Exchange Rates and the Current Account

By RUDIGER DORNBUSCH AND STANLEY FISCHER*

This paper develops a model of exchange rate determination that integrates the roles of relative prices, expectations, and the assets markets, and emphasizes the relationship between the behavior of the exchange rate and the current account. In its orientation, it draws on and extends recent work, particularly by Pentti Kouri (1975; 1976), most closely related to this paper, and also by Jacob Frenkel and Carlos Rodriguez, Robert Flood, Charles Wilson, and Dornbusch (1975; 1976).

Early theories of the exchange rate singled out purchasing power parity or the current account as the chief determinants of the exchange rate. Work of a macroeconomic orientation, in particular the influential papers by Robert Mundell and J. Marcus Fleming, introduced capital mobility as an important aspect of exchange rate determination and presented a first formulation of the assets market view. In this theory, the exchange rate achieves a level such that the goods market clears and money demand equals money supply at the prevailing level of income and world interest rates.

Extensions of this approach have emphasized the possibility of international nominal interest differentials arising from exchange rate expectations. Coupled with assumptions about the formation of exchange rate expectations, in particular rational expectations, these formulations have introduced the idea of exchange rate dynamics and of overshooting arising from differential adjustment speeds in goods and assets markets.

In a parallel development, exchange rate theory has been extended to reintroduce the current account as an important determinant of the exchange rate. In this perspective, assets markets determine the exchange rate at a point in time, but the current account through its effect on net asset positions, and therefore on assets markets, determines the path of the exchange rate over time. The introduction of rational expectations merges the assets and current account theories of exchange rates because it can lead to a fully anticipated equilibrium path in which asset prices adjust in part to reflect future current account developments.

The present paper extends this literature in two respects. First we depart from the one-commodity model that has been used extensively. Instead we assume that the country to be analyzed produces a differentiated product, whose world relative price is endogenous. This is an important departure from earlier models because the extension implies that the behavior of the exchange rate is not exclusively determined by the behavior of equilibrium real money demand via a strict purchasing power parity link.

Our second extension, drawing on work by Fischer, Olivier Blanchard, and Wilson, is to consider the current effects of anticipated future disturbances. This question is important because it suggests patterns of exchange rate and current account behavior that do not flow from expectations-augmented current account models.

Section I develops the basic model for the case of static expectations. The extension to perfect foresight is developed in Section II. Anticipated future disturbances are analyzed in Section III. Concluding comments are contained in Section IV.

I. The Model with Static Expectations

In this section we analyze a small open economy that trades in goods and securities with the rest of the world. The home country is at full employment, prices are flexible, and output is given. The world demand for

*Massachusetts Institute of Technology. We are indebted to George Borts and an anonymous referee for their suggestions. Financial support was provided by grants from the National Science Foundation.

the home country's product depends on the relative price or the terms of trade. In the import market, the home country is small in the sense that the world price of importables is given in terms of foreign exchange.

The asset menu of our model is severely restricted so as to concentrate on essentials. Domestic residents can hold domestic money or foreign interest-earning bonds.[1] The foreign bonds are "real" bonds promising to pay a unit of foreign output indefinitely.[2] The world interest rate is taken as given.

Short-run equilibrium in this economy corresponds to an exchange rate and a domestic price level—a terms of trade and a real value of cash balances, equivalently—such that the money market clears and the market for domestic goods is in equilibrium. The equilibrium is contingent on a given stock of external assets, and in turn it determines equilibrium saving and hence the current account imbalance and asset accumulation until a long-run equilibrium with a balanced current account is attained.

A. *Short-Run Equilibrium and Dynamics*

We start by setting out the basic model. Equilibrium in the money market obtains when money demand, a function of income and the alternative cost of holding money is equal to the supply of money:

$$(1) \qquad M=k(r^*+x)[Py+eP^*a] \qquad k'<0$$

where M is the nominal money supply, r^* and x are the given foreign interest rate and the anticipated rate of depreciation of the exchange rate, P is the price of domestic output, and y is domestic physical output. The term eP^*a denotes the income from foreign bonds measured in terms of domestic currency, which is of course part of domestic income. Here e is the exchange rate, P^* the given foreign price level, and a the number of income streams each yielding one unit of foreign output indefinitely.

Dividing equation (1) by the domestic price of domestic output we have one of our equilibrium conditions:

$$(1') \qquad m=k[y+\lambda a]; m\equiv M/P; \lambda\equiv eP^*/P$$

where m and λ denote the real value of money and the terms of trade, respectively. For the present we treat expected depreciation as identically equal to zero so that in conjunction with the given foreign interest rate the opportunity cost of holding money is constant and so accordingly is k.

In the goods market we assume that domestic demand for our output, D, is a function of the terms of trade λ, and real wealth w. Foreign demand for our goods, X, is just a function of the terms of trade:

$$(2) \qquad y=D(\lambda,w)+X(\lambda); D_\lambda, X_\lambda>0; D_w>0$$

where real wealth is the sum of the real value of cash balances plus the real value of external assets, $\lambda a/r^*$:

$$(3) \qquad w\equiv m+\lambda a/r^*$$

An increase in the relative price of foreign goods (a rise in λ) is assumed to shift demand toward domestic goods. An increase in wealth raises aggregate spending, part of which falls on domestic output thus raising demand.

When the goods market clears, the current account equals the excess of income over spending. In our economy, without a government sector, taxes, or investment, the excess of income over spending is equal to saving. Saving is assumed to be a decreasing function of nonhuman wealth and an increasing function of labor income where the latter is by assumption constant and therefore suppressed as an argument:[3]

$$(4) \qquad S=S(w); S_w<0$$

[1]Without loss of generality, we exclude domestic holdings of foreign monies since they are dominated as securities by foreign interest-earning assets.

[2]It is inevitable that a special case has to be chosen —foreign bonds could be nominal or real, in domestic currency or foreign currency, in terms of domestic or foreign output. The choice does have implications for the results we derive.

[3]This saving behavior reflects the standard life cycle theory of saving and consumption. See Franco Modigliani. The reader will note an asymmetry between our money demand which is, along transactions

Finally we note that the current account surplus is equal to the rate at which the home country acquires claims on the rest of the world. Accordingly we can write

$$\dot{a}/r^* = S(w)/\lambda \tag{5}$$

This completes the formal model and we now proceed to show the determination of short-run equilibrium.

We can solve (1′) for the equilibrium stock of real balances as an increasing function of the value of external assets:

$$m = m(\lambda a) \qquad m' > 0 \tag{1''}$$

An increase in the value of external assets raises real income, real money demand, and therefore, via a decline in the price level, the equilibrium real money stock.

Having determined equilibrium real balances, we can turn to the goods market where we determine the equilibrium terms of trade as a function of the given level of external assets, a. With real balances determined in (1″) real wealth is a function of the terms of trade and external assets. An increase in external assets a raises real wealth directly and via the induced change in real balances. There is accordingly an increase in demand for domestic output. To restore equilibrium the terms of trade must improve —λ, the relative price of imports, must decline. The decline in the terms of trade falls proportionately short of the increase in assets. Otherwise real wealth would be unchanged or rise so that the relative price decline via the substitution effect would leave an excess demand.[4]

$$\lambda = \lambda(a); \lambda' < 0; \phi \equiv -(a/\lambda)d\lambda/da < 1 \tag{6}$$

demand lines, a function of income, and our saving function where wealth is a determinant. It is readily verified that introducing wealth rather than income as a determinant of money demand will not change the analysis. Income as the sole determinant of saving, on the contrary, would imply instability.

[4]From equations (1′), (2), and (3), we can calculate the expression for the proportional change in the terms of trade induced by a change in assets:

$$(a/\lambda)\, d\lambda/da = -\frac{(a/r^* + ka)\, D_w}{D_w(a/r^* + ka) + D_\lambda + X_\lambda}$$

Accordingly $\phi \equiv -(a/\lambda)\, d\lambda/da$ is less than unity in absolute value.

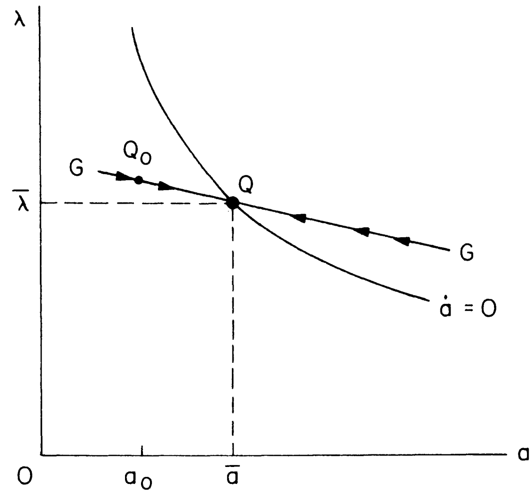

FIGURE 1

In Figure 1 we show as the GG schedule the relation between the equilibrium terms of trade and external assets. Moving down and along the schedule real wealth rises, raising demand for domestic output and therefore requiring an offsetting increase in the relative price of domestic goods.

We also show in Figure 1 the schedule $\dot{a} = 0$ along which the current account is in balance. The schedule is a rectangular hyperbola since wealth is constant only for a given value of external assets. The schedule must cross the GG schedule from above. To the left of the $\dot{a} = 0$ schedule, real wealth is too low, saving is positive, and therefore assets are being accumulated. Conversely, to the right of the $\dot{a} = 0$ schedule, there is dissaving and asset decumulation through a current account deficit.

At any point in time there exists an amount of external assets, say a_o. Associated with that asset position there is an equilibrium stock of real balances and a level of real wealth that determine spending, the equilibrium terms of trade $\lambda(a_o)$, and the current account. At point Q_o in Figure 1, with assets a_o, there is a current account surplus and asset accumulation. The accumulation will persist until we reach the steady-state level of assets $\bar{a}$ where the current account achieves balance.

Note particularly that, as the economy moves along GG, the current account is in

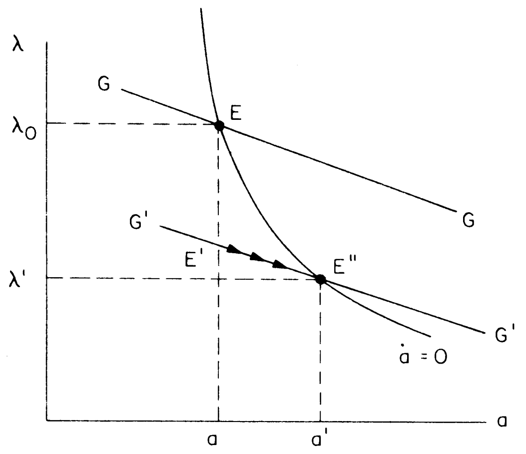

FIGURE 2

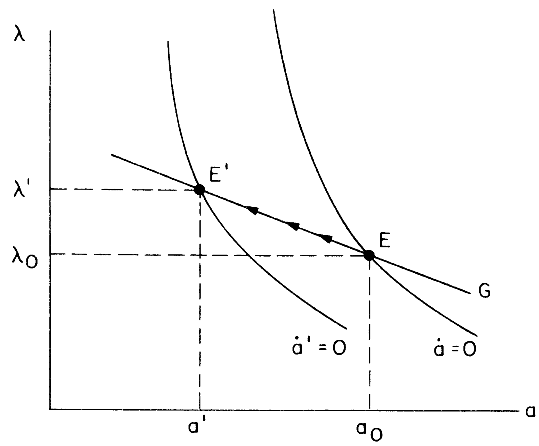

FIGURE 3

surplus (we are acquiring foreign assets). The terms of trade improve and with P^* fixed, a current account surplus accompanies an appreciating exchange rate.

To demonstrate the stability of the model formally, we observe the stability condition:

$$(7) \qquad \frac{d\dot{a}}{da} = S_w\left(1 - \phi + \frac{rm'}{\lambda}\right) + \frac{\dot{a}}{a}\phi$$

As shown above, ϕ is less than one along the GG schedule so that stability is ensured in the neighborhood of the steady state.

B. *Comparative Statics*

The long-run equilibrium shown in Figure 1 can be disturbed by changes in exports or the composition of domestic spending, on one side, or by changes in saving with corresponding increases in the level of spending on either domestic goods or imports.

Consider first an increase in world demand for our goods, a shift in the $X(\lambda)$ function in equation (2). At the initial equilibrium there is now an excess demand for domestic output, and accordingly, we require an improvement in the terms of trade, or a decline in wealth through reduced external assets, to maintain market equilibrium. Thus in Figure 2 the GG schedule shifts to $G'G'$. The new long-run equilibrium is at E'' with an improvement in the terms of trade and an increase in external assets.

The adjustment process to the new equilibrium involves an immediate improvement in the terms of trade to point E', and at that point a current account surplus. The current account surplus leads to external asset accumulation and further improvement in the terms of trade until real wealth returns to its initial level at point E''. At E'' the trade deficit, measured in terms of foreign goods, increases by the increase in a. In terms of domestic goods the deficit is equal to λa and remains unchanged (between E and E'').

As an alternative disturbance we consider now an increase in imports arising from a reduction in saving. Assume that in terms of equation (4) we have a reduction in planned saving with a corresponding increase in import spending. In Figure 3 we show this as a leftward shift of the zero saving schedule. We now require lower external assets to maintain zero saving. The new long-run equilibrium at point E' is one with a decline in external assets and a worsening of the terms of trade. The new equilibrium is reached through the current account deficit at point E that leads to external dissaving. The demand for domestic goods declines with the reduction in external assets, and domestic competitiveness has to be enhanced through a decline in the relative price of domestic goods so as to maintain market equilibrium.

C. Exchange Rate Behavior in the Adjustment Process

We focus now on exchange rate movements in the adjustment process, and particularly on the relationship between the exchange rate and the current account. It is apparent that the exchange rate is determined along with the general equilibrium in the goods and assets markets. We can study its behavior by starting from the definition of the terms of trade, $\lambda \equiv eP^*/P$. Accordingly we can write the exchange rate as

$$(8) \quad e \equiv \lambda P/P^* \equiv [\lambda/(M/P)][M/P^*]$$

Equilibrium λ is determined from equation (2) (and shown by the *GG* schedule) and, given y, is a function only of a. Equilibrium M/P is from (1′) a function of a and λ, but since the latter is a function of a, M/P too may be taken to be a function only of a. Accordingly we can write the equilibrium exchange rate as a (diminishing)[5] function of a:

$$(9) \quad e = \frac{\lambda(a)}{M/P(\lambda, a)}(M/P^*) = J(a)(M/P^*) \qquad J_a < 0$$

Expanding (9) around the long-run equilibrium, we can write the linear approximation:

$$(10) \quad e = \bar{e} + \gamma(a - \bar{a}); \gamma \equiv J_a(M/P^*) < 0$$

where the bar denotes long-run equilibrium values. Equation (10) shows that the equilibrium exchange rate is equal to the long-run equilibrium rate $\bar{e}$, adjusted for the deviation of external assets from their steady-state level.

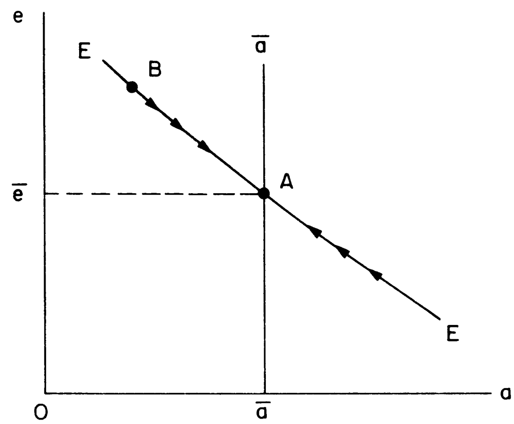

FIGURE 4

The equilibrium exchange rate path is shown in Figure 4 as the *EE* schedule. The figure shows that for levels of external assets below the steady-state level $\bar{a}$, such as at point *B*, the exchange rate is above its steady-state level $\bar{e}$. Assets are accumulated as a moves up to $\bar{a}$ (from point *B* to point *A*), at the same time as e appreciates to $\bar{e}$. Since asset accumulation takes place through a current account surplus, we have a current account surplus accompanying an appreciating exchange rate in the adjustment process. This is in accordance with the popular view of the relation between the exchange rate and the current account.[6]

II. Exchange Rate Expectations and the Adjustment Process

In this section, we take account of expectations of inflation in their effect on velocity and thus on the terms of trade, the exchange rate, and the rate of accumulation. Once again, we are in a full-employment context. We start with the recognition that the alternative assets are domestic money and foreign assets. By assumption, goods are not storable. Thus the relevant alternative cost to money holders is the foreign interest rate

[5]From (1″), (6), and (8), we have

$$de/da = -(e/a)\left[\phi + (1-\phi)\frac{a\lambda}{Y + a\lambda}\right] < 0$$

[6]It may be useful for the reader to go back to Figures 2 and 3 and confirm in those cases the relationship between the exchange rate and the current account specified in this paragraph.

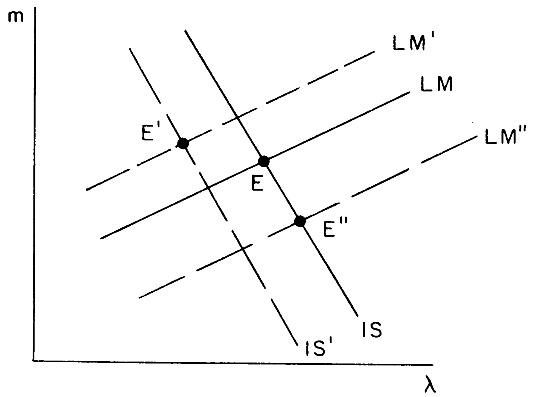

FIGURE 5

plus the anticipated rate of depreciation x. Given the foreign interest rate, velocity thus depends on the expected rate of depreciation. We are interested now in describing the adjustment process once these expectations, allowed to be rational, are taken into account.

We shall eventually study the dynamic adjustment process in some detail. But we begin with the short-run (instantaneous) equilibrium of the economy, implied by equations (1″) and (2), the money and goods market equilibrium conditions, respectively. Note that now $k=k(x)$[7] and that an increase in the anticipated rate of depreciation of our currency raises velocity or reduces k.

The instantaneous equilibrium determines the terms of trade λ and the stock of real balances m as functions of the stock of foreign assets a, and the expected rate of depreciation x. Figure 5 shows the money market equation (1′) and goods market equation (2) as the LM and IS curves, respectively. We repeat (1′) and (2) for convenience:

$$(1') \qquad m=k(x)[y+\lambda a];\, m\equiv M/P$$

$$(2) \qquad y=D(\lambda, m+\lambda a/r^*)+X(\lambda)$$

The LM curve is upward sloping since an increase in λ increases income measured in domestic goods, and increases the demand for money. The IS curve slopes downwards because an increase in λ increases the demand for our output, and has therefore to be offset by a fall in m to maintain goods market equilibrium.

The equilibrium at E depends, at any moment, on the values of a and x in a manner we shall now examine. An increase in assets a increases the demand for money and moves the LM curve up to LM'; it also increases the demand for goods and therefore moves the IS curve down to IS' (a lower m is needed to maintain goods market equilibrium). The new equilibrium is at E'. The terms of trade unambiguously improve, while it can be shown that the stock of real balances rises, that is, that the horizontal shift in the IS curve is less than that of the LM curve. Both these results—that an increase in our holdings of foreign assets increases the stock of real balances, and improves the terms of trade—are intuitively plausible.

Next we consider the effects of an increase in the expected rate of depreciation on m and λ. An increase in x reduces the demand for money and shifts the LM curve down to LM''. In the new equilibrium at E'', the terms of trade have worsened and real balances have fallen. Since $e=\lambda P/P^*$ and both λ and P have risen, the anticipation of depreciation induces an actual depreciation of the exchange rate.

Summarizing this discussion, we can write the equilibrium terms of trade and real balances as follows:

$$(11) \qquad \lambda=\lambda(a,x) \qquad \lambda_a<0, \lambda_x>0$$

$$(12) \qquad m=m(a,x) \qquad m_a>0, m_x<0$$

Next we use the definition of the terms of trade $\lambda\equiv eP^*/P$ to write:

$$(13) \qquad e=\lambda P/P^*$$

or, using the definition of equilibrium real

[7]The variable k is actually a function of (r^*+x) but we suppress r^* since it is assumed constant.

balances, and the equilibrium conditions in the money and goods markets in (11) and (12):

$$(14) \quad P \equiv M/m(a,x) = eP^*/\lambda(a,x)$$

or

$$(15) \quad e = (M/P^*)\frac{\lambda(a,x)}{m(a,x)}$$

$$= (M/P^*)\, J(a,x); \qquad J_a<0, J_x>0$$

We now have an equation for the equilibrium exchange rate in terms of the anticipated rate of depreciation and the stock of external assets. Given the properties of (11) and (13), it is apparent that an increase in external assets leads to an appreciation in the exchange rate. The increase in assets raises real balances which implies a fall in the price level. The rise in wealth in turn raises spending and thus leads to an improvement in the equilibrium terms of trade —a fall in import prices relative to domestic prices. For import prices to fall relative to domestic prices, with domestic prices falling absolutely, the exchange rate must appreciate. An increase in the anticipated rate of depreciation leads to an actual depreciation of the exchange rate, as noted above.

We now move on to discuss the dynamic adjustment of the economy under the assumption of rational expectations. We focus on the dynamics of the exchange rate and the stock of foreign assets. Under the rational expectations hypothesis, in a nonstochastic model, the anticipated rate of depreciation of the exchange rate is equal to the actual rate of depreciation.

To implement formally the assumption of perfect foresight we equate the expected rate of depreciation x, which determines the equilibrium exchange rate in (15) with the actual rate of depreciation $\dot{e}$. Thus setting $x=\dot{e}$ in (15) and inverting that equation to solve for $\dot{e}$ we have

$$(16) \quad \dot{e} = \theta\left(a, \frac{e}{M/P^*}\right) \qquad \theta_1>0, \theta_2>0$$

It is perhaps worth noting again that (16) describes the dynamic behavior of the exchange rate only under the explicit assumption $x=\dot{e}$, i.e., that the expected and actual rates of depreciation are equal.

The second dynamic equation is that for foreign asset accumulation:

$$(17) \quad \frac{\dot{a}}{r^*} = (1/\lambda)S(m(a,x)+\lambda(a,x)a/r^*)$$

or

$$(17') \quad \dot{a} = \Psi\left(a, \frac{e}{M/P^*}\right) \qquad \Psi_1<0, \Psi_2>0$$

The derivation of the derivatives of $\Psi(\;)$ is straightforward if tedious; it has to be noted that the condition $\Psi_1<0$ is assumed. The assumption that $\Psi_1<0$ means that the *total* effect of an increase in external assets on the current account is negative:

$$(18) \quad \Psi_1 = \frac{\partial(\dot{a}/r^*)}{\partial a} + \frac{\partial(\dot{a}/r^*)}{\partial x}\frac{\partial x}{\partial a} < 0$$

The first term is negative since increased assets given expectations raise real wealth and spending, and thus worsen the current account. This was the stability condition in Section I above. The second term involves the effect of increased assets on exchange rate expectations. An increase in assets leads to the expectation of decumulation and depreciation, and therefore reduces real balances and expenditure, thus potentially offsetting the direct effect of higher assets. The stability condition here requires that the former effect dominate and thus is entirely sensible.

Equipped with (16) and (17) we construct Figure 6. The equilibrium is, as is frequently the case with rational expectations, a saddle point; the path the economy follows to the long-run equilibrium at E is shown by the locus FF.[8] Note that the perfect foresight path in Figure 6 shows the conventional

[8]There remain some problems in proving that the economy would choose a path such as FF rather than a divergent path. See Fischer and Blanchard for discussion of this point. We choose to study the properties of FF since it is the only convergent path for the exchange rate, given fixed M.

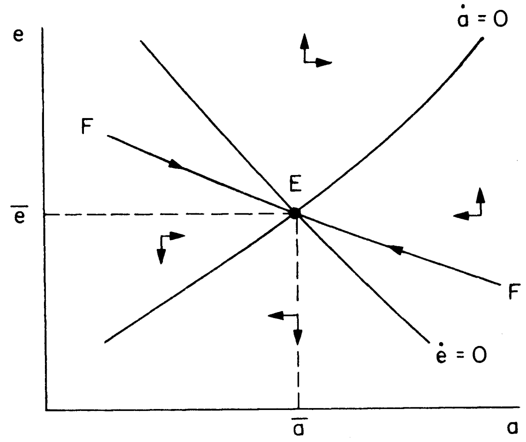

FIGURE 6

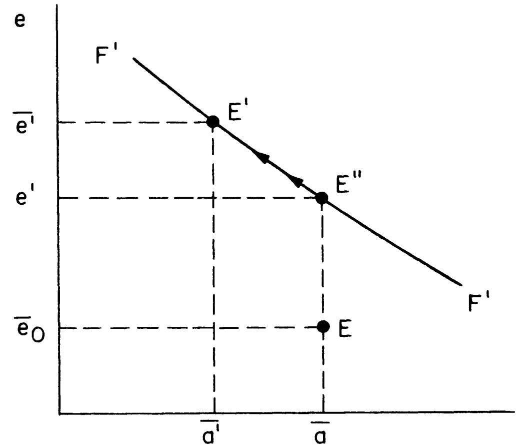

FIGURE 7

association of an appreciating exchange rate and a current account surplus. When assets are above their long-run level, and thus are declining, the exchange rate is below its long-run level, and is thus depreciating.

Consider now the impact effect and adjustment process in response to (unanticipated) disturbances. That question is of interest because it allows a comparison with the case of constant velocity and thus introduces the role of expectations in the determination of short-run exchange rate behavior. We look first at the case of an increase in imports with an offsetting reduction in domestic saving as studied in Figure 3 above. We saw there that the long-run effect is a reduction in external assets and a worsening of the terms of trade. This combination implies a long-run depreciation of the exchange rate since the decline in the value of income from external assets λa reduces equilibrium real money demand and thus implies an increase in prices. For a worsening of the terms of trade the exchange rate accordingly must depreciate.

Figure 7 shows the initial equilibrium at point E, and the new long-run equilibrium, with lower $\bar{a}$ and higher $\bar{e}$, at E'. Before the unanticipated increase in imports, the exchange rate is $\bar{e}_o$ and the stock of foreign assets $\bar{a}$. In the short run, external assets are given at $\bar{a}$. But the reduced saving and increased import spending create the expectation of depreciation, reducing the demand for real balances, increasing the price level, and reducing real spending (through a real balance effect in the goods market). The terms of trade deteriorate to maintain goods market equilibrium; the deterioration of the terms of trade imply an immediate adjustment of the exchange rate to E''. The impact effect of the disturbance is to cause a one-time discrete depreciation; thereafter the exchange rate depreciates along the path to E' as assets are decumulated.

In discussing the case of an unanticipated increase in exports, studied in Figure 2 above, we sketch the use of the graphical apparatus set out in this section. Figure 8 shows the initial equilibrium at E. We know from Figure 2 that in the new long-run equilibrium, a is higher than it was at E, and λ is lower. We know further that λa is unchanged between the two equilibria (see Section I). Since y is constant, and since $x=0$ in both long-run equilibria, the stock of real balances is unchanged and the price level is unchanged. Since λ falls and P is unchanged, the exchange rate must appreciate between old and new equilibria. We therefore know that the new equilibrium in Figure 8 is to the southeast of E; it is shown at E'. Passing through E' are the $\dot{e}'=0$ and $\dot{a}'=0$ loci.[9]

[9]It is possible, though complicated, to work through all the equations set out in this section to reach the conclusion that E' is to the southeast of E. It is much easier to use the properties of the long-run equilibrium.

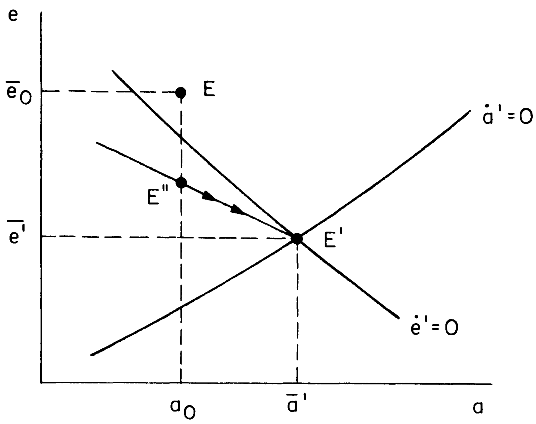

FIGURE 8

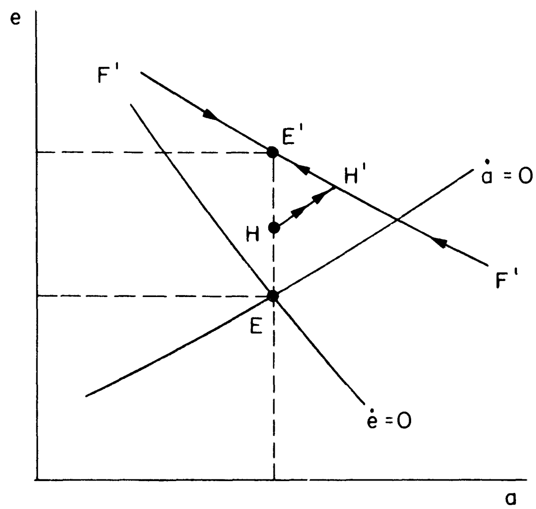

FIGURE 9

The only ambiguity that apparently remains is whether the exchange rate initially appreciates (as in Figure 8) or depreciates. However, there is no ambiguity and Figure 8 is correct. This can be shown formally by proving that the $(\dot{e}'=0)$ locus shifts downward. More intuitively, we know that the exchange rate will be appreciating on the path to E'. Even were x to remain equal to zero, we would have λ fall as in Figure 2; now we have higher real balances, therefore more wealth, and a larger fall in λ is required. Since P and λ both fall, e has to fall. Again, the transition path is one on which an appreciating exchange rate is accompanied by a current account surplus.

We may also ask how the inclusion of exchange rate expectations in this section affects the dynamics as compared with Section I, where velocity was assumed constant and expectations were ignored. Allowing for expectations increases the magnitude of the initial decline in the terms of trade. Anticipated appreciation increases the demand for money (and therefore the stock of real balances, wealth, and the demand for our goods) and thus requires a larger initial fall in the terms of trade.

No exchange rate paper can be complete without examining the effects of a change in the stock of money. It is easy to show that an unanticipated increase in the stock of money merely increases the exchange rate proportionally and immediately, and that there is no accompanying process of accumulation. The immediate adjustment is, of course, a consequence of the assumption of continuous full employment and price flexibility.

III. Anticipated Disturbances

Up to this stage, the association between an appreciating exchange rate and a current account surplus has been strong. However, this connection is modified when we analyze the effects of anticipated disturbances.[10]

We study now the adjustment process to a current announcement of a *future* increase in the nominal quantity of money. We immediately note that at the point in time where the money stock actually increases, we are back in the framework of analysis of the previous section shown as the path $F'F'$ in Figure 9, with the new long-run equilibrium at point E'. What happens, though, in the period between the announcement and the actual increase in money?

In the transition period, the adjustment process is governed by equations (15), (16), and (17'). In terms of Figure 9 this means that the initial $\dot{e}=0$ and $\dot{a}=0$ loci remain

[10]Anticipated future disturbances and their impact on exchange rates have been studied by Wilson.

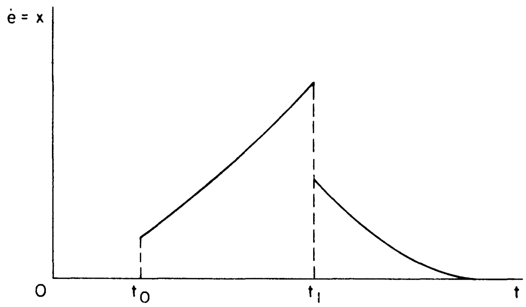

FIGURE 10

relevant for the analysis. We have also to observe that any jump in the exchange rate has to occur immediately and cannot lie further ahead along the adjustment path. This must be true since otherwise there would be the anticipation of infinite capital gains and therefore incipient capital outflows that would immediately move the rate. With these two considerations in mind, we observe from Figure 9 the qualitative properties of the adjustment path.

There will be an immediate depreciation of the exchange rate at the time of announcement of a future increase in the money stock. From then on, the exchange rate will continue to depreciate and the anticipation of depreciation, by lowering real balances, wealth and spending, will give rise to a current account surplus. The process continues until we reach a point like H' exactly at the time the money supply increases. Exchange rate depreciation continues, but the increased real balances, wealth, and spending now lead to a deficit and decumulation of external assets until the initial real equilibrium is reattained.

We can gain further insight into the adjustment process by studying the behavior of the rate of depreciation shown in Figure 10. The rate of depreciation, $\dot{e}=x$, is described in (16). It is apparent that at the time of announcement t_o, the only change is the jump in the level of the exchange rate, and thus we have the anticipation of a depreciating rate. Along the adjustment path from H to H' in Figure 9, assets are growing as is the exchange rate. Accordingly, using (16), the rate of depreciation is increasing.

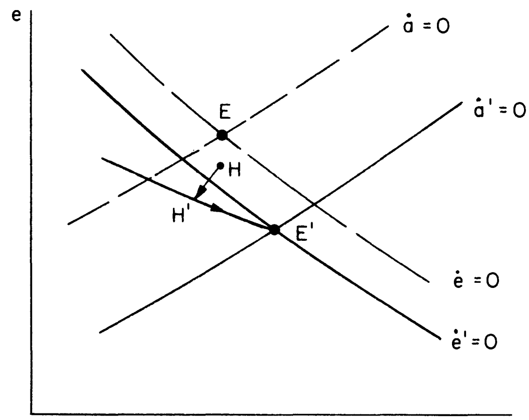

FIGURE 11

Once point H' is reached at time t_1, there is a discrete reduction in the rate of depreciation. Since the exchange rate cannot jump now, but nominal money does increase, the rate of depreciation must decline. From then on, depreciation continually decreases until it reaches zero in the steady state.

The adjustment path of the current account and of the rate of depreciation of course qualify, in a very important way, the popular association between monetary disturbances, depreciation, and the external balance. The striking results here are that the anticipation of a money supply increase should initially lead to a surplus, and that the rate of depreciation should decrease exactly at the point in time where the increase in money actually occurs.

These results operate through the effects of the anticipated change in the money stock on absorption. The anticipated increase in the money stock causes an anticipated—and therefore actual—depreciation of the currency, reducing the demand for money, and thereby reducing real balances. Savings are thus increased, and assets are imported through the current account surplus. After the money stock is actually increased, there is a real balance effect working in the opposite direction, causing dissaving through the current account.

To confirm that the incorporation of anticipated policy changes generally changes the character of the results of Section III, we will take up our running example of an anticipated increase in exports. Figure 11 contains the diagram; it is to be compared with Figure 8.

The appearance of Figure 11 is very similar to that of Figure 8. This time the exchange rate appreciates initially and continues appreciating as assets are decumulated in anticipation of the increase in exports. The initial exchange rate is chosen such that the economy reaches point H' at the moment the increase in exports occurs. The economic explanation of the path followed is similar to that outlined above; the anticipated appreciation may be thought to be the driving force in the dynamics.

IV. Concluding Remarks

Recent models of exchange rate determination and dynamics have emphasized asset stock equilibrium as the relevant framework. The study of exchange rate dynamics has typically been formulated in a macro-economic setting that emphasizes the speeds of adjustment of goods and assets markets, and in which expectations dominate the short-run behavior of the exchange rate.

This paper focuses instead on the association between the current account and the exchange rate. It retains many elements of the recent approaches including asset equilibrium, and the distinction between anticipated and unanticipated disturbances to the economy. But it extends recent approaches by giving an important role to the accumulation of assets over time through the current account. Asset accumulation, together with expectations, dominates the dynamic behavior of the exchange rate.

One point of difference with asset market models of the exchange rate concerns the question of overshooting. Monetary changes in models where assets markets move rapidly relative to goods markets lead to a more than proportionate depreciation of the exchange rate. The reason is that real balances increase because of the predetermined price level, that equilibrium nominal interest rates decline, and that international interest arbitrage requires an offsetting expectation of appreciation. The only way, with the anticipation of long-run depreciation, that we can have an expectation of appreciation is for the exchange rate to overshoot. The model differs in important respects from our presentation. Here the price level is fully flexible so that (current) monetary disturbances have no real effects. Open-market operations, a monetary expansion with a contraction in external assets, lead to a decline in real balances and therefore to an appreciation that in the short-run is more than proportional to the fall in money. Thus there is overshooting in the present model, not because prices are sticky, but because in the short-run external assets are predetermined.

Our model has the important shortcomings of a very restricted menu of assets, and of short-run price flexibility and continuous full employment. The compensation is the introduction of the current account as an important element in open-economy macroeconomics and exchange rate determination. In doing so, the paper provides a theoretical rationale for the popular view that there is an association between the current account and the behavior of the exchange rate. However, such a view has to be qualified because anticipated disturbances that will ultimately depreciate the exchange rate can, initially and in contrast to the conventional view, lead to the combination of a current account deficit and appreciating exchange rate.

REFERENCES

O. Blanchard, "Backward and Forward Solutions for Economies with Rational Expectations," *Amer. Econ. Rev. Proc.*, May 1979, *69*, 114–18.

R. Dornbusch, "A Portfolio Balance Model of the Open Economy," *J. Monet. Econ.*, Jan. 1975, *1*, 3–20.

______, "Capital Mobility, Flexible Exchange Rates and Macroeconomic Equilibrium," in Emil Claassen and Pascal Salin, eds., *Recent Issues In International Monetary Economics*, New York 1976.

S. Fischer, "Anticipations and the Non-Neutrality of Money," *J. Polit. Econ*, Apr.

1979, *87*, 225–52.

J. M. Fleming, "Domestic Financial Policy under Fixed and Floating Exchange Rates," *Int. Monet. Fund Staff Papers*, Nov. 1962, *9*, 369–79.

R. Flood, "A Model of Asset Trade," unpublished manuscript, Univ. Virginia 1977.

J. A. Frenkel and C. A. Rodriguez, "Portfolio Equilibrium and the Balance of Payments: A Monetary Approach," *Amer. Econ. Rev.*, Sept. 1975, *66*, 674–88.

P. J. K. Kouri, "Essays on the Theory of Flexible Exchange Rates," unpublished doctoral dissertation, M.I.T. 1975.

______, "The Exchange Rate and the Balance of Payments in the Short Run and in the Long Run: A Monetary Approach," *Scand. J. Econ.*, No. 2, 1976, *78*, 280–304.

F. Modigliani, "The Life Cycle Hypothesis of Saving Twenty Years Later," in Michael Parkin and A. R. Nobay, eds., *Contemporary Issues in Economics:...Warwick, 1973*, Manchester 1975.

Robert A. Mundell, *International Economics*, New York 1968.

C. A. Rodriguez, "The Role of Trade Flows in Exchange Rate Determination: A Rational Expectations Approach," unpublished manuscript, Columbia Univ. 1977.

C. A. Wilson, "Anticipated Shocks and Exchange Rate Dynamics," *J. Polit. Econ.*, June 1979, *87*, 639–47.