The Role of the Exchange Rate in Monetary-Policy Rules

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For a country that chooses not to "permanently" fix its exchange rate through a currency board, or a common currency, or some kind of dollarization, the only alternative monetary policy that can work well in the long run is one based on the trinity of (i) a flexible exchange rate, (ii) an inflation target, and (iii) a monetary policy rule.[1] While not often put into this three-part format, the desirability of such a monetary policy in an open economy is, in my view, the clear implication of three corresponding strands of recent monetary research: (i) research on fixed-exchange-rates regimes, including the influential 1995 article "The Mirage of Fixed Exchange Rates" by Maurice Obstfeld and Kenneth Rogoff and the many analyses of the breakdown of fixed-exchange-rate regimes in the late 1990's; (ii) research on the practical success with inflation targeting by Ben Bernanke et al. (1999); and (iii) research on the benefits of simple monetary-policy rules (see e.g., Taylor, 1999a).

This clear policy implication, however, does not end the debate about how exchange rates should be taken into account in formulating monetary policy. Even if one excludes capital controls and sterilized exchange-market intervention from consideration because they are not effective or attractive ways to de-link exchange-rate movements from the domestic interest rate, a crucial question remains: "How should the instruments of monetary policy (the interest rate or a monetary aggregate) react to the exchange rate? Should policymakers avoid any reaction and focus instead on domestic indicators such as inflation and real GDP? Or is "the rule of thumb" that "a substantial appreciation of the real exchange rate . . . furnishes a prima facie case for relaxing monetary policy," as characterized by Obstfeld and Rogoff (1995, p. 93), a better monetary policy rule? Or perhaps policymakers should heed the Obstfeld-Rogoff warning that "substantial departures from PPP [purchasing-power parity], in the short run and even over decades" make such a policy reaction to the exchange rate undesirable. More generally, if one accepts the trinity concept of monetary policy in an open economy, then what is the role of the exchange rate in the monetary-policy rule?

I. New Normative Macroeconomic Research

Empirical research on monetary-policy rules has recently begun to focus on this important exchange-rate question. The research is part of what might be called "new normative macroeconomic research." The approach uses quantitative models combining theoretical and technical ideas from a number of different schools of thought.[2] Four research steps define the approach: (i) place a potential monetary-policy rule into a macroeconomic model, (ii) solve the model using some numerical solution algorithm, (iii) examine the properties of the stochastic behavior of the variables (inflation

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[1] That these are the only two good alternatives is called the "bipolar view" of exchange rates. But as the "trinity concept" suggests, the flexible-exchange-rate "pole" is actually a wide range of possible flexible-exchange-rate regimes: there are many different policy rules that go along with a flexible exchange rate. By an "inflation target" I mean the inflation rate around which the central bank would like the actual inflation rate to fluctuate. By a "monetary-policy rule" I mean a contingency plan that specifies how the central bank should adjust the *instruments* of monetary policy (the interest rate or a monetary aggregate) in order to meet its inflation and other targets.

[2] Models used in this new normative macroeconomic research are usually estimated/calibrated dynamic, stochastic, general-equilibrium models. They emphasize good microeconomic foundations and draw ideas from schools of thought called the "new classical macroeconomics," the "new Keynesian macroeconomics," the "real-business-cycle school," and "new neoclassical synthesis," "new Wicksellian macroeconomics," and "new open-economy macroeconomics"; hence, the word "new" in the term is not so new! For further discussion of open economy, see Bennett McCallum and Edward Nelson (2000), Obstfeld and Rogoff (2000), and Lars E. O. Svensson (2000).

and output), and (iv) choose the rule that gives the most satisfactory performance, using a loss function that comes as close as possible to capturing peoples' preferences. It is also becoming more common to check results for robustness using some other models.

What does this research have to say about the role of the exchange rate in monetary-policy rules? The exchange rate is an important part of the transmission mechanism in many of the policy-evaluation models.[3] The exchange rate usually enters as part of an arbitrage equation relating the interest rate in one country to the interest rates in other countries through the expected rate of appreciation of the exchange rate. Most models that have been used for policy evaluation assume perfect capital mobility; they either have an *ex ante* interest-rate parity condition or a reduced-form relationship between the real interest rate and the real exchange rate implied by such a relationship. The exchange rate also affects the terms of trade and thus the flow of exports and imports. Perhaps most difficult to model is the way that changes in the exchange rate affect the price of foreign goods sold in another country and are then passed through to domestic prices. This is where improved micro-foundations of price rigidities based on optimally derived staggered price-setting equations with monopolistic competition will probably have the greatest payoffs.

II. Brief Review of Research on the Role of the Exchange Rate in Policy Rules

I review the exchange-rate implications of several recent normative policy-evaluation studies: Laurence Ball (1999), Svensson (2000), and Taylor (1999b). There is currently much work going on in this area, so the review must be considered preliminary. To summarize, these studies consider policy rules of the following form:

$$(1) \qquad i_t = f\pi_t + gy_t + h_0 e_t + h_1 e_{t-1}$$

where i_t is the short-term nominal interest rate set by the central bank, π_t is the rate of inflation, and y_t is the deviation of real GDP from potential GDP. The variable e_t is the real exchange rate (an increase in e_t is a real appreciation). Observe that no intercept terms appear in equation (1), which implies that the target inflation rate is zero and that the interest rate and the exchange rate are measured relative to the long-run steady-state values. That the long-run equilibrium real interest rate and long-run equilibrium real exchange rate are not known in practice is a difficulty with using such policy rules that is not addressed in this paper. Of course the class of linear policy rules represented in equation (1) is a simplification of a more complex nonlinear class in which lags of output, inflation, and the interest rate might appear along with more lags of the exchange rate.

The policy parameters are f, g, h_0, and h_1. If $f > 1$, $g > 0$, and $h_0 = h_1 = 0$, then equation (1) is the monetary policy rule that I proposed in my 1993 paper with no reaction to the exchange rate. It is tempting to refer to the case where the h parameters in equation (1) are zero as a *closed-economy monetary-policy rule* and to the case were they are nonzero as an *open-economy monetary-policy rule,* but such a terminology would be very misleading because in reality the optimal policy for an open economy may be to set both h_0 and h_1 to zero, at least as an approximation.

In the context of equation (1), the question about the role of the exchange rate in a policy rule is a question about whether the h parameters should be nonzero and, if so, what their signs and numerical values should be. For example, one interpretation of the rule of thumb discussed by Obstfeld and Rogoff (1995) and mentioned above would be that h_0 is less than zero and h_1 is equal to zero. Then a higher than normal real exchange rate would call on the central bank to lower the short-term interest rate, which presumably would represent a "relaxing of monetary policy."

The lagged exchange rate in equation (1) allows for slightly more complicated dynamics

[3] The multi-country model that I used in my 1993 paper (and also discussed below) includes a big role for the exchange rate. Simulations of that model and other similar models showed, however, that if the central bank reacted strongly to the exchange rate then macroeconomic performance would worsen. That was why I omitted the exchange rate in the 1993 rule for the U.S. Federal Reserve Board. But it is not clear that the same conclusion would hold for other countries.

than simply reacting to the current exchange rate. For example, if h_1 is positive and h_0 is negative but greater in absolute value than h_1, then the initial interest-rate reaction is partially offset in the next period. Note that another interpretation of the rule of thumb discussed by Obstfeld and Rogoff (1995) is that $h_0 < 0$ and $h_1 = -h_0$; then the interest rate reacts to the *change* in the exchange rate. This may be a better algebraic interpretation of the idea that an appreciation of the exchange rate would call for an easing of monetary policy, but without a structural model to stochastically simulate the rule, it is difficult to know which of these two interpretations would work better.

The version of equation (1) studied by Ball (1999) has $h_0 = -0.37$ and $h_1 = 0.17$. These are the policy parameter values that Ball found to be optimal using a very simple open-economy model with sticky prices. The signs and magnitudes are consistent with either interpretation of the rule of thumb mentioned by Obstfeld and Rogoff (1995) since both h_0 and $h_0 + h_1$ are less than zero. Thus, an appreciation of the exchange rate of 10 percent would call for a cut in the interest rate of 3.7 percentage points, followed by a partial offset of 1.7 percentage points, implying a long-run reaction of a 2-percentage-point cut in the interest rate. The negative interest-rate response is called for in Ball's model (and in most open-economy models) because the appreciation has a contractionary effect on aggregate demand; the appreciation makes foreign goods cheaper and domestic goods more expensive, thereby reducing net exports. The cut in interest rates mitigates this contraction.

The partial interest-rate offset is due to the lagged impact of the appreciated exchange rate on inflation. The measured inflation rate is temporarily low because of the appreciation; however, because the decline in inflation is temporary, it is not appropriate for the central bank to ease monetary policy any additional amount, because of the lower inflation that would otherwise occur using equation (1). The positive coefficient h_1 prevents this additional easing.

For the Ball (1999) open-economy model, such a rule leads to better performance than a rule in which both h parameters are equal to zero. Performance is measured in terms of the size of the fluctuations of real GDP around potential GDP and the size of the fluctuations of inflation around the inflation target, both meant to be approximations to peoples' preferences. (To be sure, this review focuses entirely on the impact on inflation and output variations, rather than on the exchange rate or the composition of output.) More specifically, Ball found that, holding the standard deviation of output relative to potential output constant (at 1.4 percent), the interest-rate rule that reacts to the exchange rate as well as to output and inflation reduces the standard deviation of the inflation rate around the inflation target from 2.0 percent to 1.9 percent (Ball, 1999 p. 134) compared with a rule that reacts only to inflation and output. Perhaps what is most surprising about this finding, however, is that the improvement is small, especially given what seem to be large reaction coefficients.

Using another model with forward-looking agents and more explicit microfoundations, Svensson (2000) considers a policy rule that is very similar to the rule examined by Ball (1999). For Svensson, the policy rule in equation (1) has the parameters $h_0 = -0.45$ and $h_1 = 0.45$. Svensson's (2000) simulations show that this rule reduces the standard deviation of inflation from 2.1 percent to 1.8 percent; however, it also increases the variance of output from 1.7 percent to 1.8 percent. Thus, a policy rule that reacts to the exchange rate in this way can actually lead to a deterioration of output performance.

Finally, consider a third study of this class of policy rules with a different model and with a different application. In Taylor (1999b), I examined a monetary-policy rule that has the same form as the one examined by Ball (1999) and Svensson (2000). It has exchange-rate reaction coefficients of $h_0 = -0.25$ and $h_1 = 0.15$ and was examined as a candidate for a monetary-policy rule for the European Central Bank. The exchange rate e_t is the dollar–euro exchange rate. Thus, a 10-percent depreciation of the euro relative to the dollar would have called for a 1-percentage-point increase in the interest-rate target for the European Central Bank. This would consist of a 2.5-percentage-point increase in the short run, partially offset by a 1.5-percentage-point cut in the next period. Observe that these coefficients are somewhat smaller than the reaction coefficients in the Ball study.

Using a seven-country model with France, Germany, and Italy joined into a single currency union representing the European Monetary Union and with Britain, Japan, Canada, and the United States conducting their own monetary policy, I simulated this policy rule for the European Central Bank. Compared with the rule that did not react to the exchange rate, I found that the exchange-rate reaction led to better performance for some countries in Europe (France and Italy) but had poorer performance in Germany. Currently there are a number of other policy-evaluation research projects underway examining how the exchange rate should go into a policy rule, but they seem to be suggesting similar conclusions, either that there are small performance improvements from reacting to the exchange rate or that such reactions can make performance worse.

III. An Explanation for the Findings

Why does directly reacting to the exchange rate not yield a greater improvement in performance in these studies? Why does the performance deteriorate in some cases? While more research with better models is needed, I believe a preliminary answer is possible. There are two main factors to consider.

First, although the policy rule in (1) with the h parameters set to zero has no direct reaction of the interest rate to the exchange rate, it does have an important *indirect* reaction of interest rates to the exchange rate. To see this, suppose that the h parameters are equal to zero. Thus the interest rate will react only to inflation and to real output. But of course, since this is a policy rule one can expect that if inflation or real GDP rises or falls in the future then the interest rate will also rise or fall in the future. The nature of a policy rule is that it is a contingency plan that will be used for many periods into the future.

Now suppose that there is an appreciation of the exchange rate as discussed in the above example of Obstfeld and Rogoff (1995). In most open-economy models, such an appreciation will have two effects: it will lower real GDP by expenditure-switching, and it will lower inflation because the price of imported goods will not increase as rapidly with the appreciation of the currency. Inflation may also be lowered by the decline in output. In empirically estimated models, these inflation and output effects of the exchange-rate change will occur with a lag, because such lags exist in the data. There is inertia in the monetary-transmission mechanism. Because of this lag, an appreciation of the exchange rate today will decrease the level of output and inflation that is expected in the future. With a policy rule like equation (1) in place, this expectation of lower future output and lower future inflation lowers expectations of interest rates in the future. In other words, the appreciation of the exchange rate today (period t, say) will increase the probability that the central bank will lower the interest rate in the future (period $t + 1$, say). With a rational-expectations model of the term structure of interest rates, these expectations of lower future short-term interest rates will tend to lower long-term interest rates today. Thus, the appreciation of the exchange rate, through the inertial effects of exchange-rate transmission and the existence of a policy rule, will result in a decline in interest rates today, even though the exchange rate is not directly in the policy rule.

This channel from an appreciation of the exchange rate to a decline in the interest rate might be even stronger if the policy rule in equation (1) were based on forecasts of future inflation and output, as in the models studied by Nicoletta Batini et al. (2000). Then the appreciation lowers the forecast of inflation and output, and the central bank lowers the short-term interest rate today. However, if most of the interest-rate effect is based on changes in long-term interest rates, then the effect exists even if equation (1) is based on current inflation and output.

To summarize, although the policy rule in equation (1) may not appear to involve an interest-rate reaction to the exchange rate, it implies such a reaction. What might appear to be a closed-economy policy rule is actually just as much an open-economy rule as if the exchange rate appeared directly. This may also explain why adjusting the h parameters away from zero might not improve performance very much: the exchange rate reaction is already there. This may also explain the puzzle of A. Huang et al. (2000) who found that even in a small open economy such as New Zealand a monetary-policy rule in the form of equation (1) with the h parameters equal to zero closely describes the actions of the central bank. The

implied interest-rate decisions of the Reserve Bank of New Zealand during the flexible-exchange-rate/inflation-targeting period of 1989–1999 are well explained by a monetary-policy rule without a reaction to the exchange rate.

A second reason why reacting to the exchange rate might not improve performance very much was alluded to in the quote from Obstfeld and Rogoff (1995) above. There may be some deviations of the exchange rate from purchasing-power parity that should not be offset by changes in interest rates; the required changes in interest rates will have adverse affects on real output and inflation that may be worse than the swings in the exchange rate themselves. In some situations the changes in the exchange rate might reflect changes in productivity that should not be offset. Even a random change in the exchange rate, due perhaps to fads or irrational expectations, may have small consequences relative to the cost of smoothing them out.

This second reason suggests a preference for an indirect reaction of the interest rate, as described above, rather than a direct reaction. Temporary fluctuations in the exchange rate may not have much effect on expectations of inflation and thus have little effect on interest rates with an indirect reaction, while such movements could result in harmful swings in interest rates if there were a strong direct reaction.

IV. Conclusion

An important and still unsettled issue for monetary policy in open economies is how much of an interest-rate reaction there should be to the exchange rate in a monetary regime of a flexible exchange rate, an inflation target, and a monetary-policy rule. Research to date indicates that monetary-policy rules that react directly to the exchange rate, as well as to inflation and output, do not work much better in stabilizing inflation and real output and sometimes work worse than policy rules that do not react directly to the exchange rate.

This paper endeavors to explain this finding by positing an indirect effect of exchange rates on interest rates. The indirect effect exists even if the central bank follows a policy rule without a direct exchange-rate effect. Inertia combined with rational expectations causes this indirect effect. The indirect effect may have advantages compared with the direct effect because it results in fewer and less erratic fluctuations in the interest rate. More research is needed to establish this advantage and to see if the findings hold up to more general measures of people's preferences, including perhaps the composition of output or the exchange rate itself.

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