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Monetary and Fiscal Impacts on Exchange Rates

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This paper describes and tests the proposition that the mixture of monetary and fiscal policies significantly affects exchange rates. We begin with the historical background describing the major shift in policy mix since the 1973 oil crisis. We then test two models of exchange-rate determination for four currencies vis-a-vis the U.S. dollar. Finally, we consider the policy implications of the shift in U.S. policy mix—expanding government debt and contracting money growth—for the behavior of the dollar-exchange rate, the conclusion.

Many analysts argued during the early 1970s that individual countries would gain greater independent control over their domestic stabilization policies if they adopted a system of floating exchange rates. Two problems related to fixed exchange rates commanded a good deal of attention before generalized floating actually began in 1973.

First, rapid economic expansion in an open economy often tended to increase imports and decrease exports, leading to deficits in the balance of payments. A current-account imbalance which was not offset by capital flows had to be met out of official foreign-exchange reserves. When pressure on these reserves increased, a country had to choose between a politically unpopular devaluation or politically unpopular deflationary measures.

Second, the United States, as the principal reserve currency country, could "export" its inflation under fixed exchange rates. Attempting to maintain fixed exchange rates required that any excess supply of U.S. dollars, putting downward pressure on the dollar, had to be absorbed in the foreign exchange market by countries within the fixed rate system. Purchasing these dollars at a fixed rate tended to expand foreign money supplies and, over time, to lead to additional inflation. Attempts to offset this expansion in foreign money supplies by individual "sterilization" operations usually proved to be only moderately effective.

Floating exchange rates promised to do away with these problems. Instead of reducing a country's international reserves, an incipient balance-of-payments deficit would trigger an appropriate exchange rate depreciation. Such a depreciation, it was hoped, would no longer be unpopular because it would represent an automatic market response—a smooth adjustment, rather than a decision by politicians to devalue by a discrete amount. Furthermore, U.S. inflation could no longer be exported because U.S. monetary expansion would depreciate the dollar, alleviating the incipient price pressure in other countries. Floating exchange rates thus would permit independent domestic stabilization policies, because any domestic move which would have encountered international constraints under the fixed exchange-rate regime would now only produce automatic and—it was thought—less painful adjustments in exchange rates.[1]

Since the advent of floating, the industrial countries have indeed followed independent domestic economic policies, in the sense that policies have differed radically both between countries and between the pre- and post-floating periods in any given country. The quadrupling of oil prices in late 1973 severely strained the industrialized countries, forcing most into recession in 1974 and 1975. Sev-

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eral countries ran large budget deficits in the hope of stimulating economic growth and getting out of the recession. The distinguishing feature between countries, however, was their choice of means to finance these deficits.

An expansionary budget deficit must be financed. If the central bank buys government bonds by increasing the reserve base of the banking system, the debt is *monetized* resulting in *monetary expansion*. If the debt is sold directly to the public, however, the policy may be characterized as *fiscal expansion*. In either case, the debt is ultimately held by the public either as money or as government debt.

Wary of kindling rapid inflation, some countries—notably Japan—shifted their policy stance in the 1974-75 recession away from monetary expansion towards fiscal expansion. Others maintained the previous balance between monetary and fiscal policy, while some shifted toward monetary expansion.

The United States showed a fairly consistent rate of monetary expansion between the 1968-73 and 1973-79 periods—slightly lower after floating began than before (Table 1). Germany, the United Kingdom and (especially) Japan showed lower monetary growth between the two periods, while Canada and Italy showed increasing rates of growth.

The disparities in fiscal expansion were even greater (Table 2). Every country in our sample displayed a major increase in total government debt between 1968-73 and 1973-79. In the latter period, government debt increased between 94 percent (the U.S.) and 667 percent (Japan), with the increases elsewhere spread between 100 and 300 percent.

The expansion of government debt was particularly noticeable in Japan. Following the 1973 oil crisis, Japan's sectoral saving behavior changed dramatically. According to flow-of-funds statistics, the public-sector deficit as a percent of nominal GNP rose from 2 percent to 9 percent between 1973 and 1978, while the corporate-sector deficit dropped from about 6 percent of nominal GNP in 1973 to almost zero in 1978. According to the Bank of Japan, following the oil crisis, Japan and other countries "resorted to fiscal measures in an attempt to stimulate business activity, which caused the substantial increase in the financial deficit of the public sector. Subsequently, the financial deficit of the public sector in leading Western countries has tended to decrease, while in Japan it has accelerated, necessitating massive issues of public bonds, mostly government bonds, which caused the inevitable increase of the stock of public bonds."[2]

Table 1
Annual Average Growth of M-2 Money Supply (Percent)

	1968-73	1973-79
Canada	12.3	17.0
Germany	11.1	8.6
France	14.2	14.4
Italy	16.9	20.9
Japan	20.2	12.0
U.K.	15.8	11.4
U.S.	9.2	8.5

SOURCE: *International Financial Statistics*, IMF, November 1981 Data Tape, Lines 34 and 35.

Table 2
Percentage Increase in Total Government Debt (Percent)

	1968-73	1973-79
Canada	29.1	139.2
Germany	30.0	230.2
France	- 14.1	186.9
Italy	127.1	301.7
Japan	102.1	666.8
U.K.*	10.6	134.2
U.S.	21.4	93.9

SOURCE: *International Financial Statistics*, IMF, November 1981 Data Tape, Lines 88 and 88b. *U.K. figures are for national debt in sterling; *CSO Financial Statistics*, February 1979 and February 1981.

I. Monetary-Fiscal Mix

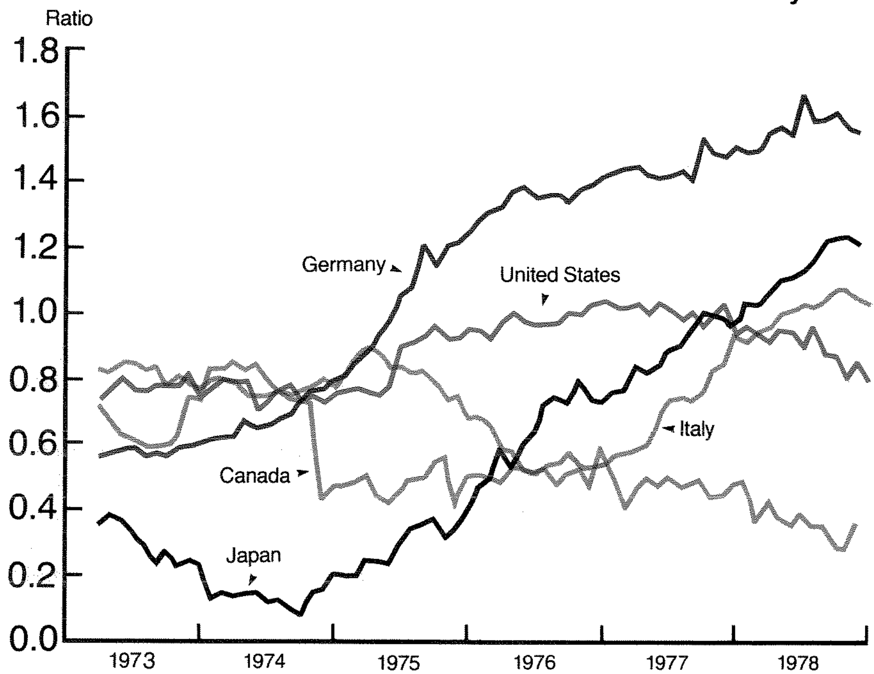
One way of capturing the monetary-fiscal policy mix is to compare the ratio (sigma) of government bonds held by the public to the central bank's reserve money stock. An increase in sigma implies a financing of new government debt by an increase in the direct holdings of the public; it represents greater reliance on fiscal policy than on monetary policy.

As a rough indicator of fiscal-monetary policy mix, the sigma ratios revealed a major shift in policy emphasis among major industrial countries after 1974 (Figure 1). Canada, Germany, Italy and the U.S. all had sigma ratios roughly between .6 and .8 during the 1973-74 period, with Japan's sigma ratio considerably lower. But a dramatic shift occurred after 1974. Germany and Japan displayed a rapid increase between 1975 and 1978, with Japan moving from the lowest ratio of the five countries to the second highest. The sigma ratio rose slightly for the U.S. in 1975-76 but declined thereafter. Canada's sigma ratio fell in 1974 but then remained rather stable, while Italy's sigma rose rapidly after 1976.

Obviously, then, industrialized countries have employed widely different mixtures of monetary and fiscal policies in the past decade. The promise of floating exchange rates has been in that sense fulfilled. But since exchange rates are now designed to reconcile policies which would have been inconsistent under the earlier regime, there arises a question of just how different mixtures of monetary and fiscal policy interact to affect exchange rates.

This question takes on heightened significance for the United States, for obvious reasons. This country has now adopted essentially a policy followed by Japan after the first oil price shock: one of curtailing monetary growth while incurring an expansion in government debt. In early 1982, the Federal Reserve was continuing its anti-inflationary policy by attempting to reduce the growth rate of the narrowly-defined money stock, M-1, while fiscal

Figure 1
Ratio of Government Bonds to Reserve Money



policy promised to produce record deficits over the 1982-84 fiscal years. The result of such a change in monetary-fiscal policy mix is the focus of this paper.

Early theories of the determination of exchange rates emphasized their role as equilibrators of trade flows between countries. Recent theories, however, have insisted on a wider role: the exchange rate in the short-run must equilibrate the demand and supply of financial assets denominated in different currencies. Equilibrium between supply and demand, according to recent theories, occurs much more quickly in financial-asset markets than in goods-and-services markets. The exchange rate thus may be viewed as the equilibrium relative price of financial assets in the short run but only as the equilibrium relative price of goods in the long run.

In this article, we will consider two *asset-market* approaches to the determination of exchange rates. The first and simplest approach is a *monetary model*. It maintains that, given the nature of international capital markets, only relative monetary policies are relevant to determining exchange rates. Thus we specify and estimate a monetary model for the rates of Canada, Germany, Italy and Japan against the U.S. dollar. This simple model does not provide an adequate explanation of exchange-rate movements, however. Thus we estimate a more general model, a *portfolio-balance model*, which maintains that both monetary and fiscal policy are relevant to the determination of exchange rates. Empirical results for the four currencies vis-a-vis the U.S. dollar help support this model, by showing that the exchange rate is affected both by the stock of money and the amount of government debt. The mix of monetary and fiscal policy thus is important to exchange-rate determination in the short run.

II. Monetary Model

The most popular theory of exchange-rate determination in the post-floating period has been the monetary approach.[3] The exchange rate, as the value of one country's currency expressed in units of another's currency, thus may be viewed as a measure of the relative price of goods between the two countries, for the value of a country's currency is just the inverse of its price level.

This monetary approach is distinguished by three key assumptions. First, there is continuous equilibrium in money and goods markets. Second—a related point—there is also purchasing power parity, since a unit of one's home currency always buys as much at home as that same unit buys abroad when converted into foreign currency.[4] Third, there is perfect substitutability among all bonds, foreign and domestic—"there is only one bond in the world." Thus the only way in which foreign and domestic asset markets are distinguished is by their different currencies. Furthermore, different mixtures of monetary and fiscal policy do not affect the exchange rate, because by this assumption bonds issued by any government simply increase the world bond stock. U.S. dollar denominated bonds are perfect substitutes for yen denominated bonds in private portfolios.

As a necessary consequence of these assumptions, there is interest-rate parity—or, equivalently, perfect capital mobility. Abstracting from expectations of appreciation or depreciation, any deviation of a country's interest rate from the rest of the world's is reversed by a capital inflow or outflow.

Given these assumptions, the monetary approach suggests that monetary equilibrium exists in each country at the intersection of the aggregate supply and demand curves for money. Because continuous equilibrium is assumed, one need in theory only attend to the demand curve (or equally to the supply curve), for the country is always on both of the curves.[5] The monetary approach is fundamentally a hypothesis of the stability of demand for money functions across countries.

Money demand is usually thought to be a function, among other things, of the price level, real income and interest rates. Equilibrium, then, guarantees a unique price level in each country for given amounts of those variables, and with all other influences on money demand held constant. Purchasing-power parity requires—again as an equilibrium condition, not as a theory of causation—that the exchange rate between any two countries be at a level which preserves the value of one currency measured in goods when it is converted into the other.

Formally, let the money-demand function of the home country be written:

$$m = c + p + \alpha y - \beta i \tag{1}$$

where m is money; p is prices; y is real income; and c is a constant, all written in natural logarithms: i is the rate of interest, and α and β are parameters. This relationship is assumed to hold contemporaneously for all variables.

Similarly, let the money-demand function for the foreign country be written:

$$m^* = c^* + p^* + \alpha^* y^* - \beta^* i^* \tag{2}$$

Purchasing-power parity requires that:

$$e = p - p^* \tag{3}$$

where e is the logarithm of the exchange rate in units of home currency per unit of foreign currency.

Making the further assumptions that $\alpha = \alpha^*$ and $\beta = \beta^*$—that is, that the money-demand functions are identical between countries—and subtracting equation (2) from equation (1), yields:

$$(m - m^*) = (c - c^*) + (p - p^*) + \alpha(y - y^*) - \beta(i - i^*) \tag{4}$$

Substituting equation (3) into equation (4) and rearranging gives

$$e = C + (m - m^*) - \alpha(y - y^*) + \beta(i - i^*) \tag{5}$$

where $C = c^* - c$.

The assumption of identical coefficients in both money-demand functions greatly simplifies the development of the model. This is arbitrary, however, and a slightly more complicated version could be developed without imposing such a restriction.

Equation (5) is the fundamental equilibrium condition of the simple monetary model of exchange-rate determination. It suggests three testable hypotheses: first, the estimated coefficient (elasticity) with respect to changes in relative money supplies is positive and unity; second, the coefficient on relative real income is negative; and, third, the coefficient on relative interest rates is positive. An increase in e is a depreciation of the home currency. Thus, other things constant, an increase in the domestic money supply should produce an equiproportional depreciation of the exchange rate; an increase in domestic real income should produce an appreciation; while an increase in the domestic rate of interest should produce a depreciation.

This last result may seem illogical: commonly it is thought that a country supports its exchange rate by forcing interest rates up. In this model the opposite result holds because, given real income and money, and given the assumption of money-market equilibrium, an increase in interest rates reduces the demand for money, producing incipient excess supply. By equation (4) prices of goods must rise in order to equate money demand to the existing supply, or else the equilibrium assumption will be violated. This price rise produces a depreciation because of purchasing-power parity.

We can make the model dynamic by assuming further that purchasing-power parity holds only in the long run because prices adjust only slowly. Some such assumption must be made in practice to explain extended departures from purchasing-power parity.

The monetary approach is deceptively simple. Without any further assumptions, the simple model of equation (5) can be extended to include expectations of exchange-rate movements. The interest-rate parity assumption is equivalent to an assumption of completely effective arbitrage—that is, any sustained difference in interest rates must be reflected in the difference between spot and expected future exchange rates. Formally, for small differentials in interest rates:

$$i - i^* = \tilde{e} - e \tag{6}$$

where $\tilde{e}$ is the forward exchange rate over the period equal to the time of maturity of the bonds to which i and i* correspond. Substituting equation (6) into equation (5) and rearranging:

$$e = \frac{C}{1+\beta} + \frac{1}{1+\beta}(m_t - m_t^*) - \frac{\alpha}{1+\beta}(y_t - y_t^*) + \frac{\beta}{1+\beta}\tilde{e}_t + u_t \tag{7}$$

Equation (7) suggests that an expectation of an appreciation reflected in a fall in the forward rate would be reflected in a spot depreciation as well. The spot rate, then, is not independent of the forward rate. However, if we assume the forward rate is the expectation of the future spot rate, conditioned on past and current values of the spot rate, then the forward rate is itself not independent of the spot rate.[6] Random errors in determining the current spot rate—the u_t in equation (7)—will be correlated with the forward rate. This violates the assumption that the error terms be uncorrelated with the independent variables, which is necessary if ordinary least-squares estimates are to be unbiased and consistent.

In the estimations which follow, we make no assumptions about expectations of exchange-rate changes; indeed we estimate the simple model of equation (5). Nevertheless, because of the interest-rate parity condition in equation (6), errors in determining e_t are transmitted to the interest-rate differential, $(i_t - i_t^*)$. This again introduces a correlation between an independent variable and the error term, rendering ordinary least-squares estimates biased and inconsistent.

In order to secure consistent estimates of equations (5), we resort to an instrumental-variables technique in which the instrument for $(i - i^*)$ is $(\sigma - \sigma^*)$, where $\sigma = \ln(B/RM)$, the ratio of government bonds in private hands to central-bank reserve money (monetary base). This should be closely correlated with $(i - i^*)$ because σ represents the mixture of government stabilization policies—i.e., the balance between outside bonds and outside money. A rise in σ must result either from a rise in bonds or a fall in reserve money, either of which tends to raise interest rates. Similarly, a fall in σ would be associated with a fall in rates. This bond-money ratio, being under government control, therefore is exogenous and uncorrelated with the error term in equation (5).[7]

The results of the exchange-rate estimations (Table 3 and Chart 1) vary somewhat from country to country, but they give little support on the whole for the simple monetary approach. In three of the four cases, the coefficient on the money differential is positive as predicted. For Japan it is negative but statistically insignificant, while in Germany it is correctly positive though insignificant nonetheless. In the remaining two cases, the coefficients are of

Table 3
Monetary Model for Currencies of Canada, Germany, Italy and Japan Against the U.S. Dollar (Monthly, March 1973 – December 1978)

	Independent Variables				Summary Statistics			
Dependent Variable	Constant	$\ln(m_{us}/m)$	$\ln(y_{us}/y)$	$(i_{us}-i)$	$\bar{R}^2$	DW	RHO	SER
$\ln\frac{\text{(U.S. \$)}}{\text{(Canadian \$)}}$	-1.27 (9.5)	.54** (9.2)	.07[w] (0.6)	-.03[a] (5.8)	.948	1.78	.73	.013
$\ln\frac{\text{(U.S. \$)}}{\text{(German DM)}}$	-.99 (9.8)	1.51[c] (1.4)	.07[w] (.28)	.033** (2.8)	.888	1.94	.86	.034
$\ln\frac{\text{(U.S. \$)}}{\text{(Italian Lira)}}$	-3.06 (6.5)	.67** (7.3)	.02[w] (.19)	.02** (4.8)	.971	1.96	.79	.027
$\ln\frac{\text{(U.S. \$)}}{\text{(Japanese Yen)}}$	-8.50 (3.6)	-.52[w] (1.19)	-.30[c] (1.04)	-.04[a] (5.5)	.958	2.12	.83	.028

t-statistics in parentheses under the coefficients.
All estimates use the FAIR technique with $\ln(\sigma - \sigma^*)$ as an instrument (see footnote 7).

** Significantly different from zero at the 99-percent confidence level and of the predicted sign.

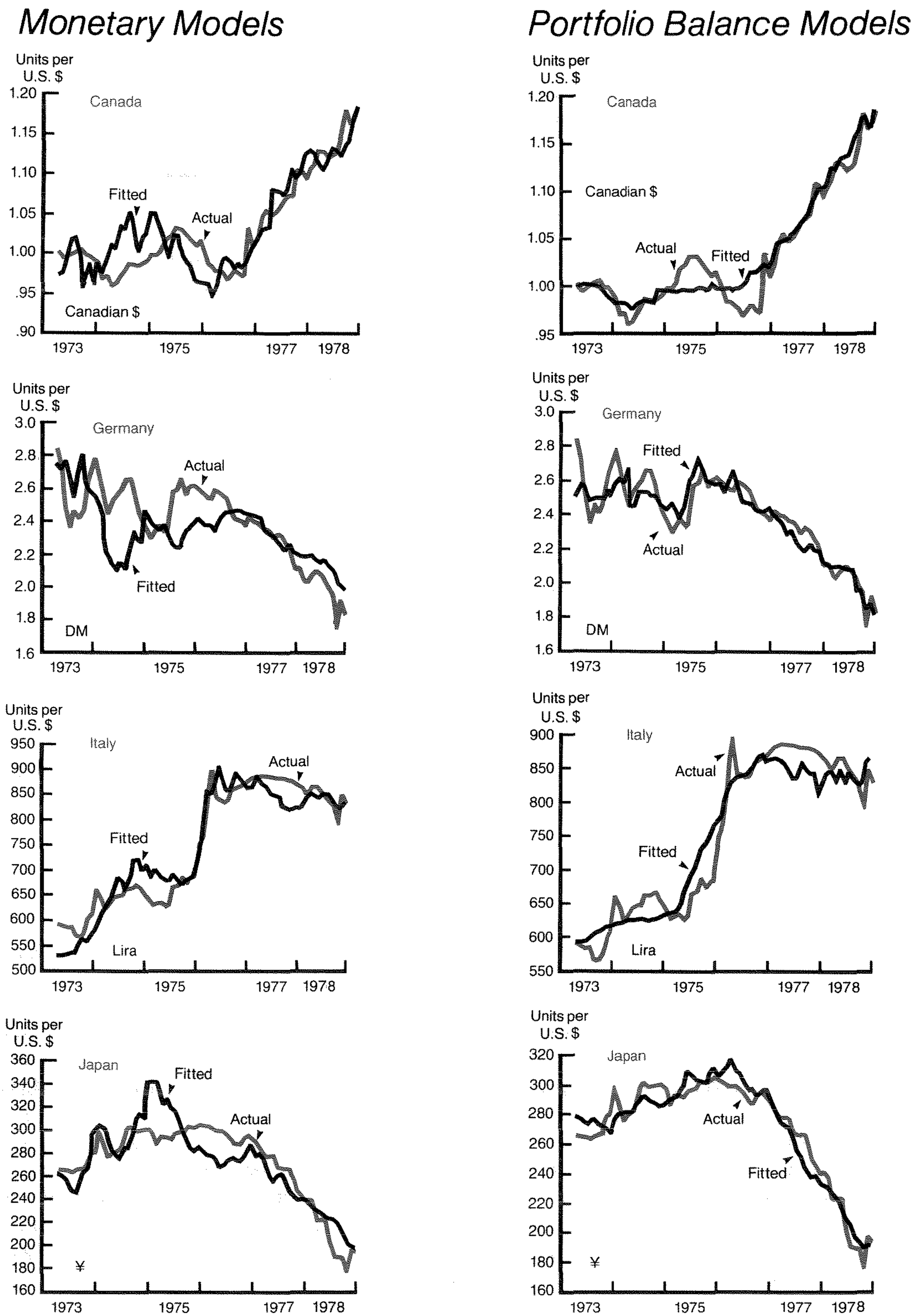
[c] Insignificant, but of the predicted sign.

[w] Insignificant and not of the predicted sign.

[a] Significant at the 99-percent confidence level, but not of the predicted sign.

See data appendix for a description of the data.

Chart 1



Monetary Models
Portfolio Balance Models
Units per U.S. $
Canada
1.20
1.15
1.10
1.05
1.00
.95
.90
Fitted
Actual
Canadian $
1973
1975
1977
1978
Germany
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
DM
Italy
950
900
850
800
750
700
650
600
550
500
Lira
Japan
360
340
320
300
280
260
240
220
200
180
160
¥

the correct sign and significantly different from zero. Contrary to the prediction of the simple monetary approach of equation (5), however, they are also significantly different from unity.

The coefficient on the income differential is of the wrong sign in every case but Japan, and it is insignificant in every case. In contrast, the coefficient on the interest-rate differential is significant in every case, of the correct sign for Germany and Italy and of the incorrect sign for Canada and Japan.

In all, the U.S. dollar/Italian lira rate offers the best support for the monetary approach: it carries a significant coefficient with the correct sign on both the money and interest-rate differentials, while its incorrectly signed coefficient on the real-income differential is insignificant. Still, the coefficient on the money differential is significantly different from unity, violating a crucial prediction of the simple monetary model. The U.S. dollar/Japanese yen rate is the least supportive of the monetary approach: every coefficient carries the incorrect sign or is insignificant. The remaining pair of exchange rates show mixed results. The results were littled improved with the removal of the assumption of identical money-demand coefficients, or with a greater role given to real interest-rate differentials in the short-run determination of the exchange rate.

The mixed results for the monetary approach may reflect the instability in U.S. money demand observed over the 1974-75 period. Instability in money-demand coefficients would create difficulties even for a more sophisticated form of the monetary approach, such as one distinguishing between real and nominal interest rates or one permitting short-run deviations from purchasing-power parity.

III. Portfolio-Balance Model

Some of the empirical failings of the simple monetary model of exchange-rate determination can be explained if we relax some of the model's assumptions. The beauty of the monetary model is its simplicity; but what it loses in simplicity when these assumptions are relaxed, it gains in greater realism. Abandoning the assumption of perfect substitutability between domestic and foreign bonds implicitly introduces portfolio-balance considerations into the monetary model. In this section, we set out a fuller model of international portfolio balance and estimate it.

With this approach, we widen the scope of the model to include the demand functions for money, domestic bonds and foreign bonds, each dependent on the domestic and the foreign rate of interest for a given expected future exchange rate. In the short run, the supplies of all three assets are fixed. Domestic bonds and money are determined by the monetary and fiscal authorities. Domestic holdings of foreign bonds represent cumulated current-account surpluses and deficits. Total wealth denominated in domestic currency equals the sum of these asset stocks, with the foreign bond stock converted at the current exchange rate. The interest rates and the exchange rate must simultaneously adjust in order to bring the demands for these stocks into accord with the fixed supplies.

As with the monetary approach, the portfolio-balance approach models private sector behavior. Unlike that model, however, it refers to outside rather than inside assets, that is, liabilities created by the public sector rather than the private sector. In the monetary model, the asset markets of the two countries are linked by the direct effect of money on the goods market: money as purchasing power determines the price of goods, and the exchange rate insures parity between the currencies given these prices. For such a mechanism, money is whatever can be used to buy goods—currency, of course, but also demand deposits and other sufficiently liquid assets (i.e., inside money).

In contrast, in the portfolio-balance approach the goods market is pushed into the background. The exchange rate adjusts the domestic currency value of foreign financial assets in private portfolios to the level considered optimal by portfolio holders, given interest rates and asset stocks. Money and bonds are treated as forms of wealth. Since inside assets (e.g., demand deposits or corporate bonds held domestically) are at once the asset of some private entity and the debt of some other private entity, they cancel out when all private-sector assets and liabilities are added up. Only the liabilities of the government-currency, central-bank reserves, and treasury debt—and of the foreign sector are net financial wealth to the private sector. A change in interest rates may force an individual to alter his holdings of inside as well as outside assets, yet taken as a whole the private sector is in equilibrium once it willingly holds all the outside assets supplied to it by the government.

The portfolio-balance approach directly models financial markets. The price level of the home or foreign country plays no direct part in the short run, yet the goods market still influences financial equilibrium in this approach. From the home country's view, higher prices abroad encourage domestic exports and discourage imports. A resulting current-account imbalance must be counterbalanced by capital flows into the home country. These capital flows are simply newly-acquired foreign assets, which increase domestic wealth and require interest-rate and exchange-rate changes to rebalance domestic portfolios.

From this general discussion, we next turn to a simple portfolio-balance model suggested by Branson, Halttunen and Masson.[8] This model shares with the monetary model the fundamental assumption of continuous financial market equilibrium, which simply means that it is a static and not a dynamic model. Its equations specify the shares of wealth willingly held by the private sector in various assets for given interest rates. These equations do not specify the adjustment process followed by interest rates or exchange rates as they move from one equilibrium to another with a change in any of the asset stocks.

The fundamental distinction between the two models concerns the substitutability between domestic and foreign bonds; domestic and foreign bonds are perfect substitutes in the monetary model but are not in the portfolio model. Purchasing-power parity need not hold even when prices have fully adjusted, since changes in domestic asset supplies can alter interest rates so as to drive the exchange rate away from its purchasing-power parity value over a sustained period.

A further assumption, useful in simplifying the model and peculiar to it, is that the home country is small—i.e., it cannot affect the foreign country's rate of interest. Consequently, the foreign rate of interest can be assumed to be exogenous.

The formal structure of the model is:

$$RM = m(i,i^*)W \quad \text{Central Bank Reserve Money Equilibrium} \tag{8}$$

$$B = b(i,i^*)W \quad \text{Domestic Government Bonds Equilibrium} \tag{9}$$

$$eF = f(i,i^*)W \quad \text{Domestically Held Foreign Bond Equilibrium} \tag{10}$$

$$RM+B+eF \equiv W \quad \text{Wealth Constraint} \tag{11}$$

where RM is central-bank reserve money (monetary base), B is privately-held domestic government bonds, F is domestically-held foreign assets denominated in foreign currency, e is the exchange rate expressed in units of domestic currency per unit of foreign currency (e.g., dollar per Deutschemark), i is the rate of interest on B, i^* is the rate of interest on F, and W is total wealth defined by the identity, equation (11). RM and B are assumed to be non-traded assets. The desired fraction of wealth held as money is m; held as domestic bonds, b; and held as foreign assets denominated in foreign currency, f.

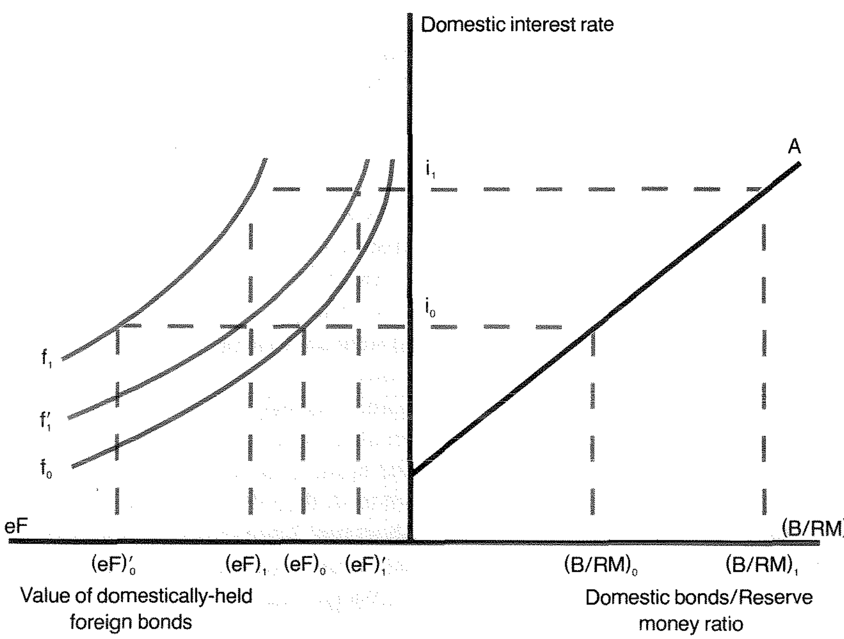
Although expectations of future exchange-rate changes are theoretically important in the portfolio-balance model, they are assumed to be static for simplicity in this exposition. Moreover, because of the wealth constraint, equation (11), equations (8)-(10) are not independent. Given W and any two of RM, B or F, the remaining one can be calculated from equation (11); equivalently, any one of equations (8)-(10) can be eliminated from the system. For example, with equation (10) eliminated, the system as written has only two equilibrium equations, but three variables—i, i^* and e. It is, therefore, formally undetermined. Here is where the small-country assumption helps simplify things. If the home country cannot affect the foreign rate of interest, then $i^* = \bar{i}^*$, some fixed rate in the extreme short run. Then only equations (8) and (9) are needed to determine the domestic rate of interest and the exchange rate.

Let us examine the mechanism through which this formal model determines the exchange rate. In the right-hand panel in Figure 2, the ratio of domestic government bonds to outside money (B/RM) is plotted against the domestic interest rate (i) for a constant domestic rate of inflation and a constant foreign rate of interest (i*). The shape of A depends on the functions m and b. For simplicity we will assume it to be linear. In the model with equation (10) eliminated and $i^* = \bar{i}^*$, dividing equation (9) by equation (8) yields $(B/RM) = b(i,i^*)/m(i,i^*) = \phi(i)$. Hence for each value of i there is a value of (B/RM), and vice versa, which is independent of W and F: for any value of i*, the ratio of domestic bonds to outside money *alone* determines the domestic interest rate.

The left-hand panel plots the domestic currency value of private holdings of foreign assets (eF) against the domestic interest rate for constant inflation, foreign interest rate and the stocks of domestic bonds and outside money. The curve (f_1) slopes downward because domestic and foreign bonds are substitutes in domestic portfolios. An increase in the domestic interest rate, other things equal, increases the demand for domestic bonds and decreases the demand for foreign bonds as shares in total wealth. An increase in domestic bonds stocks and outside money shifts the curves (f) up and to the left. To understand this point, consider an equiproportional increase in B and RM: the ratio (B/RM) remains constant and therefore for a given i* and f(i,i*), i remains constant; nevertheless, W has increased [see equation (11)]; and, therefore, by equation (10), eF must be greater by the amount $f \cdot \Delta w$.

Now let us consider the effects of changes in various asset stocks (Figure 2). Begin with a bond/money ratio $(B/RM)_1$, an interest rate i_1 and—reading off curve f'_1—the value of holdings of foreign assets $(eF)'_1$. Now, holding B and F constant, allow RM to rise so that the bond/money ratio moves left to $(B/RM)_0$. The new interest rate is i_0. At the same time the increase in the stock of money shifts the curve f'_1 outward to f_1, because total wealth is now greater. The intersection of f_1

Figure 2
Determination of Domestic Interest Rate and Exchange Rate



with i_0 corresponds to $(eF)'_0$, which is greater than $(eF)'_1$. According to our initial assumption, F has not changed, therefore e must be greater: the exchange rate *depreciates* as the stock of outside money increases. (Recall that F represents the domestic holdings of foreign assets accumulated through the current account. In the short run with wealth fixed, the current account is in balance, and hence F is a given. Any change in domestic assets then alters the domestic interest rate and the *value* of the fixed stock of foreign assets.)

The effect of an expansion of the domestic bond stock is trickier to gauge. Begin with the domestic bond/money ratio at $(B/RM)_0$, on interest rate i_0 and value of holdings of foreign assets $(eF)_0$ on curve f_0, and let the domestic bond stock expand until it moves to $(B/RM)_1$, holding RM and F constant. The interest rate increases from i_0 to i_1. Wealth increases, shifting the curve f_0 outward. It is crucial, however, just how far f shifts. In the case in which f shifts only to f'_1, the new value of foreign-asset holdings $(eF)'_1$ is less than the initial $(eF)_0$. With F constant, e must fall in order for (eF) to reach this level: in this case, an increase in the stock of bonds *appreciates* the exchange rate. On the other hand, when f shifts further out to f_1, the new value of foreign-asset holdings $(eF)_1$ is greater than $(eF)_0$, and therefore e must rise: in this case, an increase in the stock of bonds *depreciates* the exchange rate.

A change in the stock of domestic bonds can thus either appreciate or depreciate the exchange rate, depending upon the relative size of two effects—the one shifting the curve f outward, and the other moving upward along the given f curve. The situation is familiar in economic analysis: a wealth effect conflicting with a substitution effect. As the wealth effect dominates, the exchange rate depreciates; as the substitution effect dominates, it appreciates.

Branson has shown that if domestic bonds and money are better wealth substitutes than domestic bonds and foreign bonds, the wealth effect will dominate and the exchange rate will depreciate, and vice versa. To understand this condition, consider once again the expansion of the domestic-bond stock leading to the shift from $(B/RM)_0$ to $(B/RM)_1$. The increase in domestic bonds initially tends to increase wealth, which in turn increases the demand for both money and foreign assets at an unchanged rate of interest. The domestic interest rate must rise in order to increase the demand for domestic bonds until it equals the new greater supply—and in order to decrease the demand for money until it equals its unchanged supply.

If domestic bonds and foreign bonds are better wealth substitutes than domestic bonds and money, the rise in the interest rate that restores the equality between money demand and supply will produce a greater drop in the demand for foreign assets than in the demand for money at the new level of wealth. The value of the unchange stock of foreign assets $(eF)_0$ would then be greater than demand for them. Thus with F constant, e must fall—that is, the exchange rate must appreciate—to bring the value of the supply of foreign assets into line with demand. A fall in the value of foreign assets, all else constant, reduces wealth. The curve f, although shifting outward in line with the wealth increase in the domestic bond stock, thus exhibits less of a shift than that increase by itself would warrant.[9]

On the other hand, if domestic bonds and money are better wealth substitutes than domestic bonds and foreign bonds, the rise in the interest rate from i_0 to i_1 (which makes money demand equal money supply) produces a smaller drop in the demand for foreign assets. That demand at the new level of wealth exceeds the value of the unchanged stock $(eF)_0$, and e thus must increase—that is, the exchange rate must depreciate—to adjust the supply of foreign assets to the demand. This increase in the value of the supply of foreign assets, all else constant, increases wealth. Thus the curve f shifts farther out than the increase in the stock of bonds by itself would warrant.

The effect of an increase in F, the stock of foreign assets denominated in foreign currency, is straightforward. An increase in F does not change the bond/money ratio, so the interest rate remains unchanged. At a fixed exchange rate, the increase in F would increase (eF), the stock of foreign assets denominated in domestic currency. This in turn would increase wealth, and thereby increase the demand for bonds and money beyond the fixed stocks of each. Hence, wealth must not increase if the supply and demand of money and domestic bonds are to be equal. Therefore, (eF) must fall to its former level. Since F is fixed at its new level, only e can fall. It will fall in the exact proportion that F increased: an increase in the stock of foreign assets denominated in foreign currency, appreciates the exchange rate by the same proportion (i.e., the elasticity of e with respect to F is -1).

We have seen the effects of changes in each of the foreign asset stocks on the exchange rate, other things held constant. The system of equations (8) - (11) can be solved to yield the reduced form:

$$e_t = (RM_t, B_t, F_t, i_t{}^*) \tag{12}$$

The exchange rate depends on the three asset stocks and the exogenous foreign interest rate. Following Branson and his colleagues, we estimate a linear equation in which i* is replaced by the asset stocks of the foreign country (indicated by stars), which are the determinants of i*. The substitution of RM*, F* and B* for i* now eliminates the "small country assumption" for the U.S.; that is, we cannot assume that other countries' interest rates are insensitive to the monetary-fiscal policy mix of the foreign country.

$$\begin{aligned} e_t = c + \overset{(+)}{\alpha_1} RM_t + \overset{(\pm)}{\alpha_2} B_t + \overset{(-)}{\alpha_3} F_t \\ + \overset{(-)}{\beta_1} RM_t^* + \overset{(\mp)}{\beta_2} B_t^* + \overset{(+)}{\beta_3} F_t^* + u_t \end{aligned} \tag{13}$$

where c is a constant and the u_t are random errors.[10] The (+) or (−) signs over the coefficients indicate the expected direction of change of the exchange rate resulting from an increase in the corresponding asset stock, based on the analysis above.

Our estimation results are reasonably supportive of the portfolio-balance approach, especially when contrasted with the estimations of other investigators (see Table 4 and Chart 1). Five of eight coefficients on the domestic-bond stock variables are

Table 4
Portfolio-Balance Model for Currencies of Canada, Germany, Italy and Japan Against the U.S. Dollar (Monthly, March 1973 – December 1978)

	Independent Variables							Summary Statistics			
Dependent Variable	Constant	B^{US}	B^f	RM^{US}	RM^f	F^{US}	F^f	$\bar{R}^2$	DW	RHO	SER
U.S. $ / Canadian $	1.128 (16.25)	$.00003^c$ (.06)	.0072** (3.02)	$.00076^c$ (.86)	$-.0105^c$ (.61)	$.00274^{WW}$ (4.01)	$.256(10^{-5})^c$ (.73)	.960	2.16	.76	.0109
U.S. $ / German DM	.0578 (.54)	-.00183** (3.32)	$.195(10^{-3})^c$ (.52)	.00196* (2.36)	$.00235^W$ (2.08)	$-.749(10^{-3})^c$ (.96)	$.714(10^{-6})^c$ (1.66)	.920	1.90	.44	.0129
U.S. $ / Italian Lira	.00221 (7.03)	$-.382(10^{-5})$* (2.48)	$.766(10^{-8})^c$ (1.55)	$-.995(10^{-6})^w$ (.44)	$-.23(10^{-7})$** (3.35)	$-.228(10^{-5})^c$ (.64)	$-.771(10^{-8})^w$ (1.16)	.973	1.86	.80	.0362
U.S. $ / Japanese Yen	.0024 (3.3)	$-.991(10^{-5})$* (2.33)	$.453(10^{-7})$* (2.03)	$.465(10^{-5})^c$ (.61)	$.945(10^{-7})^w$ (1.34)	$-.152(10^{-4})^c$ (1.45)	$.141(10^{-6})$* (2.05)	.963	2.04	.65	.0001

t-statistics in parentheses under the coefficients.

All estimates use the FAIR technique with RM^f assumed endogenous.

f- superscript indicates foreign-country variables; US superscript indicates United States' variables.

* Significantly different from zero at the 95-percent confidence level and of the predicted sign.

** Significantly different from zero at the 99-percent confidence level and of the predicted sign.

c Insignificant, but of the predicted sign.

w Insignificant, and not of the predicted sign.

W Significantly different from zero at the 95-percent confidence level, but not of the predicted sign.

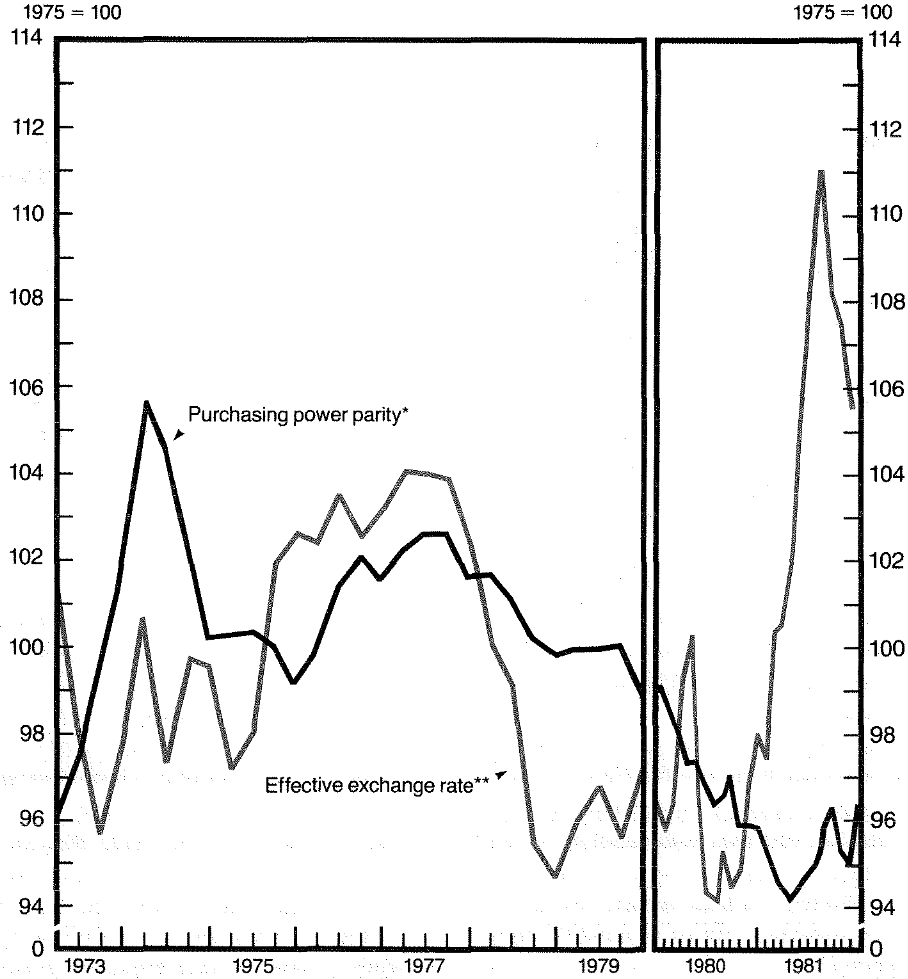
WW Significantly different from zero at the 99-percent confidence level, but not of the predicted sign.

See data appendix for a description of the data.

significant, which suggests that the simple monetary model errs in omitting consideration of nonmonetary assets. We have shown above that the coefficients on domestic-bond stocks could take either sign in theory. Interestingly, there is great consistency in the sign pattern: negative coefficients on the United States' bond stock, B^{us}, and positive coefficients on the foreign-bond stock, B^f. In other words, an increase in the domestic-bond stock *appreciates* the exchange rate from a country's own viewpoint, which is consistent with domestic bonds and foreign bonds being better substitutes than domestic bonds and money.

Only for the U.S. dollar/German DM equation is the coefficient on the United States' reserve-money stock significant and of the correct sign. In the other equations it is insignificant and, in the case of the U.S. dollar/Italian lira rate, of the wrong sign as well. The foreign reserve-money stock shows mixed results. It is insignificant in two cases—of

Chart 2
U.S. Effective Exchange Rate and Purchasing Power Parity



* Trade-weighted index of foreign wholesale prices relative to U.S. wholesale prices.
** Trade-weighted value of the U.S. dollar in terms of the currencies of fifteen trading partners.
Source: Morgan Guaranty *World Financial Markets*.

the correct sign with respect to Canada and of the wrong sign with respect to Japan. It is significant and of the correct sign in the case of the Italian lira, but significant and of the incorrect sign in the case of the German DM.

The coefficient on the United States' foreign-asset stock is significant and of the wrong sign in the case of Canada—but of the correct sign, though insignificant, for the other rates. The coefficients on the foreign countries' foreign-asset stock are again mixed: of the correct sign but insignificant for Canada and Germany; of the wrong sign though still insignificant for Italy; and of the correct sign and significant for Japan.

In all, the equations for the U.S. dollar/Japanese yen and the U.S. dollar/Italian lira best support the portfolio-balance approach—in both equations, the only coefficients with incorrect signs are statistically insignificant—yet these equations tell different stories. The lira equation provided the most support for the monetary approach. In the portfolio-balance model, the U.S. bond stock and Italian reserve money are significant in explaining the exchange rate. The significance of these two factors—because bonds are a direct influence on the interest-rate differential and reserve money on the inside-money differential—is broadly consistent with the relative success of the Italian monetary equation.

The Japanese yen equation provided the least support for the monetary approach. With the portfolio-balance model, both domestic bond stocks and the Japanese foreign-bond stock are significant, while both reserve-money stocks are not. This suggests that non-monetary, financial variables are crucial in determining this rate. To the extent that the monetary model assumes these variables away, then one would expect it to fail.

The Canadian and German equations are flawed in having significant coefficients with the wrong sign. The German reserve-money stock carries a positive, rather than the expected negative sign. U.S. foreign-asset stock in the Canadian equation carries the incorrect, positive sign. Canada is a difficult country to model, however, because of the close integration of the U.S. and Canadian financial markets. A significant amount of Canadian debt is denominated in U.S. dollars, which muddies the distinction between domestic and foreign assets for both countries and probably confuses the estimation of such simple models as those presented here.[11]

When we compare the $\bar{R}^2$s reported for each equation in Tables 3 and 4, we clearly see that portfolio-balance models generally track actual exchange rates better than the simple monetary model. (For Italy they do about the same.) A casual inspection of the charts strikingly reveals the same point. (For convenience, Chart 1 presents fitted and actual values of the exchange rate expressed as units of foreign currency per dollar, rather than as estimated.)

IV. Conclusions and Policy Implications

In the period since floating began in March 1973, the five countries in our study followed very different domestic economic policies and exhibited very different exchange-rate patterns. Over the period covered by our estimations, the rate against the U.S. dollar appreciated sharply for Germany and Japan and depreciated sharply for Canada and Italy. Our estimations suggest that asset-market models help explain these movements. So it is fair to say that they are explained—at least in part—by different mixtures of economic policies adopted by these various countries.

To be sure, the monetary model—even in the best case, Italy—is not well supported. But the portfolio-balance model generally is moderately well supported, and does strikingly well in the cases of Italy and Japan. The portfolio-balance model is a more general model, since it includes more assets and does not restrict the degree of substitutability between them. Other technical differences notwithstanding, the monetary model can be thought of as a portfolio-balance model in which domestic and foreign bonds are perfect substitutes.

The argument can be made that the monetary approach was not given a fair test. All exchange rates estimated were vis-a-vis the U.S. dollar and, as is now well known, a "shift" in U.S. money demand appears to have taken place around 1974-75. Thus the assumption of stable money-demand functions may not have held over the estimation period. Nevertheless, when cross-exchange rates not involving the dollar were estimated—e.g., the

DM/yen exchange rate—the monetary approach still did not perform any better.

Our results should be interpreted cautiously. The estimations cover a limited period, and the quality of the data is often poor—especially for the foreign-bond stocks in the portfolio-balance models. Still, our estimations are favorable enough to encourage further research emphasizing the effects of financial-policy mixtures on the behavior of exchange rates.

The policy implications must also be viewed cautiously. The portfolio models estimated here are short-run models whose long-run implications have not been empirically described. Nonetheless, the estimated portfolio models suggest that the dollar exchange rate against the German mark, Italian lira and Japanese yen will appreciate in the short run should the U.S. run a sizable government deficit which is financed in the private market. Our evidence suggests that, in the short run at least, a combination of large Federal deficits and slow monetary-base growth will result in a major appreciation of the U.S. dollar.

As Charles Pigott has shown in the Fall 1982 issue of this *Review*, substantial and prolonged deviations from purchasing-power parity occurred in recent years between the U.S. and other major industrial countries.[12] (See Chart 2.) Pigott attributes the deviations to shifts in relative prices. Such deviations could also be due to the behavior of real interest rates, caused by changes in the monetary-fiscal policy mix among major countries. A large increase in U.S. government debt in 1982, combined with low monetary growth, would thus continue to keep the effective (trade-weighted) U.S. dollar-exchange rate away from its purchasing-power value, as has occurred since late 1980.

If the dollar remains strong, U.S. goods exports could remain weak for some time, primarily because 98 percent of U.S. exports are denominated in dollars. However, a strong dollar does not necessarily imply that other countries' net exports will improve at our expense. Such a development would depend on the currency composition of various countries' exports. In 1980, for example, Japan denominated 61 percent of its exports in dollars, and 93 percent of its imports.[13] For Germany the U.S.-dollar denominations were 7 percent for exports and 33 percent for imports. Hence, in the short run, a strong dollar could hurt the net export earnings of some of our trading partners as well as the U.S.

The strength of the dollar also affects other countries by the valuation effects on their financial wealth denominated in dollars. Many European countries and middle-Eastern oil exporters have a large portion of their net financial wealth denominated in dollars. A continued strong dollar in 1982 could provide positive wealth effects to countries which otherwise would be weakened by that factor. The exchange value of the dollar thus affects a country's net wealth position as well as its demands for exports and imports. Testing alternative theories of exchange rates helps to improve our understanding of how macroeconomic policy affects trade flows and the value of national wealth.

Data Appendix

Data for both the monetary and the portfolio models cover five countries—Canada, Germany, Italy, Japan and the United States. Except where noted in other sections, all data come from the following sources:

- Board of Governors of the Federal Reserve system, *Statistical Release H.6* (FRB), various issues.
- International Monetary Fund, *International Financial Statistics* (IFS), February 1980.
- Morgan Guaranty Bank, *World Financial Market* (WFM), various issues.

Unless otherwise noted all series run from 1972 to September 1979, even though the estimation period is generally March 1973 to December 1978.

Seasonally adjusted (SA) data are used. Unless noted differently, all seasonally adjusted data are adjusted over the period January 1972 to September 1979 (or, for IFS data, to latest available date), with the use of the X11 (multiplicative) method. For series that are sums or differences of component series, the components are seasonally adjusted before computations are made.

All stock data are expressed in billions of the national currencies of each country, except for the foreign asset stock (F) for Canada and Germany, which are expressed in millions.

Variable Names and Definitions

B = net private claims on government (private ownership of government debt) = IFS line 32an (Monetary Survey: Claims on Government (net) (SA)-IFS line 12a (Central Bank: Claims on Government) (SA)

e = end-of-period exchange rate (U.S. dollars per foreign unit) = 1/(IFS line ae (Market Rate/Par or Central Rate))

F = net private financial claims on foreigners ((total foreign assets held less official reserves and government holdings of foreign debt less direct investment in foreign countries) less total liabilities to foreigners less official holdings by foreigners of home country's debt-direct investment in home country)). Generally, we accumulated surpluses (deficits) on current account less changes in reserves over annual benchmarks for net foreign-asset positions. We then interpolated this quarterly series to monthly. Sources for benchmark data were:

- *Bank of Canada Review*, February 1980, Table A15.
- *Monthly Report of the Deutsche Bundesbank*, October 1979, pp. 27-34.
- Bank of Japan, private communication.
- Bank of Italy, *Annual Report*, 1976, Tables G 15, G 20, G 21.
- Department of Commerce, "International Investment Position of the United States," Table 3, *Survey of Current Business*, September 1977 and August 1979.

For further details, see data appendix of J. Bisignano and K. D. Hoover, "Alternative Asset Market Approaches to Exchange Rate Determination," Federal Reserve Bank of San Francisco *Working Papers in Applied Economic Theory and Econometrics*, No. 105, August 1980.

i = short-term interest rate = WFM representative money-market rate.

m = widely defined money stock = IFS line 34 (Money) (SA) + IFS line 35 (quasi-money) (SA). This obtained for all countries except the U.S., for which m = FRB M-2 (old definition) (SA).

RM = central-bank money (monetary base) = IFS line 14 (Reserve Money) (SA).

y = real income proxied by the index of industrial production = IFS line 66..C (Industrial Production) (SA).

σ = ratio of net private financial claims on government to central-bank money = B/RM.

FOOTNOTES

1. See for example H. G. Johnson, **The Case for Flexible Exchange Rates**, Institute for Economic Affairs, London 1969, or Egon Sohmen, **Flexible Exchange Rates**, University of Chicago Press, 1969. The advocates of floating of course carried the day; nevertheless, the battle was pitched: see for instance Paul Einzig, **The Case Against Floating Exchanges**, Macmillan, St. Martin's Press, 1970, and a retrospective survey of the debate in H. Fournier and J. E. Wadsworth (eds.) **Floating Exchange Rates—Lessons of Recent Experience**, Leyden: A. W. Sijthoff, 1976. With the turbulent experience of the 1970's behind us, the lines of battle are joined once more: see Gottfried Haberler, "Flexible-Exchange Rate Theories and Controversies Once Again," American Enterprise Institute Reprint No. 119, January 1981.

2. "Recent Trends in the Flow of Funds in Japan—Centering on the Expansion of Public Sector Deficit," The Bank of Japan, Economic Research Department, Special Paper No. 79, p. 1, December 1978. Examination of the individual country summaries in the various issues of the O.E.C.D. **Economic Outlook** also confirm that public debt expanded in major industrial countries following the 1973 oil crisis, especially in Japan.

3. Two useful reviews of general asset-market and specific monetary-models approaches may be seen in Michael Mussa, "Empirical Regularities in the Behavior of Exchange Rates and Theories of the Foreign Exchange Market," in **Policies for Employment, Prices, and Exchange Rates**, North-Holland Publishing Company, 1979, and John F. O. Bilson, "Recent Developments in Monetary Models of Exchange Rate Determination," International Monetary Fund, **Staff Papers** (January 1979). A representative selection of estimated monetary/exchange-rate models is contained in Jacob A. Frenkel and Harry G. Johnson, eds., **The Economics of Exchange Rates: Selected Studies**, Addison-Wesley Publishing Company (1978). An important extension of the monetary approach stressing real interest rates is found in Jeffrey Frankel, "On the Mark: A Theory of Floating Exchange Rates Based on Real Interest Differentials," **American Economic Review**, September 1979.

4. Abstracting of course from transportation costs and barriers to trade.

5. In practice, this is possible only if the demand curve is more stable than the supply curve—that is, if the supply curve is subject to more shocks or random error than the demand curve—or if econometric identification can be secured in some other way.

6. See Bilson (note 3 above) for an illustration of the use of rational expectations in the monetary approach, where the forward rate is equated to the mathematical expected value of the future spot rate. The now-common procedure showing that the current spot rate is a function of the entire future history of expectations of the exogenous variables originates with Thomas J. Sargent and Neil Wallace, "Rational Expectations and the Dynamics of Hyperinflation," **International Economic Review** (June 1973).

7. Initial estimates of equation (5) for several countries showed the presence of substantial first-order serial correlation. Consequently, we now estimate it using the FAIR technique, an estimation method which guarantees consistent estimates when using Cochrane-Orcutt corrections for first-order serial correlation with instrumental variables. See Ray C. Fair, "The Estimation of Simultaneous Equation Models with Lagged Endogenous Variables and First Order Serially Correlated Errors," **Econometrica** (May 1970).

8. "Exchange Rates in the Short Run: The Dollar Deutschemark Rate," **European Economic Review**, 10, (1977) pp. 303-324. For other expositions, see W. H. Branson and H. Halttunen, "Asset-Market Determination of Exchange Rates: Initial Empirical and Policy Results," in J. P. Martin and A. Smith (eds.), **Trade and Payments Adjustment under Flexible Exchange Rates**. London: Macmillan, 1979; W. H. Branson, "Asset Markets and Relative Prices in Exchange Rate Determination," **Sozialwissenschaftliche Annalen**, Band 1, 1977, pp. 69-89; and Joseph Bisignano and Kevin Hoover, "Alternative Asset Market Approaches to Exchange Rate Determination," Federal Reserve Bank of San Francisco, **Working Papers in Applied Economic Theory and Econometrics**, No. 105, August 1980.

9. H. Genberg and H. Kierkowski, in "Impact and Long-Run Effects of Economic Disturbances in a Dynamic Model of Exchange Rate Determination," **Weltwirtschaftliches Archiv** (1979), provide a very similar analysis with a diagram quite like Figure 3.

10. See Bisignano and Hoover ("Alternative Asset Market Approaches . . ."). Branson, *et al.*, in fact, drop the domestic bond stocks, B and B*, for the econometrically spurious reason that the sign of their coefficients cannot be determined *a priori* (Branson, *et al.*, 1977, p. 311). Whether or not the sign of the coefficient is known in advance, an omitted variable biases the regression. The portfolio-balance model presented here is a model of private behavior. Of course, it is well known that governments intervene in foreign-exchange markets to support their own or another country's currency. We do not plan to model this process here. Nevertheless, we must mark its effect: buying and selling foreign exchange produces changes in the monetary base; if these transactions are related to the exchange rate (e.g., the domestic government sells foreign exchange when the exchange rate depreciates, decreasing its monetary base, and buys when the rate appreciates, increasing its monetary base), then errors in determining e, the u_t in equation (13), will be correlated with RM. Such a correlation violates the conditions necessary for ordinary least-squares estimates to be unbiased and consistent. Consistency can be obtained by using an instrumental variable technique. Preliminary estimations showed that the u_t in equation (13) have substantial first-order serial correlation. Consequently, we have estimated equation (13) using the FAIR technique, an instrumental variable estimator with Cochrane-Orcutt corrections for first-order serial correlation described earlier.

11. In a forthcoming paper, "Some Suggested Improvements to a Simple Portfolio Balance Model of Exchange Rate Determination with Special Reference to the U.S. Dollar/Canadian Dollar Rate," **Weltwirtschaftliches Ar-**

chiv, (Heft 1, 1982), we attempt to improve the portfolio-balance model for Canada by: 1) using bilateral data for the holdings of foreign asset stocks; 2) explicitly dealing with the problems of currency of denomination; and 3) setting out a more general portfolio-balance model which does not make the small-country assumption. In addition, we use tests of Granger/causality to test the appropriateness of the small-country assumption for the case of Canada.

12. See Charles Pigott, "The Influence of Real Factors on Exchange Rates," Federal Reserve Bank of San Francisco **Economic Review** (Fall 1981).

13. See S.A.B. Page, "The Choice of Invoicing Currency in Merchandise Trade," **National Institute Economic Review** (November 1981). Page notes that invoicing some portion of exports and imports in both domestic and foreign currencies tends to smooth the adjustment to exchange-rate changes, and results in less severe J-curves than would result when all export transactions are denominated in the exporters' home currency.

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