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THE DOLLAR EXCHANGE RATE AS A LEADING INDICATOR FOR AMERICAN MONETARY POLICY

by

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ABSTRACT

In order to stabilize the U.S. price level, what is the most appropriate leading indicator for American monetary policy?

Under fixed exchange rates in the 1950s and 60s, the U.S. monetary system was relatively well insulated from foreign financial influences. Consequently Milton Friedman's doctrine of 'domestic monetarism' was valid: growth in the U.S. domestic money supply was a good predictor of future fluctuations in the dollar prices of U.S. goods and services.

But under floating exchange rates and the more open U.S. economy of the 1970s and 80s, the domestic monetarist model breaks down: U.S. M1 by itself fails to track the now much greater cyclical fluctuations in the American price level. However, when the (floating) dollar exchange rate is entered as an additional explanatory variable in the statistical regression equations, it provides excellent predictions of inflation or deflation within the American Economy a year to two hence.

Several related explanations are offered. Fluctuations in the forward-looking dollar exchange rate reflect changing expectations of inflation in the future, and in the effective demand for U.S. money in the present. International commodity arbitrage, in the now more open U.S. economy, affects domestic dollar prices slowly but eventually quite strongly. And changes in money growth in other industrial countries are inversely related to the strength of the dollar in the foreign exchanges, and directly related to worldwide inflationary or deflationary pressure.

Unlike other central banks, the U.S. Federal Reserve System has not responded systematically to pressure in the foreign exchanges. Over the past decade and a half, this fundamental asymmetry in the operation of the world dollar standard has amplified the cycle of inflation and deflation experienced by the world in general, and by the U.S. economy in particular.

THE DOLLAR EXCHANGE RATE AS A LEADING
INDICATOR FOR AMERICAN MONETARY POLICY

In his 1967 presidential address to the American Economic Association, Milton Friedman usefully distinguished what monetary policy can and cannot do. The central bank can't be expected to achieve sustained control over real variables such as output or unemployment. Nor in free financial markets can it succeed, other than temporarily, in pegging interest rates.

More positively, Friedman suggested that "of the various alternative magnitudes it (the central bank) can control, the most appealing guides for policy are exchange rates, the price level defined by some index, and the quantity of some nominal monetary total ... . Of the three guides listed, the price level is clearly the most important in its own right" (page 108).

Friedman deemed exchange rates to be the least desirable guide for the United States of the 1960s. "Far better to let the market, through floating exchange rates, adjust to world conditions the 5 percent or so of our resources devoted to international trade while reserving monetary policy to promote the effective use of the other 95 percent" (page108). And this intellectual support for an inward-looking monetary policy remains dominant among American macroeconomists in the significantly more open U.S. economy of the present day.

Though differing over monetary strategy--whether exchange rates should float and whether the rate of growth in domestic money should be fixed--let us adopt Friedman's same basic objective. <u>The long run goal of monetary policy is to stabilize the purchasing power of the national</u>

money, while avoiding short-run cycles of inflation or deflation.

Unfortunately, the central bank has no direct means of stabilizing broad price indices such as the GNP deflator, producer price index (PPI), or the consumer price index (CPI). Proposals have been advanced to stabilize much narrower price indices by the monetary authority directly intervening in markets for a few homogeneous primary commodities (Graham, 1942; Hart, 1976),[1/] or simply promulgating such a commodity price index to be the standard of value (Hall, 1983). But these proposals turn out to be impractical or undesirable (Friedman, 1951; McKinnon, 1979).

So in practice central banks intervene only in financial markets, in domestic bonds or foreign exchange, to determine the domestic money supply and--eventually--the prices of goods and services. And Friedman correctly identifies the fundamental problem with this indirect

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1/ Proposals for the United States to return to a gold standard are not easy to classify.

If the U.S. unilaterally adopts a gold standard at some fixed parity, this fails to guarantee stability of the U.S. price level in terms of a broader commodity price index or guarantee stability of exchange rates with major trading partners. The price of foreign goods could still fluctuate widely in dollar terms. Indeed, without (symmetrical) monetary adjustments by other countries, an "equilibrium" gold parity would be difficult for the U.S. by itself to maintain.

On the other hand, if all the major countries agree to go back to gold simultaneously, then proper monetary coordination among them could, conceivably, maintain fixed exchange rates and a common price level. However, international monetary coordination could be achieved without a gold cover--see the last section of this paper and McKinnon [1984].

Even if gold parities could be mutually established across several countries, a gold standard system would leave no discretionary mechanism for dealing with worldwide inflation or deflation--depending on what the monetary demand for gold turned out to be. And the demand for gold would be particularly unstable during the transition period when major countries were deciding on whether or not to reestablish gold convertibility.

approach: monetary actions taken today need not affect the price level for some months or years hence. While interest rates and exchange rates in financial markets react quickly to new money issue, goods markets react sluggishly.

Consequently, information from the national income accounts on the current state of business--inflation or deflation, strength or weakness --can be a treacherous monetary indicator. Overreacting to current deflationary pressure (knowledge of which is itself only available with a considerable lag), the central bank might increase the money supply unduly and cause an excess demand for goods, price inflation and cyclical instability in the future.

The problem can be recast into one of balancing the demand for and supply of domestic money at the existing price level. How can the central bank judge when the current stock of nominal money--with ongoing and suitably controlled growth--provides just those real balances that people wish to hold into the indefinite future on the (correct) expectation that the price level won't change? Meanwhile, interest rates and possibly exchange rates change continually and quickly in response to shifting money-market conditions.

In this paper, two approaches towards signalling--and resolving this most basic problem of monetary control--are analyzed and tested empirically for the United States. The first is Professor Friedman's, what I shall call the 'domestic monetarist' position, which relies purely on domestic monetary indicators. The second takes a more open-economy approach by utilizing additional information from the dollar exchange rate and movements in foreign money supplies.

Domestic Monetarism and the Insular Economy

For a financially mature economy like the United States, Friedman posits that the domestic demand for money is relatively stable and insulated from international influences. True, there may be some short-run fluctuations in liquidity preference or in interest rates which influence the demand for money. But empirically these are neither predictable nor persistent.

In the 1950s and 1960s, the American economy was large and relatively autonomous within the industrial world. Imports were not a high proportion of GNP and were confined to a fairly narrow spectrum of primary products and manufactures. The dollar was dominant as a reserve currency with a good record of price stability, and access to other country's capital markets was limited by exchange controls and by their lack of depth. Under the prevailing Bretton Woods System of fixed exchange rates, other countries generally subordinated their monetary policies to maintain roughly the same rate of price inflation in tradeable goods as that which prevailed in the United States.

Elsewhere [McKinnon, 1981], I have characterized the United states of the 1950s and 60s as an insular economy: one with limited financial and commodity arbitrage with the outside world, but not one fully closed to foreign trade.

In an insular economy, the central bank best confines its attention to purely domestic monetary indicators. Insofar as domestic money holders become nervous about the future course of inflation, "real" domestic assets such as goods, land, objects of art and so on are the natural inflation hedges into which they might initially shift--until nominal interest rates on domestic financial assets are bid up as a sufficient offset. Holdings of foreign exchange are not significant items on their menu of alternative assets.

Could the domestic interest rate(s) indicate when current monetary policy was too tight or too easy? Unfortunately, no, whether or not the economy is insular or open. Although immediately available, information from interest rates is ambiguous when inflationary expectations are volatile.

For example, an increase in nominal interest rates could signal an upward shift in the money-demand function--genuinely tight money, or signal that inflationary expectations have risen and bond holders are demanding higher yields to compensate for money being too plentiful. Indeed, in 1979 the U.S. Federal Reserve System stopped keying on the (Federal Funds) interest rate precisely because of this dilemma. Increasing interest rates in 1977 and 1978 induced the Fed to supply too much money, thereby contributing to the inflationary explosion of 1979-80.

To minimize having the central bank itself be a source of instability in their (implicitly) insular economy, therefore, domestic monetarists inspired by Professor Friedman [1960] would fix domestic money growth at some low level--say three to five percent per year--whatever the central bank's best guess of expected long-run growth in real output minus any projected trend in the velocity of money. The precise number chosen is less important than the forward commitment to keep money growth constant, thus providing assurance to the general public that major inflations or deflations will be avoided.

Deviations of domestic money growth from this long run target, information which may only be known some weeks later, is the "signal" domestic monetarists would have the central bank use to either tighten or loosen up.

Indeed, in an insular economy with a stable demand for domestic money, changes in the domestic money supply itself should satisfactorily predict changes in domestic prices some months, or a year or two hence. And, as shown below, U.S. M1 was a sufficient statistic for predicting U.S. prices during the 1950s and 1960s--a period during which the Fed was relatively successful in stabilizing the American price level.

Monetary Control in an Open Economy

But the monetary history of the United States from the early 1970s into the 1980s is quite a different story. The American economy became highly open in the following important respects:

(1) In international commodity trade, foreign price competition at the prevailing exchange rate strongly affects a very broad spectrum of American agriculture, mining, and manufacturing; and

(2) International capital flows among the industrial countries are virtually unrestricted; and

(3) While still the dominant reserve currency for denominating internationally liquid assets, the dollar now faces substantial rivalry from other hard currencies such as yen and Deutsche marks. Not only

Americans, Japanese, and Europeans, but portfolio managers in other countries (LDCs) continually shift their asset preferences--mainly for interest-bearing bonds--among dollars, yen, and various European currencies.

But why might this increased openess make any difference to the problem of monetary stabilization? After all, the supply of U.S. money remains, as in an insular economy, the dominant control variable for influencing the American price level--with uncertain lags and credibility problems in linking future expectations to present policy.

However, if expectations of future American price inflation should change, liquid foreign exchange assets--and not domestic inventories of goods or other physical assets--are now the preferred portfolio alternative to holding dollar claims. At the margin, switching to foreign bonds or bank accounts--denominated in freely convertible hard currencies such as marks or yen--is now much more convenient than acquiring relatively illiquid physical assets.

Under floating exchange rates in the 1970s and 80s, foreign central banks are no longer officially obligated to subordinate their monetary policies to that being followed by the United States. Thus foreign hard currencies are more differentiated from dollars with respect to potential inflation or deflation in the future. Of course, most central banks will claim that they intend to stabilize their domestic price level. But gimlet-eyed international investors will inevitably suspect that some are being more successful than others--

given the very difficult problem of intertemporal monetary control which they all face.

This relationship is symmetrical: investors holding yen or mark assets can easily switch into dollars should they change their assessments of Japanese or German monetary policies, wealth taxes, or other sources of future risk. In an open economy without exchange controls, purely domestic inflation hedges become less attractive than they would be in an insular economy.

Increased openess is, therefore, at once a disadvantage and an advantage for resolving our intertemporal problem of monetary control.

On the one hand, the option to acquire liquid foreign exchange makes holders of dollar assets much more sensitive to changing assessments of American monetary policy--as well as future taxation and political risk--relative to similar policies in other countries. The effective demand for both money and bonds denominated in dollars has become more volatile--potentially complicating the Federal Reserve's intertemporal problem of monetary control. The unexpectedly sharp two-to-four-year cycles of inflation in the 1970s, and deflation in the early 1980s, are the unfortunate consequences.

On the other hand, the foreign exchanges provide information: they immediately register pressure for or against dollar denominated assets. In particular, when exchange rates are not fixed, the floating dollar could signal the Fed when expectations of future American price inflation, and the effective demand for U.S. money, were changing. But this remains to be demonstrated.

The Asset Approach to Exchange Rates and the Domestic Price Level

In empirical work beginning in the mid 1970s, Jacob Frenkel, Michael Mussa and Richard Levich have established that a freely floating exchange rate behaves like an asset price. (For a recent summary, see Frenkel and Mussa [1985], and Levich [1985].) Rather than being dominated by current or past flows of imports and exports, the exchange rate varies continually to maintain day-to-day balance across international asset portfolios.

Like the prices of common stocks, the exchange rate seems to be a forward-looking variable that responds only to new information, "news," as if international investors were continually trying to anticipate what monetary and other financial policies each country might follow--or how its terms of trade might change. If some political economic event, say an election, causes people to believe that a country's relative inflation rate or other taxation of wealth will be higher in the future, its exchange rate will depreciate immediately and thus add to the inflationary pressure.

Hence, this now commonly accepted asset approach to exchange rate determination is consistent with our open-economy theory of inflation hedges sketched above. Should inflationary expectations change, foreign exchange rather than "real" assets is the most convenient alternative to holding financial assets--including money--denominated in domestic currency.

A corollary to this asset approach is that current exchange rate movements do not reflect past changes in the income, prices, or other trade and financial variables. Indeed, attempts to predict exchange rates econometrically, on the basis of generally available information from the past, have all failed out of sample [Meese and Rogoff, 1983]. Given our particular concern with intertemporal monetary control, one should note that fluctuations in current exchange rates have not been explainable by (past) growth in domestic money and do indeed reflect new information beyond what past or current growth in M1, M2, the monetary base, and so on might suggest.

A further corollary is that exchange rates move further, and much more rapidly, than (equilibrium) movements in relative national price levels, trade balances, output, and so on--the "overshooting" phenomenon (Dornbusch, 1976). Even though economies are now very open, domestic price levels remain sticky when measured in the national currency. Over months and up to a year or two, fluctuations in nominal exchange rates are equivalent to changes in real rates.

On a purely statistical basis, therefore, floating exchange rates seem to lead prices rather than the other way around [Frenkel, 1978]. Given the continual changes in people's perceptions of the future as revealed in their shifting international asset preferences, a floating exchange rate is nearly always "out of equilibrium" from the point of commodity markets [Ohno, 1985]--thus imposing either inflationary or deflationary pressure on the domestic price level.

The Asymmetrical Position of the United States

While accurate as far as it goes, the asset approach treats all countries symmetrically by not differentiating among them. And in a symmetrical float, any one exchange rate might be an ambiguous monetary indicator of inflation or deflation to come within the domestic economy:2/

First is the question of choosing that exchange rate--yen, marks, francs, guilders, lire or some combination--to which the Fed should respond. Which "hard" foreign currency should be the standard of reference?

Secondly, if just one exchange rate was considered, say the mark/dollar rate, wouldn't this reflect disturbances in the German money market as much as the American? Couldn't a rise in the mark/dollar rate simply reflect actual or expected excess money issue in Germany, and thus throw out a confusing signal for what the Fed should be doing?3/

2/ Unless all countries are "small" with completely independent monetary and financial policies. Then the statistical law of large numbers would smooth out all foreign portfolio disturbances in any one country's average exchange rate with the outside world. Those exchange fluctuations that remained would then be uniquely associated with domestic financial disturbances within the country in question. But this extreme form of symmetry is hardly consistent with the "large" American economy's position at the center of the world dollar standard as described below.

3/ In general, complete price-level and exchange-rate stabilization across the hard-currency industrial countries requires full scale monetary coordination. Either the Fed or the Bundesbank, or perhaps both, should adjust their national money growth rates in response to pressure on the mark/dollar rate. And elsewhere I have spelled out [McKinnon, 1974 and 1984] out how such a first-best monetary agreement among Germany (representing the European bloc), Japan, and the United States could work.

In the text, however, we are considering a more limited, "second-best", approach. Suppose reactions of other central banks to exchange rate changes continue more or less as they have since floating began in early 1973. Is then the average dollar exchange rate a potentially useful monetary indicator for the Fed by itself?

Fortunately both of these potential ambiguities can be resolved by appealing to our historical experience with floating, and by noting the asymmetrical position of the United States under the continuing world dollar standard [Kenen, 1983, McKinnon, 1979]. Since the early 1970s, the dollar shows very high variance against all other currencies viewed collectively--see Figure 1 for the IMF's "merm" weighted dollar exchange rate against 17 other industrial countries.

In the two-to-four year swings with which we are concerned, the dollar exchange rates of countries outside of North America are highly correlated with one another: rising together in 1971-73 and in 1977-79 and then falling sharply from 1980 through 1984--see Figures 3 and 4 for Germany, the Netherlands, the U.K. and Japan. To be sure, there are differing long-term trends in exchange rates over the past 15 years: with the yen and mark tending to appreciate against the dollar, and sterling (as well as French francs and lire) tending to depreciate. Nevertheless, the European and Japanese dollar exchange rates have tended to move similarly on a quarterly or annual basis.[4/]

The upshot is that shifts in portfolio preferences for or against U.S. dollar assets seem to be dominated by changing expectations of what American monetary and financial policies--or commercial prospects--will be in the future. Or, putting this proposition the other way around, there is no other sufficiently large country in the system whose

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4/ Canada is the major exception. Because its currency is more closely tied to the American, the Canadian dollar does not provide international speculators with much of a portfolio alternative to holding U.S. dollars.

domestic financial disturbances--either actual or anticipated--significantly impinge on the average dollar exchange rate of the United States.

This fundamental asymmetry in the world's exchange rate system goes beyond the disproportionate economic size of the American economy. The dollar remains the vehicle currency for international capital flows and for denominating most official exchange reserves, as well as being the invoice currency for most international trade in primary commodities such as oil. Thus other countries' governments "have a view" of what their dollar exchange rates should be, and react to smooth (not very successfully) major fluctuations. When the dollar is weak they tend to expand, and when the dollar is strong the tend to contract.

Based on smoothed (5-quarter moving averages) and unsmoothed quarterly data, Figure 2 shows the strong inverse correlation between changes in the strength of the dollar in the foreign exchanges and money growth in the "rest of the world" (ROW): the 10 major industrial countries outside of the United States. Table 1 (based on annual data) shows how the series on ROW money growth was constructed using fixed GNP weights for the mid year (1977) in the series. Figure 2 shows particularly high foreign money growth in 1971-73 and 1977-79 when the dollar was falling, and the fall off in ROW money growth over 1980-82 when the dollar exchange rate recovered. Most recently, the rise of the dollar in 1984 forced a reduction in ROW money growth sharply below its long-run norm (Table 1).

One important implication of this asymmetry is that the United States, as the center country, has had more complete independence in choosing its own monetary policies than other industrial countries--and its cycles of inflation or deflation tend to spread out into the rest of the industrial world [McKinnon, 1982]. Because other countries monetary policies are somewhat more (although by no means completely) endogenized, fluctuations in the dollar exchange rate are more likely to reflect changing money-market conditions in the United States leading to eventual world-wide inflation or deflation.

For example, if the dollar suddenly appreciates, this indicates that U.S. monetary policy has become tighter--because of an unexpected supply constraint (such as a fall in the American money multiplier) or because the effective national and international demand for U.S. money has increased. (The simple statistical regression model presented below attempts to distinguish between these two cases.) In either event, the consequential deflationary pressure on the American economy is reinforced by monetary contraction abroad and further deflation in the prices of internationally tradeable goods. These international repercussions strengthen the effect of the dollar exchange rate in predicting future American price inflation.

American Prices and U.S. Money Growth: Statistical Evidence from the 1950s and 60s

How well does the principle of domestic monetarism, whch treats the United States as if it was an insular economy, fare in the fixed exchange rate period of the 1950s and 60s in comparison to floating rates in the 1970s and 80s?

Constructing a complete structural model of the American macroeconomy--in which output, prices, interest rates and so on are jointly determined is beyond the scope of this paper. Instead consider a single reduced-form regression of current U.S. price inflation on (current and) past percentage changes is U.S. narrow money--M1 as presently defined by the Federal Reserve's Board of Governors.

$$(1) \qquad \dot{P} = C + a\dot{M} + a_{-1}\dot{M}^{US}_{-1} + \ldots\ldots\ldots\ a_{-n}\dot{M}^{US}_{-n} + u$$

The dot over each variable indicates percentage rates of change in either annual or quarterly data. Each regression is based on first differences of the logarithms of some general price index and of the money supply lagged n periods. Although perhaps losing some information contained in levels of the variables, the first difference approach has the advantage of suppressing (spurious) correlation associated with trends in which both the price level and money supply increase through time. Because n extends up to three years (12 quarters), then the 'a' coefficients pick up the impact of variance in money growth on (cyclical) fluctuations in prices.

The other major statistical problem is to choose an appropriate time period--weeks, months, quarters, years--over which to average each observation on P and M. Even if price data were available on a weekly basis, it would not be usable given the sluggishness with which the price level adjusts to any (unexpected) changes: there would be too much serial correlation in the 'u' disturbances--as well errors in measurement of both P and M. On the other hand, annual observations would seem to smooth too much. Intra-year cyclical fluctuations in M and P would be averaged out, leaving too few observations.

Consequently, I have chosen to run the ordinary least squares regressions explaining movements in the U.S. wholesale price index (WPI) and in the GNP deflator (DEF) on an annual basis--Tables 3 and 4, and on a quarterly basis--Tables 5, 6, and 7. Fortunately, they tell the same interesting and sharply-defined story.

The U.S. WPI, as calculated by the International Monetary Fund, is a rather broad price index for tradeable goods including both finished manufactures and crude materials--whereas the closely related U.S. producer price index includes only finished goods. On the other hand, the GNP deflator is yet more general: including a high volume of nontradeable services whose prices move more sluggishly. Thus the WPI shows much more variance (Table 2) than the GNP deflator.

Nevertheless, in the 1950s and 1960s, U.S. M1 explains movements in both American price indices rather well--despite all the limitations of our single-equation regression approach. The annual regressions, based on 12 observations for 1958-69, show the best R^2 to be 0.47 for the WPI (Table 3), and to be 0.70 for the GNP deflator (Table 4). The signs of the 'a' coefficients are correct (positive) and add up to about .65, although the number of observations is too few to say much about levels of significance for individual coefficients.

Table 5 shows the results of running equation (1) as a 12-quarter, third degree, polynomial distributed lag--and is based on 44 observations from 1962 to the first quarter of 1973 when the float began.[5] The concurrent observation on M is omitted to minimize simultaneity. These quarterly regressions tell much the same story: $\bar{R}^2$ is 0.47 for the WPI regression, and 0.61 for the GNP deflator. These equations are well behaved with no serial correlation in the residuals and the sum of the coefficients on the money supply are highly significant--and considerably greater than that shown in the annual regressions. The WPI reacted a bit faster to U.S. money growth than did the GNP deflator--as one would expect from the way in which the two indices are constructed.

In short, besides being the instrument by which monetary policy is conducted, U.S. M1 was itself a robust indicator of future cyclical price inflation in the United States. In the 1950s and 60s, when exchange rates were largely fixed, the system behaved as if the demand for American money was stable.

The Collapse of Domestic Monetarism in the 1970s and 80s

For the period of floating exchange rates from 1973 to 1984, however, consider running the same regressions fitting equation (1) for the United States. Now the good statistical fit for $\dot{P}$ on $\dot{M}$ completely disappears!

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[5] The results of estimating these equations and the subsequent ones are invariant to the choice of the distributed lag--whether 3rd or 4th degree polynomial, with or without end point constraints, and so on [Ambler, 1985].

In comparison to the earlier period, Tables 3, 4 and 5 show the sharp reductions in $\bar{R}^2$ which in most cases becomes insignificant; the signs of the 'a' coefficients are now often negative in Tables 3 and 4 based on annual data; and serial correlations in the 'u' residuals is much more marked--particularly in Table 5 based on quarterly data.

Apparently, one can no longer predict the now much-larger cyclical fluctuations in the U.S. price level by looking at changes in U.S. money growth by itself.

Several hypotheses might explain this breakdown in the domestic monetarist equation in the 1970s and 1980s--including the more rapid pace of domestic financial innovation causing M1's velocity to shift, oil shocks, and so on. Let us, however, proceed to test the proposition that shifts in international portfolio preferences destabilize(d) the demand for money in the United States (or at leasted reflected any shifts that did occur), and that the dollar exchange rate is a useful leading indicator of such changes.

The Dollar Exchange Rate

Consider amending our basic regression equation to incorporate the dollar exchange rate as an additional explanatory variable.

(2) $$\dot{P} = C + \sum_{i=0}^{n} a_{-i}\dot{M}^{US}_{-i} + \sum_{i=0}^{n} b_{-i}\dot{E}^{US}_{-i} + v$$

E is the International Monetary Fund's measure of the dollar exchange rate trade ("merm") weighted against 17 other industrial countries. Because E is measured in foreign currency units per dollar, $\hat{E}$ being positive represents dollar appreciation. Thus one would expect the 'b' coefficients in equation (2) to be negative. An appreciation of the dollar portends future reductions in U.S. price inflation because:

(i) The effective demand for U.S. dollar assets in general and U.S. money in particular has increased; and

(ii) Foreign goods will now be cheaper in dollar terms, putting downward pressure on American tradeable goods prices; and

(iii) Money growth in other industrial countries tends to decline--adding to the worldwide deflationary pressure.

Obviously, our simple regression equation (2) cannot distinguish among these three interrelated effects. But neither need the Federal Reserve in order to better stabilize the U.S. price level by making use of the information contained in the exchange rate.

For the period of floating exchange rates from 1973 to 1984, $\hat{E}$ turns out to be highly significant as shown in Tables 3, 4, and 5. The 'b' coeficients are significantly negative and $\bar{R}^2$ is high and positive when equation (2) is run on annual or on quarterly data, and when either the WPI or the GNP deflator are the dependent variable. Indeed, the robustness of the dollar exchange rate as a leading indicator of future American price inflation is quite remarkable.

Focussing first on Table 5 based on quarterly data (with a 12-quarter polynomial distributed lag on both $\hat{E}$ and $\hat{M}$), one can see that the sum of the 'b' coefficients is -0.34 for the GNP deflator, and -1.07 for the WPI. A one percent increase in the dollar exchange rate will eventually reduce price inflation in U.S. tradeable goods (the WPI) by about one percentage point, and reduce inflation in the U.S. GNP deflator by about one third of that. These are large numbers because it is not unusual for the dollar exchange rate to move as much as 10 or 20 percent in a year. Indeed, the "effect" of shifts in the dollar exchange rate on cyclical changes in American price inflation seems much larger than that which can be explained solely by international commodity arbitrage or foreign money growth under points (ii) and (iii) above. A positive $\hat{E}$ could also indicate deflationary pressure within the United States--as if the demand for U.S. money was changing.[6]

Tables 3 and 4, based on annual data, show that the effect of E on the WPI is somewhat more immediate--taking place early in the second year after the dollar exchange rate changes and continuing into to the third. Whereas, E's impact on the GNP deflator is stretched out more toward the end of the second and into the third year.

Figure 5 shows the negative impact of $\hat{E}$ on changes in the U.S. WPI after 5 quarters. The simple correlation coefficient between the unsmoothed $\hat{WPI}$ and $\hat{E}$ (lagged) is -0.53; whereas when both series are smoothed this negative correlation increases to an astonishing -0.82.

Finally, the incorporation of the exchange rate into our basic regression equation run for 1973-84 makes the 'a' coefficients associated with U.S. M1 more sensible: they become positive and closer

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[6] A full theoretical description of how the effective demand for demand for domestic money might change in response to portfolio shifts in the international bond market--the principle of indirect currency substitution--is provided in McKinnon [1985].

to being statistically significant. Indeed, the (spurious) negative coefficients for the first 4 or 6 quarters after the money supply changes (without the exchange rate in the equation) take on normal positive signs. This improvement is likely associated with the reduction of serial correlation in the residuals once the exchange rate is introduced. Serial correlation often reflects the influence of an omitted independent variable.

In summary, from the 50s and 60s to the 70s and 80s, the great deterioration in the quality of our basic monetary equation for the United States is avoided once the dollar exchange rate is included as an additional explanatory variable.

A Cautionary Note

Because of the inherent asymmetry in the world dollar standard, monetary equations like (1) or (2) above need not fit at all well for countries other than the United States--such as any European country or Japan.

First, as we have seen, other countries domestic money growth rates are much more endogenized to the state of the foreign exchanges. Thus M is not truly an independent right-hand side variable.

Secondly, when other countries exchange rates are strong (and the dollar is weak) these are also times of international inflationary pressure emanating from the United States throughout the world economy. Thus, the domestic deflationary pressure from an appreciating (non-American) currency is obscured.[7]

For example, although the European currencies had sharply appreciated in the late 1970s against the U.S. dollar, they still suffered the worldwide inflation of 1979-80--albeit in a more muted fashion than the United States (Table 2). Thus the exchange rate could have the "wrong" sign if one applied a regression model such as equation (2) to, say, Germany because of the influence of the international business cycle.

Only for the center country, the United States, does equation (2) apply for the 1970s and 80s. America had the only "independent" monetary policy, and its exchange rate fluctuations governed the international business cycle.

World Monetary Variables and U.S. Price Inflation Under Floating Rates

Because of the inverse correlation between the strength of the U.S. dollar and money growth in the rest of the world under "dirty" floating, the explanatory variable E in equation (2) already captures much of the impact of worldwide inflationary or deflationary pressure. But can the Fed obtain yet more useful information about the future American price level by looking directly at money growth in other industrial countries?

7/ This inherent asymmetry between the United States and other countries was not understood by Franco Spinelli (1983) in his strong criticism of my open-economy approach to monetary stabilization. Moreover, Spinelli defined his "World" monetary variables incorrectly. For a more complete analysis and rebuttal of Spinelli's work, see Bulchandani and Ohno (1985).

I have argued that changes in the demand for dollar assets in general, and for U.S. money in particular, are manifested in the foreign exchange market in two ways:

-under predominantly "clean" floating, by fluctuations in the average dollar exchange rate against other major currencies; and

-when other countries' central banks act to smooth their dollar exchange rates, by fluctuations in foreign money growth.

In the latter case, changes in growth of foreign "hard" moneys--which are to some extent substitutible for dollars in international asset portfolios (McKinnon, 1982)--may itself have an additional inflationary impact on internationally tradeable goods in the world at large. And indeed, Table 2 shows the remarkable positive correlation in cycles of price inflation across the industrial countries. This then feeds back on the U.S. price level.

So foreign money growth, under the world dollar standard, both reflects changing money demand in the United Staes and has its own supply side effect on the world price level. And the simple regression models presented below cannot pretend to disentangle these two effects.

Tables 3, 4, 6 and 7 present the results of running regression equations of the form:

$$(3) \qquad \dot{P}^{US} = C + \sum_{i=0}^{n} \dot{M}^{W}_{-i} + u$$

$$\text{or} \qquad \dot{P}^{US} = C + \sum_{i=0}^{n} \dot{M}^{ROW}_{-i} + v$$

$\dot{M}^W$ is percentage growth in "world" money, including U.S. M1 with a heavy weight, as shown in Table 1 for annual data; and $\dot{M}^{ROW}$ is money growth in the 10 industrial countries other than the United States portrayed in Table 1.[8/]

In the 1970s and 1980s, world money does much better than U.S. money in predicting either the U.S. WPI or the GNP deflator: the regression coefficients for $\dot{M}^W$ are highly significant. The effect of world money on American tradeable goods prices (Table 6) is greater than its effect on the American GNP deflator (Table 7) as one would expect.

Even ROW money by itself does considerably better than U.S. money by itself in predicting U.S. prices as--Tables 6 and 7 based on quarterly data make clear. Moreover, the explanatory power of U.S. money improves substantially when ROW money is included as an additional explanatory variable (tables 6 and 7)--as if it were indeed proxying for shifts in the domestic demand for American M1.

In summary, money growth in the rest of the world does seem to be important, and there is a prima facie case for the Fed to take other countries monetary policies into account when formulating its own.

Under present world monetary arrangements, however, the dollar exchange rate seems to dominate these world and and ROW money supply variables. Suppose E is added as an additional explanatory variable,

8/ I have used fixed (mid period) GNP weights--and not fluctuating exchange rates--for constructing these world money aggregates. This permits us to distinguish the exchange-rate from the world-money supply in our regressions explaining the U.S. price level. Apart from this statistical convenience, however, there is a strong economic rationale for focussing on this definition of world money (Table 1) as a potential control variable for the world price level--see McKinnon, 1984, Ch. 5.

and regressions are run in the format:

$$(4)\qquad \begin{aligned} \dot{P}^{US} &= C + \sum_{i=0}^{n} \dot{M}^{W}_{-i} + \sum_{i=0}^{n} \dot{E}^{US}_{-i} + u \\ \text{or} \quad \dot{P}^{US} &= C + \sum_{i=0}^{n} \dot{M}^{ROW} + \sum_{i=0}^{n} \dot{E}^{US}_{-i} + v \end{aligned}$$

Then, Tables 6 and 7 show that the E variables remain significant with (correct) negative signs, but M^W and M^{ROW} become insignificant with sometimes the wrong signs. This dominance of the dollar exchange rate is undoubtedly related to its inverse correlation with the world money variables.

As a first approximation, therefore, the Fed could treat the dollar exchange rate by itself as its primary signal of when American monetary policy was too tight or too easy provided that the reactions of foreign central banks remain similar to what they have been in the past.

Implicit Versus Explicit Monetary Coordination with Other Countries: A Concluding Note

Clearly, the U.S. Federal Reserve System should take a more open-economy approach to the problem of stabilizing the U.S. price level. But it would be a mistake to completely jettison monetarist rules governing domestic money growth: people still need forward assurance of what the monetary authority plans to do. A more *ad hoc* monetary strategy, even one where the dollar exchange rate was given some (indeterminate) weight, could add to uncertainty about the future and make the current demand for dollar assets--including money--more volatile.

Consider the following simple rules which could be unilaterally announced by the American monetary authorities:

(1) The Fed would continue for the year ahead to project "normal" noninflationary growth in the major U.S. monetary aggregates--say 4 to 6 percent growth in M1.

(2) However, if the dollar was unusually strong in the foreign exchange markets, U.S. money growth would increase beyond its norm until the dollar came down--and vice versa.

If it had followed such a procedure, the Fed could have greatly ameliorated--perhaps largely avoided--the two great inflations of 1973-74 and 1979-80 by contracting in 1971-72 and again in 1978-79. Similarly, by expanding more in late 1981 and early 82, the Fed could have avoided the unusually rapid deflation of 1982-83.

Most recently, by failing to respond to the sharp run-up of the dollar in 1984 by monetary ease, the Fed imposed undue deflation on American tradeable goods industries and a slowdown in real growth in the American economy in 1985. The Fed eased in 1985, but that was a bit late given that the exchange rate signal occurred much earlier.

Under (2) above, the Fed could go one step further. Exchange rate targets against hard foreign moneys could be made more precise through some purchasing power parity calculation. Elsewhere, I and others (McKinnon, 1984 and Williamson, 1983) have suggested "soft" target zones--for example, aiming to keep the dollar within 2.1 to 2.3 marks, and between 200 to 220 yen in 1985.

Once the dollar moved outside these zones, the Fed would be obligated to alter its monetary stance. If the Fed clearly announced its new strategy, private expectations would then more readily coalesce around what the exchange rate was likely to be--making it naturally more stable. Protectionist pressure in the American economy would abate once the 'real' price of dollars in terms of foreign currencies was confined to a narrow band which properly aligned the American price level with those prevailing in other industrial countries.

Although I believe that having the Fed unilaterally key on the dollar exchange rate would better stabilize the U.S. price level (and the world economy more generally), this hypothesis does rest on the assumption that <u>implicit</u> monetary cooperation by other central banks will continue. That is, when the dollar is unusually strong, other industrial countries would slow their money growth to smooth their exchange rate--and then speed up when the dollar became weak--as Figure 2 indicates they have done in the past.

However, suppose now the Fed officially adopts our new monetary strategy of keying on the dollar exchange rate <u>without any explicit agreement</u> on international monetary coordination. Although not necessarily likely, other central banks might now relax and not take symmetrical action to smooth their dollar exchange rates. Let the Fed do it!

For example, if in 1984 the Fed had embarked on a major monetary expansion in response to the strong dollar, other central banks might have expanded in parallel--or at least not contracted as they actually did (Figure 2). Then, not only would the dollar not have come down in the foreign exchange market, but there could have been too much monetary expansion overall--leading to worldwide inflation in 1985-86.

To deal with this dilemma, the Fed could informally monitor what other central banks are doing. If they (unexpectedly) expanded in parallel with the Fed when the dollar was strong, the Fed would be forced to lay off somewhat and give the exchange rate less weight.

Far better to secure an explicit agreement among the Fed, the Bank of Japan, and the Bundesbank (representing the European bloc) to react symmetrically to pressure on the dollar exchange rate.[9] Under such an agreement, only the Fed would be forced to substantially revise its operating procedures from an 'insular' to an open-economy mode. And, international altruism aside, having the Fed key on the dollar exchange rate would be very much in America's own best interests.

9/ In Chapter 5 of An International Standard for Monetary Stabilization (1984), I have outlined a more complete set of rules as one possible basis for such an agreement. The ultimate objective is to secure the mark/dollar and yen/dollar exchange rates, while stabilizing the three countries' common price level measured in terms of tradeable goods.

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TABLE 1
Money growth in domestic currencies, 11 industrial countries
(percentage change in annual averages of M1)

	Belgium	Canada	France	Germany	Italy	Japan	Nether-Lands	Sweden	Switzer-land	United Kingdom	United States	World average	Rest of world[a]
(Weights: GNP 1964)	(.0132)	(.0394)	(.0778)	(.0892)	(.0494)	(.0681)	(.0144)	(.0167)	(.0113)	(.0796)	(.5408)		
1956	2.9	-1.2	10.3	7.2	8.5	16.4	-3.7	7.4	6.0	1.0	1.1	3.78	6.94
1957	-0.1	4.0	8.6	12.1	6.3	4.1	-2.0	3.4	1.8	2.7	-0.6	2.43	6.01
1958	5.8	12.8	6.4	13.1	9.9	12.8	11.9	1.6	9.2	3.0	4.3	6.47	9.04
1959	3.2	-3.2	11.4	11.8	14.0	16.5	4.5	18.0	6.1	4.6	0.1	4.53	9.74
1960	1.9	5.1	13.0	6.8	13.5	19.1	6.7	-1.2	10.2	-0.8	-0.4	3.72	8.58
1961	7.7	12.4	15.5	14.8	15.7	19.0	7.7	10.7	8.1	3.2	2.9	7.39	12.68
1962	7.2	3.3	18.1	6.6	18.6	17.1	7.5	5.6	16.6	4.4	2.1	6.18	10.99
1963	9.8	5.9	16.7	7.4	16.9	26.3	9.8	8.1	8.9	0.3	2.8	6.86	11.65
1964	5.6	5.1	10.3	8.3	6.7	16.8	8.5	7.7	0.2	5.0	4.1	6.16	8.59
1965	7.4	6.3	9.0	8.9	13.4	16.8	10.9	6.4	12.8	2.7	4.3	6.59	9.30
1966	6.7	7.0	8.9	4.5	15.1	16.3	7.2	9.9	3.1	2.6	4.6	6.31	8.33
1967	4.7	9.5	6.2	3.3	13.6	13.4	7.0	9.8	6.0	3.2	3.9	5.49	7.37
1968	6.8	4.4	5.5	7.6	13.4	14.6	8.8	-1.8	11.5	6.0	7.0	7.51	8.12
1969	2.3	6.9	6.1	8.2	15.0	18.4	9.4	2.0	9.5	0.4	5.9	7.00	8.30
1970	-2.5	2.4	-1.3	6.4	21.7	18.3	10.6	7.3	9.8	6.4	3.8	5.80	8.15
(Weights: GNP 1977)	(.0172)	(.0487)	(.0885)	(.1122)	(.0471)	(.1404)	(.0228)	(.0195)	(.0148)	(.0572)	(.4316)		
1971	10.3	12.7	13.7	12.0	22.9	25.5	16.7	9.0	18.2	11.8	6.8	12.45	16.74
1972	15.0	14.3	13.0	13.6	18.0	22.0	17.7	11.8	13.4	13.1	7.1	12.21	16.10
1973	9.8	14.5	9.9	5.8	21.1	26.2	7.4	9.6	-1.0	8.6	7.3	11.06	13.91
1974	6.8	9.3	12.6	6.0	16.6	13.1	3.1	16.3	-1.7	4.8	5.0	7.78	9.88
1975	12.4	13.8	9.9	13.8	8.3	10.3	18.7	15.2	2.4	15.6	4.7	8.83	11.96
1976	9.6	8.0	15.0	10.4	20.5	14.2	11.8	14.0	7.3	13.8	5.7	9.91	13.10
1977	8.0	8.4	7.5	8.3	19.8	7.0	14.3	8.3	4.7	14.4	7.6	8.72	9.57
1978	6.7	10.0	11.2	13.4	23.7	10.8	5.3	13.6	12.7	20.1	8.2	10.99	13.11
1979	3.5	6.9	12.2	7.4	23.9	9.9	2.7	12.7	7.8	11.5	7.7	9.23	10.39
1980	-0.2	6.3	8.0	2.4	15.9	0.8	4.2	21.1	-5.4	4.9	6.2	5.53	5.01
1981	3.6	4.3	12.3	1.2	11.1	3.7	2.6	12.0	-0.9	10.0	7.2	6.50	5.96
1982	3.4	2.0	14.9	3.5	9.9	7.1	4.9	9.8	3.1	8.3	6.5	6.96	7.31
1983	5.0	10.2	12.1	10.3	17.3	3.0	10.6	11.4	7.6	13.4	11.1	10.1	9.48
1984	3.3	2.3	8.2b	3.3	8.4b	2.9	4.1	2.4b	2.5b	14.9b	6.9	6.08	5.45

- Not available
Source: Federal Reserve Bank of St. Louis, "International Economic conditions," June and August 1985
a United States excluded.
b preliminary.

TABLE 2

Price inflation in tradeable goods, 11 industrial countries (percentage change in annual averages of WPIs)

	Belgium	Canada	France	Germany	Italy	Japan	Nether-Lands	Sweden	Switzer-land	United Kingdom	United States	World average	Rest of world[a]
(Weights: GNP 1964)	(.0132)	(.0394)	(.0778)	(.0892)	(.0494)	(.0681)	(.0144)	(.0167)	(.0113)	(.0796)	(.5408)		
1958	-4.4	0.4	5.1	-0.5	-1.7	-6.5	-1.3	4.3	-3.2	0.8	1.5	0.68	-0.30
1959	-0.3	0.8	7.2	-0.8	-2.9	0.9	0.2	0.9	-1.6	0.3	0.2	0.57	1.00
1960	1.2	0.2	3.5	1.3	0.8	1.1	0.0	4.1	0.6	1.3	0.2	0.81	1.54
1961	-0.2	0.2	3.0	1.5	0.0	1.1	-0.2	2.2	0.2	2.6	-0.4	0.47	1.50
1962	0.8	1.1	0.6	0.9	3.2	-1.6	0.3	4.7	3.3	2.3	0.2	0.64	1.16
1963	2.5	1.3	2.9	0.5	5.3	1.6	2.4	2.9	3.9	1.0	-0.4	0.72	2.03
1964	4.7	0.9	3.5	1.0	3.0	0.4	6.1	3.4	1.3	3.1	0.2	1.15	2.27
1965	1.1	1.3	0.7	2.5	1.8	0.7	3.0	5.2	0.6	3.5	2.0	1.98	1.95
1966	2.1	2.9	2.8	1.7	1.5	2.4	5.0	6.4	1.9	2.9	3.4	3.02	2.57
1967	-0.9	1.9	-0.9	-1.0	-0.2	1.7	1.0	4.3	0.3	3.1	0.2	0.45	0.75
1968	0.2	2.2	-1.7	-0.7	0.6	1.0	1.9	2.0	0.1	4.1	2.4	1.68	0.83
1969	5.0	3.7	10.7	1.9	3.6	2.0	-2.5	3.5	2.8	3.7	3.9	3.99	4.09
1970	4.7	2.4	7.5	5.0	7.4	3.7	4.6	6.8	4.2	7.1	3.6	4.54	5.65
Weights: GNP 1977)	(.0172)	(.0487)	(.0885)	(.1122)	(.0471)	(.1404)	(.0228)	(.0195)	(.0148)	(.0572)	(.4316)		
1971	-0.5	2.0	2.1	4.3	3.3	-0.8	4.5	3.2	2.1	9.1	3.3	2.94	2.67
1972	4.0	4.3	4.7	2.5	4.1	0.8	5.1	4.6	3.6	5.3	4.4	3.74	3.24
1973	12.4	11.2	14.7	6.6	17.2	15.8	6.9	10.3	10.7	7.4	13.1	12.42	11.91
1974	16.8	19.1	29.1	13.5	40.8	31.4	9.6	25.3	16.2	22.6	18.8	22.00	24.43
1975	1.2	11.2	-5.7	4.6	8.5	3.0	6.7	6.4	-2.3	22.2	9.3	6.93	5.12
1976	7.1	5.1	7.4	3.7	23.8	5.0	7.8	9.0	-0.7	17.3	4.6	6.58	8.09
1977	2.4	7.9	5.6	2.7	16.6	1.9	5.8	9.2	0.3	19.8	6.1	6.35	6.55
1978	-1.9	9.3	4.3	1.2	8.4	-2.5	1.3	7.6	-3.4	9.1	7.8	4.99	2.86
1979	6.3	14.4	13.3	4.8	15.5	7.3	2.7	12.5	3.8	12.2	12.5	10.73	9.39
1980	5.8	13.5	8.8	7.5	20.1	17.8	8.2	13.9	5.1	16.3	14.0	13.33	12.82
1981	8.2	10.1	11.0	7.7	16.6	1.7	9.2	11.6	5.8	10.6	9.0	8.50	8.13
1982	7.7	6.0	11.1	5.8	13.9	1.8	6.6	12.6	2.6	8.6	2.1	4.80	6.85
1983	5.2	3.5	11.0	1.5	10.5	-2.2	1.8	11.2	0.5	5.5	1.3[b]	2.73	3.82
1984	7.4	4.1	13.3	2.9	10.4	-0.2	4.2	7.9	3.3	6.2	2.4	3.98	5.18

\- Not available

Source: IMF, International Financial Statistics, 1984 Yearbook and July 1985, line 63, wholesale price indices including finished goods and primary products.

[a] United States excluded.

Table 3

AMERICAN TRADEABLE GOODS PRICES (WPI), THE DOLLAR EXCHANGE RATE, AND GROWTH IN U.S. AND WORLD MONEY
(annual data, yearly averages; t-statistics in parentheses)

Fixed Exchange Rates: 1958-69

$\dot{WPI}^{US}$	C	$\dot{M}^{US}$	$\dot{M}^{US}_{-1}$	$\dot{M}^{US}_{-2}$	$\bar{R}^2$	SER	DW	Regression Method
	-0.94 (-1.35)	0.32 (1.73)	0.21 (1.29)	0.13 (0.64)	0.43	1.12	1.87	OLS
	0.83 (-1.27)	0.37 (2.18)	0.23 (1.49)		0.47	1.09	1.99	OLS

$\dot{WPI}^{US}$	C	$\dot{M}^{W}$	$\dot{M}^{W}_{-1}$	$\dot{M}^{W}_{-2}$	$\bar{R}^2$	SER	DW	Regression Method
	-3.14 (-0.92)	0.45 (1.04)	0.21 (0.66)	0.05 (0.15)	0.00	1.59	1.20	OLS
	-2.99 (-0.97)	0.46 (1.14)	0.22 (0.74)		0.00	1.50	1.21	OLS
	-4.10 (-1.02)	0.49 (1.22)	0.36 (1.04)		-	1.46	1.79	AR(1) (ρ=.33)

(continued on next page)

Notes: $\dot{WPI}^{US}$ is percentage inflation in US Wholesale Prices, including finished goods and raw materials, as tabulated on line 63 of the IMF International Financial Statistics (IFS). $\dot{M}^{US}$ is the percentage increase in USMI (narrow money). $\dot{M}^{W}$ is the percentage increase in M1 of 11 major industrial countries using fixed GNP weights and compiled from International Economic Conditions, Federal Reserve Bank of St. Louis--see Table 1. $\dot{E}$ is percentage increase in the trade (merm) weighted value of the dollar against currencies of major US industrial trading partners; see line amx of the IFS. $\bar{R}^2$: percentage of variance explained adjusted for degrees of freedom. **SER**: standard error of the regression. **DW**: Durbin-Watson Statistic. **OLS**: ordinary least squares. **AR(1)**: **OLS** corrected for serial correlation. The regression period reflects the span of the dependent variable. Hence 1973-84 and 1958-69 each consist of 12 annual observations.

Table 3 (Continued)

Floating Exchange Rates: 1973-84

$\dot{WPI}^{US}$	C	$\dot{M}^{US}$	$\dot{M}^{US}_{-1}$	$\dot{M}^{US}_{-2}$	$\dot{E}_{-1}$	$\dot{E}_{-2}$	R^2	SER	DW	Regression Method
	3.86 (0.34)	-1.39 (-1.60)	-0.22 (-0.25)	2.38 (1.71)			0.20	4.86	1.04	OLS
	-30.88 (-0.38)	-0.17 (-0.25)	-1.11 (1.15)	2.77 (3.06)				3.94	2.50	AR(1) (ρ=.93)
	-5.18 (-0.48)		-0.43 (-0.45)	2.50 (1.66)			0.06	5.26	0.87	OLS
	-35.71 (-0.39)		1.23 (1.64)	2.74 (3.32)				3.69	2.46	AR(1) (ρ=.94)
	2.07 (0.37)		-0.34 (-0.71)	1.39 (1.77)	-0.61 (-5.25)		0.76	2.64	2.72	OLS
	1.97 (0.48)		0.33 (0.78)	0.68 (1.09)	-0.46 (-4.58)	-0.34 (-2.83)	0.87	1.93	2.46	OLS
	2.98 (0.79)			0.88 (1.59)	-0.48 (-5.11)	-0.29 (-2.97)	0.88	1.99	2.40	OLS
	-1.60 (-0.32)	0.65 (1.20)	0.56 (1.23)	0.30 (0.43)	-0.45 (-4.64)	-0.50 (-2.84)	0.88	1.87	2.24	OLS

$\dot{WPI}^{US}$	C	$\dot{M}^{W}$	$\dot{M}^{W}_{-1}$	$\dot{M}^{W}_{-2}$	$\dot{E}_{-1}$	$\dot{E}_{-2}$	R^2	SER	DW	Regression Method
	-12.72 (-3.01)		0.30 (0.62)	2.00 (4.58)			0.74	2.79	2.02	OLS
	-0.85 (-0.13)		-0.21 (-0.46)	1.26 (2.56)	-0.40 (-2.27)		0.82	2.30	2.33	OLS
	1.63 (0.28)		0.08 (0.17)	0.70 (1.32)	-0.36 (-2.26)	-0.24 (-1.78)	0.86	2.04	1.92	OLS
	2.15 (0.47)			0.72 (1.48)	-0.37 (-2.92)	-0.23 (-1.97)	0.88	1.91	1.96	OLS

Table 4

AMERICAN GNP DEFLATOR, THE DOLLAR EXCHANGE RATE, AND GROWTH IN U.S. AND WORLD MONEY
(annual data, yearly average; t-statistics in parentheses)

Fixed Exchange Rates: 1958-69

$\dot{DEF}^{US}$	C	$\dot{M}^{US}$	$\dot{M}^{US}_{-1}$	$\dot{M}^{US}_{-2}$	$\bar{R}^2$	SER	DW	Regression Method
	2.91 (1.55)	0.16 (1.42)	0.33 (3.27)	0.15 (1.22)	0.70	0.69	0.63	OLS
	0.65 (1.53)	0.21 (1.95)	0.36 (3.47)		0.69	0.71	0.95	OLS
	0.59 (1.02)	0.19 (1.84)	0.38 (3.80)		-	0.67	1.64	AR(1) (ρ=0.31)
$\dot{DEF}^{US}$	C	$\dot{M}^{W}$	$\dot{M}^{W}_{-1}$	$\dot{M}^{W}_{-2}$				
	-1.48 (-0.54)	0.28 (0.79)	0.36 (1.37)	0.03 (0.10)	0.00	1.28	0.36	OLS
	-1.41 (-0.56)	0.29 (0.87)	0.36 (1.50)		0.08	1.22	0.38	OLS
	3.09 (0.41)	-0.09 (-0.50)	0.21 (1.18)		-	0.87	1.42	AR(1) (ρ=.93)

(continued on next page)

Notes: $\dot{DEF}^{US}$ is annual percentage change in the United States GNP deflator: the most general American measure of price inflation, including both goods and services.

For other definitions, see notes to Table 3. 1958-69 and 1973-74 each consist of 12 annual observations.

Table 4 (Continued)

Floating Exchange Rates: 1973-84

$\dot{DEF}^{US}$	C	$\dot{M}^{US}$	$\dot{M}^{US}_{-1}$	$\dot{M}^{US}_{-2}$	$\dot{E}_{-1}$	$\dot{E}_{-2}$	R^2	SER	DW	Regression Method
	5.56 (1.52)	-0.56 (-2.00)	-0.39 (-1.35)	1.20 (2.69)			0.47	1.56	1.02	OLS
	5.75 (1.34)	-0.55 (-2.01)	-0.34 (-1.10)	1.10 (2.26)			-	1.53	1.65	AR(1) (ρ=0.44)
	1.94 (0.53)		-0.47 (-1.44)	1.25 (2.43)			0.30	1.80	1.40	OLS
	3.41 (0.99)		-0.46 (-1.53)	1.03 (2.12)	-0.12 (-1.73)		0.43	1.63	1.84	OLS
	3.35 (1.19)		-0.09 (-0.30)	0.64 (1.49)	-0.04 (-0.61)	-0.19 (-2.22)	0.61	1.33	1.52	OLS
	3.08 (1.23)			0.59 (1.59)	-0.04 (-0.58)	-0.20 (-3.06)	0.66	1.25	1.56	OLS
	2.88 (1.27)			0.61 (1.74)		-0.22 (-3.95)	0.68	1.21	1.70	OLS

$\dot{DEF}^{US}$	C	$\dot{M}^{W}$	$\dot{M}^{W}_{-1}$	$\dot{M}^{W}_{-2}$	$\dot{M}^{W}_{-3}$	$\dot{E}_{-1}$	$\dot{E}_{-2}$	R^2	SER	DW	Regression Method
	4.38 (1.85)		-0.57 (-2.10)	0.84 (3.41)				0.47	1.56	1.60	OLS
	0.45 (0.17)		-0.33 (-1.37)	0.59 (2.66)	0.44 (2.41)			0.66	1.26	1.79	OLS
	2.99 (0.61)			0.09 (0.25)	0.34 (1.42)	-0.27 (-0.29)	-0.14 (-1.30)	0.61	1.34	1.20	OLS
	4.01 (2.14)				0.33 (1.62)		-0.18 (-2.64)	0.67	1.23	1.44	OLS

Table 5

American Prices, the Dollar Exchange Rate
and U.S. Money Growth: Historical Comparisons
(quarterly data, t-statistics in parenthesis)

Dependent Variable	$\dot{M}^{US}$	$\dot{E}^{US}$	$\bar{R}^2$	SER (Percentage points)	DW	Time Period
$D\dot{E}F^{US}$	0.98 (8.24)		0.61	0.26	2.03	62.2-73.1
$W\dot{P}I^{US}$	1.62 (5.58)		0.47	0.64	2.07	62.2-73.1
$D\dot{E}F^{US}$	0.44 (1.12)		0.11	0.58	0.78	73.2-84.4
$W\dot{P}I^{US}$	0.81 (0.70)		-0.04	1.73	0.98	73.2-84.4
$D\dot{E}F^{US}$	0.57 (1.91)	-0.34 (-4.87)	0.55	0.41	1.33	73.2-84.4
$W\dot{P}I^{US}$	1.20 (1.35)	-1.07 (-5.17)	0.49	1.12	2.21	73.2-84.4

Note: Variables defined in Tables 3 and 4. Data are log differences of quarterly averages. **OLS** regressions run as a 3rd order polynominal distributed lag on right-hand side variables: 12 lagged observations with omission of concurrent observation. Regression coefficients above are the sum of the 12 estimated coefficients for each lag.

Table 5A

American Prices, the Dollar Exchange Rate, and U.S. Money Growth: Historical Comparisons (quarterly data, t-statistic in parenthesis)

Dependent Variable	$\dot{M}^{US}$	$\dot{E}^{US}$	R^2	SER (Percentage points)	D.W.	Time Period
$\dot{DEF}^{US}$	0.98 (8.18)		0.60	0.27	1.92	62.2-73.1
$\dot{WPI}^{US}$	1.66 (5.52)		0.43	0.66	2.01	62.2-73.1
$\dot{DEF}^{US}$	0.24 (0.59)		0.12	0.58	0.77	73.2-84.4
$\dot{WPI}^{US}$	0.78 (0.63)		-0.04	1.72	1.01	73.2-84.4
$\dot{DEF}^{US}$	0.81 (2.46)	-0.41 (-5.70)	0.55	0.41	1.52	73.2-84.4
$\dot{WPI}^{US}$	1.63 (1.81)	-1.16 (-5.59)	0.57	1.11	2.08	73.2-84.4

Note: Variables defined in Tables 3 and 4, Data are log differences of quarterly averages. OLS regressions run as a 3rd order polynominal distributed lag on right-hand side variables: concurrent observation plus 12 lagged observations. The regression coefficients shown above are the sum of the 13 estimated coefficients for each lag.

Table 6

World Money and U.S. Tradeable Goods Prices (WPI)
Under Floating Exchange Rates: 1973.2 to 1984.4
(quarterly data, t-statistics in parentheses)

$\dot{M}^{W}$	$\dot{M}^{ROW}$	$\dot{M}^{US}$	$\dot{E}^{US}$	R^2	SER (percentage points)	D.W.
3.11 (5.49)				0.45	1.12	1.80
	1.49 (4.73)			0.39	1.32	1.69
		0.81 (0.70)		-.04	1.73	0.98
			-0.84 (-6.02)	0.50	1.21	1.95
1.06 (0.77)			-0.62 (-1.86)	0.46	1.25	2.05
	0.03 (0.05)		-0.80 (-2.60)	0.46	1.25	2.05
		1.20 (1.35)	-1.07 (-5.17)	0.49	1.12	2.21
	1.83 (5.38)	2.38 (2.39)		0.42	1.29	2.01

Notes:
- Detailed definitions of variables are in Table 3.
- $W\dot{P}I$ is dependent variable: growth in the U.S. wholesale Price Index as defined by line 63 of IFS.
- $\dot{M}^{W}$ is percentage growth in world (narrow) money: 11 industrial countries.
- $\dot{M}^{ROW}$ is percentage money growth in 10 countries other than U.S.
- M^{US} is U.S. narrow money: M1.
- E is the IMF's in index of the dollar exchange rate: foreign. currency/dollars "merm" weighted against 17 other industrial countries.
- Data are log differences of quarterly averages
- OLS regressions are run as an unconstrained 3rd order polynomial distributed lag on the right-hand side variables: lagged 12 quarters excluding concurrent one. The regression coefficients above are the sum of the 12 estimated coefficients for each lag.

Table 7

World Money Variables and U.S. GNP Price Deflator
Under Floating Exchange Rates: 1973.2 to 1984.4
(quarterly data, t-statistics in parentheses)

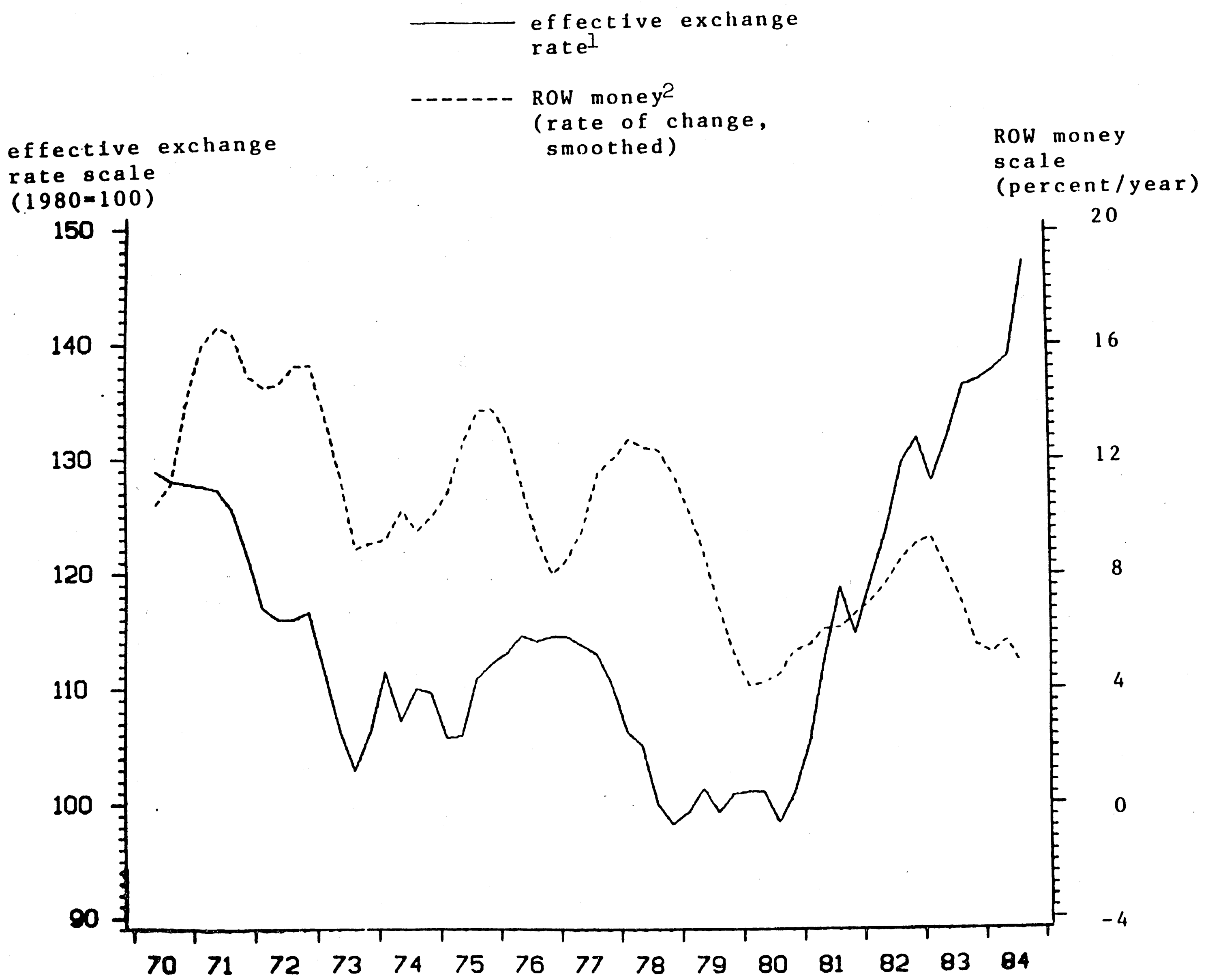
$\dot{M}^{W}$	$\dot{M}^{ROW}$	$\dot{M}^{US}$	$\dot{E}^{US}$	R^2	SER (percentage points)	D.W.
0.76 (3.87)				0.50	0.43	1.22
	0.36 (3.40)			0.48	0.45	1.20
		0.44 (1.12)		0.11	0.58	0.78
			-0.30 (-6.15)	0.53	0.43	1.23
-0.32 (-0.79)			-0.24 (-2.47)	0.66	0.36	1.70
	-0.19 (-1.06)		-0.30 (-3.27)	0.64	0.37	1.67
		0.57 (1.91)	-0.34 (-4.87)	0.55	0.41	1.33
	0.44 (3.92)	0.62 (1.87)		0.52	0.43	1.39

Notes:
- Detailed Definitions of Variables are on Table 3.
- $\dot{DEF}^{US}$ is dependent variable: growth in U.S. GNP deflator.
- $\dot{M}^{W}$ is percentage growth in world narrow money: 11 industrial countries.
- $\dot{M}^{ROW}$ is percentage money growth in 10 countries other than U.S.
- M^{US} is U.S. narrow money: M1.
- E^{US} is the IMF's index of the dollar exchange rate: foreign. currency/dollars "merm" weighted against 17 other industrial countries.
- Data are log differences of quarterly averages.
- OLS regressions are run as an unconstrained 3rd order polynomial distributed lag on the right-hand side variables: lagged 12 quarters excluding concurrent one. The regression coefficient above are the sum of the 12 coefficients for each lag.

Figure 1

U.S. EFFECTIVE EXCHANGE RATE AND THE REST OF THE WORLD MONEY

(quarterly observations)

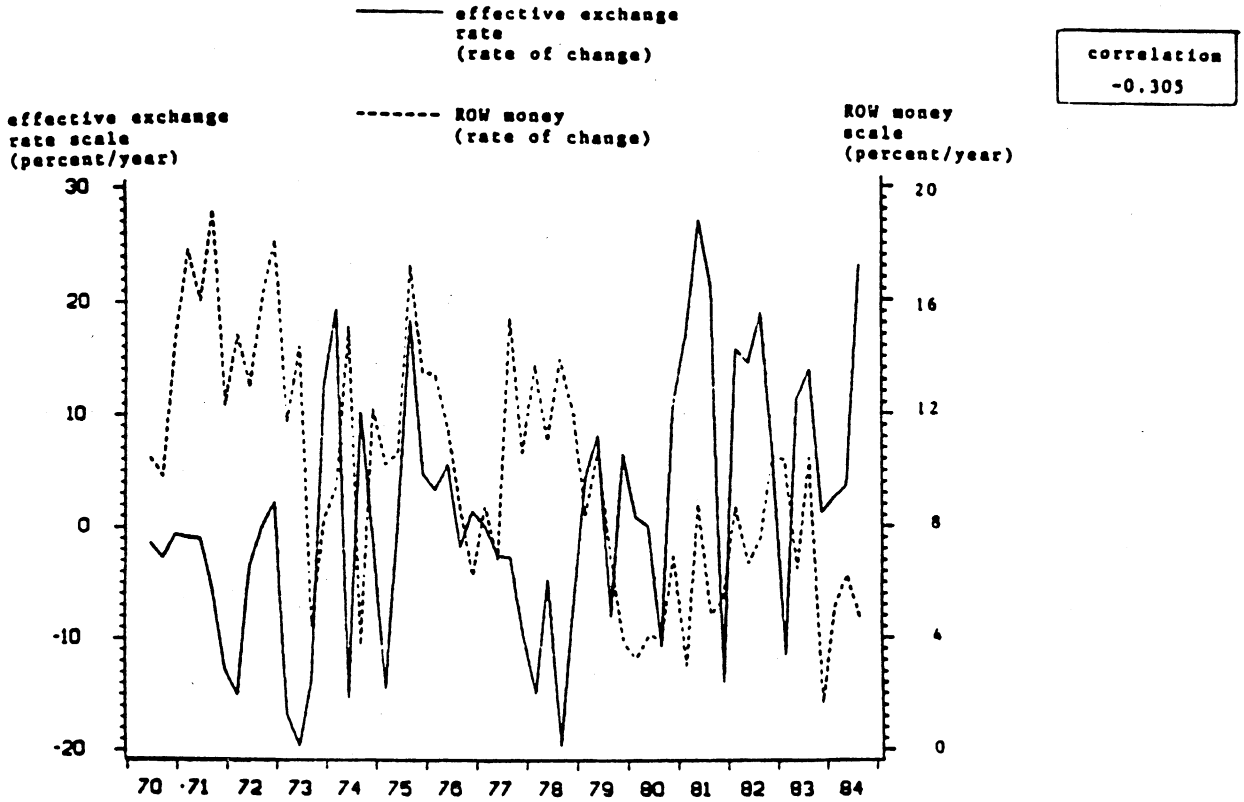


[1]IMF definition: MERM (trade) weighted nominal rate against 17 countries.

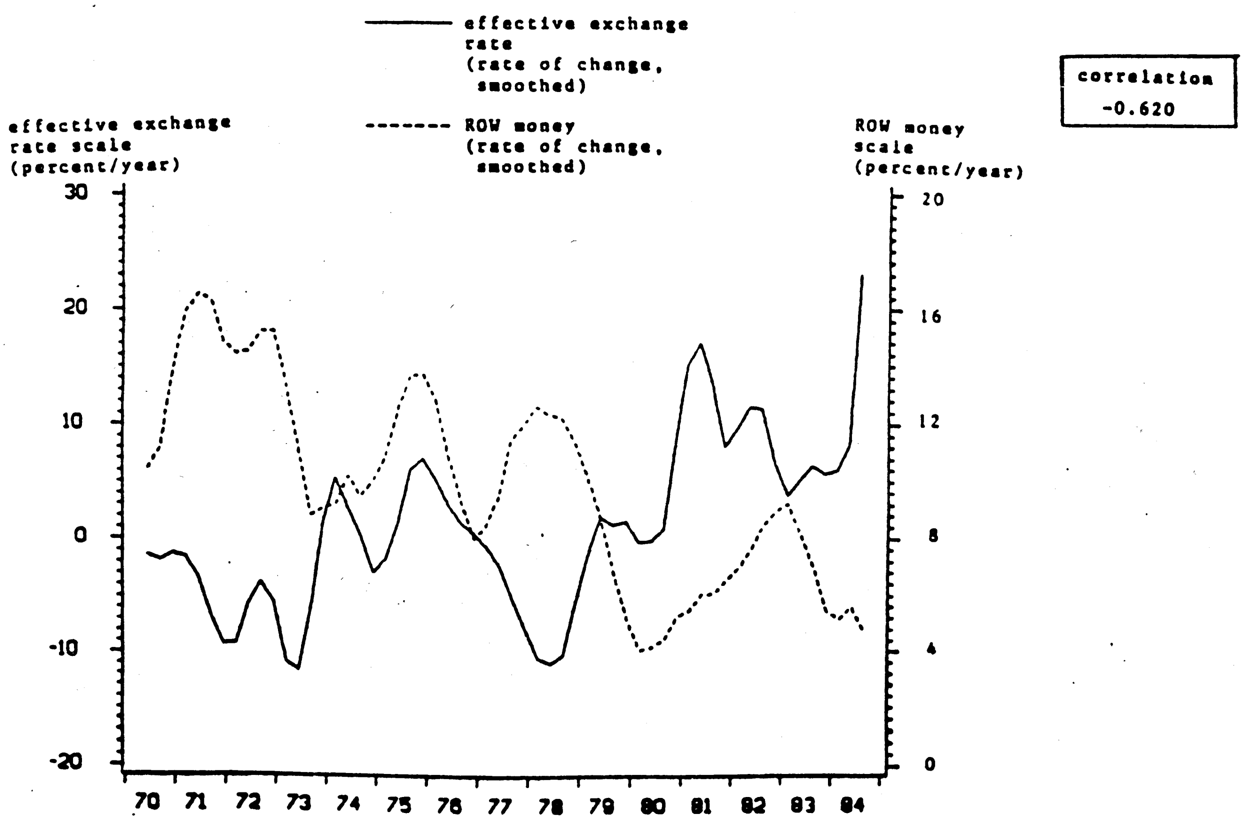
[2]Percent growth in nominal money in 10 industrial countries other than U.S.: see Table 1.

Figure 2

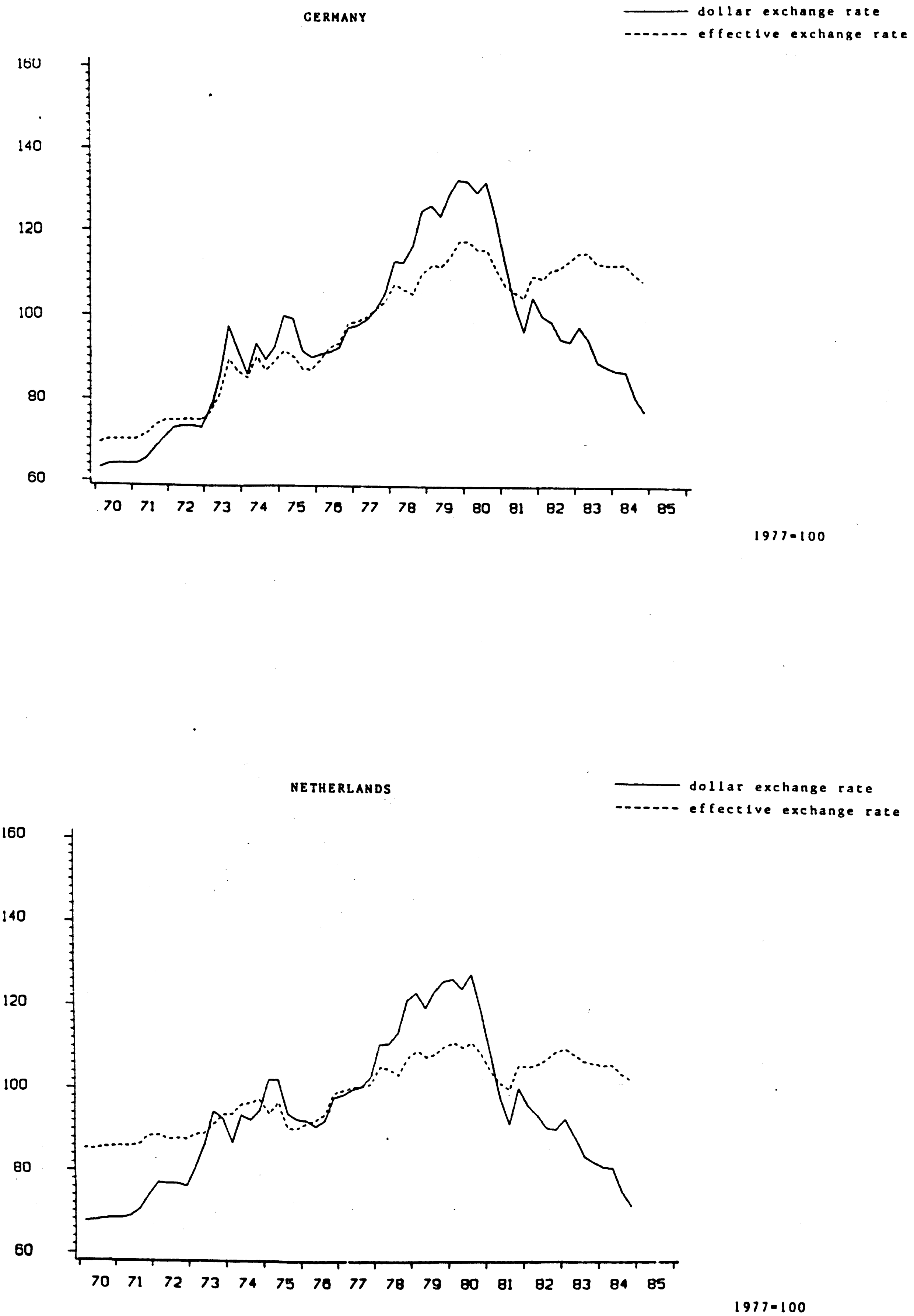
U.S. EFFECTIVE EXCHANGE RATE AND THE REST OF THE WORLD MONEY



U.S. EFFECTIVE EXCHANGE RATE AND THE REST OF THE WORLD MONEY



<u>Figure 3</u>


GERMANY
dollar exchange rate
effective exchange rate
160
140
120
100
80
60
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
1977=100
NETHERLANDS
dollar exchange rate
effective exchange rate
160
140
120
100
80
60
70
71
72
73
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75
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77
78
79
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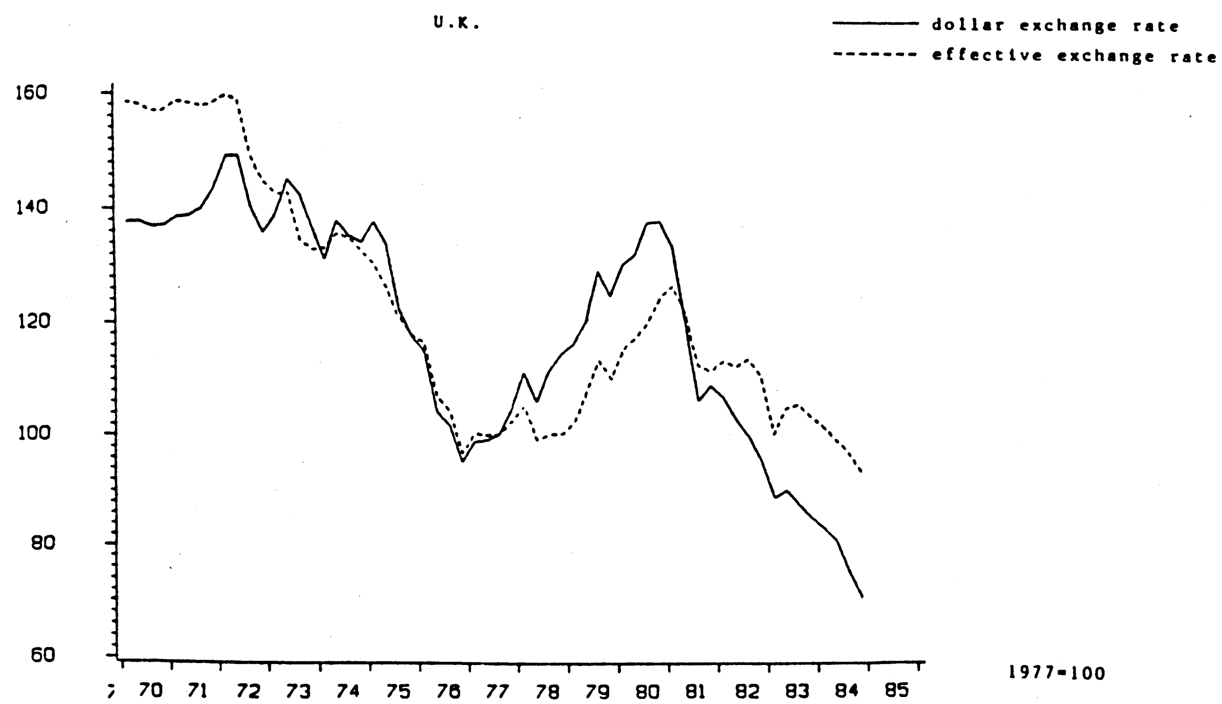
85
1977=100

Figure 4



U.K.
dollar exchange rate
effective exchange rate
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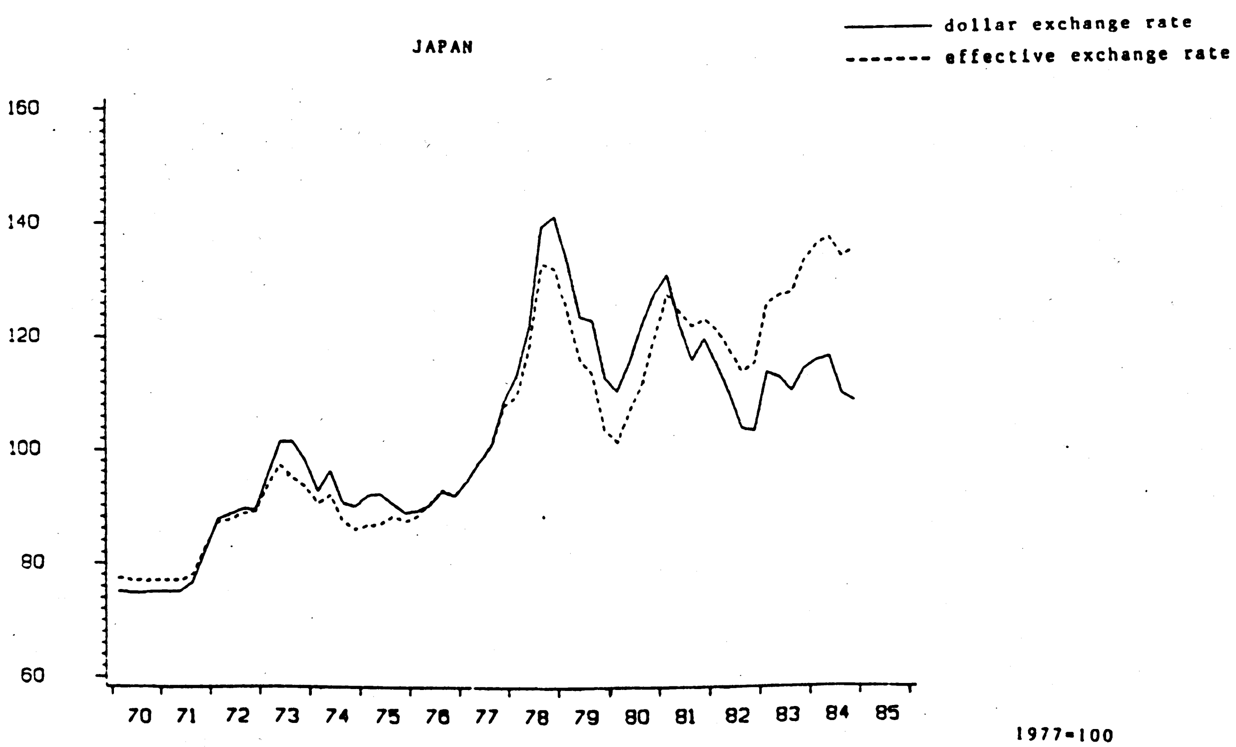
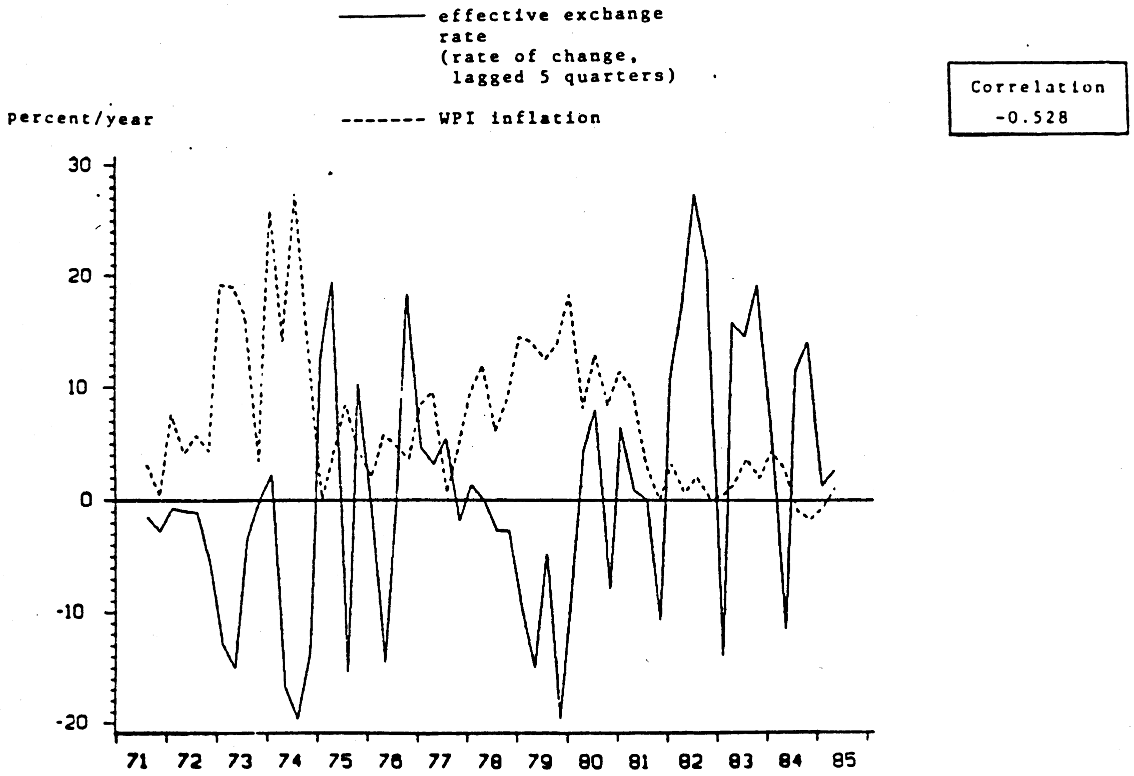
100
80
60
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85
1977=100



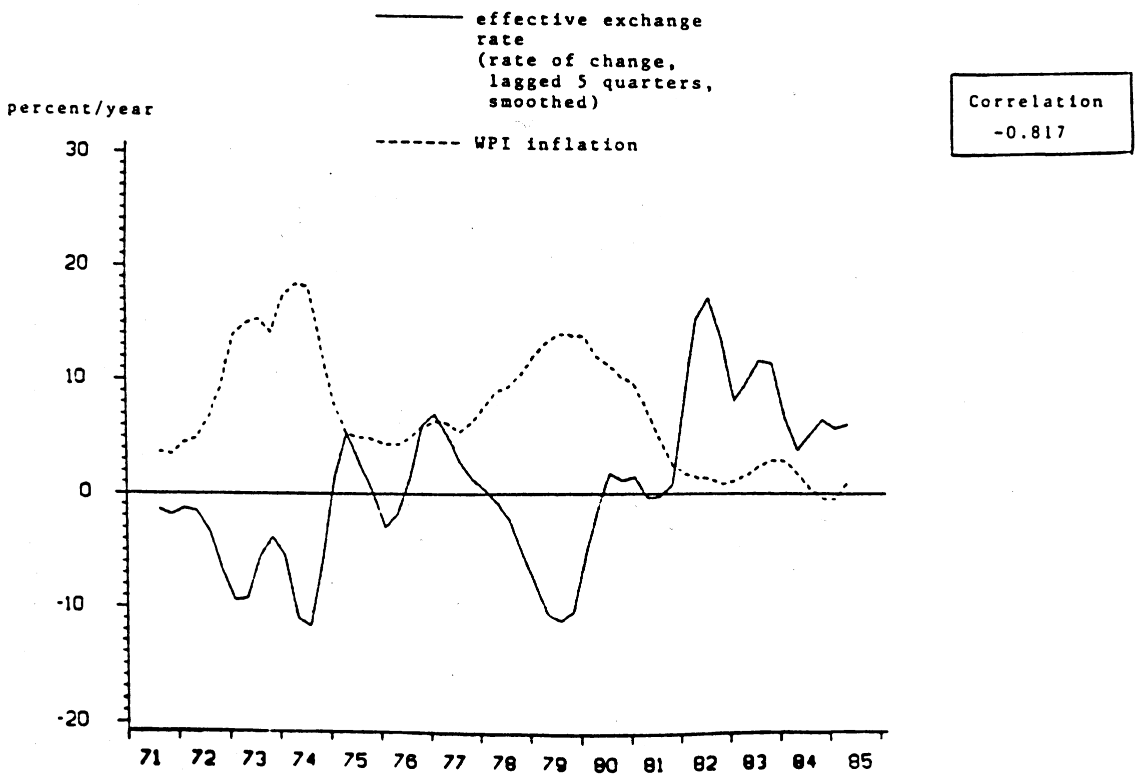
JAPAN
dollar exchange rate
effective exchange rate
160
140
120
100
80
60
70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85
1977=100

Figure 5

U.S. EFFECTIVE EXCHANGE RATE AND WPI



U.S. EFFECTIVE EXCHANGE RATE AND WPI



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