Monetary Policy under Exchange-Rate Flexibility

Rudiger Dornbusch*

Introduction

The continuing depreciation of the dollar stands out as one of the big policy issues. It has started to impinge on U.S. monetary policy; it influences the chances for international commercial diplomacy, and it is enhancing the move toward European monetary integration. Above all it leaves most observers with a puzzle as to the causes of the ongoing depreciation.

This paper will, of course, not resolve the puzzle. It rather attempts to lay out the basic analytical framework that has been developed for the analysis of exchange-rate questions and to relate it to the question of monetary policy. Part I concentrates on the development of the relevant theoretical framework. The main points to be made here are: (i) exchange rates are primarily determined in asset markets with expectations playing a dominant role; (ii) the sharpest formulation of exchange-rate theory is the "monetary approach," Chicago's quantity theory of the open economy; (iii) purchasing power parity is a precarious reed on which to hang short-term exchange-rate theory; (iv) the current account has just made it back as a determinant of exchange rates.

In Part II we review the main strands of empirical research on exchange-rate determination. The review concentrates mainly on the monetary approach where work has been quite plentiful, but also looks at some alternative formulations.

Part III pulls together these elements to form some conjectures about the working of monetary policy under flexible rates and about the dollar depreciation. In particular we draw attention to the trade-off between increased net exports and the inflationary impact induced by a depreciation.

The topic covered in this paper has received an extraordinary amount of professional attention in the last few years and much fruitful research has been accomplished. The fine surveys by Isard (1978), Kohlhagen (1978) and Schadler (1977) will place our sketchy review in the perspective of the literature and the books by Black (1977) and Willett (1977) help relate our topic to the ongoing policy discussions.

*Rudiger Dornbusch is Professor of Economics at the Massachusetts Institute of Technology. The author gratefully acknowledges helpful discussions with Jeffrey Frankel, Jacob Frenkel, Stanley Fischer and Michael Rothschild as well as financial support from the NSF.

I. Theory

In this part we review the main strands of exchange-rate theory. We start off with two rock-bottom models that, in an oversimplified manner perhaps, represent exchange-rate theory as viewed by the person in "the Street." These models, purchasing-power parity and a balance-of-payments theory of the exchange rate, each contain, of course, more than a germ of truth and thus serve as a useful introduction to our review.

We proceed from there to more structured models that emphasize macroeconomic interaction or the details of asset markets. These theories can be described as asset-market theories of the exchange rate. Extensions of these models are then considered in an effort to add realism. These extensions deal with expectations, questions of dynamics and of indexing and policy reaction.

A. Purchasing-Power Parity and the Quantity Theory

The purchasing-power parity theory of the exchange rate is one of those empirical regularities that are sufficiently true over long periods of time to deserve our attention but deviations from which are pronounced enough to make all the difference in the short run. Clearly, purchasing-power parity (PPP for short) is much like the quantity theory of money and indeed can be viewed as the open economy extension of quantity theory thinking.[1]

1. PPP Theory: PPP theory argues that exchange rates move over time so as to offset divergent movements in national price levels. A country that experiences a hyperinflation, for example, will experience at the same time a corresponding external depreciation of its currency.

The theory leaves open two important operational questions. The first deals with the channels through which this relation between inflation differentials and depreciation will come about. The second question concerns the extent to which PPP is complete, — does it hold in the short run and is there no responsibility for trend deviations over time?

The extent to which PPP holds exactly, at every point in time, and without trend deviation has been an important issue in trade theory. There is no question that theory has shown the possibility of systematic deviation that arises from the existence of nontraded goods. Specifically, Balassa and Samuelson have argued that because services tend to be nontraded, labor-intensive and show low technical progress as opposed to traded manufactures, we would expect fast-growing and innovating countries to experience an increase in their real price level over time. With prices of tradables equalized, the productivity growth in the traded sector would raise wages and the relative price of nontraded goods and thus the real price level in the fast-growing countries.

A second source of systematic deviation has been pointed out by earlier literature, including Viner, that dealt with the effect of capital flows or current account imbalance. Here it was argued that a borrowing country has a relatively high (real) price level. The argument here relies on the fact that an

[1]For extensive reviews see Officer (1976), Frenkel and Johnson (1978) and the collection of essays in the May 1978 issue of the *Journal of International Economics*.

increase in aggregate demand, financed by borrowing and a current account deficit, would raise the relative price of nontraded goods and thus the real price level. There are thus two reasons for trend deviations or systematic deviations from PPP that serve as important reservations to the generality of the theory.

Setting these reservations aside we are still left with the issue of how rapidly and completely we expect PPP to hold and through what channels it comes about. Here the literature is considerably more diffuse. A hard-core theory, associated with what Marina Whitman (1975) has aptly called "global monetarism" asserts the "law of one price." Goods produced by us and by our competitors behave as if they were perfect substitutes. Simple arbitrage by market participants will establish uniformity of price in closely integrated markets.

This hard-core view is no longer very fashionable except, of course, for raw materials, commodities and food. A more differentiated view would argue that in the short run and perhaps even in the long run there is substantial scope for product differentiation. Under these conditions price adjustment is no longer a matter of arbitrage but rather becomes a question of substitution. When our prices get out of line with those of our competitors so that we become more competitive, then we would expect demand to shift toward our goods, and in a fully employed economy, start putting upward pressure on costs and ultimately prices. The price adjustment here is certainly time-consuming; it depends not only on substitutability between supply sources — Okun's distinction between customer and auction markets is important here — but also on the state of slack in the economy and on the expected persistence of real price changes. The description of this mechanism suggests that deviations from PPP are not only possible, but may persist for some time.

The empirical content of PPP theory can be summarized as in equation (1):

$$k = (1 - a_1)\bar{k} + a_1 k_{-1} + a_2 z \ ; \ 0 < a_1 < 1, a_2 > 0$$

where k and k_{-1} measure the current and lagged deviation from PPP, $\bar{k}$ is the equilibrium real price level that has perhaps a time trend and z measures the systematic effect of borrowing or current account imbalance on the deviation from PPP. We would expect a_1 to be positive thus showing some serial correlation or persistence in deviations from PPP.

2. Money, Prices and the Exchange Rate: We turn now to a development of the "monetary approach" of exchange-rate theory. This model or approach combines the quantity theory of money — fully flexible prices determined by real money demand and nominal money supply — with strict PPP to arrive at a theory of the exchange rate.

The approach can be simply formulated in terms of a combined theory of monetary equilibrium and exchange-rate determination. Let M, P, V and Y be nominal quantity of money, the price level, velocity and real income. Then the condition of monetary equilibrium can be written as:

$$\text{(2)} \qquad \frac{M}{P} V(r,Y) = Y$$

where our notation indicates that velocity may be a function of other variables, such as interest rates, r, or income.

We can rewrite equation (2), solving for the price level, as:

$$(2)' \qquad P = V \frac{M}{Y}$$

which states that for a given velocity an increase in money leads to an equiproportionate rise in the price level. A rise in velocity likewise raises the price level while an increase in real income, by raising real money demand, would lower the equilibrium level of prices.

To go from here to a theory of the exchange rate we draw on a strict version of PPP which states that our price level is equal to foreign prices, P*, converted at the exchange rate, E:

$$(3) \qquad P = P^{*}E$$

where E is the domestic currency price of foreign exchange. Substituting (3) in (2)′ yields an expression for the equilibrium exchange rate:

$$(4) \qquad E = (1/P^{*})\, V \frac{M}{Y}$$

The equilibrium exchange rate depends on nominal money, real output and velocity. An increase in nominal money or in velocity will depreciate the exchange rate in the same proportion. A rise in real income will lead to appreciation. What is the mechanism?

The theory argues that domestic prices are fully flexible, but are linked to world prices by PPP. Given the nominal quantity of money any variations in the demand for money must be offset by compensating changes in the level of prices and thus in the exchange rate. An increase in real money demand, because say of an increase in real income, will be accommodated by a decline in the level of prices so as to raise the real value of the existing nominal money stock. With a decline in our prices, though, we are out of line with world prices and thus require appreciation of the exchange rate.

To complete the theory we note two extensions. First there is symmetry in that the foreign price level, P*, is determined by foreign money demand and supply so that we can write (3) as

$$(4)' \qquad E = \left(\frac{M}{M^{*}}\right)\left(\frac{V}{V^{*}}\right)\left(\frac{Y^{*}}{Y}\right)$$

Clearly then, what matters for exchange-rate determination in this view is *relative* money supplies, velocities and real incomes in the two countries. Our exchange rate will depreciate if, other things equal, our nominal money stock rises relative to that abroad.

The second extension is a specification of a velocity function. Here the tradition has been to assume that velocity depends on real income and the alternative cost of holding money:

$$(5) \qquad V = Y^{\lambda-1} \exp(\theta r)$$

where r is the nominal rate of interest. The functional form is a matter of expositional convenience and monetary tradition.

Substituting (5) in (4)′ and taking logs we obtain the standard equation of the "monetary approach":[2]

$$(6) \qquad e = m - m^* \lambda (y - y^*) + \theta (r - r^*)$$

where e, m, m*, y, y* are logarithms of the corresponding capital letter variables.

In the final form, equation (6) shows that an increase in our relative money stock or a decline in our relative income will lead to depreciation as would a rise in our relative interest rate. The last conclusion is particularly interesting since it certainly is the opposite of the conventional wisdom that a rise in interest rates will lead to appreciation. We return to the question below when we compare the relation between interest rates and the exchange rate in alternative theories. We note here the explanation: an increase in interest rates reduces the demand for real money balances. Given the nominal quantity of money the price level has to rise to reduce the real money stock to its lower equilibrium level. With our prices thus getting out of line internationally a depreciation is required to restore PPP.

B. Balance-of-Payments Theory of Exchange Rates

A textbook view of exchange rates will argue that the exchange rate adjusts to balance receipts and payments arising from international trade in goods, services and assets. The current account is affected by the exchange rate because it changes relative prices and thus competitiveness, the capital account is affected to the extent that expectational considerations are important. The theory can be formulated with the help of equation (7):

$$(7) \qquad BoP = 0 = C(EP^*/P, Y, Y^*) + K(r, r^*, s)$$

where BoP denotes the balance of payments, EP*/P measures the relative price of foreign goods and thus serves as a measure of our competitiveness, C denotes the current account, K the rate of capital inflow and s is a speculative variable which we disregard for the present.

Figure 1 shows the schedule BB along which our balance of payments is in equilibrium, given prices, foreign income and interest rates. A rise in E or a depreciation of the exchange makes us more competitive and thus improves the current account. To restore overall balance-of-payments equilibrium, lower interest rates are required so as to generate an offsetting rate of capital outflow. We can readily show that in this framework the exchange rate depends on interest rates, activity levels, relative price levels and the exogenous determinants of the composition of world demand:

[2]The literature of the monetary approach has predominantly used the forward premium rather than the interest differential. See, for example, Frenkel and Clements (1978). The theoretical rationale is, I believe, the idea that the relevant substitution is between domestic and foreign monies rather than between money and bonds. For a further discussion see Abel et al. (1977).

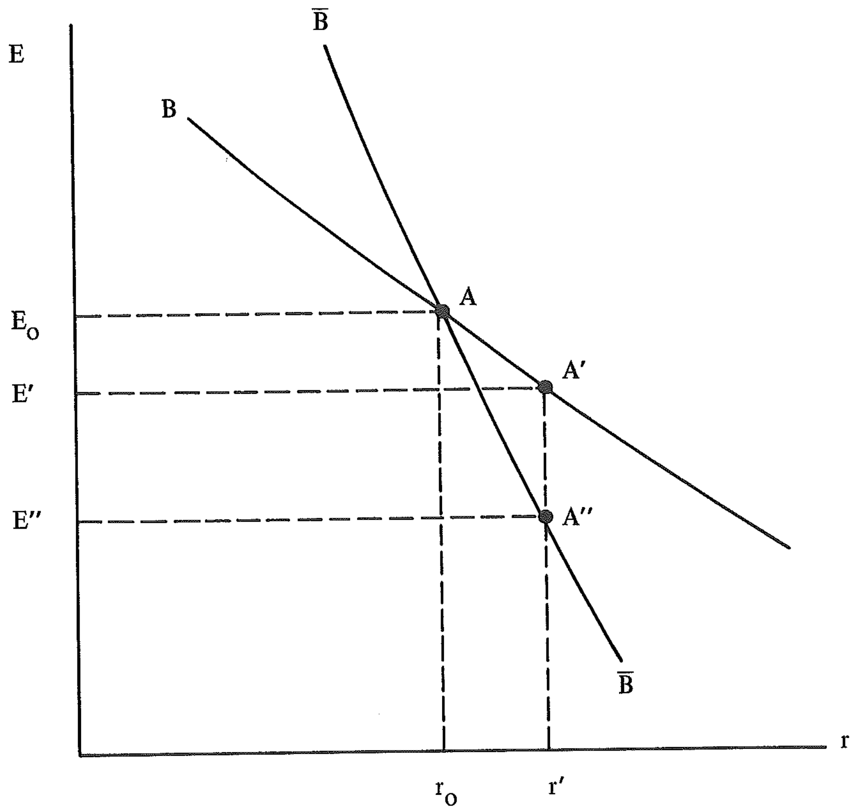


FIGURE 1

(8) $$E = E(Y, Y^*, r, r^*, P^*/P)$$

Specifically, an increase in our income, because of say an autonomous increase in spending, will worsen the current account and thus requires an offsetting depreciation. An increase in foreign prices leads to a precisely offsetting appreciation and an increase in our interest rate leads to an appreciation. The mechanism through which higher interest rates at home lead to an appreciation can be illustrated with the help of Figure 1. In the first place the increase in interest rates will lead to a net capital inflow or a reduced rate of outflow and thus causes the overall balance of payments to move into surplus. The exchange rate will accordingly appreciate — assuming the right elasticities — until we have an offsetting worsening of the current account. This is shown by the move from A to A′ on BB.

We may not want to stop at this point but rather recognize that the higher interest rates and the exchange appreciation will exert subsidiary domestic effects. With higher interest rates aggregate demand declines and thus output will fall. The same effect arises from the appreciation and the resulting deterioration of the current account. Thus we have a second round of adjustments to the decline in income which shifts the BB schedule inward over time. The long-run balance-of-payments schedule that incorporates the equilibrium level of income implied by the real exchange rate and interest rate is the steeper schedule $\overline{BB}$. In the long run we have further appreciation until point A″ is reached.

Two points deserve emphasis here. First, the approach views changes in exchange rates as changing (almost one for one) relative prices and competitiveness. It in this respect represents a view opposite to that embodied in the monetary model. Second, it contradicts the monetary model in predicting that an increase in interest rates will lead to an appreciation. I will not pursue this model further, but rather take a specialized version and embody it in a macroeconomic setting.

C. The Mundell-Fleming Model

The balance-of-payments model has drawn attention to the role of capital flows in the determination of exchange rates. This is also the perspective adopted by the modern macroeconomic approach to exchange-rate determination that originated with the pathbreaking work of Mundell (1968) and Fleming (1962). Their theory argues that the exchange rate enters the macroeconomic framework of interest and output determination because changes in exchange rates affect competitiveness. Depreciation acts much in the same way as fiscal policy by affecting the level of demand for domestic goods associated with each level of output and interest rate. A depreciation shifts world demand toward our goods and thus acts in an expansionary manner.

The Mundell-Fleming model is illustrated in Figure 2 for the case of perfect capital mobility. Perfect capital mobility means that there is only one rate of interest at which the balance of payments can be in equilibrium. If the rate were lower, there would be outflows that would swamp any current account surplus and conversely if it was higher. This is illustrated by the horizontal BB schedule. The LM schedule is the conventional representation of monetary equilibrium. Higher income levels raise the demand for money. Given the money stock, interest rates will have to rise to contain money demand to the existing level of supply. Finally, the IS schedule resembles that of a closed economy except that it includes as a component of demand net exports as determined by income and competitiveness. That is why a depreciation will shift the IS schedule out and to the right.

Consider now a monetary expansion indicated by a rightward shift of the LM schedule. The impact effect is of course to lower interest rates and thus to exert an expansionary effect on demand. The decline in interest rates, however, leads to exchange depreciation because of incipient capital outflows. The depreciation in turn enhances our competitiveness raising demand and shifting the IS curve to the right until we reach point A′. Here output and income have risen sufficiently for the increased money stock to be held at the initial rate of interest.

The framework has an important lesson for exchange-rate theory and monetary policy. First, under conditions of perfect capital mobility and given

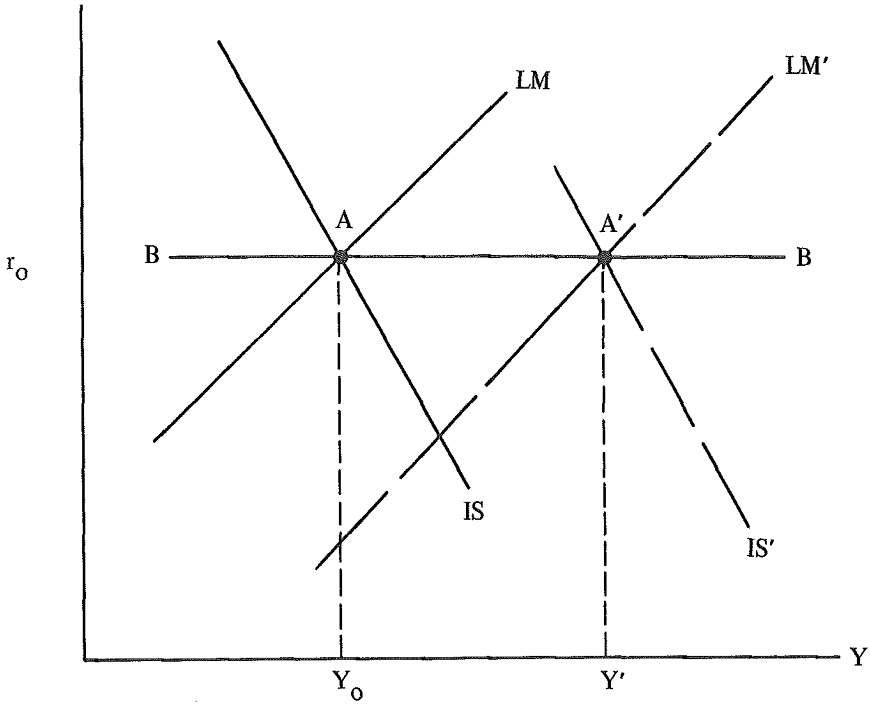


FIGURE 2

the world rate of interest, monetary policy works not by raising the interest-sensitive components of spending, but rather by generating a depreciation and thereby a current account surplus. Monetary policy works not through the construction sector but rather through the net export component of demand. This is of course a striking result, due in part to the small country assumption. It draws attention to the central role of net exports in aggregate demand and to the link between interest rates and exchange rates. It is the latter link that has become central to recent exchange-rate models.

The theory implies an equilibrium exchange rate which we can obtain either from the condition of goods market equilibrium:[3]

$$E = E(r, Y, Y^*, P^*/P, \ldots) \tag{9}$$

or as a reduced-form equation of the full system:

$$E = E(M, Y^*, \ldots) \tag{10}$$

where the dots denote fiscal policy variables and other exogenous determi-

[3]The condition of goods market equilibrium is: $Y = A(r, Y) + C(EP^*/P, Y, Y^*)$ where A ( ) denotes aggregate spending by domestic residents and C is the trade balance. We solve the equation for the exchange rate to obtain (9).

nants of goods and money demand. It is interesting to note that in (9) an increase in the (world) interest rate, because it reduces aggregate demand and thus creates an excess supply of goods, requires an offsetting depreciation that increases competitiveness and gives rise to a trade surplus.

In its present form the model has three limitations: First, there is no role whatsoever for exchange-rate expectations. This point is important because it implies that strict interest equality must obtain internationally. Second, the model allows for no effect from the depreciation on domestic prices. The depreciation is not allowed to affect either the general price level, and therefore the real value of the money stock, or the price of our output and therefore our competitiveness. It is quite apparent that in fact we should expect at least some spillover into domestic prices and that this spillover will determine the extent to which the real effects of a monetary expansion are dampened. We return to this question in section 5 below and in part II where we look at the empirical evidence. The third limitation concerns the absence of any dynamics. This limitation is important not only in respect to the price adjustment that we just noted but also for the adjustment of trade flows. The existence of adjustment lags, reviewed below in part II, implies the possibility that monetary policy in the short run may fail to be expansionary.

D. The Portfolio-Balance Model

The Mundell-Fleming model emphasizes the high substitutability between domestic and foreign assets. Capital mobility is perfect so that the slightest deviation of interest rates from the world level unleashes unbounded incipient capital flows. An alternative formulation emphasizes a more limited substitutability between domestic and foreign assets and introduces the level of the exchange rate as a variable that along with asset yields helps achieve balance between asset demands and asset supplies.[4] The model concentrates on asset markets but can readily be extended to include the allocational effects of exchange rates in affecting the current account.

Consider now the basic model as shown in equations (11)-(13) and Figure 3. In equation (11) we show the condition of monetary equilibrium where W denotes nominal wealth and where $\phi(r,r^*)$ is the fraction of wealth people wish to hold in the form of domestic money:

$$M = \phi(r,r^*)W \qquad \phi_r, \phi_{r^*} < 0 \tag{11}$$

Equilibrium in the market for domestic assets requires that the existing supply, X, equal the demand:

$$X = \psi(r, r^*)W \qquad \psi_r > 0; \psi_{r^*} < 0 \tag{12}$$

where $\psi(r,r^*)$ is the desired ratio of domestic assets to wealth. The ratio is assumed to increase with the own rate of return and to decline with the return

[4]Portfolio balance models as discussed here have been developed among others by Boyer (1977), Dornbusch (1975), Dornbusch and Fischer (1978), Flood (1976) Henderson and Girton (1975), Kouri (1976, 1977), Branson (1976), and Porter (1977).

on foreign assets. Equations (11) and (12) together with the wealth constraint:

$$W = M + EF + X$$

imply an equilibrium condition in the market for net external assets:

$$(13)\quad EF = (1-\Psi - \phi)W = \rho\,(r, r^*)W \;\; ; \; \rho_{r^*} > 0, \rho_r < 0$$

where F denotes net holdings of foreign assets measured in terms of foreign exchange. Note that since net external assets can be negative, ρ can be negative. We assume that assets are substitutes so that asset demands respond positively to their own yield and negatively to yields on alternative assets.

In Figure 3 we show the money and domestic-asset market equilibrium schedules for given stocks of each of the assets. Along MM the domestic money market is in equilibrium. Higher interest rates reduce money demand so that equilibrium requires a depreciation and thus a rise in the domestic currency value of foreign assets and hence wealth. The exchange rate thus plays a balancing role by affecting the valuation of assets. Along XX the domestic asset market is in equilibrium. Higher interest rates raise the demand for domestic assets and thus require an appreciation to reduce wealth and asset demand thus restoring equilibrium.

We want to establish next the effect of changes in foreign interest rates, changes in domestic money or net external assets. In terms of Figure 3 an increase in the foreign interest rate creates an excess supply of domestic money and domestic securities thus shifting the MM schedule down and to the right and the XX schedule up and to the right. Without question the equilibrium exchange rate depreciates.

Consider next an increase in the domestic money stock. At the initial equilibrium there will be an excess supply of money and an excess demand for domestic (and foreign) securities. Accordingly the MM schedule will shift down and to the right while the XX schedule shifts down and to the left. It is readily established that the net effect is unambiguously a depreciation of the exchange rate.[5]

Finally we consider an increase in net external assets. Now both the money market and domestic security market schedules shift to the left. They will shift in the same proportion, as inspection of (11) and (12) together with the wealth constraint will reveal. Accordingly the equilibrium exchange rate appreciates in proportion to the increase in foreign assets.

The implications of the portfolio balance model are summarized in equation (14) which shows the reduced-form equation for the equilibrium exchange rate:[6]

[5]*Using equations (11) and (12) along with the definition of wealth we have:*

$$dE/dM = \left(\frac{1}{F}\right) \frac{\Psi_r\,(1-\phi) + \Psi\phi_r}{\phi\Psi_r - \Psi\phi_r} = \frac{1}{F}\,\frac{\Psi_r\rho + \Psi\,(\Psi_r + \phi_r)}{\phi\Psi_r - \Psi\phi_r} > 0$$

which is positive on our assumption of substitution.

[6]The effect of an increase in domestic securities on the equilibrium exchange rate is ambiguous.

$$(14) \qquad E = E(r^*, M, X, F); \quad E_{r^*} > 0; E_M > 0; E_X \lesseqgtr 0; E_F < 0$$

Furthermore since (14) is homogeneous in domestic nominal money and securities we can rewrite the equation as:[7]

$$(14)' \qquad E = \gamma(r^*, X/M) \frac{M}{F}$$

In this form we emphasize that the equilibrium exchange rate depends on relative asset supplies. In particular an increase in domestic nominal assets — money and securities — relative to external assets will lead to an equiproportionate depreciation. This homogeneity property is, of course, desirable since it corresponds to an ongoing, neutral inflation process.

The portfolio balance model draws attention to the substitution possibility between domestic and foreign assets. Domestic and foreign securities are no longer perfect substitutes and accordingly their relative supplies determine, along with the nominal money stock, equilibrium interest rates and the exchange rate. A link with the current account is established by virtue of the fact that external assets are acquired over time through the current account surplus. Accordingly, as Kouri (1976, 1977) and others have emphasized, the current account determines the evolution of the exchange rate over time. In particular a current-account surplus which implies accumulation of net external assets leads to an appreciating exchange rate.

The model remains a partial-equilibrium representation in two important respects. First, we do not consider the interaction between financial markets, the exchange rate, goods markets, and the current account. Second, we do not allow for any expectational effects.

What makes this model potentially attractive for the analysis of exchange-rate questions is the direct relation between asset-market disturbances and movement in exchange rates. It extends the monetary model because we do not have to rely on shifts in money demand or supply as sole determinants of exchange-rate movements but rather can consider shifts between domestic and foreign assets, for example, as motivated by, say, expectations.

E. Expectations and Exchange-Rate Dynamics

We have so far concentrated on models of the exchange rate that are largely static and that do not emphasize the role of expectations. We extend the analysis now to questions of dynamics and to the place of expectations. The role of expectations is central to exchange-rate determination, and therefore to policies under flexible exchange rates. The spot exchange rate is almost entirely dominated by the course the public expects it to take in the near future. These expectations, of course, are influenced by the structure of the

[7]To derive (14)′ we note that taking the ratio of (11) and (12) and solving for the equilibrium interest rate we have: $r = h(r^*, X/M)$. From (13) and the wealth definition we obtain:

$$E = \frac{\rho}{1-\rho} (M/F + X/F) = (M/F) \frac{\rho}{1-\rho} (1 + X/M)$$

Substituting the equilibrium interest rate $r = h(\qquad)$ yields (14)′, where $\gamma(r^*x, X/M) \equiv$.

$$\frac{\rho(r^*, h(r^*, X/M))}{1-\rho\,(r^*, h(r^*, X/M))} (1 + X/M).$$

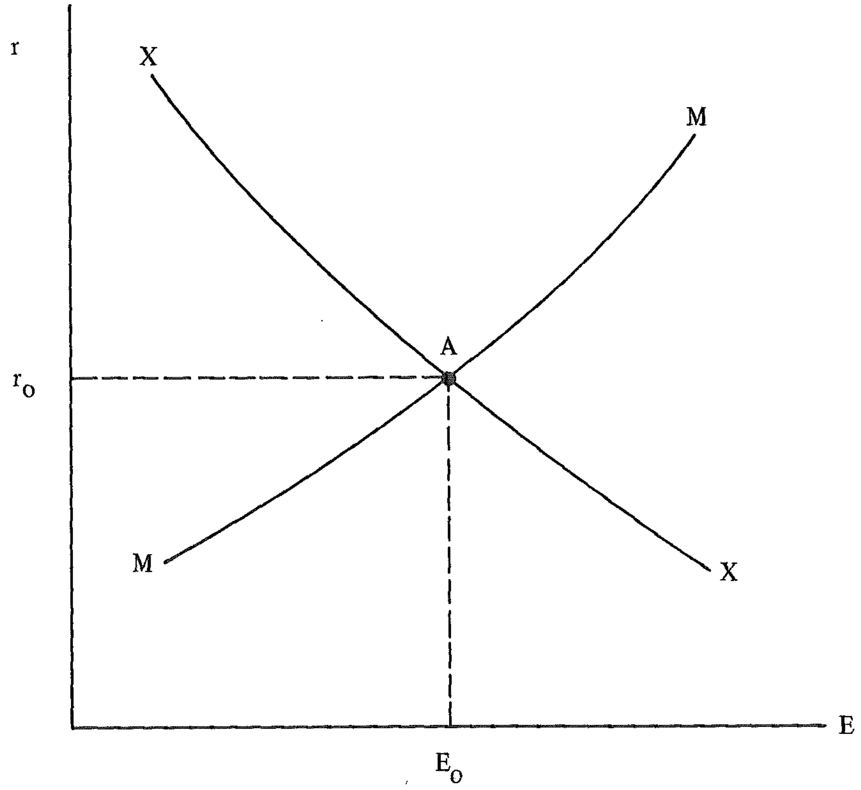


FIGURE 3

economy and institutional features such as indexing or systematic policy responses. We will in this section first review a fairly general model of exchange-rate expectations and dynamics and then extend the analysis to discuss the idea of a virtuous and vicious circle.[8]

1. Expectations: We return to the assumption of perfect capital mobility to establish a relationship between interest rates, current exchange rates and expected exchange rates. With perfect capital mobility asset holders would find themselves indifferent between holding domestic or foreign assets provided they carry the same yield, that is provided the interest differential matches the anticipated rate of depreciation:

(15) $$r\text{-}r^* \cong (\bar{E}/E - 1)$$

where r-r* is the interest differential, and where $(\bar{E}/E - 1)$ is the expected depreciation of the domestic currency which is defined as the percentage

[8]This section draws on Dornbusch (1976).

excess of the expected future spot rate, $\bar{E}$, over the current spot rate, E. We can rewrite (15) to yield an equation for the spot rate:

$$(15)' \qquad E = \frac{\bar{E}}{1 + r - r^*}$$

Equation (15)′ is central to a correct interpretation of exchange-rate movements. It argues that movements in the spot rate are due either to changes in interest differentials, given expectations, or to changes in expectations over the future course of exchange rates. Specifically, an increase in our interest rate will lead to an appreciation. The anticipation of depreciation, given interest rates, will lead to an immediate depreciation in the same proportion.

We close the model of exchange-rate determination with a theory of nominal interest rates and a theory of how exchange-rate expectations are formed. This is the point where our model ties in with the earlier theories. Thus we can appeal, for example, to the Keynesian model to argue that interest rates are determined by income, the terms of trade, and the real money stock. Suppose the foreign interest rate is given. The domestic interest rate, using the condition of money-market equilibrium as implicit in an LM schedule, will depend on income and real money:

$$(16) \qquad r = r(M/P, Y)$$

The expected future or long-run equilibrium exchange rate, $\bar{E}$ can be written as a function of the terms of trade, σ, and long-run price levels, $\bar{P}/\bar{P}^*$

$$(17) \qquad \bar{E} = \sigma(\quad)\frac{\bar{P}}{\bar{P}^*} = \sigma(\quad)\frac{\pi\bar{M}}{\pi^*\bar{M}^*}$$

which in turn are proportional to long-run money stocks, $\bar{M}$, $\bar{M}^*$ with the factors of proportionality, π and π^*, determined by exogenous real variables. Substituting (16) and (17) in (15)′ gives us a reduced-form equation for the equilibrium exchange rate:

$$(18) \qquad E = \frac{\sigma(\quad)(\pi\bar{M}/\pi^*\bar{M}^*)}{1 + r(M/P,Y) - r^*} = E(\sigma, M/P, Y; \pi, \pi^*, \bar{M}, \bar{M}^*)$$

What are the implications of our model for exchange-rate determination and monetary policy? The analysis is helped by Figure 4. The schedule QQ shows the equilibrium exchange rate of (18) for given long-run money, terms of trade and price levels and a given foreign interest rate.

The QQ schedule is downward sloping since, given money, a higher price level, say a move to point A‴ — raises the equilibrium interest rate at home and thus creates a differential in favor of the home country. To offset the differential the spot rate must appreciate — E must decline — to the point where the anticipated rate of depreciation matches the interest differential.

How will a permanent increase in the money stock work itself out in this framework? An increase in money in the long run, with all prices flexible will increase prices and exchange rates in the same proportion. This implies that

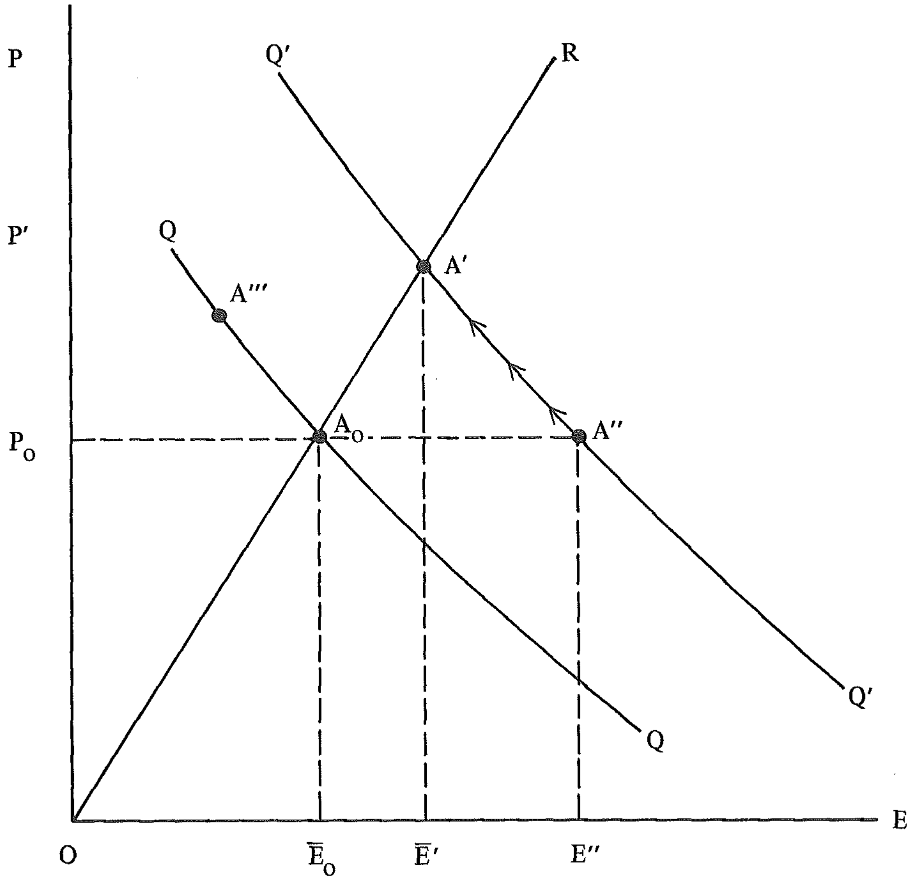


FIGURE 4

the QQ schedule shifts out to Q′Q′ and that in the final long-run equilibrium we will be at point A′ with all real variables unchanged. In the short run, though, an increase in nominal money is an increase in the real money stock. Prices are unlikely to jump and therefore a lower rate of interest is required for the public to hold the higher real money stock. With a decline in interest rates there will be an incipient capital outflow until the exchange rate has depreciated enough to create the anticipation of appreciation exactly at the rate of the interest differential. This is true at point A″ where the exchange rate has depreciated beyond its new long-run level. This *overshooting* of exchange rates is an essential counterpart of permanent monetary changes under conditions of short-run price stickiness and perfect capital mobility.

By how much will exchange rates overshoot? That depends on the nature of the price adjustment process. If prices rise very rapidly because interest response of money demand is low and that of goods demand is high or because demand is highly responsive to relative prices — then the overshooting will tend to be small. Conversely, if the adjustment process of prices is slow, then the overshooting is large.

The adjustment, following the impact effect of an increase in money, is shown in Figure 4 by the movement along Q′Q′. The exchange rate has depreciated thus making domestic goods more competitive. Interest rates at home have declined thereby raising demand. Both factors work to put upward pressure on our price level. Prices will rise, real money declines and interest rates rise back up until the new long-run equilibrium at A′ is reached.

2. *Virtuous and Vicious Cycles*[9] The framework we have laid out here helps understand a controversy that has developed about the working of a flexible-rate system. It has been argued that flexible rates make inflation stabilization more difficult in soft-currency countries and easier in hard-currency countries. The reason is that monetary policy, through the rapid reaction of exchange rates and through the overshooting, exerts rapid inflationary pressure in expanding countries and inflation-dampening in relatively tight countries. Monetary policy becomes quite possibly ineffective if one recognizes that the inflationary pressure of depreciation is quite soon translated into domestic price increases. These price increases limit the gain in competitiveness from a depreciation. In these circumstances monetary policy is primarily inflationary; it has very little, if any, effect on real aggregate demand. All that would happen is that renewed attempts at stimulating aggregate demand would translate into increasing inflation rather than more employment.

What institutional factors would check or enhance such an ostensibly unstable process? It has been argued with force that the virtuous and vicious cycle is entirely a matter of monetary determination. Unless monetary policy validates the depreciation it will ultimately undo itself. There can be little disagreement with this conclusion, except that it is fundamentally irrelevant as an observation about policy. The relevant policy setting is one where widespread indexation, for example, will immediately translate depreciation into wage and price inflation with the consequence of growing unemployment if the central bank fails to accommodate through further monetary expansion. The central bank may in practice have very little power to stop this inflationary process and the right starting point is incomes policy not monetary policy. At the same time it is, of course, true that the prospect of an effective stabilization program will immediately receive the side benefit of an appreciation and a consequent bonus in terms of inflation reduction.

F. Summary

We have now reviewed a wide spectrum of exchange-rate theories. There is little purpose in endorsing one particular formulation since each of these models seeks to capture a special effect and thus is more or less suitable for a particular instance of policy analysis. Some models view the place of the exchange rate mainly in its short-term effects on competitiveness and its long-

[9]The virtuous and vicious cycle has been discussed among others by Krugman (1977), Sachs (1978), Basevi and de Grauwe (1977) and Willett (1977).

term role in keeping prices in line internationally. Monetary and portfolio models assign importance to exchange-rate movements through valuation effects, exchange-rate movements change the real value of the money stock or the relative supplies of domestic and foreign assets.

If a choice has to be made between models, then I do see a difference between Quantity Theory-oriented models that leave for the exchange rate the purely passive role of keeping the current stock of real balances just right and expectations-oriented asset-market models in which the current level of the exchange rate is set primarily by references to its anticipated path. In this latter perspective changes in current rates bring about an adjustment dynamics the details of which depend on the differential speeds of adjustment in goods and money markets and where the adjustments that are taking place are quite possibly directed toward events that have not yet materialized but are already anticipated.

Monetarist models, of course, also recognize the importance of expectations. In those models, however, the spot rate is influenced by the effect of anticipated depreciation on real money demand. The anticipation of depreciation would reduce real money demand thus raising the price level and therefore, via PPP, lead to a depreciation of the exchange rate. The extent of the depreciation depends on the interest responsiveness of money demand. By contrast in the present model the anticipation of depreciation leads directly, as of given prices and interest rates, to an equiproportionate depreciation of the spot rate.

From the perspective of monetary policy these two strands of modeling differ of course quite radically. The Quantity Theory model assumes quite literally that prices are fully, instantaneously flexible. It thus cannot have any use for monetary policy, except perhaps to stabilize the price level in the face of money-demand fluctuations. All other models, of course, share a macroeconomic — as opposed to monetarist — persuasion where monetary policy works, more or less, because the central bank can move the real money stock. In this perspective exchange rates become a vehicle for monetary policy. One of the chief channels of monetary policy is the direct effect of money on interest rates and on the exchange rate and thereby on relative prices and aggregate demand. The empirical problem is of course whether this link makes price adjustment more rapid, or to put it differently, whether flexible rates make the Phillips curve steeper.

II. Some Empirical Evidence

In this part we will look at some of the empirical evidence that has a bearing on the exchange rate models discussed above. We will start with the evidence on PPP. From there we turn to the monetary model of exchange rates which is reviewed in section B. The asset market model is considered in section C. A discussion of the two key issues for monetary policy — the inflationary impact of import price changes and the response of trade flows to relative prices — is presented in section D.

Table 1

INFLATION AND DEPRECIATION: 1970-77
(Average Annual Rates)

	CPI	Deflator	Effective Nominal Rate	Effective Real Rate	$ Rate
Canada	7.5	8.4	-.3	.5	-.0
France	9.0	9.0	-.2	.8	-1.7
Germany	5.6	5.7	-5.3	-2.1	-6.3
Italy	12.9	n.a.	7.4	1.7	5.1
Japan	10.7	8.7	-3.6	-1.3	-4.1
United Kingdom	13.9	14.3	6.4	.9	4.7
United States	6.6	6.4	2.0	2.2	—

Note: In the last three columns a minus sign indicates an appreciation of the effective rate and an appreciation relative to the U.S. dollar respectively. The effective real rate is based on wholesale prices.
Source: *International Financial Statistics*

A. The Evidence on PPP

PPP has been studied in the literature for the last 50 years. We draw attention here to the recent review by Officer (1976) and careful study by Kravis and Lipsey (1978). Most students of PPP conclude that the theory does not hold up to the facts except in a very loose and approximate fashion. Thus Table 1 shows inflation and depreciation rates for some industrialized countries. It is true that the high inflation countries experienced on average a depreciation in their effective exchange rates. It is also true, however, that the matching between inflation differentials and depreciation is not very close.

To gain some measure of the performance of PPP we have looked at the real exchange rate for the United States and Germany. The real exchange rate here is defined as the ratio of the U.S. CPI multiplied by the exchange rate (DM/$) and divided by the German CPI, EP^*/P. On strict PPP grounds that ratio should be independent of the exchange rate and should not show any persistence in deviations from its mean. Chart 1 shows the log of the real exchange rate as the solid line. Needless to say, the real exchange rate shows very substantial fluctuations that are systematically associated with movements in the exchange rate. Thus in mid 1975 for example the dollar appreciated relative to the DM by nearly 10 percent and we see in the chart associated increase in the real exchange rate. Conversely, the depreciation of the dollar in late 1977 and early 1978 is reflected in a declining real exchange rate.

Can these deviations from PPP be modeled in a simple fashion? In particular are these deviations from PPP short-lived and self-liquidating? A formulation that tests this hypothesis regresses the log of the real exchange rate, $k = e+p^*-p$, on its own lagged value and a constant. Using monthly data for the period March 1974-May 1978 we obtain:

(19) $k = .33 + .69k_{-1}$ Rho = .65 SER = .018 DW = 1.91
$(.11)\ (.10)$

The model suggests that deviations from PPP do have persistence. To make that point we can rewrite (19) in terms of its long-run value $\bar{k}$:

(19)′ $k = .31\bar{k} + .69k_{-1}$

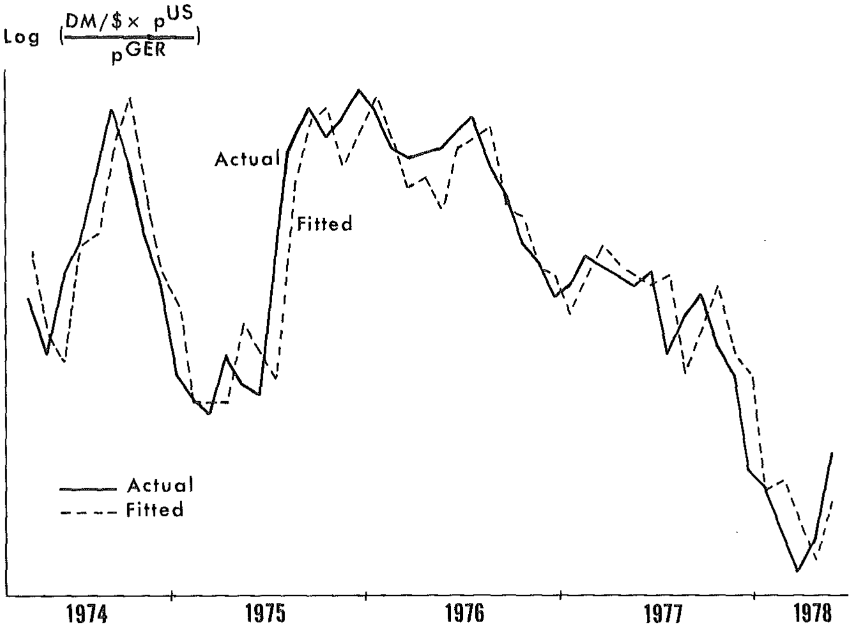
so that the real exchange rate depends to the extent of one-third on its long-run value and two-thirds on its recent history.[10]

One strand of literature, referred to earlier, sees deviations from PPP associated with current-account imbalance and capital flows. To the extent that an increase in interest rates will draw in capital flows we would expect the interest differential to help explain deviations from PPP. In (20) we report a PPP equation that includes the interest differential as an explanatory variable:

(20) $k = .19 + .81k_{-1} - 2.61(r-r^*)$ Rho = .60 SER = .018 DW = 1.90
$(.12)(.10)\ (1.56)$

Chart 1

The German - U.S. Real Exchange Rate



[10]From (19) we have $\bar{k} = \frac{.33}{1-.69} = \frac{.33}{.31}$. We can therefore rewrite (19) as $k = .31\left(\frac{.33}{.31}\right) + .69k_{-1}$ or $k = .31\bar{k} + .69k_{-1}$.

The equation shows that an increase in the interest differential in favor of Germany would cause the real exchange rate to decline. That would correspond to the case where the interest differential appreciates the mark at unchanged prices. While the interest differential thus has the expected sign, it is very imprecisely estimated and contributes little to explaining the behavior of the real exchange rate.

We have now seen the evidence on substantial and persistent deviations from PPP. I believe there is no surprise, if only because of the important role of nontraded goods. Consider for example the rates of inflation for different price indices reported in Table 2. We limit ourselves to Japan and Germany since these are the only countries that report export and import prices (as opposed to unit values). The table reveals persuasively the very substantial changes in relative prices. Export prices systematically rise at lower rates than the GNP deflator thus lending impressive support to the Balassa-Samuelson hypothesis. The terms of trade — the ratio of export to import prices — change by more than .5 percent per year.

Table 2

MEASURES OF PRICE CHANGE
(Average Annual Rates)

	GERMANY				JAPAN			
	CPI	DEF	EXP	IMP	CPI	DEF	EXP	IMP
1958-70	2.4	4.0	1.2	-0.3	5.2	4.9	0.8	0.2
1958-77	3.5	4.6	2.6	2.1	7.2	6.3	3.8	4.1

Source: Federal Reserve Bank of St. Louis and *International Financial Statistics*

In addition to sectoral changes in relative prices over time we have to recognize that pricing strategies differ across industries, across countries, and across the business cycle. In the United States pricing in manufacturing has been based on standard unit labor costs with little impact of aggregate demand or competitors' prices. Abroad there is evidence for substantially more flexible prices. The asymmetry reduces but does not eliminate the scope for exchange-rate changes to affect relative prices and thus bring about deviations from PPP.

B. The Monetary Approach

The sharpest formulation of exchange-rate determination is the "monetary approach" that is associated with the University of Chicago. It is represented in work such as Bilson (1978a, b, c)Dornbusch (1976b), Frenkel (1976), Frenkel and Clements (1978) and Hodrick (1978). The approach assumes, as we have seen, perfect price flexibility as well as PPP.[11] With these assumptions

[11]PPP is not always assumed to be instantaneous. Bilson (1978) allows for autoregressive adjustment such as in (19').

monetary equilibrium here and abroad implies an equilibrium exchange rate that can be written as in (6) and is repeated here for convenience:

$$(6) \qquad e = m - m^* - \lambda(y - y^*) + \theta(r - r^*)$$

The theory predicts that an increase in our income will appreciate the exchange rate and that monetary expansion or higher interest rates will depreciate the exchange rate. Equations such as (6) have been estimated for France in the 20s, Germany in the hyperinflation period, the United Kingdom and Germany, and the United States and Germany in the 70s. Table 3 reports in equations 1 and 4 estimates for such an equation. In each case the coefficient on relative money supplies was restricted to unity. The estimates for the period March 1974-May 1978 show that the coefficients have the expected sign, although the coefficient on interest rates is not statistically significant. We also note the very high estimate of serial correlation and the low level of the Durbin Watson even after correction for serial correlation. In sum, the equation is not very satisfactory.

There are several improvements on the basic formulation that deserve attention. A first one recognizes that the demand for money is poorly specified. There is no recognition of adjustment lags, although they have been found significant in domestic studies of money demand.[12] Nor does the equation include a long-term interest rate or deposit rate that measures the alternative cost of holding money rather than long-term assets.

Both equations 2 and 4 include a short-term and a long-term interest differential. The coefficient of the long-term rate is of the expected positive sign and is statistically significant.

Equations 3 and 6 complete the specification of money demand by allowing for partial adjustment so that our exchange rate equation becomes:

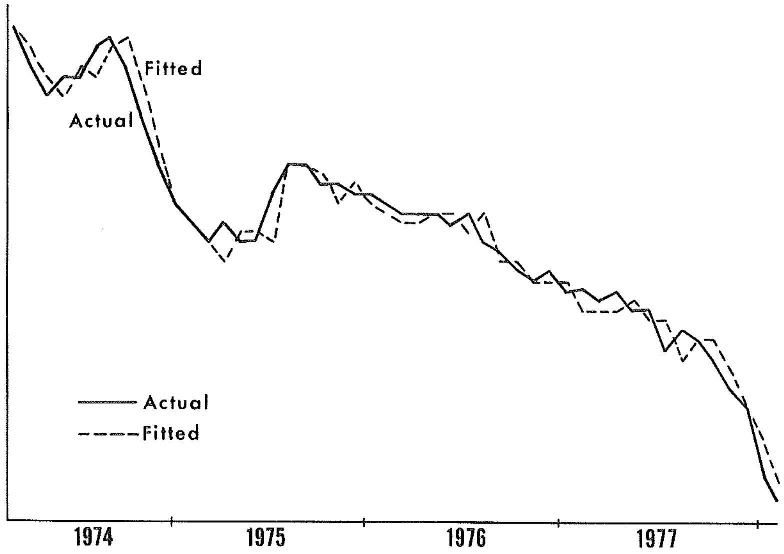
$$(6)' \qquad e = m - m^* + a_0\,(e + m^* - m)_{-1} - a_1\,(y - y^*) + a_2\,(r - r^*) + a_3\,(r_L - r_L^*)$$

This specification shown in Chart 2 substantially improves the equation by reducing the standard error and raising the Durbin Watson. The lagged coefficient is of the expected sign and magnitude and is statistically signficant. At the same time, however, the adjustment changes the sign of the short-term interest differential which now becomes negative, although it remains insignificant. This change of sign is maintained when instrumental variables estimation is used as in 6. In fact the stability of the coefficients across estimation techniques lends further support to our formulation.

One interpretation of this sign pattern has been offered by Jeffrey Frankel (1978). He argues that the exchange-rate equation of the form shown in 2 or 4 is a reduced-form equation from a system where we have both short-term real effects of monetary changes and longer term inflation differentials. In this perspective a rise in the short-term rate has to be matched by depreciation to

[12]In Bilson (1978b) the possibility of lagged adjustment of real money demand is explicitly recognized. In the empirical implementation, however, only a lagged exchange rate is used.

Chart 2
The Modified Monetary Approach



generate an offsetting expectation of appreciation. Changes in the long-term interest differential, by contrast, are a proxy for changes in the long-term inflation differential. Increased inflation thus raises long-term interest rates and leads to a depreciation of the spot rate.

C. A Criticism of the Monetary Model

A serious criticism of the monetary approach would start from the recognition that PPP does not hold as any direct test will show. Therefore an equation like (6), which explicitly relies on PPP, cannot be derived or expected to hold. This leaves expectations as the only direct link between exchange rates and the monetary sector. The argument returns us to equation (15)′ written for convenience in logs:[13]

$$(15)' \qquad e_t = {}_t\bar{e}_{t+1} - {}_t d_{t+1}$$

where the prefix denotes the time at which expectations are formed and where ${}_t d_{t+1}$ denotes the one-period interest differential starting at time t.

We now want to sketch what the implications for empirical testing of an

[13]Equalizing the expected return from an investment at home and abroad we have the following relation between the dollar returns:

$$(1 + r^*)\,\bar{E}/E = (1 + r)$$

where $\bar{E}$ is the exchange rate at which we anticipate to convert foreign exchange earnings. We can rewrite this equation as: $E = \bar{E}(1+r^*)\,/\,(1+r)$ or, taking logs, $e = \bar{e} - d$ where $d = \log(1+r)\,/\,(1+r^*) \propto r - r^*$.

Table 3

MONTHLY DM/$ EXCHANGE-RATE EQUATIONS: 1974/3 – 1978/5

#	$m-m^*$	$(e+m^*-m)_{-1}$	$(y-y^*)$	$(r_s-r_s^*)$	$(r_L-r_L^*)$	const.	Rho	SER	DW
1.	1		-.41	.87		1.13	.97	.021	1.28
			(.20)	(1.61)		(.10)			
2.	1		-.38	.14	9.12	1.24	.97	.021	1.41
			(.20)	(1.61)	(4.38)	(.09)			
3.	1	.67	-.23	-1.05	10.27	.46	.53	.018	1.94
		(.11)	(.17)	(1.49)	(3.18)	(.20)			
4.	1		-.45	3.23		1.13	.97	.022	1.36
			(.21)	(3.14)		(.12)			
5.	1		-.61	8.01	29.55	1.44	.65	.029	1.79
			(.33)	(6.65)	(3.52)	(.03)			
6.	1	.57	-.26	-1.51	13.37	.60	.58	.018	1.90
		(.21)	(.27)	(5.56)	(6.33)	(.31)			

Notes: The estimated equation is: $e+m^*-m = const + a_0 (e+m^*-m)_{-1} + a_1 (y-y^*) + a_2 (r_S-r_S^*) + a_3 (r_L - r_L^*)$ where all variables are defined in the text. Equations 1–3 were estimated using a correction for first order serial correlation. Equations 4–6 were estimated using Fair's method with production, the lagged right- and left-hand variables and time as instruments. Standard errors are in parentheses.

expectations based approach would be. For that purpose we subtract from (15)′ last period's exchange rate:[14]

(21) $e_{t-1} = {}_{t-1}\bar{e}_{t+1} - {}_{t-1}d_{t+1}$

where ${}_{t-1}d_{t+1}$ is the two-period interest differential:

(22) $$e_t = e_{t-1} + ({}_t\bar{e}_{t+1} - {}_{t-1}\bar{e}_{t+1}) - {}_t d_{t+1} + {}_{t-1}d_{t+1}$$
$$= e_{t-1} + \epsilon_t + {}_{t-1}d_t - \eta_t$$

The explanation for our equilibrium exchange rate as written here will rely on the rational use of information. Today's equilibrium exchange rate is equal to last period's adjusted for the one-period interest differential that prevailed between last period and this period. The remaining determinants of the exchange rate are white noise or fresh news or unanticipated events. They represent respectively the change in the expected future spot rate between last period and this period, ϵ_t and the reassessment of the one-period interest differential starting today, that is news about the term structure, η_t.[15]

The emphasis on exchange-rate movements as embodying new information is, of course, an essential aspect of assets-market theories of the exchange rate. This is particularly recognized in the work by Mussa (1976, 1977).

In this formulation the exchange rate will depreciate today relative to its previous level for one of three reasons:

(1.) the depreciation was anticipated and already reflected in the one-period interest differential ${}_{t-1}d_t$ which in this case would have been positive.

(2.) There is news about interest rates. The one-period differential, starting today, had been incorrectly predicted and the reassessment of the interest differential leads to a depreciation in the one-period rate. An unanticipated increase in interest rates with unchanged expectations about future exchange rates will lead to an appreciation of the spot rate.

(3.) The last piece that leads to a change in the exchange rate is news about next period's equilibrium exchange rate. Again here we look solely at a

[14]For subsequent reference we also define the log of the two-period interest rate starting last year: ${}_{t-1}d_{t+1} \equiv {}_{t-1}d_t + {}_{t-1}v_{t+1}$ where ${}_{t-1}v_{t+1}$ is the expected one-period rate differential between t and t+1, expectations being formed at t−1. With these definitions we can define the term $\eta \equiv {}_t d_{t+1} - {}_{t-1}v_{t+1}$ as the unanticipated change in the one-period interest rate. The term $\epsilon_t \equiv {}_t\bar{e}_{t+1} - {}_{t-1}\bar{e}_{t+1}$ represents new information about the future exchange rate.

[15]A closely related question, the efficency of the forward market, has been extensively tested by running regressions of the form $e_t = a_o + a_1 f_{t-1} + u_t$ where f_{t-1} is the forward rate at t−1. The test involves the joint hypothesis of $a_o = 0$ and $a_1 = 1$. See Levich (1978). The focus of interest here, of course, is that the serially uncorrelated innovations should be explained in the terms of a structural model.

change in expectations due to new information. It is apparent that rationality requires that ϵ and η be serially uncorrelated.[16]

This model of the equilibrium exchange rate draws attention to the right variables in an exchange-rate equation. The right variables in addition to the lagged rate and the one-period differential and change of differential are the *unanticipated* components of the variables that systematically affect exchange rates. Thus an unanticipated, permanent increase in money will depreciate the exchange rate in the same proportion if interest rates remain unaffected and more than proportionately if interest rates transitorily decline. A change in the terms of trade with unchanged price trends and output will immediately depreciate the exchange rate in the same proportion.

From the perspective of the monetary approach this formulation suggests that we need both a structural model that will tell us about long-term determinants of exchange rates and the dynamics of the economy and we need a model of the unanticipated component of the exogenous variables. The model differs, of course, from the monetary approach since the latter could be written as:

$$(6)'' \qquad e_t = e_{t-1} + a_0\, \Delta\,(m\text{-}m^*) \text{-} a_1\, \Delta\,(y\text{-}y^*) + a_2\, \Delta\,(r_S \text{-} r_S^*)$$

where the Δ denotes first differences. In contrast to (6)″ we have in (22) the unanticipated components of these first differences but we have in addition other structural determinants of exchange rates as they arise in a world not bound by strict PPP. To implement an equation like (22) the procedure clearly parallels work on interest rates or output determination where the implications of rational expectations have started to be tested.

D. The Portfolio-Balance Model

The portfolio-balance model has received relatively less attention than the simple monetary model. This is due, in part, to the data requirements and in part to the fact that the theory is less structured in its predictions. Nevertheless, drawing on work by Branson, Halttunen and Masson (1977) and Porter (1977) we can report some results for the \$/DM exchange rate.

We recall from equation (14)′ that the equilibrium exchange rate is determined by relative asset supplies. More particularly, an increase in the ratio of money to domestic assets will lead to a depreciation as will an increase in the ratio of domestic assets to foreign assets. The tests that have been performed have excluded domestic assets entirely and thus focus only on money and net foreign assets where the latter are obtained by cumulating current account surpluses.

In the Branson-Halttunen-Masson (BHM) model the \$/DM exchange rate is estimated for the period 1971:8-1976:12:

[16]Since η_t is observable there may be a temptation to run an equation

$$e_t = e_{t-1} + {}_{t-1}d_t + \eta_t + \epsilon_t$$

treating t as the error term. The procedure is not appropriate since the revision of interest rates is likely to be correlated with ϵ_t as the case of unanticipated money, for example, makes clear.

$$(23) \quad E = -4.85 - .0618M + .09M^* + .6758F - .3976F^*$$
$$\quad\quad (-.1) \quad (-1.7) \quad (2.8) \quad (1.7) \quad (-1.9)$$

$$Rho = .87 \quad R^2 = .94 \quad DW = 1.35$$

where t-statistics are given in parentheses, and where M, M*, F and F* denote German and U.S. nominal money stocks and net external assets. The equation supports the theory in that the coefficients of money and foreign assets have the correct signs. The corresponding elasticities are respectively: –.73, 1.85, .05 and –.22.

These elasticities with respect to money very broadly support a monetary view. The interesting novelty, however, is the inclusion of net foreign assets which here have an unambiguous effect. A current account surplus, by leading to accumulation of external assets, gives rise to an appreciation. This is an important link that had been neglected by earlier asset market views and for which support is therefore all the more important.

I see the chief interest of the portfolio model as a direction of research that moves exchange-rate theory away from money and PPP toward a perspective that emphasizes increasingly real variables: relative asset supplies, exchange-rate expectations, the terms of trade and the current account.

E. The Impact of Traded-Goods Price Movements

In this section we study briefly the impact that movements in traded-goods prices exert on the economy. Two questions concern us here. One is the extent to which an increase in import prices increases consumer prices and the GNP deflator. That question is important because it measures the inflationary impact of exchange depreciation as brought about, for example, by expansionary monetary policy. The second question concerns the responsiveness of trade flows to relative price changes. That question is of interest because it measures the extent to which depreciation induced movements in competitiveness create net exports and thus aggregate demand. Both questions are essential aspects of the dynamic extension of the Mundell-Fleming model in section 1 C above.

1. The Inflationary Impact of Import Prices: An exchange-rate depreciation will, for given world prices, raise the domestic price of imports. There is thus a direct impact on consumer prices to the extent that the CPI includes importables. There are additional effects, however, to the extent that prices of closely competing goods will tend to rise. Finally, there may be a more time-consuming adjustment as money wages rise in response to the induced CPI inflation. We have tried to capture all these effects in a rough way by a price equation that relates the rate of CPI and GNP deflator inflation to their own lagged levels, the prime male unemployment rate, u, and important price inflation, $\dot{P}$. Table 4 summarizes these results, using U.S. quarterly data for 1965/I-1977/IV.

The equations strongly support the idea that an increase in import prices spills over into increased domestic inflation. In the short run an increase in import price inflation of 2 percentage points will raise domestic inflation by about a third of 1 percent. The long-run effect is about double that figure. It is

Table 4

THE IMPACT OF IMPORT PRICE INFLATION IN THE UNITED STATES

Price Index	const	$\dot{P}_{-1}$	1/u	$\dot{P}_m$	R^2	DW
CPI	.002 (.003)	.43 (.14)	.007 (.005)	.15 (.03)	.64	1.92
GNP Deflator	.004 (.002)	.40 (.10)	.004 (.003)	.15 (.02)	.78	1.96

Note: The inflation rates on the right-hand side are one-year moving averages. Standard errors are in parentheses.

perhaps interesting to note that the magnitude of the short- and long-run effects of import prices substantially exceeds the share of imports in GNP or expenditures and thus demonstrates that there is substantial spillover.

The impact of import prices on domestic prices can thus be determined with considerable accuracy. The harder question is the impact of depreciation on import prices. Here we have substantial differences across commodities. A reasonable approximation would be to assume that an across-the-board 1 percent depreciation in the effective exchange rate would raise import prices by between a third and a half percentage point. The difference is made up in part by a decline in prices abroad and in part by a reduction in foreign profit margins.

If we combine these numbers with those in Table 1, we conclude that a 5 percentage point depreciation in the effective exchange rate would in the short run raise inflation by about .4 percent and in the long run by about double that amount. For the United States there is thus clearly an inflationary impact but it really is not very substantial in magnitude.

The experience of Germany, Switzerland, or Japan is of course quite different. With substantially more open economies import prices exert a more sizable effect on domestic prices. Accordingly, the large appreciations which these countries have experienced have made a large contribution toward stabilization of inflation. Table 5 shows inflation rates of consumer and import prices for these countries. Chart 3 looks at the case of Japan. With import prices actually declining there is a powerful check on domestic wage and price movements and thus a possibility of reducing inflation without a major recession.

2. *The Responsiveness of Trade Flows:* To complete our framework of reference we briefly look at the responsiveness of trade flows to changes in relative prices. We noted earlier that an expansionary monetary policy will depreciate the exchange rate and thus change relative prices. We now ask how much of a change in net exports can be expected. There is of course a wide body of empirical studies to draw on. We limit ourselves here to some recent estimates

by Deppler and Ripley (1978), Goldstein and Khan (1978) and Hooper (1978).

Table 6 summarizes the elasticities with respect to relative prices that emerge from these studies for the case of the United States.

The table reveals two by now well-established facts: First, that there is substantial long-run adjustment to relative price changes. The cumulative reponse of world demand to a reduction of 5 percent in the relative price of U.S. export goods is about 10 percent. Similarly on the import side we have evidence for substantial elasticities in the long-run response.

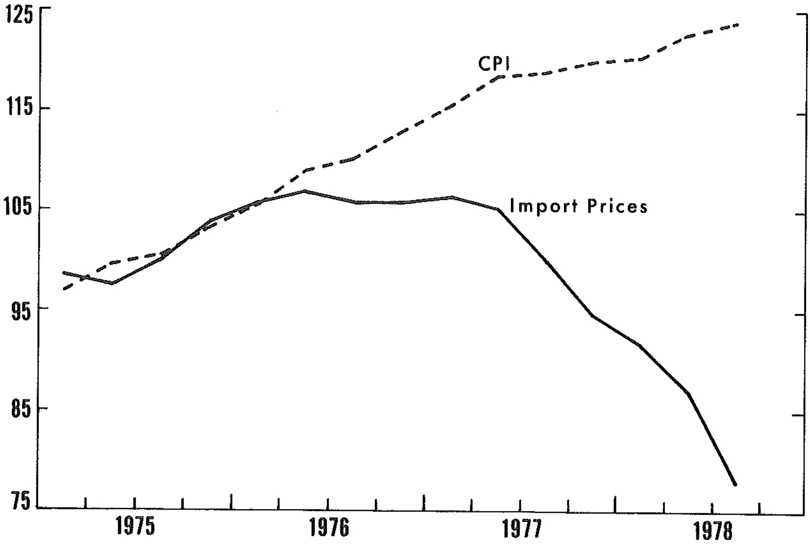
The second fact concerns adjustment lags. These lags are very pronounced as can be seen from the difference between short-run and long-run elasticities. The exact time shape of the response is very hard to determine with any precision but can readily be summarized by saying that full adjustment is a matter of years, not quarters.

The evidence then suggests that a reduction in the relative price of U.S. goods will increase net exports and thus improve the current account and add to demand. In this direction there is some compensation for the inflationary effect of monetary policy through increased prices. It is important to recognize, though, that the trade adjustment is slow and that accordingly this channel of monetary policy may be a poor instrument of cyclical stabilization policy.

III. Concluding Observations

The theoretical framework and the empirical evidence allow us to form some tentative conclusions about the determination of exchange rates and the

Chart 3
Japanese Prices



Source: International Financial Statistics

Table 5

DOMESTIC AND IMPORT PRICE INFLATION

	GERMANY		SWITZERLAND		JAPAN	
	Domestic	Import	Domestic	Import	Domestic	Import
1975	5.9	-1.7	6.7	-9.8	11.9	7.6
1976	4.5	6.7	1.7	0.4	9.3	6.0
1977	3.9	1.5	1.3	1.2	8.1	-4.2
1977/78	2.7	-6.5	1.4	-10.0	3.6	-17.0

Note: Domestic inflation is measured by the CPI. The 1977/78 data correspond to the period 1977/II to 1978/II.

Source: *International Financial Statistics* and Federal Reserve Bank of St. Louis.

Table 6

TRADE ELASTICITIES

	Short Run	Cumulative
	EXPORT DEMAND	
Total: a.	—	-2.32
b.	-1.26	-2.12
Manufactures:	-0.29	-1.52
	IMPORT DEMAND	
Manufactures:	—	1.92
Total Nonoil:	—	.92-1.15

Note: On the export side estimates a. and b. are from Goldstein and Khan (1978). The estimates for manufactured goods are from Deppler and Ripley (1978). The short run for the former is a quarter, for the latter a year. The nonoil import elasticity estimates are from Hooper (1978) using equations without a time trend.

scope for monetary policy under flexible rates. The conclusions must remain tentative because the theory itself remains very much in flux — much as the domestic counterpart in macroeconomics, and because the empirical evidence is only starting to come in and to receive proper scrutiny. With these caveats in mind here are some conclusions:

A first conclusion must concern the "right" model of exchange-rate determination. I take the evidence, theoretical and empirical, to reject the monetary approach in the narrow way in which it has been empirically implemented. The portfolio approach is important because it draws attention to the current account but the empirical work remains largely to be done. My own preference remains with an extended Mundell-Fleming model that recognizes the determination of exchange rates in assets markets, the differential speeds of adjustment of assets and goods markets and the central role of expectations of the future exchange rate in influencing the current rate. PPP in this model is a long-run tendency, although, of course, the terms of trade may have to change secularly to accommodate biased growth patterns. Given such a framework, what are our conclusions about monetary policy?

(A) Monetary policy under flexible rates and high capital mobility works not only by affecting the interest-sensitive components of aggregate demand but also by increasing net exports. Expansionary monetary policy will depreciate the exchange rate and thereby, at least temporarily, improve our competitiveness.

(B) Will expansionary monetary policy improve the current account? The gain in competitiveness that is at least transitorily achieved by an expansionary monetary policy will no doubt by itself improve net exports and thus add to aggregate demand. There is, however, a potentially offsetting increase in imports arising from the domestic expansion in demand due to lower interest rates and thus higher investment and consumption spending. The net effect on the current account remains uncertain since it depends on the relative magnitudes of the decline in interest rates and the response to relative prices. It is certainly not a foregone conclusion (except when interest rates cannot at all decline from the world level) that monetary expansion and depreciation *must* improve the current account. To the extent, though, that the interest rate effects in the first place affect construction, one would not expect the adverse absorption effects on the current account to arise early compared to the relative price effects.

(C) Monetary policy has an immediate effect on exchange rates. A change in the nominal quantity of money in the short run is a change in the real quantity of money which will bring about a change in interest rates. With changed interest rates and unchanged expectations spot rates have to move to maintain yields in line internationally. If monetary policy affects exchange-rate expectations, then the exchange-rate adjustments have to be even more pronounced.

(D) The instability or volatility of exchange rates arises from two sources. The first is the very low interest elasticity of money demand which implies that fluctuations in the demand or supply of money produce large fluctuations in interest rates and therefore require large movements in exchange rates to maintain yields internationally. The second source is instability in the exogenous variables — there is plenty of news.

(E) Movements in exchange rates affect the level of import prices directly and spill over into consumer, wholesale and producer prices. The extent and speed of this spillover is an essential question from the perspective of monetary policy. While the increase in import prices is helpful in establishing a gain in competitiveness, it, of course, hurts from a point of view of inflation. The more rapid and the more substantial the spillover of import prices into domestic prices, the more inflationary is monetary policy and the less effective it is with respect to aggregate demand.

Table 7

MONETARY GROWTH AND DEPRECIATION
(Annual Rates)

		Monetary Growth				Effective $ Rate
		Germany	Japan	United Kingdom	United States	
1976		10.3	14.2	11.4	5.1	-5.0
1977		8.3	7.0	21.5	7.1	1.1
1977	I	12.6	4.2	13.4	7.2	—
	II	6.0	-3.0	15.9	8.6	2.7
	III	12.7	16.9	29.5	8.3	2.7
	IV	10.3	7.0	29.7	7.7	10.0
1978	I	25.3	9.7	17.3	6.3	13.2
	II	6.5	13.2	n.a.	10.3	5.7

Note: The quarterly data show quarter-to-quarter changes at annual rates. The last column shows the annual rates of change of the effective dollar exchange rate. A minus sign indicates an appreciation of the dollar.

Source: Federal Reserve Bank of St. Louis, *International Financial Statistics* and *OECD Economic Outlook.*

(F) The empirical evidence indicates that the changes in real exchange rates and competitiveness induced by nominal exchange-rate movements persist for a considerable length of time. The reaction of trade flows and direct investment to these changes in relative prices are, however, slow to come about so that the net export channel cannot be counted upon as one of the more rapid responses to monetary policy.

Having reviewed in a broad manner the implications of theory and evidence for the role of monetary policy under flexible rates, we conclude with another aspect of the same question: to what extent do monetary factors account for the ongoing depreciation of the dollar? There is a worrying temptation, in this connection, to look to monetary factors as the dominant explanation. Thus the *Wall Street Journal* in a continuing public education effort has reminded us once more:

> . . . And surely the price of the dollar depends on supply and demand for the dollar. It declines because the Federal Reserve supplies more dollars than are demanded. For all the talk of swap networks, gold sales and so on, the *only* way the decline will be reversed is for the Fed to constrict the supply of dollars.[17]

Table 7 summarizes monetary growth rates for M_1 for some of the major industrialized countries and the United States. The table also shows the

[17]See *Wall Street Journal,* August 30, 1978 "The Counsel of Surrender".

behavior of the effective dollar exchange rate. Note that for the last five quarters the dollar has been depreciating, although U.S. monetary growth has been among the lowest. Note in particular German monetary growth which surely must be reckoned high. No doubt the lesson of the monetary approach — the exchange rate is the *relative* price of two moneys — must have been overlooked.

If monetary factors do not account for the full extent of the depreciation, what factors should we look to for an explanation? Of course, we should remember that real factors do have an impact on exchange rates. Suppose a given trend of monetary policies in the United States and abroad and therefore a given trend of prices. Suppose now that a current account deficit arises and that there is no expectation that it will close in the near future of itself. A change in the terms of trade will be required to restore competitiveness and thus help achieve full employment current-account balance. A deterioration of our terms of trade, of course, with a given path of prices will require a depreciation of the exchange rate.

Now let me argue why I believe this story to be a major explanation for the dollar depreciation. I see two main reasons for a "structural" U.S. current-account deficit. One is the medium-term reduced growth rates in other industrialized countries, in particular Japan and Germany. This implies that with unchanged U.S. growth (I take it a 3.5–4 percent growth path will be maintained) and given the evidence on U.S. and foreign income elasticities in trade, there will be continuing if not growing imbalance.

The second and possibly more important reason is the growing competitiveness of LDCs in manufacturing trade. These countries have achieved substantial industrialization in their domestic markets and have to look to the world market for continuing growth. They have already made an impressive performance in the U.S. market as shown by the fact that their share in our manufactured imports in the last five years has risen from 15 percent to more than 20 percent. I suspect that this trend will be substantially accelerated as the large European and Japanese direct investment in these countries starts to bear fruit. The U.S. market will increasingly prove to be the testing ground for newcomers' export drives. The resulting effect for our current account is unquestionably a deterioration unless we manage to outpace with new products and innovations the rate at which the rest of the world imitates U.S. techniques.

At present there is no evidence of a restructuring of the economy toward a dynamic, trade-oriented stance. Accordingly there is no surprise that the market should anticipate deteriorating terms of trade and ongoing depreciation. The anticipation of course translates into an immediate depreciation. The depreciation presents a conflict. It is directly and immediately inflationary and to that extent interferes seriously with an attempt to contain inflation. At the same time, though, it contributes to a restoration of U.S. competitiveness and thus helps maintain or increase aggregate demand. Since the medium-term deterioration in the terms of trade is largely inevitable, it is important not to interefere with the depreciation but rather to concentrate on a more basic macroeconomic reorientation toward fiscal restraint for an improvement in the current account combined with monetary and fiscal policies conducive to investment and growth.

References

Abel, A., Dornbusch, R., Huizinga, J., and Marcus, A. (1979) "Money Demand during Hyperinflation." *Journal of Monetary Economcs*, .

Artus, J. (1976) "Exchange Rate Stability and Managed Floating: The Experience of the Federal Republic of Germany." *IMF Staff Papers*, July.

Basevi, G. and De Grauwe, P. (1977) "Vicious and Virtuous Circles." *European Economic Review*, 10.

Bilson, J. (1978a) "The Monetary Approach to the Exchange Rate: Some Empirical Evidence." *IMF Staff Papers*, March.

——— (1978b) "Rational Expectations and the Exchange Rate." In J. Frenkel, and H.G. Johnson, (eds.) *The Economics of Exchange Rates*, Addison Wesley, 1978.

——— (1978c) "The Current Experience with Floating Exchange Rates: An Appraisal of the Monetary Approach." *American Economic Review*, May.

Black, S. (1977) *Flexible Exchange Rates and National Economic Policy*. Yale University Press.

Boyer, R. (1977) "Devaluation and Portfolio Balance." *American Economic Review*, March.

Branson, W. (1977) "Asset Markets and Relative Prices in Exchange Rate Determination." *Sozialwissenschaftliche Annalen*, Band I.

Branson, W., Halttunen, H. and Masson, P. (1977) "Exchange Rates in the Short Run." *European Economic Review*, 10.

Deppler, M.C. and Ripley, D.C. (1978) "The World Trade Model: Merchandise Trade." *IMF Staff Papers*, March.

Dooley, M. and Isard, P. (1978) "A Portfolio Balance Rational Expectations Model of the Dollar-Mark Rate." Unpublished Manuscript, Board of Governors of the Federal Reserve.

Dornbusch, R. (1975) "A Portfolio Balance Model of the Open Economy." *Journal of Monetary Economics*, May.

——— (1976a) "Expectations and Exchange Rate Dynamics." *Journal of Political Economy*, December.

——— (1976b) "Capital Mobility, Flexible Exchange Rates and Macroeconomic Equilibrium." In E. Claassen and P. Salin (eds.) *Recent Issues in International Monetary Economics*.

——— and Fischer, S. (1978) "Exchange Rates and the Current Account." Unpublished Manuscript, Massachusetts Institute of Technology.

——— and Frenkel J.A. (eds.) *International Economic Policy: Theory and Evidence*. Johns Hopkins University Press, 1979.

Fleming, J.M. (1962) "Domestic Financial Policies under Fixed and Flexible Rates." *IMF Staff Papers*, November.

Flood, R. (1976) "Asset Trading, Exchange Rate Determination and Exchange Rate Dynamics." Unpublished Manuscript, London School of Economics.

Frankel, J. (1978) "On the Mark." forthcoming, *American Economic Review*.

Frenkel, J. (1976) "A Monetary Approach to the Exchange Rate: Doctrinal Aspects and Empirical Evidence." *Scandinavian Journal of Economics*, 2.

——— and Clements, K. (1978) "Exchange Rates in the 1920's: A Monetary Approach." Unpublished Manuscript, University of Chicago.

——— (1978) "Purchasing Power Parity." *Journal of International Economics*, May.

——— and Johnson, H.G. (1978) *The Economics of Flexible Exchange Rates*, Addison-Wesley.

Girton, L. and Roper, D. (1977) "A Monetary Model of Exchange Market Pressure Applied to the Postwar Canadian Experience." *American Economic Review*, September.

Goldstein, M. and Khan, M.S. (1978) "The Supply and Demand for Exports: A Simultaneous Approach." *Review of Economics and Statistics*, May.

Henderson, D. (1978) "The Dynamic Effects of Exchange Market Intervention Policy: Two Extreme Views and a Synthesis." Unpublished Manuscript, Board of Governors of the Federal Reserve System.

—— and Girton, L. (1974) "Central Bank Operations in Foreign and Domestic Assets under Fixed and Flexible Exchange Rates." In P. Clark. et al (eds.) *The Effects of Exchange Rate Adjustments*, U.S. Treasury.

Hodrick, R. (1978) "An Empirical Analysis of the Monetary Approach to the Determination of the Exchange Rate." In J. Frenkel, and H.G. Johnson, (eds.) *The Economics of Exchange Rates*, Addison Wesley.

Hooper, P. (1978) "The Stability of Income and Price Elasticities in U.S. Trade." International Finance Discussion papers, No. 119, Board of Governors of the Federal Reserve.

Humphrey, T. (1978) "The Monetary Approach to Exchange Rates: Its Historical Evolution and Role in Policy Debates." *Economic Review*, Federal Reserve Bank of Richmond, July/August.

Isard, P. (1978) *Exchange Rate Determination: A Survey of Popular Views and Recent Models*. Princeton Studies in International Finance, No. 42.

Kohlhagen, S.M. (1978) "The Behavior of Foreign Exchange Markets — A Critical Survey of the Empirical Literature." New York University, Series in Finance and Economics.

Kouri, P. (1975) "The Theory of Exchange Rates." Ph.D. dissertation, Massachusetts Institute of Technology.

—— (1976a) "The Exchange Rate and the Balance of Payments in the Short Run and in the Long Run: A Monetary Approach." *Scandinavian Journal of Economics*, No. 2.

—— (1976b) "Foreign Exchange Market Stabilization and Speculation under Flexible Exchange Rates." Unpublished Manuscript, University of Stockholm.

—— and Braga de Marco, J. (1978) "Exchange Rates and the International Adjustment Process." *Brookings Papers on Economic Activity*, 1.

Kravis, I. and Lipsey, R. (1978) "Price Behavior in the Light of Balance of Payments Theory." *Journal of International Economics*, May.

Krugman, P. (1977) "Essays on Flexible Exchange Rates." Ph.D. dissertation, Massachusetts Institute of Technology.

Laidler, D. (1977) "Expectations and the Behavior of Prices and Output under Flexible Exchange Rates." *Economica*, November.

Levich, R. (1978) "On the Efficiency of Markets for Foreign Exchange." In R. Dornbusch and J. Frenkel (eds.) *International Economic Policy: Theory and Evidence*, Johns Hopkins University Press.

Mundell, R.A. (1967) *International Economics*, MacMillan.

Mussa, M. (1976) "The Exchange Rate, the Balance of Payments and Monetary and Fiscal Policy under a Regime of Controlled Floating." *Scandinavian Journal of Economics*, 2.

—— (1977) "Exchange Rate Uncertainty: Causes, Consequences and Policy Implications," Unpublished Manuscript, University of Chicago.

Nichans, J. (1977) "Exchange Rate Dynamics with Stock/Flow Interaction." *Journal of Political Economy*, December.

Officer. L. (1976) "Purchasing Power Parity Theory of Exchange Rates: A Review Article." *IMF Staff Papers*.

Porter, M. (1977) "The Exchange Rate and Portfolio Equilibrium." Unpublished Manuscript, Monash University.

Rodriguez, C. (1978) "The Role of Trade Flows in Exchange Rate Determination: A Rational Expectations Approach." Unpublished Manuscript, Columbia University.

Sachs, J. (1978) "Wage Indexation, Flexible Exchange Rates and Macroeconomic Policy." Unpublished Manuscript, Harvard University.

Sargen, N. (1977) "Exchange Rate Flexibility and Demand for Money." *Journal of Finance*, May.

Schadler, S. (1977) "Sources of Exchange Rate Variability: Theory and Empirical Evidence." *IMF Staff Papers*, July.

Whitman, M. (1975) "Global Monetarism." *Brookings Papers*, 3.

Willett, T. (1978) *Floating Exchange Rates and International Monetary Reform*. American Enterprise Institute.

Discussion

William H. Branson*

The conventional wisdom on exchange-rate determination and the role of monetary policy has changed dramatically in the past ten years, as can be seen by comparing the 1969 conference volume on the adjustment mechanism and this 1978 volume.

Rudiger Dornbusch's paper is a comprehensive and succinct survey of the new theoretical approaches and the evidence. I agree with the general conclusions stated at the end of the introduction and in the concluding observations. So my points here clarify or extend points on the paper, rather than raise serious objections. I will discuss these points on purchasing power parity, the monetary approach, the portfolio-balance approach, and capital mobility in the order that they appear in the paper.

1. Purchasing Power Parity (PPP)

At the beginning of his section I on theories, Dornbusch notes two reasons why the exchange rate might deviate from PPP in the long run — differential productivity growth between traded and nontraded goods, and a nonzero balance on capital account. There is another reason for long-run movement in the real exchange rate, k in section II of the paper. This is variation in the international distribution of ownership of assets, as shown in Branson (1978).

The long-run equilibrium condition to which the real exchange rate must adjust is that the current-account balance, plus any exchange-rate insensitive capital flows, be zero. For convenience, I will assume here that the latter are zero. Then we have the equilibrium condition that $X(k) - rF = 0$, where X is net exports of goods and noncapital services, and rF is net investment income on net foreign claims F. If the current-account balance is nonzero during disequilibrium periods, F accumulates or decumulates. This moves rF between long-run equilibria, requiring a change in k. This is essentially a restatement of the transfer problem; the real exchange rate must adjust to accommodate the annual "transfer" of capital income. If the adjustment mechanism also involves temporary migration, labor remittances may also require adjustment in k.

*William H. Branson is Professor of Economics and Public Affairs, Woodrow Wilson School of Public and International Affairs, Princeton University.

2. The Monetary Approach

The monetary approach to the exchange rate is summarized in the "monetary approach" equation (6) (p. 94). Dornbusch emphasizes that the theory assumes both perfect price flexibility and instantaneous tracking of PPP. I would like to draw attention, in addition, to the assumption that the interest rates, r and r*, are assumed to be exogenously determined. If the broader asset-market model, or portfolio-balance model holds, then r is determined endogenously with the exchange rate, and the OLS estimate of θ in (6) will be biased upward. This can be seen easily by adding an error term u_t to (6), and considering a case where the random $u_t > 0$. This results in e_t rising above the predicted value from (6). This in turn increases wealth in the asset-market model, increasing the demand for money and the equilibrium interest rate. So if the interest rate is endogenously determined, r in (6) will be positively correlated with the error term, and the estimate of θ will be biased upward. This is a straightforward example of simultaneous-equations bias. The problem cannot be escaped by banishing wealth from the money-demand function, as in the MPS model. This is possible in a many-asset model with a short-term riskless asset that dominates money. But in the monetary approach, there is no such menu of assets. The r here must be the rate of return on the entire aggregate of nonmoney assets.

Now compare the estimates of θ, the coefficient of $(r_s - r_s^*)$ in equations 1 – 3 of Table 3 (p. 111) with those in equations 4–6. The first three equations are estimated by OLS, the second three by instrumental variables, eliminating the upward bias. In each case, the OLS estimates are higher, although in no case is the estimate significant. Getting the interest rate coefficient right in the exchange-rate equation evidently requires endogenizing the interest rate, which means moving from monetary approach to the broader portfolio-balance approach.

3. The Portfolio-Balance Approach

In section I D of the paper, Dornbusch lays out the portfolio-balance model [equations (11) – (14)], and in section II D., he reports estimates for the dollar-deutsche mark rate from Branson-Halttunen-Masson, and the DM/SDR rate from Porter. In the form developed here, which exactly follows Branson (1977), the model is a pure revaluation model with static expectations, in the sense that the exchange rate tomorrow is expected to be what it is today. One of the purposes in developing and testing this model was to *test* the proposition that most people here take for granted: that expectations are especially important in the exchange market. The pure-revaluation version of the portfolio-balance model has the same qualitative implications for the path of the exchange rate following a monetary shock as an expectations-based model; compare Branson (1977) and Dornbusch (1976). And as Dornbusch notes, it provides a fair "fundamentals" equation for the $/DM rate. So I would object to Dornbusch's attempt to define the asset market, or portfolio-balance, model as "expectations oriented" at the end of section I.

There is one peculiar feature of this model that Dornbusch (generously) ignores. In general, there is no requirement that F, net foreign assets, be positive. All the standard results of the model assume $F > 0$. But a country can be a net debtor in foreign assets. In that case, $\rho(\bullet)$ in equation (13) and $\lambda(\bullet)$ in (14)′ are negative, and an increase in F raises E. What is happening here? Consider the effect of excess demand for F in the pure revaluation model. In the "normal" case in which $F > 0$, the resulting increase in E raises EF, restoring equilibrium. All is well. But if $F < 0$, an increase in E reduces EF, increasing excess demand. So if $F < 0$ the model (and perhaps the foreign exchange market) is unstable and $\partial E / \partial F > 0$.

This all turns out to be relevant empirically. In reestimating the $/DM equation (23) adding 1977:1 to 1978:6 to the data, BHM obtain quite similar estimates except that the coefficient of F (German private holdings of net foreign assets) is near zero and insignificant. In investigating the possible reasons for this, the fact that F was negative from 1973:1 to 1974:3 was noted. During that period the Bundesbank's interventions exceeded the current account surplus. The equation was then reestimated splitting the sample into periods with $F > 0$ and those with $F < 0$. In the $F > 0$ regime, the coefficient is significantly positive, and in the $F < 0$ regime it is significantly negative, as expected for German F in an equation for the $/DM rate. So in the pure-revaluation model's view, the period 1973:1 – 1974:3 may have been unstable in the strict sense.

One additional point on the BHM equation (23) may be interesting. We have looked at the 1978 predictions from both equation (23) estimated through 1978:6, and the $F > 0$ version of the split-sample equation. Both say that the actual $/DM rate was on target in the first two or three months of 1978. Then the actual fell increasingly below predicted to June 1978, where the gap was about 10 percent. Since June the gap has closed. So from the point of view of the portfolio-balance model, the surprise is not in the rapid fall of the dollar since summer, but the strength of the dollar (low $/DM rate) in April – June. The recent movement has been a return (roughly) to equilibrium.

4. Capital Mobility and Free Capital Movements

The term "perfect capital mobility" is used at several points in the paper with meanings that are a little confusing. In the discussions of the Mundell-Fleming model and of expectations in section I, the term is assumed to imply interest equalization. I suggest that "perfect capital mobility" be broken into two components: (a) free capital markets, and (b) perfect substitutability of assets denominated in different currencies. Both (a) and (b) are needed for interest equalization, but only (a) is needed in conclusion (A) in Section III.

Direct evidence on assumption (b) is scarce, but it is used strongly in the Mundell models to pin down the interest rate and to give the result that an expansionary fiscal policy not accommodated by domestic monetary expansion will yield a capital account and balance-of-payments surplus. The upward pressure on the interest rate yields a potentially infinite inflow of capital. This assumption is contradicted by the RDX2 model for Canada, where expansionary fiscal policy leaves the balance of payments roughly unchanged, and by my calculations using several models for the United States, where fiscal expansion worsens the balance of payments. So I would question the easy assumption of perfect substitutability, but it is not needed for Dornbusch's conclusions.