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Exchange Rates and the International Adjustment Process

AFTER only a few years of experience with the system of flexible exchange rates, considerable doubts have arisen about its ability to function smoothly without central-bank intervention in the foreign-exchange markets. Another concern is the problem of balance-of-payments adjustment arising from surpluses of the Organization of Petroleum Exporting Countries and from current-account "imbalances" among industrial countries. These concerns have emerged concretely in recent discussions about the causes of the "weak" U.S. dollar and about the appropriate policy response, if any.

Several explanations have been offered for the depreciation of the dollar against most other major currencies. One, the balance-of-payments explanation, attributes the decline to the deterioration of the U.S. current account. This explanation assumes that the current-account deficit increases the supply of dollar assets that foreigners must hold and thus causes a depreciation of the dollar in relation to other currencies. This view implies that, when desirable, the dollar can be strengthened in one of

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three ways: by policies that reduce the current-account deficit, by policies that make the dollar more attractive, or by direct intervention in the foreign-exchange market.

An alternative interpretation of the weakness in the dollar is offered in terms of differences in monetary policies and long-term inflationary prospects between the United States and the countries with "strong" currencies. According to this view, intervention in the foreign-exchange market cannot strengthen the dollar permanently because the intervention has no effects on the "fundamental causes" of weakness in the dollar.

Our objective in this paper is to relate different policy views evident in these discussions to the theory of flexible exchange rates and balance-ofpayments adjustment.¹ In the first section we introduce the asset-market view of the determination of exchange rates. The second section offers empirical evidence on the attractiveness of different currencies as possible vehicles of international financial intermediation, which would permit "recycling" the surpluses of the OPEC countries to borrowers in different parts of the world. The last section analyzes the "fundamentals" of exchange-rate determination, first in a world in which asset preferences are symmetric and then in one in which they are asymmetric.

The Asset-Market Approach to Exchange Rates

One of the most dramatic developments in the world economy in the postwar period has been the increase in international investment and the growth of a truly transnational system of financial intermediation. Against this background, we begin the analysis of the determination of exchange rates by embedding the foreign-exchange market in a generalequilibrium model of several interconnected financial markets. We use

1. Recent contributions have been surveyed and synthesized in earlier issues of this journal. See Marina v. N. Whitman, "Global Monetarism and the Monetary Approach to the Balance of Payments," *BPEA*, 3:1975, pp. 491-536; Rudiger Dornbusch and Paul Krugman, "Flexible Exchange Rates in the Short Run," *BPEA*, 3:1976, pp. 537-75. See also Susan Schadler, "Sources of Exchange Rate Variability: Theory and Empirical Evidence," International Monetary Fund, Staff Papers, vol. 24 (July 1977), pp. 253-96; and Michael Mussa, "Macroeconomic Interdependence and the Exchange Rate Regime," in Rudiger Dornbusch and Jacob Frenkel, eds., International Economic Policy (forthcoming).

the analytical framework developed by James Tobin in his generalequilibrium approach to monetary theory.²

To take a simple case, consider a world economy with two countries and six types of financial assets: two monies, securities denominated in those monies, and equity claims on physical capital located in the two countries. Thus six assets are traded in the international financial markets and, to clear these markets, five relative prices are needed: the interest rates in the two countries; the two prices of equity; and the relative price of the two monies (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.³

Short-run equilibrium in the financial markets occurs when the total demand for each asset equals its supply. The demands for assets depend upon expected rates of return, risk and liquidity characteristics, 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, the 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: domestic open-market operations, which involve the exchange of domestic money for securities denominated in domestic currency; and intervention

2. For a concise treatment, see Tobin, "A General Equilibrium Approach to Monetary Theory," Journal of Money, Credit, and Banking, vol. 1 (February 1969), pp. 15-29, reproduced in Tobin, Essays in Economics, vol. 1: Macroeconomics (Markham, 1971), pp. 322-38; some aspects of the market view of exchange rates were developed in papers collected in the Scandinavian Journal of Economics, vol. 78 (no. 2, 1976), entire issue. See also Lance Girton and Dale W. Henderson, "Central Bank Operations in Foreign and Domestic Assets under Fixed and Flexible Exchange Rates," in Peter B. Clark, Dennis E. Logue, and Richard J. Sweeney, eds., The Effects of Exchange Rate Adjustments (U.S. Department of the Treasury, OASIA Research Department, 1977), pp. 151-79.

3. The forward 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.

in the foreign-exchange market. Such intervention can take several forms ---namely, exchange of domestic money for foreign money, of domestic money for foreign-currency securities, and of domestic-currency securities for securities in foreign currency. If the interest-rate parity holds, intervention of the last type is identical to intervention in forward exchange markets.4

In practice, intervention in spot markets takes the form of exchange of domestic money for foreign-currency securities because central banks rarely hold monies of other countries. For example, the dollar holdings of foreign central banks consist of dollar securities rather than dollar money. Hence intervention in the foreign-exchange markets by foreign central banks has no effect on the U.S. monetary base.

Other types of financial policies can also be incorporated into this framework. Thus a change in the currency composition of a government debt issue is similar in its effects to intervention in the forward market. Another form of official intervention in the foreign-exchange market is the influence that some European governments exert on the currency composition of security issues of state-owned corporations.

The general-equilibrium approach to monetary policy implies that it is impossible to define rules of behavior for governments and monetary

4. Only three of these different types of monetary policy are independent. This is illustrated by the example given in the following table, which shows the change in the supply of assets to the public brought about by various policies. For convenience the two countries are called America and Germany and their currencies the dollar and the mark, respectively. As shown in column 4, a forward-market purchase of 100 marks has the same effect as an increase of 100 marks in the supply of dollar securities and an equal decrease in the supply of mark securities. (The seller of forward marks, in effect, gets out of marks and into dollars for the period of the forward contract.) The supply of dollar securities can also be increased by a domestic open-market sale in America (column 1), while the supply of mark securities can be reduced by a domestic open-market purchase in Germany (column 2). These two open-market operations increase the monetary assets of the private sector in Germany and decrease them in America. The changes in assets can be offset by intervention of the central bank in the spot market (column 3).

		Monet	ary policy				
-	Open-mark	et operation	Inter	vention			
- Asset	Dollars (1)	Marks (2)	Spot market (3)	Forward market (4)			
Dollars	-100	0	100	0			
Marks	0	100	-100	0			
Dollar securities	100	0	0	100			
Mark securities	0	-100	0	-100			

authorities that would free the exchange rate from conscious manipulation; this implication is relevant to the ongoing debate about "dirty floating."

Can the partial-equilibrium analysis of exchange-rate determination.⁵ on which policy debates often rely, be reconciled with the general-equilibrium approach outlined above? In the short-run analysis of exchange rates, 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.⁶ Furthermore, because of its generalequilibrium nature, the asset-market approach entails a different perspective of the dynamic interaction between the current account and the exchange rate, which 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 country with a surplus. The transfer will occur without changes in asset prices only if there are no differences in the menu of assets held by residents of different countries or in the marginal effect of changes in wealth on asset demands across countries. In the absence of differences in the marginal patterns of asset holdings, current-account imbalances would not themselves alter exchange rates except for the gradual changes they produce in total asset supplies. With those differences, however, a relationship exists between currentaccount surpluses and deficits on the one hand and changes in exchange rates on the other.

From the perspective of the general-equilibrium model, the dynamic

5. For representative textbook expositions of the theory of foreign exchanges, see Richard E. Caves and Ronald W. Jones, *World Trade and Payments: An Introduction*, 2d ed. (Little, Brown, 1977), chap. 17, and Charles P. Kindleberger, *International Economics*, 5th ed. (Irwin, 1973), chap. 17. The classic paper on the foreign exchange market, anticipating much of the subsequent work, is Joan Robinson, "The Foreign Exchanges," in Joan Robinson, ed., *Essays in the Theory of Employment,*" 2d ed. (Macmillan, 1948), reprinted in Howard S. Ellis and Lloyd A. Metzler, eds., *Readings in the Theory of International Trade* (Blakiston, 1950), chap. 4. Reference should also be made to earlier work by Fritz Machlup, "The Theory of Foreign Exchanges," in ibid., chap. 5.

6. This statement must be qualified when allowance is made for rational expectations about the path of the exchange rate. In that case, changes in prospective currentaccount surpluses or deficits will have a first-order effect on the exchange rate. See Pentti J. K. Kouri, "The Exchange Rate and the Balance of Payments in the Short Run and in the Long Run: A Monetary Approach," Scandinavian Journal of Economics, vol. 78 (no. 2, 1976), pp. 280-304. analysis of the behavior of asset prices over time requires a complete specification of saving behavior in different countries and of the channels through which total asset supplies shift from one period to the next, such as government budget deficits or surpluses and new issues of equities and bonds for financing investment expenditures. For example, a currentaccount deficit in America that reflects a stimulative government budget with accommodating monetary policy would be associated with a "weakening of the dollar" whereas a current-account deficit reflecting buoyant investment expenditure financed by equity issues could well be associated with a "strengthening of the dollar."

The relationship between the current-account adjustment process and relative asset prices is analogous to the relationship between that process and output prices. We will show that, if spending patterns are identical across countries, an increase in the current-account surplus of a country caused, for example, by an increase in the propensity to save of that country would call for no change in relative prices among commodities and among nations to restore equilibrium in the world economy. Rather, such a transfer would be effected in part through a reduction in output and employment in the world economy and in part through a deflation of prices and a reduction in interest rates.

These considerations are relevant to understanding the macroeconomic implications of the transfer from oil-consuming to oil-exporting countries.⁷ Such a transfer of wealth has different effects on equilibrium in financial markets—or portfolio effects—to the extent that the portfolio preferences of OPEC countries are not the same as those of oil-consuming countries. The policy problem arising from the portfolio effects is that of "recycling"—offsetting the shift in portfolio preferences by changing the mix of asset supplies.

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

The transfer may also require an internal adjustment between the trad-

7. The 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.

able and nontradable sectors of the economy, since the relative price of traded goods in terms of nontraded goods may have to rise in countries that must expand the tradable sector to pay for their oil imports.

Finally, the transfer has an important intertemporal dimension because the propensity to save 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 decrease the real burden of the transfer for countries with a current-account deficit and increase it for countries with a surplus. However, the deflation of prices would tend to increase the real burden of the transfer for countries in debt, and would reduce world aggregate demand, given the presumption that deficit countries have higher propensities to spend. In the absence of sufficiently flexible adjustment of prices and interest rates, the higher propensity to save associated with the transfer will impose still a further macroeconomic burden by reducing the level of output and employment in the world. This introduces the paradox of thrift on a world scale.

In addition to these factors relevant to the transfer, it is noteworthy that expectations of changes in the exchange rates play a central role in the asset-market approach. An expected appreciation of a currency, ceteris paribus, increases the expected return on assets in the currency, and thus, given the total supply of assets, will cause an actual appreciation of that currency. Not only do these expectations influence current exchange rates; they also adjust to equilibrate foreign-exchange markets. Indeed, in the extreme case in which securities of different currencies are perfect substitutes, the "burden of adjustment" falls entirely on expectations about exchange rates. With nominal interest rates determined by monetary policy in the short run, equilibrium requires that the expected rate of depreciation be equal to the interest-rate differential.

Of crucial importance is speculative behavior, which introduces an element of instability in the foreign-exchange market. Like speculators in the stock market, the "gnomes" of the foreign-exchange market speculate on the views of the next buyer. To anchor the chain of expectation 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 an anchor, the exchange rate is indeterminate. An undervalued currency can always be validated by sufficiently great and accelerating depreciation of the currency; similarly, an accelerating appreciation can justify an overvalued currency.

The Choice of Currency in International Financial Intermediation

International financial intermediation traditionally has been dominated by only a few currencies, principally 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 convenience in terms of low transaction costs. Since the introduction of generalized floating, however, a new dimension has become relevant in the choice of currency—namely, differences in the risks and returns arising from changes in exchange rates. In the Bretton Woods system, these properties became relevant only when market confidence in the parities of key currencies was shaken.

Rational lenders and borrowers are presumably concerned with the *real* values of their assets and liabilities, and hence the purchasing power of a currency over goods and services available in the world economy is the appropriate standard of its value. The corresponding index of value, under some simplifying assumptions,⁸ can be written as

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

where P_j = the price level in country *j*, α_j = the expenditure share in currency *j*, $S_{ij} = S_i/S_j$ is the price of currency *j* in terms of currency *i*, and $S_N = 1$.

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

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

8. The basic assumption is that the indirect utility function is of the form

$$U(X_1, \ldots, X_N) = \prod_{i=1}^N X_i^{\alpha_i}.$$

This utility function implies that expenditure on commodity X_i is a constant fraction α_i of total expenditure. If (P_1, \ldots, 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

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

When computing the purchasing power of currencies we treat national outputs as composite goods.

$$Q = \prod_{j=1}^{N} P_{\overline{j}}^{\alpha_{j}}$$

is the inverse of the world price level and

$$S_i^e = \prod_{j=1}^N S_{ij}^{\alpha_j}$$

is the effective exchange rate of currency *i*.

It is also useful to define a composite world currency that consists of all N currencies in value weights $(\alpha_1, \ldots, \alpha_N)$. The effective exchange rate of that composite currency is

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

Therefore, Q is the purchasing power of the composite world currency and S_{i}^{e} , the price of that currency in terms of currency *i*. Because the purchasing power of the world currency is independent of changes in exchange rates, it can be used to measure world inflation under either fixed or flexible exchange rates, without a conceptual "break" in the series at the time of the transition.

Our concept of the composite world currency is close to the special drawing rights (SDR) concept and, in fact, supports the definition of the latter as a "basket of currencies."⁹ Thus our measure of an effective exchange rate can be viewed as the SDR exchange rate of a currency, and is equal to the ratio of that currency's purchasing power to the purchasing power of world money. The effective exchange rates of different currencies can then be meaningfully compared.

Our concept of purchasing power and effective exchange rates is designed to obtain a standard with which to evaluate assets and liabilities

9. Alternative definitions of such baskets are reported in International Monetary Fund, International Monetary Reform, Documents of the Committee of Twenty (IMF, 1974), pp. 43-45. See an interesting discussion, "The Commercial Use of SDRs," in Morgan Guaranty Trust Company of New York, World Financial Markets (August 19, 1975), pp. 4-11.





Source: International Monetary Fund, International Financial Statistics tape, November 1977. a. Only the last month in each quarter has been used in the plotting. For the composition of world money, see text note 11.

denominated in different currencies. In contrast, the measures of effective exchange rates currently in use are designed to capture the effect of changes in exchange rates on trade flows.¹⁰

Figure 1 illustrates the behavior of the purchasing power of three key

10. For a comparison of different indexes of effective exchange rates, see Rudolf R. Rhomberg, "Indices of Effective Exchange Rates," International Monetary Fund, *Staff Papers*, vol. 23 (March 1976), pp. 88–112. See also Morgan Guaranty, *World Financial Markets* (August 1976), pp. 5–14, for revised estimates of effective exchange rates using geometric averages and bilateral trade weights.

currencies—the Deutsche mark, the pound sterling, and the U.S. dollar and a composite world currency from mid-1970 to late 1977. In preparing the indexes shown in the figure, we used the wholesale price indexes for each of the three key currencies; for the world, we used the wholesale price indexes of eight major industrial countries whose currencies are most widely used in international transactions.¹¹

Two features of the figure are prominent. First, the purchasing power of world money declined steadily; by late 1977, it had lost about half of the value it had in mid-1970. Second, the behavior of the purchasing powers of the currencies of individual countries is markedly different. Whereas the Deutsche mark lost only about 20 percent of its purchasing power during this period, the pound sterling lost more than 60 percent of its value; and the purchasing power of the U.S. dollar declined slightly faster than that of world money.

The divergent behavior of purchasing powers of a wider range of currencies is apparent from table 1, where we show in column 1 the mean rates of change in the purchasing powers of eight currencies and gold¹² from the perspective of an international investor.¹⁸ The Swiss franc and the Deutsche mark have relatively low rates of depreciation of their purchasing powers but only gold increased in purchasing power.

Columns 2 through 4 report the range and standard deviations of these changes, and provide measures of the variability of currency values during the period of floating rates. These measures are quite different from the 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 the variability of exchange rates per se but rather about movements in the purchasing powers of currencies.

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

12. 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. Gold is extremely variable: the highest value of the purchasing power of the Deutsche mark is 1.07 (in July 1973), whereas the purchasing power of gold reaches 2.97 (in March 1974).

13. The international investor is assumed to divide his expenditure among products of different countries according to the weights used in the computation of the purchasing-power indexes.

	Change in	n purchasing	power of cu	errency ^a	Mean interest return	
Country	Mean (1)	Minimum (2)	Maximum (3)	Standard deviation (4)	Nominal ^b (5)	Real (6)
Canada	-11.33	-36.46	19.73	13.66	7.56	-3.77
France	-10.26	-64.33	23.03	17.09	9.59	-0.67
Germany	-3.45	-44.28	42.82	17.31	6.39	2.94
Italy	-17.02	-71.62	20.87	17.47	10.91	-6.12
Japan	-8.13	-40.70	15.42	14.38	8.93	0.80
Switzerland United	-1.73	-36.76	42.27	16.46	4.44	2.71
Kingdom	-16.34	-52.40	18.35	14.12	10.19	-6.15
United States	-9.57	-46.68	17.53	12.85	6.23	-3.34
Gold	8.64	-84.04	198.38	61.05	0.00	8.64

Table 1. Change in Purchasing Power of Major Currencies and Gold andMean Return on Assets, April 1973 to October 1977Percent per year

Source: Same as figure 1. Column 6 is an approximation formed by summing column 1 and column 5. Figures are rounded.

a. Change in purchasing power of currencies over the last quarter from the viewpoint of the international investor, with weights as in text note 11.

b. Nominal return refers to the Treasury bill rate for Canada, the United Kingdom, and the United States; call money rate for France, Germany, and Japan; medium-term security yields for Italy; and interest rate implied by covered 90-day interest-rate arbitrage with the Eurodollar rate in London for Switzerland.

In the absence of capital controls and other impediments to international investment, financial instruments denominated in a currency whose purchasing power is falling faster than those of other currencies will be acquired by investors only if they receive a correspondingly higher compensation in terms of nominal return. It is clear from column 6 of table 1, however, that nominal interest-rate differentials have not, on average, been sufficient to eliminate differences in rates of decline of purchasing powers. Thus securities denominated in the two strongest currencies have, on average, earned a real annual return of close to 3 percent, while those denominated in the two weakest currencies have, on average, yielded a negative real annual return of over 6 percent. Given the prominence of the U.S. dollar in international financial intermediation, it is noteworthy that the mean real annual return on dollar short-term securities has been more than 6 percent below that on mark securities.

These ex post data do not imply that expected returns ex ante were as

widely different. Indeed, the standard deviations of the mean real returns are so large that differences in these returns are statistically insignificant.

In the case of securities, nominal returns are free to vary, and should change as an adjustment to differences in the rates of depreciation of currencies. In the case of assets with fixed nominal returns, such as currency included in various monetary aggregates, adjustment must instead involve substitution from more rapidly depreciating assets to more stable ones. Such a process of substitution would expand the use of strong currencies as media of exchange.

We now turn to an explicit consideration of portfolio selection by riskaverse investors among short-term securities of different currencies. Neglecting transaction costs and investments in other types of assets, it can be shown that, under certain conditions, a rational investor chooses his portfolio in each period to maximize a linear function of mean real return (\bar{r}) and variance (σ^2) —thus

$$\max{(\bar{r}-0.5\beta\sigma^2)},$$

where β measures the risk aversion of the investor.

Let x_i be the portion of wealth invested in short-term securities in currency i; the mean return of the portfolio is then

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

where

$$\sum_{i=1}^N x_i = 1,$$

and $r_i = R_i + v_i$ is the expected real return on securities in currency *i*; R_i is the nominal interest rate, and v_i is the expected rate of appreciation of the purchasing power of currency *i*.¹⁴

The variance of the rate of return is given by

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

14. Note that v_i is different for investors with different expenditure shares. See Pentti J. K. Kouri, "The Determinants of the Forward Premium," seminar paper 62 (University of Stockholm, Institute for International Economic Studies, August 1976; processed).

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 is the solution of this portfolio problem, can be interpreted as consisting of two portfolios—a portfolio that minimizes the variance of real return, denoted by x^m , and a speculative portfolio, denoted by x^s , that depends on expected realreturn differentials relative to the minimum-variance portfolio, on the one hand, and the risk aversion of the investor, on the other.

We now outline the determinants of these portfolios and some of their properties. The minimum-variance portfolio of the N securities is given by

(1)
$$x^{m} = \begin{bmatrix} \theta^{-1}\Phi \\ \cdots \\ \gamma^{1} \end{bmatrix} \alpha \equiv \begin{bmatrix} \Gamma^{1} \\ \cdots \\ \gamma^{1} \end{bmatrix} \alpha \equiv \Gamma \alpha,$$

where

$$\sum_{i=1}^{N} x_i^m = 1$$
$$\gamma_j^1 = 1 - \sum_{i=1}^{N} \Gamma_{ij}^1$$

and

$$\gamma^1 = (\gamma^1_1, \ldots, \gamma^1_N)$$

- x_i^m = the proportion of securities in currency *i* and $x^m = (x_1^m, \ldots, x_N^m)'$
- α_i = the share of expenditure on products of country *i* and $\alpha = (\alpha_1, \ldots, \alpha_N)'$
- Θ = the variance-covariance matrix of proportionate changes in the prices of the Nth currency in terms of the remaining N 1 currencies
- $\Phi = an N 1 \times N$ matrix of covariances between proportionate changes in the prices of the Nth currency in terms of the remaining N - 1 currencies on the one hand and the prices of the Nth currency in terms of the N composite goods on the other.¹⁵

The discussion of two polar cases brings out some interesting properties of the minimum-variance portfolio. In the first case, if all relative prices among the composite national outputs are constant and thus each

15. The choice of the Nth currency is arbitrary. The analysis does not depend on the equality between the number of currencies and the number of composite goods.

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 uncorrelated, the share of currency *i* in the minimum-variance portfolio is equal to σ_m^2/σ_i^2 , where σ_m^2 is the variance of the rate of inflation of the minimum-variance portfolio and σ_i^2 is the variance of the rate of inflation in country *i*.¹⁶ When relative prices do not change in an unpredictable way, domestic currency is not necessarily a safer store of value than foreign currency. The safest currency for all investors, regardless of their country, is the currency of the country with the least unpredictable inflation. In the absence of capital controls and restrictions on the use of foreign currencies, we would expect the safe currency to gain increasingly widespread use as the unit of denomination of financial instruments. The second case, assumed in much of the literature on foreign-exchange risk, occurs when the local-currency prices of national outputs are deterministic. Then the minimum-variance portfolio is simply the vector of expenditure shares $(\alpha_1, \ldots, \alpha_N)$ and the Γ matrix above is equal to the $N \times N$ identity matrix.

The first special case is likely to be relevant in an environment of high, unpredictable inflation; the second case, in a setting in which inflation rates are moderate and variations in exchange rates reflect large and unpredictable deviations from their purchasing-power parities.¹⁷

16. In the general case when the covariances among national inflation rates are not zero, the expression for the minimum-variance portfolio is

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

where Ω is the variance-covariance matrix of the national inflation rates, e is an $N \times 1$ vector with each element equal to one. In the general case, $\sigma^2 = e'\Omega^{-1}e$ rather than

$$\sigma_m^2 = \sum_{i=1}^N (1/\sigma_i^2).$$

For a more detailed analysis of international investment in equity claims as well as in securities when purchasing-power parity holds, see Pentti J. K. Kouri, "International Investment and Interest Rate Linkages under Flexible Exchange Rates," in Robert Z. Aliber, ed., *The Political Economy of Monetary Reform* (Macmillan, 1977), pp. 74–96.

17. Even if purchasing-power parity holds, the minimum-variance portfolio may depend on expenditure shares. This occurs when there are changes in relative prices caused by "real" factors, and these changes are correlated with changes in the purchasing power of monies.

The speculative portfolio of the N bonds is given by

$$x^{s}=\frac{1}{\beta}\Psi r,$$

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

where

$$\delta_i = -\sum_{j=1}^{N-1} (\Theta^{-1})_{ij}, \quad \delta = (\delta_1, \ldots, \delta_{N-1}),$$
$$\delta_N = -\sum_{i=1}^{N-1} \delta_i,$$

 r_i is the real return on securities in currency *i*, and $r = (r_1, \ldots, r_N)'$.

That the rows and columns of Ψ add to zero implies that the speculative portfolio can be written alternatively as a function of real interestrate differentials \hat{r}_i or real forward premiums,

(3)
$$x^{*} = \frac{1}{\beta} \Psi \hat{r} = \frac{1}{\beta} \Psi \hat{f},$$

where

 $\hat{r}_i = r_i - r_N, \qquad i = 1, \ldots, N$

and

$$f_i = f_i + (\nu_i - \nu_N), \quad i = 1, ..., N$$

is the real forward premium of currency *i* against currency N (and $f_N = 0$).

In this interpretation, x^* represents speculative positions in the N-1 forward markets and the minimum-variance portfolio represents a "capital position" in securities in the N currencies.

Note that a borrower chooses the currency composition of his debt portfolio to obtain a desired balance between risk and return in the same way that a lender chooses the desired currency composition of his port-

folio. 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, as suggested by this analysis.

We now apply this framework to study the demands for securities in five major currencies, using monthly data for the period of floating exchange rates.¹⁸ In the analysis we treat the means, variances, and covariances of proportionate changes in the purchasing powers of these currencies as constants and again use exchange rates against the dollar (the N^{th} currency) and wholesale price indexes¹⁹ of the five countries to compute the Γ and Ψ matrixes. In table 2 we show these matrixes computed from monthly, quarterly, and yearly proportionate changes in purchasing powers.

Each column of the Γ matrix represents the minimum-variance portfolio of a *national* investor, and a weighted average of these columns gives the minimum-variance portfolio of an international investor. The reported Γ matrixes reveal strikingly the dominance of the domestic currency in the minimum-variance portfolios of U.S., German, and U.K. national investors for all holding periods. There is a sharp contrast in the results for French and Japanese investors, however; for them, the Deutsche mark and, surprisingly, the pound sterling assume an important role, especially as the holding period lengthens. For the yearly holding period, the French franc and the Japanese yen drop out of competition in almost all minimum-variance portfolios and are, in fact, generally held in negative amounts.

Columns 6 through 10 of table 2 show the effect of changes in expected real returns on speculative demands for securities in the five currencies. Apart from the last column, the resulting Ψ matrixes show the effects of changes in expected real forward premiums against the U.S. dollar on speculative demands in the forward markets for the four remaining currencies. For all currencies and holding periods, the own-effects (indicated in boldface on the diagonal) are consistently higher than the cross-effects (reading across the line, excluding boldface). Some complementarities

18. The five currencies are the U.S. dollar, Deutsche mark, pound sterling, Japanese yen, and French franc.

19. The inclusion of imported goods in the wholesale price indexes means that the expenditure share of a resident of country i in the products included in the wholesale price index of that country is equal to one, which would not be the case if the price index included only domestically produced goods.

Table 2. Portfolio Dive	rsification :	across Currer	icies of Five	Countries 1	for National I	nvestor, Selec	ted Holding	Periods		
			F matrix [*]					₽ matrix		
Holding period and country	France (1)	Germany (2)	Japan (3)	United Kingdom (4)	United States (5)	France (6)	Germany (7)	Japan (8)	United Kingdom (9)	United States (10)
Monthly France Germany Japan United Kingdom	0.48 0.31 0.13 0.13	-0.05 1.05 -0.08 0.04	-0.20 0.09 0.07	0.01 0.00 1.08	-0.06 0.01 0.10	2.42	-1.39 1.87	-0.34 -0.41 3.05	-0.55 -0.11 -0.61 2.27	-0.13 0.03 -1.69 -0.99
United States Quarterly France	0.14 0.08	0.04	0.22 -0.54	-0.07 -0.04	1.15 -0.05	2.10	-1.11	0.06	-0.65	2.79 -0.41
Germany Japan United Kingdom United States	$\begin{array}{c} 0.49 \\ -0.13 \\ 0.33 \\ 0.23 \end{array}$	1.13 -0.13 0.14 0.04	0.29 0.50 0.29 0.46	0.00 0.09 1.14 0.02	0.08 0.26 0.14 1.09		1.60	-0.82 2.86	-0.07 -0.54 1.82	$0.40 \\ -1.55 \\ -0.57 \\ 2.12$
<i>Yearly</i> France Germany Japan United Kingdom United States	-0.22 0.90 -0.52 0.76 0.07	-0.20 1.24 -0.43 0.13	-0.67 0.68 0.12 0.66 0.20	-0.00 -0.11 -0.47 1.17 0.42	-0.12 0.23 -0.48 0.44 0.92	1.71	-0.33 3.42	-0.48 -2.80 4.53	-1.20 -2.01 1.98 3.71	0.29 1.72 -3.24 -2.49 3.71
Source: Method described a. Defined as in text equa b. Defined as in text equa	l in text; base tion 1. tion 2.	d on data from	April 1973 to	August 1977.						

National cu rr ency	Value weights (1)	Minimum- variance portfolio (2)	Mean real forward premium in percent per year (3)	Speculative portfolio (4)	Total demand (5)
France	11	-11.17	-3.04	-1.41	-12.58
Germany	18	32.68	7.03	4.25	36.93
Japan	11	-11.66	-1.74	-0.93	-12.59
United Kingdom	13	30.74	-13.33	-5.46	25.28
United States	47	59.28	0.00	3.59	62.87
Total	100	100.00	•••	0.00	100.00

 Table 3. Demand by International Investor for Assets in Hypothetical Minimum-Variance, Speculative, and Total Portfolios, Based on Monthly Data, 1973–77

 Percent

Sources: Column 1—Morgan Guaranty Trust Company of New York, *World Financial Markets* (August 19, 1975), p. 6; column 2—quarterly Γ in table 2 weighted by values in column 1, table 3; column 3—calculated as described in the text; column 4—quarterly Ψ in table 2 multiplied by one-fourth of real forward premium in column 3, table 3; column 5—column 2 plus column 4. Figures are rounded.

appear in speculative demands; perhaps the most interesting one is that between the U.S. dollar and the Deutsche mark, which becomes stronger with the lengthening of the holding period. However, an increase in the expected rate of return on dollar securities always increases the demand for dollars by more than it increases the demand for marks, resulting in a reduction in the speculative demand for marks in the forward market.

To conclude the analysis, we show in table 3 a hypothetical minimumvariance portfolio and a speculative portfolio for an international investor. The expenditure shares used in the computations are shown in column 1. Reflecting the findings discussed above, the French franc and the Japanese yen are held in negative amounts in the minimum-variance portfolio shown in column 2; these negative amounts imply that the international investor would borrow on these two currencies to invest in the remaining ones. The dominance of the U.S. dollar in this portfolio reflects the large weight given to it in the assumed expenditure pattern.²⁰

In column 4 we show hypothetical speculative demands for securities

20. These weights correspond to the "simplified SDR" proposed in Morgan Guaranty, *World Financial Markets* (August 19, 1975), p. 6; they attempt to capture the unique role of the U.S. dollar and also of the pound sterling in international transactions. In fact, if average export weights had been used, as above, the resulting weights would have been United States, 0.30; Germany, 0.26; United Kingdom, 0.13; Japan, 0.16; and France, 0.15. in the five currencies. They are evaluated using the Ψ matrix for a quarterly holding period (shown in table 2) and the average 90-day forward premiums against the U.S. dollar, adjusted for the differences in mean rates of change in the purchasing power of the respective currency and the dollar (shown in column 3). These demands are determined only to the scale factor β in equation 3. Despite the fact that the mean real return on the U.S. dollar has been negative during this period—as noted above in the discussion of table 1—it has substituted for other currencies to such a degree that its weight in the speculative portfolio is almost as large as that of the Deutsche mark.²¹

In column 5 we show total demands for securities in the five currencies for the case in which the scale factor in the speculative portfolio is equal to one.²² 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.

Fundamentals of Exchange-Rate Behavior

This paper opened with an explanation of how, at any given time, equilibrium is reached in international financial markets through changes in exchange rates, interest rates, and other asset prices. In the last section we studied how portfolio behavior in these markets is in turn influenced by price behavior. We now analyze the interaction of asset markets with output, price, and current-account adjustments to gain further insight into the fundamental determinants of exchange-rate behavior.

THE FISHER PARITY

We begin the analysis by considering an environment of highly developed international financial markets and, as a first approximation, no changes in risk premiums. Under these circumstances, a crucial condition of equilibrium in international financial markets is the Fisher parity rela-

22. This in fact is the case in which the Arrow-Pratt measure of relative risk aversion is one.

^{21.} A paradoxical illustration of the substitution effects is the negative weight of the yen in the speculative portfolio.

tionship, which connects foreign-exchange markets to credit markets. In its simplest form it can be written as

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

where

 S_t = the spot price of foreign currency in terms of domestic currency in period t

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

- $\tilde{S}_{t, t+1}$ = the expected spot price of foreign currency in terms of domestic currency in period t + 1 on the basis of information available in period t
- $R_{t, t+1}$ = the nominal interest rate on a one-period riskless security denominated in the domestic currency. (The same term with an asterisk refers to the foreign country.)

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 spot rate in the next period is held with certainty.²³

If expectations are also consistent, the expected value of the exchange rate for the next period must also satisfy the Fisher parity. By recursion, the exchange rate expected to prevail in period τ on the basis of information available in period t ($\tilde{S}_{t,\tau}$) is related to the spot exchange rate thus:

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

where

$$\tilde{F}_{t+i,t+i+1}$$
 = the one-period forward price of foreign
currency expected to prevail in period
 $t + i$ on the basis of information avail-
able in period t

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

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

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

If forward and bond markets exist for each maturity, and if the term structure of interest rates satisfies the expectations hypothesis,²⁴ the relation between the spot exchange rate expected to prevail at time τ on the basis of information available at time t and the forward price for period τ can be written in the form

$$\tilde{S}_{t,\tau} = F_{t,\tau} = \left(\frac{1+R_{t,\tau}}{1+R_{t,\tau}^*}\right)S_t, \quad \tau = t+1, \ldots,$$

where

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

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

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.

As a simple example, suppose that the annual rate of interest for 90-day maturities is 4 percent in Germany while it is 6 percent in the United States; equilibrium in the 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, reveal how this expectation will be brought about in response to the emergence of an interest-rate differential. It could occur via a decline in the dollar spot price of the mark with no change in the expected future price (and thus in the forward price); or it might work through an increase in the expected future price of the mark (and thus in the forward price) with no change in the spot price.

^{24.} For an analysis of the relation between the term structure of interest-rate ratios and the term structure of exchange-rate expectations, see Michael G. Porter, "A Theoretical and Empirical Framework for Analyzing the Term Structure of Exchange Rate Expectations," International Monetary Fund, *Staff Papers*, vol. 18 (November 1971), pp. 613-45.

Since spot exchange rates move freely, 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 and expectations about the equilibrium real exchange rate. Expectations about price levels can in turn be linked, via the quantity equation, to expectations about money supplies and 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. Purchasing-power parity would determine the exchange rate; the quantity equations would determine domestic and foreign price levels; and, given the current and expected exchange rates, the Fisher parity would determine the term structure of interest-rate differentials.²⁵ But because prices are not instantaneously flexible, the theory of exchange-rate determination must be embedded in a macroeconomic theory of output, price, and interest-rate determination.

The Fisher parity is then the link between the exchange rate and expectations about the long-run fundamentals that determine its value in classical equilibrium. If this equilibrium will ultimately be reached in period T, the fundamental determinants of exchange-rate behavior can be summarized by the following equation:

(4)
$$S_t = \left(\frac{1+R_{t,T}^*}{1+R_{t,T}}\right) \cdot \tilde{s}_{t,T} \cdot \left(\frac{\tilde{P}_{t,T}}{\tilde{P}_{t,T}^*}\right),$$

where $\tilde{s}_{t,T}$ is the equilibrium relative price of foreign goods in terms of domestic goods expected to prevail in period T on the basis of views held in the current period t, and $\tilde{P}_{t,T}$ ($\tilde{P}_{t,T}^*$) is the expected domestic (foreign) price level in period T.

THREE TIME HORIZONS

Although the choice of T is arbitrary, it is the longest of three time horizons in the adjustment process. These can be illustrated with the aid

25. In classical equilibrium, the ratio of price levels depends in general on differences in nominal interest rates because the velocity of circulation of monies depends on interest rates and differences in the expected rates of depreciation of their purchasing powers. of the diagram below, which depicts the standard model of an open economy under conditions of perfect capital mobility.²⁶

Initial equilibrium is shown at point A_0 , with a domestic interest rate R_0 (equal to the world interest rate) and domestic output level equal to Y_0 . A permanent reduction in the nominal money supply then shifts the *LM* schedule to the left, to *LM'*.



26. The original references are Robert A. Mundell, "Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates," *Canadian Journal of Economics and Political Science*, vol. 29 (November 1963), pp. 475-85, reproduced in Richard E. Caves and Harry G. Johnson, eds., *Readings in International Economics* (Irwin, 1968), pp. 487-99, and J. Marcus Fleming, "Domestic Financial Policies under Fixed and Floating Exchange Rates," International Monetary Fund, *Staff Papers*, vol. 9 (November 1962), pp. 369-80, reproduced in Richard N. Cooper, ed., *International Finance: Selected Readings* (Penguin, 1969), pp. 291-303. For an exposition, see Rudiger Dornbusch and Stanley Fischer, *Macroeconomics* (McGraw-Hill, 1978), pp. 639-41.

In the short run the output level is fixed so that the interest rate increases to R_1 . But that 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, in that short run, the spot rate has to overshoot its long-run equilibrium value to induce expectations of subsequent depreciation. In the Keynesian medium run, the rise in the exchange rate lowers the demand for goods; it thus shifts the *IS* schedule to the left, to *IS'*, until a 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 restores both the *LM* and *IS* schedules to their initial positions. The economy returns to A_0 and its initial interest rate and output level but with a lower price level.

In the long-run perspective, which abstracts from the entire adjustment process, $A_0A_1A_2A_0$, relative price levels are determined by relative money supplies; relative price structure is determined by real factors; and exchange rates are determined, via purchasing-power parity, by relative price levels.

By contrast, the Keynesian perspective, which abstracts from domestic price adjustment, identifies the exchange rate as the relative price of outputs and thus emphasizes the relative-price elasticities and the distribution of demand among countries as the crucial parameters driving the exchange rate.

Finally, the short-run perspective emphasizes the rapid adjustment of asset markets through movements in interest rates and exchange rates, assuming fixity of both quantities and domestic prices in product and factor markets. This asymmetry in adjustment speeds makes it possible for asset prices, including exchange rates, to overshoot their equilibrium levels. In fact, such overshooting has been suggested as an explanation for the volatility in exchange rates in recent years, and we return to the matter below.

CYCLICAL BEHAVIOR OF THE EXCHANGE RATE

The cyclical behavior of the exchange rate should therefore be analyzed in terms of intersections of IS and LM schedules that define Keynesian equilibrium positions. Cyclical fluctuations in the exchange rate are possible only insofar as monetary conditions permit cyclical differences among countries in long-term interest rates. In fact, if a central bank pegs the domestic interest rate to the foreign interest rate, speculators will stabilize the exchange rate between the two currencies. The stability of the floating Canadian dollar in the 1950s has been explained in this way.

The crucial role of exchange-rate expectations, however, was ignored in the pioneering analysis of exchange-rate regimes by Mundell and Fleming.²⁷ Their model suggested that cyclical fluctuations in exchange rates could occur and could offset cyclical shifts in demand between countries 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 rate must be constant.

We will now incorporate exchange-rate expectations and interest-rate differentials in a cyclical analysis of the exchange rate, constructing a simple Keynesian model of a world economy that consists of two countries of equal size. The variables are defined in terms of deviations from their full-employment values.²⁸

We present first 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.

(5)
$$X = a_1(S + P^* - P) - a_2(R - \mu) - a_3(R^* - \mu^*) + u + v$$

(6)
$$X^* = -a_1(S + P^* - P) - a_3(R - \mu) - a_2(R^* - \mu^*) - u + v$$
,

where X = domestic GNP

S = the price of foreign currency

- P = the domestic price level
- R = the domestic nominal interest rate
- μ = the expected rate of inflation in the domestic economy
- u = a demand disturbance capturing a shift of demand toward domestic output
- v = a global demand disturbance affecting the domestic and foreign economies equally.

An asterisk denotes the foreign economy; all variables except R, R^* , μ , and μ^* are in logarithmic form.

27. Mundell, "Capital Mobility," and Fleming, "Domestic Financial Policies."

28. Nonetheless, the notation below employs the same symbols used earlier in the paper to designate levels of the variables. Furthermore, to save on notation, equations for the two countries are of the same form. Aside from the simple aggregation property, however, no crucial result depends on this assumption.

Next are the equations of the LM schedules, which specify conditions of equilibrium in the two credit markets as

(7)
$$M - P = -b_1\pi - b_2R + X$$

(8)
$$M^* - P^* = b_1 \pi - b_2 R^* + X^*$$

where

- $M(M^*) =$ logarithmic deviation of the domestic (foreign) money stock from its trend value
 - π = the expected proportionate rate of change in the price of foreign currency in terms of domestic 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 hold:

(9)
$$\pi = R - R^*.$$

Fourth, we assume that expectations about the exchange rate are formed rationally, so that, in equilibrium

(10)
$$\pi = \dot{S},$$

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

Equilibrium in the foreign-exchange market is related to the difference in the cyclical positions or relative GNP gaps of the two countries. This can be seen by subtracting equation 8 from equation 7, and substituting 9 into that equation and finally solving for π :

(11)
$$\pi = \frac{-1}{b'} \left[(M - P) - (M^* - P^*) - (X - X^*) \right],$$

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

The difference in the cyclical positions of the two countries depends on the relative price of their outputs and its expected rate of change as well as on the autonomous disturbance term. From equations 5, 6, and 9,

(12)
$$X - X^* = d_1(S + P^* - P) - d_2(\pi + \mu^* - \mu) + 2u,$$

where

$$d_1 = 2a_1$$
$$d_2 = a_2 - a_3.$$

The intertemporal substitution in the regional distributions 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. Shifts in the distribution of demand between the two countries, associated with changes in the variable u alter the relative cyclical positions, as equation 12 shows, and may thus affect the equilibrium exchange rate via equation 11. But the global demand shifts (changes in v) do not alter the exchange rate, although they affect output in both countries (equations 5 and 6).

If we now assume stable prices and stationary price expectations, so that $P = P^* = \mu = \mu^* = 0$, equations 10, 11, and 12 yield

(13)
$$\dot{S} = -\frac{1}{b'+d_2}(M-M^*-2u)+\frac{d_1}{b'+d_2}S.$$

Since the coefficient on S is positive, the equilibrium solution S = 0 is a saddlepoint. Thus there are any number—in fact, a continuum—of time paths of the exchange rate that satisfy this equation, although only one along which the exchange rate converges to its long-run equilibrium value. As noted above, an undervalued exchange rate can always be justified by a sufficiently high accelerating rate of depreciation. In terms 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 longterm expectations. In particular, we shall assume that fluctuations take place because the "composite" exogenous variable, $y = M - M^* - 2u$, follows a path

(14)
$$\dot{y} = -\lambda y,$$

where λ measures the persistence of the deviation from the trend value. Since the solution of the differential equation is of the form S = Ay, we have $\dot{S} = -\lambda S$. For given long-term expectations, the equilibrium exchange rate can be solved as

(15)
$$S = \frac{1}{d_1 + \lambda(b' + d_2)} (M - M^* - 2u).$$

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

cyclically strong country will be weak relative to its equilibrium value. When the difference in the cyclical positions of the countries is caused by differences in the behavior of autonomous demand (as captured by u), the reverse is true.

The equation also shows the parameters that determine the sensitivity of the equilibrium exchange rate with respect to cyclical fluctuations in its determinants. The shorter the duration of these disturbances (the larger is λ), the greater the substitution elasticities of money demand (b'), and the greater the intertemporal elasticity of substitution in the distribution of demand (d₂), the more stable is the exchange rate. 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 speculators rather than by central banks.

Paradoxically, monetary policies in the two countries must then cause the exchange rate to display more variability than would be the case in the absence of active monetary policy. In fact, given the emergence of a demand shift u, the adjustment in the exchange rate required to keep both countries at full employment is given by²⁹

(16)
$$S = -\left(\frac{2}{d_1 + \lambda d_2}\right)u.$$

Only if the substitution elasticity of money demand is zero (b' = 0) will the required adjustment in equation 16 be the same as the implied adjustment in 15. Thus monetary policy can be interpreted as offsetting the changes in velocity induced by stabilizing speculation.

We noted above that the exchange rate does not generally depend on shifts in the level of world demand, as captured by v. But the global disturbance may affect the exchange rate if monetary policies in the two countries respond to it differently. If, for example, the foreign country pursues a passive monetary policy while the domestic country actively uses monetary policy to maintain full employment, a global decline in demand will lead to a depreciation of the domestic currency. This exchangerate adjustment would not be necessary if monetary policies were coordinated, a point that has some relevance for the current policy impasse in

29. The two countries choose R and R^* so as to make $X = X^* = 0$ in text equations 5 and 6. The equilibrium responses of interest rates associated with 16 are then

$$R = \frac{1}{a_2 + a_3} v + \frac{\lambda}{d_1 + \lambda d_2} u \quad \text{and} \quad R^* = \frac{1}{a_2 + a_3} v - \frac{\lambda}{d_1 + \lambda d_2} u.$$

industrial countries. Given the global nature of the last recession, expansion could have taken place without a shift in exchange rates if it had been initiated simultaneously in all countries.

EXCHANGE-RATE BEHAVIOR IN AN INFLATIONARY ENVIRONMENT

In the environment of stable long-run expectations discussed above, exchange-rate fluctuations are transitory and largely 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 an anchor for long-term expectations.³⁰

From the above model the long-run equilibrium value of the exchange rate is given by

$$S = (M - M^*) + b'(\mu - \mu^*).^{31}$$

While high substitution elasticities of money demand contribute to stable exchange rates when prices are stable, 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 currencies.

The diagram below analyzes the dynamic response of the exchange rate to permanent reductions in the money supply of the foreign country. The difference in price levels appears on the horizontal axis and the exchange rate along the vertical axis.³² The *PP* schedule represents the purchasingpower-parity relation between the exchange rate and the difference in prices. Any long-run equilibrium must lie on this schedule.

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

31. In long-run equilibrium, $X = X^* = 0$, $R = \mu$, $R^* = \mu^*$, and $\dot{S} = \pi = \mu - \mu^*$, 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:

$$M - P = -(b_1 + b_2) \mu + b_1 \mu^*; M^* - P^* = b_1 \mu - (b_1 + b_2) \mu^*.$$

By the purchasing-power-parity equation, $S = P - P^*$; hence the result reported in the text.

32. The analysis of the dynamic response of the exchange rate to a permanent reduction in the rate of growth of the foreign money supply could be conducted with this apparatus, provided that the difference in price levels and the exchange rate were measured relative to the trends set by the relative money supplies.

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Difference in price levels

In the long run an unanticipated permanent reduction of the foreign money supply will cause an equiproportionate decline in foreign prices matched by an increase 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.³³

What happens to the spot exchange rates depends on the behavior of interest rates in the adjustment process. Immediately, short-term interest rates in the foreign country will increase. If the interest-rate differential persists in favor of the foreign country, the long-term interest-rate differential will also turn in its favor and the spot exchange rate must immediately overshoot its long-run equilibrium. In the diagram the path of the exchange rate would then be $A_0A'_0A_1$.

33. This is the disturbance analyzed in Rudiger Dornbusch, "Expectations and Exchange Rate Dynamics," *Journal of Political Economy*, vol. 84 (December 1976), pp. 1161-76.

The overshooting need not occur, however, if the decline in the foreign money supply is anticipated. A possible adjustment path in that case is indicated by path $A_0A'_0A_2A_1$. At the moment when the monetary disturbance is first expected, the price of foreign currency jumps to A''_0 . This shift increases inflation in the domestic economy and reduces it in the foreign economy; it raises the domestic interest rate relative to the foreign interest rate, and therefore, if the exchange market is to be in equilibrium, the price of foreign currency must rise continuously until the disturbance actually occurs. It is only when the interest-rate differential turns in favor of the foreign country that the price of its currency declines in the process of adjustment from A_2 to A_1 .

Suppose 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_3A_0 back to its initial equilibrium value. The speculative cycle $A_0A_0''A_2A_3A_0$ is caused entirely by expectations that the market considered justified ex ante but that turned out to be incorrect ex post. This mistake in speculation is compatible with "efficiency" in the foreign-exchange market but it imposes macroeconomic costs by forcing unnecessary adjustments in output and labor markets. Offsetting action by the central bank may thus be necessary.

CURRENT-ACCOUNT ADJUSTMENT

The final part of this analysis considers the impact of changes in exchange rates on the current-account balance.

Suppose that the propensity to save increases in one of the countries. From the model, the effect on the exchange rate depends on how the world distribution of demand changes. If demand falls equally in both countries, the transfer of surplus saving 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 in the world 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 currentaccount surplus resulting from the increased propensity to save 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 the two countries to translate the increase in saving into productive investment.

In the world of Fisher parity, the role of changes in exchange rates in effecting changes in the current-account balance is obscured by the assumption of perfect substitutability among assets. In fact, surpluses and deficits in the current account 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 requires changes in relative asset prices.

To consider the role of relative asset prices in this transfer process, we assume that there are only two types of financial instruments in the world economy—two national monies, which we will call the dollar (for America) and the mark (for Europe). The process through which the supplies of these two assets are reallocated between the two countries is the current-account adjustment process.

In this simple framework, we investigate only the effects of shifts in the propensity to save and of shifts in asset preferences, and thus abstract from differences in spending patterns, the traditional concern of transfer analysis.

All of these disturbances figure in recent discussions regarding the international balance-of-payments problem. Does Germany have a currentaccount surplus because of a high saving propensity or because of a shift of demand toward German products? Is the dollar weak because of a portfolio disequilibrium or because of the factors that underlie America's trade-account deficit? Answers to these questions are obviously important because 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 to other currencies, changing the mixture of asset supplies might be the appropriate response. If, in contrast, the cause is a change in real factors that implies a deterioration in America's equilibrium terms of trade, such a policy would clearly be inappropriate.

The formal structure of the model is defined by the following equations:

$$XP = aX^*P^*/S$$

$$XP + X^*P^*/S = c_1XP + c_1^*X^*P^*/S + c_2W + c_2^*W^*$$

$$D^* = m(\pi)(M^*/S)$$

$$B = X^*P^*/S - c_1^*X^*P^*/S - c_2^*W^*$$

$$M^*/S + D^* \equiv W^*$$

$$W \equiv D$$
$$\overline{W} \equiv W + W^*$$
$$\overline{D} \equiv D^* + D,$$

where

 $X(X^*) = \text{American (European) output}$ $P(P^*) = \text{the price level in America (Europe)}$ S = the mark price of dollars $W(W^*) = \text{American (European) financial wealth in dollars}$ $\overline{W} = \text{world financial wealth in dollars}$ $D(D^*) = \text{American (European) holdings of dollars}$ $\overline{D} = \text{the total supply of dollars}$ $M^* = \text{total supply and European holdings of marks}$ $c_1, c_2(c_1^*, c_2^*) = \text{the propensity to consume from income and wealth,}$ respectively, in America (Europe) a = the ratio of American to European expenditure m = the desired ratio of dollar to mark holdings in Europe $\pi = \text{the expected rate of depreciation of the dollar}$ B = current-account surplus of Europe.

The first equation gives the equilibrium distribution of world demand for American and European goods.³⁴ The second equation defines the equilibrium level of nominal income (in dollars) in the world economy. Shifts in the saving propensity will be interpreted as shifts in the c_1 and c_1^* parameters. The third equation defines portfolio equilibrium in the foreign-exchange market. 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. The fourth equation defines the equilibrium current-account surplus of Europe as the discrepancy between domestic income (measured in dollars) and domestic absorption. The remaining equations are accounting identities.

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

The first two equations can be solved for the equilibrium level of nominal income in the world economy (measured in dollars);

$$XP + X^*P^*/S = \frac{c_2(1+a)}{as_1 + s_1^*} \overline{W} + \frac{(c_2^* - c_2)(1+a)}{as_1 + s_1^*} W^*,$$

where s_1 and s_1^* are the American and European saving propensities, $(1 - c_1)$ and $(1 - c_1^*)$, respectively.

The asymmetry of consumption propensities between the two regions $(c_2 \text{ and } c_2^*, \text{ respectively})$ links the level of demand in the world economy to the transfer process: if the European propensity to consume is less than the American one, 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 the current account. In the short run Europeans must hold the dollars they have acquired through past surpluses in the current account. If collectively they try to shift from dollars to marks, the mark price of dollars will drop on the foreign exchanges until portfolio equilibrium is 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 D^*D^* schedule in the diagram below 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 D_0^* . Given that stock, short-run equilibrium in the foreign-exchange market occurs at A_0 with the exchange rate S_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

$$B = \phi W - \phi^* W^*,$$

where

$$\phi = \frac{s_1^* c_2}{a s_1 + s_1^*}$$
$$\phi^* = \frac{a s_1 c_2^*}{a s_1 + s_1^*}$$

From the perspective of this equation, adjusting the current account involves simply reallocating asset holdings between the two countries. The



long-run equilibrium distribution of assets depends on the saving propensities of America and Europe and the distribution of demand between the two countries:

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

Substituting from the wealth constraints, this long-run equilibrium condition for the current account takes the form

$$D^* = \frac{\phi}{\phi + \phi^*} \,\overline{D} - \frac{\phi^*}{\phi + \phi^*} \frac{M^*}{S}.$$

The AA schedule in the diagram shows the combinations of the dollar exchange rate and holdings of dollars by Europeans that are consistent with a current-account balance of zero. The intuitive reason why it is upward

sloping is that an increase in the holdings of dollars by Europeans stimulates import demand in Europe; therefore, to keep the current account in equilibrium the mark has to depreciate—that is, the mark price of dollars must rise.

Long-run equilibrium in the balance of payments between America and Europe obtains at point A_1 with exchange rate S_1 and the stock of European holdings of dollars equal to D_1^* . At that point the current-account balance is zero, as it is at any point on the AA schedule. Any point above AA implies a surplus in Europe's current-account balance while any point below that schedule implies a deficit for Europe. With the initial stock of dollar holdings D_0^* , the European current account is in surplus. Consequently, the European stock of dollars increases while the dollar depreciates until long-run equilibrium is reached at A_1 , with exchange rate S_1 and European dollar holdings D_1^* .

A parallel between exchange-rate theory, as developed here, and the theory of investment is illuminating. The short-run equilibrium value of the exchange rate (S_0) corresponds to the demand price of capital in investment theory, while its long-run equilibrium value corresponds to the supply price of capital. In investment theory a discrepancy between the demand price and the supply price leads to an adjustment of the stock of capital through investment. In exchange-rate theory a discrepancy between the tween the short-run and the long-run equilibrium values of the exchange rate leads to an adjustment of the stock of foreign assets through the balance of payments.

The long-run equilibrium values of the dollar-mark exchange rate and the stock of dollars held by Europeans are given by the following equations:

$$S = \frac{\phi^*(1+m) + \phi m}{\phi} \left(\frac{M^*}{\bar{D}}\right)$$
$$D^* = \frac{\phi m}{\phi^*(1+m) + \phi m} \bar{D}.$$

They depend not only on the supplies of the two assets, but also on spending patterns, saving behavior, and portfolio preferences.

These two equations and the last diagram allow us to examine the adjustment of the balance of payments to (1) a shift of demand toward European goods; and (2) an increase in the propensity to save either in Europe or America.

First, a shift of demand toward European goods can be thought of as a shift of the AA schedule to the right. In the new long-run equilibrium position, the mark price of dollars is lower 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, adding to inflation in America and reducing inflation in Europe. The dollar does not, however, depreciate enough to restore full-employment equilibrium in America (given some rigidity in domestic prices and wages). While the asymmetry in asset preferences introduces a partial automaticadjustment mechanism against regional shifts in demand, the adjustment of the exchange rate alone is not sufficient to maintain full-employment equilibrium.

Now, if asset preferences were identical in the two countries, an increase in the saving propensity of Europe would exert 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 world prices, and in part wasted through higher unemployment in the world economy.

When asset preferences are not identical, the increase in European saving and the long-run increase in European wealth must shift 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 our earlier description of international financial markets, 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.

Summary

To sum up, this paper has attempted to relate exchange rates to the process of current-account adjustment. A number of problems emerge that offer directions for future research in the framework of a fully specified general-equilibrium model.

Our analysis of the interaction between the foreign-exchange market

and international financial markets emphasizes 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, because it involves an intertemporal perspective of the adjustment process, although the question of the appropriate horizon for current-account adjustment is not settled.

We then looked at currency preferences in international financial intermediation, in order to assess the types of financial instruments used as assets in international trade. 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 that minimize variance from changes in the purchasing powers of currencies, and the own-effects and crosseffects of returns on speculative-portfolio proportions for a given holding period. We found that, among major currencies during the period of floating rates, the domestic currency was a preferred habitat for investors of Germany, the United States, and the United Kingdom, but not of France and Japan. Predicting changes in purchasing powers, using the framework when there are discrete changes in exchange rates, and estimating the relative risk aversion of investors remain tasks for further research.

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

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

Both of these sources of fluctuations in exchange rates suggest a role for monetary policy. The former points to the need for monetary policymakers to take an intertemporal view of current-account adjustment and thus help in strengthening the required international financial intermediation. The latter underlines the opportunity for costless changes in the mixture of asset supplies that may prevent transmission of exchange-rate changes to economic activity and thereby forestall costly macroeconomic adjustments in output and employment. The case for intervention by central banks to facilitate the current-account adjustment process is even stronger when differences in asset preferences are significant.

We therefore think that the "weakness" of the U.S. dollar in recent months and the recycling of the OPEC surpluses call for changes in the mixture of asset supplies in the United States and other oil-importing countries, and also that national and international monetary authorities should take a longer perspective in policy with respect to current-account "imbalances" among industrialized countries.

Comments and Discussion

Walter S. Salant: I think this paper deserves longer study than I have been able to give to this version, the latest of several. It contains a good deal of illuminating analysis.

What I regard as suggestive and fruitful is the combination of the treatment of current-account imbalances as changes of net wealth and the treatment of net wealth as a determinant of aggregate demand along with income. The distribution of wealth among countries is a determinant of the distribution of global aggregate demand among them. The paper analyzes the implications of this relation for equilibrium in the currentaccount balance and the foreign-exchange market and for the process of balance-of-payments adjustment and macroeconomic adjustment. This is one aspect of the authors' more general attempt to bring together the flow and asset-market or stock-adjustment approaches to the analysis of the foreign-exchange market. The contrast in these approaches underlies some of the differences of opinion now being expressed about the reasons for the recent decline of the dollar.

The authors bring into their theoretical treatment the fact, obvious enough to observers of actual foreign-exchange markets, that expectations about future exchange rates have a central role in explaining their actual current behavior. In their view, these expectations, besides exerting an exogenous influence on current exchange rates, also adjust to equilibrate exchange markets. I should like to see an elaboration of this statement, including a clearer definition of expectations and of their adjustment. Does the statement that expectations adjust to equilibrate the foreign-exchange market mean that the expected level of the rate at some future time adjusts? Or that its expected future rate of change or the expected duration of change adjusts? There is a sentence that refers to expectations as being about the *rate* of depreciation, but a few sentences later expectations seems to refer to an expected *level* of the exchange rate. If it is this latter expectation that adjusts and thereby helps to equilibrate the exchange market, I do not see why that should change as a result of current behavior of the market. Presumably, expectations about levels and rates of change are generally related, but it is possible that one could change when the other did not, or that a given change in one could be associated with a variety of alternative changes in the other.

It is also not clear to me whether the adjustment of expectations to which the authors refer is a change in a single number or in a schedule of expected future levels or rates of depreciation associated with the current level or rate of depreciation rather than a movement along a given schedule. If expectations are a schedule, why should that schedule change when the rate changes?

In short, the statement about the endogeneity of expectations seems to be trying to convey a message that may be important, but it is phrased too elliptically and too obscurely for me to understand. Thinking about it does bring home, however, that talk about expectations needs to be precise.

The authors then refer to a notion of the future level of an exchange rate as necessary to provide an anchor for expectations, in the absence of which the exchange rate would be indeterminate. I concur with that view and with the authors' likening of the foreign-exchange market to the stock market, perhaps because I have often made the point myself even when flexible rates were only a gleam in the eyes of economists.

There is a reference to the equilibrium real exchange rate. That seems to me to require some definition. The term "real exchange rate" is usually used to refer to the nominal exchange rate that has been corrected for changes in relative price levels. I have the impression, although I am not certain about this, that in this paper the authors refer to the effect on the equilibrium *nominal* exchange rates of all the factors, not only changes in relative price levels, that may influence exchange rates, such as changes in reciprocal demand—in other words, factors other than the price level.

One more small point remains—not relevant to the substance of the paper—about which there is frequent misunderstanding. There is a reference to the current-account balance as the discrepancy between income and absorption. Income and output are assumed to be interchangeable there. Although this conventionally accepted equivalence is valid when income and output are measured in current dollars, I think it is worth

noting that when the terms of trade change, real income and real output, expressed in noncurrent prices, are not necessarily equal, and neither are changes in those two magnitudes in constant prices, so those terms cannot properly be regarded as interchangeable. The change in the real currentaccount balance is the change in the difference between real output and real expenditure, not between real income and real expenditure. If it is real income rather than real output that determines real expenditure, the distinction between changes in real output and real income caused by a change in the terms of trade has some significance.

Marina v. N. Whitman: As those who have tried to read it have doubtless discovered, this is an ambitious, rich, complex, frequently insightful, and often infuriatingly cryptic paper. The cryptic quality has two basic causes. First, the authors cite special-case results without making explicit the assumptions on which their results depend; second, they sometimes fail to explain the steps involved in complex and subtle chains of reasoning that are obvious to them but not necessarily to the reader.

Their aim, as I understand it, is to combine the separate pieces of the international-adjustment literature into some unified framework. They do not entirely achieve this aim; in particular, they do not clarify, formally or even verbally, the ways in which the different models in their paper are linked together. In one respect, in fact, the various parts are inconsistent with one another; that is, the discussion of the Fisher parity relationship in the section entitled "Fundamentals of Exchange-Rate Behavior" is predicated on the assumption that domestic and foreign assets are perfect substitutes, while the model in the immediately preceding section, "The Choice of Currency in International Financial Intermediation," and the one in the section, "Current-Account Adjustment," both are predicated on the assumption of imperfect substitutability.

In trying to provide a unifying approach, however, the authors give us a crash course in the macroeconomic analysis of open economies, as well as many interesting insights that help explain some of the "surprises" dealt by recent experience, summarized in their introduction. The basic thrust of the paper is that the short-run determination of exchange rates in asset markets is linked through interest rates and expectations regarding exchange rates to the commodity and factor markets, because interest rates and exchange rates influence income, expenditure, employment, and prices. Furthermore—and this is a major point of the paper—because commodities and assets produced by different countries are not perfect substitutes, and because the preferences of citizens of different countries differ, employment and output are ultimately linked to the exchange rate also via the effects on demand of the redistribution of wealth associated with current-account surpluses or deficits.

The authors argue that these wealth-distribution effects can be ignored only if there is symmetry in all marginal propensities. If people had the same preferences throughout the world the open-economy model would become the same as the model for the closed economy, in which wealthredistribution effects are generally ignored. In fact, such effects can also be ignored under either of two alternative assumptions: (1) the perfect substitutability of domestic and foreign goods and assets, or (2) the socalled small-country assumption, according to which all prices are determined in the outside world so that no adjustments in relative prices occur.

Unfortunately, the authors create a certain amount of confusion in the process of making this point, and of distinguishing their generalequilibrium approach from the partial-equilibrium analysis of exchangerate determination that still prevails as the conventional wisdom in most textbooks on international economics. Consider, for example, their statement that "if spending patterns are identical across countries, an increase in the current-account surplus of a country caused, for example, by an increase in the propensity to save of that country would call for no change in relative prices among commodities and among nations to restore equilibrium in the world economy." No one, including the authors, would deny that any disturbance that increases the current-account surplus under fixed rates will cause the currency to appreciate under floating rates. Their point is rather that, under the assumption of identical spending patterns, there would be no additional subsequent effect on exchange rates. The confusion arises from a failure to distinguish clearly between the primary impact on the exchange rate caused by a disturbance creating a flow disequilibrium in the ex ante demand for and supply of foreign exchange at the initial exchange rate, and the secondary impact caused by the expenditure effects of wealth transfers-that is, redistribution of stocks of wealthimplied by a nonzero current account.

I have already referred to the problems created for the reader by the fact that this paper consists of a number of separate models. The model in the final section of the paper is probably the most puzzling and the least

satisfactory, primarily because of its failure to spell out the behavioral relationships that are subsumed in the two parameters a and m representing, respectively, the distribution of demand among the commodities and the assets produced by different countries.

One result of the particular specification used is to obscure a crucial difference between this model and other "monetary approach" models, in particular, the Dornbusch "prototype" model¹ that I utilized for expositional purposes in my survey of this analytical approach (BPEA, 3:1975). In the model presented by Kouri and de Macedo, the automatic balanceof-payments adjustment mechanism is at most a partial one, and depends specifically on the effects of wealth transfers on the level and distribution of expenditures. In the Dornbusch model, payments equilibrium is fully (rather than partially) restored after a disturbance, despite the fact that any secondary effects of wealth transfers are excluded by the assumption that domestic and foreign goods are perfect substitutes. In that model, it is the endogeneity of the nominal money supply under fixed exchange rates, or of real money balances under flexible rates, that drives the automatic adjustment process. In other words, although both are characterized as "monetary approach" models, the adjustment processes are entirely different.

In another respect, however, the models presented here serve to emphasize and reinforce one of the problems common to standard monetary-approach models. In the latter, exchange rates are determined by the conditions for equilibrium in asset markets in the short run and by quantity-theory and purchasing-power-parity conditions in the long run. The monetary-approach models yield determinate results for the long run only if there is no feedback from exchange rates to price levels. Otherwise, short-run departures from long-run equilibrium will alter the long-run equilibrium position.

In the models of this paper, short-run and long-run equilibrium exchange rates are connected by the "anchor" of long-term expectations. But the authors' assumption of stationary long-term expectations clearly does not resolve the problem once wealth-redistribution effects are introduced into the system. Rather, market participants must correctly gauge what the equilibrium exchange rate will be once all the macroeconomic and current-account—or wealth-transfer—adjustment processes have

1. Rudiger Dornbusch, "Devaluation, Money, and Nontraded Goods," American Economic Review, vol. 63 (December 1973), pp. 871–80.

worked themselves out. Otherwise, the entire Fisher parity process will get off on the wrong track and, once it does, there will be no way to get it back on the original track—a problem the authors note in the description of their equilibrium solution as a saddlepoint.

This situation poses two problems. First, getting on the "right track" requires an incredible amount of information. Presumably, knowledge of all the behavioral parameters in the system is required to generate correct long-term expectations. Second, while price levels need not be exogenous, the parameters a and m in the final model, which describe the distribution of demand, must be. If these are not exogenous, then the long-run equilibrium exchange rate will be indeterminate, and we are left again with the fundamental conundrum confronting models that incorporate expectations as one of the determinants of economic behavior.

General Discussion

A number of discussants were intrigued by the analysis of currency choices and the hypothetical portfolios presented in the paper. Martin Neil Baily was impressed that such a large share of the portfolios was in dollars, even when no particular allowance was made for the greater convenience and lower transaction costs associated with the dollar's role as a world vehicle currency. Marina Whitman was puzzled about the extent to which the calculated portfolios rested on the empirical results of the 1973-77 period and the extent to which they were based on theoretical assumptions about risk aversion and the like. She doubted that they corresponded to "real world" estimates of demand elasticities. Arthur Okun suggested that the analysis implicitly assumed that people extrapolated the variances and covariances of the past and relied on forward premiums, but did not regard the actual returns on various currencies in the past as meaningful predictors. De Macedo pointed out to Baily that the weights used for the international investor attempted to capture in a rough way the special role of the dollar.

Walter Salant engaged in a dialogue with Kouri and de Macedo on the concept of equilibrium and disequilibrium for various markets. Christopher Sims expressed some discomfort with the conventional assumption invoked in this paper that asset markets are in continuous equilibrium. He thought that holdings of assets—especially those used for transactions—

could fluctuate in random ways; the holders may not monitor them explicitly on a day-to-day basis and might react only when quantities got out of line with prices over a period of time. On that view, Sims saw the need for a detailed discussion of the dynamics of asset markets as well as of output and product-price adjustments. Kouri defended the assumption of continuous equilibrium in asset markets as one of convenience rather than conviction.

Baily and Charles Holt pressed Kouri on the nature of the determinants of the long-run expectations that served fundamentally as the anchor in exchange markets.

Ralph Bryant saw the analytical contribution of the paper as an attempt to link asset markets and goods markets, focusing on the transfer of wealth between countries via imbalances in the current account in the balance of payments, which in turn requires further portfolio rebalancing by private economic agents. He noted that the analysis was inconsistent with the conventional view that flexible exchange rates insulate countries from monetary disturbances originating abroad. In his view no exchange-rate regime can provide that kind of insulation.

Robert Solomon and Kouri essentially agreed on the difficulty of distinguishing clean and dirty floating in a world in which many types of government decisions, including borrowing abroad by most governments, would have impacts on exchange rates. Lawrence Krause thought that there was a point to distinguishing those types of interventions in the exchange market that prevent wealth, portfolio, or money-supply adjustments from taking place in response to international developments. In this sense, he thought, intervention in the spot exchange market did operate differently from other policies that would have exchange-rate effects. Kouri contended that a change in currency demands that represented a shift in portfolio preferences should be offset by changing the mix of assets in the same sense that an increase in liquidity preference should be accommodated by adjustments of the domestic money supply. In response, Krause expressed his skepticism that such shifts in international asset preferences were likely to be truly exogenous; rather, they might be symptoms of a more fundamental change that would require different forms of adjustment.