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Real Dollar Exchange Rates under the Bretton-Woods and Floating Exchange-Rate Regimes

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The focus of the paper is on real exchange rates for the dollar over the period 1957 to 1985. Most such exchange rates followed an almost step-like pattern, showing relatively little movement in the late 1950s and 1960s, falling abruptly and then remaining low in the 1970s and finally in the 1980s rising back to levels close to those that prevailed initially. Contrary to much recent commentary, therefore, the period that appears different is not the last five years but the decade that preceded them. An important factor underlying this pattern of exchange-rate movement, according to results presented in the paper, was the behavior of monetary policy and, hence, inflation in the United States. What remains to be established is the precise mechanism linking money and real exchange rates and the (relative) strength of those links.

The commentary on floating exchange rates has been dominated by negative conclusions. On the one hand is the now considerable body of literature claiming that many of the important relationships posited by theory have not held up well empirically (*e.g.*, Meese and Rogoff, 1983, 1985). On the other is the widely voiced belief in a substantial dollar overvaluation during the course of the 1980s attributable to the effects of federal government budget deficits in the United States (*e.g.*, Williamson, 1983).

A potential problem with both sets of analysis, however, is that they focus on a relatively narrow data set, for the most part being confined to exchange rates for the major currencies and, more important, to the floating-rate period alone. In this paper, I report results of on-going research with an expanded body of data covering 11 industrial countries and the years 1957 to 1985.[1] Since this period encompasses both the floating-rate period and a substantial portion of the fixed-rate period that preceded it, I focus on real rather than nominal exchange rates.[2]

The longer temporal span of these data than those used in most other studies leads to an important descriptive finding. Variations in foreign vs. US dollar real exchange rates, on average and for most of the countries viewed individually, were dominated by two similar but largely offsetting movements, undergoing

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substantial declines in the early 1970s and then substantial increases in the early 1980s. The levels of real exchange rates thus exhibit an almost step-like pattern, with averages for the 1980s not very different from those for the late 1950s and the 1960s.

This pattern is similar to, but somewhat different in timing from, the pattern observed in real interest rates in the United States. One explanation advanced for the latter's behavior (Huizinga and Mishkin, 1985) associates it with changes in the behavior of inflation and, hence, monetary policy. Studies of exchange rates during inflationary episodes in other eras (Bernholz, 1982) and studies describing exchange-rate movements in other inflationary economies during the post-WWII era (Harberger, 1966) show temporal patterns of real exchange rates that are similar to those that I observe for real dollar exchange rates in this sample.

Empirical results presented in the paper contain evidence consistent with an inflation explanation. Left largely unexplained, however, is the precise mechanism through which inflation produces these effects on real exchange rates, though several possible and not necessarily mutually exclusive channels are discussed.

I. Real Exchange Rate Behavior

Figure 1 summarizes the average behavior of real exchange rates for the United States dollar over the period 1957 to 1984. In it, I have plotted the average of the logarithms of quarterly real exchange rate indexes for the 11 industrial countries shown individually in Figures 2 through 12.[3] Table 1 contains results of dummy variable regressions used to perform analyses of variance of these series.

In each instance, the real exchange rate is defined as the ratio of the foreign price of US goods to the foreign price of foreign goods. In logarithmic form it, therefore, corresponds to the deviation from purchasing power parity

$$\langle 1 \rangle \qquad q_t = e_t - (p_t - p_t^*),$$

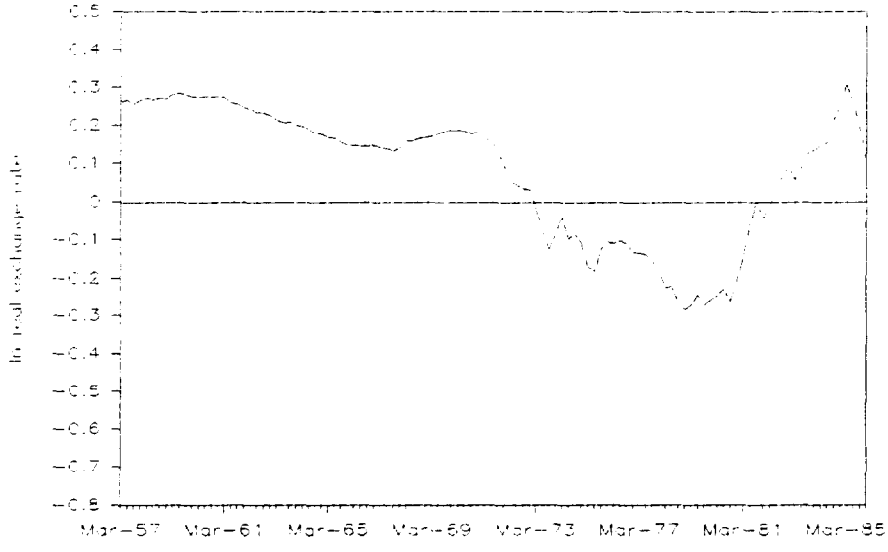

FIGURE 1. Average real dollar exchange rate.

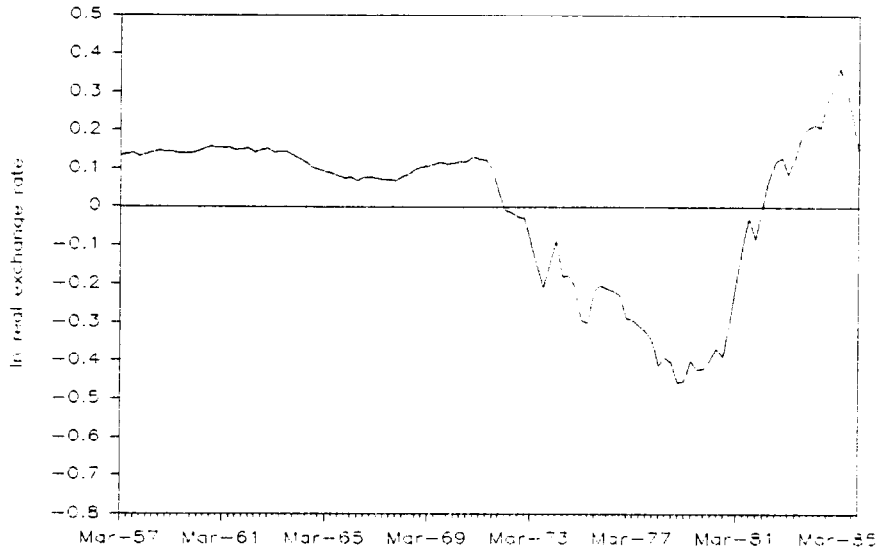

FIGURE 2. Belgium.

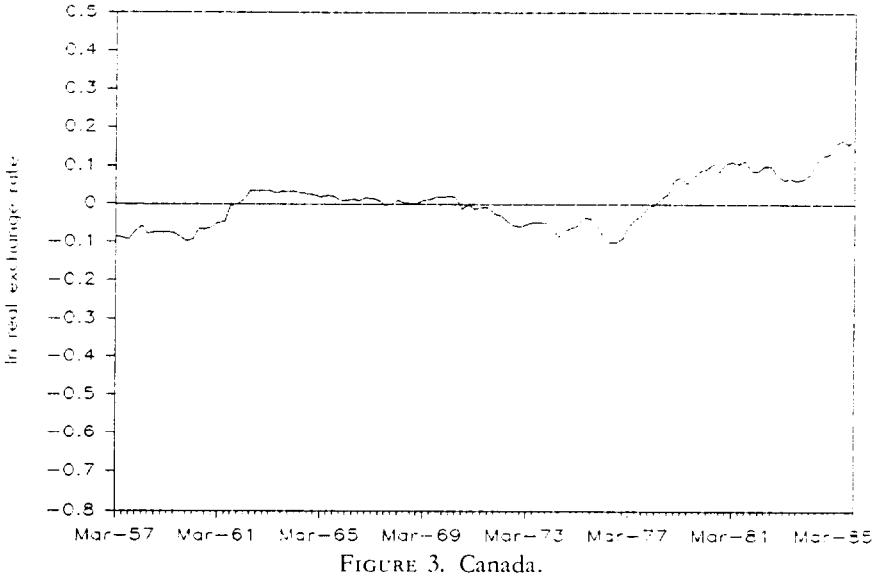

FIGURE 3. Canada.

where e is the logarithm of the foreign currency price of a United States dollar and p and p^* are the logarithms of the foreign and US price levels, respectively. In each instance, the base year of the index was 1970. Note, however, that the values of the logarithms of the indexes in 1970 are generally not zero since the estimates by Kravis, *et al.* (1978) of equilibrium price levels relative to the dollar in that year were used as adjustment factors.[4]

Let us focus on the index of the average real exchange rate first. The chart shows a slight downtrend in the average rate over the years 1957 to 1970, an abrupt decline during the following three years, a further downtrend between 1974 and 1980, with a dip in the late 1970s, and a rise thereafter to levels that are the same

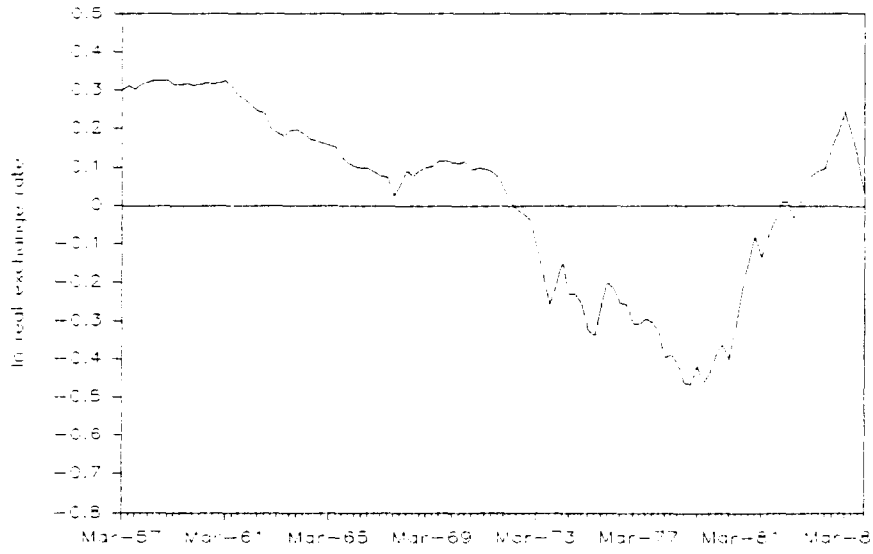

FIGURE 4. Denmark.

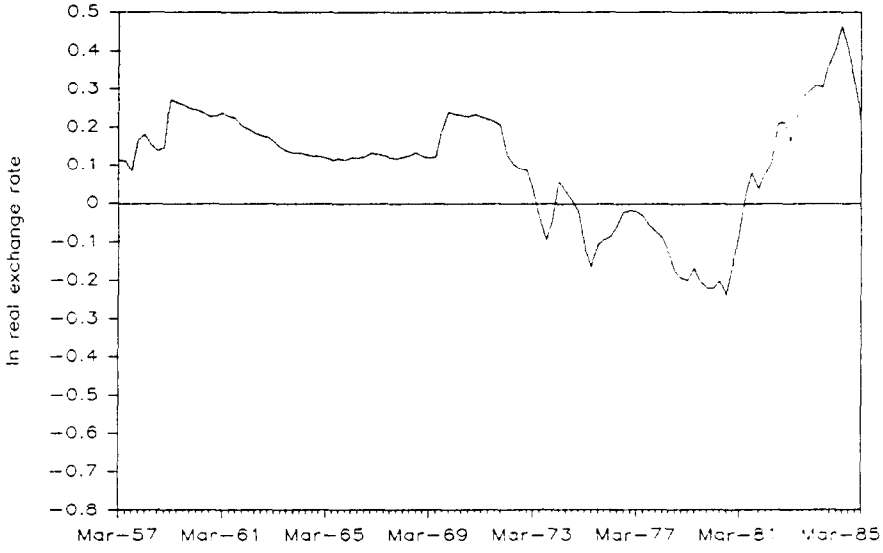

FIGURE 5. France.

or somewhat greater than those prevailing in 1970. Most of the individual series, with the exception of Canada, follow the same general pattern, though the magnitude and timing for several countries—Italy and the United Kingdom are noticeable in this regard—is somewhat different than for the others. The visual impression, therefore, is of three more or less distinct periods: the years up to the breakdown of Bretton Woods, the bulk of the 1970s, and the first half of the 1980s.

The regressions reported in Table 1 reinforce this picture. In each instance, the logarithm of the index was regressed on a constant and two dummy variables, one taking the value 1 for the periods 1957:I to 1972:II and 1981:I to 1985:IV and 0

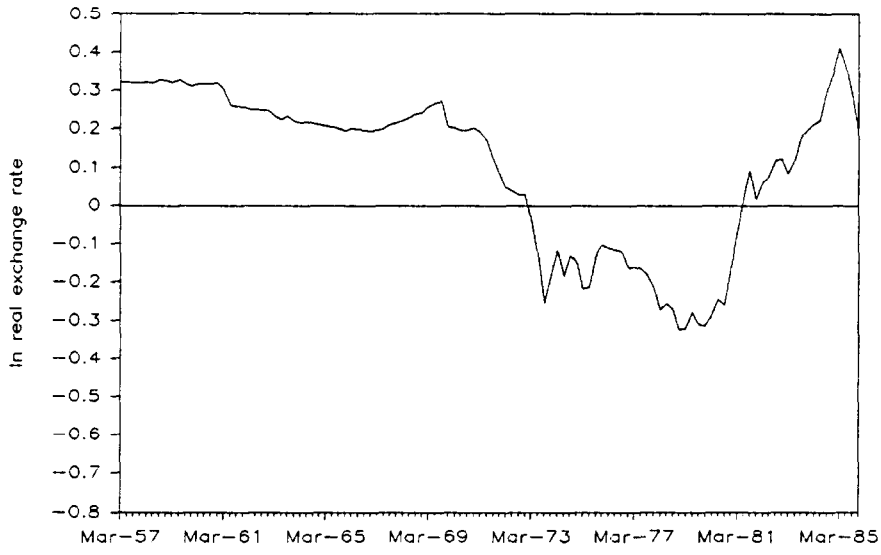

FIGURE 6. Germany.

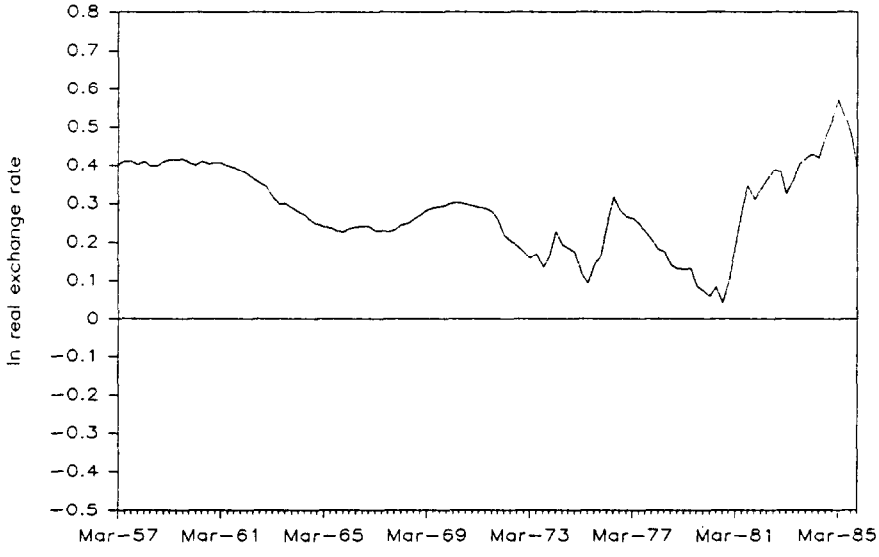

FIGURE 7. Italy.

otherwise, the other taking the value 1 for the period 1981:I to 1985:IV alone and 0 otherwise. The constant, therefore, is an estimator of the mean for the period 1972:III to 1980:IV; the algebraic sum of the constant and the coefficient of the first dummy is an estimator of the mean for the period ending in 1972:II; and the algebraic sum of the constant and the coefficients of both dummies is an estimator of the mean for the period from 1981:I on. The R^2s for these regressions, therefore, show the proportions of the total variation in the quarterly indexes due to the differences in these means. These are listed in the second to the last column in the table. In the last column, the R^2s from related regressions in which the second

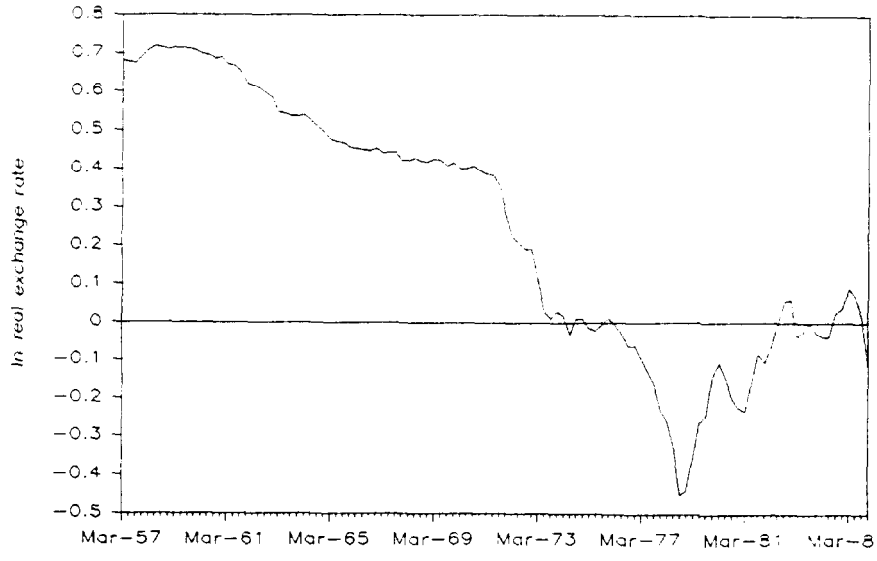

FIGURE 8. Japan.

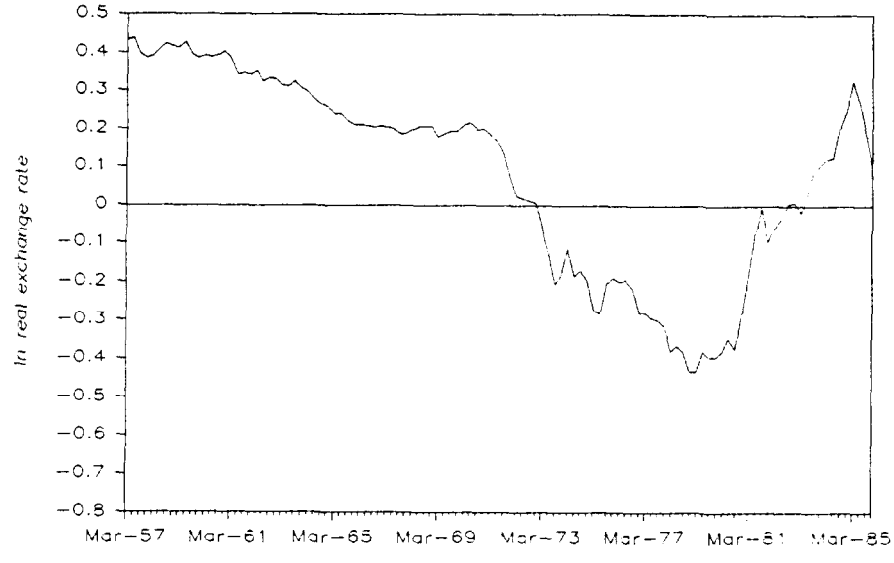

FIGURE 9. Netherlands.

dummy variable was omitted are listed. These show the proportions of the total variation accounted for by the difference between the means for the middle period and the means for the other two periods combined.

For the average real exchange rate index and for the indexes for most of the countries taken individually both sets of figures are substantial. The R^2s for the average index are 0.79 for the regressions with two dummy variables and 0.75 for the regressions with one dummy variable. The medians of these figures for the individual regressions are 0.78 and 0.66, respectively. Only in the cases of Canada and the United Kingdom are any of the figures much below 0.50.

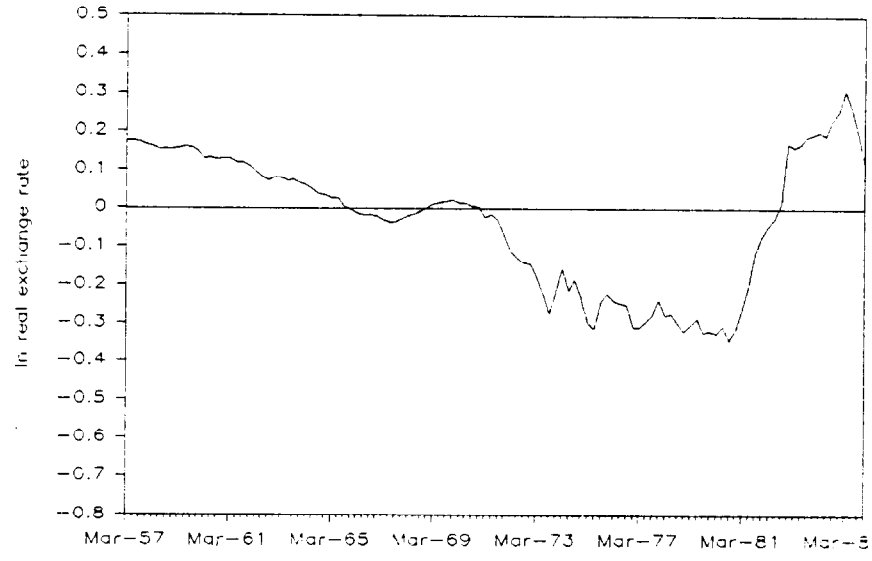

FIGURE 10. Sweden.

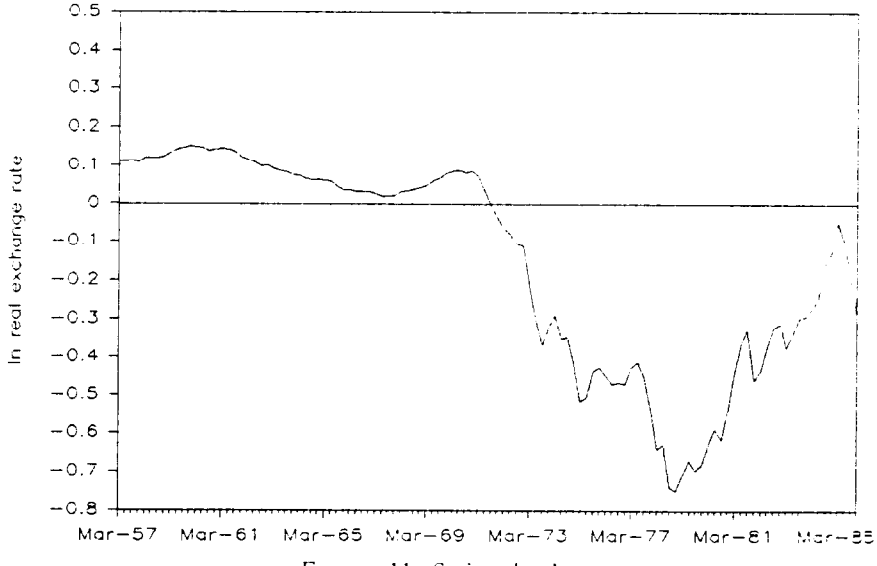

FIGURE 11. Switzerland.

One inference to be drawn from this descriptive analysis has to do with the range of possible explanations for exchange rate behavior during these years. The fact that the variations in almost all of the series are dominated by two movements suggests that any attempt to explain overall behavior will prove fruitless if it is incapable of accounting for those two major shifts.[5] The commonality of movements in the various countries, coupled with the lack thereof for Canada, the country most closely linked with the United States, suggests further that any such explanation will have to focus heavily on US economic factors.

A final point has to do with purchasing power parity. What we observe in these

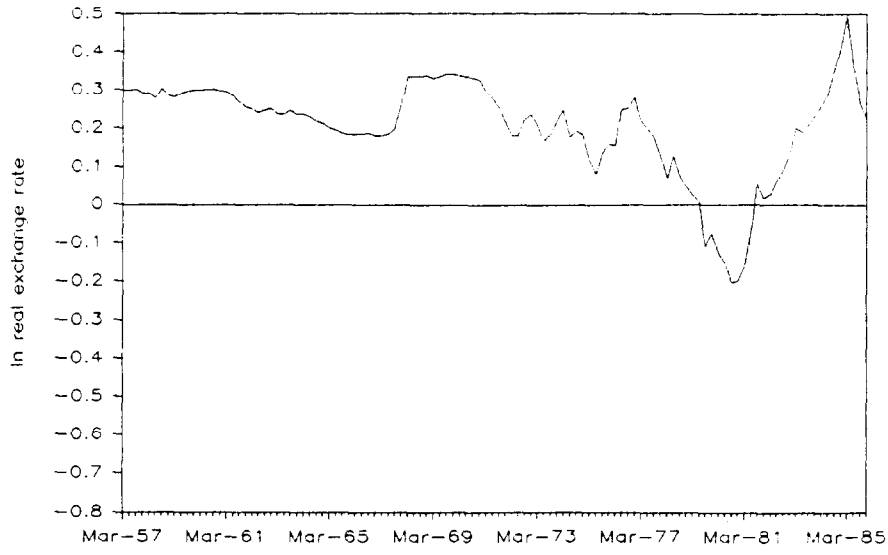

FIGURE 12. United Kingdom.

data are deviations from purchasing power parity over substantial periods of time, but over still longer periods, a tendency for changes in nominal exchange rates to converge towards differential rates of inflation and, surprisingly, an apparent tendency for the levels to converge towards our measure of the level of purchasing power parity.[6]

II. Two Competing Hypotheses

Most empirical studies of exchange rate behavior—real or nominal—have taken 1971 or, more often, 1973 as their starting point, the two dates being associated with the initial breakdown and final demise of the Bretton Woods system of fixed exchange rates, respectively. The authors of such studies typically find that the conventional models of exchange rate determination based on either the monetary or the asset-market approach do not fare well in explaining exchange rate movements over these periods.[7] Underlying the failure is a failure of the purchasing power parity condition (or its analogue in terms of relative excess supplies of money) to hold. A major reason is the behavior of the dollar in the early 1980s, one that the standard regression equations are unable to capture.[8]

One hypothesis views this increase purely in terms of the increase in the federal budget deficit in the United States (as conventionally measured).[9] 'Crowding out,' according to the argument, raises real rates of interest in the United States. This leads to a surplus on capital account, which, in turn, causes increases in real exchange rates for the dollar.

There are two sets of problems associated with this argument. One is the conflicting empirical evidence with regard to the links among deficits, real interest rates, and real exchange rates. The relationship between deficits and real rates of interest, as I read both the scholarly literature and the reactions of the bond market, is considerably weaker than commonly alleged.[10] By the same token, there is at

TABLE 1. Analysis of variance regressions: real exchange rates for the dollar, 1957:I to 1985:IV.

$$q_t = a_0 + a_1 D1,3 + a_2 D3 + e_t$$

Exchange rate	a_0	a_1	a_2	SEE	R_2^2	R_1^2
Average	−0.153	0.353	−0.102	0.080	0.793	0.748
	(11.233)	(20.801)	(4.982)			
Belgium	−0.276	0.391	0.014	0.095	0.787	0.786
	(17.030)	(19.351)	(0.525)			
Canada	−0.016	0.001	0.121	0.049	0.470	0.044
	(1.853)	(0.115)	(9.541)			
Denmark	−0.293	0.475	−0.155	0.111	0.783	0.726
	(15.465)	(20.157)	(5.439)			
France	−0.086	0.254	0.054	0.087	0.673	0.656
	(5.763)	(13.680)	(2.407)			
Germany	−0.187	0.424	−0.070	0.087	0.827	0.812
	(12.553)	(22.911)	(3.136)			
Italy	0.167	0.149	0.081	0.074	0.561	0.490
	(13.217)	(9.478)	(4.282)			
Japan	−0.100	0.626	−0.555	0.135	0.834	0.462
	(4.286)	(21.647)	(15.934)			
Netherlands	−0.260	0.535	−0.208	0.114	0.812	0.728
	(13.315)	(22.066)	(7.107)			
Sweden	−0.263	0.316	0.044	0.093	0.724	0.716
	(16.423)	(15.839)	(1.820)			
Switzerland	−0.479	0.555	−0.365	0.109	0.844	0.609
	(25.656)	(23.901)	(13.053)			
UK	0.107	0.156	0.082	0.108	0.294	0.240
	(5.816)	(6.789)	(2.953)			

Note: $D1,3$ is a dummy variable taking the value 1 for the periods 1957:I to 1972:II and 1981:I to 1985:IV and 0 otherwise; $D3$ is a dummy variable taking the value 1 for the period 1981:I to 1985:IV and 0 otherwise; R_2^2 is the coefficient of determination for the reported regression; R_1^2 is the coefficient of determination for a similar regression on $D1,3$ alone; absolute values of t-statistics are in parentheses beneath the coefficients.
Source: IMF, *International Financial Statistics*.

present little hard evidence showing strong links between either the one or the other and real exchange rates.

The second set of problems is statistical in a narrower sense. Proponents of the deficit explanation focus exclusively on the increase in real exchange rates for the dollar in the 1980s. As we have seen, however, any attempt to explain the time pattern of real exchange rates over a broader sample period has to account not simply for this one major movement but for the decline in the 1970s as well. By itself, the deficit argument is incapable of doing so. The US government budget deficit as a ratio of GNP was much higher on a period-average basis in the early 1980s than in the 1970s. But in the 1970s, the period of low real exchange rates for

the dollar, it was actually quite a bit higher than in the late 1950s and the 1960s. Over the years 1957 to 1970, the deficit-to-GNP ratio averaged 0.4 per cent. In the period 1971 to 1980, in contrast, the average was 1.8 per cent, much lower than the 4.3 per cent figure registered from 1981 to 1985 but over four times the average for the preceding period.

If deficits account for the increase in real exchange rates for the dollar in the 1980s, then something else must account for their decline in the 1970s. *A priori*, there is no reason to exclude there being two factors involved—the deficit in the 1980s and something else in the 1970s. Nevertheless, an hypothesis of this sort is virtually impossible to disprove: two explanations for two movements leaves no degrees of freedom.

For both sets of reasons, therefore, I turn to the alternative explanation alluded to earlier which views the dollar's behavior over this period as heavily influenced by inflation or, tracing the process back a step further, by the forces on the sides of both the demand for and the supply of money that determine inflation. This explanation, in principle, is capable of explaining both of the major moves in the dollar. Furthermore, it is consistent with outside evidence of several sorts.

One such type of evidence comes from studies of other key economic variables that exhibit temporal patterns similar to that observed for real exchange rates. Real income growth and the unemployment rate is the first example. Milton Friedman in his Nobel lecture (1977) attributed the upward trend in average rates of unemployment in industrial countries through the middle of the 1970s to the effect of price uncertainty on economic efficiency. He described this relationship between inflation and average unemployment rates as the mirror image of a similar but inverse relationship between inflation and average real growth rates. His 'tentative hypothesis' rationalized the two relationships along the lines of von Hayek's (1945) analysis of the informational role of prices and Gray's (1978) work on contracts. Friedman described these effects as intermediate term in nature, holding over long but not the longest period. As outside evidence to support these arguments, he cited the work of Harberger (1966) and Sjaastad (1974) on Latin American inflation.

A somewhat related argument with regard to real rates of interest on financial assets has recently been presented by Huizinga and Mishkin (1985). They explain the low real interest rates in the 1970s in the United States, the subsequent increases near the end of that decade and the higher average real rates experienced to date in the 1980s in terms of fluctuations in the rate of inflation. They provide only a bare outline of the mechanism linking inflation and real interest rates, but point to the existence of a similar inflation-related phenomenon in the early 1920s.[11]

Another body of literature that bears mentioning, is that dealing with inflation and real returns on equities. Cagan (1974), examining stock prices for a sample of 24 countries over the period 1939 to 1969 and several smaller longer-term international samples, the earliest of which began in 1856, found extremely long lags—a median lag of a decade and a half—before real returns on equities return to pre-inflationary levels. Fama and Gibbons (1982) and others (*e.g.*, Mandelker and Tandon, 1985) point to similar phenomena in later data. These authors claim, however, that the link between the two is the anticipated real growth rate. A fall in the anticipated real growth rate, other things the same, leads via its continuing effect on the demand for money to an increase in inflation. Market participants, meanwhile react to this decrease in the anticipated real growth rate by bidding equity prices down.

The other type of evidence has to do with exchange rates themselves. Harberger's Latin American work cited above is one source of data consistent with those I have presented. Real exchange rate estimates contained in his 1966 paper for several Latin American countries experiencing high inflation show a temporal pattern similar to the pattern for real dollar exchange rates described above.

Bernholz in a monograph dealing explicitly with this issue examines data for the 1970s (through the year 1979) as well as for a wide range of historical experience. In each of the earlier episodes—Sweden in the eighteenth century, France during its revolution, Russia near the start of the nineteenth century, the United States during the Civil War and the hyperinflationary European economies and France during the 1920s—he documents exchange rate behavior similar to that of the 1970s. In every instance, the depreciation of the inflationary country's exchange rate for a time considerably outpaced its rate of inflation. The real exchange rate, therefore, fell and remained low for a protracted period, ranging from two years or so in the case of the hyperinflations to roughly a decade in the case of Sweden. Bernholz rationalizes these results in terms of a Dornbusch-type model of exchange rate overshooting.

III. Empirical Results

A model that can be used as a guide for the empirical analysis of the effects of the monetary factors and the other factors of potential importance for the behavior of real exchange rates is a modified version of the 'sticky-price' monetary model, in which, following Stockman (1980) the equilibrium real exchange rate can vary.

To illustrate the model, let us begin with a long-run equilibrium relationship, in which, in the absence of changes in the equilibrium real exchange rate, purchasing power parity holds:

$$\bar{e}_t = \bar{p}_t - \bar{p}_t^* + \bar{q}_t, \tag{2}$$

where $\bar{e}_t$ is the (long-run) equilibrium nominal exchange rate, $\bar{p}_t$ and $\bar{p}_t^*$ are the equilibrium domestic and United States price levels, $\bar{q}_t$ is the equilibrium real exchange rate, and all variables are logarithms.

If we assume for simplicity that $\bar{q}_t$ only changes in response to unexpected developments, we can write an expression for the expected change in the nominal exchange rate as a function of the gap between its actual and long-run equilibrium levels and the difference in the expected rates of change in the long-run equilibrium price levels, which we will represent by $\bar{\pi}$ and $\bar{\pi}^*$, respectively:

$$E[de]_t = \theta(e_t - \bar{e}_t) + \bar{\pi}_t - \bar{\pi}_t^*, \tag{3}$$

where $E[de]_t$ denotes the expected change in the log exchange rate between t and $t+1$.

Assume that uncovered interest parity holds so that

$$E[de]_t = i_t - i_t^*, \tag{4}$$

where i and i^* are the domestic and the United States nominal interest rates, respectively.[12] Now combine ⟨3⟩ and ⟨4⟩ and the result is:

$$e_t - \bar{e}_t = -\frac{1}{\theta}[(i_t - \bar{\pi}_t) - (i_t^* - \bar{\pi}_t^*)] \tag{5}$$

Finally, take the difference between ⟨1⟩ and ⟨2⟩ to arrive at an expression for $e_t - \bar{e}_t$ in terms of actual and equilibrium real exchange rates, combine that with ⟨5⟩ and the result is

$$\langle 6 \rangle \qquad q_t = \bar{q}_t - \frac{1}{\theta}[(i_t - \bar{\pi}_t) - (i_t^* - \bar{\pi}_t^*)] + (\bar{p}_t + p_t) - (\bar{p}_t^* - p_t^*).$$

The actual real exchange rate (the deviation from purchasing power parity) is thus a function of three sets of factors—the equilibrium real exchange rate, the real interest rate differential and the gaps between actual and equilibrium price levels in the two countries.[13]

The first is generally posited to depend upon real variables alone. The last depends upon monetary factors—the supply of and demand for money in the two countries, the temporal patterns of their movements and expectations with regard to both.[14] The second depends upon a mixture of the two.

Faster money supply growth in the United States, for example, with sticky prices and other things the same will open a (negative) gap between the equilibrium and the actual price level. At the same time, it will also lead to a decrease in real interest rates in the United States relative to those abroad. As a result, the nominal exchange rate measured as we have here—the foreign currency price of a dollar—will decline both in absolute terms and relative to the unchanged actual price levels. As real interest rates return to their old levels and the actual price level approaches the now higher equilibrium price path these effects on real exchange rates will be reversed. The deviations from purchasing power parity will be eliminated.

What we have ended up with then is an equation that relates the actual real exchange rate to a group of proximate determinants that are consistent with a broad-based theoretical approach, the more so if we allow risk to enter in. The equation, however, is theoretically incomplete and from several standpoints deficient. One I have already discussed—the need to specify the factors that influence these proximate determinants and how they do so.

Involved here are several related questions—the structural model that determines the variables on the right hand side of ⟨6⟩, the expectations generating process and the issue of the relevant time horizon. Mussa, in a series of papers (1982, 1984, and 1985), has discussed these issues extensively. In the several variants of the basic model Mussa develops, the nature of exchange-rate disequilibrium is spelled out in considerable detail. A key element is the relationship between the actual and the long-run equilibrium price level through time. The basic model, therefore, provides an open-economy analogue to and is consistent with the wide range of adjustment processes deemed possible in theoretical discussions of price-level adjustment in closed-economies (*e.g.*, Friedman, 1969).

Within this context Mussa shows that what is important are past unanticipated movements in the exogenous variables. Real exchange rates deviate from their long-run equilibrium values in response to past shocks in the monetary variables (both supply and demand) that determine price levels or in the real variables that determine the long-run equilibrium real exchange rate.[15] These shocks, moreover, have a future dimension to them absent in the typical model underlying equation ⟨6⟩. A shock to the level of today's domestic money supply, for example, leads to a revision in expectations with regard to the entire future time path of the price level.[16] The model, therefore, can be used to rationalize behavior in organized

markets, such as the spot foreign exchange market, in which news with regard to variables that will only have visible economic effects in the future affect prices in the market in the present.

These features of Mussa's approach are all relevant to the empirical applications that follow. The one omission from the model that bears mentioning, since it is also of potential importance empirically, is with regard to the overall formation of economic policy (the policy regime) and its relationship to economic participants' expectations.

To estimate a regression equation based upon equation ⟨6⟩, I used annual data for the seven of the 11 countries for which there were independent estimates of purchasing power parity in 1970. These regressions took the general form

$$\langle 7 \rangle \qquad q_{jt} = b_0 + b_1 y_{jt} + b_2 op_{jt} + b_3 m_{jt} + e_{jt},$$

where y is the logarithm of relative levels of real *per capita* income (scaled via the Kravis *et al.* estimates for 1970), op is the logarithm of the openness variable (the relative share of exports plus imports in nominal income), m is the relative growth rate of money, e is the error term, j denotes the country and t the year.[17] In certain of the regressions, I also included lagged or leading money terms and dummy variables for either the periods identified earlier or for the individual countries. Results are reported in Table 2.

The two real variables included in the regressions were those that have proven useful in past studies. Real *per capita* income has had particularly widespread use (*e.g.*, Kravis and Lipsey, 1983). High-income countries, according to the argument, have higher productivity in general than low-income countries and higher productivity in tradable goods industries in particular. With prices of tradable goods tending to be equalized among countries and wage rates tending to be equalized among industries within countries, these productivity differentials translate into higher average wages in high-income as opposed to low-income countries and hence higher price levels. The sign of the coefficient b_1 should, therefore, be negative.

Greater openness can be expected to have a positive effect on other countries' price levels relative to that of the USA and hence a negative effect on their real dollar exchange rate. Kravis and Lipsey trace this influence of openness on the price level through factor markets and thence the market for services. Melvin and Bernstein (1984) view openness as decreasing the divergence between tradable goods prices and the overall price level. In both instances the hypothesized sign on b_2 is negative.

The first regression reported in the table only includes real variables. These, however, account for a substantial fraction of the variation. The $\bar{R}^2$ is 0.48 and the coefficient on real income is roughly 12 times its standard error. One problem is that the coefficient of the openness variable is of the wrong sign. A further problem is in the pattern of residual variation in the regressions.

In the second row, I report the results of a regression in which dummy variables for the periods 1973–79 and 1980–84 are included as additional regressors. Both variables are highly significant. Furthermore, they trace out a pattern similar to that observed in the analysis of variance regressions reported in Table 1. Hence, while real variables—relative real incomes, actually—account for a substantial fraction of the overall variation in the sample, they do not capture fully the two major common temporal shifts in real exchange rates identified earlier.

TABLE 2. Regressions for real exchange rate: 7 countries, 1960–83[a]

Period	Variables[b]											SEE	$\bar{R}^2$	F^c
	Constant	*yr*	*op*	m_{t+2}	m_{t+1}	m_t	m_{t-1}	m_{t-2}	m_{t-3}	*D*2	*D*3			
1960–83	−0.282	−0.741	−0.043									0.164	0.457	
	(5.670)	(11.911)	(1.700)											
	0.024	−0.504	−0.031							−0.266	−0.144	0.127	0.674	
	(0.482)	(9.198)	(1.477)							(10.555)	(4.716)			
	−0.246	−0.696	0.034			0.724	0.190	−0.308	−0.552			0.160	0.482	2.980
	(4.924)	(8.609)	(1.261)			(2.694)	(0.736)	(1.192)	(2.805)					
	0.028	−0.416	−0.024			0.765	0.213	−0.141	−0.309	−0.265	−0.109	0.123	0.696	4.028
	(0.574)	(6.181)	(1.073)			(3.602)	(1.047)	(0.703)	(1.514)	(10.742)	(3.425)			
	−0.259	−0.574	0.054		0.904	0.266	−0.144					0.158	0.496	5.193
	(5.344)	(7.210)	(2.129)		(3.225)	(0.979)	(0.572)							
	0.022	−0.317	−0.009		0.881	0.434	−0.001			−0.269	−0.092	0.117	0.723	10.635
	(0.460)	(5.014)	(0.461)		(4.215)	(2.091)	(0.006)			(11.530)	(3.021)			
1960–82	−0.242	−0.567	0.044	0.808	0.744	0.322	−0.122	−0.412	−0.256			0.151	0.554	5.509
	(4.926)	(6.766)	(1.723)	(2.817)	(2.517)	(1.173)	(0.471)	(1.549)	(0.986)					
	0.045	−0.021	−0.304	0.641	0.723	0.352	−0.096	−0.239	−0.043	−0.260	−0.141	0.110	0.764	7.521
	(0.994)	(1.021)	(4.669)	(3.065)	(3.348)	(1.731)	(0.501)	(1.230)	(0.224)	(11.712)	(4.472)			

Note: [a]The countries making up the sample were Belgium, France, Germany, Italy, Japan, the Netherlands, and the United Kingdom.

[b]The symbols *yr*, *op* and *m* represent the logarithm of relative real *per capita* income levels, logarithm of openness (the ratio of exports and imports to GNP for the foreign country relative to the ratio for the United States) and the relative rate of monetary growth. The first two appear in the regressions in contemporaneous form; the last appears as indicated, with various leads and lags. The symbols *D*2 and *D*3 represent dummy variables for the periods 1973 to 1979 and 1980 on, respectively. Figures in parentheses are absolute *t*-values.

[c]In each instance, the *F*-ratio tests the null hypothesis that the coefficients of the monetary variables are all zero. All imply significance at the 0.05 level or better.

Sources: IMF, *International Financial Statistics*; Kravis *et al.* (1978).

Monetary variables go part of the way in explaining these movements. Results of regressions including contemporaneous and lagged values of relative money supply growth are reported in the next two rows. In both instances these variables taken as a group are statistically significant at conventional levels. Furthermore the pattern of coefficients—positive, then negative with the sum approaching zero—is consistent with these variables serving as a proxy for (unanticipated) monetary shocks.

Adding the period dummies, however, again results in a statistically significant and substantial decrease in the residual variation. These monetary variables, therefore, do not completely account for the two large common temporal movements in the series. One problem here may be the crudeness of the proxies that I have used.

For one thing, there has been no allowance for differences in the behavior of money demand among countries. More important, I suspect, are problems of an expectational nature. No attempt has been made to distinguish between anticipated and unanticipated movements. Correspondingly, to the extent that these variables implicitly incorporate expectations, they do so purely in terms of past values of money supplies. They ignore any information that might be contained in the variables that ultimately influence money supplies (or demands).

Where this procedure is particularly liable to break down is in the neighbourhood of changes in policy regimes.[18] One can argue that two such changes occurred during this sample period. The first was associated with the breakdown of fixed exchange rates and the move to floating rates in the early 1970s. This was international in scope.[19] The second, which was primarily a United States phenomenon, was associated with the announced changes in Federal Reserve operating procedures in 1979, and the Reagan election in the following year.[20] At both junctures, we might, therefore, expect past values of money to become misleading indicators of anticipated values and for shifts in the estimated equations to become particularly apparent.

There are several kinds of evidence that are consistent with this belief. Most important are the results of further regressions in which future values of the money variable are included as regressors. These results, which are reported in rows five through eight of Table 2, show an improvement in goodness of fit and a substantial increase in the F-values for the test of the null hypothesis that the coefficients of the money terms taken as a group are zero.

Further evidence is provided by comparing real exchange rates for the countries that were identified as different—Canada, Italy, and the United Kingdom—with real exchange rates for the other countries. Canada with the closest policy links to the United States shows the least variability in its real exchange rate and the greatest difference *vis-à-vis* the other countries. The one noticeable movement in the Canadian versus United States dollar rate occurs in the late 1970s, when links between the two countries appear to have been temporarily altered.

Real exchange rates for Italy and the United Kingdom, the two countries with the most expansive policies and the highest inflation rates, show much less of a decline than those for the other countries in the first half of the 1970s and by 1975 were back at roughly their 1970 levels.

After 1975, both real exchange rates—like those of all countries except Canada—again declined. The decline in the real pound price of the dollar, however, was particularly dramatic after 1979, a feature of the data that is consistent with the

hypothesis that market participants initially foresaw and then increasingly reacted to the Thatcher election and the substantial reduction in British monetary growth that ensued.[21]

IV. Conclusions

The paper began with an analysis of the longer-term pattern of real exchange rates, identifying two substantial and largely offsetting movements in most real exchange rates for the dollar during the past three decades that in a statistical sense have dominated the behavior of these series.

The second—the upward movement in real dollar exchange rates at the start of the 1980s—is well known and has been widely discussed in recent years, both in the literature attempting to explain exchange rate behavior and as part of the broader literature concerned with economic policy in general and fiscal policy in particular. The first—the decline in real exchange rates in the early 1970s—though widely discussed during and immediately after the event, has been almost completely ignored in assessment of exchange rate behavior in the 1980s.

The question is whether the two movements are related and hence whether the overall behavior of the series is of economic significance or whether the two are completely separable events and the apparent pattern in the data no more than a statistical artifact.[22] Crucial to the government-deficit explanation of real exchange rate behavior in the 1980s is the belief that they are separable: the deficit explanation can be applied to the episode in the 1980s but is incapable of explaining the difference in average levels of real exchange rates in the late 1950s and 1960s relative to those in the 1970s.

The explanation I have advanced, in contrast, views the two movements as closely related and largely part of the same process. Monetary policy in the United States became increasingly more expansive during the approximate decade and a half beginning in the middle of the 1960s. The Bretton-Woods system of fixed exchange rates broke down in the early 1970s as a result and real dollar exchange rates fell, in part, most likely, because of past monetary excesses in the United States, in part because of changed beliefs with regard to the extent to which monetary policies in the United States and in foreign countries would diverge in the future.

In the early 1980s, the reverse occurred. Monetary policy in the United States changed and was perceived to have done so by economic participants. Exchange rates for the dollar, therefore, rose in both nominal and real terms.[23]

Evidence has been presented that is consistent with this characterization of exchange rate behavior. This evidence revolves around regression results for a time series of cross-country data for the period 1960 to 1983. It also includes comparison of differences in exchange rate behavior among groups of countries. Likewise consistent with this explanation is the behavior of other real variables during these years and of real exchange rates during other inflationary episodes. These analyses are pertinent to the issues of the seemingly anomalous long-lived nature of inflation-related effects on exchange rates and on the other variables both in general and during these years in particular.

Left unanswered, however, are several important questions. These include issues having to do with the formation of expectations, the relative contribution of real

factors to real exchange rate movements and the channels through which monetary factors operated.[24]

The simple theoretical model underlying equation ⟨6⟩ views the contribution of monetary factors to real exchange rate movements in terms of differences in the timing of the response of exchange rates and price levels to shocks and the resultant overshooting of the nominal exchange rate. Future disequilibria play no explicit role. In a more complete formulation of the model, such disequilibria do matter. In neither, however, is there any possibility for longer-run non-neutrality of money of the type described by Friedman in his analysis of the unemployment–inflation relationship. Non-neutralities with regard to asset prices and asset returns over long periods seem to me to be a distinct possibility and, indeed, provide a way to explain the behavior of real returns on both stocks and bonds during the 1970s. Like the other questions referred to above, this one clearly bears further investigation.[25]

Notes

1. Also see Lothian, forthcoming.
2. The two regimes have substantially different implications with respect to the behavior of nominal exchange rates and monetary policy. The Lucas critique, therefore, applies. Examining real exchange rates is one way to alleviate some of these problems.
3. The alternative to this measure would be one of the various trade-weighted indexes. Data for such indexes are, however, only available for part of this sample period, beginning in 1970 at the earliest. As a result, they provide little insight into either the pattern of real exchange rate movements within the Bretton-Woods period or between that period and the period of floating rates.
4. They estimate foreign vs. United States equilibrium price levels for 1970. I extrapolated these measures backward and forward using the cost of living indexes published by the International Monetary Fund (IMF) to obtain continuous indexes of purchasing power parity.
5. The substantial decline in real exchange rates in the early 1970s appears to have been totally ignored. Most of the analyses I have seen take 1973 or thereabouts as their starting point. Typical of this approach is the considerable number of studies of and other commentary on dollar 'overvaluation' in the 1980s. Most use the percentage change in the real exchange rate between some point in the middle to the end of the 1970s and some point in the early 1980s as a measure of such overvaluation. The implicit assumption is that the initial point in the 1970s is one of equilibrium.
6. The recent paper by Davutyan and Pippenger (1985) contains interesting evidence in this regard. The authors compare the behavior of nominal exchange rates relative to purchasing power parity in the 1970s with similar behavior in the 1920s. They show that purchasing power parity performed tolerably well in the 1970s, in the sense that the standard errors in (logarithmic) purchasing power parity equations for the 1970s are roughly equal to those obtained in investigations of countries experiencing moderate rates of inflation in the 1920s. The belief to the contrary is rooted in comparisons of R^2s for relationships estimated for countries experiencing hyperinflation in the 1920s with those estimated for the 1970s. The R^2s are a good deal higher, but so also are the standard errors of estimate.
7. Meese and Rogoff (1983) reach this conclusion in a comparison of the predictive power of such models relative to a naive (random-walk) model over the period 1973 to 1981. Their later (1985) paper contains largely corroborative results for a sample extending through June 1984.
8. For a sample period beginning in 1974 and ending in mid-1981, Frankel (1984) documents the breakdown of exchange rate equations based on both the monetary and the portfolio balance model when data for the 1980s are added. To ascertain the causes of the problem, he employs proxies for shifts in the demand for money and for real variable induced shifts in the real exchange rate. He concludes that the two types of factors were of roughly equal importance in explaining differences in real exchange rate behavior between the 1970s and the 1980s.

9. A major problem with these measures is their exclusion of the government's capital gain on their outstanding bond liabilities as a result of inflation. See the discussions in Siegel (1979), Cagan (1981), and Darby and Lothian (1983).
10. A number of studies have found little or no influence of deficits on interest rates. See, for example, Plosser (1982) and Evans (1985) and the references cited therein.
11. Huizinga and Mishkin construct a measure of the *ex-ante* real rate of interest on one-month treasury bills. They attribute the sharp increase in this measure, the date of which they set in November 1979, to a shift in the monetary regime towards less inflationary policies. They construct comparable measures using commercial paper for the period 1916 to 1927 and attribute the substantial increase in this measure beginning in June 1920 to a deflationary regime change following the end of the First World War.

    It is interesting to note that real sterling exchange rates for the dollar in the early 1920s also rose substantially. The sterling–dollar purchasing power parity index constructed by Friedman and Schwartz (1963, pp. 769–770) declined 14 per cent following the outbreak of war in Europe in 1914, remained at more or less the same level continually through 1919, and then increased sharply in 1920. For the period 1920 to 1924 it averaged 14 per cent higher than during the previous five years.
12. The model can be expanded to allow for risk. In this case, the expected change in the exchange rate equals the nominal interest-rate differential plus the risk premium. The latter, then appears as an additional term in an expanded version of equation ⟨6⟩ derived below. See Hooper and Morton (1982) and Frankel (1983).
13. The first two sets of terms within the brackets are not real interest rates in the totally conventional sense. The nominal rates that enter equation ⟨4⟩ are one-period rates while the expected inflation rates are long-term equilibrium rates. In effect, therefore, we have a combination of influences — those due to (short-term) real interest rates and those due to the term structure of either interest rates or inflation rates.
14. This description requires qualification. Real variables (*e.g.*, real income growth) enter the demand for money function. In this sense, both monetary and real variables affect the price level.
15. As stated in the previous footnote, the separation is not complete due to the influence of real variables on money demand. An additional influence is that of the equilibrium real exchange rate on the nominal exchange rate.
16. These shocks enter with weights that decline geometrically going forward in time in a fashion analogous to the discounting of future income streams in computing present values.
17. As income variables, I used either GDP or GNP depending upon the country. Exports and imports were defined on a national income accounts basis. Money was defined as M1 for all countries except the United Kingdom, for which, following Darby and Lothian (1983), I used the monetary base. The sources of all of these data were IMF publications and companion tapes. Note that the monetary data are year-end.
18. Expectations of such an event may be an important factor. Economic participants may substantially alter the probability they attach to such an event well before it occurs. See Klein (1975) for a discussion of the shift in monetary policy in the United States prior to the actual move to floating exchange rates and market participants' adjustment to that shift. The paper by Cooley, *et al.* (1982) contains a general discussion of regime changes in an explicitly probabilistic context.
19. Lothian (1985, 1986) provides evidence with regard to the effects of this change in monetary policy and inflation internationally.
20. The two years following the Reagan election were on average a period of tighter policy than in the late 1970s. Given the extreme variability in monetary growth over shorter periods, this fact may have only gradually been recognized. This tighter policy coupled with deregulation in banking and the resultant move to interest payments on transactions deposits apparently has had feedback effects on the demand for money. Some of the increase in recorded rates of M1 growth for the period beginning in 1982 has, therefore, most likely been offset. Given this higher average rate of monetary growth since late 1982, however, it is probably premature to view the policy regime as having undergone a permanent change.
21. For a discussion of British monetary policy following the Thatcher election see Darby and Lothian (1983).
22. If the logarithms of real exchange rates followed a random walk, we would expect to see patterns of movement similar to those illustrated by the charts. There is evidence (*e.g.*, Darby, 1983) that real exchange rates can be approximately so described. As Gould, *et al.* (1978) point out in a different context, though, knowing that the real exchange or any other variable (their concern is

velocity behavior) can be described in terms of a particular time-series representation in no way precludes our investigating the nature of the shock involved or the relationship between the series in question and other variables of interest. In this regard also see the discussion of price level behavior in Gandolfi and Lothian (1983).

23. The substantial decline in real exchange rates for the dollar since February 1985 may provide an additional degree of freedom. To date, however, the episode still appears to be in progress and is consistent with monetary as well as other explanations of exchange rate behavior.
24. A particularly interesting set of questions concerns the relationships among real rates of interest, real exchange rates, real income growth, and investment. One argument that has been made is that an investment boom in the 1980s engendered by tax changes increased real rates of interest and that these increases in turn increased real exchange rates for the dollar. Meese and Rogoff (1985), however, present evidence of differences in the time-series processes generating real exchange rates and real interest rates, thus suggesting the lack of a simple relationship between the two sets of variables.
25. The standard theoretical presentations assume neutrality. Non-neutrality might, however, be rationalized along the lines of a shift in the terms of trade, the efficiency of the United States as a producer of world monetary services being reduced in the 1970s by increased uncertainty with regard to the path that US price level would follow. See Klein (1979) for a discussion of the international monetary role of the United States.

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