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Exchange Rates and Monetary Policy

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Exchange rates have been given increasing consideration in the conduct of monetary policy. This article develops a model of the determination of the exchange rate, interest rate, price level, and level of output to derive the optimal response of monetary authorities to exchange rate movements. The relative magnitudes and persistence of disturbances, as well as the structure of the economy, are shown to play roles. Advocates of using monetary policy to maintain greater fixity of exchange rates view monetary shocks as the predominant source of disturbances to the economy.

In recent years, a number of policy makers, academics, and practitioners have suggested that the Federal Reserve pay more attention to the dollar exchange rate in its formulation of monetary policy. These calls have ranged from using monetary policy to maintain the value of the dollar exchange rate at some benchmark or parity level, to targeting the dollar within "zones," or simply using the dollar as an important "signal," or indicator, for the appropriate direction of monetary policy.

The Federal Reserve, in fact, has paid more attention to the exchange rate in the formulation of policy during the past three years. In testimony to Congress outlining monetary policy objectives, Federal Reserve Chairman Greenspan has underscored the importance of the dollar as a factor in monetary policy deliberations.[1] The growing importance of the exchange rate in the implementation of U.S. policy also is indicated in the monetary policy directives of the Federal Open Market Committee.[2]

Moreover, since the Group of Five (U.S., Germany, Japan, Britain, and France) Agreement in September 1985, the United States has expressed its willingness to cooperate internationally with foreign central banks in using exchange rates as an indicator of appropriate monetary policy. On several occasions, policy makers have gone a step further, suggesting that the exchange rate be used as the primary "target" of policy rather than simply an indicator. For example, the exchange rate dominated other concerns when finance ministers and central bankers met at the Louvre meeting of the G-7 (G-5 plus Canada and Italy) in February 1987 and issued a communiqué calling for greater policy coordination to stabilize the dollar.

Although policymakers recently have been more willing to consider exchange rates in the formulation of monetary policy, the advisability of doing so remains an unresolved issue among economists. In a series of recent papers supporting an increased focus on exchange rates, McKinnon (1982, 1985) argues that the U.S., Japan, and Germany should use purchasing power parity exchange rates as the basis for a coordinated monetary policy. In McKinnon's judgment, speculative capital flows arising from shifts in international portfolio preferences are the dominant factor affecting exchange rates. In such an environment, targeting the exchange rate would work to offset the disturbances to financial markets.

In contrast, other economists (for example, Obstfeld [1985] and Willett [1985]) have argued that this approach to monetary policy is inappropriate. Willett argues that ". . . international considerations certainly should not be ignored in monetary analysis, but exchange-rate targeting offers neither a fail safe guide to monetary policy formulation nor a painless way to control inflation."[3] In Willett's view, "real" factors, such as fiscal policy, productivity shifts, and technological change, have played a major role in moving exchange rates in recent years.

In this debate, one of the most important theoretical and empirical issues focuses on the distinction between the "monetary" and "real" causes of exchange rate movements. This formulation of the problem marks an important departure from the traditional monetary policy debate. Traditionally, the policy debate has contrasted the desirability of money aggregate targeting with interest rate targeting (Poole, 1970). The new emphasis contrasts the desirability of money aggregate targeting with exchange rate targeting.

This article reviews the issues surrounding the appropriate role of exchange rates in the formulation and control of monetary policy in the United States. Our objectives are two-fold. First, we attempt to clarify the meaning of an exchange rate policy *per se* and how it relates to domestic monetary policy. Second, in the context of the recent debate and its focus on "monetary" versus "real" disturbances to the economy, we illustrate some of the factors that are important in determining an "optimal" exchange rate policy.

The rest of the paper is organized as follows. In Section I, we discuss the instruments available to the central bank in its attempt to implement an effective exchange rate policy. The important distinction between "sterilized" and "unsterilized" foreign exchange intervention is drawn and it is argued that exchange rate policy is effective only if it involves the latter. In Section II, we formulate an open economy macroeconomic model of the determination of the exchange rate, interest rate, price level, and level of output. To focus clearly on the issues associated with the present policy debate, the model is kept simple by allowing only transitory money and real aggregate demand shocks.

We derive the optimal response of the monetary authorities to exchange rate changes in their attempts to minimize output and price fluctuations in the economy. We show that the relative magnitudes of the disturbances facing the economy, as well as the structure of the economy, play an important role in determining the appropriate response of the monetary authorities to exchange rate changes.

In Section III, we discuss how the analysis is influenced by other types of shocks to the economy and by the introduction of permanent shocks. Specifically, we investigate the role played by supply shocks (for example, oil shocks, labor force shocks, and productivity or technology shocks) and by permanent disturbances to the exchange rate and other variables affecting the economy's long-run equilibrium. The value of an "exchange-rate focused" monetary policy is evaluated under these circumstances, and the contrast between interest-rate targeting and exchange-rate targeting is drawn. Section IV summarizes and draws conclusions.

I. What is an Exchange Rate Policy?

An exchange rate policy implies a systematic effort on the part of the monetary authorities to influence the level or rate of change of the exchange rate. A variety of policy instruments are potentially available to influence the exchange rate, including foreign exchange market intervention, domestic monetary policy, various forms of controls on international trade and capital flows, and official announcements of future policies.

Most attention has focused on either foreign exchange market intervention or domestic monetary policy as the primary instruments available to the central bank in its pursuit of a systematic exchange rate policy. Although there may be some potential value in "expectations" or "announcement" effects associated with a central bank's announcement concerning the appropriate level for the exchange rate, normally, the central bank must also change some current market fundamentals to credibly implement an exchange rate policy.

In many respects, it is possible to accomplish the same objectives with either domestic monetary policy or foreign exchange intervention policy. Domestic monetary policy typically involves a change in the domestic monetary base (that is, reserves held by the banking sector plus currency held by the public) brought about by the central bank through the open market puchase or sale of domestic government securities. Foreign exchange intervention involves the exchange of domestic assets for foreign assets by the central bank. Foreign exchange market intervention activity may take two forms: (1) "unsterilized," or "monetary," intervention operations—purchases or sales of the

foreign currency in the foreign exchange market that have a direct effect on the domestic monetary base; and (2) "sterilized," or "non-monetary," intervention—purchases or sales of foreign currency in the foreign exchange market that are simultaneously offset by domestic open market operations.

In the case of unsterilized intervention, the central bank changes its net foreign asset holdings through purchases and sales of foreign exchange and allows a corresponding change in its monetary liabilities, that is, the monetary base. For example, the central bank may decide to purchase foreign currency from the private sector. To pay for its purchase, the central bank credits banks' reserve accounts, causing the domestic base to increase. The central bank then may choose to purchase a foreign government bond or an interest-bearing foreign commercial bank account with its foreign exchange receipts.[4] However, whether the central bank continues to hold the foreign currency or interest-bearing foreign assets, the domestic monetary base has increased in the same way that it would with domestic open market operations.

Unsterilized intervention thus amounts to using the foreign exchange market to conduct monetary policy in lieu of the domestic financial market. In fact, in many nations with relatively undeveloped domestic money markets, the foreign exchange market is the primary vehicle through which the central bank adjusts commercial bank reserves and the domestic money base.[5]

With sterilized intervention, in contrast, the central bank offsets the change in its net foreign asset holdings with a change in its net domestic assets. In the case of an increase in its foreign asset holdings discussed above, the central bank would sell a domestic bond in order to leave domestic base money unchanged. The net effect is that the central bank holds more foreign bonds and fewer domestic bonds, leaving base money unchanged. With the monetary liabilities of the central bank unchanged in this case, the effect of the foreign exchange market intervention operations on the monetary base is "sterilized."

Changes in the portfolio holdings of the private sector mirror those of the central bank. In the examples above, both sterilized and unsterilized intervention decrease the foreign assets held by the public. Unsterilized intervention increases the public's holdings of base money, and sterilized intervention increases the public's holdings of domestic bonds.

Few disagree that unsterilized intervention has a significant influence on the market exchange rate. By changing base money, monetary intervention influences the broader monetary aggregates, prices, interest rates, exchange rates, and usually real variables as well. Extensive empirical evidence suggests that monetary policy has a pervasive influence over the nominal and real exchange rate in the short-run, and is the primary determinant of the nominal exchange rate in the longer run, as the nominal exchange rate adjusts to reflect differences in trend inflation between nations.[6]

On the other hand, because it amounts to an exchange of domestic bonds for foreign bonds held in private portfolios, sterilized intervention will be effective only if investors view the bonds as less-than-perfect substitutes (and the investors are risk averse). In this instance, relative yields and the exchange rate will adjust in response to the change in the relative supplies of assets in portfolios.

However, most studies have failed to find systematic effects on exchange rates arising from sterilized official intervention operations over periods longer than a month.[7] Moreover, attempts to find significant and systematic portfolio ("risk premia") effects in the foreign exchange market generally also have been unsuccessful.[8] In light of this evidence, the Report of the Working Group on Exchange Market Intervention (the Jurgensen Report) commissioned at the 1982 Versailles economic summit concluded that a credible exchange rate policy must be supported by fundamental policy shifts, particularly in monetary policy.[9]

Thus in practice, as well as in theory, it is much more effective for central banks to implement an exchange rate policy by changing the monetary base through unsterilized intervention than through other potential instruments. We will therefore concentrate on this aspect of exchange rate policy in the analysis below.

II. Analytics of Monetary Policy and Exchange Rate Determination

We now formulate a rational expectations model of a small open economy that illustrates the process by which the equilibrium exchange rate is determined. Since our focus is on the implications of short-term macroeconomic disturbances, in this model we posit the existence of transitory money and real demand shocks of domestic and foreign origin. The implications of considering aggregate real supply shocks and permanent shocks within the model are discussed in Section III.

The Model

The model comprises four equations: aggregate demand and supply equations for the domestic good, an international interest rate relation linking domestic and foreign interest rates, and an equation describing money market equilibrium:

$$y_t = c_0 + c_1(p_t - E_{t-1}p_t) \tag{1}$$

$$y_t = a_0 + a_1(s_t + p_t^* - p_t) - a_2[i_t - (E_t p_{t+1} - p_t)] + u_t^d \tag{2}$$

$$i_t = i_t^* + E_t s_{t+1} - s_t \tag{3}$$

$$m_t = p_t - b_1 i_t + b_2 y_t + u_t^m \tag{4}$$

where all variables (except interest rates) are expressed in logarithms, foreign variables are denoted by an asterisk (*), and E_t represents the expectations operator conditional on information available at time t.

Equation (1) describes domestic output supply behavior, with output y_t depending on unanticipated changes in the domestic price level, $p_t - E_{t-1}p_t$. This specification implicitly presumes that the wages at which workers supply their labor to firms are based on price expectations formed from information available in the previous period. Because of this one period "contract lag," firms expand output when current prices rise above the price expected by workers. In the absence of unanticipated price changes, output equals its "natural" level, c_0.[10]

Equation (2) describes domestic aggregate output demand behavior. Aggregate real demand for the domestic good depends on a constant term a_0; positively on the real exchange rate, $s_t + p_t^* - p_t$; negatively on the domestic real interest rate, $i_t - (E_t p_{t+1} - p_t)$; and on a (white-noise) random demand disturbance term u_t^d with mean zero and variance σ_d.[11] Here s_t denotes the nominal exchange rate defined as the domestic currency price of foreign currency; i_t denotes the domestic nominal interest rate; and p_t^* denotes the foreign price level. A rise in s represents an increase in the amount of domestic currency necessary to buy a unit of foreign currency and hence a nominal depreciation in domestic currency value.

A rise in the real exchange rate $s_t + p_t^* - p_t$, that is, a real depreciation of the domestic currency, induces greater demand for domestic output while a higher real interest rate induces lower current consumption (and investment) and thereby reduces current demand. The demand disturbance term may be interpreted as representing the effects of transitory exogenous shifts in the demand for domestic output arising, for example, from changes in autonomous private and foreign (export) spending, or in domestic fiscal expenditures. (Permanent shifts in demand are reflected by changes in the parameter a_0.) Note that in the case of perfect international substitution of goods, a_1 becomes infinite in size, and this aggregate demand equation reduces to the familiar purchasing power parity relationship.

Equation (3) represents the international interest rate parity condition. Assuming risk neutrality on the part of agents and perfect capital mobility, equilibrium in the international bond market requires that the domestic nominal interest rate, i_t, equal the foreign nominal interest rate, i_t^*, plus the expected depreciation of the domestic currency. This condition implies that the return to holding domestic and foreign assets is equal. An exogenous risk-premium term could be introduced without affecting the analysis.

Finally, equation (4) represents the money market equilibrium condition. This requires the domestic real money supply to equal domestic real money demand, where the latter depends positively on domestic output, and negatively on the domestic nominal interest rate. In addition, money demand is affected by a (white-noise) random shock term, u_t^m, with mean zero and variance σ_m. The shock term represents transitory shifts in the demand for money. For example, a transitory shift by foreign residents away from foreign currency and toward domestic currency (currency substitution) or a transitory downward velocity shift of domestic origin would be represented by positive realizations of u_t^m.

To allow the possibility of exchange market intervention by monetary authorities, it is assumed that the nominal money supply is determined by the following intervention rule:

$$m_t = \bar{m} - k(s_t - \bar{s}), \tag{5}$$

where the money supply is given by the sum of a constant

trend component $\bar{m}$ and a component that varies in response to deviations in the current level of the nominal exchange rate from its long-run equilibrium level $\bar{s}$.

A zero value of k corresponds to a policy that targets money supply growth. A non-zero value of k corresponds to a monetary policy that responds to the current level of the exchange rate as a signal of economic conditions.[12] The polar cases of fixed and flexible rates correspond to infinite and zero values, respectively, of the intervention parameter, k. Intermediate values of k correspond to managed floating. With more general specifications of the intervention rule, monetary authorities might respond to other signals as well, such as the domestic interest rate or price level. (See Turnovsky [1981].)[13]

A positive value of k implies that policy is directed at "leaning against the wind," that is, a depreciation in domestic currency value (rise in s) induces a contraction of the money supply. This is a widely employed policy for moderating exchange rate movements. A negative value of k implies the opposite policy of "leaning with the wind."

For simplicity, the analysis retains the small-country assumption, and treats the foreign country variables p_t^* and i_t^* as exogenous, constant, and for convenience, equal to zero.

Equilibrium Adjustment

The set of equations (1)–(5) can be solved for the current values of y_t, p_t, s_t, and i_t as functions of money and demand disturbances:[14]

$$y_t - \bar{y} = -\frac{c_1(a_1 + a_2)}{A_0} u_t^m + \frac{c_1(b_1 + k)}{A_0} u_t^d \qquad (6)$$

$$p_t - \bar{p} = -\frac{a_1 + a_2}{A_0} u_t^m + \frac{b_1 + k}{A_0} u_t^d \qquad (7)$$

$$s_t - \bar{s} = -\frac{a_1 + a_2 + c_1}{A_0} u_t^m - \frac{1 + b_2 c_1}{A_0} u_t^d \qquad (8)$$

$$i - \bar{i} = \frac{a_1 + a_2 + c_1}{A_0} u_t^m + \frac{1 + b_2 c_1}{A_0} u_t^d \qquad (9)$$

where

$$A_0 = (b_1 + k)(a_1 + a_2 + c_1) + (a_1 + a_2)(1 + b_2 c_1),$$

and $\bar{y}$, $\bar{p}$, $\bar{s}$, and $\bar{i}$ are the long-run equilibrium levels of the system, which may be shown to equal:

$$\bar{y} = c_0$$

$$\bar{p} = \bar{m} + + b_1 \bar{i}^* - b_2 c_0$$

$$\bar{s} = \frac{c_0 - a_0 + a_1(\bar{p} - \bar{p}^*) + a_2 \bar{i}^*}{a_1}$$

$$\bar{i} = \bar{i}^*$$

Observe that the long-run nominal exchange $\bar{s}$ depends on long-run real and nominal factors. The long-run equilibrium value of the domestic currency depreciates ($\bar{s}$ rises) as the long-run domestic price level ($\bar{p}$) rises, as the long-run output level (c_0) rises, and as aggregate demand (a_0) shifts permanently downward.

Output, the domestic price level, the exchange rate, and the domestic interest rate may diverge from their long-run equilibrium values because of transitory disturbances. We now discuss the effects of transitory increases in nominal money demand and in real aggregate demand on the equilibrium for the economy.

A transitory rise in money demand (u_t^m) induces a nominal appreciation of the domestic currency, a rise in the domestic interest rate, and a decline in the domestic price level. In addition, because the nominal currency appreciation is larger than the fall in domestic prices, the rise in money demand causes a decline in $s_t - p_t$, that is, a real appreciation as well.[15] Consequently, the demand for the domestic good decreases. With wages fixed during the contract period, the fall in the domestic price level raises the producer's real wage, implying a fall in aggregate supply and output. Thus during the contract period, the upward shift in money demand has a contractionary effect on the economy.

On the other hand, a transitory positive real demand shock (u_t^d) induces a nominal appreciation of the domestic currency and a rise in the domestic price level, as well as a real appreciation, that is, a fall in $s_t - p_t$. Intuitively, the demand shock creates an excess demand for domestic output. Excess demand then induces an increase in the real value of the domestic currency to shift demand away from the domestic market.

The sign and magnitude of the intervention parameter k plays an important role in the equilibrium adjustment of the economy.[16] Observe that if k is positive, the larger is k, the larger is the denominator A_0. Consequently, from expressions (6)–(9), the responses of output, the price level, the exchange rate, and the interest rate to monetary shocks are less (in absolute value) than in the absence of any intervention. Intuitively, the more policymakers lean against the wind ($k > 0$), the more the effects of any money demand shocks are dampened by offsetting changes in the

money supply in response to changes in the exchange rate. Analogously, if the authorities lean with the wind ($k < 0$), then exchange rate movements exaggerate equilibrium responses to money shocks.

In contrast, it can be shown that the price and output responses to aggregate demand disturbances are magnified in the case of leaning against the wind and are dampened in the case of leaning with the wind. For example, a positive demand disturbance directly creates higher output and prices, but because the monetary authority responds to the associated appreciation in the domestic currency by increasing (decreasing) the money supply, the monetary authority induces a stronger (weaker) output response when a strategy of leaning against (with) the wind is pursued.

Optimal Intervention

The optimal degree of intervention can be determined by finding that value of k that minimizes the expected value of a particular policy loss function (L). For simplicity, we assume that policymakers are concerned with minimizing a weighted average of squared deviations of domestic output and the price level from their equilibrium levels:

$$L = w_1(y - \bar{y})^2 + w_2(p - \bar{p})^2$$

$$0 \leq w_1 \leq 1, \quad 0 \leq w_2 \leq 1, \quad w_1 + w_2 = 1$$

It is assumed that in determining the optimal exchange rate response function, policy makers know the structural parameters of the economy; the only source of uncertainty concerns the relative magnitudes of the stochastic disturbances.

It can then be shown that the formula for the optimal intervention strategy ($\hat{k}$) has the following form:

$$\hat{k} = -b_1 + \frac{(a_1 + a_2)(a_1 + a_2 + c_1)\sigma_m}{(1 + b_2 c_1)\sigma_d} \qquad (10)$$

where σ_m and σ_d signify the variances of the transitory money and aggregate demand shocks, respectively.

According to equation (10), the optimal intervention strategy depends on the relative variances of money and aggregate demand shocks, as well as on the structural parameters of the economy. In the presence of both domestic monetary and aggregate demand disturbances, a limited form of foreign exchange intervention is called for, with the degree of intervention determined by the relative importance of the two disturbances.[17]

Equation (10) implies that the greater is the relative magnitude of money shocks, the more the authorities should lean against the wind and intervene to resist exchange rate movements (that is, the higher should be the value of $\hat{k}$) since this policy stance will lead to smaller output effects arising from the initial money shocks. Quite simply, a positive money demand shift tends to appreciate the exchange rate. If the central bank increases the money supply in response, money market equilibrium may be restored with little or no effects on real output.[18] Conversely, the greater is the relative magnitude of aggregate demand shocks, the lower should be the value of $\hat{k}$, and the less should the authorities lean against the wind. If the variance of aggregate demand disturbances is large enough, in fact, leaning with the wind (that is, $\hat{k} < 0$) is desirable. In this instance, the authorities will again intervene, but in a manner that leads to a *decrease* in the money supply in response to the exchange rate appreciation so as to lessen the stimulatory effect on output.

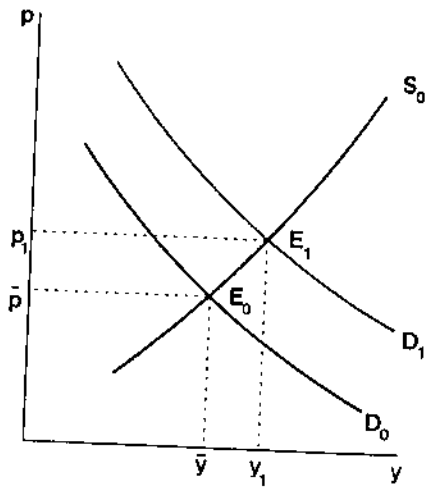
In the extreme case that money disturbances alone affect the economy ($\sigma_d = 0$), (10) implies that $\hat{k}$ takes on an infinite positive value, and perfectly fixed exchange rates are desirable. This corresponds with the rule proposed by McKinnon (1982, 1985). One interpretation of McKinnon's views is that the preferences of international investors between foreign and domestic currency are unstable (so-called "speculative" capital flows), and in turn lead to a predominance of money demand shocks in the U.S. economy. Ample evidence of U.S. money demand shocks exists, and some research indicates foreign sources of shocks, as well. The main rationale for McKinnon's policy recommendation of greater fixity in exchange rates (larger $\hat{k}$) is based on his perception of the greater relative importance of money shocks facing the economy.[19]

Perfectly flexible rates, in contrast, are desirable only in the special case that aggregate demand disturbances alone affect the economy ($\sigma_m = 0$) *and* the interest sensitivity of money demand is zero ($b_1 = 0$). A major economic rationale for Willett's (1985) policy recommendation of greater exchange rate flexibility (low $\hat{k}$ value) is his perception that real disturbances have been a relatively large source of uncertainty in the economy over the past decade.

Optimal exchange rate policy depends on the structural parameters of the economy in addition to the relative magnitudes of disturbances.[20] For example, in this framework the authorities should lean harder against the wind, the greater are the sensitivities of aggregate demand to the real exchange rate (a_1) and of aggregate supply to price surprises (c_1).

Note that the relative preferences of policymakers for output or inflation (w_1, w_2) do not appear in expression (10). The reason is that in this simple model, the economy is affected only by aggregate money and real demand

Chart 1



disturbances. Policies that minimize output fluctuations also minimize variations in inflation. Hence, the output-inflation tradeoff reflected in the weights w_1 and w_2 assigned by policymakers in their loss function drops out of the optimal intervention function.

This can be illustrated with Chart 1. The chart shows the effects on the economy of a monetary shock (downward shift in money demand) or goods market shock (rise in the demand for domestic output). Both shift the aggregate demand curve upward from D_0 to D_1, and put temporary upward pressure on prices and output. The supply schedule is unaffected. To offset the positive shock to aggregate demand, the central bank contracts money and shifts aggregate demand back to D_0. Since the contraction of aggregate demand stabilizes both output and the price level around the equilibrium values $\bar{y}$ and $\bar{p}$, there is no policy conflict in this case between the output and price objectives of the central bank.[21] In Section III we discuss how this result is affected by the introduction of real supply shocks.

III. Qualifications and Extensions

The simple analytical model described above demonstrates some of the complexities involved in attempting to formulate the appropriate role of exchange rates as an indicator or signal in the conduct of monetary policy. We have focused on two important types of shocks—money disturbances and real aggregate demand disturbances—to help us distinguish between the most divergent points of view among economists concerning the appropriate role of exchange rates in monetary policy decisions. The real world is more complicated than any simple model can hope to depict, however, and to some extent, the gains in clarity associated with our model partly have been made by abstracting from several other important policy issues. In this section we extend the analysis to address some of these complications. Specifically, we investigate the complications arising when the economy faces shocks to aggregate supply, and when the shocks are permanent rather than transitory. We also consider the relative merits of an exchange rate rule as opposed to an interest rate rule in the conduct of monetary policy under these circumstances.

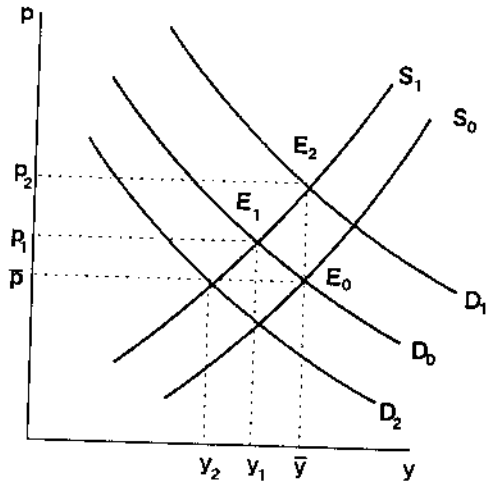
Supply Shocks

The introduction of a stochastic term in the real supply equation (1) captures the effects of transitory supply shifts arising from changes in technology and productivity, labor force growth, or natural resource availability in the economy. The oil shocks of the early and late 1970s, for example, are typically viewed as having significant unanticipated effects on the output supply function. Introducing supply shocks complicates the analysis in two important ways.

First, the optimal degree of monetary response k becomes a function of the variance of supply disturbances as well as of money demand and real aggregate demand. However, the appropriate response to exchange rate movements generated by supply disturbances no longer is clear-cut because the effect of a supply shock on the exchange rate is ambiguous. If goods demand is highly responsive to the real exchange rate (that is, foreign and domestic goods are close substitutes) and to real interest rates (a_1 and a_2 are large), then the domestic currency will appreciate in response to a positive supply disturbance. If demand is not responsive (a_1 and a_2 are small), however, the currency will depreciate in order to induce the purchase of the additional domestic output associated with the positive supply shock.[22] Thus, assuming policymakers are able to distinguish between supply and demand shocks, they still must know not only the *signs* of the relevant structural parameters (a_1 and a_2), but also their magnitudes to develop the optimal response of monetary policy to movements in exchange rates.

A second complication associated with the introduction of supply shocks in the model concerns the output-inflation tradeoff. With supply shocks, output and the price level move in different directions. In this case, the relative

Chart 2



weights policymakers place on inflation and output stability in their loss function (w_1, w_2) become important for the optimal monetary response to exchange rates.

Chart 2 illustrates the basic conflict for the case of an adverse (negative) supply shock that shifts the aggregate supply schedule from S_0 to S_1. Downward pressure is placed on output (to y_1) and upward pressure is placed on the price level (to p_1). With only one instrument (money), policymakers must choose which target, or linear combination of the two targets, they wish to stabilize. For example, if policymakers are concerned solely with output stability ($w_1 = 1$, $w_2 = 0$ in the loss function), the central bank should expand aggregate demand to D_1. This would stabilize output at its long-run equilibrium, but would exaggerate the price rise to p_2. The appropriate exchange rate policy in this case is to lean with (against) the wind if the supply shock induces a currency depreciation (appreciation).

At the other extreme, if policymakers are solely concerned with price stability ($w_1 = 0$, $w_2 = 1$), then the appropriate response would be to follow a contractionary monetary policy and reduce aggregate demand from D_0 to D_2. This would keep prices around the longer-term equilibrium ($\bar{p}$), but also would exaggerate the contractionary effect on output and move y to y_2. In this case, the policymaker should lean against (with) the wind if the supply shock induces a currency depreciation (appreciation).

Thus, in general, when the economy is facing a supply shock, greater output stability is gained at the expense of larger fluctuations in price and *vice versa*. Hence, policymakers' views of the relative costs involved in the output-inflation tradeoff become an important element in the determination of the optimal exchange rate policy.[23]

Permanent Disturbances

The focus of our analysis thus far has been on short-term stabilization policy. Our analytical framework for the optimal monetary response to exchange rate changes was therefore couched in terms of transitory disturbances to various markets.

In reality, of course, the economy faces not only temporary shocks but also permanent shocks. Moreover, temporary shocks may persist for more than one period. For example, the rise of the dollar during the early to mid-1980s was associated first with a significant monetary contraction and then with a large fiscal expansion. These were not simple one-period transitory disturbances, but lasted over a period of several years.

The effects of these policy shifts on the exchange rate and the price level have been the subject of a large body of research. Unquestionably, the long-term equilibrium value of the exchange rate $\bar{s}$ was affected by these developments. The bulk of the empirical research supports our model's prediction that a permanent monetary contraction (decline in $\bar{m}$) or fiscal expansion (rise in a_0) works to appreciate the long-term equilibrium value of the dollar exchange rate. This is seen by inspection of the expression for $\bar{s}$ given in Section II.

Our central bank loss function assumes that policymakers attempt to stabilize output and prices around their long-run equilibrium values. It is implicitly assumed that there is no attempt to offset longer-term movements in these values, and as such no reaction by the central bank to changes in $\bar{s}$. The justification for this approach is that monetary policy has no effects on the long-term (equilibrium) value of output, regardless of the form of the policy rule and response to exchange rate movements.

This formulation of the problem is appropriate for a short run focus over the course of the business cycle, but raises an important question: what if the central bank cannot distinguish transitory ($s - \bar{s}$) movements from long-term equilibrium movements ($\bar{s}$) in the exchange rate? We have assumed that the central bank knows the equilibrium values of all variables, including the exchange rate, and therefore can distinguish transitory movements, as distinct from movements in the long-run values. However, if there is a confusion between transitory and permanent movements, in addition to uncertainty concerning the nature of the underlying disturbances (real or monetary shocks), the noise in the information provided by the exchange rate is increased.

In practice, of course, policy makers *do* have difficulty distinguishing between permanent and transitory disturbances. If the Federal Reserve had attempted to offset the appreciating dollar associated with the persistent fiscal stimulus between 1982 and 1984, for example, monetary policy would have been significantly more expansionary than it was. The monetary stimulus to aggregate demand would have pushed nominal output growth and inflation significantly higher, making U.S.-produced goods more expensive even with an unchanged dollar exchange rate. The equilibrium real value of the dollar ($s + p^* - p$) still would have appreciated. Hence, it is apparent in this example that an attempt by the Fed to offset the sustained pressures on the dollar would have primarily shifted the effects away from the nominal exchange rate towards the domestic price level. Thus, to the extent that permanent or very persistent shocks are important, monetary policy needs to allow the exchange rate to adjust to the new long-run equilibrium level.

Exchange-Rate versus Interest-Rate Targets

Exchange rates and interest rates are both asset prices which, if allowed to adjust freely to market conditions, might serve as indicators of the direction of monetary policy. This raises an interesting question: in what ways does an exchange-rate target differ from an interest-rate target?

In our model, as long as the economy only faces shocks to real goods demand and/or money demand, there is no substantive difference between an exchange-rate policy target and an interest-rate policy target. This is seen in the reduced-form equations (8) and (9) for s and i, respectively. The exchange rate and interest rate response to money demand and real demand shocks are equal in magnitude and opposite in sign.

Thus, for example, a transitory increase in U.S. money demand would raise interest rates and cause the dollar to appreciate. Similarly, a transitory increase in the demand for U.S. goods also would raise interest rates and cause the dollar to appreciate. In both cases, exchange rates and interest rates give the same signal and do not help to distinguish between the two types of shocks. The Federal Reserve therefore gains no additional information by looking at interest rates (exchange rates) when following an exchange-rate (interest-rate) rule in its attempts to stabilize output and prices.

When supply shocks are present, however, this is not necessarily the case since the interest rate may reveal information about economic conditions that is not reflected in exchange rates alone. For example, under circumstances discussed above (low aggregate demand responsiveness to changes in exchange rates and interest rates), a positive supply shock, such as a transitory fall in oil prices, will cause the domestic currency to depreciate and *raise* interest rates. In this case, looking at both exchange rates and interest rates would enable policymakers to distinguish the supply disturbances from other shocks that would depreciate the dollar and lower interest rates, such as a fall in money demand or in goods demand. Thus, under the more general circumstances where supply shocks are taken into account, an optimal monetary policy rule would incorporate both exchange rates and interest rates.[24]

VI. Conclusions

This paper has investigated the issues surrounding a central bank policy of targeting exchange rate levels. We first distinguish between the various policy instruments that are potentially available to the central bank in its attempts to "manage" exchange rates. We argue that a credible exchange rate policy must be supported by monetary policy in order to be effective. However, we also demonstrate that a monetary policy designed to minimize exchange rate fluctuations will not generally be an optimal policy. In particular, the appropriate monetary response to an exchange rate movement should be dictated by the extent to which the exchange rate provides a reliable "signal" to future changes in variables of ultimate policy interest, that is, output and/or prices.

To analyze these issues, we present an open economy macroeconomic model that explicitly allows for different degrees of monetary response to exchange rate changes. The model takes into account short-term (transitory) disturbances to the goods market and money market. In this stochastic setting, we show that the optimal monetary response to exchange rate changes depends on the nature of the shocks the economy faces.

In the introduction we pointed out that two polar views on the appropriate use of exchange rates have dominated the policy debate; one view argues for strong monetary responses to incipient exchange rate movements (fixed exchange rates) and the other view argues for relatively little monetary response (floating exchange rates).

Our analysis suggests that there are reasonable arguments supporting both points of view, depending on how one reads the historical record on the types of disturbances that have predominated. Namely, the main conclusion

arising from our theoretical analysis is that an economy facing primarily money market disturbances will benefit from a strong monetary response to exchange rate fluctuations. An active exchange rate policy in this sense will reduce domestic output fluctuations. However, if goods market disturbances are the primary source of economic fluctuations, then less active exchange rate management would be appropriate.

Those who argue for an "activist" monetary response and relative fixity in exchange rates usually view monetary shocks—either of domestic or foreign origin—as having been the predominant source of shocks to the U.S. economy over the past decade. Moreover, the presumption is that the relative frequency and magnitude of the monetary shocks will continue to predominate in the near future. In contrast, those who argue for a limited monetary response usually view real demand disturbances—either of domestic or foreign origin—as the predominant source of shocks to the U.S. economy. These different readings of the historical record lead observers to different views on optimal exchange rate policy.

There is ample evidence of numerous real and monetary shocks influencing the U.S. economy over the past decade. Examples of recent real aggregate demand shocks are the large shifts in government spending and tax policies under the Reagan Administration, the introduction of new competitors from East Asia in world trade, and the boom in business investment spending in the early 1980s. Examples of recent monetary shocks are the shift in foreign investment preferences toward U.S. assets in the early 1980s, financial innovation in the U.S. economy and related velocity shifts, and Federal Reserve monetary control regime shifts.

Which type of shocks has been more important, how persistent have they been, and which will likely predominate in the future? The relative importance of shocks in the historical record is an empirical issue that remains to be resolved, despite voluminous research in this area. In the face of this uncertainty, to say nothing of the problems introduced by such supply shocks as the movements in the price of oil over the last 15 years, it would appear that some pragmatism in policymaking would be appropriate. One can interpret U.S. policy actions in this light. The Fed's recent move to a greater focus on the exchange rate is largely a pragmatic response to recent events and the concern that at times the degree of exchange rate volatility has been excessive. A gradual move away from perfectly flexible exchange rates and toward greater exchange rate fixity supported by monetary policy has been the result.

NOTES

1. See Greenspan (1988).

2. Furlong (1989) uses the order in which various economic factors were mentioned in the FOMC monetary policy directives from 1985 through August 1988 to evaluate the importance of each factor in policy decisions. This ranking criterion shows that increasing attention has been paid to exchange rates.

3. Willett (1985), p. 212.

4. The central bank need not convert its foreign exchange receipts into foreign currency securities, but in practice, central banks rarely hold the monies of other countries.

5. Switzerland is an example of an industrial nation that undertakes all of its open market operations through the foreign exchange market.

6. Empirical evidence showing a strong link between changes in the money aggregates and exchange rates has been found by Frankel (1979) and Mussa (1979), among others.

7. See Obstfeld (1982), Hutchison (1984), and Loopesko (1984).

8. See Frankel (1982).

9. The sale of government bonds to finance government budget deficits generally plays a larger role in determining the bond mix in private portfolios than does intervention. This poses another difficulty for central banks in using sterilized intervention as a tool for exchange rate management.

10. In an open economy, aggregate supply may depend also on anticipated changes in the price of domestic goods relative to changes in the general price level, and hence on changes in the expected real exchange rate. However, we implicitly assume that the *ex ante* labor supply function is inelastic with respect to the real wage prior to signing labor contracts. Once labor contracts are signed, the (*ex post*) amount of labor supplied is determined by the demand for labor which depends only on the price of domestic goods. This implies that aggregate supply would be independent of the real exchange rate.

Equation (1) could be modified to incorporate wage indexation. With full wage indexation, an unanticipated change in the general price level can lead to proportional adjustment of the domestic price. In this case, unless there were aggregate supply shocks, output would always be constant. For a concise discussion of these issues, see Marston (1985).

11. For simplicity, the real domestic interest rate is defined in terms of p, the price of the domestic good alone, rather than the general price level, which includes the price of imported goods. An analogous assumption is employed below when the nominal money supply is deflated by p. The general results are unaffected by this simplification.

12. The difference between using the exchange rate as a "signal," or "indicator," as opposed to a "target," of policy is fairly subtle. This is because any systematic monetary response to exchange rate movements will, in turn, influence the value of the exchange rate. In the case where the signal is an exogenous variable to the system (an observable signal that reflects, for example, a composite of underlying exogenous disturbances), this complication does not arise. It is noteworthy that a monetary policy that simply fixes the value of the exchange rate dissipates the "signalling" value of the exchange rate unless equivalent information concerning the changes in international reserves associated with government intervention activities is revealed to agents. See Bhandari (1982), Kimbrough (1983, 1984), Flood and Hodrick (1985), and Glick and Wihlborg (1986).

13. It should be noted that in the model as specified, lagged variables would be irrelevant to policymakers, since disturbances are not serially correlated and the current period's equilibrium is always independent of the previous period's equilibrium.

14. For details, see Glick and Hutchison (1989). It should be noted that the particular assumptions of one-period contract lags, transitory disturbances, and no inventory or real investment channels through which the effects of current shocks would persist into the future imply that current shocks have no effect on the economy beyond the current period. Thus, the rational expectation at time t of any future value of a variable is the long-run stationary value of that variable.

15. This may be seen by subtracting the coefficient for a money demand shock in (7) from the corresponding coefficient in (8). Recall that the foreign price level is assumed constant, implying $p^* = 0$.

16. Note that in this model, foreign exchange intervention is based on the authorities' knowledge of the current exchange rate, while agents base wages on information available in period $t - 1$. It is this asymmetry that allows intervention to influence output. This asymmetry may be justified by relatively greater costs associated with renegotiating nominal wages compared with adopting policy responses. See Henderson (1984).

17. The role of the relative variances of disturbances in determining exchange rate policy previously has been noted by Boyer (1978), Frankel and Aizenman (1982), Henderson (1984), and Devereux (1988). The results are analogous to those of Poole (1970) for optimal monetary policy in a closed economy. More complex policies involving two policy instruments are necessary if agents have more than one objective or if the coefficients of the model are not known with certainty.

18. It should be pointed out that Frenkel and Aizenman (1982) draw the opposite conclusion and conclude that greater exchange rate flexibility should be permitted if money shocks dominate. The reason is that they employ a model that assumes purchasing power parity and no wage contract lags so that income and the exchange rate essentially are determined by money market conditions.

In the presence of money shocks, their model implies that it is better to restore money market equilibrium by allowing price changes to occur through exchange rate changes than through output changes.

19. This rationale for monetary policy in the form of unsterilized intervention presumes that the predominant disturbances to the economy are portfolio shifts between domestic and foreign monies. If, however, the predominant disturbances are shifts between domestic and foreign-currency denominated securities and if these assets are imperfect substitutes, the appropriate monetary policy would be sterilized intervention. In this case, the central bank will offset the shift in asset demand without affecting the money supply.

20. It should be emphasized that the Lucas critique (1972) implies that the behavioral parameters of the model depend on agents' expectations concerning future government policies. Therefore, changes in government policies may affect the structure of the economy and the effectiveness of the policies themselves.

21. An alternative way to draw this conclusion is to note from the reduced-form equilibrium expressions (6) and (7) that output and price fluctuations are multiplicatively related by the parameter c_1.

22. The relevant condition for an appreciation in response to a positive supply disturbance is $(a_1 + a_2)b_2 > 1$. See Glick and Hutchison (1989).

23. The introduction of wage indexation generally reduces the impact of supply shocks. See Devereux (1988).

24. Imperfect substitutability between domestic and foreign assets also would affect the relative information content of the exchange rate and interest rate.

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