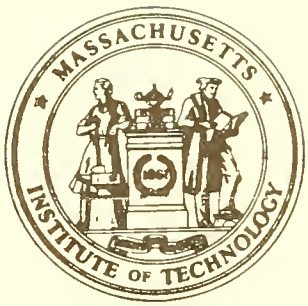


working paper
department
of economics

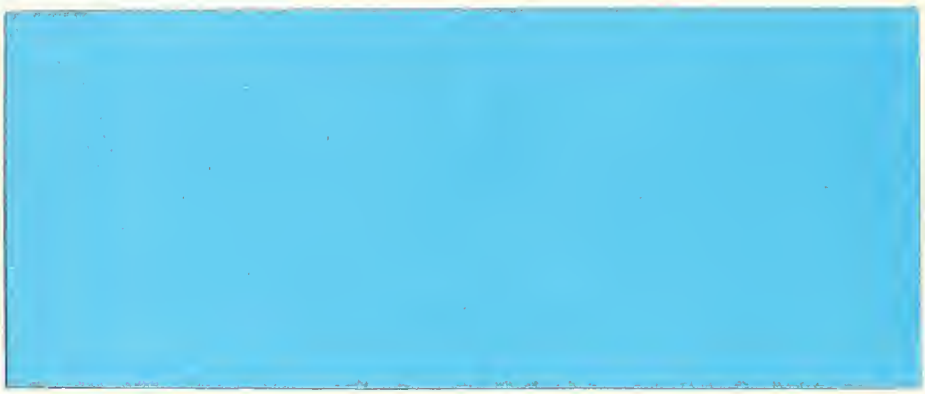
THE THEORY OF FLEXIBLE EXCHANGE RATE REGIMES AND MACROECONOMIC POLICY

Rudiger Dornbusch

Number 165 September 1975

massachusetts
institute of
technology

50 memorial drive
cambridge, mass. 02139



THE THEORY OF FLEXIBLE EXCHANGE RATE REGIMES AND MACROECONOMIC POLICY

Rudiger Dornbusch

Number 165 September 1975

Revised, September 1975

THE THEORY OF FLEXIBLE EXCHANGE RATE REGIMES AND MACROECONOMIC POLICY*

Rudiger Dornbusch
Massachusetts Institute of Technology

This paper is concerned with some issues in the theory of flexible exchange rates. Specifically, we study the determinants of the exchange rate, both in the short and long run, the role of capital mobility and speculation in that context, and the scope for the international transmission of disturbances. In discussing the transmission of disturbances particular emphasis is given to the idea that in the short run monetary and price disturbances are not offset by matching exchange rate changes and, for that reason, are spread internationally.

The issues raised in this paper have been, to a large extent, discussed in the literature. We note here, in particular, Mundell (1964, 1968) and Fleming (1962) in their discussion of stabilization policy under flexible exchange rates as well as the subsequent work by Argy and Porter (1972) that formalizes the role of expectations in this context. Work by Black (1973, 1975) has emphasized the role of asset markets in exchange rate determination and a paper by Niehans (1975) has explored the interaction of exchange rate expectations and relative price responses to question the effectiveness of monetary policy under flexible rates.

---

*I wish to acknowledge helpful comments on an earlier draft from Stanley Black, Stanley Fischer, Jacob Frenkel and Dwight Jaffe. Financial support was provided by a grant from the Ford Foundation.

The present paper adds to that strand of literature in that it distinguishes shortrun effects of policies, sustained in part by price rigidities and expectational errors, from the longer run effects where relative prices and homogeneity are given emphasis. The aggregation departs from the standard Keynesian model of complete specialization and two traded goods in distinguishing traded goods as a composite commodity and nontraded goods. Such an aggregation is preferred since it breaks the identification of the exchange rate with the terms of trade, introduces scope for a monetary interpretation of the exchange rate and leaves room at the same time for intersectoral considerations.

In Section I we lay out a general equilibrium framework for the discussion of exchange rates from a long-run perspective. The critical assumptions of that theory are purchasing power parity for traded goods and monetary equilibrium. In Section II the assumption of purchasing power parity is relaxed to yield a short-run or "money-market" theory of the exchange rate. In Section III we return to purchasing power parity and investigate the role of speculation in affecting the scope for the international transmission of monetary disturbances and for the operation of monetary and fiscal policy. In Section IV the discussion is extended to a dual exchange rate system.

I. A General View of Exchange Rate Determinants

In this section we outline a fairly general and eclectic view of the determinants of exchange rates. Such a view links monetary and real variables as jointly influencing the equilibrium level of the exchange rate. The view is appropriate to full equilibrium or the 'long run' and is a benchmark from which to judge departures and alternatives.

A critical ingredient of this approach is purchasing power parity, in the narrow sense of goods arbitrage for internationally traded goods, so that the exchange rate equates the prices of traded goods in alternative currencies:[1]

$$P_T = eP_T^* \tag{1}$$

where P_T and P_T^* represent the domestic and foreign currency prices of traded goods and where e is the domestic currency price of foreign exchange.[2]

The prices of traded goods can be related to the price levels, P and P^*, respectively. The appropriate relationship is given by the equilibrium relative price of traded goods in terms of the price levels, θ and θ^*:

$$P_T = \theta P \quad ; \quad P_T^* = \theta^* P^* \tag{2}$$

The determinants of the equilibrium relative price structure, denoted here by θ and θ^*, will be discussed below.[3] For the present it suffices to note that an increase in the equilibrium price of traded goods by x percent raises their relative price θ by $(1-\gamma)$xpercent where γ and $(1-\gamma)$, respectively, denote the shares of traded goods and nontraded goods in the price index.

Using (2) in equation (1), we can express the exchange rate in terms of price levels and relative prices:

$$e = (P/P^*)(\theta/\theta^*). \tag{3}$$

---

[1] We abstract here from tariffs and transport costs that introduce obvious modifications in (1).

[2] All starred variables refer to the foreign country.

[3] See pp. 15-16 below.

The next step is to link up the discussion with the monetary sector. This is achieved by multiplying and dividing (3) by the domestic and foreign nominal quantity of money, M and M^*.[1] Furthermore, imposing the conditions of monetary equilibrium:

$$M/P = L(\ ) \ ; \ M^*/P^* = L^*(\ ), \tag{4}$$

where L and L^* represent the domestic and foreign demand for real balances, we arrive at (5):[2]

$$e = (M/M^*)(L^*/L)(\theta/\theta^*). \tag{5}$$

Equation (5) collects the principal determinants of exchange rates. These are, respectively, the nominal quantities of monies, the real money demands, and the relative price structure. It can be viewed as an <u>equilibrium</u> exchange rate since in its derivation we have used the conditions of goods arbitrage, money market equilibrium and, implicitly in using (2), home goods market equilibrium. The usefulness of (5) is enhanced by considering the logarithmic differential denoting a percentage change by a "^":

$$\hat{e} = (\hat{M} - \hat{M}^*) + (\hat{L}^* - \hat{L}) + (\hat{\theta} - \hat{\theta}^*). \tag{6}$$

The first term in (6) captures the effects of monetary changes on the exchange rate. Other things equal, the country with the higher monetary growth will have a depreciating exchange rate. This particular term captures the effect of differences in long-run inflation rates between countries and their reflection in exchange rates.

---

[1] The choice of monetary aggregate in (4) is presumably that for which real money demand is most stable. Furthermore, we do not require that in (4) the same monetary aggregate for both countries be used.

[2] For a similar equation that concentrates on traded goods, see Collery [1971].

The effect of changes in real money demand is captured in the second term in (6). The country that experiences a (relative) increase in real money demand will have an appreciation in the exchange rate. Among the factors that exert an influence on real money demand, we note here, in particular, interest rates, expected inflation, and real income growth. The real money demand term in (6) constitutes one of the links between the exchange rate, the monetary sector and the real sector. This term helps explain how changes in productivity, for example, get reflected in exchange rate changes.

The last term in (6) collects the effect of changes in the relative price structure on the exchange rate. This term arises entirely from real considerations and, in fact, has been identified in some literature as the "real exchange rate."[1] Given the nominal quantity of money and the demand for real balances, and therefore the price level, an increase in the equilibrium relative price of traded goods will be reflected in a depreciation in the exchange rate. Changes in absorption, shifts in demand, or biased output growth, given a monetary policy that sustains the price level, will therefore directly affect the exchange rate.

An example will show how equation (6) can be applied. Assume that in the home country we have an increase in spending that falls entirely on traded goods, while abroad everything remains unchanged. Assume further that because of the absence of capital mobility the exchange rate adjusts to maintain trade balance equilibrium. In Figure 1 we show the equilibrium

[1] See, for example, Corden [1971 , Chapter 5] and Dornbusch [1974b]. Much of the partial equilibrium literature concerned with real trade questions uses implicitly (3) together with the assumption that monetary or fiscal policies maintain constant the level of prices, P and P^*. Under these assumptions the exchange rate can be identified with the relative price structure.

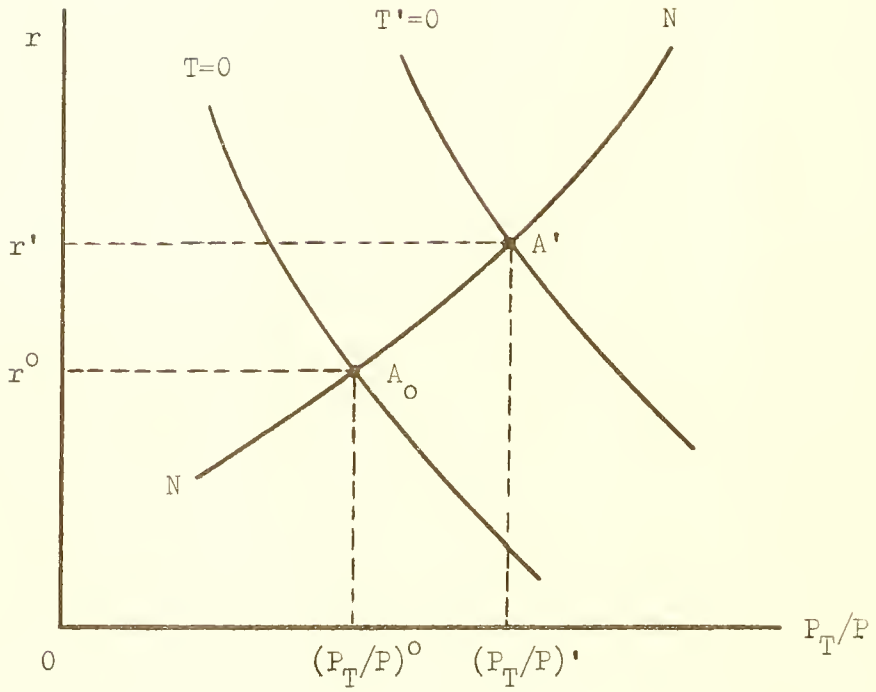


FIGURE 1

in the home goods market along the NN schedule. At higher interest rates, and hence lower real spending, we require a higher relative price of traded goods to clear the home goods market. An increase in interest rates has an expenditure reducing effect that has to be offset by the expenditure and production switching effects of a relative price change. Along the T=0 schedule, we have trade balance equilibrium. At lower interest rates and hence higher aggregate real spending, we require a higher relative price of traded goods to maintain trade balance. The initial equilibrium is at point A_0.

An increase in spending that falls on traded goods creates at the initial equilibrium an excess demand for traded goods and therefore requires higher interest rates and/or a higher relative price of traded goods to maintain trade balance. The T=0 schedule accordingly shifts to T'=0, and our new equilibrium is at point A' with an increase in both interest rates and the relative price of traded goods. The higher interest rate is required to restore balance between income and spending. At that higher interest rate, spending on home goods has declined and we accordingly require a reduction in their relative price.

Consider next the implications of this disturbance for the exchange rate. The higher equilibrium interest rate lowers the demand for real balances and therefore contributes, via an increase in the price level, to a depreciation of the exchange rate. This effect is further enhanced by the required increase in the relative price of traded goods so that the net result is an unambiguous depreciation of the exchange rate.[1]

---

[1] If the increased spending had fallen entirely on home goods, the required relative price adjustment would have been a fall in the relative price of traded goods and therefore ambiguity in the net effect of the disturbance on the exchange rate.

The example features several aspects of the exchange rate determination that are worth spelling out in more detail. First, and perhaps foremost, the exchange rate is determined in a general equilibrium framework by the interaction of all markets (and countries). A particularly important feature is that the equilibrium obtains in both the flow and stock markets so that the exchange rate is in no manner determined by the current flow demands and supplies of foreign exchange.[1]

Next we give emphasis to the role of monetary considerations in the context of exchange rate determinations. As has been emphasized by J. Robinson [1935], the exchange rate is proximately determined by the balance between money supply and real money demand. The fact that the approach taken here is "monetary" in no manner precludes the role of "real" factors since these must be expected to enter as determinants of the demand for real balances and thus exert an effect on the exchange rate. Mussa [1974] has emphasized this point for the analysis of the balance of payments and has noted the obvious extension to a flexible rate regime.

Since the exchange rate is determined as part of the general, real and monetary equilibrium of the system, there is no relevant sense in which one would want to assert that the exchange rate is an exclusively monetary phenomenon. Indeed, the equilibrium exchange rate can change without any accompanying change in the money supply, or the real money demand.

---

[1]There is a peculiar tradition in the discussion of the markets for both bonds and foreign exchange, and unlike in the discussion of equity prices, that associates price formation with the rate at which funds flow, rather than with the conditions required for the existing stocks to be held. The "tradeable funds" approach in the foreign exchange market has a "loanable funds" equivalent in the bond market. This issue is not new. See, for example, Pollak [1944] and Laursen [1955]. The latter raises the issue quite explicitly and opts for a stock approach. See, also, Dornbusch [1974a2, 1975], Johnson [1975], and, in particular, Black [1973].

Such would, for example, be the case if there were a change in the composition of production between home goods and traded goods. Having noted the role of real considerations in this context, it is important, however, to recognize that organizing thought about the exchange rate around the monetary sector is likely to be a direct and informative approach. To appreciate this point, consider the alternative of a "wage approach."

A wage approach can be formulated by using in (3) the definition of real wages, $w = W/P$ and $w^* = W^*/P^*$, to obtain an equation similar to (6):

$$(6)' \qquad \hat{e} = (\hat{W} - \hat{W}^*) + (\hat{w}^* - \hat{w}) + (\hat{\theta} - \hat{\theta}^*).$$

Provided the general equilibrium structure is used to fill in the details of (6)', we arrive at the same answer as we would obtain from (6). The choice then must lie in an assumption about the stability of the relevant behavioral equations and, perhaps, an assumption about the dominant source of disturbances.

A third feature of this approach is the long-run or equilibrium nature of exchange rate determination. This view is implicit in the fact that we allow all markets to clear and that we explicitly impose the condition of monetary stock equilibrium, goods market equilibrium and purchasing power parity for traded goods. Either of these conditions may not hold in the short run, and, therefore, exchange rates can depart from the prediction in (6)'.

For short-run purposes, we will assume that the exchange rate is altogether dominated by the asset markets and more specifically by capital mobility and money market equilibrium. Arbitrage of traded goods prices

and goods market equilibrium is attained only over time.[1] Within such a perspective, we could assume that the price level and real income, at a point in time, are given and that the interest rate is determined by the quantity of money along with elements that shift the demand for real balances. Interest arbitrage for given expected future spot rates, determined by speculators, will then set the spot rates. Such a view is explored in the next section.

II. Short-Run Determination of Exchange Rates

In the short run, the scope for goods arbitrage may be limited, and accordingly purchasing power parity as in (1) may only obtain for a limited set of commodities. Under these conditions, it is useful to abstract altogether from the detail of goods markets and rather view exchange rates as being determined entirely in the asset market. Such a view will assume capital mobility and indeed assign a critical role to it. Exchange rates in this perspective are determined by interest arbitrage together with speculation about future spot rates. To provide an example of this approach, we consider the effects of an increase in the nominal quantity of money in a "small country."

Given real income and other determinants of the demand for real balances, the equilibrium interest rate, at which the existing quantity of money is willingly held, will be a function of the real quantity of money:[2]

$$r = r(M/P,\ldots). \tag{7}$$

---

[1] Magee [1974] has presented information on the adjustment time for purchasing power parity, or arbitrage, to be achieved. The evidence suggests a significant lag and a substantial dispersion across commodities.

[2] Equation (7) is obtained by solving the money market equilibrium condition, $M/P = L(r,\ldots)$.

Interest arbitrage, assuming that on a covered basis domestic and foreign assets are perfect substitutes, requires that the domestic interest rate, less the forward premium on foreign exchange, λ, be equal to the foreign interest rate, r^*:[1]

$$r - \lambda = r^* , \tag{8}$$

where the forward premium is defined as the percentage excess of the forward rate, $\bar{e}$, over the current spot rate:

$$\lambda \equiv (\bar{e} - e)/e .$$

Substituting (7) and λ in (8) we have a relationship between the real money supply, the spot rate and the forward rate:

$$r(M/P,...) = r^* + \bar{e}/e - 1 \tag{8}'$$

Differentiating (8)' and denoting the interest responsiveness of money demand by σ we obtain:[2]

$$\hat{e} = \hat{\bar{e}} + (1/\sigma)\hat{M} \tag{9}$$

where by assumption the foreign interest rate and the price level are held constant. Equation (9) suggests that a change in the forward rate induces an equiproportionate change in the spot rate, while an increase in the money supply causes a depreciation in the spot rate that is inversely proportional

---

[1] For recent evidence on covered interest arbitrage, see Frenkel and Levich [1975].

[2] From the conditions of money market equilibrium $M/P = L(r,...)$, we have: $dr = \hat{M}(M/P)/L_r \equiv -(1/\sigma)\hat{M}$. The interest responsiveness of money demand, that is, the semi-logarithmic derivative $\sigma \equiv -L_r/L$, is for the short run significantly less than unity. Econometric models such as the MPS model estimate a short run elasticity of $-rL_r/L = .05$, so that with an interest rate of $r = .1$ we obtain a value of $\sigma = .5$.

to the interest responsiveness of money demand. Since the interest responsiveness of money demand is of the order of $\sigma = .5$, a monetary expansion will be matched by significantly more than proportionate depreciation.

So far we have assumed that the forward rate is exogenous. The next step is therefore to link the forward rate to the analysis. For the point to be made it is sufficient to assume that the forward rate is set by speculators in a perfectly elastic manner at the level of the expected future spot rate and that expectations about the latter are formed in an adaptive manner. With these assumptions we have:

$$\bar{e} = \pi e + (1 - \pi)\, e_{-1} \quad ; \quad 0 < \pi < 1 \tag{10}$$

The impact effect of a change in the spot rate is therefore to raise the forward rate but proportionately less, so the price of foreign exchange is at a forward discount. Substituting from (10), the expression $\hat{\bar{e}} = \pi \hat{e}$ in (9) yields the total impact effect of a monetary expansion on the spot rate:

$$\hat{e} = \frac{1}{(1-\pi)\sigma}\, \hat{M} \tag{9}'$$

We note that the adaptive expectations serve to increase the impact effect of money on the exchange rate. In fact, the more closely the forward rate is determined by the current spot rate, the closer π is to unity, the larger the exchange rate fluctuations induced by a variation in money.

In interpreting the effect of a monetary expansion on the exchange rate, three considerations stand out: First domestic and foreign assets are assumed perfect substitutes on a covered basis as is reflected in [8]. This implies that, independently of any particular assumptions about

expectations, a reduction in domestic interest rates has to be matched by a forward discount on foreign exchange in order to equalize the net yields on domestic and foreign assets. The next two considerations are dependent on the particular expectations assumption in [10] and concern, respectively, the direction and magnitude of the change in the spot rate. A reduced domestic interest rate, for asset market equilibrium, has to be matched by an expected appreciation of the exchange rate. The expectations mechanism in [10] implies that a depreciation in the spot rate will give rise to such an expectation, since the elasticity of expectations, π, is less than unity. With an elasticity of expectations less than unity, a depreciation of the spot rate is accompanied by a less than proportionate depreciation of the expected future spot rate, or an anticipated appreciation. Finally, the magnitude of the depreciation in the spot rate that is required depends on both the interest response of money demand, σ, and the elasticity of expectations, π. The smaller the interest responsiveness of money demand, the larger the interest rate change that is brought about by a monetary expansion and therefore, the larger the expected appreciation that has to be brought about by a depreciation in the spot rate. Furthermore, a given depreciation of the spot rate will give rise to an expected appreciation of the future spot rate that is smaller, the larger the elasticity of expectations. Accordingly, large exchange rate changes will arise in circumstances where interest response of money demand is small and the elasticity of expectations is large.

The short run determination of exchange rates is entirely dominated by the conditions of equilibrium in the asset markets and expectations. The liquidity effect of money on the interest rate has a counterpart in

the immediate depreciation of the spot rate that has to be sufficient to cause the existing stock of domestic assets to be held. It is in this sense that in the short run the exchange rate is determined in the asset markets.

Over time the exchange rate is determined by the interaction between goods markets and asset markets. This is so because the price level will rise to match the expansion in the nominal quantity of money until, in the long run, the monetary expansion is exactly matched by a price increase so that real balances and interest rates are unchanged and the spot and forward rate depreciate in the same proportion as the increase in the nominal quantity of money. The exact dynamics of that adjustment process will depend on the speed with which prices respond as compared to expectations. The response of prices will be due, in part, to the traditional effect of a reduced interest rate on aggregate spending. There will be in the present framework an additional channel that serves to speed up the responsiveness of prices to a monetary expansion. The impact effect of a monetary expansion on the spot rate, as of a given price level, will cause a departure from goods arbitrage. Domestic goods will become relatively cheap as compared to foreign goods and therefore induce a substitution of world demand toward domestic goods. This additional channel implies that even if domestic aggregate spending were unresponsive to the interest rate, or slow to adjust, there remains a subsidiary channel, the arbitrage effect, that serves to drive up domestic prices and causes the real effects of a monetary expansion to be transitory.

III. Speculation, Macroeconomic Policies and the Transmission of Disturbances

In the present section we go beyond the impact effect of disturbances and consider the behavior over time of the economy in response to policy-induced or speculative disturbances. In particular, we want to show that speculation that is not guided by "rational expectations" allows monetary changes to be transmitted internationally even under circumstances where prices are fully flexible. For the purposes of the present section, we continue to assume that the home country is small and therefore faces given world prices of traded goods and a given world rate of interest. We furthermore assume that goods arbitrage is continuously maintained. In addition to internationally traded commodities, the home country produces and consumes nontraded goods. Price and factor cost flexibility ensure that markets clear all the time and full employment is maintained.

The analysis focuses on the equilibrium conditions in the markets for home goods and in the asset market. Consider first the home goods market. The excess demand for home goods will depend on the relative price of traded goods in terms of the price level, P_T/P, the interest rate that determines absorption for a given level of real income, and the level of government spending on nontraded goods, g:

$$N(P_T/P, r, g) = 0 \quad ; \quad N_{P_T/P} > 0,\ N_r < 0,\ N_g = 1 \tag{11}$$

An increase in the relative price of traded goods creates an excess demand as consumers substitute toward home goods, while productive resources move into the traded goods sector, thus reducing the supply of home goods. An increase in the interest rate reduces absorption, part of which falls on

home goods and to that extent creates an excess supply. Finally, an increase in government spending directly adds to home goods demand. We can solve the equilibrium condition in (11) for the equilibrium relative price of traded goods in terms of the interest rate and government spending:

$$(11)' \qquad P_T/P = \theta(r;g); \quad \theta_r > 0, \theta_g < 0 .$$

Equation (11)' is plotted in Figure 1 as the NN schedule.[1]

Consider next the condition of equilibrium in the money market. With a demand for real balances that depends on interest rates and real income, we can solve the money market equilibrium condition for the equilibrium interest rate as a function of the real money supply and real income.

$$(12) \qquad r = r(M/P;y) \quad ; \quad r_{M/P} < 0, \; r_y > 0 .$$

Next we substitute the equilibrium interest rate in (11), and noting that purchasing power parity obtains with a given price of foreign goods, $P_T = eP_T^*$, we can write the home goods market equilibrium condition as:

$$(13) \qquad \bar{N}(eP_T^*/P, r(M/P), g) = 0$$

where $\bar{N}$ denotes the reduced form that embodies the condition of money market equilibrium and where the constant level of real income is suppressed as an argument.

---

[1] The trade balance is given by $T = T(P_T/P, r)$ where the relative price term again reflects substitution between home goods and traded goods and the interest rate term reflects absorption or the level of spending. Accordingly, an increase in the relative price of traded goods worsens the trade balance, while an increase in the interest rate improves the trade balance.

In Figure 2 we show the home goods market equilibrium schedule $\bar{N}\bar{N}$. The schedule is positively sloped and flatter than a ray through the origin. The reason is as follows. At a higher price level, we have lower real balances, higher interest rates, and therefore reduced real spending. Part of the reduction in real spending falls on home goods and creates an excess supply that has to be eliminated by a decline in their relative price, that is, by an increase in the exchange rate or the price of traded goods relative to the price level.[1] The $\bar{N}\bar{N}$ schedule is drawn for a given nominal quantity of money and a given foreign currency price of traded goods.

We again assume that covered interest arbitrage ensures that interest rates are linked internationally so that (8) continues to hold. The forward rate is set by speculators, according to the adaptive expectations scheme in (10). Substituting the expression for the forward rate in (8), and using the equilibrium interest rate in (12), we obtain the condition for money market equilibrium together with covered interest arbitrage:

$$r(M/P) - (1 - \pi)(e_{-1}/e - 1) = r^{*} , \tag{14}$$

A critical property of the speculative behavior is that an increase in the spot rate creates a forward discount, since it will cause the forward rate to rise less than proportionately. To maintain interest parity, a forward discount on foreign exchange has to be accompanied by a reduction in domestic relative to foreign interest rates. Given the nominal quantity of money, such a decline in interest rates would arise if the domestic price level declined. The asset market equilibrium schedule aa in Figure 2

---

[1] For a given foreign currency price of traded goods, the ratio e/P represents the domestic relative price of traded goods in terms of the price level.

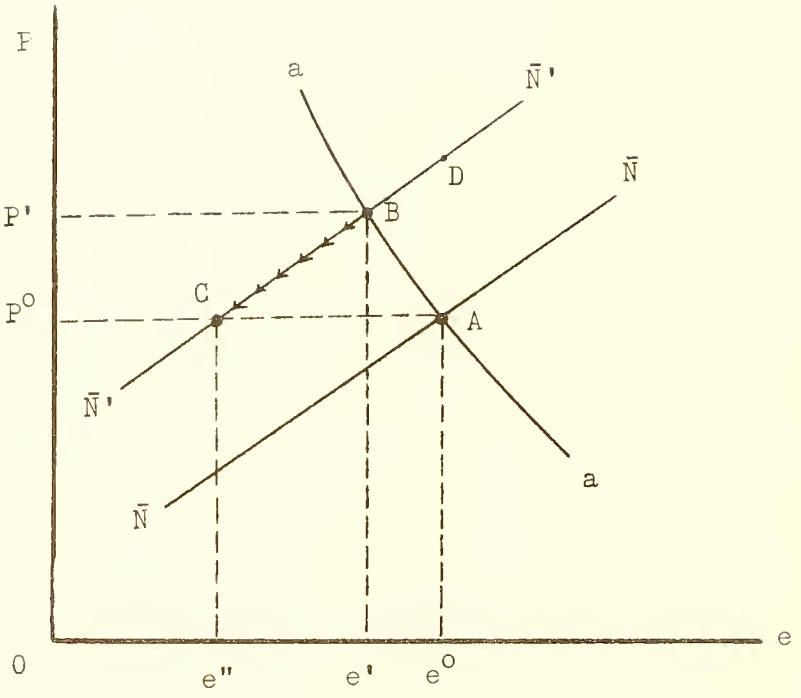


FIGURE 2

reflects equation (14) for a given foreign interest rate, a given nominal quantity of money, and a given past spot rate e_{-1}. The initial equilibrium obtains at point A with all markets clearing and the forward rate at par so that no revision of expectations is required.

Consider next the effect of an increase in the foreign price level. We note from (14) that there is no direct effect on the asset market and therefore the aa schedule remains unaffected. Consider next the home goods market. At an unchanged exchange rate, the increase in the foreign price level raises the domestic currency price of traded goods and hence their relative price, so that an excess demand for home goods would arise. To eliminate the excess demand, the exchange rate would have to appreciate to fully offset the foreign price increase. This is represented in Figure 2 by a leftward shift of the $\bar{N}\bar{N}$ schedule to $\bar{N}'\bar{N}'$ in the proportion of the foreign price increase.

The short-run effect of the price increase is to move the economy to point B with an appreciation in the exchange rate that falls short of the foreign price increase and an increase in the domestic price level. Furthermore, the relative price of traded goods rises, and the increase in the price level reduces real balances and therefore raises interest rates with a matching premium on forward exchange.

Quite obviously, the foreign price change in the short run exerts real effects in the home country. The flexible exchange rate, in this formulation, fails to isolate the home country from foreign nominal disturbances. The explanation for this nonneutrality lies in the behavior of speculators.

The adjustment process from the initial equilibrium at point A to the short-run position of equilibrium can be viewed in the following manner:

The increase in the foreign currency price of traded goods, at the initial exchange rate, raises the domestic currency price of traded goods, the price level and therefore the rate of interest. Such a position is shown at point D where the home goods market clears and the price level has risen, although proportionately less than the price of traded goods. At that point covered, interest arbitrage is not satisfied, since the increased interest rate is not compensated by an offsetting forward premium on foreign exchange. Therefore, an incipient capital inflow develops that causes the spot rate to appreciate until the appropriate premium has been generated. This is the move from point D to the short run equilibrium at point B.[1]

In the short run the failure of exchange rates to fully offset the foreign price increase implies that the domestic nominal and real equilibrium is affected by a foreign nominal disturbance. The domestic price level rises as do interest rates. Domestic absorption declines and real spending on home goods falls so that a deflationary effect is exerted on that sector. The reduction in absorption and the induced increase in the relative price of traded goods imply an expansion in the production of traded goods and a trade balance surplus. The trade surplus in turn is financed by a capital outflow.

The equilibrium at point B is only transitory, since it is sustained by expectational errors. Speculators underpredict the actual appreciation of the exchange rate and therefore will revise their forecast. That revision causes at each current rate the premium to decline and therefore

---

[1] The effect of a foreign price increase on the exchange rate at point B is given by $\hat{e} = \frac{-\delta}{\delta+\sigma(1-\pi)} \hat{P}_T^*$ where δ is the elasticity of the price level with respect to the price of traded goods along the $\bar{N}\bar{N}$ schedule. Unless $\pi=1$, the exchange rate change does not fully offset the increase in foreign prices. See Appendix I.

to create a covered differential in favor of the home country that leads to continued appreciation of the exchange rate. That process moves the economy from point B to C over time. The process will continue until the exchange rate has sufficiently appreciated to fully offset the increase in foreign prices. This is true at point C, where the domestic price level and hence interest rates have returned to their initial level.[1]

The lack of homogeneity that the system exhibits in the short run applies similarly to an increase in the domestic money stock. In the short run, price flexibility notwithstanding, the price level and the exchange rate increase proportionately less than the money supply, and accordingly, the interest rate decreases while the forward rate goes to a discount. The change in the spot rate induced by a monetary expansion in the short run is given by:

$$\hat{e} = \frac{\delta}{\delta+\sigma(1-\pi)}\hat{M} \qquad , 0 < \delta < 1 \tag{15}$$

where δ is the elasticity of the price level with respect to the price of traded goods along the $\bar{N}\bar{N}$ schedule. We note that in the present context, and unlike in Section II, the exchange rate changes proportionately less than the nominal quantity of money. This is entirely due to the adjustment in prices that is permitted here and that serves to lower the increase in real balances associated with a given increase in the nominal quantity of money.

Over time, as expectations are revised, the system will converge to neutrality in the sense that the monetary change leaves all real variables unchanged. The short run real effects of a monetary change are again due

---

[1]The dynamics and stability of the adjustment process are studied in Appendix I.

to expectational errors, or more precisely, to the fact that speculators use irrelevant information and therefore affect the real equilibrium. If instead the equilibrium exchange rate in (5) were used as a basis of prediction, the system would be homogeneous, even in the short run.

The adjustment process to a monetary disturbance is illustrated in Figure 3. Initial equilibrium obtains at point A, with a relative price structure indicated by the slope of the ray OR. The increase in the nominal quantity of money at the initial equilibrium exchange rate and prices lowers interest rates and therefore creates an excess demand for home goods and a departure from covered interest arbitrage. For home goods equilibrium to obtain, the exchange rate and prices would have to increase in the same proportion as the nominal quantity of money. This is indicated by an upward shift of the $\bar{N}\bar{N}$ schedule in the proportion $AC/OA = \hat{M}$. The asset market equilibrium in the short run does not possess homogeneity properties, since the elasticity of exchange rate expectations is less than unity, which is equivalent to saying that expectations are sticky. Accordingly, the aa schedule shifts upward in a smaller proportion. Short run equilibrium will obtain at point B with an increase in the exchange rate and prices that are proportionately smaller than the increase in money. In that short-run equilibrium, the relative price of home goods will be higher compared to A, which is a reflection of the fact that in the short run the interest rate declines and absorption expands. The adjustment of expectations over time will shift the a'a' schedule up and to the right until the long run real equilibrium is restored at point C, where expectational errors have subsided and prices and exchange rates fully reflect the monetary change.

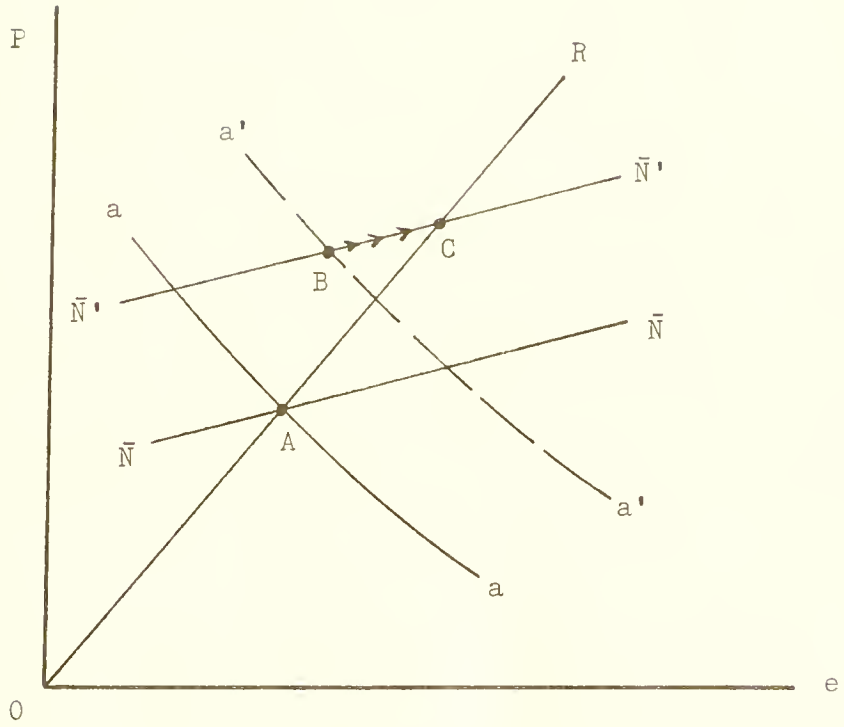


FIGURE 3

In discussing stabilization policy under flexible exchange rates, Mundell [1963, 1964] notes that with perfect capital mobility monetary policy exerts strong effects on nominal income, while fiscal policy has no effect. The reason is that, in the absence of forward market considerations, the given interest rate in the world determines the domestic interest rate and hence velocity. Given velocity, fiscal policy has no effect on nominal income, while monetary policy becomes most powerful. The present framework, following Mundell [1964] and Wonnacott [1972], notes that the short-run changes in forward premia allow interest rate and hence velocity changes that tend to dampen the effect of monetary policy. In the short run, monetary policy causes a depreciation of the exchange rate accompanied by a premium on forward exchange and a decline in interest rates. The decline in interest rates lowers velocity and therefore dampens in the short run the nominal income expansion. Over time the revision of expectations eliminates the premium and therefore restores interest rates and velocity to their initial level and thus causes monetary changes to be reflected in equiproportionate changes in nominal income.

In concluding this section we return to the transmission of foreign price disturbances and ask what policies the government could pursue to offset the transmission process. Here the choice has to be made between price level stability, or stability of the real equilibrium, that is, of interest rates, absorption and relative prices. If the preference is for stability of the real equilibrium, then the government should peg the interest rate, or the exchange rate, and therefore increase the domestic nominal quantity of money in the same proportion as the foreign price increase. If such a policy is followed, domestic prices move along with

foreign prices at constant exchange rates and without any real effects. The alternative of a constant domestic price level will require a reduction in the nominal quantity of money in the short run and will involve larger relative price fluctuations. Noting that a constant price level policy will require in the adjustment process, first a decline in the nominal price of home goods, and increase in the nominal price of traded goods with a subsequent reversal, any downward rigidity of prices will make such a policy costly. The same argument implies to the automatic adjustment process associated with a constant nominal quantity of money. These remarks accordingly provide a support for a policy of pegging interest rates and exchange rates in the case of foreign nominal disturbances.

IV. Speculative Disturbances and Dual Exchange Rates

In the present section, we will investigate the effects of exogenous speculative disturbances and proceed from there to a discussion of a dual exchange rate system that has been advocated as a remedy against the influence of speculation on the real sector.

To allow for an exogenous change in the expected future spot rate, we modify (10) to:

$$\bar{e} = \pi e + (1 - \pi)e_{-1} - eu, \tag{16}$$

where u denotes a current shift term in expectations. Specifically, an increase in u implies that given the current and past spot rate, we have an expected appreciation in the exchange rate and therefore a forward discount. Using the present form of the forward rate in the asset market equilibrium condition yields:

$$r(M/P) - (1 - \pi)(e_{-1}/e - 1) + u = r^{*} \quad . \tag{17}$$

Consider now the implication of an anticipated appreciation of the exchange rate. In Figure 4 we have the initial full equilibrium at point A. An increase in the expected future spot rate will shift the asset market equilibrium schedule down and to the left to a'a'. At the initial equilibrium interest rate and prices, the anticipated appreciation creates a covered differential in favor of the home country and therefore causes an incipient capital inflow that appreciates the exchange rate.

Short-run equilibrium obtains at point B. The anticipated increase in the future spot rate is reflected in an appreciation in the current spot rate, a discount on forward exchange, and a decline in the domestic interest rate. More importantly, the decline in traded goods prices that is implied by the appreciation and the decline in the relative price of traded goods imply a deflationary influence in that sector. Traded goods prices decline relative to costs, and for that reason, the speculative attack imposes a real cost on the traded goods sector. This is very much the problem currently experienced by strong currency countries and, in particular, Switzerland.[1]

The short-run equilibrium at B is sustained by expectations that will prove erroneous and, to that extent, will over time give rise to revision of expectations and a return to the initial equilibrium. More likely, however, the sectoral problems caused by the speculative pressure on the

---

[1] Under the heading, "Are the Swiss Enjoying Their Strong Currency? No. Not in the Least," the Wall Street Journal of February 27, 1975 notes: "And what is it like to be the cynosure of international money markets? It is, the Swiss will tell you, increasingly uncomfortable, if not miserable."

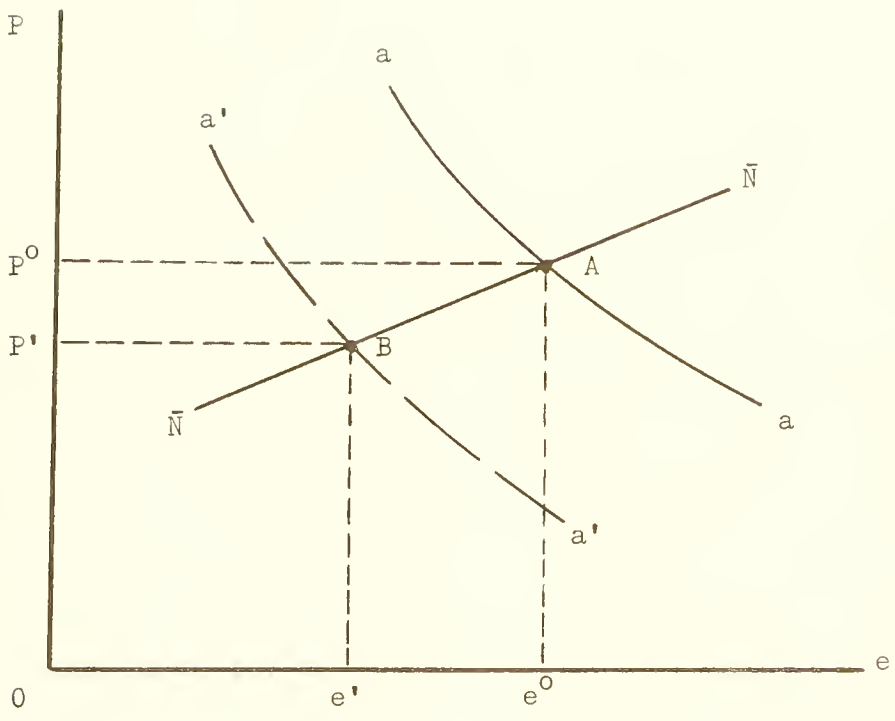


FIGURE 4

exchange rate will give rise to some form of intervention. There would seem to be a case for dual exchange rates that isolate the current account transactions from speculative attacks; alternatively, and this has been a solution favored by the Swiss, to join a strong currency area and thereby share the burden of a speculative attack.

A dual or two-tier exchange market can be readily introduced in the preceding analysis. Under such a regime, we distinguish the official rate, $\tilde{e}$, applicable to current account transactions, from the free rate that applies to capital account transactions.[1] In the following, we will assume that interest earnings can be converted at the free rate, e. The latter assumption implies that the analysis underlying the asset market equilibrium schedule aa in Figure 5 remains unchanged. Equilibrium in the asset market continues to require that covered interest arbitrage obtains where the forward rate continues to be formed by an adaptive expectations mechanism.[2] The home goods market equilibrium schedule $\bar{\bar{N}}\bar{\bar{N}}$ is drawn as a function of the official rate $\tilde{e}$. Initial equilibrium obtains at point A, where the official rate, $\tilde{e}^0$, happens to coincide with the free rate.

To illustrate the working of the system, now consider again in Figure 5 the problem of a speculative attack in the form of an increase in the expected future spot rate. The incipient capital flow will immediately bid up the free rate to e', where the spot rate has appreciated sufficiently

---

[1] For a discussion of dual exchange rate systems, see Fleming [1971], Swoboda [1974], and Sheen [1974].

[2] What determines the level of the free rate in the long run? The present model is not equipped to answer that question because the adaptive expectations mechanism implies that in the long run the forward rate is equal to the spot rate. In the absence of a difference between spot and forward rates, interest rates will be equated at any level of the free rate. The free rate has no effect on the real system and therefore, in the present model, is indeterminate in the long run.

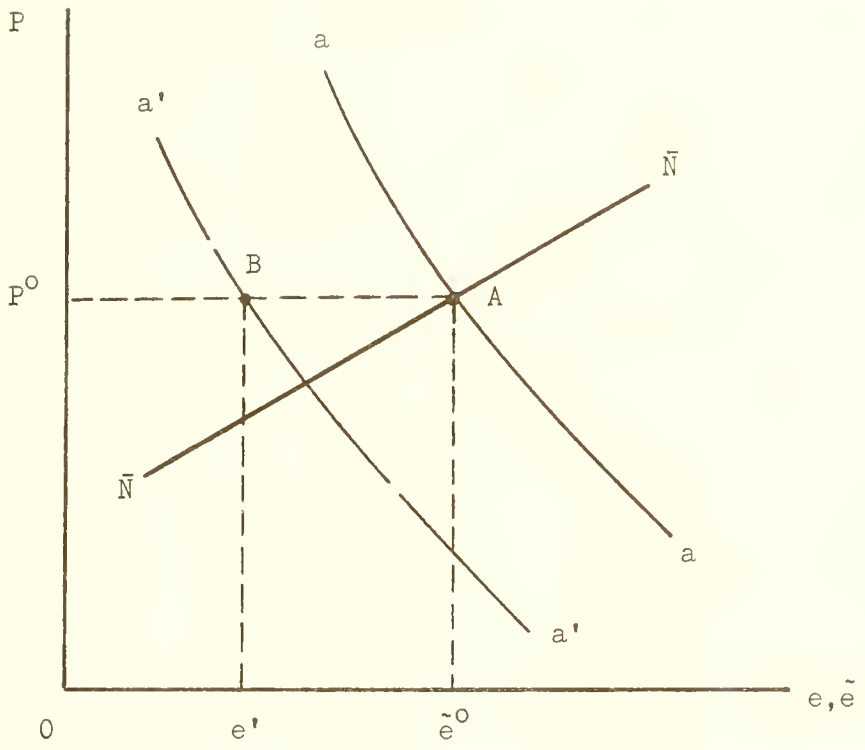


FIGURE 5

to offset the expected appreciation. There is no effect at all on the equilibrium price level, relative prices, or interest rate because the relevant rate for the determination of relative prices is the fixed official rate $\tilde{e}^0$. Under these circumstances, the economy is entirely shielded from the effects of speculation on the real sector. How does the system differ from a unified free rate? Under the latter, the appreciation of the exchange rate would have put downward pressure on traded goods prices and the price level, while here the international price connection via the official rate remains undisturbed.

How does a dual exchange rate system affect the scope of domestic policies? Consider an increase in government spending or a cut in taxes that gives rise to an expansion in aggregate real spending. In Figure 6, we show that, as a consequence of higher real spending, we have an excess demand for home goods and therefore the market equilibrium schedule shifts up to $\bar{N}'\bar{N}'$. With the official rate fixed at $\tilde{e}^0$, the increased spending causes an increase in the domestic price level and in the relative price of home goods, to P'. The increased price level, in turn, implies higher interest rates. To maintain asset market equilibrium in the face of higher domestic interest rates, we experience an appreciation in the spot free rate to e'. At that rate, the spot rate has sufficiently fallen relative to the forward rate to generate a premium that offsets the higher domestic interest rate.

The equilibrium at point B implies that fiscal policy under a dual exchange rate system exerts a stronger effect on interest rates and the price level and that the same increase in spending gives rise to a smaller increase in the relative price of home goods. The latter point can be

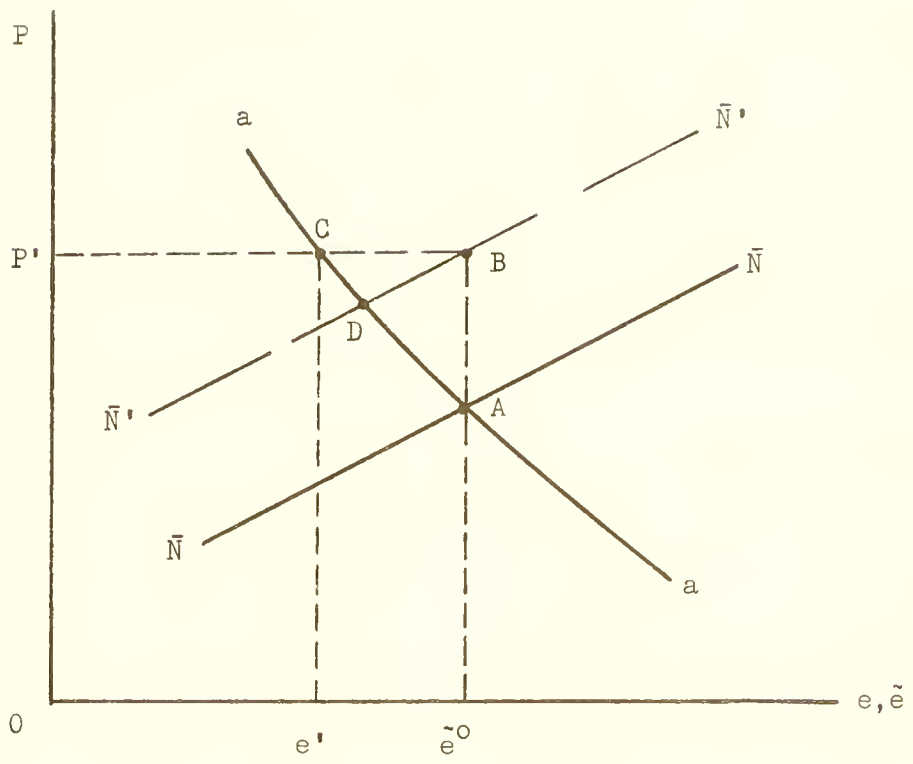


FIGURE 6

appreciated by noting that under a unified free rate we would be at point D. The explanation is simply that under a dual system we have larger increases in interest rates and therefore more of a dampening of the increased spending and for that reason require only smaller relative price changes. The counterpart of the smaller relative price changes is, however, a larger change in nominal income. To the extent that sectoral considerations are relevant, and they most assuredly are, the question of relative prices and intersectoral resource allocation is important. From that perspective, the dual rate system is more nearly neutral than a system with a free unified rate.

Concluding Remarks

This paper has developed models of the determination of exchange rates and of the operation of a flexible exchange rate system. Among the conclusions, two deserve emphasis here. First, that the exchange rate, as a first approximation, is determined in the asset markets. This implies that expectations and changes in expectations as much as changes in money supplies dominate the course of the exchange rate in the short run.

The second conclusion that we wish to retain here concerns the lack of homogeneity that a flexible rate system is likely to exhibit in the short run. With prices sticky, or exchange rate expectations sticky, monetary changes as much as foreign price disturbances will be transmitted internationally and thus destroy the argument that a flexible rate system provides isolation from and for monetary disorder.

Appendix I

In this appendix we will derive some of the results presented in Section III and discuss the stability of the adjustment process. We start with the equation for the $\bar{N}\bar{N}$ schedule that embodies equilibrium in the home goods market, given monetary equilibrium:

$$\bar{N}(eP_T^*/P, r(M/P), g) = 0 \tag{1}$$

We can solve that equation for the equilibrium price level, $\bar{P}$, as a function of the money supply, traded goods prices in terms of foreign currency and the exchange rate:

$$P = \bar{P}(eP_T^*, M, g) \tag{2}$$

Noting that the excess demand in (1) is homogeneous of degree zero in all prices and the quantity of money it follows that the equilibrium price level in (2) is homogeneous of degree one in the quantity of money and the domestic currency price of traded goods. Accordingly, we can write the logarithmic differential of (2) as follows:

$$\hat{P} = \delta(\hat{e} + \hat{P}_T^*) + (1 - \delta)\hat{M} \quad ; \quad 0 < \delta < 1 \tag{3}$$

where government spending is held constant.

Taking similarly the differential of the asset market equilibrium condition:

$$r(M/P) = r^* + (1 - \pi)(e_{-1}/e - 1) \tag{4}$$

we obtain:

$$\hat{M} - \hat{P} = -\sigma(1 - \pi)(\hat{e}_{-1} - \hat{e}) \tag{5}$$

where the foreign interest rate is held constant. Combining (3) and (5) yields an expression for the change in the spot rate as a function of the disturbances:

$$\hat{e} = \frac{\delta}{\delta + \sigma(1-\pi)} (\hat{M} - \hat{P}_T^*) + \frac{\sigma(1-\pi)}{\delta + \sigma(1-\pi)} \hat{e}_{-1} \tag{6}$$

In the short run $\hat{e}_{-1} = 0$ and the first term in (6) indicates the impact effect of a monetary or foreign price disturbance. In the long run, $\hat{e} = \hat{e}_{-1}$, and therefore nominal disturbances are reflected in corresponding exchange rate changes.

Consider next the stability question.[1] Substituting the equilibrium price leve, $\bar{P}(\quad)$ in (4) yields a final reduced form equation that relates the current spot rate to the past spot rate for given money and foreign prices:

$$r(M/\bar{P}(eP_T^*, M, g)) - (1-\pi)(e_{-1}/e-1) = r^* \tag{7}$$

Equation (7) is a difference equation in the exchange rate. To determine stability we differentiate (7) and evaluate at equilibrium the derivative to obtain:

$$de/de_{-1} = \frac{\sigma(1-\pi)}{\delta + \sigma(1-\pi)} < 1 \tag{8}$$

which ensures stability.

---

[1] There is a growing body of partial equilibrium models exhibiting instability in the foreign exchange market because of a failure to link that sector with the asset markets. See, for example, Allen and Miller [1974] and Britton [1970]. Minford [1974] in a very interesting formulation shows that instability can be attributed to a failure to consider the monetary effects of exchange rate changes.

In Figure 7 we show equation (7) for an initial nominal quantity of money as the upward sloping line EE with a slope less than unity. An increase in the nominal quantity of money shifts the schedule upward in the same proportion to E'E'. From the initial equilibrium at A, the spot rate immediately jumps to point B and then moves along E'E' until the new equilibrium at point C is reached. We have inserted, too, in Figure 7 the path of the forward rate ADC. The forward rate by (10) will always lie between the current and past spot rate and therefore consistently underpredicts the actual exchange rate. This departure from rational expectations forms the basis of the transitory real effects of a monetary disturbance.

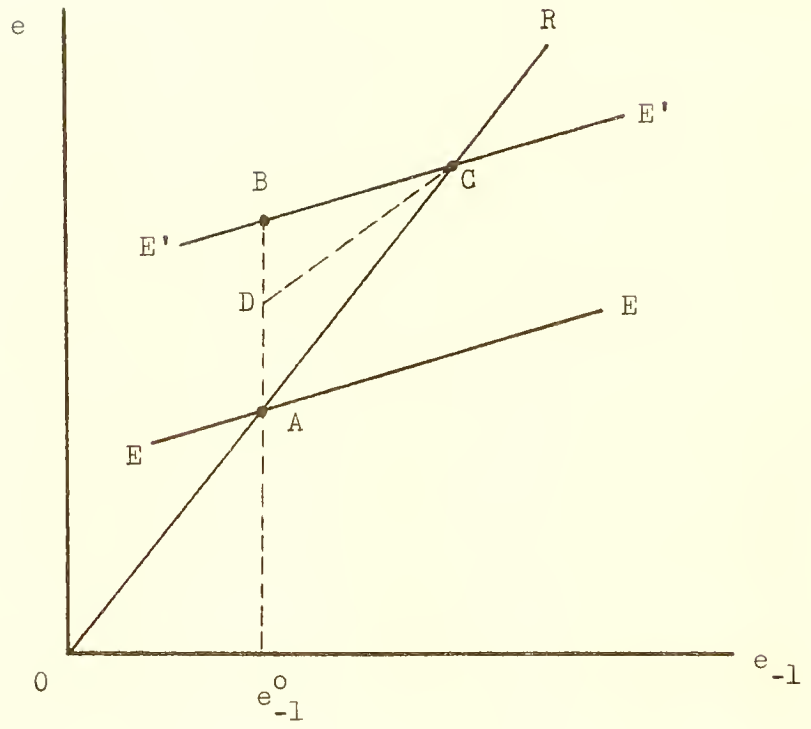


FIGURE 7

References

Allen, W., and Miller, M. (1974). "The Stability of the Floating Exchange Rate." Unpublished manuscript, Bank of England.

Argy, V., and Porter, M. (1972). "The Forward Exchange Market and the Effects of Domestic and External Disturbances Under Alternative Exchange Rate Systems." I.M.F. Staff Papers, Vol. 19, No. 3.

Black, S. (1973). International Money Markets and Flexible Exchange Rates. Princeton Studies in International Finance, No. 32, Princeton University.

_____, "Exchange Rate Policies for Less Developed Countries in a World of Floating Rates." Unpublished manuscript, Vanderbilt University, 1975.

Britton, A. J. C. (1970). "The Dynamic Stability of the Foreign Exchange Market." Economic Journal, 80, pp. 91-96.

Collery, A. (1971). International Adjustment, Open Economies and the Quantity Theory of Money. Princeton Studies in International Finance, No. 28, Princeton University Press.

Corden, M. (1971). The Theory of Protection. Clarendon Press.

Dornbusch, R. (1974a). "Capital Mobility, Flexible Exchange Rates and Macro-economic Equilibrium." Forthcoming in Recent Developments in International Monetary Economics, edited by E. Claassen and P. Salin, North-Holland, 1976.

_____, (1974b). "Tariffs and Nontraded Goods." Journal of International Economics, 4, pp. 177-185.

_____, (1975). "A Portfolio Balance Model of the Open Economy." Journal of Monetary Economics, 1, pp. 3-19.

Fleming, J. M. (1962). "Domestic Financial Policies under Fixed and Floating Exchange Rates." I.M.F. Staff Papers, 9, pp. 369-379.

_____, (1971). Essays in International Economics. Allen and Unwin.

Frenkel, J., and Levich, R. (1975). "Transactions Costs and the Efficiency of International Capital Markets." Unpublished manuscript, University of Chicago.

Johnson, H. G. (1975). "World Inflation and the International Monetary System." Unpublished manuscript, University of Chicago.

Laursen, S. (1955). "The Market for Foreign Exchange." Economia Internazionale, VIII, pp. 762-783.

References (continued)

Magee, S. (1974). "U.S. Import Prices in the Currency Contract Period." Brookings Papers on Economic Activity, 1, pp. 117-164.

Minford, P. (1974). "Structural and Monetary Theories of the Balance of Payments." Unpublished manuscript, University of Manchester.

Mundell, R. A. (1964). "Exchange Rate Margins and Economic Policy." In Murphy, C. (ed.), Money in the International Order. Southern Methodist University Press.

_____, (1968). International Economics. Macmillan.

Mussa, M. (1974). "A Monetary Approach to Balance of Payments Analysis." Journal of Money, Credit and Banking, VI, 3, pp. 333-351.

Niehans, J. (1975). "Some Doubts About the Efficacy of Monetary Policy Under Flexible Exchange Rates." Journal of International Economics, 5, pp. 275-281.

Polak, J. J. (1944). "European Exchange Depreciation in the Early Twenties." Econometrica, 12, pp. 151-162.

Robinson, J. (1936). "Banking Policy and the Exchanges." Review of Economic Studies, III, pp. 226-229.

Swoboda, A. K. (1974). "The Dual Exchange Rate System and Monetary Independence." In Aliber, R. Z. (ed.), National Monetary Policies and the International Financial System, University of Chicago Press.

Sheen, J. (1974). "Dual Exchange Rates and the Asset Markets." Unpublished manuscript, International Monetary Project, London School of Economics.

Wonnacott, P. (1972). The Floating Canadian Dollar. American Enterprise Institute, Foreign Affairs Study 5.