may potentially affect spot rates within this setting, it is useful to consider the dynamic implications of equation IV.1. Let ψ_t denote the foreign exchange risk premium, defined as the expected excess return on holding foreign bonds for one period; $E_t[\Delta s_{t+1} + i_t^* - i_t]$ where i_t and i_t^* are the US and foreign one-period interest rates. With this definition, we may write the rate of depreciation as $\Delta s_{t+1} \equiv i_t - i_t^* + \psi_t + \Delta s_{t+1} - E_t\Delta s_{t+1}$. Combining this expression with equation IV.1, we obtain

$$\Delta s_{t+1} = (i_t - i_t^* + \psi_t) + (1-\theta)\sum_{i=0}^{\infty} \theta^i \{E_{t+1}[f_{t+1+i}] - E_t[f_{t+1+i}]\}. \qquad \text{(IV.2)}$$

The first term on the right-hand side identifies the expected rate of depreciation at time t. The second term identifies the unexpected component of depreciation, $\Delta s_{t+1} - E_t\Delta s_{t+1}$, as a function of changing expectations concerning future fundamentals.

How can equation IV.2 help us think about the possible channels through which intervention can operate? Let us consider an unexpected sterilized intervention undertaken after the period t spot rate has been determined. If the intervention is to have any impact on s_{t+1}, it must operate through the second term in equation IV.2. (Recall that the first term identifies $E_t\Delta s_{t+1}$ and so cannot be influenced by an unexpected intervention after time t.) Thus, according to this textbook model, an intervention can be effective only if it leads to a revision in the expected path of future fundamentals.

Two transmission channels have been considered in the intervention literature: the signaling and portfolio balance channels. Intervention operates via the signaling channel by changing expectations concerning fundamentals directly. The act of intervening signals to all agents in the economy that they should revise their fundamentals' forecasts. This seems most plausible in the case of the money stock component of fundamentals because it is controlled by the central bank.

However, the signaling channel could also operate if the central bank is believed to have superior information about the future path of any fundamentals component. The portfolio balance channel of influence operates directly on one component of fundamentals, the risk premium. Sterilized intervention between t and $t + 1$ changes the currency composition of publicly held government debt. This, in turn, must lead to a change in the equilibrium risk premium, provided debt in different denominations is not a perfect substitute in agents' portfolios. As a result, the path of fundamentals may be altered from $t + 1$ onward, a fact that is recognized by agents leading to a revision in expectations.

The empirical evidence on the efficacy of intervention operating via either the signaling or portfolio balance channel has not been compelling (for a recent survey, see Sarno and Taylor 2001). For example, examining the signaling channel, Graciela Kaminsky and Karen Lewis (1996) found that intervention was informative about the course of future monetary policy. However, they also found that the reaction of the exchange rate was inconsistent with the implied signal about future policy. It has also proved difficult to establish that interventions significantly affect the risk premium in the manner necessary for the portfolio balance channel to operate.

These results are symptomatic of a larger empirical problem: Macro models do a very poor job of accounting for exchange rate dynamics over horizons of one year or less. However broadly we interpret the definition of fundamentals, empirical specifications derived from equation IV.2 explain almost nothing of the day-to-day, week-to-week, or month-to-month changes in spot rates. It would be remarkable indeed if we could find robust evidence supporting the efficacy of intervention through either the signaling or portfolio balance channels when macroeconomic models of exchange rate determination have performed so poorly.

A Microeconomic-Based View of Intervention

Macroeconomic exchange rate models pay little attention to the details of how trading in the foreign exchange market actually takes place. The implicit assumption is that the details of trading (e.g., who quotes prices and how trade takes place) are unimportant for the behavior of exchange rates over months, over quarters, or longer. This view, though still widely held, is being questioned by a new class of exchange rate models that explicitly study the behavior of market participants.[1]

These microeconomic-based models start from the premise that information about the current (and future) state of the economy is dispersed

1. E.g., see Evans and Lyons (2002b, 2004b). A comprehensive list of recent research papers in micro-based exchange rate modeling can be found at http://www.georgetown.edu/faculty/evansm1.htm.

across agents. They then examine how dispersed information about the state of the economy becomes embedded into the exchange rate via trading in the foreign exchange. Specifically, microeconomic-based models examine how agents trade in foreign currency (and other assets) based on their private information and the spot rate quotes made by market makers. They also study how market makers revise their spot rate quotes in response to both public information (i.e., from macroeconomic announcements) and private information gleaned from the trades initiated by other agents. Because market-maker quotes determine the prices at which foreign currency is traded, the quote-revision process governs the dynamics of spot exchange rates.

The need to model the behavior of traders and market makers makes microeconomic-based models rather mathematically complex. Nevertheless, we can illustrate the essential principle at work with a slight modification of equation IV.2:

$$\Delta s_{t+1} = (i_t - i_t^* + \psi_t) + (1 - \theta)\sum_{i=0}^{\infty} \theta^i \{E_{t+1}^m[f_{t+1+i}] - E_t^m[f_{t+1+i}]\} \quad \text{(IV.3)}$$

where E_t^m denotes the expectations of a representative market maker at the start of period t. Equation IV.3 represents how the market maker would change her quote for the spot exchange rate between the start of periods t and $t+1$.[2] Although this equation looks strikingly similar to equation IV.2, its potential for explaining exchange rate dynamics is quite different. To see why, suppose that market makers have a too pessimistic view about fundamentals at the start of period t with the result that the dollar price for FX they quote is too low. On seeing this, traders will initiate purchases of FX at s_t because they have a less pessimistic view of fundamentals.

This positive order flow for FX will not go unnoticed by market makers. Recognizing that traders have private information about the state of fundamentals, they will revise their forecasts of fundamentals upward so that their next dollar price for FX (i.e., s_{t+1}) will be higher. Thus, spot rate dynamics are driven by changing expectations, as in macro models. However, the key difference is that the revision in expectations is induced by order flow, which is itself induced by the presence of heterogeneous information. This prediction concerning the link between exchange rate dynamics and order flows is strongly supported in the data. For example, Evans and Lyons (2002a) find that order flows can account for up to 80 percent of the variance in daily spot rate changes.

Equation IV.3 helps us think about how intervention could be effective in a micro-based model. As above, any effect must take place via a revision in the expected path of fundamentals. Here, however, it is market-maker

2. Equation IV.3 does not distinguish between bid and ask quotes for the sake of clarity. To see how equation IV.3 can be derived from an optimizing model of market makers and traders, see Evans and Lyons (2004a).

expectations that are the focus of attention. As in the macro model, interventions could affect market-maker expectations directly via the portfolio balance channel insofar as they induce changes in the risk-premium component of fundamentals.

Interventions could also affect expectations indirectly via trading. Notice that sterilized intervention in support of the dollar takes the form of negative order flow for FX initiated by the central bank. In cases where the intervention is secret, it should have the same effect on the spot rate as negative order flow from private traders of the same size. Evans and Lyons (forthcoming) estimate that a $1 billion intervention of this type would have moved the dollar-mark spot rate by approximately 0.44 percent.

In practice, interventions are rarely secret. In these cases, their effectiveness will depend on two interrelated factors. First, the inferences that market makers draw from the order flow initiated by a central bank will generally differ from those based on order flows from private traders: The central bank is presumably a more credible source of superior information concerning future fundamentals. (This is a variation on the signaling channel described above.)

Second, nonsecret intervention trades may lead other traders to reassess their desired portfolio positions. As a result, the order flow initiated by the central bank may trigger a much larger order flow from other traders. If the order flow implications of the central bank's intervention are magnified in this manner, their impact on market-maker expectations, and hence the spot rate, could be significant.

Fratzscher's and Kubelec's Results

The empirical evidence presented by Marcel Fratzscher and Christopher Kubelec is most readily interpreted in terms of microeconomic-based models. Indeed, it is hard to see how the results they present could be consistent with macroeconomic exchange rate models.

Chapter 11, by Fratzscher, starts from the observation that during the 1990s actual interventions by the US and euro/German monetary authorities were largely replaced by "oral interventions"—statements by government officials advocating either a strengthening or weakening of the currency. The author constructs a novel data set based on wire service news releases that categorizes these statements by US Treasury secretaries, Japanese finance ministers, and central bank officials and the members of the Bundesbank Zentralbankrat (1990–98) and the European Central Bank's Governing Council (after 1998). He then examines how the incidence of oral interventions relates to (1) exchange rate developments, (2) monetary policy, and (3) the history of recent interventions.

Understanding when and why oral interventions take place is interesting only if they are effective. If they are ineffective, oral interventions appear

to be nothing more than a form of market commentary. In a companion paper, Fratzscher argues that this is not the case in the dollar/deutsche mark–euro and yen/dollar markets (Fratzscher 2004). In particular, he claims that (1) oral interventions are at least as effective as actual interventions, (2) oral interventions are equally effective across different monetary policy regimes, and (3) oral interventions reduce spot rate volatility.

How should we interpret these results? From the perspective of the macroeconomic model (i.e., equation IV.2), oral interventions should have no impact on spot rates unless the official making the statement was disclosing news about the future course of fundamentals (hitherto unknown to the public). This seems particularly hard to believe in the US case, given the independence of the Federal Reserve. Could statements about the strength of the dollar really lead everyone to change their forecasts for future US monetary policy?

The microeconomic-based model provides a different perspective. Suppose traders' opinions about the future path of fundamentals diverge widely but market makers quote a spot rate based on expectations equal to the average among traders. In this world, oral interventions may be interpreted by traders as changing the risk or expected return associated with holding their particular portfolio. And, as a result, the statement may induce an order flow that is interpreted by market makers as signaling new information about fundamentals.

Notice that under these circumstances oral interventions can move spot rates if they change the balance of opinion among traders. This is a much weaker condition than required in the macroeconomic exchange model. Even if the US Treasury secretary has no private information about future monetary policy, statements about the strength of the dollar could still lead rational traders to reassess the desirability of their portfolio positions and so trigger the order flow necessary to move spot rates.

Unfortunately, it is difficult to assess whether such microeconomic-based mechanisms lie behind the results in Fratzscher (2004) because they only tell us how spot rates changed (on average) on days when positive or negative statements about the currency were made. Moreover, although oral interventions appear to have a statistically significant effect on the daily change in spot rates, their economic significance is much less clear.

This is particularly apparent if we plot the incidence of oral interventions on a graph of each spot rate (see figures 1 through 6 in Fratzscher 2004). If oral interventions had an economically significant impact, we should see a series of statements in support of a strong dollar followed by a persistent fall in the dollar/deutsche mark–euro rate. This happened during some periods (e.g., in 1999) but not in others (e.g., around the start of 1998 and 2002).

In fact, I think a reasonably unbiased eye would conclude from this visual evidence that oral interventions had only a 50-50 chance of being fol-

lowed by a sizable spot rate move in the "right" direction. Similarly, if the incidence of interventions is linked to recent exchange rate developments, as the statistical results in table 11.3 indicate, this should also be evident from the plots. Again, I think any reasonably unbiased eye would find the evidence far from compelling. This contrast between the statistical and visual evidence points to a potentially important flaw. The results in tables 11.3, 11.4, and 11.5 are derived from a logit model that includes a set of explanatory variables that are meant to proxy for the conditions before an oral intervention. Because none of the estimates come from a model that contains all the (possible) explanatory variables, the estimates reported in the three tables are almost surely subject to omitted-variable bias. Furthermore, all the explanatory variables are constructed as dummies. This seems reasonable when describing the history of recent interventions, but much less so when summarizing past monetary or exchange rate conditions. Imposing an artificial classification scheme on the history of monetary policy and spot rates so that all the explanatory variables take the form of dummies most likely introduces a significant specification error into the results.

Chapter 10, by Kubelec, is also cast within the class of microeconomic-based models in that it focuses on how the choice of trading strategy affects the dynamics of spot rates. The basic idea is that traders choose between a "chartist" and "fundamentalist" forecasting rule for spot rates depending upon their past and expected future profitability. On the basis of this decision, they then make trading decisions, which in aggregate determine the spot exchange rate. Intervention plays a role in this model via its effect on the forecasting choice made by traders. In particular, Kubelec argues that intervention will be most effective in states of the world where the current spot rate is viewed as being far from some long-run level. Essentially, intervention can more easily persuade traders following "destabilizing" strategies to change their plans in these states than when the spot rate is close to its long-run level.

Clearly, this line of argument is very much in the spirit of the microeconomic-based channels for intervention discussed above. What is much less clear from Kubelec's chapter is how changes in the strategies followed by traders affect spot rates. This is an important omission. Even if intervention changes the behavior of other traders in the market, this need not change spot rates in the "right" direction unless market makers have an incentive to do so.

Kubelec's empirical evidence comes from a nonlinear regression model estimated in monthly data using the yen-dollar exchange rate:

$$s_t - s_t^m = \varphi_0 Int_t + G(Int_{t-d}, s_{t-i} - s_{t-i}^m)(s_{t-1} - s_{t-1}^m) + \varepsilon_t \qquad \text{(IV.4)}$$

where $s_t - s_t^m$ is the deviation of the current spot rate s_t from the long-run level s_t^m implied by a monetary model, and Int_t denotes the size of the

intervention in month t. The $G(.)$ function governs the rate of mean reversion in $s_t - s_t^m$ and depends on three lags of $s_t - s_t^m$ and a lagged value of Int_t.

Kubelec's contention is that intervention is more successful in changing trading behavior when $s_t - s_t^m$ is large and that this change will be manifest in a higher level of mean reversion. In other words, intervention should push the value of $G(.)$ closer to zero when the lagged values of $s_t - s_t^m$ are large. Kubelec's estimates support this hypothesis. His figure 10.3 provides an elegant comparison, based on the model estimates, of how the absence of intervention would have resulted in much less mean reversion in $s_t - s_t^m$ over the sample period.

Of course, the evidence in figure 10.3 is only as convincing as the specification of the nonlinear regression. Although the specification appears generally consistent with Kubelec's theoretical argument, equation IV.4 above does not represent a structural model. And, as such, estimates of the model are open to alternative interpretations. Moreover, the model estimates provide no direct evidence that interventions affect trading behavior. Another concern centers on the form of the $G(.)$ function. Ideally, we would like the data to determine the most appropriate form of this function. In practice, however, Kubelec's specification imposes the restriction that interventions affect $G(.)$ only when $s_{t-3} - s_{t-3}^m \neq 0$. This means that intervention can affect the rate of mean reversion only in the manner Kubelec hypothesized. The evidence in figure 10.3 would have been more convincing if the model specification had allowed intervention to affect the rate of mean reversion even when the spot rate was close to its long-run level.

Endogeneity is also a potential problem. Because interventions are undoubtedly related to the strength of the currency before they are undertaken, it can be difficult to disentangle the impact of intervention per se from the exchange rate conditions that prompted the action. In particular, the fact that interventions appear most effective when $s_t - s_t^m$ is large could be attributed to the fact that the size of $s_t - s_t^m$ governs the rate of mean reversion. Although Kubelec attempts to control for this by including the lagged value of $s_t - s_t^m$ in $G(.)$, we have no way to judge whether these controls are adequate.[3] In the end, interventions may appear to have been effective in this sample simply because they were timed to coincide with market pressures turning the spot rate back to its long-run level.

In summary, Fratzscher and Kubelec have presented some interesting results on the connections between intervention and spot rate dynamics. I think it is fair to say that their findings provide suggestive evidence supporting the idea that intervention is effective, at least under some circumstances. Unfortunately, in common with much of the literature, both

3. Similarly, there is no way to assess whether the instrumental variable procedure (mentioned only in a footnote) adequately addresses the endogeneity problem.

chapters lack evidence on the channel through which intervention could operate. Addressing this aspect of intervention should, in my view, be a high priority for future research.

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