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Can a Central Bank Influence Its Currency's Real Value? The Swiss Case

THE SWISS National Bank (SNB) is one of the few central banks that conducts monetary policy by announcing and generally achieving a targeted growth rate for the money stock. Policy is conducted in this manner because SNB officials, believing that excessive growth in the money stock is the cause of inflation, have established long-run price stability as the central bank's primary objective. Moreover, because large, unexpected changes in money growth are thought to create uncertainty that can raise real interest rates and reduce output, SNB officials believe the average rate of money growth not only should be low (to achieve low inflation rates) but stable as well.[1] Thus, in Switzerland, both rapid money growth and large, unexpected changes in the money stock have been rare.

The historical evidence clearly indicates that SNB actions have met their objectives: growth in the monetary base since 1982, for example, has been targeted at rates between 2 percent and 3 percent and has been, on average, 2.4 percent over these seven years. The average rates of inflation and real Gross Domestic Product (GDP) growth over the same seven years have been 2.0 percent and 2.3 percent, respectively.

Despite its commitment to money growth targets, the SNB realizes Switzerland is a small open economy that exports about 40 percent of Gross National Product (GNP). Thus, domestic real activity can be affected adversely by appreciations of the Swiss franc that raise the real price of Swiss goods to foreign buyers relative to prices charged by competing foreign suppliers. If, for example, Swiss exporters respond to an exchange rate appreciation by reducing Swiss franc prices (which will maintain the foreign currency price of their goods), the quantity of exports sold will not change but their profit margins will shrink. On the other hand, if exporters maintain current Swiss franc prices, the prices paid by foreign buyers will rise (because of the exchange rate appreciation) and the quantity of exports sold will decline.[2] These specific effects on Swiss exporters pose a policy problem because, in the aggregate, they are likely to cause some reduction in real GNP growth.

[1]See, for example, the arguments put forth by Mascaro and Meltzer (1983).

[2]Whether profits rise or fall will depend on the elasticity of demand for exports. See Belongia and Hermann (1989) for some estimates of the responsiveness of Swiss exports to exchange rate changes.

What makes the Swiss case interesting in this context is that a central bank committed to money growth targets and a low, stable inflation rate made an abrupt, but temporary, policy shift because of exchange rate pressures. Specifically, the SNB abandoned its money growth targets in 1978-79 in an attempt to reduce the real value of the Swiss franc in foreign exchange markets and avert a recession.[3] As figure 1 shows, the franc had appreciated sharply both against the Deutschemark (DM) and the dollar, which represent the two most important currencies for Swiss trade. In response to this currency appreciation, the Swiss monetary base was expanded at an annual rate of 95 percent between July 1978 and January 1979.

The rapid money growth and exchange rate movements shown in the figure provide a case study to help answer the type of question faced by many countries, including the United States, in recent years: If the real value of a nation's currency has risen "too high," over what time horizon and by what amount can actions by the central bank reduce the real exchange rate?[4] In this article, we use the Swiss experience over the period of flexible exchange rates and some orthodox results from economic theory to suggest general conclusions about the effects of monetary actions on the real exchange rate.

NOMINAL AND REAL EXCHANGE RATES

The real exchange rate is defined as the nominal spot rate adjusted for price level differences across countries. If purchasing power parity (PPP) conditions were met continuously, the real exchange rate would be constant. Because economic developments often affect the nominal spot rate and price levels across countries with different lags and in different ways, however, the real exchange rate generally varies through time. Movements in the real exchange rate, therefore, represent those changes in the nominal rate that cannot be attributed to inflation differentials. Specifically, changes in the real exchange rate reflect structural changes in real economic performance across countries.

Distinguishing between the real and nominal exchange rate is crucial to any analysis of the effects of exchange rate movements because only changes in a currency's real value affect trade flows. A change in the nominal exchange rate alone will not affect trade flows; the potential benefits from importing Swiss goods due to the decline in the franc's nominal value will be offset exactly by the higher prices for Swiss goods that caused the nominal depreciation.[5] Thus, if a central bank's actions are intended to influence trade flows — not simply to change the relationship between foreign and domestic price levels — the analysis must focus on what happens to the real exchange rate.[6] Moreover, because we are interested in how monetary actions might affect the real exchange rate, we must examine economic models that permit central bank actions to do so.

THEORETICAL MODELS OF EXCHANGE RATE RESPONSES TO MONETARY CHANGES

Establishing a relationship between changes in the money stock and real economic magnitudes produces some conflict among competing economic theories. One class of models posits different speeds of adjustment across markets

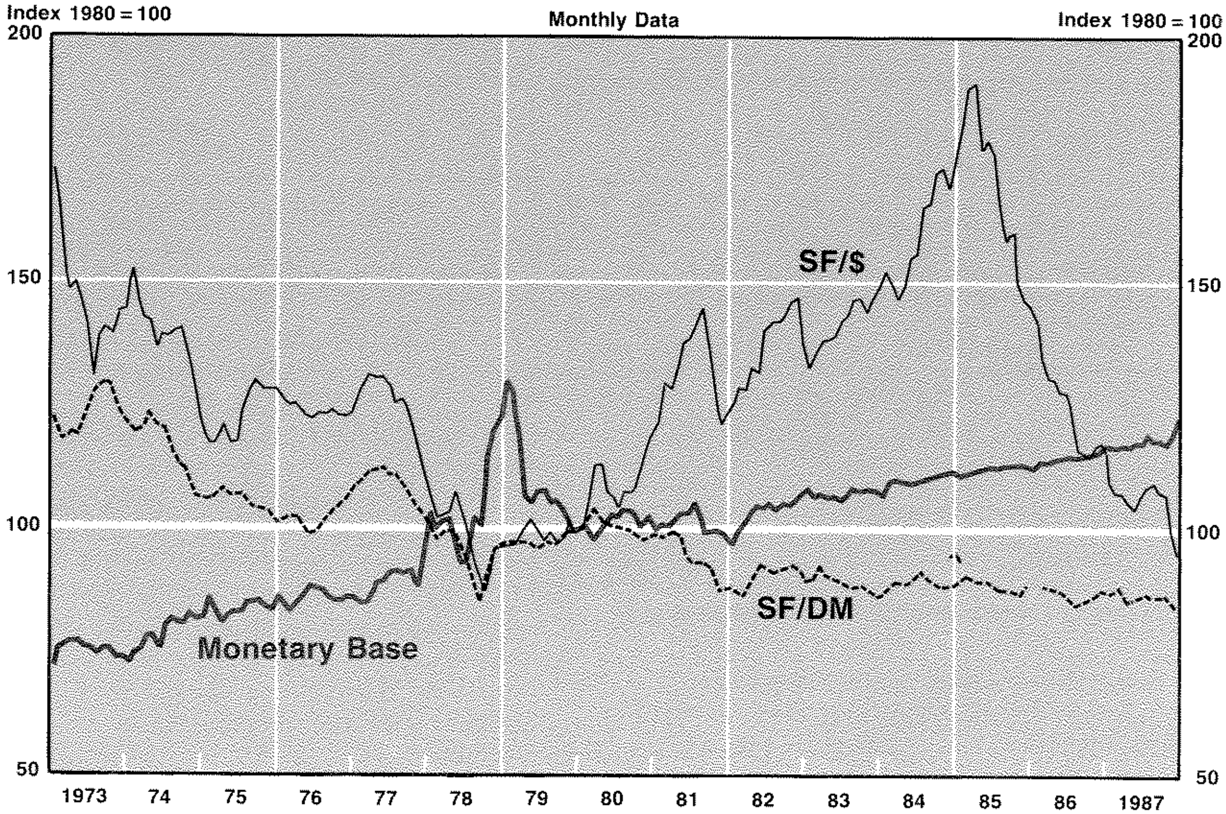
[3]See Rich and Béguelin (1985, p. 85) for a discussion of this episode and, in particular, SNB reference to a DM/Swiss franc exchange rate lower bound of 0.80 (their footnote 9).

[4]Note that, in many respects, the Swiss debate parallels that of the United States in the early 1980s. During that period, analysts discussed the relationships between exchange rates and exports [see, for example, Batten and Belongia (1986)] and the appropriate responses of both the Federal Reserve and foreign central banks to a rising dollar [see Batten and Kamphoefner (1982) and Batten and Ott (1984)]. This attempt to change the level of the exchange rate is to be contrasted with efforts to reduce exchange rate volatility. Gartner (1987) offers some evidence on the latter case for the SNB.

[5]Unless we are dealing in very special cases—such as a world with indexed contracts or no unexpected price changes—nominal exchange rate changes also will be changes in the real exchange rate. For some simple expositions of these relationships and the distinction between real and nominal exchange rates, see Batten and Luttrell (1982) and Batten and Belongia (1986).

[6]At least two important issues are ignored from this perspective. First, the rapid money growth associated with the 1978-79 intervention was followed by a rapid increase in the Swiss inflation rate. Second, Swiss importers and consumers, who benefit from a higher exchange rate, will be made worse off if the exchange rate declines. Thus, a discussion of the *net* benefit of a lower exchange rate is considerably more complicated than a narrow focus on the welfare of Swiss exporters alone.

Figure 1
Real Exchange Rate of the Swiss Franc/$, Swiss Franc/DM and the Swiss Monetary Base



in response to a monetary change. In this case, real magnitudes can be affected by fully-anticipated monetary changes because, say, prices of financial assets react more quickly than prices of durable goods and, as a consequence, relative prices, output and other real magnitudes may be affected in the short run. Another class of models hypothesizes that fully anticipated events will not affect real variables because they already will incorporate these expectations into current values. Thus, only "shocks" or "surprises" are allowed to affect real magnitudes. Despite their particular differences, however, models from both classes predict that monetary changes will affect real variables only temporarily.[7] We discuss specific models of each type in the sections below.

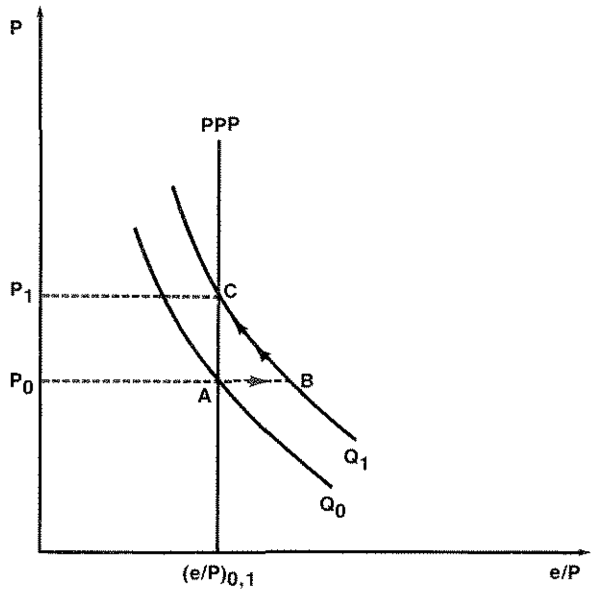
Fully Anticipated Monetary Changes: The Dornbusch Model

One model that relates exchange rate movements to actual changes in the money stock is the Dornbusch (1976) model of overshooting real exchange rates. The model is derived for a small country whose actions cannot affect the world economy; moreover, it is assumed that perfect capital mobility exists (that is, interest rate parity holds continuously) and people form expectations rationally. The model includes a money market with a standard money demand function and a market for domestic goods.

In the long run, this model assumes that exchange rates will be consistent with purchasing

[7]Note that this also implies trade will be affected, if at all, only temporarily and after some lag.

Figure 2
Exchange Rate Adjustments in the Dornbusch Model



power parity. In the short run, however, the possibility that exchange rates may overshoot their long-run PPP values is introduced through different speeds of adjustment in financial and goods markets.

Figure 2 illustrates the effects of a monetary change on the real exchange rate, e/P, (the price of the foreign currency divided by the domestic price level; the foreign price level is assumed to be constant) and the domestic price level, P. At all points on Q_0, the money market is in equilibrium, that is, interest rate parity holds. The goods market equilibrium is represented by the vertical line labeled PPP because, on this line, purchasing power parity holds. Moreover, it is assumed that the goods market equilibrium occurs for a given real exchange rate. A monetary expansion implies that Q_0 shifts upward to Q_1. The new long-run equilibrium, at point C, is given by the intersection of PPP and Q_1 at the same real exchange rate but a higher domestic price level. This implies that an expansionary monetary policy change does not affect real variables in the long run.

The transition from the old to the new equilibrium, however, does not take place through a depreciation of the nominal exchange rate that is exactly in line with increases both in the domestic price level and the domestic nominal interest rate. In the short run the money market will dominate the goods market because it reacts instantaneously to a monetary change and finds its new equilibrium immediately. The goods market, however, is out of equilibrium in the short run because price adjustments lag and the quantity of goods demanded exceeds quantity supplied at the existing price level.

This excess liquidity will cause short-term interest rates to fall and, thus, will make the domestic currency less attractive to hold. Furthermore, investors know that the currency must depreciate to restore an equilibrium between the goods market and money market. Therefore, they will move to shift portfolios immediately from domestic assets into foreign assets. This portfolio shifting, induced by the excess supply of domestic currency, will cause both nominal and real exchange rates to depreciate until interest rate parity is reestablished. At this intermediate stage of the adjustment process, indicated by point B in figure 2, domestic interest rates are below foreign interest rates, and the domestic price level has not yet adjusted. When the price level eventually does adjust, there is a movement along Q_1 in the figure toward the new long-term equilibrium, C. At C, the nominal exchange rate has depreciated but the real exchange rate has returned to its initial value.

The mechanics of the Dornbusch model—specifically, the initial adjustment from point A to point B followed by the permanent, long-run adjustment to point C—imply that the SNB can influence real exchange rates in the short run at the price of a temporary inflation. The model also indicates that, in the long run, monetary policy has no effect on real exchange rates. Both conclusions are valid, however, only if other central banks do not offset the measures taken by the SNB. Overall, given certain simplifying assumptions, the Dornbusch model offers two testable propositions: Do monetary actions cause changes in the real exchange rate and, if so, over what period of time?

An Alternative Model of the Real Exchange Rate: The Influence of Unexpected Monetary Changes

Another strategy in modeling the real exchange rate, consistent with the earlier discussion and following the asset approach to exchange rate determination, has been to focus on *unexpected* changes in assorted macroeconomic variables. In contrast to the Dornbusch model, which allows actual differences between domestic and foreign variables to have short-run real effects through adjustment lags, other models have focused on differences between actual and expected values of explanatory variables in foreign and domestic economies. In this case, although differences in the commodity market and currency market adjustment processes still may be important, the emphasis is directed more to the influence of "surprises" on the exchange rate. Variables included, among others, have been unexpected changes in the money stock, the government budget surplus (or deficit) and real GNP.

In each case, the variables for these models were thought to determine or measure differences in real activity across countries so that an unexpected change in them would signal a reassessment of real performance across countries and, hence, a reassessment of relative currency values. Despite their theoretical appeal, however, models of this type have had limited success in explaining substantial amounts of the variation in real exchange rates. Surveys by Bomhoff and Korteweg (1983) and Bomhoff (1987) have provided economic and econometric reasons to explain the decided empirical failures of theoretical exchange rate equations.

For our interest in the narrow issue of SNB monetary policy and the real exchange rate, a model adopted by Hooper (1983) and Shafer and Loopesko (1983) offers a straightforward approach. Starting with conditions of uncovered interest parity and a long-run equilibrium current account balance of zero, an expression for the log of the real exchange rate (RER) can be written as:

(1) $RER = (r - \pi^e) - (r^* - \pi^{e*}) + \alpha\Sigma CAB,$

where r and π^e denote the nominal interest rate and expected inflation, respectively, * denotes a foreign variable and $\alpha\Sigma CAB$ is the cumulative current account balance. Thus, the log of the real exchange rate is stated as a positive function of both the domestic-foreign real interest differential and the cumulative current account balance.

Equation 1 in its current form, however, is not directly useful for our purposes because the policy question applies to *changes* in the real exchange rate, not its level. Moreover, we are interested only in the simple bivariate relationship between monetary actions and exchange rate changes. Finally, and perhaps most important, equation 1, as written, has no specific reference to monetary policy actions.

To apply equation 1 to the current investigation of monetary policy's influence on the real exchange rate, the CAB term was dropped and the remaining terms were differenced so that changes in the real exchange rate were related to changes in the real interest differential.[8] That is:

(2) $\Delta RER = \Delta(r - \pi^e) - \Delta(r^* - \pi^{e*}).$

After these simplifying assumptions and manipulations, we have, in equation 2, reduced the problem to one in which changes in either the domestic or foreign real interest rates, or both, cause a change in the real exchange rate.[9]

To allow a role for monetary policy actions in equation 2, a long history of economic literature suggests that unexpected changes in money growth can affect the real interest rate, at least temporarily, by altering inflationary expectations or through a liquidity effect. Moreover, if equation 2 is a generally correct expression for the real exchange rate, an announced, credible policy by the SNB to increase money growth to reduce the franc's real value should have no effect because rational agents will incorporate the information into revised expectations for higher future inflation and, as a consequence, higher nominal interest rates and a lower nominal exchange rate. But, with all nominal magnitudes adjusting by the exact amounts and without lags, there is no latitude for a temporary change in the real exchange rate.

Because this second model suggests that fully anticipated monetary policy actions will leave

[8]Dropping this variable is justified on two grounds. First, the Swiss current account balance has been nearly constant over time such that variations in it are unlikely to be an important source of exchange rate fluctuations. The second reason is the theoretical result that it is a persistent change in CAB — not its level — which will affect the real exchange rate. For a discussion of this independence of a stable CAB *level* and the exchange rate, see Mussa (1985).

[9]This abstracts from the special case in which the domestic and foreign rates change in a way that leaves the differential unchanged.

the real interest differential and, hence, the real exchange rate unaffected, equation 2 suggests that a successful attempt by the SNB to reduce the franc's real value must be both unanticipated and not offset by the actions of other central banks. Whether the predictions of either model are supported by the data is investigated in the next section.

EMPIRICAL ADAPTATION

Because the sole question of interest is whether monetary actions, however measured, affect the real exchange rate, we did not attempt to estimate structural equations derived from either of the theoretical models discussed earlier. Instead, we chose to examine statistical tests that indicate whether monetary actions "cause" a change in the real exchange rate.[10] Moreover, because Swiss monetary actions that, *ceteris paribus*, would affect the real exchange rate may be offset by actions of other central banks, our causality tests were estimated based on *differences* between changes in the growth rates of the monetary base across countries.

The general form of the equations estimated for these tests is depicted as:

$$(3)\ \Delta RER_t = a + \sum_{i=o}^{p} b_i B_{t-i} + \sum_{j=1}^{q} c_j\ \Delta RER_{t-j} + \varepsilon_t,$$

where RER is the real Swiss franc/DM or Swiss franc/dollar exchange rate, B is a measure of relative monetary actions, a, b_i and c_j are coefficients to be estimated and ε_t is a random error term. Lag lengths for the explanatory variables, p and q, were chosen by a final prediction error (FPE) criterion.[11] The real exchange rates used are monthly averages of the Swiss franc/dollar and Swiss franc/DM nominal rates adjusted by ratios of the respective countries' consumer price indexes. The monetary base was chosen as the basic measure of monetary actions in all three countries. By allowing contemporaneous values of monetary actions to enter these regressions, we explicitly assume that monetary policy decisions are exogenous.

To test the Dornbusch model, the B variable in equation 3 was measured as the difference between Swiss and German or Swiss and U.S. monetary base growth rates. For the second model, measures of unexpected changes in the base growth rates were needed. In fact, the relationships discussed earlier indicated that B should be represented as the difference between Swiss and German or Swiss and U.S. monetary surprises. To construct these measures, second differences of logarithms were used to represent unanticipated changes in each individual monetary base series. Then these individual series were used to construct the differences between Swiss and German or Swiss and U.S. monetary policy surprises.[12]

The relationships described by equation 3 were estimated with monthly data over a 1973-86 sample period; the results are shown in table 1. Section A of the table, based on differences between actual growth rates of the monetary base across countries, indicates a marginally significant effect of monetary actions on the real Swiss franc exchange rate. The FPE criterion, picked only contemporaneous measures of monetary actions as the best representation of the model in the U.S. case; for the German case, contemporaneous and two lagged values of relative monetary actions were chosen.[13] Although this variable was marginally significant in the U.S. case, the sign of the estimated coefficient for relative monetary actions is incorrect. Since theory suggests a positive response for this specification of the data, (relatively faster Swiss money growth will increase the number of Swiss francs per dollar) the negative sign in the U.S. case is puzzling. For the German case, the estimated coefficients

[10]See Jacobs, et al. (1979) for some of the more common critiques of causality testing. Also see Zellner (1979) for a more general discussion of causality tests and their application. Although Fratianni, et al. (1987) apply this testing procedure to the money-exchange rate relationship, their study does not include the Swiss franc and uses the nominal, rather than real, exchange rate.

[11]See, for example, Batten and Thornton (1985).

[12]These measures of unanticipated monetary changes should be "white noise," series whose movements cannot be explained by their own past behavior or the behavior of other variables. Tests for white noise indicated that the second differences of logarithms of each country's monetary base series had this characteristic.

[13]An alternative would be to estimate models for a variety of lag lengths and look for patterns in the results. This also was done for all pairs of possible lags, up to 12 months, for both the monetary variable and the exchange rate (144 regressions for each of the four equations reported). The general finding was that significant effects of monetary actions—whether actual or unanticipated—were found for all lag pairs up to six months.

Table 1

Estimated Relationships Between Monetary Actions and Changes in the Real Swiss Franc Exchange Rate

A. The Effects of Actual Monetary Actions (B is specified as Δln SWMB - Δln USMB or Δln SWMB - Δln GEMB)

Swiss franc/$:

$$\Delta \ln RER_t = -\underset{(1.02)}{0.002} - \underset{(1.85)}{0.172}(B_t) + \underset{(4.21)}{0.310}\Delta \ln RER_{t-1}$$

$\bar{R}^2 = 0.11$

Swiss franc/DM:

$$\Delta \ln RER_t = -\underset{(1.04)}{0.001} + \underset{(0.99)}{0.043}(B_t) - \underset{(0.84)}{0.036}(B_{t-1}) + \underset{(3.48)}{0.149}(B_{t-2}) + \underset{(5.98)}{0.449}\Delta \ln RER_{t-1} - \underset{(2.60)}{0.197}\Delta \ln RER_{t-2}$$

$\bar{R}^2 = 0.20$

B. The Effects of Relative Monetary Surprises (B is specified as ΔΔln SWMB – ΔΔln USMB or ΔΔln SWMB – ΔΔln GEMB)

Swiss franc/$:

$$\Delta \ln RER_t = -\underset{(0.75)}{0.002} - \underset{(2.17)}{0.148}(B_t) + \underset{(4.51)}{0.330}\Delta \ln RER_{t-1}$$

$\bar{R}^2 = 0.12$

Swiss franc/DM:

$$\Delta \ln RER_t = -\underset{(1.39)}{0.001} + \underset{(0.39)}{0.015}(B_t) - \underset{(0.70)}{0.032}(B_{t-1}) + \underset{(2.06)}{0.095}(B_{t-2}) + \underset{(2.07)}{0.080}(B_{t-3}) + \underset{(5.98)}{0.460}\Delta \ln RER_{t-1}$$

$$- \underset{(2.29)}{0.178}\Delta \ln RER_{t-2}$$

$\bar{R}^2 = 0.20$

NOTE: Absolute values of t-statistics are in parentheses.

for the contemporaneous and last lag of the B variable take the expected positive sign but only the latter term is significantly different from zero. In general, the conclusion seems to be that differences between actual monetary changes across countries have weak, short-lived and unpredictable effects on the real exchange rate.

Interpreting these inconsistent results is made somewhat easier, however, by returning to figure 1 and some points made earlier in the paper. The figure shows that the large increase in the Swiss monetary base during 1978-79 was associated with temporary appreciations of both the dollar and DM against the Swiss franc. This relatively small and short-lived effect was followed, however, by two distinctly different paths for the dollar and DM against the Swiss franc, with the dollar rising sharply until early 1985 and the DM returning to a path of small, gradual depreciations. Also recall that the SNB discussed its policy stance over this interval in terms of a 0.8 lower bound for the Swiss franc/DM exchange rate. The DM, of course, dominated other currencies in SNB decisions because Germany is Switzerland's largest trading partner. Overall, these bits and pieces of evidence—the path for the Swiss franc/DM exchange rate in the figure, SNB policy statements regarding a Swiss franc/DM objective, and the "correct" sign for monetary actions in the Swiss franc/DM equation—suggest that SNB actions designed to reduce the franc's real value did have some weak effect relative to its target currency.[14] That effect, however, was dissipated quickly.

Section B of the table, which redefines the monetary variable as the difference between unanticipated monetary changes across countries, shows monetary effects that are more strongly significant but still of puzzling signs. The chosen lag lengths are relatively short, suggesting the transitory nature of monetary actions on the real exchange rate.

Nonetheless, the general results again are problematic. Theory suggests that an unexpected increase in Swiss base growth that is larger than an unexpected change in foreign base growth in the same direction should be related positively to a change in the real exchange rate specified as franc/foreign currency. Thus, the positive signs in the German case are consistent with this result while the negative sign for lagged relative monetary surprises in the U.S. case is not. The inconsistent U.S. result, as in the previous case, might be explained by the instruments and objectives argument discussed in footnote 14. Even the German result is troublesome, however, in that *lagged* values of monetary surprises have a significant impact on the real exchange rate. Presumably, a surprise should have its effect felt only in the period it occurs but, in this case, its effects occur only with lags of two and three months. As with the results in Section A of the table, these results indicate significant but unpredictable influences of monetary actions on the real exchange rate.

CONCLUSIONS

Ten years ago, the SNB temporarily abandoned its monetary targets and pursued what has been interpreted as a successful intervention to reduce the Swiss franc's real value and restore export sector competitiveness. Although economic theory generally suggests that such an intervention—even when other central banks cooperate—may have little effect on the currency's real value, economic policy summits over recent years often have discussed the possibility of coordinated monetary actions to affect exchange rates. In this context, the Swiss experience presents an interesting case study of monetary effects on exchange rates.

Our empirical evidence suggests that monetary actions might be related significantly to real exchange rate movements in the short run. The trouble with this result is that these effects appear to be unpredictable and not entirely consistent with standard models of exchange rate determination. Causality tests indicated that changes in relative money growth rates between countries—whether actual or unanticipated—influence the real exchange rate for up to six months. But while short-run relationships are consistent with the conclusion that monetary actions are not likely to have exchange rate effects of a size or duration that will bring about substantial increases in exports, the conclusions for policymakers are less clear. The lack of consistency in the sign of the relationship between monetary actions and exchange rates across countries does not give a clear signal as to which monetary action should be taken to produce a given exchange rate response.

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[14]A basic rule for policy actions is that policymakers must have at least as many instruments as the number of objectives they hope to achieve. The SNB has only one instrument—the monetary base—and could use it to achieve *one* exchange rate objective, such as the Swiss franc/DM rate. Without more instruments, however, it could not simultaneously move to hit a Swiss franc/dollar objective. This lack of instruments to hit multiple objectives could explain the "correct" results for the Swiss franc/DM causality tests and the anomolous results for the Swiss franc/dollar case.

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