

EXPLAINING EXCHANGE RATE BEHAVIOR: AN AUGMENTED VERSION OF THE MONETARY APPROACH

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Prominent among competing theories of exchange rate determination in a regime of floating exchange rates is the monetary approach. This approach rests on the view that the exchange rate between two national currencies is determined by the respective national money supplies and demands in the two countries and the resulting effects on their general price levels.¹ To reach this conclusion the monetary approach combines the quantity theory of money with the purchasing power parity theory of exchange rates. The quantity theory says that the general price level is determined by the demand-adjusted money stock, i.e., by the nominal stock of money per unit of real money demand.² And the purchasing power parity doctrine holds that the exchange rate tends to equal the ratio of the price levels in the two countries concerned.³ Taken together, the quantity theory and the purchasing power parity doctrine imply that the exchange rate is determined by relative demand-adjusted money stocks operating through relative national price levels.

¹ For recent expositions of the monetary approach see Bilson [2], Frenkel [6], and Mussa [8].

² In other words, the price level equates money supply and demand by deflating the real value of the nominal money stock to the level people desire to hold.

³ According to the purchasing power parity doctrine, this condition ensures that the common currency price of a standard basket of goods is everywhere the same so that there exists no arbitrage advantage to buying in one market over another. It also ensures that the real (exchange rate adjusted) purchasing power of both currencies is everywhere the same so that there exists no incentive to switch from one currency to the other and both moneys are therefore willingly held. The purchasing power parity doctrine argues that if these conditions were violated, goods would be cheaper in one country than another and one currency would be overvalued and the other undervalued on the foreign exchanges. The resulting rush to convert the former currency into the latter in order to purchase goods where they are relatively cheap would quickly bid the exchange rate back to the purchasing power parity at which no advantage exists to converting one money into the other.

The monetary approach has a long history dating back at least to the early 1800s when David Ricardo, John Wheatley, and other British bullionist writers used it to explain the fall of the paper pound on the foreign exchanges following Britain's switch from fixed to floating exchange rates during the Napoleonic wars. Later it was employed by the Swedish economist Gustav Cassel to explain the fall of the external value of the German mark during the famous hyperinflation episode of the early 1920s. Most recently, however, it has been employed, albeit with mixed results,⁴ to explain the behavior of floating exchange rates in the post-1973 era of generalized floating.

The main shortcoming of the monetary approach is that it ignores the effect of real relative price changes on the exchange rate. In particular, it ignores the influence of changes in the *real terms of trade* (i.e., the relative price of imports and exports) and *internal relative prices* (i.e., the relative price of exports and domestic nontradeable goods), both of which function to clear national and international markets for real goods and services by equating commodity demand and supply. Determined by underlying shifts in consumer preferences, technology, and resource supplies, these real relative price changes necessitate equilibrium changes in exchange rates relative to the purchasing power parity ratio of nominal national price levels. Because the monetary approach assumes that purchasing power parity always holds, however, it cannot account for the influence of these real relative price changes on exchange rates. The result is that it ignores a key source of exchange rate

⁴ This is the conclusion reached by Kreinin and Officer [7; pp. 39-40] in their survey of empirical tests of the monetary approach. Of the 10 studies surveyed, at least 7 yield mixed or inconclusive results concerning the monetary approach. See also Stockman [10; pp. 675-6] who notes that the monetary approach has performed no better than simple purchasing power parity explanations and that "there remain substantial short-run variations in exchange rates unexplained by the monetary approach."

disturbance, namely real shocks impinging on the exchange rate through the channels of the terms of trade and internal relative prices.⁵ Far from recognizing these real channels, the monetary approach asserts that all factors affecting exchange rates must do so through monetary channels alone, i.e., through money supplies and demands. While this assumption may be warranted during periods of hyperinflation when exchange rate disturbances are of a predominantly monetary origin, it is clearly invalid in turbulent periods, such as the 1970s, when real shocks abound.

The foregoing shortcoming can be remedied by incorporating a real exchange rate component into the analytical framework of the monetary approach. The result is an augmented monetary model that captures all factors, real and monetary, affecting exchange rates. This article constructs such a model, discusses its constituent components, and uses it to explain certain characteristic features and policy implications of observed exchange rate behavior in recent years.

The Model and Its Components The model itself assumes two hypothetical open national economies each with its own currency and each producing two goods, namely (1) a purely domestic (nontradeable) good and (2) a unique exportable good, part of which is consumed domestically and part of which is exported to the other country. The basic building blocks of the model include (1) a terms of trade identity that links the exchange rate with export prices, (2) a price structure identity that links export prices to general prices via a term containing the relative price of exportables and nontradeables, (3) a quantity theory equation that links general prices to money supply and demand, and finally (4) a money demand equation that links the demands for foreign and domestic currencies to the expected rate of change of the exchange rate. Taken together, these components imply that the exchange rate is determined by the multiplicative product of the terms of trade, relative price structures, relative nominal money stocks, and relative real money demands, respectively. Of these four determinants, the first two constitute the so-called real or price-deflated exchange rate that captures the effect of real disturbances operating through nonmonetary channels. By contrast, the last two determinants constitute the

nominal or monetary element of the exchange rate. As such they capture the effect of monetary, real, and expectational disturbances operating through monetary channels, i.e., through money supply and demand.

The foregoing variables are denoted by the following symbols: let E be the observed market exchange rate (defined as the domestic currency price of a unit of foreign currency), R the real or price-deflated value of that exchange rate (i.e., the exchange rate divided by the purchasing power parity ratio of national price levels), and e the expected future rate of change of the exchange rate. Furthermore, let M be the nominal money stock (assumed to be exogenously determined by the central bank) and D the real demand for money, i.e., the stock of real (price-deflated) cash balances that the public desires to hold. Also let T be the real terms of trade (defined as the quantity of exports given up per unit of imports obtained) and S be the structure of prices in each country as represented by the relative price of exportable goods in terms of the general price level. Finally, let P_x be the price of exportable goods, P_n the price of nontradeable goods, and P the general price level defined as the weighted average of the prices of exportable goods and nontradeable goods, respectively (i.e., the aggregate price of gross domestic product). Asterisks distinguish foreign-country variables from home-country variables. The foregoing variables are linked together via the model's basic building blocks described below.

Terms of Trade The first building block of the model is the concept of the real terms of trade. Representing the quantity of exports that must be sacrificed to obtain a unit of imports, the terms of trade T is defined as the relative price of imports and exports (i.e., the ratio of import prices to export prices). Since the domestic currency price of goods imported from abroad is the same as their foreign currency export price multiplied by the market exchange rate between domestic and foreign currency, the terms of trade may be defined as

$$(1) \quad T = E P_x^* / P_x$$

where T is the terms of trade, E the exchange rate, P_x^* the foreign currency price of foreign country exportables, and P_x the domestic currency price of domestic exportables. Via this identity the terms of trade variable links the exchange rate to export prices in both countries as can be seen by rewriting the identity as $E = T P_x / P_x^*$.

⁵ Note, however, that the monetary approach does capture the effect of real shocks operating through the real income determinant of the demand for money. That is, the monetary approach captures the income effects but not the relative price effects of real disturbances.

Being a real relative price, the terms of trade is affected by real economic variables such as productivity, consumer preferences, resource supplies, and the structure of particular markets in both countries. For example, if productivity is increasing faster in A's export-producing sector than in B's, the consequent rise in A's export supply relative to B's means that A must give up more exports per unit of imports obtained from B. As a result, A's export price will fall relative to B's and the terms of trade will turn against A. Likewise a shift in world demand from A's exports to B's exports will raise the relative price of the latter and worsen A's terms of trade. Finally, suppose B's export sector becomes monopolized while A's remains competitive. B's exporters could exploit their newly acquired market power by restricting output and raising prices, thereby turning the terms of trade against A. In general, the greater the relative productivity and the lower the degree of market power in A's export sector compared with B's, and the lower the intensity of demand for A's exportables relative to B's, the worse the terms of trade for A and vice versa for B.

Internal Price Structure The second building block of the model is the concept of the internal price structure that links export prices to general prices via a term that summarizes the composition of relative prices in each country. Written as follows

$$(2) \quad P_x = SP \text{ and } P^* = S^*P_x^*$$

the internal price structure S is the ratio of export prices to general prices as can be seen by rewriting the identities as $S = P_x/P$ and $S^* = P_x^*/P^*$. Defined as the relative price of exportables in terms of the general price level, the internal price structure S is also the relative price of exports and nontradeable goods. To show this, write the general price level as a weighted geometrical average of the respective prices of the two goods, i.e.,

$$(3) \quad P = P_n^a P_x^{1-a}$$

where P denotes general prices, P_n nontraded goods prices, P_x exportable goods prices, and the weights a and $1-a$ denote the shares of the two goods in the gross domestic product. Dividing both sides of this expression by P_x and inverting the result yields

$$(4) \quad P_x/P = (P_x/P_n)^a = S$$

which says that the internal price structure S is equivalent to the relative price of exportable and nontradeable goods weighted by the latter's share in the gross domestic product.

Stated this way, the price structure variable measures the internal opportunity cost of producing exportables such that a rise in S means that a country will have to give up more nontradeables per additional unit of exportables produced. And, when combined with the terms of trade, it also measures the opportunity cost of transforming nontradeables into imports by way of exportables. Thus if Q_n/Q_x represents the quantity of nontradeables given up to produce a unit of exportables (the internal price structure) and Q_x/Q_m is the quantity of exportables sacrificed to obtain a unit of imports (the terms of trade), it follows that the product of these ratios $(Q_n/Q_x)(Q_x/Q_m) = Q_n/Q_m$ shows the domestic nontradeables cost of obtaining imports by means of exports. In this regard the price structure variable represents the *indirect* terms of trade just as the relative price of exports and imports represents the *direct* terms of trade.

Being a real relative price, the internal price structure is affected by real economic variables such as intersectoral differences in productivity, tastes, and the degree of market power. For example, if productivity (and hence output) is advancing faster in a country's export-producing sector than in the rest of the economy, the resulting rise in the relative supply of exportables will lower their internal relative price thereby altering the price structure. Likewise a reduction in the degree of market power in the export sector relative to the rest of the economy will result in a fall in the relative price of exportables and a corresponding change in the internal price structure. Similarly, a shift in demand away from a country's exportable good to its nontradeable good will lower the internal relative price of exportables and alter the structure of prices.

Before proceeding to the third building block of the model, it should be noted that substituting equation 2 into equation 1 and solving for the exchange rate yields

$$(5) \quad E = T \frac{S}{S^*} \frac{P}{P^*}$$

which expresses the exchange rate as the product of the terms of trade, relative price structures, and the purchasing power parity ratio of national price levels, respectively. Regarding this expression three points should be made. First, it recognizes that factors other than national price levels affect exchange rates. In particular, it says that the purchasing power parity ratio of national price levels is *a* determinant but not *the* sole determinant of exchange rates. In this respect it differs from the simple monetary approach,

which identifies the exchange rate with the purchasing power parity determinant alone.

Second, equation 5 specifies the terms of trade and relative price structures as the constituent components of the real (price-deflated) exchange rate. That is, since the real exchange rate is by definition the observed exchange rate divided by the purchasing power parity ratio of national price levels, it follows that the real exchange rate R is the product of the terms of trade and relative internal price structures as can be seen by writing the equation as $E/(P/P^*) = R = TS/S^*$. This real exchange rate changes with shifts in the terms of trade and internal price structures. It also undergoes temporary changes when sluggish price adjustment prevents national price levels from responding as fast as exchange rates to changes in underlying economic conditions.

Third, the equation shows that the strict purchasing power parity condition assumed by the monetary approach holds only if the real exchange rate R is unity. This can be seen by rewriting equation 5 as

$$(6) \quad E = R \frac{P}{P^*}$$

which says that the exchange rate will equal the purchasing power parity ratio of national price levels only when the real exchange rate is one. But the real exchange rate will be unity only in the special case in which both countries produce a single identical traded good (or standard basket of traded goods) such that commodity arbitrage will render the real price of this good everywhere the same. In all other cases the real exchange rate can be expected to possess a value other than unity. Hence we conclude that the strict purchasing power parity condition postulated by the monetary approach rests on the special assumption of a one-good world.⁶

Quantity Theory of Money The third building block of the model is the quantity theory of money which links general prices P to national nominal money supplies M and real money demands D . Written as follows

$$(7) \quad P = M/D \text{ and } P^* = M^*/D^*$$

the quantity theory says that the general price level in each country is determined by the demand-adjusted money stock, i.e., by the nominal stock of money per unit of real money demand. Written in the form $M/P = D$, the quantity theory also expresses the condition of money market equilibrium

according to which the price level adjusts to equate the real (price-deflated) value of the nominal money stock with the public's real demand for it thereby clearing the market for real cash balances. Note that equation 7 implies that the purchasing power parity ratio of domestic to foreign national price levels is determined by relative national money supplies and demands. Here is the essence of the simple monetary approach to exchange rate determination, namely the extension of the quantity theory of money to the open economy under floating exchange rates.

Money Demand Functions The fourth component of the model consists of money demand functions linking the demands for foreign and domestic currency to the expected future rate of change of the exchange rate. Money demand is assumed to be a function of four variables, including (1) real income (a proxy for the transaction demand for money), (2) nominal interest rates (the opportunity cost of holding money rather than bonds), (3) expected future rate of inflation (the anticipated depreciation cost of holding money rather than goods), and (4) expected rate of change of the exchange rate (the anticipated rate of return from holding foreign money rather than domestic money). In what follows, however, all but the last of these money demand determinants are suppressed and real money demands D in both countries are treated as a function solely of the anticipated future rate of change e of the exchange rate, i.e.,

$$(8) \quad D = D(e) \text{ and } D^* = D^*(e).^7$$

Equation 8 emphasizes the crucial role of exchange rate expectations in the determination of current exchange rates. It implies that exchange rates behave as efficient asset prices, being extremely sensitive to expectations of future conditions and adjusting instantaneously to changes in those expectations. In particular, it states that money demand functions provide the channel through which expectations in-

⁷ Equation 8 enters exchange rate expectations directly into the money demand function on the grounds that such expectations constitute the anticipated depreciation cost of holding one currency over the other. The same result can be derived indirectly by assuming (1) that the demand for each currency is determined by the nominal interest rate on securities denominated in that currency, (2) that international nominal interest rate differentials equal the forward premium on foreign exchange (the interest rate parity condition), and (3) that the forward premium equals the expected rate of depreciation of the exchange rate. This latter interpretation views the expected rate of change of the exchange rate not as the cost of holding one currency over the other but rather as the relative opportunity cost of holding either currency instead of securities. Both interpretations yield the same conclusion, namely that expectations of future exchange rates influence current exchange rates through real money demands.

⁶ See Sakakibara [9; p. 204] for a discussion of this point.

fluence exchange rates, i.e., expectations determine relative demands for the two currencies and therefore also the exchange rate between them. Thus a rise (fall) in the expected future rate of change of the exchange rate will, by raising (lowering) the expected yield from holding foreign rather than domestic currency, shift demand to the former (latter) thereby depreciating (appreciating) the current exchange rate. In this way current exchange rates are determined by exchange rate expectations operating through the channel of relative national money demands.

Components of the Exchange Rate The foregoing elements can be combined into a single reduced form expression by substituting equations 2, 7, and 8 into equation 1 and solving for the exchange rate. The resulting expression is

$$(9) \quad E = T \frac{S}{S^*} \frac{M}{M^*} \frac{D^*(e)}{D(e)}$$

which says that the exchange rate is composed of the product of four groups of factors, namely the real terms of trade, relative internal price structures, relative nominal money supplies, and relative real money demands, respectively. Of these four components, the first two comprise the real exchange rate and the last two the underlying determinants of the nominal or purchasing power parity exchange rate. More precisely, the terms of trade and relative price structure variables account for real influences affecting the exchange rate through nonmonetary channels. By contrast, the relative nominal money stock variable accounts for purely monetary influences affecting the exchange rate through monetary channels (i.e., through money supplies). Finally, relative real money demands account for real and expectational influences affecting the exchange rate through monetary channels (i.e., through money demands).

Regarding the effect of these four determinants on the exchange rate, the equation predicts that a rise in each will tend to depreciate the exchange rate and a fall to appreciate it. That is, the equation predicts that a country's currency will depreciate upon:

- (1) a worsening of the terms of trade (i.e., a rise in the export cost of obtaining imports),
- (2) a rise in the relative price structure reflecting an increase in the nontradeables cost of producing exportables,
- (3) a rise in the relative money stock due to a faster rate of monetary expansion at home than abroad, and

- (4) a rise in the demand for foreign relative to domestic money due, say, to a rise in the expected future rate of depreciation of the exchange rate.

Conversely, the equation indicates that the exchange rate will appreciate given (1) an improvement in the real terms of trade, (2) a fall in the nontradeables cost of producing exportables, (3) a reduction in domestic relative to foreign money growth, and (4) a rise in domestic relative to foreign money demand reflecting improved prospects for the value of the domestic currency.

Application of the Model Having outlined the augmented monetary model, the next step is to use it to answer certain questions arising from exchange rate experience in the post-1973 era of floating exchange rates. The first question is: What has caused the large exchange rate fluctuations observed in recent years?⁸

The model outlined above identifies three sources of exchange rate disturbance, namely

- real shocks operating through the terms of trade and relative internal price structures,
- monetary and real shocks operating through money supplies and demands, and
- changes in exchange rate expectations operating through relative money demands.

All three types of shocks were prevalent in the turbulent 1970s and all three contributed to exchange rate movements. Real shocks occurred in the form of oil embargoes, changes in international demands, commodity shortages, tax and regulatory burdens, shifts in commercial policy, productivity growth differentials and the like. Monetary shocks occurred in the form of divergent money growth rates and frequent sharp shifts in short-term policy targets. Also, during this period uncertainty about future developments became more intense. The policy surprises and the associated increased uncertainty about the future induced large and frequent changes in exchange rate expectations. Channeled through real money demands, these expectational changes were immediately embodied in the price of foreign exchange which jumped to its new equilibrium level consistent with the altered expectations. In short, the events of the 1970s indicate the extent to which disturbances can affect exchange rates. Given the abundance of shocks, surprises, and uncertainties in the post-Bretton

⁸ See Artus and Young [1; pp. 25-33] for a discussion of these fluctuations.

Woods period it is small wonder that exchange rates moved as much as they did.

Exchange Rate Volatility The second question refers to the high degree of short-run (daily, weekly, monthly) volatility exhibited by exchange rates. With respect to volatility, Frenkel [5; p. 23] and Flood [3; pp. 10-13] note that since the adoption of floating exchange rates in early 1973 exchange rates have displayed a degree of variability far exceeding that of national price levels and sometimes approaching that of stock prices quoted on the securities exchanges. And Artus and Young [1; p. 26] argue that exchange rates have been much more volatile than their underlying economic and financial determinants (e.g., money growth rate differentials, real relative prices, inflation differentials and the like). Why are exchange rates so volatile?

Exchange rates are more volatile than their basic economic determinants because they depend not only upon the current value of those determinants themselves but also upon expectations of the entire future paths of those determinants. This expectational factor magnifies the impact of unanticipated changes in economic conditions on the exchange rate. Those changes affect the exchange rate directly and also indirectly through their effect on expectations. In particular, by inducing shifts in exchange rate expectations, disturbances to underlying economic conditions may engender large and frequent movements in exchange rates. For example, unforeseen changes in monetary growth rates may, by altering expectations of future monetary conditions, produce disproportionately large changes in current exchange rates. Viewed this way, exchange rate volatility is seen to stem from large and frequent shifts in exchange rate expectations operating through relative money demands.

In this connection, the model stresses that exchange rates are efficient asset prices dominated by expectations of the future and extremely sensitive to new information (announcements, rumors, unforeseen events, policy surprises and the like) that alters those expectations. Consequently, when new information appears it is immediately discounted into the market price of foreign exchange which jumps to its new equilibrium level consistent with the changed expectations. Since new information abounds by definition in periods of turbulence and uncertainty, it follows that exchange rates will exhibit a large degree of volatility in such periods. The 1970s constitute a prime example of such a period. Given the economic shocks, political upheavals, policy surprises, and un-

certainty that dominated that period, the observed volatility of exchange rates is no mystery. That volatility reflected the large and frequent shifts in expectations induced by the shocks, surprises, and news of that period.

Sources of Departure From Purchasing Power Parity

The third question is: Why have exchange rates since 1973 failed to conform to the predictions of the purchasing power parity theory? That theory predicts that exchange rates will move over time as the ratio of nominal national price levels so as to leave the real value of money and its counterpart, the real price competitiveness of goods, everywhere the same. These predictions have not held up well in recent years. On the contrary, as Jacob Frenkel convincingly demonstrates in his paper "The Collapse of Purchasing Power Parities During the 1970s" [4], exchange rates have frequently deviated sharply from purchasing power parities and in many cases these deviations have persisted with the passage of time. What caused these deviations that have produced such large discrepancies between the external and internal values of currencies?

The model suggests that deviations from purchasing power parity occur for two reasons. One is non-synchronous movements of exchange rates and price levels due to sluggish price adjustment; exchange rates adjust much faster than national price levels to changes in underlying economic conditions. Being efficient asset prices, exchange rates are extremely sensitive to unforeseen changes that alter expectations of the future. By contrast, national general prices are composed largely of commodity prices reflecting past and present conditions as embodied in existing contracts and are therefore relatively unresponsive to unforeseen changes in economic conditions. Consequently, when changes occur, sensitive exchange rates adjust immediately whereas sluggish national price levels lag behind. The resulting differential speed of price response causes a temporary divergence from purchasing power parity. It follows that in turbulent periods like the 1970s, when shocks and surprises occur frequently, exchange rates will deviate from purchasing power parity much of the time.

Sluggish price adjustment is not the only source of deviation from purchasing power parity, however. The model suggests that real structural changes in tastes, technology, and market structure also play a role. Operating through real relative prices, these structural changes necessitate real equilibrium changes in the exchange rate and thereby produce systematic divergences from purchasing power parity. In terms

of the exchange rate equation $E = RP/P^*$, real structural changes generate movements in the real exchange rate R , thereby necessitating equilibrium shifts in the market exchange rate E relative to the purchasing power parity ratio of national price levels.

To illustrate how real structural changes produce systematic deviations from purchasing power parity, consider a hypothetical case in which the United States exports wheat to OPEC in exchange for oil. For convenience, assume that the monetary authorities are stabilizing general prices in both countries so that no exchange rate disturbances arise from that source. That is, all shifts in money demand (due, for example, to productivity-induced increases in income) are accompanied by corresponding changes in the money supply so as to leave general prices and purchasing power parity unchanged. Now suppose that OPEC forms a cartel and quadruples the price of oil. The rise in the price of oil relative to the price of wheat means that the United States now has to export more wheat than before to obtain a barrel of imported oil. The resulting worsening of the U. S. terms of trade and the consequent rise in the real exchange rate causes the dollar to depreciate relative to OPEC currencies despite no underlying change in purchasing power parity. In short, a real shock in the form of increased market power induces a real exchange rate depreciation relative to the unchanged purchasing power parity.

As another example, suppose that U. S. demand shifts away from fuel-inefficient Cadillacs to fuel-efficient Toyotas, thereby raising the price of the latter relative to the price of the former such that more Cadillacs have to be given up in trade to obtain a Toyota. As before, general price levels are assumed constant. The resulting worsening of the U. S. terms of trade with Japan causes a real depreciation of the dollar relative to the yen necessitating an equilibrium shift in the exchange rate relative to the unchanged purchasing power parity.

Finally, suppose that Canada's export productivity doubles relative to U. S. export productivity, thereby rendering Canadian exports half as expensive as before in terms of U. S. exports. The resulting improvement in the U. S. real terms of trade causes the U. S. dollar to appreciate against the Canadian dollar despite no change in the purchasing power parity. The same thing would happen if productivity were advancing faster in the U. S. export sector than in the domestic nontradeables sector, thereby rendering exportables cheaper in terms of nontradeables. The resulting reduction in the real cost of transforming nontradeables into exportables and thereby into

imports would strengthen the external value of the U. S. dollar on the foreign exchanges. In both cases the U. S. would experience a real exchange rate appreciation and a corresponding departure from purchasing power parity.

These examples illustrate how real shocks such as productivity growth differentials and international shifts in demand can induce systematic departures from purchasing power parity. In this perspective there is nothing mysterious about the failure of exchange rates to move in conformity with national price levels in the post-Bretton Woods era of floating exchange rates. Given the abundance of real shocks in that period (e.g., oil embargoes, commodity shortages, diverging productivity growth rates, shifts in international demands, changes in commercial policy and the like), persistent departures from purchasing power parity were to be expected.

Residual Validity of the Purchasing Power Parity Doctrine The last question raised by recent exchange rate experience refers to the residual validity of the purchasing power parity doctrine. What remains of the doctrine given the departures from purchasing power parity? Is it still a useful guide to exchange rate behavior? Does it still have something to teach us?

Regarding the validity of the doctrine the model presented above yields the following conclusions. First, the purchasing power parity doctrine can be expected to hold in the long run when the source of exchange rate disturbance is predominantly of a monetary origin. Such nominal disturbances have no lasting impact on the real exchange rate and therefore leave the purchasing power parity price-exchange rate relationship intact. Second, the doctrine is unlikely to hold in the short run since exchange rates tend to adjust to changes in underlying monetary conditions more quickly than national price levels thereby causing temporary divergences from purchasing power parity. Third, nor will purchasing power parity hold exactly in the long run when the source of exchange rate disturbance is of a predominantly real origin. Such real shocks alter real relative prices and thereby loosen the linkage between price levels and exchange rates postulated by the doctrine. What this means is that although the purchasing power parity doctrine is a reliable guide to long run exchange rate movements originating in the monetary sector, its forecasting accuracy diminishes when real shocks affect exchange rates.

Note, however, that the purchasing power parity doctrine remains a useful tool even when real struc-

tural changes produce systematic disparities between exchange rate movements and changes in national price levels. It continues to be useful because it identifies divergent rates of price inflation as an important source of exchange rate movements and points out that this source could be eliminated if countries would pursue stable noninflationary monetary policies. That is, it specifies unstable monetary policies as a prime cause of exchange rate movements and stresses that this cause could be removed if countries would practice monetary stability. It also serves as a reminder that policies that strengthen the internal value of a currency will also strengthen its external value on the foreign exchanges. And, in stressing that exchange rates are endogenous variables determined by underlying monetary conditions, the doctrine yields the important insight that exchange rate depreciation per se cannot be inflationary because it merely reflects rather than creates underlying inflationary pressures. For these reasons the purchasing power parity doctrine remains a useful analytical tool.

Policy Implications Having employed the augmented monetary model to interpret recent exchange rate behavior, it remains to outline the policy implications of the model. At least three policy implications stem from the augmented monetary model. The first is that it is impossible for countries to peg both the external and internal value of their currencies in an inflationary world subject to real economic shocks. As a result, floating exchange rates may be necessary for countries desiring to stabilize general prices.

To see this, recall the real/nominal exchange rate equation $E = RP/P^*$. It is obvious from this expression that it is impossible to peg both the exchange rate E and domestic prices P if the real exchange rate R and/or foreign prices P^* are changing. Given foreign prices, a rising real exchange rate means that a country that wishes to stabilize its domestic price level must be prepared to abandon fixed rates and let its currency depreciate on the foreign exchanges. Similarly, given the real exchange rate, rising foreign prices mean that a country that wishes to pursue domestic price stability must let its currency appreciate on the foreign exchanges. Under these conditions only floating exchange rates are compatible with domestic price stability. For this reason, floating exchange rates may be necessary for countries wishing to achieve price stability in an inflationary world also subject to real economic shocks. Given price stability as the overriding policy goal, pegged exchange rates would be inferior to floating rates.

A second policy implication of the model is that proposed purchasing power parity policy intervention rules should be rejected. Such rules would require the authorities to intervene in the market for foreign exchange to insure that exchange rates conform to the purchasing power parity path of national price levels.

Such intervention rules are singularly ill-advised. They wrongly assume that policymakers can and should eliminate all real exchange rate changes. To be sure, real exchange rate changes stemming from erratic macroeconomic policies can and should be eliminated by pursuing stable, predictable policies. But real exchange rate changes stemming from fundamental structural changes in national economies should be accepted. For, as noted above, such changes generate changes in real relative prices that require equilibrium shifts in exchange rates relative to purchasing power parity. An intervention rule that ties exchange rates rigidly to national price levels in accordance with purchasing power parity ignores the need for such real exchange rate changes. It also fails to recognize that, because of sluggish national price levels, real exchange rate changes may be necessary to accomplish adjustments that would otherwise be achieved by movements in national price levels. For example, real exchange rate changes may serve the useful role of providing a temporary outlet for monetary shocks not accommodated by price level movements.

The model's third policy implication is that, short of obtaining a coordinated international program to equalize inflation rates in the trading world, the best way to reduce exchange rate fluctuations is to pursue a stable and predictable domestic noninflationary monetary policy. Not only would such a policy strengthen both the internal and external value of the currency, but it would also contribute to exchange rate stability in at least two ways. First, it would eliminate the unstable monetary growth that is a direct cause of exchange rate fluctuations. Second, it would exert a stabilizing effect on exchange rates via the expectations channel. This is so because market exchange rates are dominated by expectations of future monetary policies and these expectations themselves are influenced by current monetary policies. It follows that stable monetary policies will induce expectations of future policy stability and thereby exert a stabilizing influence on current exchange rates.

Note, however, that a stable domestic monetary policy alone would not eliminate all sources of exchange rate fluctuations. On the contrary, fluctuations could still result from unstable policies abroad

as well as from unavoidable real disturbances. But stable monetary policy would eliminate one source of exchange rate variability, namely that produced by erratic and unstable domestic monetary policies. In short, while domestic monetary policy can do little to stop exchange rate disturbances originating from the real sector or from unstable policies abroad, it can stop one source of disturbance, namely that emanating from the domestic monetary sector.

Concluding Comments This article has presented an augmented monetary model of exchange rate determination and has used it to address certain questions raised by recent experience with floating exchange rates. The article's main conclusion is that real as well as monetary factors affect exchange rates and that they do so through nonmonetary channels, i.e., through real relative prices. The simplest version of the monetary approach ignores this, however, and for that reason must be augmented with a real exchange rate component if it is to account for all factors affecting exchange rates. Without this modification, the simple monetary approach is capable of accounting only for nominal movements in the exchange rate.

Even so, however, the simple version of the monetary approach remains a useful analytical tool. It provides a reliable guide to long-run exchange rate behavior when the source of exchange rate disturbance is of a predominantly monetary origin. It reminds us that excessive monetary growth is a primary source of exchange rate depreciation and that one can eliminate this source by adhering to stable noninflationary monetary policies. It also reminds us that exchange rates and price levels cannot be treated as independent, unrelated variables since policies that affect one tend to affect the other in the same way. It notes that since exchange rates themselves are determined by monetary policy they cannot be treated as independent policy instruments. And, in stressing that exchange rates are endogenous variables determined by underlying monetary conditions, it makes the important point that floating exchange rates cannot be inflationary since they reflect rather than generate inflationary pressures. In so doing, it effectively refutes the popular argument that floating rates cause inflation. These propositions remain valid even when real exchange rate changes occur. For this reason the monetary approach remains a useful analytical tool.

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EURODOLLARS*

Marvin Goodfriend

The Nature of the Eurodollar Eurodollars are deposit liabilities, denominated in United States dollars, of banks located outside the United States.¹ Eurodollar deposits may be owned by individuals, corporations, or governments from anywhere in the world. The term Eurodollar dates from an earlier period when the market was located primarily in Europe. Although the bulk of Eurodollar deposits are still held in Europe, today dollar-denominated deposits are held in such places as the Bahamas, Bahrain, Canada, the Cayman Islands, Hong Kong, Japan, Panama, and Singapore, as well as in European financial centers.² Nevertheless, dollar-denominated deposits located anywhere in the world outside the United States are still referred to as Eurodollars.

Banks in the Eurodollar market and banks located in the United States compete to attract dollar-denominated funds worldwide. Since the Eurodollar market is relatively free of regulation, banks in the Eurodollar market can operate on narrower margins or spreads between dollar borrowing and lending rates than can banks in the United States. This allows Eurodollar deposits to compete effectively with deposits issued by banks located in the United States. In short, the Eurodollar market has grown up as a means of separating the United States dollar from the country of jurisdiction or responsibility for that currency, the United States. It has done so largely to reduce the regulatory costs involved in dollar-denominated financial intermediation.

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¹ Dollar-denominated deposits at a bank located outside the United States are Eurodollars, even if the bank is affiliated with a bank whose home office is in the United States.

² See Ashby [1] and [2] for discussions of Europe's declining share of the global Eurocurrency market. The Eurocurrency market includes, along with Eurodollars, foreign currency-denominated deposits held at banks located outside a currency's home country.

The Size of the Eurodollar Market Measuring the size of the Eurodollar market involves looking at the volume of dollar-denominated loans and deposits on the books of banks located outside the United States. However, dollar-denominated loans and deposits may not match. Consequently, a decision must be made whether to measure the volume of Eurodollars from the asset or liability side of the bank balance sheet.

A liability side measure may be too broad, since it may include foreign currency liabilities incurred to fund loans to domestic residents denominated in domestic currency. Strictly speaking, this is a traditional type of international financial intermediation. Measuring Eurodollar market volume from dollar-denominated assets, however, may also overstate the size of Eurodollar volume since these assets may reflect nothing more than traditional foreign lending funded with domestic currency-denominated deposits supplied by domestic residents.

In practice, Eurodollar volume is measured as the dollar-denominated deposit liabilities of banks located outside the United States. For example, the Bank for International Settlements (BIS) defines and measures Eurodollars as dollars that have "been acquired by a bank outside the United States and used directly or after conversion into another currency for lending to a nonbank customer, perhaps after one or more redeposits from one bank to another."³

Under a liability side measure such as the one used by the BIS, the sum of all dollar-denominated liabilities of banks outside the United States measures the gross size of the Eurodollar market. For some purposes, it is useful to net part of interbank deposits out of the gross to arrive at an estimate of Eurodollar deposits held by original suppliers to the Eurodollar market. Roughly speaking, to construct the net size measure, deposits owned by banks in the Eurodollar market are netted out. But deposits owned by banks located outside of the Eurodollar market area are not netted out because these banks are considered to be

³ Bank for International Settlements, **1964 Annual Report**, p. 127.

original suppliers of funds to the Eurodollar market. For still other purposes, such as comparing the volume of deposits created in the Eurodollar market with the United States monetary aggregates, it is useful to further net out all bank-owned Eurodollar deposits. Doing so leaves only the nonbank portion of the net size measure, or what might be called the net-net size of the Eurodollar market.

The most readily accessible estimates of the size of the Eurodollar market are compiled by Morgan Guaranty Trust Company of New York and reported in its monthly bank letter *World Financial Markets*.⁴ Morgan's estimates are based on a liability side measure and include data compiled by the BIS. However, Morgan's estimates are somewhat more comprehensive. Morgan reports estimates of the size of the entire Eurocurrency market based roughly on all foreign-currency liabilities and claims of banks in major European countries and eight other market areas.

As of mid-1980 Morgan estimated the gross size of the Eurocurrency market at \$1,310 billion.⁵ The net size was put at \$670 billion.⁶ Morgan also reports that Eurodollars made up 72 percent of gross Eurocurrency liabilities, putting the gross size of the Eurodollar market at \$943 billion.⁷ No net Eurodollar market size is given. However, 72 percent of the net size of the Eurocurrency market yields \$482 billion as an approximate measure of the net size of the Eurodollar market. Finally, Morgan reports Eurodollar deposits held by nonbanks at \$200 billion, and those held by United States nonbank residents as less than \$50 billion.⁸

M2 is the narrowest United States monetary aggregate that includes Eurodollar deposits. M2 includes overnight Eurodollar deposits held by United States nonbank residents at Caribbean branches of Federal Reserve member banks. As of June 1980,

M2 measured \$1,587 billion; its Eurodollar component was \$2.9 billion.⁹

Even though it is conceptually appropriate to include term Eurodollar deposits held by United States nonbank residents in M3, they are only included in L, the broadest measure of money and liquid assets reported by the Federal Reserve, because the data used to estimate their volume is available with a long lag relative to other data in M3. M3 was approximately \$1,846 billion in June 1980; the Eurodollar component of L was \$51.8 billion.¹⁰ Eurodollar deposits owned by United States nonbank residents continue to grow rapidly, but these comparisons show clearly that such Eurodollar deposits still account for a relatively small portion of United States nonbank resident holdings of money and liquid assets.

Incentives For Development of the Eurodollar Market¹¹ By accepting deposits and making loans denominated in United States dollars outside the United States, banks can avoid many United States banking regulations. In particular, banks located outside the United States are not required to keep noninterest-bearing reserves against Eurodollar deposits. These foreign banks hold balances with United States banks for clearing purposes only. Moreover, there is no required Federal Deposit Insurance Corporation insurance assessment associated with Eurodollar deposits. Virtually no restrictions exist for interest rates payable on Eurodollar deposits or charged on Eurodollar loans; and there are few restrictions on the types of assets allowed in portfolio.

⁹ Board of Governors of the Federal Reserve System, H.6 statistical release, "Money Stock Measures and Liquid Assets" (February 20, 1981), pp. 1, 4.

¹⁰ Ibid., pp. 1, 5. The figure for U. S. nonbank resident Eurodollar holdings given by the Federal Reserve exceeds that reported by Morgan because the Federal Reserve includes in its figure Eurodollar CDs held in the name of U. S. banks that are being held for the beneficial interest of U. S. nonbank residents.

Eurodollar deposits included in L are those held by U. S. nonbank residents at all banks in the United Kingdom, Canada, and at branches of U. S. banks in other countries. These account for nearly all U. S. nonbank resident Eurodollar holdings. Some overnight Eurodollar deposits issued to U. S. nonbank residents by banks other than Caribbean branches of member banks are only included in L because current data do not separate these overnight Eurodollars from term Eurodollars.

At present, Eurodollars held by non-U. S. residents are not included in any of the U. S. monetary aggregates. As improved data sources become available, the possible inclusion of Eurodollars held by non-U. S. residents other than banks and official institutions could be reviewed. See Board of Governors of the Federal Reserve System, *Federal Reserve Bulletin* (February 1980), p. 98.

¹¹ See Dufey and Giddy [9, pp. 110-12] for more discussion of the conditions that made large-scale Eurodollar market growth possible.

⁴ See Morgan Guaranty Trust Company of New York, *World Financial Markets* (January 1979), pp. 9-13, for a discussion of Morgan's method of measuring the size of the Eurodollar market. Other useful discussions of issues involved in measuring the Eurodollar market's size are found in Dufey and Giddy [9, pp. 21-34] and Mayer [11].

⁵ Morgan Guaranty (December 1980), p. 15. Most of the growth of the Eurocurrency market has occurred in the last two decades. For instance, Dufey and Giddy [9, p. 22] reports Morgan's earliest estimate of the gross size of the Eurocurrency market as only \$20 billion in 1964. See Dufey and Giddy [9, Chapter III] for a discussion of the growth of the Eurocurrency market.

⁶ Morgan Guaranty (December 1980), p. 15.

⁷ Ibid.

⁸ Ibid., p. 4.

In most Eurodollar financial centers, entry into Eurodollar banking is virtually free of regulatory impediments. In addition, banks intending to do Eurodollar business can set up in locations where tax rates are low. For example, Eurodollar deposits and loans negotiated in London or elsewhere are often booked in locations such as Nassau and the Cayman Islands to obtain more favorable tax treatment.

Foreign monetary authorities are generally reluctant to regulate Eurodollar business because to do so would drive the business away, denying the host country income, tax revenue, and jobs. Even if the United States monetary authorities could induce a group of foreign countries to participate in a plan to regulate their Euromarkets, such a plan would be ineffective unless every country agreed not to host unregulated Eurodollar business. In practice, competition for this business has been fierce, so even if a consensus should develop in the United States to regulate Eurodollar business, it would be extremely difficult to impose regulations on the entire Eurodollar market.

Instruments of the Eurodollar Market¹² The overwhelming majority of money in the Eurodollar market is held in fixed-rate time deposits (TDs). The maturities of Eurodollar TDs range from overnight to several years, with most of the money held in the one-week to six-month maturity range. Eurodollar time deposits are intrinsically different from dollar deposits held at banks in the United States only in that the former are liabilities of financial institutions located outside the United States. The bulk of Eurodollar time deposits are interbank liabilities. They pay a rate of return which, although fixed for the term of the deposit, is initially competitively determined.¹³

From their introduction in 1966, the volume of negotiable Eurodollar certificates of deposit (CDs) outstanding reached roughly \$50 billion at the beginning of 1980.¹⁴ Essentially, a Eurodollar CD is a negotiable receipt for a dollar deposit at a bank located outside the United States.

On average over the past seven years, fixed-rate three-month Eurodollar CDs have yielded approximately 30 basis points below the three-month time deposit London Interbank Offer Rate (LIBOR).¹⁵ LIBOR is the rate at which major international banks are willing to offer term Eurodollar deposits to each other.

An active secondary market allows investors to sell Eurodollar CDs before the deposits mature. Secondary market makers' spreads for short-term fixed-rate CDs are usually 5 or 10 basis points.¹⁶

Eurodollar CDs are issued by banks to "tap" the market for funds. Consequently, they have come to be called Tap CDs. Such Tap CDs are commonly issued in denominations of from \$250,000 to \$5 million. Some large Eurodollar CD issues are marketed in several portions in order to satisfy investors with preferences for smaller instruments. These are known as Tranche CDs. Tranche CDs are issued in aggregate amounts of \$10 million to \$30 million and offered to individual investors in \$10,000 certificates with each certificate having the same interest rate, issue date, interest payment dates, and maturity.

In recent years Eurodollar Floating Rate CDs (FRCDs) and Eurodollar Floating Rate Notes (FRNs) have come into use as a means of protecting both borrower and lender against interest rate risk. Specifically, these "floaters" shift the burden of risk from the principal value of the paper to its coupon.

Eurodollar FRCDs and FRNs are both negotiable bearer paper. The coupon or interest rate on these instruments is reset periodically, typically every three or six months, at a small spread above the corresponding LIBOR. Eurodollar FRCDs yield, depending on maturity, between $\frac{1}{8}$ and $\frac{1}{4}$ percent over six-month LIBOR.¹⁷ They are an attractive alternative to placing six-month time deposits at the London Interbank Bid Rate. Eurodollar FRN issues have usually been brought to market with a margin of $\frac{1}{8}$ to $\frac{1}{4}$ percent over either the three- or six-month LIBOR or the mean of the London Interbank Bid and Offer Rates.¹⁸ To determine LIBOR for

¹² Dobbs-Higginson [8, pp. 55-61], Dufey and Giddy [9, pp. 228-32], and Stigum [16, Chapters 15 and 16] contain useful surveys of Eurodollar instruments.

¹³ See Stigum [16, p. 433] and Dufey and Giddy [9, p. 227] for discussions of Eurodollar deposit rate tiering according to perceived issuing bank creditworthiness.

¹⁴ Bank of England, Financial Statistics Division, International Banking Group. This data only includes London dollar CDs. But until recently, virtually all Eurodollar CDs have been issued in London. See "Out-of-Towners," *The Economist* (July 12, 1980), p. 89.

¹⁵ This spread was calculated from data in Salomon Brothers, *An Analytical Record of Yields and Yield Spreads* (1980).

¹⁶ Dobbs-Higginson [8, p. 59].

¹⁷ Credit Suisse First Boston Limited, "A Description of the London Dollar Negotiable Certificate of Deposit Market" (January 1980), p. 3.

¹⁸ Salomon Brothers, *Eurodollar Floating Rate Notes: A Guide to the Market* (1980), p. 3. The spread between interbank bid and offer rates is normally $\frac{1}{8}$ percent, so an issue priced at $\frac{1}{4}$ percent over the mean of the bid and offer rates would return $\frac{3}{16}$ percent over LIBOR.

Eurodollar FRNs, "the issuer chooses an agent bank who in turn polls three or four Reference Banks—generally, the London offices of major international banks. Rates are those prevailing at 11:00 a.m. London time two business days prior to the commencement of the next coupon period."¹⁹

Eurodollar FRCDs have been issued in maturities from 1½ to 5 years and are employed as an alternative to short-term money market instruments. Eurodollar FRNs have been issued in maturities from 4 to 20 years, with the majority of issues concentrated in the 5- to 7-year range. Eurodollar FRNs tend to be seen as an alternative to straight fixed-interest bonds, but they can in principle be used like FRCDs. Eurodollar FRNs have been issued primarily, but not exclusively, by banks.

A secondary market exists in Eurodollar FRCDs and FRNs, although dealer spreads are quite large. Secondary market makers' spreads for FRCDs are normally ¼ percent of principal value.²⁰ The spread quoted on FRNs in the secondary market is generally ½ percent of principal value.²¹

Interest Rate Relationships Between Eurodollar Deposits and Deposits at Banks in the United States Arbitrage keeps interest rates closely aligned between Eurodollar deposits and deposits with roughly comparable characteristics at banks located in the United States. This is illustrated in Charts 1 and 2. Chart 1 shows yields on Federal funds and overnight Eurodollar deposits. Chart 2 shows yields on Eurodollar CDs and CDs issued by banks located in the United States.

The Relative Riskiness of Eurodollar Deposits and Dollar Deposits Held in the United States²² There are three basic sources of risk associated with holding Eurodollars. The first concerns the chance that authorities where a Eurodollar deposit is held may interfere in the movement or repatriation of interest or principal of the deposit. But this risk factor does not necessarily imply that Eurodollar deposits are riskier than dollar deposits held in the United States. The riskiness of a Eurodollar deposit relative to a dollar deposit held in the United States can depend on the deposit holder's residence. For

United States residents, Eurodollars may appear riskier than domestic deposits because of the possibility that authorities in the foreign country where the deposit is located may interfere in the movement or repatriation of the interest or principal of the deposit. Foreign residents, Iranians for example, may feel that the United States Government is more likely to block their deposits than the British Government. Consequently, Iranians may perceive greater risk from potential government interference by holding dollar deposits in the United States than by holding Eurodollar deposits in London.

A second element of risk associated with Eurodollars concerns the potential for international jurisdictional legal disputes. For example, uncertainty surrounding interaction between United States and foreign legal systems compounds the difficulty in assessing the likelihood and timing of Eurodollar deposit payment in the event of a Eurodollar issuing bank's failure.

A third type of risk associated with holding Eurodollars concerns the relative soundness *per se* of foreign banks compared to banks located in the United States. Specifically, it has been argued that Eurodollars are absolutely riskier than deposits held in the United States because deposits held in the United States generally carry deposit insurance of some kind while Eurodollar deposits generally do not. In addition, it has been argued that in event of a financial crisis banks located in the United States are more likely to be supported by the Federal Reserve System, whereas neither Federal Reserve support nor the support of foreign central banks for Eurodollar banking activities in their jurisdiction is certain.

A related factor compounding the three basic risk factors identified above is the greater cost of evaluating foreign investments compared with domestic investments. Acquiring information on the soundness of foreign banks is generally more costly than assessing the soundness of more well-known domestic banks. This means that for a given level of expenditure on information acquisition, investors must generally accept more ignorance about the soundness of a foreign bank than a domestic bank.

Two comments on this argument are relevant here. First, the fact that it is more costly to evaluate foreign than domestic investments does not imply that Eurodollar deposits are inherently riskier than deposits held in the United States. If a depositor resides in the United States the argument implies that a given expenditure on research will generally

¹⁹ Ibid., p. 7.

²⁰ Dobbs-Higginson [8, p. 59].

²¹ Ibid., p. 56.

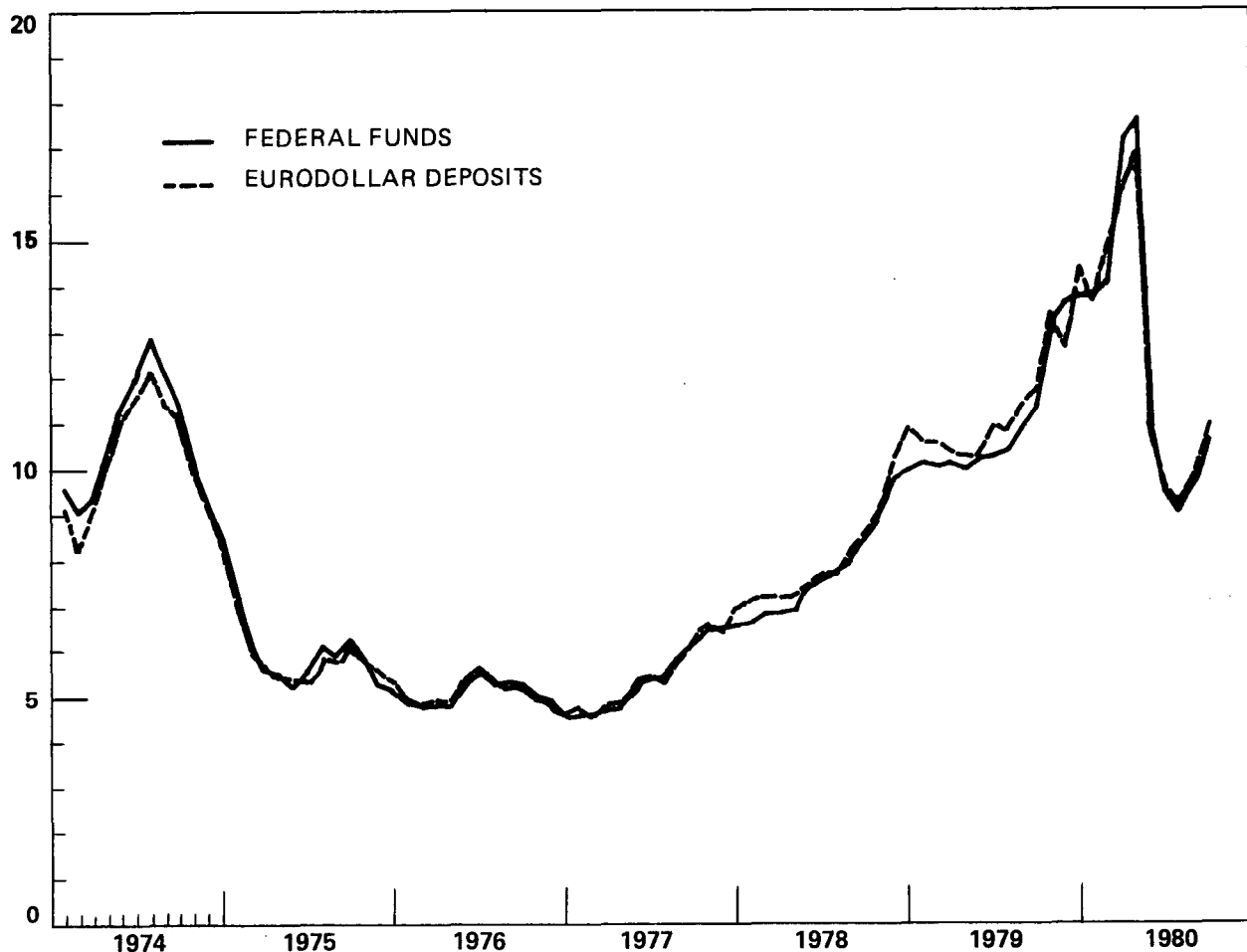
²² See Dufey and Giddy [9, pp. 187-90] and Tyson [17] for more discussion of the riskiness of Eurodollars.

Chart 1

YIELDS ON FEDERAL FUNDS AND OVERNIGHT EURODOLLAR DEPOSITS

Percent per annum

(monthly average)



Source: Morgan Guaranty Trust Company of New York, *World Financial Markets*.

yield more information about the safety of deposits located in the United States than in the Eurodollar market. But if the depositor resides outside the United States, the reverse may be true.

Having said this, it must be pointed out that the amount of financial disclosure required by regulatory authorities abroad is generally not as great as in the United States. This fact may make it more difficult to evaluate the soundness of non-U. S. banks than U. S. banks for any depositor, regardless of his residence.

Second, to a large extent assessing the safety of Eurodollar deposits relative to deposits in banks located in the United States is made easier by the fact

that many banks in the Eurodollar market are affiliated with and bear the name of a bank whose home office is in the United States. For example, a London branch of a United States bank is as closely associated with its home office as a branch located in the United States.

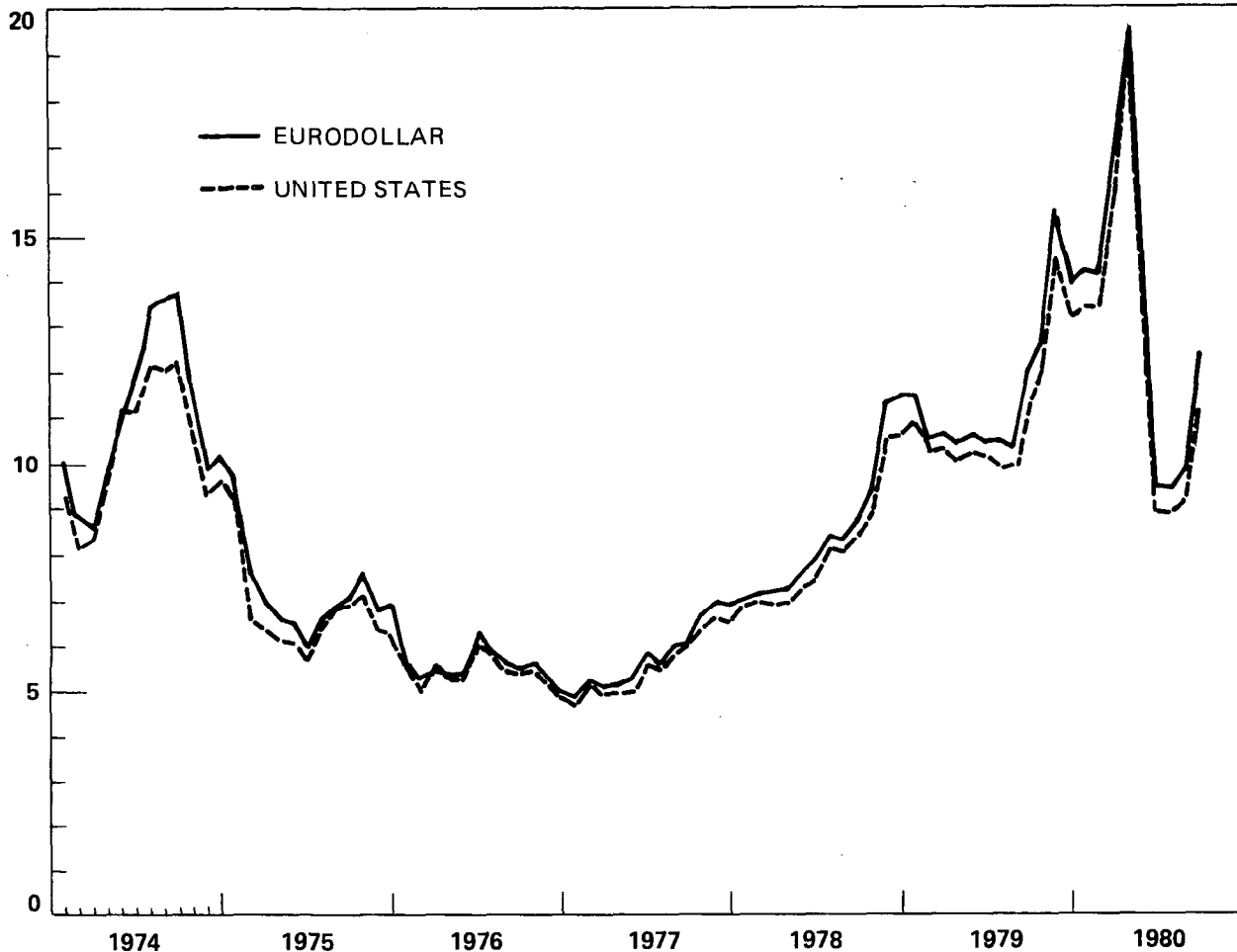
However, foreign offices bearing the name of a United States bank, usually in a slightly altered form, have been set up as subsidiaries. Under most legal systems, a branch can not fail unless its head office fails; but a subsidiary can fail even if its parent institution remains in business. Technically, a foreign office can bear the name of a United States bank in some form, and yet the parent institution may not be

Chart 2

YIELDS ON UNITED STATES AND EURODOLLAR THREE-MONTH CERTIFICATES OF DEPOSIT

Percent per annum

(at or near the first of the month)



Source: Salomon Brothers, *An Analytical Record of Yields and Yield Spreads*, Part IV, Table 2.

legally bound to stand fully behind the obligations of its foreign office. This suggests that a foreign office named after a parent United States bank may not be as sound as its namesake, although the parent bank, unquestionably, has great incentive to aid the foreign office in meeting its obligations in order to preserve confidence in the bank's name.

On the whole, it is difficult to assess the relative riskiness of Eurodollar deposits and dollar deposits held in the United States. Some factors affecting relative risk can be identified, but their importance is difficult to measure. What is more, perceived relative riskiness can depend on the residence of the depositor. The extent to which risk-related factors

affect the interest rate relationship between Eurodollar deposits and comparable deposits at banks in the United States remains unclear.

Summary From the depositor's point of view, Eurodollar deposits are relatively close substitutes for dollar deposits at banks located in the United States. Eurodollar deposits are able to compete effectively with deposits offered by banks located in the United States because Eurodollar deposits are free of reserve requirements and most other regulatory burdens imposed by the United States monetary authorities on banks located in the United States. In fact, the tremendous growth of the Eurodollar market

in the last two decades has largely been the result of efforts to move dollar financial intermediation outside the regulatory jurisdiction of the United States monetary authorities.

Host countries have competed eagerly for Euro-dollar business by promising relatively few regulations, low taxes, and other incentives to attract a

portion of the Eurodollar banking industry. Financial intermediation in United States dollars is likely to continue to move abroad as long as incentives exist for it to do so. Since these incentives are not likely to disappear soon, the Eurodollar market's share of world dollar financial intermediation is likely to continue growing.

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THE QUANTITY THEORY TRADITION AND THE ROLE OF MONETARY POLICY

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Introduction Currently, there is an intense debate within the economics profession over the extent of the role that the central bank should play in the economy. One view, with intellectual roots in the work of nineteenth and early twentieth century "quantity theorists," favors a limited role for the central bank with two-fold objectives. One objective is achievement of a stable price level. Knut Wicksell, a Swedish economist, could write at the turn of the century, "The establishment of a greater, and if possible absolute, stability in the value of money has thus become one of the most important practical objectives of political economy."¹ Another objective is to ensure that the actions of the central bank do not themselves become a source of economic instability. Wicksell referred to this possibility in the following quote. "By means of money (for example by State paper money) it is possible—and indeed this has frequently happened—to destroy large amounts of real capital and to bring the whole economic life of society into hopeless confusion."² The ideas associated with the "quantity theory of money" are reviewed in the following sections. A final section presents evidence in graphical form that is often used to support quantity theory ideas.³

Quantity Theory In order to understand the quantity theory of money, it is necessary to start with a definition and an analytical distinction. "Money" in popular parlance is used in three senses. It can mean income, credit, or the currency and transactions balances held by the public at financial institutions. It is the last definition that is used in the expression "the quantity theory of money." The

analytical distinction is between "nominal" and "real" quantities. Nominal quantities are measured in dollars; real quantities are measured independently of dollars. The nominal quantity of money one holds is simply the number of dollars of currency and transactions balances he has. The real quantity of money one holds is the amount of goods and services that this nominal quantity will purchase. The price level, typically, is expressed as the number of dollars required to purchase a specified basket of goods and services. The price level, or its reciprocal, then translates a given nominal quantity of money into a real quantity. It is their real, not nominal, money balances that individuals care about.

The flavor of quantity-theory thinking is conveyed by two assumptions. One is that the public's demand for real money holdings is "stable." The other is that the monetary authority determines the nominal money holdings of the public, and then the public determines the real value of these nominal money holdings as a consequence of variations in the price level due to its (the public's) spending behavior. At the existing price level, the given nominal quantity of money determines an actual quantity of real money balances. A discrepancy between these actual real money balances and the real money balances desired by the public causes the public to alter the rate at which it spends. These alterations in the expenditure of the public cause the price level to change in a way that eliminates the discrepancy between actual and desired money balances.

From this perspective, the price of money is the reciprocal of the price level. (The reciprocal of the price level measures units of a standardized basket of commodities per dollar.) A change in the quantity of money (or its rate of growth) may affect variables such as the real (inflation-adjusted) rate of interest and real income, but the effect is transitory. It is not these changes, but rather the change in the price level that reestablishes the equilibrium relationship of equality between the actual and the desired real money holdings of the public. A given percentage increase (decrease) in the quantity of money will

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¹ Wicksell [8; pp. 7, 8].

² Wicksell [8; p. 6].

³ The exposition of quantity theory ideas draws on Milton Friedman [3, 4, and 5]. The discussion of money and interest rates follows Milton Friedman [2].

cause the same percentage increase (decrease) in the price level. The price of money will fall (rise).⁴

The price level is determined by the interaction between the demand for and the supply of money. One implication of the assumed stability of the public's demand for money is that, as an empirical matter, changes in the supply of real money balances (caused by changes in the nominal quantity of money valued at the existing price level) are large relative to changes in the public's demand for real money balances. As a consequence, the price level, or inflation rate, can be explained primarily by reference to the supply side, that is, by the behavior of the money supply. This assumption is summarized by saying that "inflation is a monetary phenomenon."

The assumptions of the quantity theory are illustrated in Milton Friedman's illustration of a helicopter drop of money from the sky. (The helicopter corresponds to the assumption that the monetary authority controls the nominal quantity of money and that monetary disturbances arise from the actions of the monetary authority, not the private sector.) After

⁴ These ideas can be expressed by reference to the "equation of exchange" in its cash-balances formulation:

$$(1) \quad M = k(i) \cdot P \cdot y.$$

M is money, P is the price level, and y is real income. The symbol k represents the public's demand for real money balances, expressed as the fraction of a year's nominal income the public desires to hold in the form of nominal cash balances. The demand for real money balances is shown as depending on the rate of interest, i. The equation of exchange can be rewritten as follows:

$$(2) \quad \left(\frac{M}{P}\right)_s = (k(i) \cdot y)_d.$$

Given M, the nominal quantity of money, the left-hand side represents the supply of real money balances and the right-hand side represents the public's demand for real money balances. The two sides are equated by changes in the price level, P.

Quantity theorists differ with non-quantity theorists with respect to how the two sides of (2) are equated. Consider the statement, made only by non-quantity theorists, that increases (or high rates of growth) of the money supply are not inflationary in a recession. The public, it is argued, will adjust to the increased supply of real money balances by an increased demand (represented by the right-hand side of (2)). The increased demand will derive from a fall in the interest rate, i, and a rise in real income, y.

Quantity theorists argue that the above statement, about the absence of inflationary consequences due to an increase in the money supply effected during a recession, is misleading. The existence of a recession may retard the inflationary consequences of an increase in the money supply. An increase of, say, 10 percent in the money supply from a given level, however, will ultimately produce a price level 10 percent higher than if the money supply had been kept at its original level, regardless of whether the increase occurred during a recession. From the quantity-theory perspective, in which the price of money is the reciprocal of the price level, an increase in the money supply must ultimately cause an equiproportionate rise in the price level. Otherwise, the demand for money is unstable.

Individuals have gathered up the fallen money, they will try to reduce their money holdings to their original level by spending more than they receive. Individuals taken collectively, however, cannot spend more dollars than they receive. The public cannot reduce its increased holdings of nominal money. What the public will do is increase the rate at which it spends. The increased rate of expenditure will cause prices to rise. The surplus money holdings are eliminated, not through a reduction in the nominal quantity of money, but rather through a reduction in the real quantity of money caused by the rise in the price level. The rise in the price level returns the real money holdings of the public to their original level.

Because of its control over the nominal quantity of money, the monetary authority influences the rate at which the public spends. For example, in the helicopter illustration, an increased quantity of money causes the public to spend at a faster rate.⁵ Quantity theorists like Irving Fisher made the relationship between money and the expenditure of the public into a monetary explanation of the business cycle. Consider a decrease in the quantity of money. The public, in an attempt to restore its money holdings to their original level, will reduce the rate at which it spends. Producers respond initially to the reduced spending on their output by reducing output and employment. In time, the price level falls and the spending of the public expressed in real terms, that is in terms of purchasing power, returns to its original level. A recession persists over the interval of time required for the price level to fall sufficiently to restore the real money balances and the real spending of the public to their original levels. The assumed stability of the public's demand for money implies that the changes in the expenditure of the public that generate the business cycle originate with changes in the supply of money, not with changes in the demand for money.

⁵ The relationship between nominal money balances and the rate of nominal expenditure by the public is formalized in the transactions version of the equation of exchange:

$$(3) \quad M \cdot V(i) = P \cdot y.$$

The right-hand side of (3) is nominal, or current-dollar, income, say, net national product. V, or velocity, is the reciprocal of the k defined in (1). It defines the rate at which the quantity of money turns over against nominal income. The velocity of money is one way of measuring the public's demand for money, and quantity theorists emphasize its stability. M times V, the left-hand side of (3), is the rate at which the public spends, measured in nominal, or current-dollar, terms. The assumption that V does not change in a way that offsets the effect of changes in M (apart from short-lived intervals of time) implies that the rate of nominal expenditure by the public is determined by M, the money supply.

Money and Interest Rates Economists differentiate among three effects of an increase of the money supply on interest rates. The first effect is the liquidity effect. An increase in the supply of money will cause asset holders to try to rearrange their portfolios in an attempt to move out of money into other assets. The result is to bid up the prices of these other assets and to depress interest rates. The second effect is the income effect. The increased supply of money increases the rate at which the public spends. The initial, stimulative impact on output increases credit demands. The second effect raises interest rates. The final effect concerns the inflation premium the public builds into interest rates. The increased supply of money will cause the price level to rise. If the public comes to anticipate increased inflation, it will increase the inflation premium built into interest rates in order to preserve the real, or inflation-adjusted, rate of return on bonds. Economists of a quantity theory persuasion emphasize, as an empirical matter, the importance of the last two effects. They argue that, in fact, high rates of growth of the money supply are associated with high, not low interest rates.

Policy Implications The quantity theory of money yields only a small number of implications for policy, but these implications are important. The most obvious implication is that control of the money stock is the key to controlling inflation. Another implication is that the behavior of the money supply is the best measure of the impact of monetary policy on the economy. This implication is important because in the past the monetary authority has used other guides for the conduct of monetary policy, in particular, conditions in the credit markets. For example, the low level of interest rates in the Great Depression was at the time viewed as evidence that monetary policy was easy. As measured by the behavior of the money supply, however, monetary policy was extremely restrictive. A final implication is that over long periods of time the rate of growth of the money supply has no direct effect on the rate of growth of real income or on the real (inflation-adjusted) rate of interest.⁶

⁶ There may, of course, be indirect effects deriving from institutional considerations such as specification of the tax code in nominal, rather than in inflation-adjusted, terms; price fixing by the government in nominal rather than in real terms; political pressure for wage and price controls; and so on. There will also be a second-order effect in that the public will hold smaller real money balances and thus will enjoy fewer services from their money balances.

The research of Milton Friedman and Anna Schwartz has given additional empirical content to the quantity theory and has produced additional implications for policy.⁷ The results of their study of the cyclical relationship between money and economic activity are consistent with the hypothesis that, in general, cyclical instability originates with the behavior of the money supply. Friedman concludes that steady growth of the money supply will eliminate most major cyclical fluctuations in economic activity.⁸ Friedman and Schwartz also contend that the relationship between money and nominal income (or the expenditure of the public) is predictable only over lengthy intervals of time or as an average of many particular instances over shorter intervals of time. For example, a discrete change in the percentage growth of the money supply will produce the same change in the percentage growth of nominal income, but only with a lag that is usually long and, in particular instances, variable.

Friedman concludes that monetary policy is not a suitable instrument for offsetting fluctuations in nominal income.⁸ The length of the lag referred to above requires that economic activity be forecast for a considerable period into the future in order for monetary policy to be used as a countercyclical tool. The variability of the lag also requires that the length of the lag be forecast in the specific instances in which monetary policy is to be used as a countercyclical tool. Friedman argues that the difficulty of forecasting the future behavior of the economy and the timing of the effect of monetary policy in particular instances means that an actively countercyclical monetary policy could destabilize, rather than stabilize, the economy.

Graphical Evidence Four charts are presented below that summarize relationships discussed above. The first chart summarizes the central relationship between money and the price level. It shows a plot of quarterly observations of the inflation rate, as measured by percentage changes over past four-quarter intervals of the GNP deflator. It also shows quarterly observations of the rate of growth of the money supply, also measured by percentage changes over past four-quarter intervals. The latter observations correspond not to the date at which they are plotted, but rather to the date seven quarters earlier. In the jargon of economists, the rate of growth of the

⁷ Friedman and Schwartz [6].

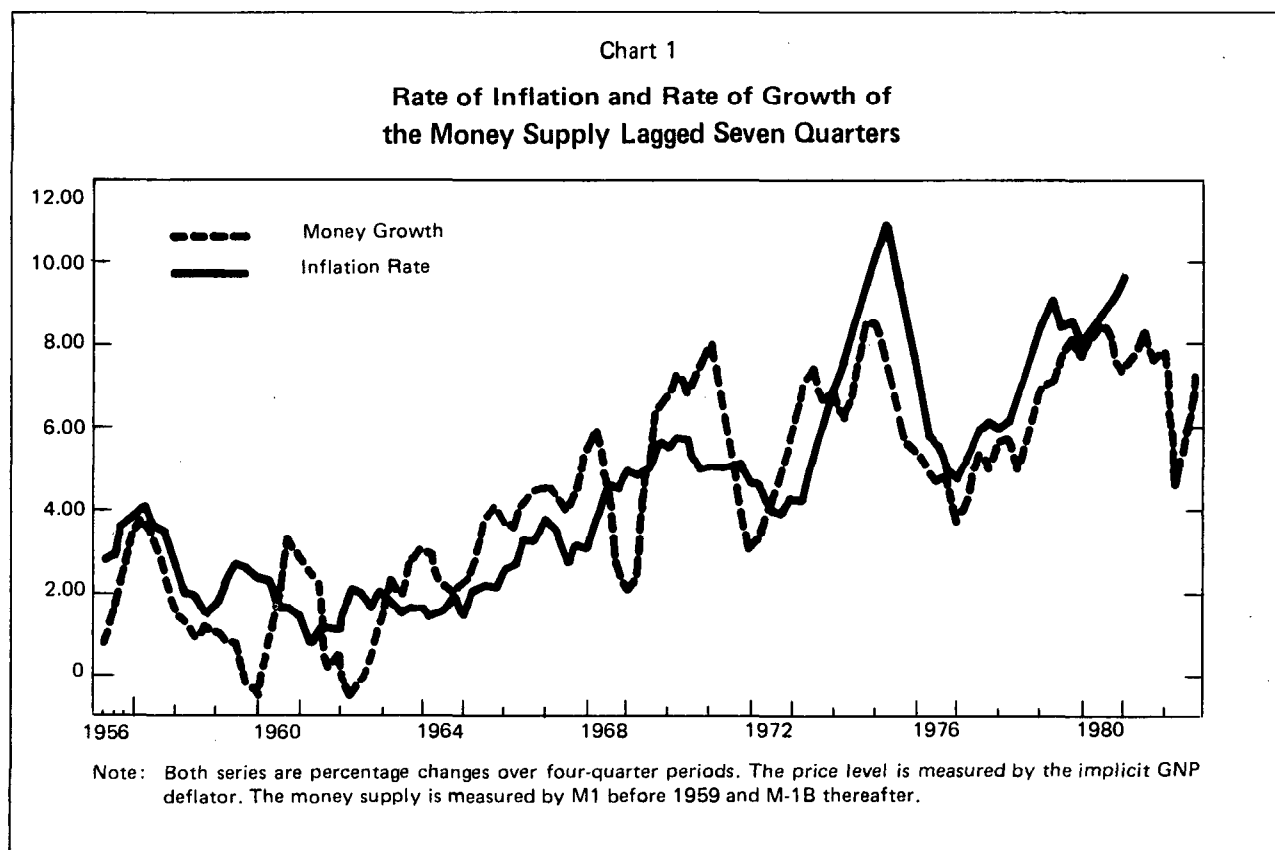
⁸ Friedman [1].

money supply series is lagged seven quarters.⁹ The rate of growth of the money supply determines the rate of inflation with a long, distributed lag. In the United States in the post-Korean War period, the bulk of the effect has come with about a two-year lag.

An examination of Chart 1 suggests several comments. First, and most important, the rate of growth of the money supply does predict broad movements of the inflation rate. Second, the level of the rate of growth of the money supply and the level of the rate of inflation are about equal for the whole period, 1956 to 1980. This result was produced by the cancelling of two effects. On the one hand, the velocity of money, the rate at which money turns over against nominal income, increased at a trend rate of about three percent. (Each year, on average, the public figured out how to support a given amount of nominal expenditure with about three percent less cash.) On the other hand, real GNP increased at a trend rate of about three percent. The first effect raised and the second effect lowered the rate of inflation relative to the rate of growth of the money supply.

⁹ The seven-quarter lag was chosen by a visual inspection of the two series. The money supply is measured by M-1B after 1959 and M1 before 1959.

Third, from the early 1960s through the early 1970s, the rate of growth of money generally exceeded the inflation rate; thereafter, the inflation rate generally exceeded the rate of growth of money. An explanation of this reversal can emphasize either the relative strength of the demand for real money balances in the former period, or the relative weakness of demand in the latter period. An explanation of the first kind is that the strong, practically cycle-free growth of the 1960s caused the public to reassess in an optimistic direction prospects for the future growth of the economy and, consequently, estimates of its wealth. Assuming that the demand by the public for real money balances depends upon the public's estimate of its wealth, such an optimistic reassessment of its wealth could have caused the relative strength in the public's demand for real money balances. An explanation of the second kind is that the high level of nominal interest rates in the 1970s spurred corporations to introduce cash-management techniques and spurred financial institutions to introduce new monetary liabilities. Such developments could have caused the relative weakness in the public's demand for real money balances.



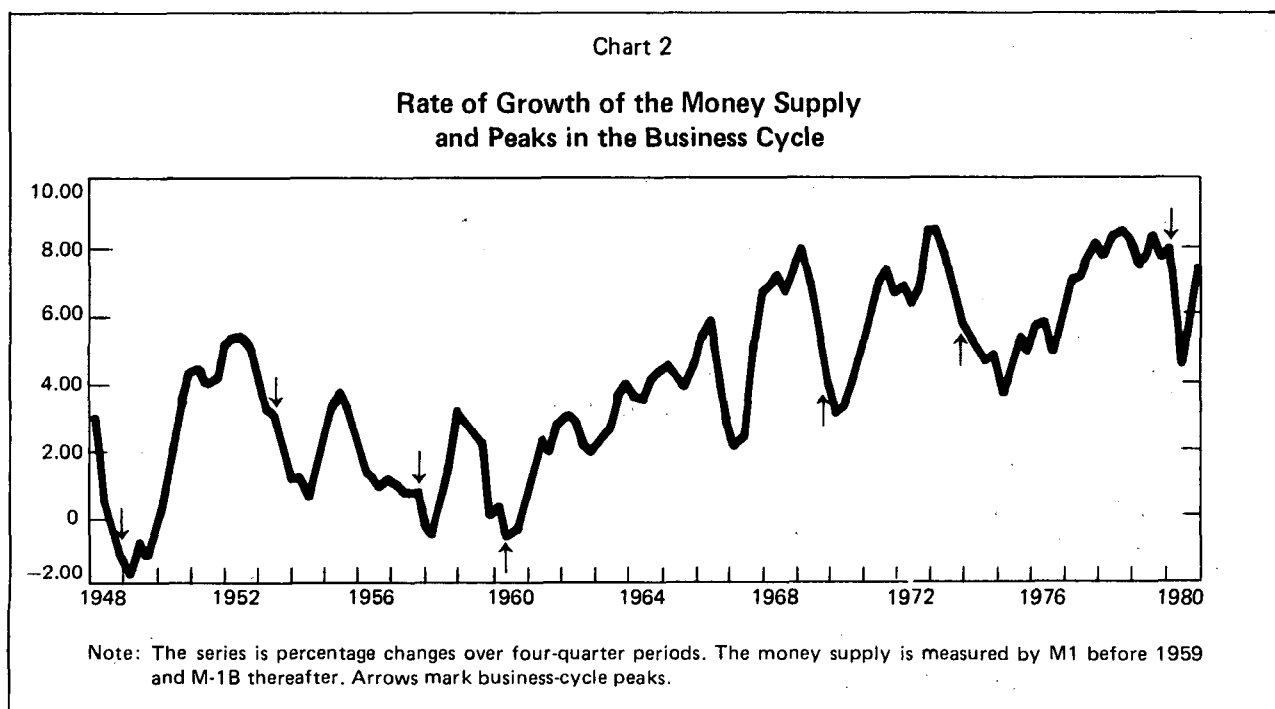
Fourth, past, not current, rates of growth of the money supply are the better predictor of the current inflation rate. This temporal relationship is consistent with the view that it is the rate of growth of the money supply that causes the inflation rate. This relationship is inconsistent with the various institutional theories of inflation. Such theories argue variously that inflation is produced as a consequence of competition among social groups for incompatibly large slices of national income, as a consequence of the greed of corporations or labor unions, or as a consequence of an ever-changing number of special, ad hoc factors like bad harvests and oil price increases. Institutional theories of inflation possess the common characteristic that the monetary authority must "finance" the price level that arises independently of its actions by providing increases in the quantity of money proportional to increases in the price level. Institutional theories of inflation, therefore, require that the movements in money and price series correlate positively either on a contemporaneous basis or with money lagging prices.¹⁰

¹⁰ Actually, institutional "theories" of inflation are not theories in the sense of the word as used by economists. These theories do not yield predictions of the rate of inflation that can, subsequently, be verified or falsified. They provide only after-the-fact rationalizations of observed rates of inflation.

Fifth, over the entire period from 1956 through 1980, the rate of inflation rises, consistent with the rise in the rate of growth of the money supply. The rate of inflation, however, is not flexible in only one direction. Reductions in the rate of growth of the money supply produce reductions in the rate of inflation. As shown in Chart 1, the most dramatic example is the fall in the rate of inflation over the two-year period beginning in 1975.

Finally, based upon the experience of the last five years, Chart 1 indicates that the rate of growth of the money supply (as measured by M-1B) that is compatible with price stability is about minus three-quarters of a percent per year. Chart 1 also indicates that, over the next two years, four-quarter inflation rates, as measured by the GNP deflator, are likely to decline from their recent level of 10 percent to 9 and then 8 percent.

Chart 2 exhibits quarterly observations of four-quarter percentage changes in the money supply (as defined in Chart 1). Arrows mark peaks in the business cycle (as demarcated by the National Bureau of Economic Research). Although the length of the lead time is variable and occasionally quite long, business-cycle peaks are preceded by peaks in the money-growth series. This relationship is consistent with the hypothesis that monetary decelerations cause recessions. The exception is the peak



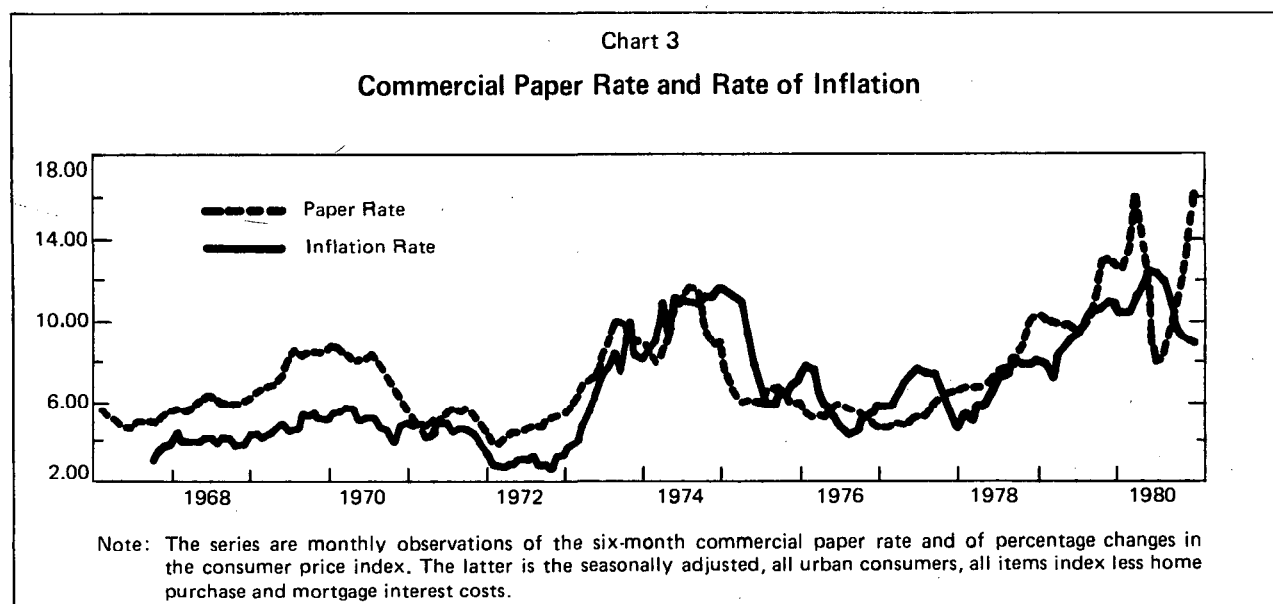
of the current business cycle, the first quarter of 1980. It was not preceded by any prior slowdown in the rate of growth of the money supply. This fact suggests that the current recession is due to non-monetary causes.

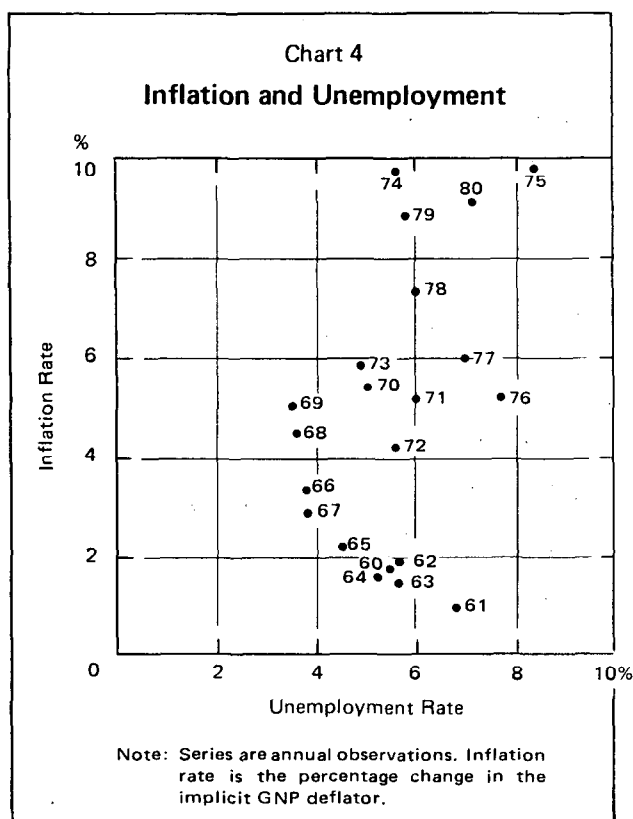
The discussion above of money and interest rates stressed the positive relation between the rate of growth of the money supply and the level of interest rates produced as a consequence of the effect of money growth on the public's expectations of inflation. Chart 3 displays monthly observations of the six-month commercial paper rate and the annualized percentage change in the consumer price index over past six-month intervals.¹¹ The inflation rate that influences the rate of interest is the one that the public anticipates will occur over future, not past, six-month intervals. The past inflation rate is used here as a proxy for the inflation rate that the public anticipated would occur in the future. Market rates do not move in lock step with inflation rates. For example, for almost a four-year period beginning in 1974, the customary positive differential between the rate of interest on money-market instruments and the rate of inflation practically disappeared. Perhaps the

pervasive uncertainty of the economic environment at this time caused investors to place a high enough premium on remaining liquid that they were willing to forego positive real rates of return. Alternatively, investors might have regularly underestimated the future rate of inflation. Short-term interest rates fell in the middle of 1974, in advance of the fall in the inflation rate, due to the sharp drop off in economic activity. More recently, short-term interest rates rose, fell, and then rose sharply. These movements were dominated by changes in expectations about the cyclical behavior of the economy, the government deficit, the Special Credit Restraint Program, and the shifts between long- and short-term financing of corporations. The broad movements in the inflation and interest rate series shown in Chart 3 are, nevertheless, similar. This broad correspondence is consistent with the hypothesis that high rates of growth of the money supply cause high rates of inflation and, consequently, high (nominal) rates of interest.

Chart 4 deals with the ability of the monetary authority to influence the behavior of real variables (such as output and employment), as well as nominal variables. Standard theorizing along quantity-theory lines has emphasized that the ability of the monetary authority to influence the behavior of real variables is transitory. For example, the monetary authority can increase the money supply in order to increase the rate of spending by the public. At first, producers may respond by working harder and producing more; real income will rise. Producers, however, will raise prices in the face of a persis-

¹¹ The CPI used is the seasonally-adjusted all urban consumers index, minus home purchase and mortgage costs. The graph using the CPI including home purchase and mortgage costs possesses a very similar appearance. The CPI series is lagged two months in order to take account of the two-month lag in its publication. For example, the observation on a January corresponds to the percentage change in the CPI over the six-month period ending in November of the previous year. For most of January, the November CPI figure is the most recent figure available.





tently higher level of demand, and, in time, the increase in money will be matched by an increase in the price level. Nominal magnitudes, that is dollar-denominated magnitudes, will rise, but real magnitudes, such as output, will return to their original levels. John Stuart Mill, in 1833, emphasized the transitoriness of the ability of the monetary authority to stimulate output. (Mill was criticizing Thomas Attwood who had argued that the money supply should be manipulated in order to maintain a high level of employment.)

Mr. Attwood opines, that the multiplication of the circulating medium, and the consequent diminution of its value, do not merely diminish the pressure of taxes and debts, and other fixed charges, but give employment to labor, and that to an indefinite extent. . . . Mr. Attwood's error is that of supposing that a depreciation of the currency really increases the demand for all articles, and consequently their production, because, under some circumstances, it may create a false opinion of an increase of demand; which false opinion leads, as the reality would do, to an increase of production, followed, however, by a fatal revulsion as soon as the delusion ceases.¹²

¹² This quote is reprinted in [7; p. 14]. Mill was talking about changes in the price level while current debates talk about changes in the rate of change of the price level.

In the above quotation, Mill points out that producers face the task of distinguishing between two types of change in demand. One type is a change particular to individual producers. This type of demand change calls for some combination of a change in price and output. The other type of demand change, associated with changes in the money supply, affects all producers. The latter type of demand change calls for a price change exclusively. Monetary policy cannot be persistently stimulative because in time producers distinguish between these two types of changes in demand.

Current theorizing in the quantity theory tradition assumes that producers of goods and services form their expectations about the future in a rational way. In forming expectations, producers make efficient use of information. In particular, they take account of the behavior of the monetary authority and of how this behavior affects the economy. Monetary policy cannot be persistently stimulative because rationally-formed expectations will cause producers to anticipate the variations in aggregate demand caused by manipulation of the money supply. Producers will respond to such variations by changing prices, not output.¹³

Exponents of the ideas expressed above point to evidence such as is contained in Chart 4. Chart 4 plots annual observations of the unemployment rate (horizontal axis) against the inflation rate (vertical axis). In the 1960s, stimulative monetary policy did produce low rates of unemployment. The observations from 1961 through 1969 associate high rates of inflation with low rates of unemployment. In the 1970s, however, after the public had come to anticipate that policy would be stimulative, monetary policy failed to lower the unemployment rate. After 1970,

¹³ The quantity theory stresses the relationship between the nominal quantity of money and the nominal, or dollar-denominated, rate of expenditure of the public. (See footnote 5 on the transactions version of the equation of exchange.) A change in the money supply, according to the theory, will produce a change in the price level, that is, a higher rate of nominal, but not real, expenditure. The quantity theory, however, says nothing about the length of time required for a change in the money supply to be fully reflected in a change in the price level. Likewise, in the interval of time before complete adjustment of the price level, it says nothing about how a change in nominal expenditure caused by a change in the money supply is divided between a change in output and in the price level. Current theorizing in the quantity-theory tradition has been directed toward filling these gaps by modeling formally how the public forms its expectations about the future and, in particular, its expectations about the behavior of monetary policy. In such theorizing, the distinction between predictable and unpredictable changes in the money supply is the key distinction for determining whether changes in the money supply are reflected in output, as opposed to price, changes.

high rates of inflation are not associated with low rates of unemployment.

Summary Economists in the quantity theory tradition believe that the monetary authority should

concentrate on two objectives, price stability and prevention of monetary disturbances arising from disruptive behavior of the money supply. These objectives, it is contended, can be achieved best by low, steady rates of growth of the money supply.

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