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Pentti J. K. Kouri and Jorge Braga de Macedo*

Cowles Foundation, Yale University

After only a few years of experience, considerable doubts have emerged about the ability of the flexible rate system to function smoothly without central bank intervention in the foreign exchange markets and without conscious policies to cope with the balance of payments adjustment problem arising from the surpluses of the OPEC countries and from current account 'imbalances' among industrial countries.

These concerns have been concretized in the recent discussions about the causes of the 'weakness' of the U.S. dollar and about the appropriate response of policy, if any, to deal with the problem.

Several explanations have been offered for the depreciation of the dollar against most other major currencies. One is the balance of payments explanation, according to which the cause is to be found in the deterioration of the United States' current account position. The current account deficit, it is said, increases the supply of dollar denominated assets that foreigners must hold and thus causes a depreciation in the value of the dollar in terms of other currencies. The policy implication of this

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view is that, to the extent it is desirable, the dollar can be strengthened either by policies that reduce the current account deficit; or by policies that make dollar claims more attractive; or by direct intervention in the foreign exchange market.

An alternative interpretation of the dollar's weakness runs in terms of differences in monetary policies and long term inflationary prospects between the United States and the 'strong currency' countries. According to this view, intervention in the foreign exchange market cannot strengthen the dollar permanently because it has no effects on the 'fundamental causes' of its weakness.

Our objective is to clarify the basis of the different views on policy evident in this debate in the theory of flexibly exchange rates and balance of payments adjustment.¹ In Part I, the asset market view of exchange rate determination is introduced. In Part II, we provide empirical evidence on the attractiveness of different currencies as vehicles of international financial intermediation, such as is required to recycle the surpluses of the OPEC countries to borrowers in different parts of the world. Part III analyzes the 'fundamentals' of exchange rate determination first in a world where assets are equally attractive, and then in a world where an explicit asymmetry in asset preferences is introduced. Some implications for policy and future research are suggested at the end.

¹Recent contributions have been surveyed and synthesized in earlier issues of these *Papers*. See Marina Whitman, "Global Monetarism and the Monetary Approach to Balance of Payments," *BPEA*, 1975, 3; Rudiger Dornbusch and Paul Krugman, "Flexible Exchange Rates in the Short Run," *ibid.*, 1976, 3. See also Susan Schadler, "Sources of Exchange Rate Variability: Theory and Empirical Evidence," *IMF Staff Papers*, July 1977, and Michael Mussa, "Macroeconomic Interdependence and the Exchange Rate Regime," forthcoming in R. Dornbusch and J. Frenkel, eds., *International Economic Policy*.

I. THE ASSET MARKET APPROACH TO EXCHANGE RATES

One of the most dramatic developments in the international economy in the post war period has been the growth of international investment and the development of a truly transnational system of financial intermediation. Against this institutional background, one has to start the analysis of exchange rate determination by embedding the foreign exchange market in a general equilibrium model of several interconnected financial markets. Thus the general equilibrium approach to monetary theory developed by James Tobin is the appropriate analytical framework.¹

To take a simple case, consider a world economy consisting of two countries and six types of financial assets: two monies, bonds denominated in these two monies, and equity claims on physical capital located in the two countries. There are thus six assets traded in the international financial markets, and therefore five relative prices are needed to clear these markets. These are the interest rates in the two countries, the prices of equity and the relative price of the two monies, or the exchange rate. The five interconnected markets in which these prices are simultaneously determined are the two credit markets, the two equity markets and the foreign exchange market.

The forward currency market can easily be incorporated into this framework. In fact, if the interest rate parity holds, the forward market is linked to the spot market through covered interest rate arbitrage.

¹For a concise treatment see his "The General Equilibrium Approach to Monetary Theory," *Journal of Money, Credit and Banking*, 1969, vol. 1, no. 1, reproduced in his *Essays in Economics, Vol. I: Macroeconomics*, New York: Markham, 1971. Some aspects of the asset market view of exchange rate determination, on the other hand, were developed in papers collected in the *Scandinavian Journal of Economics*, 1976, no. 2. See also Dale Henderson and Lance Girton, "Central Bank Operations in Foreign and Domestic Assets under Fixed and Flexible Exchange Rates," in P. B. Clark, D. E. Logue and R. J. Sweeney, eds., *The Effects of Exchange Rate Adjustments*, U.S. Government Printing Office, Washington, D.C., 1977.

Short run equilibrium in the financial markets obtain when the total demand for each asset equals the supply of that asset. The demands for assets depend on their expected rates of return, their risk and liquidity characteristics; and expenditure levels and initial holdings of these assets by residents of the two countries.

Monetary policy affects the short-run equilibrium values of the exchange rate, the interest rates and the equity prices by changing the mixture of asset supplies to the private sector in terms of liquidity composition on the one hand, and currency composition, on the other. These price effects are the channels through which, in this simplified model, effects of monetary policy are transmitted to the level and distribution of demand in the world economy, and thereby to levels of output, employment and prices in the two countries.

Two classes of monetary policies can be distinguished in this model. First, domestic open market operations which involve the exchange of domestic money for domestic currency denominated bonds. Second, intervention in the foreign exchange market. Such intervention can take several forms, namely exchange of domestic money for foreign money; exchange of domestic money for foreign currency denominated bonds; and exchange of domestic currency denominated bonds for foreign currency denominated bonds. Intervention of the last type is identical to forward exchange market intervention, if the interest rate parity holds.¹

¹Of course, only three of these different types of monetary policy are independent. This is illustrated by the example given in the following table. For concreteness the two countries are called America and Germany and their currencies dollar and mark respectively. As shown by column (4), a forward market purchase of 100 marks has the same effect as an increase of 100 marks in the supply of dollar denominated bonds and an equal decrease in the supply of mark denominated bonds. The supply of dollar bonds can also be increased by a domestic open market operation in America

In practice, spot exchange market intervention takes the second form because central banks rarely hold monies of other countries. For example, the dollar holdings of foreign central banks consist of dollar denominated bonds rather than dollar money. It is for this reason that intervention in the foreign exchange market by foreign central banks has no effect on the U.S. monetary base.

Other types of financial policies can also be incorporated in this framework. Thus, a change in the currency composition of government debt issue is similar in its effects to forward market intervention. Yet another form of official foreign exchange market intervention is the practice of some European governments to influence the currency composition of bond issues of state-owned corporations.

An important implication of the general equilibrium approach to monetary policy, relevant for the ongoing debate about 'dirty floating', is that it is impossible to define rules of behavior for governments and monetary authorities which would leave the exchange rate free from their conscious manipulation.

as shown in column (1), while the supply of mark bonds can be reduced by a domestic open market operation in Germany as shown in column (2). These two open market operations increase the supply of money in Germany and decrease it in America. The changes in the money supplies are offset by intervention in the spot market as shown in column (3).

<i>Change in the Supply of:</i>	<i>Policy</i>			
	<i>Open Market Operation in:</i> <i>Dollars</i> (1)	<i>Marks</i> (2)	<i>Intervention in:</i> <i>Spot Market</i> (3)	<i>Forward Market</i> (4)
<i>Dollars</i>	-100	0	+100	0
<i>Marks</i>	0	+100	-100	0
<i>Dollar Bonds</i>	+100	0	0	+100
<i>Mark Bonds</i>	0	-100	0	-100

How can the partial equilibrium analysis of exchange rate determination¹ be reconciled with the general equilibrium approach outlined above? There are two points to be made in this connection. First, the asset market approach emphasizes stock demands for and supplies of foreign exchange arising from capital account transactions and neglects the flow demands for and supplies of foreign exchange arising from current account transactions in the short-run analysis of exchange rate determination.² Second, the asset market approach, because of its general equilibrium nature, entails a different perspective of the dynamic interaction between the current account and the exchange rate.

This interaction arises from the fact that a surplus in a country's current account balance implies a net transfer of financial claims from the residents of other countries to the residents of the surplus country.

Such transfer can be effected without changes in asset prices only if there are no differences in the menu of assets held by residents of different countries and if the effect of wealth changes on asset demands across countries is the same on the margin.

¹For representative textbook expositions of the theory of foreign exchanges, see R. Caves and R. Jones, *World Trade and Payments*, 2nd edition, 1977, ch. 17, and C. Kindleberger, *International Economics*, 5th edition, 1973, ch. 17. The classic paper on the foreign exchange market, anticipating much of the subsequent work is J. Robinson, "The Foreign Exchanges," reprinted in *Readings on the Theory of International Trade*, edited by H. Ellis and L. Metzler, 1949, ch. 4. Reference should also be made to earlier work by F. Machlup, "The Theory of Foreign Exchanges" (ch. 5 in the same volume).

²This statement has to be qualified when allowance is made for rational expectation about the future path of the exchange rate. In that case, changes in prospective current account surpluses or deficits will have a first order effect on the exchange rate through their effect on expectations. On this point see P. Kouri, "The Exchange Rate and the Balance of Payments in the Short Run and the Long Run: A Monetary Approach," *Scandinavian Journal of Economics*, 1976, no. 2.

Therefore, in general, there is a relationship between current account surpluses and deficits on one hand and *changes* in exchange rates on the other.

In the absence of differences in the marginal patterns of asset holdings, current account balances are not relevant in themselves in the explanation of exchange rate behavior. Rather, what matters are changes in total asset supplies underlying these current account 'imbalances.'

For example, a current account deficit in America that reflects a deficit in the government budget financed by dollar denominated securities would be associated with a 'weakening of the dollar' whereas an increase in America's current account deficit reflecting an increase in investment expenditure financed by equity issue could well be associated with a 'strengthening of the dollar.'

From the general equilibrium perspective, the dynamic analysis of the behavior of asset prices over time requires then a complete specification of savings behavior in different countries and of the process through which total asset supplies are changed from one period to the next, such as government budget deficits or surpluses, new issues of equity and bonds for the financing investment expenditures and the like.

The connection between relative asset prices and the current account adjustment process is analogous to the relationship between output prices and the current account adjustment process. If spending patterns are identical across countries, an increase in the current account surplus of a country caused, for example, by an increase in savings propensity of that country, calls for no change in relative commodity prices in order for equilibrium to be restored in the world economy. Rather, such transfer will be effected in part through a reduction in the level of output and employ-

ment in the world economy and in part through deflation of the level of prices, or their rate of change, and a reduction in the level of interest rates.

These considerations are of relevance in trying to understand the macroeconomic implications of the transfer from the oil consuming to the oil exporting countries.¹ Such transfer of wealth has effects on equilibrium in financial markets, portfolio effects for short, since the portfolio preferences of the OPEC countries are unlikely to be the same as those of the oil-consuming countries. The policy problem arising from the portfolio effects is the problem of recycling, which has to do with offsetting the shift in portfolio preferences by changing the mixture of asset supplies.

The transfer to OPEC countries has also an effect on the distribution of demand across countries and across industries. Some countries will suffer a secondary burden from the oil transfer because of a shift in world demand away from their products, while other countries will pay the "oil bill" in part through improved terms of trade *vis a vis* other oil consuming countries. The policy problem here is the distribution of the "oil" deficits.

The transfer poses also an internal adjustment problem between the tradable and non-tradable sectors. Notwithstanding the ambiguity about the effects of the transfer on the terms of trade between internationally traded goods, there is a strong presumption of a required increase of the relative price of traded goods in terms of non-traded goods, in countries that have to expand the tradable sector so as to pay for the imports of oil.

¹The payment for oil imports can be viewed as a transfer payment at least in the short run because of the price inelasticity of demand for oil.

Finally, the oil transfer has an important intertemporal dimension because the savings propensity of the OPEC countries is greater than that of the oil consuming countries. If all prices and interest rates were flexible, the reduction in interest rates would reduce the real burden of the transfer to countries that are in current account deficit, and increase it to countries that are in surplus. However, deflation of prices would tend to increase the real burden of the transfer for countries in debt. It would also have a reverse Pigou-effect on world aggregate demand, given the presumption of higher spending propensity in the deficit countries.

In the absence of sufficiently flexible price and interest rate adjustment, the savings effect of the transfer will instead impose a secondary macroeconomic burden by reducing the level of output and employment in the world. This is the paradox of thrift on a world scale.

Another feature of the asset market approach is that it brings exchange rate expectations to a central role in the explanation of exchange rate behavior. An expected appreciation of a currency, *ceteris paribus*, increases the expected return on assets denominated in that currency, and thus, given their total supply, will cause an actual appreciation of that currency in terms of other currencies.

Exchange rate expectations, however, are not only an exogenous source of changes in current exchange rates but they also adjust to equilibrate the foreign exchange markets. Indeed, in the extreme case where bonds of different currency denomination are perfect substitutes, the 'burden of adjustment' falls entirely on exchange rate expectations given that nominal interest rates are determined by monetary policy in the short run. If, in such a model, the expected rate of depreciation differed from the interest rate differential, obviously no equilibrium could exist.

The crucial importance of speculative behavior introduces an element of instability in the foreign exchange market. Like speculators in the stock market, the "gnomes" of the foreign exchange market also speculate on the views of the next buyer. To anchor the chain of expectation about expectations and to prevent self-fulfilling deviant behavior, the market has to take a long view of the "fundamentals" that ultimately determine the relative price of two monies. Without such anchor, the exchange rate is indeterminate. An undervalued exchange rate can always be validated by sufficiently high and accelerating depreciation of the currency, and similarly an accelerating appreciation can justify an overvalued exchange rate.¹

II. THE CURRENCY CHOICE IN INTERNATIONAL FINANCIAL INTERMEDIATION

International financial intermediation has traditionally been dominated by only a few currencies, mainly the U.S. dollar and the pound sterling. As long as exchange rates were fixed, the central consideration in choosing the currency denomination of financial instruments was one of convenience in terms of transactions costs. Since the introduction of generalized floating, however, a new dimension has become relevant in the choice of currency denomination of financial instruments, namely differences in their risk and return characteristics arising from divergent behavior of the purchasing powers of currencies. These characteristics were only relevant in the Bretton-Woods system when market confidence in the parities of key currencies was shaken.

When relative prices of monies are not fixed, a conceptual problem arises regarding the appropriate standard of the value of an asset denominated in a particular currency. The fact that rational lenders and borrowers

¹See the discussion on page 41 below.

are concerned with the real values of their assets and liabilities, suggests the purchasing power of a currency over goods and services available in the world economy as the appropriate standard of value.

Such index of value, under some simplifying assumptions,¹ can be written as

$$Q_i = \prod_{j=1}^N (P_j S_{ij})^{-\alpha_j},$$

where $S_{ij} = S_i/S_j$ is the price of currency j in terms of currency i , and $S_N = 1$.

This expression can be decomposed into the product of an inverse of "the world price level" and the effective exchange rate of currency i :

$$Q_i = Q \cdot S_i^e,$$

where $Q = \prod_{j=1}^N P_j^{-\alpha_j}$ = inverse of the world price level,

$$S_i^e = \prod_{j=1}^N S_{ij}^{-\alpha_j} = \text{effective exchange rate of currency } i.$$

¹The basic assumption is that the indirect utility function is of the form $U(X_1, \dots, X_N) = \prod_{i=1}^N X_i^{\alpha_i}$. This utility function implies that expenditure on commodity i is a constant fraction α_i of total expenditure. If $[p_1, \dots, p_N]$ is the price vector of these N commodities in some currency, the purchasing power of that currency can then be defined as the 'utility' that one unit of that currency buys and it is of the form $\prod_{i=1}^N p_i^{-\alpha_i}$. In computing the purchasing power of currencies we treat national outputs as composite goods, for reasons of data availability.

The next step is to define a composite world currency which consists of all N currencies in value weights $[\alpha_1, \dots, \alpha_N]$. The effective exchange rate of that composite currency is one, for

$$\prod_{i=1}^N S_i^{\alpha_i} = 1.$$

Therefore, Q is simply the purchasing power of the composite world currency and S_i^e is the price of that currency in terms of currency i . Because the purchasing power of the world currency is independent of exchange rate changes, it can be used to measure world inflation under fixed and flexible exchange rates alike with no conceptual 'break' in the series at the time of the transition.

Our concept of the composite world currency is very close to the SDR and in fact can be viewed as a further analytical argument for its definition as a 'basket of currencies.'¹ In this interpretation, our measure of an effective exchange rate can be viewed as the SDR exchange rate of a currency, and is therefore different from those currently in use. In short, the effective exchange rate of a currency in our framework is equal to the ratio of that currency's purchasing power to the purchasing power of world money. Thus effective exchange rates of different currencies can be meaningfully compared.

The motivation for our concept of purchasing power and the implied concept of effective exchange rate is to obtain a standard which can be used to evaluate assets and liabilities denominated in different currencies.

¹Alternative definitions of such baskets are reported in IMF, *International Monetary Reform, Documents of the Committee of Twenty*, Washington, D.C., 1976. See an interesting discussion in Morgan Guaranty's *World Financial Markets*, August 1975, 'The commercial use of SDR's.'

In contrast, the measures of effective exchange rates currently in use are designed to capture the effect of exchange rate changes on trade flows.¹

As an illustration of the suggestiveness of the concept of purchasing power of a currency, we show in Chart 1 the behavior of the purchasing powers of key currencies and of a composite world currency from mid-1970 to late 1977. In computing these indices, we used wholesale price indices² of eight major industrial countries, whose currencies are most widely used in international transactions.³

Two features of the chart stand out. First, the steady decline in the purchasing power of world money; by late 1977 it had lost more than half of its value in mid-1970. Second, individual countries differ markedly in the behavior of the purchasing powers of their currencies whereas German and Swiss currency lost only about 20% of their purchasing power during this period, the British and Italian currencies lost almost 70% of their value during the same period. The purchasing powers of the U.S. dollar and the Canadian dollar declined slightly faster than that of world money, while the purchasing power of the French franc declined by roughly the same amount as the one of world money. The Japanese yen has been one of the

¹For a comparison of different indices of effective exchange rates, see Rudolf Rhomberg, "Indices of Effective Exchange Rates," *IMF Staff Papers*, Vol. 23, No. 1, March 1976. See also Morgan Guaranty's *World Financial Markets*, August 1976 for revised estimates of effective exchange rates using geometric averages and bilateral trade weights.

²The fact that wholesale price indices include imported goods implies a slightly different interpretation of the expenditure shares. In particular, it implies that the expenditure share of a resident of country *i* on the products included in the wholesale price index of that country is equal to 1, which would not be the case if the price index used would only include domestically produced goods.

³The countries, with weights in parentheses, are Canada (8%), France (12%), Germany (22%), Italy (8%), Japan (13%), Switzerland (3%), United Kingdom (10%) and United States (24%). These weights were derived from the average export shares in the period 1973-76.

CHART 1. Purchasing Power of Major Currencies and World Money

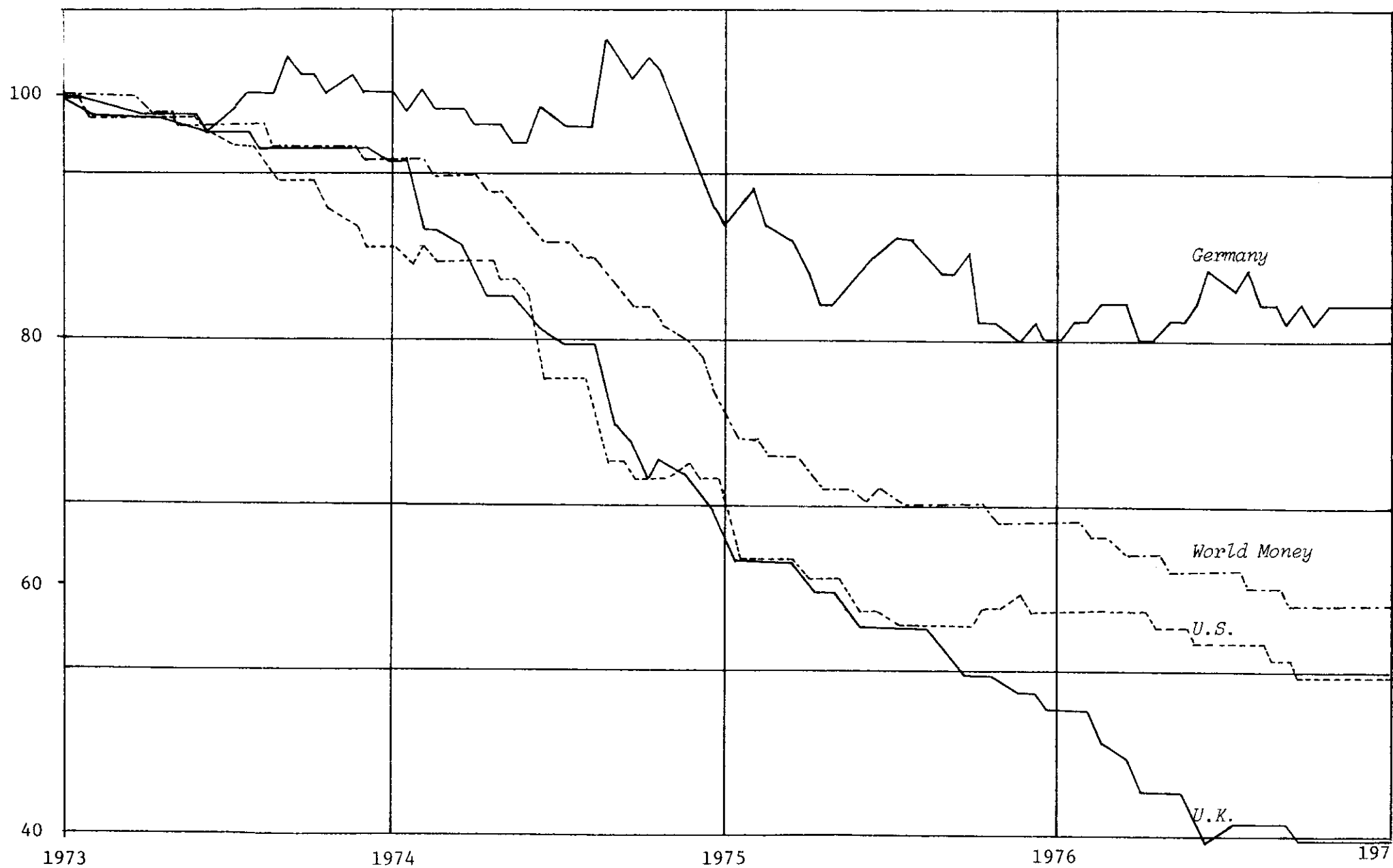


TABLE 1

Changes in Purchasing Power and Mean Returns
 (% per annum) 1973;4-1977;10

<i>Currency of Country</i>	<i>Changes in Purchasing Power</i>				<i>Mean Return</i>	
	<i>Mean (1)</i>	<i>Standard Deviation (2)</i>	<i>Minimum (3)</i>	<i>Maximum (4)</i>	<i>Nominal (5)</i>	<i>Real (6) = (1) + (5)</i>
<i>Canada</i>	-11.33	13.66	-36.46	19.73	7.56	-3.77
<i>France</i>	-10.26	17.09	-64.33	23.03	9.59	-.67
<i>Germany</i>	-3.45	17.31	-44.28	42.82	6.39	2.94
<i>Italy</i>	-17.02	17.47	-71.62	20.87	10.91	-6.12
<i>Japan</i>	-8.13	14.38	-40.70	15.42	8.93	.80
<i>Switzerland</i>	-1.73	16.46	-36.76	42.27	4.44	2.71
<i>United Kingdom</i>	-16.34	14.12	-52.40	18.35	10.19	-6.15
<i>United States</i>	-9.57	12.85	-46.68	17.53	6.23	-3.34
<i>Gold</i>	8.64	61.05	-84.04	198.38	0.00	8.64

Notes: Changes in purchasing power of currency over last quarter from the viewpoint of the international investor with weights as in footnote 3, p. 13.

Nominal returns refer to treasury bill rate for Canada, United Kingdom and United States; call money rate for France, Germany and Japan; medium term bond yield for Italy and interest rate implied by covered 90 day interest rate arbitrage with the eurodollar rate in London for Switzerland, all from *International Financial Statistics*.

strong currencies and it has lost only about 30% of its value during this period.¹

The divergent behavior of purchasing powers of different currencies is also apparent from Table 1, where we show in column (1) the mean quarterly rates of change in the purchasing powers of the same eight currencies as above and gold² from the perspective of an international investor.³

The Swiss franc and the D. mark stand put because of the relatively low rate of depreciation of their purchasing powers but only gold has increased in purchasing power during the floating rate period.

The next three columns report the standard deviations and the range of these changes and provide measures of variability of currency values during the floating rate period. The meaning of these measures is quite different from the one of similar measures computed from changes in bilateral exchange rates, which are widely quoted in discussions of exchange rate volatility. Indeed, rational investors are not concerned about exchange rate variability *per se* but rather they are concerned about unpredictable movements in the purchasing powers of currencies.

¹For graphic clarity, in Chart 1, the base of the indices is shifted from 1973;4 to 1970;6 and the only national currencies shown are the U.S. dollar, the pound sterling and the D. mark.

²Applying the concept of purchasing power to any asset is straightforward. The purchasing power of gold is computed as $Q_g = Q_{US} P_g$ where Q_{US} is the purchasing power of the dollar and P_g is the price of gold in dollars.

It was not reported in Chart 1 because of its extreme variability: the highest value of the purchasing power of the D. mark is 107 (in 1973;7) whereas the purchasing power of gold reaches 297 (in 1974;3) and in 1977;10 is as high as 223 (when the purchasing powers of the D. mark and sterling were 82 and 37 respectively).

³The international investor is assumed to divide his expenditure between products of different countries according to the system of weights used in the computation of the purchasing power indices.

In the absence of capital controls and other impediments to international investment, financial instruments denominated in a currency whose purchasing power is depreciating faster than those of other currencies will be willingly acquired by investors only if they receive a correspondingly higher compensation in terms of nominal return. It is clear from column (6) in Table 1, however, that nominal interest rate differentials have not, on an average, been sufficient to eliminate differences in rates of depreciation of purchasing powers. Thus bonds denominated in the two strongest currencies have on an average earned a real quarterly return of close to 3 percent *per annum* while the bonds denominated in the two weakest currencies have on an average yielded a negative real return of over 6 percent *per annum*. Given the prominence of the U.S. dollar in international financial intermediation it is also of interest to note that the mean real return on dollar denominated short term bonds has been over six percent *per annum* below the mean real return on mark denominated short term bonds.

It is not, of course, possible to conclude from these *ex post* data that expected returns *ex ante* were as widely different. Indeed the standard deviations of the mean real returns are so large as to make differences in these returns statistically insignificant.

In the case of financial assets whose nominal returns are free to vary, adjustment to differences in the rates of depreciation of their units of denomination takes the form of changes in nominal returns. In the case of assets with fixed nominal returns, such as a substantial fraction of the ones included in various monetary aggregates, adjustment takes instead the form of substitution from these assets to more stable valued assets. This point is important because it implies the expansion of the use of strong currencies, as media of exchange, or, in terms of aggregative monetary analysis, a decline in their velocity of circulation.

We now turn to an explicit consideration of portfolio selection by risk-averse investors between short term bonds of different currency denomination, none of which is assumed to be riskless. Neglecting transactions costs and investments in other types of assets, it can be shown, under certain conditions, that a rational investor chooses in each period his portfolio so as to maximize a linear function of mean real return (\bar{r}) and variance (σ^2)

$$\text{Max } \bar{r} - \frac{1}{2}b\sigma^2$$

where b measures the risk aversion of the investor.

Let x_i be the fraction of wealth invested in short term bonds denominated in currency i , then the mean return of the portfolio is

$$\bar{r} = \sum_{i=1}^N x_i r_i$$

where $\sum_{i=1}^N x_i = 1$ and where $r_i = R_i + \pi_i$ is equal to the real return on short term bonds denominated in currency i , R_i is the nominal interest rate and π_i is the expected rate of appreciation of the purchasing power of currency i .¹

The variance of the rate of return is given by

$$\sigma^2 = \sum_{i=1}^N \sum_{j=1}^N x_i x_j \sigma_{ij}$$

¹Note that π_i is different for investors with different expenditure shares; see Kouri, "The Determinants of the Forward Premium," IIES Seminar Paper, No. 62, August 1976.

where σ_{ij} is the covariance between unanticipated proportionate changes in the purchasing powers of currencies i and j .

The vector of portfolio proportions x_i which are the solution of this portfolio problem can be interpreted as consisting of two portfolios, namely a portfolio that minimizes the variance of real return, denoted by x^m , and a speculative portfolio which depends on expected real returns and the risk aversion of the investor, denoted by x^s .

We now outline the determinants of these portfolios and some of their properties.

The minimum variance portfolio of the N short term bonds is given by

$$x^m = \begin{bmatrix} S^{-1}\Pi \\ -\frac{\gamma^2}{2} \end{bmatrix} \alpha \equiv \begin{bmatrix} \Gamma^1 \\ -\frac{\gamma^2}{2} \end{bmatrix} \alpha \equiv \Gamma \alpha$$

where $\sum_{i=1}^N x_i^m = 1$;

$$\gamma_j^2 = 1 - \sum_{i=1}^{N-1} \Gamma_{ij}^1 \quad \text{and} \quad \gamma^2 = [\gamma_1^2, \dots, \gamma_N^2] ;$$

x_i^m is the proportion of bonds denominated in currency i and

$$x^m = [x_1^m, \dots, x_N^m]' ;$$

α_i is the share of expenditure on products of country i and

$$\alpha = [\alpha_1, \dots, \alpha_N]' ;$$

S is the variance-covariance matrix of proportionate changes in the prices of the N^{th} currency in terms of the remaining $N-1$ currencies; and

Π is an $N-1$ by N matrix of covariances between proportionate changes in the prices of the N^{th} currency in terms of the remaining $N-1$ currencies on the one hand and the prices

of the N^{th} currency in terms of the N composite goods on the other.¹

The discussion of two polar cases brings out some interesting properties of the minimum variance portfolio. First, if all relative prices between the composite national outputs are constant and thus each exchange rate satisfies the purchasing power parity equation, the minimum variance portfolio does not depend on consumption preferences. If, furthermore, the national inflation rates are not correlated with each other, the share of currency i in the minimum variance portfolio is equal to σ_M^2 / σ_i^2 where σ_i^2 is the variance of the rate of inflation in country i and σ_M^2 is the variance of the rate of depreciation of the minimum variance portfolio.² When relative prices change in an unpredictable way, there is no presumption that the domestic currency is necessarily a safer store of value than the foreign currency. The safest currency for all investors, irrespective of their country of origin, is the currency of the country with least unpredictable inflation. In the absence of capital controls

¹The choice of the N^{th} currency is, of course, arbitrary. Also, the analysis does not depend on the equality between the number of currencies and the number of composite goods.

²In the general case when the covariances between national inflation rates are not zero, the expression for the minimum variance portfolio is:

$$\begin{bmatrix} x_1^m \\ x_N^m \end{bmatrix} = \frac{1}{e' \Omega^{-1} e} \Omega^{-1} e,$$

where Ω is the variance-covariance matrix of the national inflation rates, e is an $(N \times 1)$ vector each element of which is equal to one and

$\sigma_M^2 = e' \Omega^{-1} e$ rather than $\sum_{i=1}^N (1/\sigma_i^2)$. For a more detailed analysis of

international investment in equity claims as well as in bonds when the purchasing power parity holds, see Kouri, "International Investment and Interest Rate Linkages under Flexible Exchange Rates," in R. Z. Aliber, ed., *The Political Economy of International Monetary Reform*, Cambridge University Press, 1976.

and restrictions on the use of foreign currencies, one would expect the safe currency to become increasingly widespread in its use as the unit of denomination of financial instruments.

The second polar case, assumed in much of the literature on foreign exchange risk, obtains when the local currency prices of national outputs are deterministic. Then, the minimum variance portfolio is simply the vector of expenditure shares $[\alpha_1, \dots, \alpha_N]$ and the Γ matrix above is equal to the N by N identity matrix.

The first special case is likely to be relevant in an environment of high and unpredictable inflation while the second case is likely to be more relevant when inflation rates are moderate and exchange rate variations reflect large and unpredictable deviations from their purchasing power parities.¹

The speculative portfolio of the N bonds is given by

$$x^S = \frac{1}{b} \sum r$$

where \sum is a symmetric matrix of own and own effects of interest changes on speculative demands whose rows and columns sum to zero. It is defined by:

$$\sum = \begin{bmatrix} S^{-1} & \delta^{1'} \\ \delta_i^1 & \delta_N^2 \end{bmatrix}$$

¹It should be noted that the purchasing power parity may hold and yet the minimum variance portfolio depends on expenditure shares. This is the case when there are changes in relative prices caused by 'real' factors and these changes are correlated with changes in the purchasing powers of monies.

where $\delta_i^1 = - \sum_{j=1}^{N-1} [S^{-1}]_{ij}$ and $\delta^1 = [\delta_1^1, \dots, \delta_{N-1}^1]$, $\delta_N^2 = - \sum_{i=1}^{N-1} \delta_i^1$

r_i is the real return on bonds denominated in currency i and

$$r = [r_1, \dots, r_N]'$$

The property of the rows and columns of \sum adding to zero implies that the speculative portfolio can alternatively be written as a function of real interest rate differentials or real forward premia

$$x^s = \frac{1}{b} \sum \hat{r} = \frac{1}{b} \sum \hat{f}$$

where $\hat{r}_i = r_i - r_N$, $\hat{f}_i = f_i + (\pi_i - \pi_N)$, $i = 1, \dots, N-1$, is the real forward premium of currency i against currency N .

In this interpretation, x^s represents speculative positions in the $N-1$ forward markets and the minimum variance portfolio represents a 'capital position' in short term bonds denominated in the N currencies.

Note that, in the same way that a lender chooses the currency composition of his portfolio so as to obtain a desired balance between risk and return, a borrower seeks to obtain the desired currency composition of his debt portfolio. The level of financial intermediation in different currencies that emerges from the interaction of borrowers and lenders will then depend on the riskiness of the purchasing powers of these currencies in the way suggested by this analysis.

We now apply this framework to study the demands for short term bonds denominated in five major currencies using monthly data for the floating exchange rate period.¹ In the analysis we treat the means, variances

¹The five currencies are the U.S. dollar, the D. mark, the pound-sterling, the Japanese yen and the French franc. In the tables they are abbreviated as US, GE, UK, JA and FR, respectively.

and covariances of proportionate changes in the purchasing powers of these currencies as constants and use actual data for exchange rates against the dollar (the N^{th} currency) and wholesale price indices¹ of the five countries to compute the Γ and Σ matrices.

In Table 2 we show these matrices computed from monthly, quarterly and yearly proportionate changes in purchasing powers.

To interpret the figures on the left hand panel, we note that each column of the Γ matrix represents the minimum variance portfolio of a national investor and that the minimum variance portfolio of an international investor is just a weighted average of these columns. The interesting aspect of the reported Γ matrices is the dominance of the domestic currency in the minimum variance portfolios of German, U.K. and U.S. investors for all holding periods. This is not, however, the case for French and Japanese investors. In these two cases, the D. mark and, surprisingly, also sterling, assume an important role, as the holding period increases. It is also somewhat surprising that as the holding period increases the French franc and the Japanese yen are competed out of virtually all of the minimum variance portfolios and are in fact, held in negative amounts.

The right hand panel of Table 2 shows the effect of changes in expected real returns on speculative demands for short term bonds denominated in the five currencies. Neglecting the last column, the resulting matrices show the effects of changes in expected real forward premia against the U.S. dollar on speculative demands in the forward markets for the four

¹See footnote 2, p. 13.

TABLE 2
Portfolio Diversification across Currencies
for Different Holding Periods

		Γ matrix					Σ matrix				
		FR	GE	JA	UK	US	FR	GE	JA	UK	US
Monthly	FR	<u>.48</u>	-.05	-.20	.01	-.06	2.42	-1.39	-.34	-.55	-.13
	GE	.31	<u>1.05</u>	.09	.00	.01		1.87	-.41	-.11	.03
	JA	-.06	-.08	<u>.81</u>	-.02	-.21			3.05	-.61	-1.69
	UK	.13	.04	.07	<u>1.08</u>	.10				2.27	-.99
	US	.14	.04	.22	-.07	<u>1.15</u>					2.79
Quarterly	FR	<u>.08</u>	-.18	-.54	-.04	-.05	2.10	-1.11	.06	-.65	-.41
	GE	.49	<u>1.13</u>	.29	.00	.08		1.60	-.82	-.07	.40
	JA	-.13	-.13	<u>.50</u>	-.09	-.26			2.86	-.54	-1.55
	UK	.33	.14	.29	<u>1.14</u>	.14				1.82	-.57
	US	.23	.04	.46	-.02	<u>1.09</u>					2.12
Yearly	FR	<u>-.22</u>	-.20	-.67	-.00	-.12	1.71	-.33	-.48	-1.20	.29
	GE	.90	<u>1.24</u>	.68	-.11	.23		3.42	-2.80	-2.01	1.72
	JA	-.52	-.43	<u>.12</u>	-.47	-.48			4.53	1.98	-3.24
	UK	.76	.25	.66	<u>1.17</u>	.44				3.71	-2.49
	US	.07	.13	.20	.42	<u>.92</u>					3.71

Note: Monthly data 1973;4-1977;8 from IFS.

remaining currencies. We note that for all currencies and for all holding periods the own effects indicated by the diagonal elements are consistently higher than the cross effects indicated by the off diagonal elements.

We also note that there are some complementarities in speculative asset demands, of which perhaps the most interesting is the one between the U.S. dollar and the D. mark. This complementarity appears to increase with the lengthening of the holding period. However, an increase in the expected rate of return on dollar denominated bonds always increases the demand for dollars by more than it increases the demand for marks and thus it leads to a reduction in the speculative demand for marks in the forward market.

We can now use the \sum matrix for a quarterly holding period to get an idea of the general equilibrium effects of changes in forward premia on speculative demands in the forward market, although such measure is determined only up to a scalar factor, the magnitude of which depends on the unknown degree of risk aversion.

In Chart 2 the actual 90 day forward premium on the D. mark against the U.S. dollar in percent *per annum* is plotted together with a hypothetical forward premium.

This hypothetical forward premium incorporates the effects of changes in other forward premia or speculative forward demands for the D. mark. These effects are measured in terms of the equivalent changes in the premium of the D. mark against the dollar.

¹ Denoting it by \bar{f} it is defined by the condition

$$(\sum)_{ii} \bar{f}_i = \sum_{j=1}^{N-1} (\sum)_{ij} f_j \cdot$$

It is evident from this chart that, except for a few observations, the cross market influences have consistently increased the speculative pressure on the D. mark, *ceteris paribus*.

To conclude the analysis, we show in Table 3 a hypothetical minimum variance portfolio and speculative portfolio for an international investor. The expenditures shares used in the computations are shown in column (1).

Consistent with the above results is the fact that the French franc and the Japanese yen are held in negative amounts in the minimum variance portfolio reported in column (2). This implies that the international investor would borrow in these two currencies in order to invest in the remaining ones. The dominance of the U.S. dollar in this portfolio, on the other hand, reflects the large weight given to it in the assumed expenditure pattern.¹

In column (4) we show hypothetical speculative demands for five short term bonds which are evaluated using average forward premia against the dollar adjusted for the differences in mean rates of changes in the purchasing power of the respective currency and the dollar (shown in column (3)). These demands are of course determined only up to a scale factor. It is interesting to note that despite the fact that the mean real return on the U.S. dollar has been negative during this period--as noted in connection with Table 1--its weight in the speculative portfolio is almost as large as the one of the D. mark. The reason for this is the substitution away from the other currencies.²

¹These weights correspond to the 'simplified SDR' proposed in *World Financial Markets*, August 1975, and they attempt to capture the 'special role' of the U.S. dollar and also of the pound sterling in international transactions. In fact, if average export weights had been used we would have had, instead, US = .30, GE = .26, UK = .13; JA = .16 and FR = .15.

²A paradoxical illustration of the substitution effects is the negative weight of the Japanese yen in the speculative portfolio.

CHART 2. Mark-Dollar Forward Premium Corrected for Cross-Effects

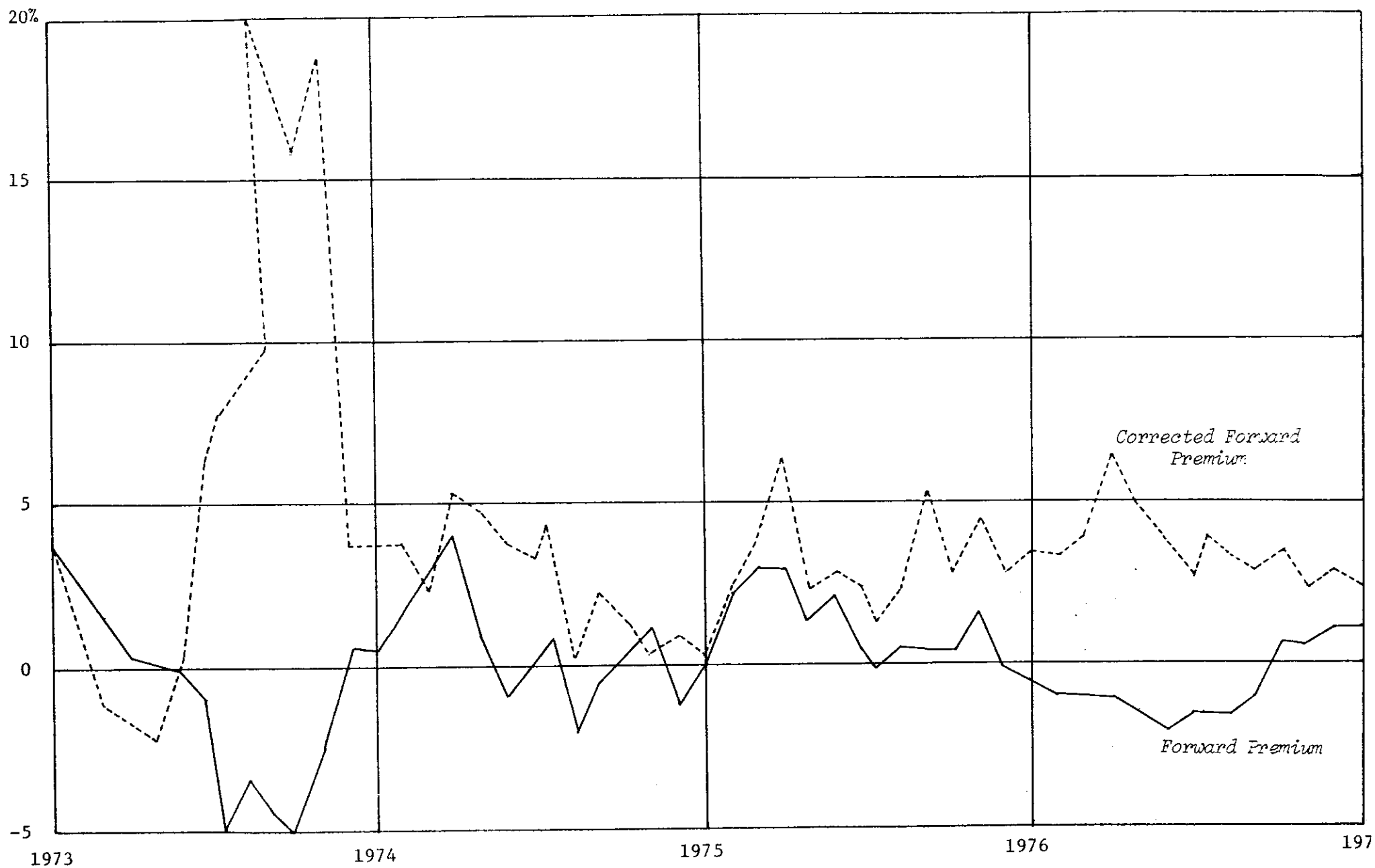


TABLE 3
Total Demand for Assets

Country	Value Weights (1)	Min. Var. Portfolio (2)	Mean Real Forward Premium (% per annum) (3)	Speculative Portfolio (4)	Total Demand (5) = (2) + (4)
FR	11	-11.17	-3.04	-1.39	-12.56
GE	18	32.51	7.03	4.25	36.75
JA	11	-11.58	-1.74	- .92	-12.50
UK	13	30.85	-13.33	-5.46	25.39
US	47	59.39	0	3.58	62.97
TOTAL	100	100.00		0.00	100.00

Notes: Monthly data 1973;4-1977;8.

Column (2) Quarterly Γ in Table 2 multiplied by column (1).

Column (4) Quarterly Σ in Table 2 multiplied by real premium in column (3) in per cent per quarter.

In column (5) we show total demands for bonds denominated in the five currencies for the case when the scale factor in the speculative portfolio is equal to one.¹ In that special case, the prominence of the pound sterling in the minimum variance portfolio is sufficient to make total demand for sterling positive despite the fact that it is held in a negative amount in the speculative portfolio.

We started our analysis by studying how, at any given point in time, equilibrium is reached in international financial markets through changes in exchange rates, interest rates and other asset prices.

In this part we have studied how portfolio behavior in these markets is in turn influenced by price behavior. We now turn to an analysis of the interaction of asset markets with output, price and current account adjustment so as to gain further insight into the fundamental determinants of exchange rate behavior.

III. FUNDAMENTALS OF EXCHANGE RATE BEHAVIOR

The Fisher Parity

We begin the analysis by considering an environment where international financial markets are highly developed and where, as a first approximation, changes in risk premia can be neglected. Then a crucial condition of equilibrium in international financial markets becomes the Fisher parity relationship, which connects foreign exchange markets to credit markets. In its simplest form it rules out risk premia altogether and can be written as

¹This, in fact, is the case when the Arrow-Pratt relative degree of risk aversion is one.

$$\tilde{S}_{t,t+1} = F_{t,t+1} = \left[\frac{1 + R_{t,t+1}}{1 + R_{t,t+1}^*} \right] S_t .$$

where S_t is the spot price of foreign currency in terms of domestic currency in period t ,

$F_{t,t+1}$ is the one period forward price of foreign currency,

$\tilde{S}_{t,t+1}$ is the expected spot price of foreign currency in terms of domestic currency in period $t+1$ on basis of information available in period t ,

$R_{t,t+1}$ ($R_{t,t+1}^*$) is the nominal interest rate on a one period riskless bond denominated in the domestic (foreign) currency.

According to these equations the expected spot price of foreign currency one period ahead is equal to its one period forward price, which, by the interest rate parity, is also equal to the spot price multiplied by the ratio of one period domestic and foreign interest rate factors.

Strictly speaking the first equation can hold only if the expectation about the next period's spot rate is held with certainty.¹

If it is assumed that expectations are also consistent, then the expected value of next period's exchange rate must also satisfy the Fisher parity. By recursion, the exchange rate expected to prevail in period t on basis of information available in period t is related to the spot

¹In fact, because of the so-called Jensen's inequality, it cannot be true at the same time if $S_{t,t+1}$ is stochastic that the expected price of foreign currency in terms of domestic currency, or $E_t(S_{t,t+1})$, is equal to the forward price of foreign currency in terms of domestic currency, or $F_{t,t+1}$, and that the expected price of domestic currency in terms of foreign currency, or $E_t(1/S_{t,t+1})$, is equal to the forward price of domestic currency in terms of foreign currency, or $1/F_{t,t+1}$.

exchange rate by:

$$\tilde{S}_{t,\tau} = F_{t,t+1} \cdot \tilde{F}_{t+1,t+2} \cdots \tilde{F}_{\tau-1,\tau} = I_{t,t+1} \cdot \tilde{I}_{t+1,t+2} \cdots \tilde{I}_{\tau-1,\tau} \cdot S_t$$

where $\tilde{F}_{s,s+1}$ = one period forward price of foreign currency expected to prevail in period s on basis of information available in period t .

$$\tilde{I}_{s,s+1} \equiv \frac{1 + \tilde{R}_{s,s+1}}{1 + \tilde{R}_{s,s+1}^*} = \text{ratio of one period interest rate factors expected to prevail in period } s \text{ on basis of information available in period } t.$$

$F_{t,t+1}$ and $I_{t,t+1}$ are the current values of the forward price and of the ratio of the interest rate factors respectively.

If it is assumed further, as an analytic simplification, that there exist forward and bond markets for each maturity, and that the term structure of interest rates satisfies the expectations hypothesis, the relationship between the spot exchange rate expected to prevail at time τ on basis of information available at time t can be written in the form:¹

$$S_{t,\tau} = F_{t,\tau} = \left[\frac{1 + R_{t,\tau}}{1 + R_{t,\tau}^*} \right] S_t, \quad \tau = t+1, \dots$$

where $F_{t,\tau}$ = τ -period forward price of the foreign currency in period t ,

¹For an analysis of the relationship between the term structure of interest rates ratios and the term structure of exchange rate expectations, see Michael Porter, "A Theoretical and Empirical Framework for Analyzing the Term Structure of Exchange Rate Expectations," *IMF Staff Papers*, November 1971, p. 612.

$$\frac{1 + R_{t,T}^*}{1 + R_{t,T}} = \text{ratio of } \tau\text{-period interest rate factors.}$$

This equation links the term structure of interest rate differences to the term structure of exchange rate expectations. It does not, however, determine the equilibrium level of the exchange rate.

To provide a simple example, if the 90-day interest rate in Germany is 4 percent, at an annual rate, while the 90-day interest rate in the United States is 6 percent, at an annual rate; equilibrium in the foreign exchange market requires, in a world of perfect substitutability, that the dollar price of the mark be expected to increase at an annual rate of 2 percent. This arbitrage condition does not, however, say anything about how this expectation will be brought about, whether through a decline in the spot price of the mark in terms of the dollar with no change in the expected future price (and thus in the forward price), or alternatively through an increase in the expected future price of the mark in terms of the dollar (and thus in the forward price) with no change in the spot price.

Since spot exchange rates are free to move, the anchor for exchange rates must be sought in long term expectations about the 'fundamental' determinants of the equilibrium exchange rate.

The long run fundamentals can be summarized by the purchasing power parity equation which ties the equilibrium exchange rate to expectations about the ratio of future price levels on the one hand, and expectations about the equilibrium real exchange rate on the other. Expectations about future price levels can then in turn be linked, via the quantity equation, to expectations about future money supplies and money demands.

If all prices were instantaneously flexible and the world economy

was always in a classical full employment equilibrium, these fundamental factors would directly determine the spot exchange rate as well. The purchasing power parity would determine the exchange rate, the quantity equations would determine domestic and foreign price levels, and, given the current and expected future exchange rates, the Fisher parity would determine the term structure of interest rate differences.¹

Given that prices are not instantaneously flexible, this dichotomy breaks down and the theory of exchange rate determination must be embedded in a macroeconomic theory of output, price and interest rate determination.

The Fisher parity becomes an equation that links the exchange rate so determined to expectations about the long run fundamentals that determine its value in classical equilibrium.

Let this equilibrium be reached in period T . Then the fundamental determinants of exchange rate behavior can be summarized by the following equation:

$$(F) \quad S_t = \frac{1 + R_{t,T}^*}{1 + R_{t,T}} \cdot \tilde{S}_{t,T} \cdot \frac{\tilde{P}_{t,T}}{\tilde{P}_{t,T}^*}$$

where $\tilde{S}_{t,T}$ = equilibrium relative price of foreign goods in terms of domestic goods expected to prevail in period T on basis of views held in the current period t ,

$\tilde{P}_{t,T}$ ($\tilde{P}_{t,T}^*$) = expected domestic (foreign) price level in period T .

¹In classical equilibrium, the ratio of price levels depends in general on differences in nominal interest rates because the velocity of circulation of monies depend on interest rates and differences in the expected rates of depreciation of their purchasing powers.

Three Time Horizons

Although the choice of T above is arbitrary, it is the largest of three time horizons of the adjustment process. These can be illustrated in Figure 1, which depicts the standard model of an open economy under conditions of perfect capital mobility.¹

Initial equilibrium is shown at point A_0 , with domestic interest rate r_0 equal to the world interest rate r^* and domestic output level equal to Y_0 . A permanent reduction in the nominal money supply shifts the LM schedule to the left, to $L'M'$.

In the short run the output level is fixed so that the interest rate increases to r_1 . A higher domestic interest rate is consistent with equilibrium in the foreign exchange market only if an increase in the price of foreign currency is expected. Thus, if convergence to equilibrium is monotonic, the spot exchange rate has to overshoot its long run equilibrium value to induce expectations of subsequent depreciation.

In the Keynesian medium run, the appreciation of the exchange rate shifts the IS schedule to the left, to $I'S'$, until new equilibrium is reached at A_2 with the same interest rates as before but with a lower level of output Y_1 .

Finally, in the long run, deflation of domestic prices and wages bring both the LM and IS schedules back to their initial positions. The economy returns to A_0 with the same interest rate and the same out-

¹The original references are R. Mundell, "Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates," *The Canadian Journal of Economics and Political Science*, November 1963, reproduced in *Readings in International Economics*, edited by R. Caves and H. Johnson, Irwin, Homewood, Ill., 1968 and J. M. Fleming, "Domestic Financial Policies under Fixed and Floating Exchange Rates," *IMF Staff Papers*, November 1962, reproduced in *International Finance*, edited by R. Cooper, Penguin Books, Baltimore, Md., 1969. For an exposition see R. Dornbusch and S. Fischer, *Macroeconomics*, New York, McGraw Hill, 1978, pp. 639-641.

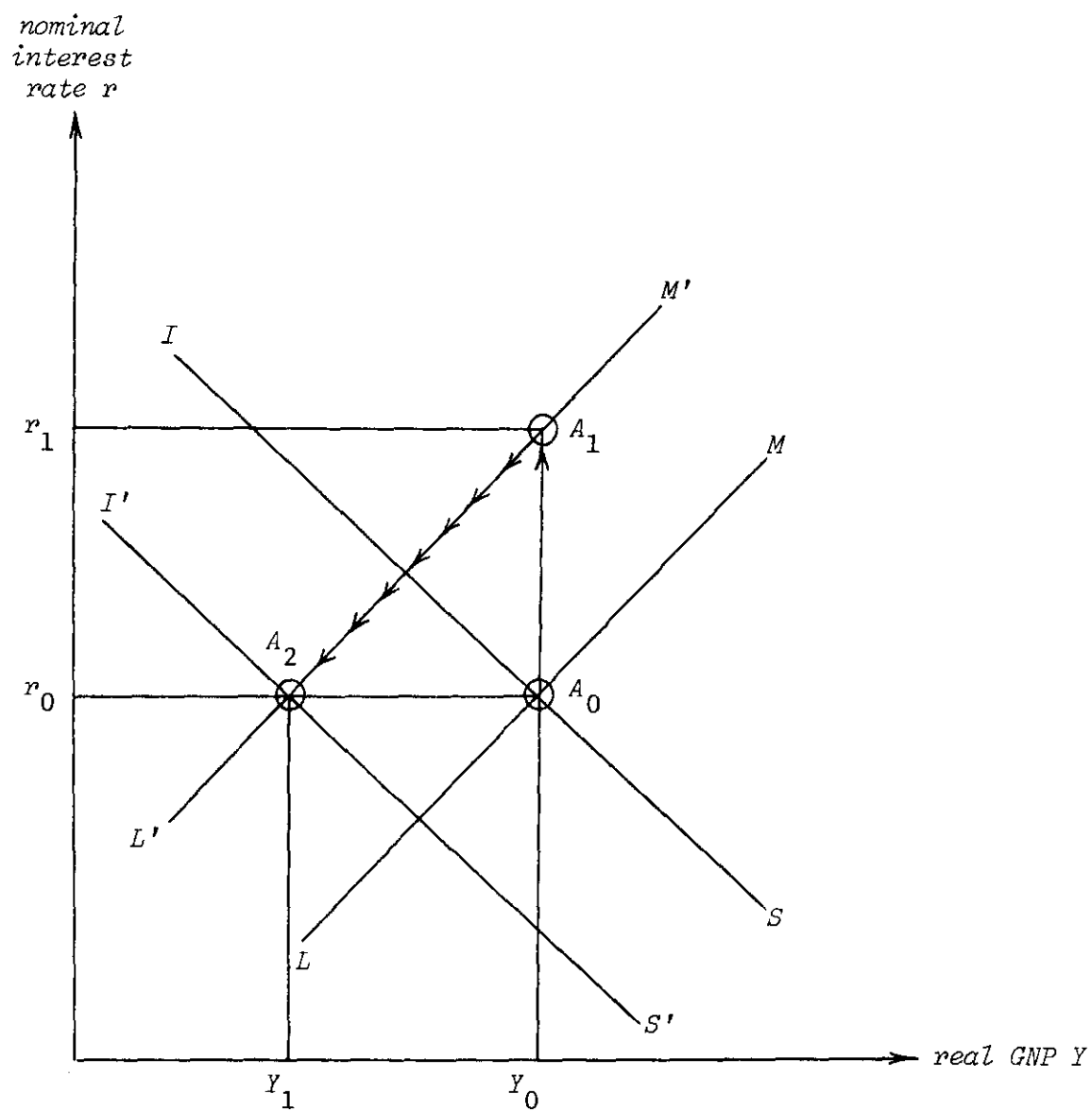


FIGURE 1

put level but with a lower price level.

The long run perspective neglects the entire adjustment process $A_0 A_1 A_2 A_0$. In this time horizon, relative price levels are determined by relative money supplies, relative price structure is determined by real factors and exchange rates are determined, via the purchasing power parity, by relative price levels.

The Keynesian perspective abstracts from price adjustment, identifies the exchange rate as the relative price of outputs and thus emphasizes relative price elasticities of the distribution of demand as the crucial parameters on which the magnitude of exchange rate movements depends.

Finally, the short run perspective emphasizes the fact that asset markets clear fast through interest rate and exchange rate adjustments while output markets respond only gradually. It is such asymmetry in adjustment speeds which raises the possibility of overshooting of asset prices, including exchange rates. In fact, it has been suggested as an explanation for the observed volatility in exchange rates in recent years.¹

Cyclical Behavior of the Exchange Rate

From equation (F) above, cyclical fluctuations in the exchange rate are possible only insofar as monetary conditions permit cyclical differences in long term interest rates. In fact, if the central bank of a country pegs the domestic interest rate to the foreign interest rate, private speculators will stabilize the exchange rate between the two currencies. The stability of the floating Canadian dollar in the 1950's can be explained in this way.

¹See the discussion on page 46 below.

The role of cyclical exchange rate fluctuations in the analysis of the exchange rate regime by Mundell and Fleming¹ was one of offsetting cyclical shifts in demand between countries. By neglecting the crucial role of exchange rate expectations, however, this pioneering analysis suggested that cyclical exchange rate fluctuations could occur without compensating movements in interest rate differences. In fact, it assumed that arbitrage would equate nominal interest rates between countries, in which case the exchange rates have to be constant.

We will study the determinants of the cyclical behavior of the exchange rate in more detail in the framework of a simple Keynesian model of a world economy consisting of two countries of equal size.

The model is set in terms of deviations of the variables from their full employment values, and consists of the following sets of equations.

First there are the equations of the *IS* schedules of the two countries which relate the equilibrium levels of output to real interest rates and the relative price of the outputs of the two countries.²

$$x = a_1(e + p^* - p) - a_2(r - \mu) - a_3(r^* - \mu^*) + u + v$$

$$x^* = -a_1(e + p^* - p) - a_3(r - \mu) - a_2(r^* - \mu^*) - u + v$$

where x , x^* = domestic and foreign GNP gaps

e = price of foreign currency

p , p^* = domestic and foreign price levels

¹See the references in footnote 1 on page 35 above.

²All variables except r , r^* , μ and μ^* are in logarithmic form and all parameters are positive.

$r, r^* =$ domestic and foreign nominal interest rates

$\mu, \mu^* =$ expected rates of inflation in the domestic and foreign economies

$u =$ a demand disturbance capturing a shift of demand towards domestic output

$v =$ a global demand disturbance affecting the domestic and foreign economies equally.

Second there are the equations of the *LM* schedules which specify conditions of equilibrium in the two credit markets as

$$m - p = -b_1\pi - b_2r + x$$

$$m^* - p^* = b_1\pi - b_2r^* + x^*$$

where $m, m^* =$ logarithmic deviations of the domestic and foreign money stocks from their trend values

$\pi =$ expected proportionate rate of change in the price of foreign currency in terms of foreign currency.

The expected rate of change of the exchange rate is an argument in the demand for money functions to allow for the possibility of substitution between domestic and foreign money.

Third, equilibrium in the foreign exchange market requires that the Fisher parity holds, namely

$$\pi = r - r^* .$$

The difference in the cyclical positions of the two countries, denoted by $z = x - x^*$, depends on the relative price of their outputs and its expected rate of change as well as the autonomous disturbance form:

$$z = d_1(e + p^* - p) - d_2(\pi + p^* - p) + u'$$

where $d_1 = 2a_1$; $d_2 = a_2 - a_3$ and $u' = 2u$.

The intertemporal substitution in the regional distribution of demand is captured by the second term on the right-hand side: an expected decline in the relative price of foreign output reduces current demand for it.

Equilibrium in the foreign exchange market is related to the difference in the cyclical positions of the two countries by

$$\pi = -\frac{1}{b'}[(m-p) - (m^*-p^*) - z]$$

where $b' = 2b_1 + b_2$, sum of substitution elasticities of money demand.

Our analysis of the cyclical behavior of the world economy¹ under

¹Given the simple aggregative structure of the model, the equations, for the world *IS* and *LM* schedules can be written as:

$$\bar{x} = -a(\bar{r} - \bar{p}) + v$$

$$\bar{m} - \bar{p} = -b\bar{r} + \bar{x}$$

where $a = 2(a_2 + a_3)$; $b = 2b_2$ and a bar over a variable refers to the world. The reduced form equations for the world GNP gap and world interest rate are:

$$\bar{x} = \frac{1}{2}(x + x^*) = \frac{a}{a+b}[\bar{m} - \bar{p}] + \frac{b}{a+b}v + \frac{ab}{a+b}u$$

$$\bar{r} = \frac{1}{2}(r + r^*) = -\frac{1}{a+b}(\bar{m} - \bar{p} - v) + \frac{a}{a+b}u$$

Note further that the aggregative structure of the model does not depend on the exchange rate regime which, instead, has to do with the cyclical behavior of the distribution of demand.

flexible exchange rates is conducted in an economic environment of stable prices and stationary price expectations. We note first the fluctuations in the output levels of the two countries reflect in part fluctuations in the level of world demand and in part shifts in the distribution of that demand between the two countries,¹ but that the cyclical behavior of the exchange rate is connected only with the latter.

We assume that the source of these fluctuations is the 'cyclical' behavior of the exogenous variables specified by:

$$\dot{v} = -\lambda v, \quad \dot{u}' = -\lambda u', \quad \dot{m} = -\lambda m, \quad \dot{m}^* = -\lambda m^*,$$

where a dot over a variable denotes the rate of change of that variable and λ measures the persistence of its deviation from the trend value.²

We also assume that exchange rate expectations are formed rationally, so that, in equilibrium:

$$\pi = \dot{e},$$

where \dot{e} is the proportionate rate of change in the exchange rate.

With these assumptions, the time paths of the exchange are given by

$$\dot{e} = \frac{1}{b' + d_2}(m - m^* - u') + \frac{d_1}{b' + d_2}e$$

¹The model permits a simple decomposition of these two factors, namely

$$x = \frac{1-x}{2} + \frac{1}{2}z \quad \text{and} \quad x^* = \frac{1-x}{2} - \frac{1}{2}z.$$

²Allowing for different persistence coefficients would not change the analysis in any essential way. See footnote 2 page 42.

Since the coefficient on e is positive the equilibrium solution $e = 0$ is a saddlepoint. Thus there is any number, in fact, a continuum, of time paths of the exchange rate that satisfy this equation,¹ although only one along which the exchange rate converges to its long run equilibrium value.

Given the structure of the model thus specified, the equilibrium exchange rate consistent with rational speculative behavior is then:²

$$e = \frac{1}{d_1 + \lambda(b' + d_2)}(m - m^* - u') .$$

This equation shows that if the difference in the cyclical positions of the two countries is due to monetary factors $(m - m^*)$, the currency of the country in a cyclically strong position will be weak relative to its equilibrium value. When the difference in the cyclical positions of the two countries is caused by differences in the behavior of autonomous demand (as captured by u), the converse is true.

The equation shows further that the extent to which 'rational' speculation in the foreign exchange market stabilizes the exchange rate against cyclical fluctuations in its determinants is stronger the shorter the duration of these disturbances (the larger λ), the greater the substitution elasticities of money demand (b') and the greater the intertemporal elasticity

¹As we pointed out above, an undervalued exchange rate can always be justified by sufficiently high and accelerating rate of depreciation. In terms of the discussion of the Fisher parity this equation defines only the term structure of (expected) exchange rates. The level of exchange rates has to be determined by an additional equation. Such an equation is provided by the assumption of stationary long term expectations.

²Denoting $m - m^* - u' = y$ we have that $\dot{y} = -\lambda y$. The solution of the differential equation is of the form $e = Ay$, which implies $\dot{e} = -\lambda e$. Given long term expectation, the equilibrium exchange rate can be solved in the simple form indicated in the text.

of substitution in the distribution of demand (d_2) . When these crucial parameters are sufficiently high, the flexible rate regime behaves much like the fixed rate regime: the exchange rate is stabilized by private 'rational' speculators rather than central banks.

Paradoxically it is then necessary for monetary policies in the two countries to behave in such a way as to cause the exchange rate to display more variability than would be the case in the absence of active monetary policy. In fact the adjustment in the exchange rate required to keep the economies of both countries at full employment is given by:¹

$$e = - \frac{1}{d_1 + \lambda d_2} u' .$$

Only if the substitution elasticities of money demand are zero will this adjustment be the same as the one underlying the equilibrium exchange rate indicated earlier. Thus monetary policy can be interpreted as offsetting the changes in velocity of circulation induced by stabilizing speculation.

We note that, again, the exchange rate does not depend on shifts in the level of world demand, as captured by v . This is not the case, however, when monetary policies in the two countries are not 'coordinated.' If, for example, the foreign country pursues a passive monetary policy while the domestic country uses monetary policy so as to maintain full employment, a global decline in demand will give rise to a depreciation

¹The equilibrium response of the interest rates in this case is

$$r = \frac{1}{a}v + \frac{\lambda}{d_1 + \lambda d_2}u \quad r^* = \frac{1}{a}v - \frac{\lambda}{d_1 + \lambda d_2}u .$$

of the domestic currency.¹

This exchange rate adjustment was not necessary in the previous cases, where monetary policies were coordinated. This point which has some relevance in understanding the current policy impasse in industrial countries: Given the global nature of the current recession, expansion would take place at unchanged exchange rates if only it was initiated simultaneously in all countries.

Exchange Rate Behavior in an Inflationary Environment

In the environment of stable long run expectations that we have been concerned with so far, exchange rate fluctuations are transitory and are to a significant extent dampened by stabilizing speculation. This suggests that the instability of exchange rates in the inflationary environment of recent years is attributable at least in part to the absence of a stable anchor for long term expectations.²

The long run equilibrium value of the exchange rate is now given by:³

¹ Given by

$$\frac{\partial e}{\partial v} = \frac{b_1 + b_2 + \frac{a}{2}}{a_1(b_1 + b_2 + d_1)} .$$

The effect of a decline in domestic demand, on the other hand is just $(1/a_1)$.

² Note that autonomous inflation need not result in exchange depreciation unless it is accommodated by monetary expansion. In fact, it may result in exchange rate appreciation if the distribution of demand is insensitive to changes in relative prices.

³ In the long run equilibrium $x = x^* = 0$, $r = \mu$, $r^* = \mu^*$ and $\pi = \mu - \mu^*$ given that all real variables are measured as deviations from trend. The expected inflation rates in turn are equal to the growth rates of the money supplies (adjusted for trend growth in real money demand). The price levels in the two countries are determined by the *LM* schedules:

$$m - p = -(b_1 + b_2)\mu + b_1\mu^* , \quad m^* - p^* = b_1\mu - (b_1 + b_2)\mu^*$$

and the exchange rate by the purchasing power parity equation $e = p - p^*$. By substitution, we get the result reported in the text.

$$e = (m - m^*) + b'(\mu - \mu^*) .$$

It is noteworthy that while high substitution elasticities of money demands contribute to stability of the exchange rate in an environment of price stability (as shown above), they increase the instability of the exchange rate in an inflationary environment by making it more sensitive to differences in the rates of depreciation of the two monies.

Consider now the dynamic responses of the exchange rate to unanticipated and anticipated permanent reduction in the money supply of the foreign country. These will be analyzed with the aid of Figure 2. We measure the difference in price levels in the horizontal axis and the exchange rate in the vertical axis.¹

The *PP* schedule represents the purchasing power parity relationship and is the locus of all long run equilibria.

The short run dynamics of the exchange rate and the difference in prices depends on the details of the macroeconomic model assumed; we will only provide a suggestive analysis. For example, the adjustment to an unanticipated permanent reduction in the foreign money supply will, in the long run, cause an equiproportionate decline in foreign prices matched by an equal depreciation in the domestic price of foreign currency and thus, in the Fisher parity framework, in the expected long run equilibrium price of the foreign currency.

What happens to the spot exchange rates depends on the behavior of interest rates in the adjustment process. Immediately, there will be

¹Note that the analysis of the dynamic responses of the exchange rate to a permanent reduction in the rate of growth of the foreign money supply could be carried out with this apparatus, provided that the difference in price levels and the exchange rate were measured relative to the trends set by relative money supplies.

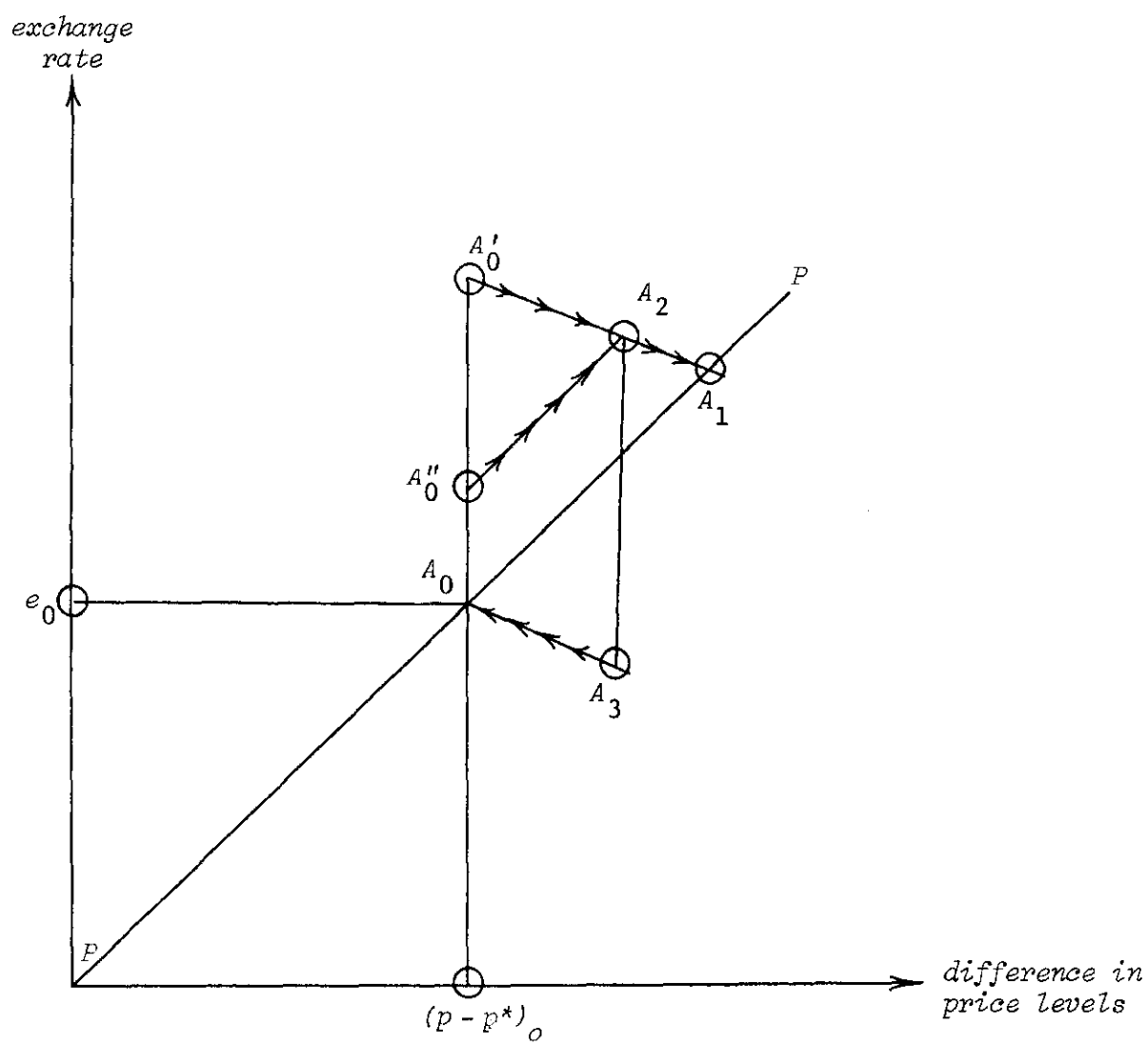


FIGURE 2

an increase in short term interest rates in the foreign country. If the interest rate differential persists in favor of the foreign country and thus the long term interest rate differential also turns in its favor the spot exchange rate must immediately overshoot its long run equilibrium, a possibility emphasized by Dornbusch as an explanation of exchange rate instability.¹ In Figure 2, the path of the exchange rate would be $A_0 A'_0 A_1$.

The initial overshooting need not occur, however, if the decline in the foreign money supply is anticipated. A possible adjustment path in that case is indicated in Figure 2 by the path $A_0 A''_0 A_2 A_1$. At the moment when the monetary disturbance begins to be expected the price of foreign currency jumps to A''_0 . The depreciation adds to inflation in the domestic economy and reduces inflation in the foreign economy; it increases the domestic interest rate relative to the foreign interest rate, and therefore, in order for the foreign exchange market to be in equilibrium, the price of foreign currency must increase continuously until the monetary disturbance actually occurs. At that point, the interest rate differential turns in favor of the foreign country and the price of foreign currency declines in the process of adjustment from A_2 to A_1 .

Suppose, however, that the anticipated monetary disturbance does not occur. Then at point A_2 the price of foreign currency falls to A_3 and thereafter increases along the path $A_3 A_0$ back to its initial equilibrium value. The speculative cycle $A_0 A''_0 A_2 A_3 A_0$ is caused entirely by expectations which the market considered justified *ex ante* but which turned out to be incorrect *ex post*.

The point is that this mistake in speculation is compatible with

¹"Expectations and Exchange Rate Dynamics," *Journal of Political Economy*, Vol. 84 (1976), no. 6.

'efficiency' in the foreign exchange market but it imposes macroeconomic costs by forcing unnecessary adjustment in output and labor markets. Offsetting central bank behavior thus appears to be necessary.

Current Account Adjustment

In the world of Fisher parity, the role for exchange rate changes in effecting changes in the current account balance¹ is obscured by the assumption of perfect substitutability. In fact, surpluses and deficits in the current account balances are financed through a variety of financial instruments, which in general cannot be regarded as perfect substitutes. Thus, the net transfer of financial claims from surplus to deficit countries cannot be effected without changes in relative asset prices, in particular exchange rates.

Before we get into the analysis of the role of relative asset prices in this transfer process in the framework of a simple monetary model of the world economy,² we consider, in the framework of the model above, the effect of an increase in savings propensity in the foreign country on the exchange rate, which in turn depends on its effect on the distribution of demand in the world economy. If it reduces autonomous demand equally in both countries, the transfer of surplus savings will be effected through a current account surplus without any change in the exchange rate.

However, given rigidities in prices, the level of interest rates

¹We are not considering here the effect of prospective current account surpluses or deficits on expectations about the exchange rate. See footnote 2 on page 6 above.

²In the spirit of the single country model in Kouri, "The Exchange Rate and the Balance of Payments...", *op.cit.*

in the world economy will not fall sufficiently to restore full employment equilibrium and thus the country in current account surplus imposes a secondary macroeconomic burden on the deficit country--as well as on itself. The current account surplus resulting from the increase savings propensity can thus be interpreted in part as an 'imbalance' but it does not call for an appreciation of the currency of the surplus country. Rather it calls for coordinated expansionary policies in both countries to translate the increase in savings into productive investment.

This result leads to the consideration of a world economy where there are two types of financial assets, namely two national monies. The process through which the supplies of these two assets are reallocated between the two countries is the current account adjustment process.

The effects of changes in savings propensities and of shifts in asset preferences¹ are ingredients in recent discussions of the 'international balance of payments problem.'

One particular illustration of such problem which we referred to at the outset is the current account imbalance between America and Germany, and we will use these countries as the domestic and foreign country, respectively, denoting their monies by the dollar and the mark. The problem of whether the American current account deficit with Germany stems from a portfolio disequilibrium, a higher savings propensity in Germany or a shift of demand toward German products is of more than analytical interest. In fact, the source of the disturbance determines the appropriate response of policy. If the cause of the dollar's weakness is a shift in asset preferences from dollars to other currencies, it might be appropriate to

¹We do not comment on differences in spending patterns, the traditional concern of transfer analysis.

offset the decline by changing the mixture of asset supplies. If, in contrast, the cause is a change in real factors which implies a deterioration in America's equilibrium terms of trade, such policy would clearly be inappropriate.

Now the formal model. The equilibrium distribution and level of demand in the world economy are given by, respectively:

$$Xp = \alpha X^*p^*/e$$

$$\bar{X} \equiv Xp + X^*p^*/e = c_1 Xp + c_1^* X^*p^*/e + c_2 W + c_2^* W^*,$$

where X (X^*) = American (European) output,

p (p^*) = price level in America (Europe),

e = mark price of dollars,

W (W^*) = American (European) financial wealth,

c_1, c_2 (c_1^*, c_2^*) = propensity to consume from income and wealth, respectively in America (Europe),

α = share of American in European expenditure.¹

\bar{X} is the equilibrium level of nominal (dollar valued) income in the world economy. Shifts in savings propensity will be interpreted as shifts in the c_1 and c_1^* parameters. We define the equilibrium current account surplus of Europe as the discrepancy between domestic income (measured in dollars) and domestic absorption

$$B = X^*p^*/e - c_1^* X^*p^*/e - c_2^* W^*.$$

¹Shifts in demand can thus be interpreted as shifts in the α parameter. They are, however, ignored here.

Equilibrium in the foreign exchange market, which in this simple framework is the same as portfolio equilibrium, and the wealth constraints are given by, respectively,

$$F = m(\pi) \cdot M^*/e$$

$$M^*/e + F \equiv W^*, \quad \text{European financial wealth,}$$

$$W \equiv M, \quad \text{American financial wealth,}$$

$$\bar{W} \equiv W + W^*, \quad \text{world financial wealth in dollars,}$$

$$\bar{M} \equiv F + M, \quad \text{distribution of dollar holdings,}$$

where M (F) = American (European) holdings of dollars,

\bar{M} (M^*) = total supply of dollars (marks),

m = desired ratio of dollar to mark holdings in Europe,

π = expected rate of depreciation of the dollar.

Thus, it is assumed that while Europeans hold dollars, Americans do not hold marks. This is a simple way to introduce an asymmetry in asset preferences, and also one that accords with the central role of the American dollar in the international financial system. Shifts in asset preferences will be interpreted as shifts in the m parameter. The expected rate of depreciation of the dollar is a crucial determinant of the demand for dollars by Europeans.

Substituting the first equation into the second and using the definition of world financial wealth, we get

$$\bar{X} = \frac{1+a}{s} c_2 \bar{W} + \frac{1+a}{s} (c_2^* - c_2) W^*$$

where $s = (1 - c_1) + (1 - c_1^*)a = s_1 + as_1^*$.

The asymmetry of consumption propensities between the two regions (c_2 and c_2^* respectively) links the level of demand in the world economy to the transfer process: if the European consumption propensity is less than the American consumption propensity, a transfer of wealth to Europe through a surplus in the current account will reduce the global level of demand.

The asymmetry of asset preferences links the exchange rate to the balance on current account. The central idea is that, in the short run, the Europeans must hold the dollars they have acquired through past current account balance surpluses. If they collectively try to reduce their dollar holdings and move into marks, the price of dollars in terms of marks will fall in the foreign exchanges until portfolio equilibrium is again restored. Thus, in the short run, the dollar exchange rate is determined by the willingness of Europeans to hold the dollars they have previously acquired.

The FF schedule in Figure 3 represents short run equilibrium in the foreign exchange market under the assumption of stationary expectations. The mark price of dollars is a decreasing function of the stock of dollars held by Europeans, given the supply of marks and the expected rate of depreciation of the dollar. The initial stock of European holdings of dollars is F_0 . Given that stock, short run equilibrium in the foreign exchange market obtains at A_0 with exchange rate e_0 .

The stock of dollars held outside America changes whenever the American current account balance is nonzero. Europe's current account surplus can be written in the simple form:

$$B = \lambda W - \lambda^* W^*$$

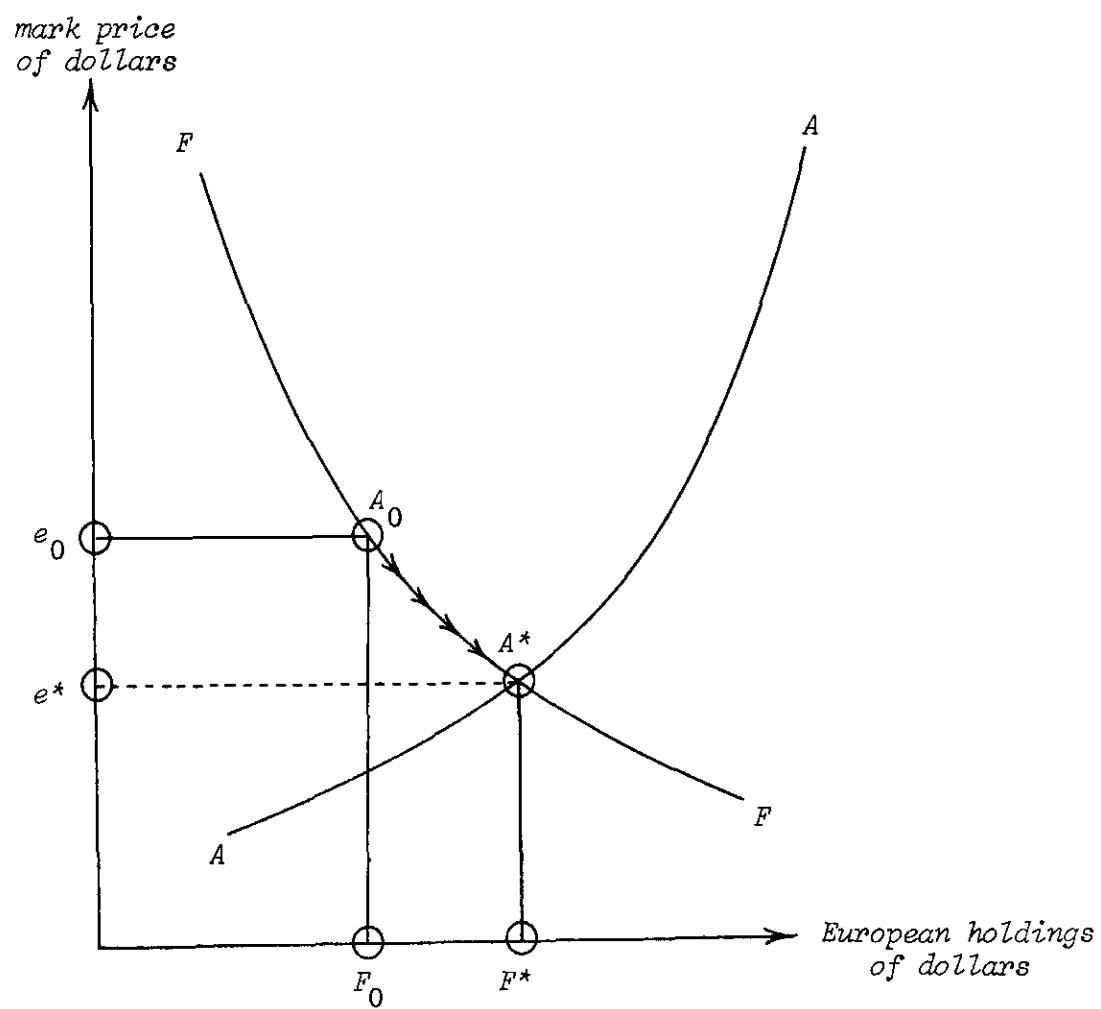


FIGURE 3

where $\lambda = s_1^* c_2 / s$,

$$\lambda^* = a s_1 c_2^* / s .$$

From the perspective of this equation, the current account adjustment process simply involves the reallocation of asset holdings between the two countries.¹ Substituting from the wealth constraints we can write the long run current account equilibrium condition in the form:

$$F = \frac{\lambda}{\lambda + \lambda^*} \bar{M} - \frac{\lambda^*}{\lambda + \lambda^*} \frac{M^*}{e} .$$

The *AA* schedule in Figure 3 shows the combinations of the dollar exchange rate and holdings of dollars by Europeans that are consistent with zero current account balance. The intuitive reason why it is upward sloping is that an increase in the holdings of dollars by Europeans increases import demand in Europe; therefore to keep the balance of payments in equilibrium the mark price of dollars has to rise.

Long run equilibrium in the balance of payments between America and Europe obtains at point A^* , with exchange rate e^* and the stock of European holdings of dollars equal to F^* . Any point above the *AA* schedule implies a surplus in Europe's current account balance ('dollar shortage') while any point below the *AA* schedule implies a deficit in Europe's current account balance ('dollar glut'). If the initial stock of dollar holdings is F_0 the European current account is in surplus. Consequently the stock of dollars increases, while the dollar depreciates

¹The long run equilibrium distribution of assets depends on the savings propensities of America and Europe and the distribution of demand between the two countries:

$$W^*/W = \lambda/\lambda^* = (s_1^*/s_1) \cdot (c_2/c_2^*) \cdot (1/a) .$$

until long run equilibrium is reached at A^* , with exchange rate e^* and stock of dollar holdings F^* .

It is illuminating at this point to draw a parallel between exchange rate theory, as developed here, and the theory of investment. The short run equilibrium value of the exchange rate (e_0) corresponds to the demand price of capital in investment theory, while the long run equilibrium value of the exchange rate (e^*) corresponds to the supply price of capital. In investment theory, a discrepancy between the demand price and the supply price gives rise to an adjustment of the stock of capital through investment. In exchange rate theory, a discrepancy between the short run and the long run equilibrium values of the exchange rate gives rise to an adjustment of the stock of foreign assets through the balance of payments.

Note that, in the following equations, the determinants of the long run equilibrium value of the dollar-mark exchange rate and the stock of dollars held by Europeans depend not only on the supplies of the two assets but also on spending patterns, savings behavior and portfolio preferences,

$$e = \gamma \frac{M^*}{\bar{M}} ; \quad F = \frac{m}{\gamma} \bar{M} ,$$

where
$$\gamma = \frac{\lambda^*(1+m) + \lambda m}{\lambda} .$$

We can now examine the adjustment of the balance of payments to a shift of demand towards European goods and to an increase in savings propensity in Europe.

A shift of demand toward European goods shifts the AA schedule to the right in Figure 3 (this is not shown). In the new long run equilibrium position the mark price of dollars is less than before while the

stock of dollars held by Europeans is greater. During the adjustment process the American current account is in deficit and the dollar depreciates continuously. The depreciation of the dollar adds to inflation in America and reduces inflation in Europe. The dollar does not, however, depreciate enough to restore full employment equilibrium in America without adjustment of domestic prices and wages. While the asymmetry in asset preferences introduces a partial automatic adjustment mechanism against regional demand shifts, the adjustment of the exchange rate alone is not sufficient.

Consider now the effects of an increase in savings propensity in Europe. If asset preferences were identical in the two countries, assets increase would cause no pressure on the exchange rate. When, as assumed above, spending patterns are also identical in the two countries, the required transfer will be in part effected through a decline in prices in the world economy and in part wasted through higher unemployment in the world economy.

When asset preferences are not identical, the increase in savings in Europe and the long run increase in European wealth implies also a long run shift in relative asset demands in the world economy. It is this portfolio shift that gives rise to the exchange rate adjustment. In this simple model, the attempt of Europeans to reduce their holdings of dollars will only cause a reduction in the mark price of dollars. In a more complete specification, however, a reduction of desired dollar holdings by foreigners would in part result in an increase in their holdings of equity claims in America, and a reduction in the American holdings of equity abroad.

To sum up, in this paper an attempt was made at relating exchange rates to the process of current account adjustment. A number of problems emerged, which provide directions for future research, in the framework of a fully specified general equilibrium model.

In fact, our analysis of the interaction between the foreign exchange market and international financial markets emphasized the role of wealth transfers and exchange rate expectations in the current account adjustment process. This contrasts with the partial equilibrium approach to the foreign exchanges, since it involves an intertemporal perspective of the adjustment process. The problem of the appropriate horizon for current account adjustment remains open, however.

We then looked at currency preferences in international financial intermediation, in order to assess the types of financial instruments used in international trade in assets. This led us to introduce and estimate concepts such as the purchasing power of a currency and of a basket of currencies, the portfolio proportions which minimize the variance in changes in the purchasing powers of currencies and the own and cross effects of returns on speculative portfolio proportions for a given holding period. We found that, amongst major currencies during the floating rate period, the domestic currency was a preferred habitat for investors of Germany, the United States and the United Kingdom, but not of France and Japan. We also used the estimated cross effects to get an idea of general equilibrium pressures on the dollar-mark forward market. Open problems are the prediction of changes in purchasing powers, the use of the framework when there are discrete changes in the exchange rates, and the estimation of the relative risk aversion of investors.

Our analysis of the fundamentals of exchange rate behavior remained theoretical. We used two models of the world economy, one where assets were assumed to be perfect substitutes, another where asymmetries in asset preferences were explicitly introduced. These two models yields two different reasons for observed exchange rate volatility, which we believe more relevant than interest rate differentials.

In the world of Fisher parity, private speculation was found to stabilize the exchange rate only insofar as there was a stable anchor for long term expectations. Since a stable anchor is unlikely to occur spontaneously in an inflationary environment, there is a presumption that "efficient" speculation has macroeconomic costs. In a world where assets are not perfect substitutes, on the other hand, exchange rate instability is brought about by shifts in asset demands.

Both of these sources of exchange rate fluctuations suggest a role for monetary policy. The former points to the necessity of monetary policies which take an intertemporal view of current account adjustment and thus help strengthening the required international financial intermediation. The latter implies that costless changes in the mixture of asset supplies may prevent exchange rate changes to be transmitted to economic activity thus calling for costly macroeconomic adjustments in output and employment. The case for central bank intervention to facilitate the current account adjustment process is even stronger when differences in asset preferences appear to be significant.

We therefore think that the "weakness" of the U.S. dollar in recent months and the recycling of the OPEC surplus call for changes in the mixture of assets in the United States and in other oil-importing countries and also that a longer horizon should be taken with respect to current account "imbalances" among industrial countries.