

ESSAYS IN INTERNATIONAL FINANCE

No. 179, December 1990

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EXCHANGE RATES IN THEORY AND  
IN REALITY

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MICHAEL L. MUSSA



INTERNATIONAL FINANCE SECTION

DEPARTMENT OF ECONOMICS  
PRINCETON UNIVERSITY  
PRINCETON, NEW JERSEY

## ESSAYS IN INTERNATIONAL FINANCE

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The author of this Essay, Michael L. Mussa, is William H. Abbott Professor of International Business in the Graduate School of Business of the University of Chicago. From 1986 to 1988, he served as a member of the President's Council of Economic Advisers, with primary responsibilities in the areas of macroeconomics and international economies. He has written numerous articles on topics in international trade and finance, monetary economics, and macroeconomics.

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PETER B. KENEN, *Director*  
*International Finance Section*

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## CONTENTS

1	INTRODUCTION	1
2	THE RANDOM CHARACTER OF EXCHANGE-RATE CHANGES	2
3	ASSET-PRICING MODELS OF EXCHANGE RATES	3
4	BUBBLES AND BANDWAGONS IN EXCHANGE-RATE BEHAVIOR	7
5	THE EMPIRICAL RELEVANCE OF PURCHASING POWER PARITY	14
6	NOMINAL-EXCHANGE-REGIME NEUTRALITY	16
7	THE DOLLAR AND U.S. MONETARY POLICY	28
8	CONCLUSION	36
	REFERENCES	37

## LIST OF TABLES

1	Sources of Real-Exchange-Rate Variability: France and the United States	19
2	Sources of Real-Exchange-Rate Variability: Switzerland and the United States, West Germany, and Austria; Austria and West Germany	22
3	Sources of Real-Exchange-Rate Variability: Ireland and the United States, United Kingdom, and West Germany	23
4	Sources of Real-Exchange-Rate Variability: Canada and the United States	25

## FIGURE

1	Exchange Rates and Relative Price Level: France and the United States	18
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## EXCHANGE RATES IN THEORY AND IN REALITY

### 1 Introduction

Seventeen years ago, the Bretton Woods System gasped its final breath, and exchange rates between the U.S. dollar and other major national currencies were left to fluctuate primarily in response to market forces. I was just beginning my career as an international economist then, and, like many other advocates of floating exchange rates, I expected the new international monetary system to be a substantial improvement on the old. It would avoid the periodic crises associated with changes in official parities or with efforts to avoid such changes. After an initial period of adjustment for exchange-rate re-alignment, it would allow market forces to move exchange rates smoothly and gradually to offset differences in national inflation rates. Monetary and fiscal policy could be used more flexibly to stabilize the domestic economy, and the use of trade and capital controls for balance-of-payments purposes would be reduced. Moreover, under floating exchange rates, payments imbalances would generally be small and easily corrected by relatively modest changes in real exchange rates. Talk about a rosy scenario! Well, at least I demonstrated a talent for economic prognostication that would later prove useful when working on official economic forecasts.

This afternoon's lecture, in honor of the distinguished international economist Frank Graham, encompasses two largely separate topics: (1) International economists are often embarrassed that our theoretical models frequently fare poorly in explaining actual economic behavior. To some extent, our embarrassment is richly deserved. Broad classes of models of exchange-rate determination are frankly unrealistic and yield implications that do not correlate with, and are even directly contradictory to, the most basic facts concerning the actual behavior of exchange rates. Their persistent use to analyze issues of economic policy reflects an element more of religious faith than of scientific confirmation. (2) By contrast, some of the apparent empirical failures of our theoretical models are correctly attributable to deficiencies of technique or lack of sophistication in analyzing and interpreting the data. Of course, I tend to believe the empirical shortcomings of my own theoretical models are explained by such deficiencies—a prejudice that may be shared symmetrically by some other scholars.

I shall discuss in this lecture the relationship between theory and reality in the behavior of exchange rates under six headings: (1) the random character of exchange-rate fluctuations; (2) the virtues of an asset-pricing model of exchange-rate determination; (3) bubbles and bandwagons in exchange-rate behavior; (4) the empirical relevance of purchasing power parity; (5) the property of nominal-exchange-regime neutrality; and (6) the U.S. dollar and monetary policy. Before proceeding to these specific issues, I should emphasize that little if anything discussed in this lecture represents a novel contribution to international economics. The operating principle here is that repeating old truths has greater value than propounding new falsehoods.

## 2 The Random Character of Exchange-Rate Changes

The most consistently observed fact concerning the behavior of floating exchange rates is that changes in exchange rates are largely random and unpredictable. This has certainly been true since 1973 of daily, weekly, monthly, and quarterly changes in exchange rates of other major currencies against the U.S. dollar, and it appears to be broadly true of other experiences with floating exchange rates. As a general empirical regularity, the stochastic behavior of nominal exchange rates under floating-rate regimes is well approximated by a random walk. Variances of increments to these random walks often exhibit systematic time-series properties, but there is little that is predictable in the first moments of exchange-rate changes.<sup>1</sup>

The random-walk model applies generally to real as well as to nominal exchange rates. Real exchange rates are defined as nominal exchange rates corrected for relative movements in national price levels. Formally, if  $e$  is the logarithm of the price of foreign currency in terms of domestic currency and  $p$  and  $p^*$  are, respectively, the logarithms of the domestic and foreign price levels, then  $q = e - (p - p^*)$  is the logarithm of the real exchange rate. An increase in  $q$  means an increase in the price of goods of the foreign country relative to goods of the home country. Many studies have shown that, under floating-exchange-rate regimes, shorter-term changes in  $q$  are largely random and unpredictable. Work by Campbell and Clarida (1987) indicates that

<sup>1</sup> The approximate random-walk behavior of exchange rates has been widely commented upon in the literature; see, for example, Poole (1967), Frenkel (1981b), Frenkel and Mussa (1980), or Mussa (1979). The time-series properties of the variances of exchange-rate changes are examined extensively in Hsieh (1988).



much of the short-term movement in real exchange rates represents changes in the corresponding long-run equilibrium rates. Work by Huizinga (1987) and others, however, indicates that real exchange rates do not wander off without bound in the long term, as would be implied if real exchange rates were truly random walks. Instead, there appears to be a broad, ill-defined limit to long-term movements of real exchange rates and a weak tendency for real exchange rates to return toward a midrange of values. Nevertheless, movements of real exchange rates over a quarter or even a year are largely unpredictable.

The approximate random-walk behavior of nominal and real exchange rates is a major source of embarrassment for efforts to model the economic determinants of exchange-rate behavior; virtually all structural models of exchange-rate behavior are empirically outperformed by a simple random-walk model. Meese and Rogoff (1983a, 1983b) reached this conclusion in their original work, and Wolfe's extensive analysis of their findings (1985) confirms their conclusions, even allowing for parameter variation over time. Structural models consistently do worse in explaining movements of exchange rates than the naive model that assumes no change in exchange rates, even when structural models are allowed the (apparently dubious) advantage of replacing expected future values of exogenous forcing variables by their actually realized values. Even if a particular model does slightly better (or not much worse) than a random walk for in-sample explanation, it usually fails when used for out-of-sample prediction. Indeed, even fancy, nonlinear time-series models of exchange rates, which may have some in-sample advantage over a naive random walk, appear to have no consistent out-of-sample advantage (see Engel and Hamilton, 1989; and Kim, 1989).

This conclusion might suggest that nothing can confidently be said about the economic determinants of exchange-rate behavior. I shall argue, however, that such a nihilistic conclusion is unwarranted. Important points can be made concerning both the appropriate structure of economic models of exchange-rate determination and the economic forces that influence the behavior of exchange rates.

### **3 Asset-Pricing Models of Exchange Rates**

The approximate random-walk character of exchange rates provides strong guidance concerning the basic structure of empirically relevant models of exchange-rate determination. In particular, exclusively backward-looking models of exchange-rate dynamics are fundamentally

inadequate. Some general form of forward-looking, asset-pricing model is clearly necessary to convey the most basic facts of exchange-rate behavior.

In a vast array of backward-looking models of exchange-rate determination, there is a fixed long-run equilibrium determined by given values of certain exogenous variables. Starting from an inherited position away from long-run equilibrium, the exchange rate converges toward this equilibrium, provided the characteristic roots of the dynamic system are negative for a continuous time system (less than one for a discrete time system). Once the exchange rate has converged to long-run equilibrium, there is no further reason for exchange-rate movement.

A change in the exogenous variables determining the long-run equilibrium will set off a new round of dynamic adjustment. Such changes are entirely extrinsic, however, to the dynamic process governing exchange-rate behavior. There is no mechanism in exclusively backward-looking models through which anticipated future changes in the exogenous variables influence the behavior of the exchange rate before these changes actually occur. Random and unpredictable exchange-rate change is simply outside their formal scope.

In contrast, asset-pricing models of exchange-rate dynamics are inherently forward looking (see Black, 1973; Frenkel and Mussa, 1980, 1985; Obstfeld and Rogoff, 1984; Wilson, 1979; and Mussa, 1976, 1982, 1984).<sup>2</sup> They incorporate the idea that the value of an asset reflects some notion of the expected present value of its future returns. More specifically, the exchange rate in such models is strongly influenced by expectations of future economic conditions believed to be relevant for determining the exchange rate. Convergent solutions for the formulae that express this forward-looking dependence require positive characteristic roots in the processes governing exchange-rate dynamics (roots greater than unity for discrete time models). Random fluctuations of the exchange rate occur naturally in response to new information about future economic conditions relevant to the current exchange rate.

These general characteristics of an asset-pricing model are well illustrated by a simple linear model. Suppose that the logarithm of the current exchange rate,  $e(t)$ , depends on economic fundamentals currently affecting the foreign-exchange market, summarized by  $x(t)$ , and

<sup>2</sup> Dornbusch's famous "overshooting" model (1976) has important forward-looking elements but does not consider explicitly how the equilibrium exchange rate depends on the expected future path of economic fundamentals.

by current expectations of the logarithm of the exchange rate next period,  $E[e(t+1) | t]$ , based on currently available information. Specifically, suppose that

$$e(t) = x(t) + b\{E[e(t+1) | t]\}, \quad (1)$$

where  $b$  is a coefficient ( $0 < b < 1$ ) that expresses the sensitivity of the current  $e$  to its expected value next period. The economic determinants of  $b$  and of the  $x$ 's reflect the economic content of a particular model of exchange-rate behavior. To account for both real and monetary influences on exchange rates, such models might involve more than one asset-pricing relationship and more than one class of economic fundamentals. They might also incorporate some backward-looking dynamic processes in order to deal with sluggish adjustment of national price levels (discussed below) or with the consequences of cumulative changes in asset stocks. (see, for example, Mussa, 1984).

If expectations are "rational" in the sense that they are consistent with the validity of equation (1) in all future periods, then (1) becomes a forward-looking difference equation that determines the entire expected future path of the exchange rate, conditional on current expectations of the future behavior of the  $x$ 's; that is,

$$E[e(t+j) | t] = E[x(t+j) | t] + b\{E[e(t+j+1) | t]\}. \quad (2)$$

The characteristic root of this difference equation is  $1/b > 1$ . The solution of the equation expresses the exchange rate expected at any date  $t+k$  as the sum of two terms:

$$E[e(t+k) | t] = E[F(t+k) | t] + B(k | t). \quad (3)$$

The first term is the discounted sum of economic fundamentals expected to influence the foreign-exchange market starting in period  $t+k$ ; specifically,

$$F(t+k) = \sum_{j=0}^{\infty} b^j [x(t+k+j)]. \quad (4)$$

For this infinite sum to converge, the characteristic root  $1/b$  must be greater than unity. The second term is the so-called "rational speculative bubble," which must have the form

$$B(k | t) = C(t)[(1/b)^k], \quad (5)$$

in which  $C(t)$  is an arbitrary number. This term does not reflect the expected behavior of the economic fundamentals; it arises from the homogeneous solution to equation (2), the solution obtained when  $E[x(t+j) | t] = 0$  for all  $j$ . Because  $1/b > 1$ , it is clear that, whenever

$C(t)$  is not zero, the rational speculative bubble,  $B(k | t)$ , adds to the path of  $E[e(t + k) | t]$  a term that explodes exponentially as  $k$  rises. The behavior of this term is completely independent of the expected behavior of the economic fundamentals. For the present, we shall make the (only) sensible assumption that  $C(t) = 0$  for all  $t$ . Later, we shall return to discuss the issue of the rational speculative bubble.

Setting  $k = 0$  in equation (3) and assuming that  $e(t)$  is equal to its own current expectation, it follows that  $e(t)$  is determined by the present discounted sum of current and expected future economic fundamentals affecting the foreign-exchange market:

$$e(t) = E[F(t) | t] = \sum_{j=0}^{\infty} b^j \{E[x(t + j) | t]\}. \quad (6)$$

Applying this result to  $e(t + 1)$  and then subtracting the corresponding result for  $e(t)$  yields an expression for the change in the exchange rate,  $D[e(t)] = e(t + 1) - e(t)$ . That expression may be decomposed into two parts: the expected change in the exchange rate,  $D^e[e(t)] = E[e(t + 1) | t] - e(t)$ , and the unexpected change in the exchange rate,  $D^u[e(t)] = e(t + 1) - E[e(t + 1) | t]$ . The expected component reflects changes that are expected to occur in the economic fundamentals, based on information available at time  $t$ :

$$D^e[e(t)] = \sum_{j=0}^{\infty} b^j \{E[x(t + j + 1) - x(t + j) | t]\}. \quad (7)$$

The unexpected component reflects new information received in period  $t + 1$  that alters expectations concerning the behavior of the economic fundamentals:

$$D^u[e(t)] = \sum_{j=0}^{\infty} b^j \{E[x(t + j + 1) | t + 1] - E[x(t + j + 1) | t]\}. \quad (8)$$

By definition, the unexpected component of the change in the exchange rate is random and unpredictable from the perspective of economic agents at time  $t$ . Hence, provided that economic agents use some sense in applying and interpreting information relevant to determining exchange rates, this term naturally explains the random component of the change in exchange rates. Moreover, the notion that random changes in exchange rates are related to new information that alters expectations about economic fundamentals is also empirically attractive. Casual observation strongly indicates that exchange rates do react to this sort of information, at least on some occasions.

To say that exchange-rate changes are largely random and unpredictable does not imply that changes in expectations about the behavior of economic fundamentals are the only source of exchange-rate fluctuations. Indeed, following on the work of Shiller (1981), there has been

extensive discussion in the finance literature about whether the volatility of stock and bond prices is greater than can plausibly be explained by the volatility of economic fundamentals. This same issue of excess volatility is relevant for exchange rates. Because it is easier to identify the relevant economic fundamentals for stock or bond prices than for exchange rates, however, it is probably more fruitful to conduct the excess-volatility debate in the arena of finance than in the arena of international macroeconomics.

#### **4 Bubbles and Bandwagons in Exchange-Rate Behavior**

Specific economic developments or political events provide plausible explanations for some observed movements in exchange rates. Yet, many sharp changes and wide swings in exchange rates are difficult to explain entirely in terms of any consistent view of the economic fundamentals that ought to drive the behavior of exchange rates. To some observers, it appears obvious that some movements in exchange rates are more likely attributable to bandwagon effects, speculative bubbles, and other anomalies than to entirely rational assessments of new information about economic fundamentals.<sup>3</sup> Moreover, this appears to be true not only of exchange rates, but also of the prices of other assets that are determined in highly organized markets.

I have long been sympathetic to the view that the behavior of asset prices, including exchange rates, is afflicted by some degree of craziness. Many aspects of human behavior impress me as not entirely sane, and I see no reason why the behavior of asset prices should be a virtually unique exception. I vividly recall serving as a member of the Council of Economic Advisers when the stock market crashed on October 19, 1987. The Dow was down 150 points at noon, 200 points at 2 P.M., 300 points at 3 P.M., and over 500 points at the market close. On that day at least, something about the behavior of stock prices appeared not to correspond to a rational assessment of information about economic fundamentals. Pure, raw panic ran rampant.

Two specific thoughts came to mind on that occasion. One was an old saying, “The man who keeps his cool while all about him are losing theirs probably just doesn’t know what the h— is happening.” The other was a story that my cousin, John Mussa, used to tell about his

<sup>3</sup> See, for example, Krugman (1985) and Miller et al. (1989). An extensive list of references to the general literature on rational speculative bubbles is given in Garber (1989), Shleifer and Summers (1990), Shiller (1990), and Stiglitz (1990).

experiences serving in the U.S. Navy during World War II. On May 8, 1942, he was working in the engine room of the U.S. aircraft carrier *Lexington* when it was torpedoed by the Japanese in the Battle of the Coral Sea. When the order came down from the bridge to abandon ship, a bosun's mate was standing at the top of the gangway, pounding on the railing with a billy club, and commanding, "One at a time, one at a time, one at a time." (I wonder if that bosun's mate later worked for the Brady Commission.)

There has been no one-day event like the stock market crash to illustrate so dramatically the importance of internal market dynamics for exchange rates. However, there is no generally accepted theory of exchange-rate determination that gives precise guidance for judging the economically appropriate values of exchange rates. Thus, reasonable people, looking at all of the generally available information, might come to substantially different conclusions concerning those values. We should therefore expect exchange rates to move substantially, within the bounds thought to be reasonable, in response to shifts in the balance of market opinion. The views of some market participants might be influenced by events and information that others believe to be irrelevant. Developments within the foreign-exchange markets themselves might influence the opinions of some traders.

The situation in which there is no firm anchor for asset prices is usefully contrasted with those in which asset prices are determined quite precisely. Consider derivative financial instruments, such as options on common stocks or on futures contracts. The possibility of arbitrage within financial markets usually fixes the prices of these derivative instruments within relatively narrow bounds, given the behavior of the prices of the underlying instruments. In contrast, there is no possibility of arbitrage to confine exchange rates (or common-stock prices) within narrow limits of theoretically determined values. A variety of forces might influence exchange-rate behavior.

It should be emphasized in this regard that a general asset-pricing model of exchange rates allows for a variety of influences on exchange-rate behavior. As already noted, such models can comfortably incorporate the effects of a number of economic fundamentals and dynamic processes. Moreover, in an exchange-rate-pricing formula like equation (6), nothing specific is assumed about the ways in which economic agents form and revise their expectations concerning the economic fundamentals they believe to be relevant for determining the exchange rate. One assumption would be that economic agents correctly understand the nature of the relevant economic fundamentals and that they

optimally forecast the behavior of those fundamentals because they truly understand stochastic processes generating their behavior. These strong assumptions add new and separate meaning to the concept of rational expectations.

Alternative assumptions about the formation and revision of expectations concerning economic fundamentals would be equally consistent, however, with the pricing equation for the exchange rate. Economic agents might misunderstand the nature of the appropriate economic fundamentals and might (or might not) learn gradually to correct their misunderstandings. They might understand the appropriate fundamentals but misunderstand the nature of the processes generating the behavior of those fundamentals, and they might (or might not) learn gradually to correct their errors. The nature of the processes generating the fundamentals might be changing over time, or with shifts in economic policies, and agents might have to learn about these changes. Under these alternative assumptions, errors in forecasting exchange rates would not necessarily satisfy the usual statistical notion of rational expectations.<sup>4</sup> Forecast errors could show significant serial correlation or other systematic time-series behavior.

Further, a sensible asset-pricing model of exchange rates need not assume that all agents have the same information or use the same model in forming their views about the appropriate values of exchange rates. Using recent developments in the theory of finance, logically consistent models of exchange-rate determination can be developed that portray a balance of power between uninformed traders who add noise to price fluctuations and sophisticated traders who correctly understand the influence of economic fundamentals (Miller et al., 1989; and see Shleifer and Summers, 1990, for a survey of the literature on “noise-trader” models). The essential point is that such models can provide an explanation for the most obvious facts about exchange rates, that is, that changes in exchange rates typically have a large, unpredictable component, and that, at least on some occasions, exchange rates apparently do react to information generally thought to be relevant for determining their behavior.

To illustrate the possibilities of a not entirely rational model of exchange-rate determination, suppose that the logarithm of the current

<sup>4</sup> Karen Lewis (1989) provides an interesting example of a model of exchange-rate dynamics in which agents learn gradually about policy changes. She shows that the learning process can induce divergences from the standard assumption that forecast errors must be white noise.

exchange rate is still determined by equation (1):

$$e(t) = x(t) + b\{E[e(t+1) | t]\}, \quad (1')$$

where  $x(t)$  summarizes the true economic fundamentals affecting the exchange rate in period  $t$ . Suppose, however, that expectations of future exchange rates are influenced not only by expectations concerning the true fundamentals, the  $x$ 's, but also by expectations concerning false fundamentals, the  $z$ 's. Formally, expectations of future exchange rates are not determined by equation (2), but rather by

$$E[e(t+j) | t] = E[x(t+j) | t] + E[z(t+j) | t] + b\{E[e(t+j+1) | t]\}, \text{ for } j > 0. \quad (2')$$

Note that expectations concerning the behavior of the  $z$ 's influence the expected future behavior of the exchange rate, but they do not directly affect the current exchange rate.

The solution for the expected exchange rate at any future date  $t+k$  implied by equations (1') and (2') is given by

$$E[e(t+k) | t] = E[F(t+k) | t] + E[G(t+k) | t] + B(k | t). \quad (3')$$

The term  $B(k | t)$  is the rational speculative bubble given in equation (5), which is eliminated by setting  $C(t) = 0$ . The term  $E[F(t+k) | t]$  is determined by equation (4) and reflects the expected present value in period  $t+k$  of the true economic fundamentals that influence the exchange rate. The term  $E[G(t+k) | t]$  reflects the expected present value of false fundamentals that influence expectations of future exchange rates:

$$E[G(t+k) | t] = \sum_{j=0}^{\infty} b^j \{E[z(t+k+j) | t]\}, \text{ for } k > 0. \quad (9)$$

For  $k = 0$ , the first term in the summation on the right-hand side of equation (9) drops out because the false fundamental by definition does not directly affect the current exchange rate. Expectations of false fundamentals, however, do indirectly affect the current exchange rate, through the term

$$E[G(t) | t] = \sum_{j=1}^{\infty} b^j \{E[z(t+j) | t]\}. \quad (9')$$

It is difficult to construct, or even to contemplate constructing, a rigorous general theory of expectations about false fundamentals that would suggest universally appropriate assumptions about the  $z$ 's. Suppose, for simplicity, that the expected level of  $z$  looking forward into the future is always constant, that is,

$$E[z(t+j) | t] = Z(t), \text{ for } j > 0. \quad (10)$$



Further, suppose that the  $z$ 's do not introduce a "pure sunspot" into the behavior of the exchange rate, in the sense of Azariadis (1981) or Woodford (1986, 1990). Assume, instead, that, as people discover that the value of  $Z(t)$  that they expect to be reflected in future exchange rates does not actually appear, they gradually revise away their beliefs about false fundamentals, but that there is a source of new errors, that

$$D[Z(t)] = a[Z(t) + u(t + 1)], \text{ with } 0 < a < 1, \quad (11)$$

where the  $u$ 's are disturbances representing new beliefs about false fundamentals that affect expectations of future exchange rates.

These assumptions about the false fundamentals yield interesting implications for the dynamic behavior of the exchange rate. Because the false fundamental does not directly affect the current exchange rate, a positive  $Z(t)$  contributes a positive element to the expected change in the exchange rate. Specifically, if there is no contribution to  $D^e[e(t)]$  from the true fundamentals,

$$D^e[e(t)] = a[Z(t)]. \quad (12)$$

In contrast, a positive  $Z(t)$  implies a negative contribution to the unexpected component of the change in the exchange rate arising both from the failure of the false fundamentals actually to affect the exchange rate directly in period  $t + 1$  (as was expected in period  $t$ ), and from the erosion of belief in the false fundamentals. Again, assuming no contribution from the true fundamentals,

$$D^u[e(t)] = -[(1 - ab)/(1 - b)]\{a[Z(t)] + [a/(1 - b)][u(t + 1)]\}. \quad (13)$$

It is noteworthy that this model of false fundamentals introduces a negative term into covariance between the expected change in the exchange rate and the unexpected change in the exchange rate. Specifically, from equations (12) and (13), it follows that this covariance necessarily involves the term  $-[(1 - ab)/(1 - b)]\{a[\text{var}(Z)]\}$ . This result is interesting in light of the apparently anomalous results found in many empirical studies of exchange rates (see Bilson, 1981; Fama, 1984; and Froot, 1990). Regressions of actual exchange-rate changes on forward premia (or interest-rate differentials) typically find negative slope coefficients, rather than coefficients of unity. This anomaly is sometimes explained by asserting the presence in foreign-exchange markets of time-varying risk premia that exert a dominant influence on systematic changes in exchange rates. Might the influence of expectations about false fundamentals provide an alternative explanation?

This model of false fundamentals is, of course, highly *ad hoc*. A

seemingly less improvised way to introduce divergences from complete rationality in models of exchange-rate behavior is to exploit the rational speculative bubble that automatically appears in the formal solution of asset-pricing models of exchange rates. With due apologies to those who have worked seriously on this issue (see, in particular, Flood and Garber, 1980; Garber, 1989; and Okina, 1984, 1985), my attitude toward rational speculative bubbles is much the same as toward a half-filled carton of spoiled milk. Hold your nose and pour it down the drain as quickly as possible.

As an empirical matter, rational speculative bubbles are not much help in explaining the actual behavior of exchange rates. Exchange-rate movements may be difficult to explain in terms of economic fundamentals, and exchange rates may sometimes become detached from values that seem consistent with a reasonable assessment of economic fundamentals. This may or may not be valid evidence of the general empirical failure of asset-pricing models of exchange-rate behavior. It is not evidence, however, that simply the addition of a rational speculative bubble will make the asset-pricing model succeed.

If such a bubble exists, it will have very powerful and precise implications for exchange-rate behavior. Specifically, if  $C(t)$  in equation (5) is not equal to zero, then the logarithm of the exchange rate must be expected to explode away from the value determined by economic fundamentals at an exponential rate determined by the factor  $(1/b)^k$ . Unending, exponentially explosive behavior is not what we observe, however, in the actual behavior of the logarithms of exchange rates.

Moreover, if a rational speculative bubble exists, it will affect not only the expected path of the logarithm of the exchange rate, but also the expected path of the rate of change of the logarithm of the exchange rate, and the expected path of every higher-order difference of the exchange rate. Specifically, taking the first difference of equation (5), it follows that the rational speculative bubble in the expected rate of change of  $e$  is given by

$$\begin{aligned} E\{[B(k+1) | t] - B(k | t)] | t\} &= C(t)[(1-b)/b][(1/b)^k] \\ &= [(1-b)/b][B(k | t)]. \end{aligned} \tag{14}$$

Thus, the rational speculative bubble in the expected rate of change of  $e$  grows exponentially along with the rational speculative bubble in  $e$ .

The evidence does not suggest, however, exponentially explosive bubbles in the expected rates of change of exchange rates (as measured by forward premia or interest-rate differentials), especially not of bubbles that correctly forecast subsequent actual changes in exchange

rates. As previously mentioned with respect to implicit market forecasts of exchange rates, the empirical anomaly that most needs explaining is the generally negative covariance between forward premia and subsequent actual changes in exchange rates. Rational speculative bubbles do not help explain this anomaly. If anything, they make its explanation more difficult.

To rescue the notion that exchange rates (and other asset prices) might be afflicted by rational speculative bubbles, some have argued that such bubbles might not go on forever but might instead be subject to the random possibility of collapse. The “Blanchard bubble” has these properties. Specifically, if a bubble,  $C(t)$ , exists in period  $t$ , and  $d$  is the probability that the bubble collapses to zero in period  $t + k + 1$  (given its existence at  $t$  and survival until period  $t + k$ , the probability of which is  $(1 - d)^k$ ), its size must be  $C(t)[1/b(1 - d)^k]$ . Thus, the expected size of the bubble in period  $k$  is still given by  $B(k | t) = C(t)[(1/b)^k]$ . Even for rational speculative bubbles that might collapse, there is absolutely no escape from the requirement that the logarithm of the exchange rate must be expected to explode away exponentially from the value determined by economic fundamentals.

To put this notion in more graphic terms, suppose that the size of a rational speculative bubble at time  $t$  is equivalent to the mass of a single hydrogen atom—approximately one gram divided by  $6.02 \cdot 10^{23}$ , or roughly two trillion-trillionths of an ounce. Even allowing for the possibility that this bubble might collapse, its size is expected to grow, within finite time, to a mass greater than the planet Earth, greater than the Sun and all the planets of the solar system, greater than the Milky Way, indeed, greater than the whole physical universe. Moreover, it is not simply that this might happen, everyone rationally expects that it will happen. Thus, a rational speculative bubble implies not only that people are sometimes crazy, but that they are systematically, calculatingly, and fanatically insane.

Another difficulty with rational speculative bubbles is that they live a life that is entirely their own, independent of any essential link to other economic phenomena. If the exchange rate is affected by a rational speculative bubble, there is no particular reason to suppose that anything done to the economic fundamentals can have any effect on this bubble.<sup>5</sup> In particular, there is no reason to suppose that an

<sup>5</sup> It is possible to construct models of rational speculative bubbles that relate the generation of bubbles to the behavior of economic fundamentals. There is, however, no intrinsic link between economic fundamentals and rational speculative bubbles. A model

effort to control economic fundamentals in a manner that would keep the exchange rate fixed or within prescribed bounds (in the absence of a rational speculative bubble) could do anything to eliminate such a bubble if it did exist. I conclude, therefore, that rational speculative bubbles are empirically irrelevant and theoretically absurd.

## 5 The Empirical Relevance of Purchasing Power Parity

The theory of relative purchasing power parity implies that movements in nominal exchange rates should offset differential movements in national price levels in order to keep real exchange rates roughly constant. As is well known, this theory has generally provided a terrible explanation of shorter-term (monthly, quarterly, or even yearly) movements of exchange rates between the United States and other industrial countries since 1973 (see Dornbusch, 1988b; Kravis and Lipsey, 1978; Frenkel, 1981a, 1981b; Krugman, 1978; Genberg, 1978; and Mussa, 1979, 1986). Depending on the country and the precise time period, the correlation between short-term changes in the nominal exchange rate and short-term changes in the ratio of national price levels often is not positive and certainly does not cluster around unity. Nevertheless, overwhelming evidence indicates that relative purchasing power parity is a relevant concept for understanding the behavior of nominal exchange rates and that it should be embodied (with suitable qualifications) in models of exchange-rate behavior.

Long-term relationships between movements in nominal exchange rates and movements in the ratio of national price levels support the empirical relevance of purchasing power parity. Consider, for example, the United Kingdom versus United States (see Frankel, 1989). Since the United States resumed gold convertibility in 1879, the nominal price of sterling has declined from \$4.86 to an average for the past ten years of about \$1.50. The general level of prices in the United Kingdom relative to those in the United States during that time has risen—as best they can be measured—by about a factor of three. If reasonable data on price levels were available for France for the past century, purchasing power parity would probably explain an even larger fraction of the change in the nominal exchange rate between the French franc and the U.S. dollar. The French franc was worth about \$0.20 under the

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with an independent source of entirely random innovations to such bubbles works perfectly well. Once a bubble gets started, there is no general reason to believe that it can be stopped by the manipulation of economic fundamentals.

gold standard before World War I. Recalling that 100 old francs were converted into 1 new franc in 1958, the nominal value of the old franc has declined by a factor of 100; that is, old francs are now worth roughly \$0.0020. Data on prices would surely confirm that prices in France relative to prices in the United States have risen by a factor of roughly 100 since the turn of the century.

Even more dramatic evidence of the relevance of purchasing power parity comes from cases where there are wide divergences in national inflation rates, leading to large changes in relative national price levels over relatively brief periods. The outstanding and most studied experience of this kind is probably the German hyperinflation from 1920 to the end of 1923. During that time, eleven zeros were added to the price of the U.S. dollar in terms of the German mark, and eleven zeros were added to the ratio of German prices to U.S. prices. Thus, the change in relative purchasing power parity between Germany and the United States accounts for most of the change in the nominal exchange rate between the mark and the dollar (see Frenkel, 1976). Similar conclusions apply for other cases in which rapid-inflation countries are compared with low-inflation countries. This would include not only European countries that experienced rapid inflation after World War I or World War II, but also, in recent years, a number of Latin American countries and Israel. Very large movements in ratios of national price levels are associated with similar large movements in nominal exchange rates.

It should be emphasized, however, that this evidence demonstrating the empirical importance of purchasing power parity does not imply the absence of significant changes in real exchange rates. It was widely recognized during the German hyperinflation that the ratio of the external value of the mark to its internal value fluctuated significantly. Indeed, Graham (1928) and Bresciani-Turroni (1928) commented on this issue in their early (and still valuable) work on the German hyperinflation. More recent research, especially by Dornbusch (1988a), confirms this phenomenon. Casual observation suggests that this is a common occurrence for countries that experience very rapid inflation. More generally, it is clear that countries experiencing rapid inflation also tend to see wide swings in their real exchange rates. Nevertheless, when several zeros are added to the national price level and also to the nominal price of foreign exchange, the empirical relevance of purchasing power parity is convincingly demonstrated. The proper conclusion is that, although the theory of purchasing power parity explains nothing about the behavior of real exchange rates and therefore not everything

about the behavior of nominal exchange rates, it is still an important part of an empirically relevant theory of the behavior of nominal exchange rates.

## 6 Nominal-Exchange-Regime Neutrality

A broad and important class of theoretical models of exchange-rate determination embodies the property of nominal-exchange-regime neutrality. This property is that the behavior of the real exchange rate between two countries should not be significantly and systematically affected by the nature of the regime controlling the nominal exchange rate between the two countries. In particular, the behavior of real exchange rates under a floating-exchange regime should not be significantly and systematically different from behavior under fixed or adjustable-peg exchange regimes.

Theoretical models that assume the continuous and instantaneous validity of relative purchasing power parity (other than as a simplifying assumption) exhibit the property of nominal-exchange-regime neutrality. More generally, theoretical models that allow changes in real exchange rates in response to changes in real economic conditions, but which embody no essential link between monetary disturbances and real-exchange-rate changes, generally exhibit nominal-exchange-regime neutrality. This class of models includes virtually all general-equilibrium models that assume national price levels adjust to their equilibrium levels as instantaneously as do exchange rates and other asset prices determined in highly organized asset markets (examples of these can be seen in Helpman, 1981; Helpman and Razin, 1982; Hodrick and Srivastava, 1984; Kareken and Wallace, 1981; Stockman, 1980, 1988; and Svensson, 1985).

Theoretical models that do not exhibit nominal-exchange-regime neutrality are typically models that assume sluggishness in the adjustment of national price levels relative to exchange rates and other asset prices. These models build on a long tradition in international economics that goes back at least to the work of Meade, Machulp, Metzler, and Mundell. More recently, Dornbusch's famous paper on "Expectations and Exchange Rate Dynamics" (1976) provides a key reference point for a large literature on sticky-price models of exchange-rate dynamics. In these sticky-price models, there is reason to expect that, when nominal exchange rates fluctuate randomly in response to new information under a floating-rate regime while national price levels continue to adjust relatively sluggishly, the behavior of real exchange

rates will be substantially and systematically different from behavior under a fixed-rate regime.

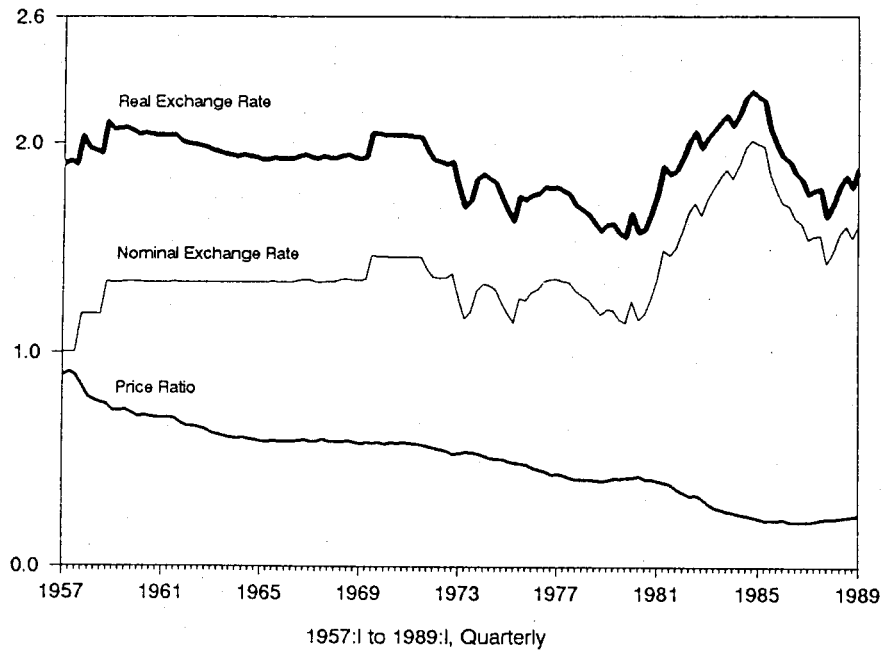
Under a floating-rate regime, shorter-term movements in the nominal exchange rate (especially the relatively large short-term movements) will tend to be reflected one-for-one in movements of the real exchange rate. Under a fixed-rate regime, these models predict that the real exchange rate will move relatively slowly in response to national inflation differentials. Under an adjustable-peg regime, the real exchange rate will behave as under a fixed rate, except at times of changes in official parities, when the real exchange rate will move together with the nominal exchange rate.

It will surprise no one here this afternoon to hear that the property of nominal-exchange-regime neutrality fails to describe reality. Many have observed that real exchange rates have fluctuated widely since the early 1970s and that the theory of relative purchasing power parity has performed very poorly as an explanation of nominal-exchange-rate movements. Jacob Frenkel (1976, 1981a), who found that purchasing power parity helped econometrically to explain exchange-rate movements in the 1920s and 1930s, speaks of the “collapse” of purchasing power parity in the 1970s. Movements in real exchange rates for the United States in the 1980s have been so spectacular that no formal econometric tests are necessary to demonstrate their presence and importance.

From a scientific standpoint, the evidence against the property of nominal-exchange-regime neutrality is even more impressive than recent substantial deviations from relative purchasing power parity. I have previously addressed this issue by examining a very broad range of experiences with the behavior of real exchange rates across alternative nominal-exchange-rate regimes (Mussa, 1986). As surely as we know anything in empirical economics, it may be stated categorically that the behavior of real exchange rates is *systematically* and *substantially* influenced by the nature of the nominal-exchange-rate regime.

Much evidence on this issue is visible to the naked eye. Consider, for example, the following graph (Figure 1), which shows the path of the logarithm of the nominal exchange rate, the path of the logarithm of the real exchange rate, and the path of the logarithm of the ratio of consumer price indices for France versus the United States, covering both the fixed-exchange-rate period of the 1950s and 1960s and the floating-rate period of the 1970s and 1980s. The devaluations of the French franc in 1957, 1958, and 1969, and the devaluation of the dollar in early 1972, are visible in the path of the logarithm of the

FIGURE 1  
 EXCHANGE RATES AND RELATIVE PRICE LEVEL  
 FRANCE AND THE UNITED STATES  
*(logarithm of real and nominal exchange rates and price ratio)*



nominal exchange rate. As would be expected if national price levels adjust relatively sluggishly, these changes in the logarithm of the nominal exchange rate are clearly associated with contemporaneous changes of similar magnitude in the logarithm of the real exchange rate.

It is readily apparent, moreover, that there is a sharp break in the behavior of the nominal exchange rate with the onset of floating in early 1973. This clearly corresponds to a similar sharp break in the behavior of the real exchange rate (but not to the relatively little change in the behavior of the ratio of national price levels). Specifically, after 1973, real and nominal exchange rates begin to show relatively large and fairly frequent up and down movements, with close correspondence between these sharp movements for real and for nominal exchange



rates. In contrast, the ratio of national price levels continues after 1973 to show the relatively smooth evolution that characterized the fixed-rate period.

There is nothing special, of course, about the case of France versus the United States. Similar graphs comparing the United States with Austria, Belgium, Denmark, France, Ireland, Italy, Japan, Luxembourg, the Netherlands, Norway, Switzerland, Sweden, and the United Kingdom would all tell essentially the same story.

These images are confirmed by some simple statistics. Consider Table 1, which reports for France versus the United States the variance of quarterly changes in the logarithms of the ratio of national price levels (consumer price indices), the variance of quarterly changes in the logarithm of the nominal exchange rate, the variance of quarterly changes in the logarithm of the real exchange rate, and the covariance of quarterly changes in the logarithms of the real and nominal exchange rates. Two periods are distinguished: the Bretton Woods period from 1957 through 1970 and the floating-rate period since early 1973.

TABLE 1  
SOURCES OF REAL-EXCHANGE-RATE VARIABILITY  
FRANCE AND THE UNITED STATES

Period	$\text{var}[D(p^* - p)]^a$	$\text{var}(De)^b$	$\text{var}(Dq)^c$	$\text{cov}(De, Dq)^d$
1957:2 to 1970:4	1.5	12.5	11.5	11.2
1973:1 to 1989:4	0.5	38.9	36.6	37.5
1957:2 to 1970:4 <sup>e</sup>	1.3	0.1	1.4	0.1

NOTE: Variances and covariances are multiplied by a factor of 10,000.

<sup>a</sup> The variance of quarterly changes in the logarithm of the ratio of the foreign (U.S.) CPI to the domestic (French) CPI, using CPI data for the last month of the quarter.

<sup>b</sup> The variance of quarterly changes in the logarithm of the nominal exchange rate, using end of the quarter data.

<sup>c</sup> The variance of quarterly changes in the logarithm of the real exchange rate,  $q = e + p^* - p$ .

<sup>d</sup> The covariance of quarterly changes in the logarithms of the nominal and the real exchange rates.

<sup>e</sup> Excluding official parity changes.

The statistics in Table 1 clearly show substantial and approximately equal increases in the variances of quarterly changes in the real and nominal exchange rates during the period of floating nominal rates.

The covariance of quarterly changes in the logarithms of the nominal and real exchange rates also increases during the floating-rate period and is nearly the same size as the respective variances. There is, however, no corresponding increase in the variance of quarterly changes in the logarithm of the ratio of national price levels. These results are even more dramatic when the quarters of official parity changes are excluded from the Bretton Woods period, but they are readily apparent in Table 1 even without this correction.

Similar statistics characterize the difference between the Bretton Woods period and the period of floating rates for other industrial countries versus the United States. In general, the variance of quarterly percentage changes in the logarithms of both nominal and real exchange rates between these countries and the United States increases by factors of between 5 and 75 during the subperiod of floating rates. Excluding observations affected by official parity changes under the Bretton Woods System, these variances rise by factors of between 25 and 75 after the shift to floating rates.

In each case, moreover, covariances of quarterly percentage changes in real and in nominal exchange rates during the floating-rate period are of nearly the same magnitude as their respective variances, testifying to the close correlation between shorter-term movements in real and nominal exchange rates during the floating-rate period. In contrast, the variances of quarterly percentage changes in ratios of national price levels show quantitatively modest increases during the period of floating rates, increases that are not surprising in light of the general increase in the size and variability of national inflation rates. These modest increases contribute little, if anything, to increases in the variances of quarterly percentage changes in real exchange rates.

This evidence does not consist of entirely independent observations. There is only one common shift in the nominal-exchange-rate regime, and the currencies of a number of European countries have tended to move together against the U.S. dollar since 1973. It is noteworthy in this regard that the same qualitative differences in the behavior of real exchange rates under different nominal-exchange-rate regimes are observed when Japan or the United Kingdom is chosen as the base country, rather than the United States. Nominal exchange rates for either Japan or the United Kingdom against other industrial countries have fluctuated fairly widely since 1973, even if not quite so widely as for the United States, and the change in the behavior of real exchange rates reflects this change in the behavior of nominal exchange rates.

More evidence against the notion of nominal-exchange-regime

neutrality comes from the behavior of real exchange rates for Western European countries. Since 1973, many Western European countries have tried to limit fluctuations in the nominal exchange rates linking their national currencies, most notably through the European Monetary System (EMS). The extent and success of these efforts, however, have varied significantly between different pairs of countries.

Consider, for example, the case of Switzerland vis-à-vis the United States, West Germany, and Austria (see Table 2). For Switzerland versus the United States, the nominal exchange rate was rigidly pegged, without official parity changes, until the Smithsonian Agreement in early 1972. Since early 1973, the Swiss franc has been essentially freely floating against the dollar. The statistics in Table 2 dramatically reveal the impact of this change in the nominal-exchange-rate regime. There is an enormous increase in the variances of quarterly changes in both the logarithms of the nominal and the real exchange rate and a corresponding increase in their covariance, without any similar change in the variance of quarterly changes in the logarithm of the ratio of national price levels.

For Switzerland versus West Germany, the change in the behavior of the nominal exchange rate after 1973 is less dramatic. The Swiss franc was allowed to fluctuate against the deutsche mark, but not with the same degree of flexibility as against the dollar. Qualitatively, the shift in behavior for the Swiss franc against the deutsche mark is the same as against the dollar. Quantitatively, however, the variances and covariance of quarterly changes in the logarithms of nominal and real exchange rates for the Swiss franc versus the deutsche mark have been only about one-fourth the similar variances and covariance for the Swiss franc versus the dollar.

The statistics for Switzerland and Austria look essentially the same. Again, these show the real importance of the nominal-exchange-rate regime—they reflect the behavior one would expect given the continued tight pegging of the nominal exchange rate between the Austrian schilling and the deutsche mark after 1973. Statistics for Austria versus West Germany confirm this interpretation. They reveal that the behavior of the real exchange rate between Austria and West Germany continues to be characteristic of behavior under a fixed-nominal-exchange-rate regime. Moreover, because there is little difference between the economic situations of Austria and Switzerland relative to West Germany, it is difficult to explain their respective differences in real-exchange-rate behavior after 1973 except by taking into account the differences in their nominal-exchange-rate regimes.

TABLE 2  
 SOURCES OF REAL-EXCHANGE-RATE VARIABILITY  
 SWITZERLAND AND THE UNITED STATES, WEST GERMANY, AND AUSTRIA  
 AUSTRIA AND WEST GERMANY

Country and Period	$\text{var}[D(p^\circ - p)]^a$	$\text{var}(De)^b$	$\text{var}(Dq)^c$	$\text{cov}(De, Dq)^d$
Switzerland and the United States				
1957:2 to 1970:4	0.4	0.1	0.6	0.1
1973:1 to 1989:4	0.9	55.0	56.3	55.2
Switzerland and West Germany				
1957:2 to 1970:4	0.6	1.2	2.1	1.4
1973:1 to 1989:4	0.5	13.1	14.3	13.4
Switzerland and Austria				
1957:2 to 1970:4	2.2	1.2	2.2	0.2
1973:1 to 1989:4	0.8	13.3	14.8	13.6
Austria and West Germany				
1957:2 to 1970:4	1.8	1.2	2.8	1.1
1973:1 to 1989:4	0.4	0.8	1.4	1.0

NOTE: Variances and covariances are multiplied by a factor of 10,000.

<sup>a</sup> The variance of quarterly changes in the logarithm of the ratio of the foreign CPI to the domestic CPI, using CPI data for the last month of the quarter.

<sup>b</sup> The variance of quarterly changes in the logarithm of the nominal exchange rate, using end of the quarter data.

<sup>c</sup> The variance of quarterly changes in the logarithm of the real exchange rate,  $q = e + p^\circ - p$ .

<sup>d</sup> The covariance of quarterly changes in the logarithms of the nominal and the real exchange rates.

Ireland presents perhaps the most telling evidence against nominal-exchange-regime neutrality. The nominal exchange rate between the Irish and British pounds was fixed rigidly until March 1979 when Ireland joined the EMS. Starting in March 1979, the Irish pound was effectively pegged, with occasional parity changes, to the deutsche mark. Table 3 reports statistics for variances in price levels and in the real and nominal exchange rates for Ireland versus the United States, the United Kingdom, and West Germany for three periods: the Bretton

TABLE 3  
SOURCES OF REAL-EXCHANGE-RATE VARIABILITY  
IRELAND AND THE UNITED STATES, UNITED KINGDOM, AND WEST GERMANY

Country and Period	$\text{var}[D(p^* - p)]^a$	$\text{var}(De)^b$	$\text{var}(Dq)^c$	$\text{cov}(De, Dq)^d$
Ireland and the United States				
1957:2 to 1970:4	1.5	4.1	5.6	4.1
1973:1 to 1979:1	4.6	21.4	24.9	20.9
1979:1 to 1989:4	1.8	39.0	40.0	38.7
Ireland and the United Kingdom				
1957:2 to 1970:4	1.3	0.0	1.3	0.0
1973:1 to 1979:1	3.1	0.0	3.1	0.0
1979:1 to 1989:4	2.0	16.2	18.8	16.5
Ireland and West Germany				
1957:2 to 1970:4	1.6	5.1	6.5	5.0
1973:1 to 1979:1	3.0	26.3	25.2	24.3
1979:1 to 1989:4	1.8	4.3	6.0	4.2

NOTE: Variances and covariances are multiplied by a factor of 10,000.

<sup>a</sup> The variance of quarterly changes in the logarithm of the ratio of the foreign CPI to the domestic CPI, using CPI data for the last month of the quarter.

<sup>b</sup> The variance of quarterly changes in the logarithm of the nominal exchange rate, using end of the quarter data.

<sup>c</sup> The variance of quarterly changes in the logarithm of the real exchange rate,  $q = e + p^* - p$ .

<sup>d</sup> The covariance of quarterly changes in the logarithms of the nominal and the real exchange rates.

Woods period from 1957 through 1970, the initial period of floating from 1973 through 1978 (when the Irish pound remained rigidly pegged to the British pound), and the period of floating from 1979 through 1989 (when Ireland was in the EMS).

During the Bretton Woods period, the real exchange rates of Ireland against the United States, the United Kingdom, and West Germany behaved in a manner associated with fixed-exchange-rate regimes: they evolved slowly in response to modest differences in national inflation rates. One exception was the devaluation of the British and Irish pounds against the dollar (and the deutsche mark) in late 1967. On that occasion, the real exchange rate of Ireland depreciated suddenly

against the United States and West Germany but showed little change against the United Kingdom. Similarly, the modest revaluations of the deutsche mark in 1962 and 1969 were associated with modest movements of the real exchange rate between Ireland and West Germany, without any significant change in the real exchange rates between Ireland and either the United States or the United Kingdom.

As indicated in Table 3, the real exchange rate of Ireland began to fluctuate widely against the United States and West Germany after the final collapse of the Bretton Woods System in March 1973, reflecting movements of the nominal exchange rates of the Irish (and British) pound against the dollar and against the separately floating deutsche mark. From 1973 to 1979, however, the real exchange rate between Ireland and the United Kingdom continued to behave in the manner associated with a fixed nominal exchange rate.

In early 1979, the real exchange rate between Ireland and the United Kingdom began to fluctuate much more widely, reflecting fluctuations in the nominal exchange rate between Ireland (now a member of the EMS) and the United Kingdom. Shorter-term movements in the real exchange rate between Ireland and the United States continued to reflect movements in the floating nominal exchange rate. In contrast, the volatility of shorter-term movements in the real exchange rate between Ireland and West Germany (and other EMS countries) fell substantially when the nominal exchange rate of the Irish pound was linked to the EMS.

Another telling case is that of the United States and Canada. The Canadian dollar floated against the U.S. dollar in two separate periods, from 1950 to 1962 and after 1970, with a fixed-rate period in between. Moreover, using consumer-price data available for both countries, real exchange rates may be calculated not only for the two countries, but also for pairs of cities in the two countries. Table 4 reports the statistical categories of Tables 1, 2, and 3 for Canada versus the United States, Toronto versus Chicago, and Vancouver versus Los Angeles. For Toronto versus Vancouver and Chicago versus Los Angeles, the in-country nominal exchange rate never changes, and the only statistic reported in Table 4 is the variance of quarterly changes in the logarithm of the ratio of consumer price indices, which is also the variance of quarterly changes in the logarithm of the real exchange rates between these pairs of cities.

The behavior of the real exchange rate between Canada and the United States during the middle period of a fixed nominal exchange rate was similar to that noted for Ireland under Bretton Woods: it

TABLE 4  
SOURCES OF REAL-EXCHANGE-RATE VARIABILITY  
CANADA AND THE UNITED STATES

Entities and Period	$\text{var}[D(p^* - p)]^a$	$\text{var}(De)^b$	$\text{var}(Dq)^c$	$\text{cov}(De, Dq)^d$
Canada and the United States				
1951:1 to 1962:2	0.6	2.4	3.0	2.4
1962:2 to 1970:1	0.2	0.1	0.3	0.1
1970:1 to 1984:3	0.8	4.2	4.7	4.1
Toronto and Chicago				
1951:1 to 1962:2	0.6	2.4	3.1	2.5
1962:2 to 1970:1	0.3	0.1	0.4	0.3
1970:1 to 1984:3	1.6	4.2	5.5	4.0
Vancouver and Los Angeles				
1951:1 to 1962:2	1.1	2.4	3.4	2.5
1962:2 to 1970:1	0.4	0.1	0.6	0.1
1970:1 to 1984:3	1.7	4.2	6.7	4.6
Toronto and Vancouver				
1951:1 to 1962:2	0.8	0.0	0.8	0.0
1962:2 to 1970:1	0.3	0.0	0.3	0.0
1970:1 to 1984:3	0.6	0.0	0.6	0.0
Chicago and Los Angeles				
1951:1 to 1962:2	0.4	0.0	0.4	0.0
1962:2 to 1970:1	0.3	0.0	0.3	0.0
1970:1 to 1984:3	1.2	0.0	1.2	0.0

NOTE: Variances and covariances are multiplied by a factor of 10,000.

<sup>a</sup> The variance of quarterly changes in the logarithm of the ratio of the foreign CPI to the domestic CPI, using CPI data for the last month of the quarter.

<sup>b</sup> The variance of quarterly changes in the logarithm of the nominal exchange rate, using end of the quarter data.

<sup>c</sup> The variance of quarterly changes in the logarithm of the real exchange rate,  $q = e + p^* - p$ .

<sup>d</sup> The covariance of quarterly changes in the logarithms of the nominal and the real exchange rates.

developed slowly reflecting modest differences in national inflation

rates. The same was true of real exchange rates between Canadian cities and U.S. cities. Indeed, the behavior of these real exchange rates was very similar to the behavior of real exchange rates between a pair of Canadian cities or a pair of U.S. cities.

In both periods of floating, the behavior of real exchange rates was substantially different from the behavior under the fixed nominal-exchange-rate period. Although the variance of quarterly changes in ratios of price levels was somewhat higher during the floating-rate periods, shorter-term movements in real exchange rates between Canada and the United States reflected primarily movements in nominal exchange rates. Similarly, real-exchange-rate movements between a Canadian city and a U.S. city reflected primarily nominal-exchange-rate movements. In contrast, the short-term variability of real exchange rates between pairs of Canadian cities or pairs of U.S. cities increased much less than for cross-border city pairs during periods of floating.

This overwhelming evidence against nominal-exchange-regime neutrality tells us something very important about the type of theoretical model we need to explain the actual behavior of real exchange rates. Models that embody the property of nominal-exchange-regime neutrality must be rejected in favor of those that imply important and systematic differences in the behavior of real exchange rates under different nominal-exchange-rate regimes. The evidence strongly indicates that these differences are intrinsically related to the relative sluggishness of the adjustment of national price levels, in contrast with the rapid adjustment of prices determined in highly organized asset markets.

This point is not merely of marginal significance. From a practical and policy perspective, the most important phenomenon to be explained in the behavior of exchange rates since the early 1970s is the breadth of the fluctuations that have occurred in real exchange rates. There would be very little challenge for theories of exchange-rate determination if movements in nominal exchange rates had primarily offset movements in ratios of national price levels, with only minor changes in real exchange rates. And there would be very little concern as well about the functioning of the floating-exchange-rate system. It is precisely because real-exchange-rate fluctuations have been closely associated with nominal-exchange-rate fluctuations that many businessmen and policymakers have expressed dissatisfaction with floating exchange rates. Without embarking on a discussion of the relative merits of alternative exchange-rate regimes, it may be forcefully stated that theoretical models that do not predict substantial and systematic



differences in the behavior of real exchange rates under different nominal-exchange-rate regimes are neither relevant nor useful.

Some proponents of flexible-price, general-equilibrium models continue to argue, however, that this class of models is relevant for understanding the behavior of exchange rates in the real world. They maintain that the use of trade and capital controls and other economic policies necessary to maintain fixed nominal exchange rates implies differences in real economic behavior that account (in a flexible-price world) for the relative stability of real exchange rates under fixed-exchange-rate regimes. This suggestion is interesting but unpersuasive. The argument logically requires that governments have the power to limit drastically most short-term fluctuations in real exchange rates through real economic policies, independently of the nominal-exchange-rate regime. Moreover, the same real economic policies should produce the same real-exchange-rate behavior, regardless of the nominal-exchange-rate regime. If, however, governments can independently shape the behavior of real exchange rates, why do they invariably choose to act only and always when they have chosen a fixed-nominal-exchange-rate regime? And why do they choose to act so deceptively as to make the hypothesis of sluggishness of adjustment of national price levels appear so empirically plausible? In terms of actual experiences with exchange-rate behavior, how does this theory explain the behavior of the real exchange rate between Ireland and its various trading partners?

Another potential line of defense for flexible-price, general-equilibrium models is that these models do not necessarily imply nominal-exchange-regime neutrality. In cash-in-advance versions of these models, for example, money is not necessarily super neutral when the Lucas assumption about the timing of transactions is replaced by the Stockman/Svensson assumption. In Lucas' model (1982), consumers learn the state of the world and have the opportunity to trade in asset markets before they go to the goods markets where cash is required for all purchases. In equilibrium, consumers hold exactly the amount of cash they require for current purchases, and there is no effect of interest rates on cash holdings. Money is super neutral in the sense that the behavior of the nominal money supply has no real effects.

In the models of Stockman (1980) and Svensson (1985), consumers must decide on money holdings before they know the state of the world and must trade in goods markets before they visit the asset markets. Consequently, consumers may hold more money than they spend in the current period, and money demand may be sensitive to

the interest rate. In two-country versions of these models, the nominal exchange rate depends on expectations of the future behavior of the two money supplies, not simply on current money supplies. However, as in a two-country version of the Lucas model, the real exchange rate depends only on the relative supplies of the two outputs and on consumer preferences for these goods.

A channel for monetary influences on the real exchange rate might be provided (with considerable analytical difficulties) by relaxing the assumption of identical preferences for residents of the two countries. With different marginal-spending preferences, relative prices would be affected (through the usual transfer-problem mechanism) by monetary disturbances that induce an excess of spending over income in one country, compensated by an excess of income over spending in the other country.

Differences in monetary policies associated with different nominal-exchange-rate regimes might therefore imply differences in the behavior of real exchange rates. More generally, modifications of the assumptions in these models that introduce real-balance effects or other mechanisms through which monetary disturbances could affect relative prices (but not sluggishness of adjustment of national price levels) might imply differences in the behavior of real exchange rates under different nominal-exchange-rate regimes. Without knowing the details of a specific model, it is difficult to know the exact implications. As a general rule, however, I would assert that such modifications will not yield models that come close to explaining the substantial differences in the behavior of real exchange rates that are so consistently observed between fixed- and floating-exchange-rate regimes and that are so easily rationalized by the assumption of some sluggishness in the adjustment of national price levels. Efforts to rescue flexible-price, general-equilibrium models through such modifications are nothing more than sophisticated hand waving.

## **7 The Dollar and U.S. Monetary Policy**

It has generally been difficult to demonstrate a consistent influence of monetary policy on the behavior of exchange rates except in circumstances of runaway inflation. This is a substantial embarrassment, for if any type of economic policy should be expected to influence the behavior of exchange rates, it would be monetary policy. Fiscal policy (either spending or taxation) and commercial policy might also be presumed to influence exchange rates, but experience with fixed-

exchange-rate regimes indicates that monetary policy is the key factor in terms of the ability to maintain a fixed exchange rate. The maintenance of pegged exchange rates under the Bretton Woods System (or more recently within the EMS) was widely recognized as imposing significant constraints on the conduct of monetary policy at the national level. Similarly, maintenance of a unified currency standard within the United States, in comparison with the multiple currencies existing during colonial times, has clearly required that individuals be allowed to determine the geographic distribution of holdings of money across different regions of the country in accord with their preferences.

Despite the strong presumption that monetary policy ought to be an important influence on the behavior of exchange rates, its influence is difficult to demonstrate for the behavior of exchange rates of major currencies against the U.S. dollar since the early 1970s. Empirical models that attempt to relate movements in dollar exchange rates to differences in money growth rates and differences in income growth rates (which presumably influence money demand) between the United States and other industrial countries do not perform very well. Indeed, naive random-walk models generally perform better. Should we, then, reject the notion that monetary policy has exerted an important (although not exclusive) influence on the behavior of dollar exchange rates? I shall argue that this is not an appropriate conclusion, at least when we take a sophisticated view both of the theoretically appropriate linkage between monetary policy and exchange rates and of the empirical evidence concerning such a linkage.

An appropriately sophisticated model of monetary influence on exchange rates should incorporate at least five distinct elements: (1) the term  $m(t)$ , which captures the influence of the expected future behavior of the domestic money supply and exogenous factors affecting domestic money demand on the equilibrium values of the logarithms of all domestic nominal prices, including the price of foreign exchange; (2) the similar term,  $m^*(t)$ , which captures the influence of expected foreign monetary fundamentals on the equilibrium values of the logarithms of all nominal prices in the foreign country (terms [1] and [2] are the asset-pricing expressions that measure the present value of the expected current and future behavior of monetary fundamentals in the two countries); (3) the asset-pricing term  $q(t)$ , which is required to capture the influence of expected real economic fundamentals on the equilibrium value of the real exchange rate; (4) the term  $\Theta(m - p)$ , which is required to capture the spill-over effects onto the logarithm of the exchange rate of the disequilibria resulting from deviations of the

logarithm of the actual domestic price level,  $p$ , from its equilibrium value,  $m$ . These disequilibria arise from the sluggishness of the adjustment of the price level (discussed further below). As in Dornbusch's famous "overshooting" model, a positive deviation of  $p$  from  $m$  spills over to induce a negative deviation of  $e$  from its equilibrium value,  $e$ . The coefficient  $\Theta > 0$  indicates the strength of this spill-over effect; (5) the term  $-\Theta^*(m^* - p^*)$ , which is the overshooting effect of deviations of the logarithm of the foreign-price level,  $p^*$ , from its equilibrium value,  $m^*$ . Combining all of these terms, the expression for the logarithm of the exchange rate is given by

$$e = m - m^* + q + \Theta(m - p) - \Theta^*(m^* - p^*). \quad (15)$$

Alternatively, defining the equilibrium exchange rate as  $e = m - m^* + q$ , the expression for  $e$  can be written as

$$e = e + \Theta(m - p) - \Theta^*(m^* - p^*). \quad (16)$$

It should be emphasized that the monetary factors influencing  $e(t)$  in equations (15) and (16) are not simple expressions proportionally related to current national money supplies. In a relatively standard version of this model, the expression for  $m(t)$  would look like

$$m(t) = E[L(t) | t], \quad (17)$$

in which  $L(t)$  is the present discounted value of differences between the logarithm of the domestic money supply  $n$ , and the logarithm of the exogenous factors influencing the real demand for domestic money,  $k$ , that is,

$$L(t) = (1 - a)[\sum_{j=0}^{\infty} a^j][n(t + j) - k(t + j)]. \quad (18)$$

The discount factor in this expression,  $a$ , is usually related to the interest semi-elasticity of money demand,  $h$ , with  $a = h/(1 + h)$ . Note that  $L(t)$  is affected by the entire future path of both the money supply and money demand.

Even more important, note that what really matters for  $m(t)$  is not the behavior of money supply or money demand, but rather what such behavior is expected to imply for the equilibrium behavior of nominal prices. Suppose, for example, that money-supply changes are widely believed to be the consequence of a policy to offset changes in real money demand, within the context of a firmly anti-inflationary policy. The observation of rapid increases in the money supply should have relatively little impact on  $m(t)$  in this situation and, hence, on  $e(t)$ . In contrast, if monetary policy is not believed to be firmly committed to

maintaining low inflation, the same observed increases in the money supply may have a substantial impact in raising  $m(t)$  and  $e(t)$ .

Now, the task is to apply these ideas to an analysis of the economic forces underlying movements in the foreign-exchange value of the U.S. dollar. The value of the dollar declined against other major currencies at the outset of floating in early 1973 and then fluctuated up and down against most European currencies and the Japanese yen for the next two years. On a trade-weighted basis (including the Canadian dollar), however, there was relatively little net change in the nominal or real foreign-exchange value of the dollar in the four years after the start of floating. In 1977, the dollar began depreciating against European currencies and the yen, reaching a low point in both nominal and real terms in the summer of 1979 and, again (after a brief recovery), in the summer of 1980. In the fall of 1980, the dollar began a spectacular, if somewhat erratic, rise that culminated in early 1985 with a roughly 50-percent real appreciation of the dollar (on a trade-weighted basis) from the lows of the summer of 1980. From March 1985 through December 1987, the dollar was on an erratic downward slide that reversed much of the real appreciation of the preceding four years. In early 1988, the dollar stabilized and then began to appreciate. Appreciation generally continued through the first half of 1989 and then was reversed with respect to European currencies but not to the yen. The challenge is to understand the economic forces that contributed to these major movements. Did monetary policy play a significant role?

A straightforward comparison of monetary growth rates in the late 1970s versus the early 1980s does not suggest a significant role for monetary policy in the major swing from dollar depreciation to strong dollar appreciation. Using M-2, annual U.S. monetary growth is slightly lower from 1980 through 1984 than from 1976 through 1980. However, the difference in M-2 growth rates does not suggest a move toward a significantly tighter monetary policy in the United States. Moreover, monetary growth rates in other industrial countries were also generally lower from 1980 through 1984 than from 1976 through 1980, thereby suggesting even less of a relative tightening of U.S. monetary policy in the early 1980s.

Growth rates for old M-1 (currency plus demand deposits) show a more dramatic downshift of U.S. monetary growth in the early 1980s. To a large extent, however, this is accounted for by a monetary deregulation that allowed households to shift out of noninterest-bearing demand deposits and into interest-bearing NOW accounts. Monetary models have thus failed in econometric tests to explain much of the

swing in the foreign-exchange value of the U.S. dollar from the late 1970s to the early 1980s simply because there is little observable corresponding swing in relative monetary growth in the United States in comparison with other industrial countries. This situation does not materially improve when differences in income growth, as a measure of differences in money-demand growth, are taken into account.

Anyone who remembers the economic events of the late 1970s and early 1980s knows, however, that there was a very dramatic shift in U.S. monetary policy toward a much less inflationary stance. The U.S. inflation rate rose from 5 percent in 1976 to 9 percent in 1978, and U.S. monetary policy accommodated this rise. In 1979, under the impact of the second oil-price shock, the inflation rate rose to 12.5 percent. Despite a short-lived effort to reduce inflation in late 1979 and early 1980, the inflation rate for 1980 reached 13 percent. Judged by the results, rather than by monetary growth rates, U.S. monetary policy appeared to be increasingly inflationary in the late 1970s.

Survey evidence indicates that, from late 1978 through 1980, longer-term inflation expectations (from the Drexel Burnham Lambert Decision Maker's Poll) were rising into double digits, surely a significant increase over comparable expectations in 1976 and 1977. Increases in expected inflation rates were also reflected in rising short-term interest rates and rising longer-term bond yields from 1976 to early 1980, and again after the brief recession of the spring of 1980. Real holding-period returns on longer-term bonds were consistently negative in the late 1970s, with the largest negative returns occurring on the longest maturities. This indicates that bond holders were consistently being surprised by increases in yields (and hence declines in bond prices) that were related to increases in expected inflation rates above previously anticipated rates.

After the second oil shock in early 1979, inflation rates also rose in other industrial countries. Most of these countries did a better job, however, of containing the inflationary consequences of this shock than did the United States, or than they had with the first oil-price shock in 1973-74. Moreover, other industrial countries generally did not experience the same acceleration of inflation from 1976 through 1978 that occurred in the United States. Thus, in the late 1970s (until sometime in 1980), the longer-term expected inflation rate in the United States was rising both absolutely as well as in relation to longer-term expected inflation rates in other industrial countries.

The implication of this development in the context of our schematic model of the exchange rate should have been a nominal and a real

depreciation of the U.S. dollar, that is, an increase in  $e$  and in  $q = e + p^* - p$ . Upward revisions in the longer-term expected inflation rate in the United States imply upward revisions in the expected behavior of the monetary fundamentals that determine  $m$ . Upward revisions in  $m$  imply, according to equation (14), increases in  $e$ . Moreover, unanticipated increases in  $m$  add positively to the deviation between  $m$  and  $p$ . Thus, the consistent tendency for inflation expectations to be revised upward should have led to an overshooting response of the nominal exchange rate that was reflected in real depreciation of the U.S. dollar.

Sometime in late 1980 or early 1981, U.S. monetary policy shifted from apparent accommodation of rising inflation to an aggressive effort to reduce inflation. The exact timing of this policy shift is difficult to determine because of the conflicting behavior of different indicators of monetary policy. It is clear with hindsight, however, that there was a substantial shift toward a much less inflationary U.S. monetary policy. We have the scars to prove it—in the form of the deep recession of 1981-82. We also have the record of an annual inflation rate since 1981 that has hovered around 4 percent (except for the temporary decline caused by the oil-price drop in 1986). This represents a very substantial improvement in U.S. inflation performance as compared to the late 1970s.

More important for present purposes, the relatively moderate inflation rate since 1981 is clearly well below the expectations of longer-term inflation that were held in the late 1970s. This low rate unquestionably led to a significant downward revision of longer-term inflation expectations during the course of the 1980s. Inflation rates also declined in other industrial countries during the early 1980s, and there was probably some corresponding downward revision in expectations of longer-term inflation. The shift from worries about high and rising inflation in the late 1970s to confidence about more moderate inflation in the early 1980s was, however, certainly greater for the United States than for most other industrial countries.

The key issue for the behavior of the exchange rate is not so much when U.S. monetary policy shifted to a disinflationary stance, but when people became convinced of such a policy shift. Clearly, they were not persuaded overnight, and they were probably not convinced for two or three years. The Federal Reserve had tightened monetary policy before 1981, after all, only to reverse field later as the economy fell into recession. As money growth was held in check, however, and nominal interest rates were pushed higher during 1981 in the face of falling inflation and a sagging economy, people were gradually convinced of a

shift in monetary policy. Persuasion undoubtedly continued during 1982, as the Federal Reserve maintained a quite tight policy despite a gravely deepening recession. The shift to an easier monetary policy after August 1982 apparently did not erode confidence in the prospect for continued moderate inflation, perhaps partly because of the high degree of slack in the economy. Confidence in the Federal Reserve's anti-inflationary stance was probably reinforced when monetary policy was tightened again between April and November of 1984 to forestall a resurgence of inflation.

It is difficult to construct reliable monthly or quarterly measures of the downward revision of longer-term inflation expectations in the United States between 1980 and 1985. Whether or not such measures, if available, would be highly correlated with monthly or quarterly changes in the nominal or real foreign-exchange value of the dollar is unclear. It is indisputable, however, that a substantial downward revision of expectations must have occurred during that time. Our schematic model indicates that such a development would account for a significant nominal and real appreciation of the dollar (that is, a decline in  $e$  and in  $q$ ). Downward revision of longer-term inflation expectations (arising from changed perceptions about U.S. monetary policy) implies downward revisions in previously expected levels of  $m$ . Downward movements in  $m$  imply lower values of  $e$ . Downward revisions to previously anticipated levels of  $m$  contribute negatively to deviations between  $m$  and  $p$ . Negative innovations to  $m - p$  spill over through the overshooting effect to reduce both  $e$  and  $q$ . Thus, the shift in the assessment of the longer-term inflationary consequences of U.S. monetary policy moved the dollar from overshooting depreciation from 1978 to 1980 to overshooting appreciation from 1981 to 1984.

In early 1985, the U.S. dollar started on a downward course that was to continue, at varying rates, for the next three years. Beginning in late 1984 and extending through 1986, U.S. monetary policy shifted to a much easier stance. Also, signals were sent through coordinated official intervention and through public announcement of the Group of 5 agreement reached at the Plaza Hotel in September 1985 that policy authorities in the leading industrial countries wanted to see a significant decline in the foreign-exchange value of the U.S. dollar. The message was that economic policies, including monetary policies, would support this end. By the summer of 1986, a number of foreign governments were no longer convinced of the need for, or desirability of, further dollar depreciation. There was, however, no signal of a general consensus to resist further dollar depreciation through coordinated and



vigorous policy actions. United States monetary policy remained expansionary, and the U.S. government indicated no apparent displeasure with the continuing depreciation of the dollar.

By early 1987, even the U.S. policy authorities had become persuaded that further substantial dollar depreciation would be undesirable, and U.S. monetary policy began to respond to fears of an overheating economy and a possible resurgence of inflation—problems that would be exacerbated by further dollar depreciation. On the other side, the Japanese government and Western European governments were concerned about the effects of further appreciation of their currencies on their export industries and on real growth. The Louvre Accord of February 1987 expressed the consensus of the Group of 7 governments that exchange rates were in line with economic fundamentals and that further dollar depreciation would be resisted and reductions in current-account imbalances pursued through other means.

The Louvre Accord was not immediately successful; the dollar continued to drop against the yen in the weeks following agreement. In the spring, however, coordinated interest-rate adjustments upward by the Federal Reserve and downward by foreign central banks apparently helped to support the dollar. This support eroded somewhat during the summer when foreign central banks began to raise interest rates and the Federal Reserve simply followed suit. The further drop in the foreign-exchange value of the dollar was not substantial, however, until after the October stockmarket crash. In the following four months, there was a general (and, I believe, correct) impression that U.S. monetary policy was more concerned with limiting the risk of recession than with maintaining a specific target for the foreign-exchange value of the dollar. The dollar came under renewed downward pressure during this period, reaching its low point at the end of 1987.

From March 1988 to June 1989, U.S. monetary policy moved to a progressively tighter stance. As fears of recession abated and concerns about inflation rose, the federal-funds rate was raised from 6 percent to 10.5 percent, and growth rates of M-1 and M-2 were reduced to the lowest levels since the tight-money period of 1981-82. The dollar strengthened in foreign-exchange markets, and, by the spring of 1989, central banks were reversing their efforts of 1987 and intervening actively to resist dollar appreciation. Their intervention was not entirely successful, however, in the face of a continued firm stance of U.S. monetary policy and expressions by Federal Reserve officials of the desirability of moving toward the longer-term goal of price stability.

It would be misleading to suggest that monetary policy was the

dominant influence on all major movements in the foreign-exchange value of the dollar during the 1980s. Nevertheless, I find the evidence very persuasive that monetary policy, especially the dramatic shift in U.S. monetary policy, played an important role in the appreciation of the dollar in the early 1980s. The extraordinary extent of appreciation between the summer of 1980 and early 1985, however, certainly leaves ample room for the effects of other economic forces, as well as for the possible influence of errors, misperceptions, and general craziness. The rapid and erratic decline of the dollar between early 1985 and late 1987 is consistent with changes in the stance of monetary policy, but it would be difficult to assert that monetary policy was necessarily the primary actor in these developments. Continued deterioration of the U.S. trade and current accounts during 1985 and 1986 may have persuaded market participants that the strong dollar of the early 1980s was economically and politically unsustainable. The firming of the dollar from the spring of 1988 to the summer of 1989 appears, by contrast, to be much more clearly linked to the tightening of U.S. monetary policy during those years.

You may note that I have said nothing about the role of fiscal policy in influencing the behavior of exchange rates. This omission is not inadvertent. The Graham Lecture is too gracious an occasion on which to discuss such a murky and controversial subject.

## **8 Conclusion**

Theories of exchange-rate determination and empirical analyses of exchange-rate behavior need not be two entirely separate subjects. The regularities that characterize the actual behavior of exchange rates have important implications for empirically relevant models of exchange-rate determination. Exchange rates should be viewed theoretically as asset prices that reflect, among other things, expectations of a variety of real and monetary factors relevant for determining exchange rates. The theoretical models should allow explicitly for fluctuations of exchange rates in response to new information about these economic factors, and they should incorporate the notion that purchasing power parity is a relevant but flexible constraint on the behavior of nominal exchange rates, especially when there are wide movements in ratios of national price levels. They should recognize that, under floating-exchange-rate regimes, nominal exchange rates typically adjust more rapidly than do national price levels, leading to substantial and systematic differences in the behavior of real exchange rates under different nominal-ex-

change-rate regimes. The theoretical models should also recognize that exchange rates are monetary variables and that monetary policies are often an important, although not exclusive, determinant of exchange-rate behavior.

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#### FRANK D. GRAHAM MEMORIAL LECTURERS

1950–1951	Milton Friedman
1951–1952	James E. Meade
1952–1953	Sir Dennis Robertson
1953–1954	Paul A. Samuelson
1955–1956	Gottfried Haberler
1956–1957	Ragnar Nurkse
1957–1958	Albert O. Hirschman
1959–1960	Robert Triffin
1960–1961	Jacob Viner
1961–1962	Don Patinkin
1962–1963	Friedrich A. Lutz (Essay 41)
1963–1964	Tibor Scitovsky (Essay 49)
1964–1965	Sir John Hicks
1965–1966	Robert A. Mundell
1966–1967	Jagdish N. Bhagwati (Special Paper 8)
1967–1968	Arnold C. Harberger
1968–1969	Harry G. Johnson
1969–1970	Richard N. Cooper (Essay 86)
1970–1971	W. Max Corden (Essay 93)
1971–1972	Richard E. Caves (Special Paper 10)
1972–1973	Paul A. Volcker
1973–1974	J. Marcus Fleming (Essay 107)
1974–1975	Anne O. Krueger (Study 40)
1975–1976	Ronald W. Jones (Special Paper 12)
1976–1977	Ronald I. McKinnon (Essay 125)
1977–1978	Charles P. Kindleberger (Essay 129)
1978–1979	Bertil Ohlin (Essay 134)
1979–1980	Bela Balassa (Essay 141)
1980–1981	Marina von Neumann Whitman (Essay 143)
1981–1982	Robert E. Baldwin (Essay 150)
1983–1984	Stephen Marris (Essay 155)
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