

International Finance Discussion Papers

Number 145

June 1979

EXPECTED AND UNEXPECTED CHANGES IN EXCHANGE RATES

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1. Introduction

Although the popular press constantly attributes jumps in exchange rates to unexpected economic statistics, the economics profession has made few if any serious attempts to distinguish empirically between the expected and unexpected factors that underlie exchange-rate movements. This paper focusses on several considerations that are relevant to drawing such a distinction. Section 2 briefly reviews the theoretical basis for the presumption that changes in exchange rates since March 1973 have been predominantly unexpected. Section 3 discusses the factors that underlie the term structure of exchange-rate expectations and presents a diagrammatic analysis of how unexpected news about different economic variables can lead to different types of revisions in exchange-rate expectations and to unexpected jumps in observed exchange rates. Section 4 discusses the role of the current account. Section 5 draws some conclusions for empirical research.

*/ This paper is a direct descendant of several joint papers with Michael Dooley, who deserves substantial credit for whatever insights the reader may find valuable. I have also benefitted from discussions with Allen Frankel, Jeffrey Frankel, James Healy, Dale Henderson, Peter Hooper, David Howard, Frank McCormick, John Morton, Michael Porter and Jeffrey Shafer. None of the acknowledged is likely to agree with all my views, nor are these views necessarily shared by the Federal Reserve System. The first draft of this paper was entitled "Conceptual Issues in Modelling Exchange-Rate Behavior: The Role of the Current Account."

2. The Portfolio Balance Model of Expected Changes

The portfolio balance model provides a theoretical basis for the presumption that changes in exchange rates have been predominantly unexpected in the years since the adjustable-peg system was abandoned. Dooley and Isard (1979) have spelled out the basis for this presumption, which is reviewed here briefly.

The portfolio balance model can be viewed as a theory of the yields that portfolio managers must expect in order for asset markets to clear, where expected yields can be expressed in terms of interest rates and expected rates of change in exchange rates. In this paper we focus on the simple case of a two-currency world with predetermined interest rates,^{1/} viewing the portfolio-balance framework as a model of the expected rate of change in the exchange rate. In a risk-neutral world the portfolio-balance model would collapse to the condition that the rate of change in the exchange rate is expected to equal the interest differential. In a risk-averse world the exchange-risk premium -- defined as the difference between the expected rate of exchange-rate change and the interest differential -- depends on the stocks of outside assets (government debts) denominated in each of the two currencies and on the distribution of private world wealth between regions with different portfolio preferences. Accordingly, changes over time in the exchange risk premium

^{1/} In particular, policy authorities are assumed to control interest rates through open market operations that adjust the mix of interest-bearing and non-interest-bearing outside assets held in private portfolios.

depend on budget deficits, current account imbalances, and official interventions in foreign-exchange markets; see Dooley and Isard for a formal derivation of these relationships.

To establish the presumption that changes in exchange rates have been predominantly unexpected, Dooley and Isard compare observed changes in exchange rates with estimates of the expected changes that the portfolio-balance model implies. If the world is viewed as risk neutral, the expected rate of change in exchange rates is the forward premium, and there is abundant evidence that forward premiums have explained only a small portion of observed changes in exchange rates during recent years.

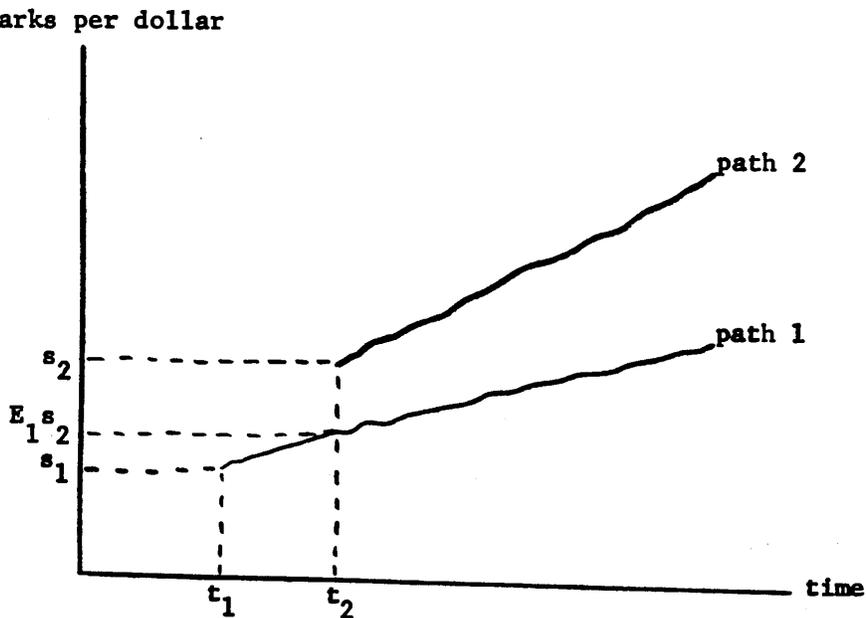
The presumption cannot be established straight-forwardly when the world is viewed as risk averse, since we cannot directly measure the risk premium. Dooley and Isard have shown, however, that regression estimates of the risk premium do not explain the major portion of observed changes in exchange rates. Casual evidence is perhaps even more convincing. Month-to-month percentage changes in the dollar-Deutschemark exchange rate between March 1973 and mid-1977, for example, exceeded annual rates of 30 per cent in 2 out of every 5 months and 60 per cent in 1 out of 5 months. Hardly any of these changes were predicted by forward premiums. Moreover, it is difficult to believe that portfolio managers were too risk averse to shift at the margin between marks and dollars in prospect of 30 or 60 per cent yields, had such yields been expected; that is, it is almost inconceivable that portfolios could have been in equilibrium under the expectation that a shift at the margin between marks and dollars would be rewarded with

a 30 or 60 per cent annual rate of return. Rather, the more credible hypothesis is that the large observed changes in exchange rates were predominantly unexpected.

3. The Term-Structure of Exchange-Rate Expectations

The portfolio-balance model can be solved for the change in the exchange rate that is expected over each of a continuum of time horizons. Thus, given a spot exchange rate s_1 observed at some point in time t_1 , the portfolio-balance model can be solved for the time path of future exchange rates that corresponds to expectations held at time t_1 . Figure 1, path 1 illustrates a hypothetical term structure of exchange-rate expectations. In a risk-neutral world this path would correspond to the term structure of interest differentials or forward premiums; see the study by Porter (1971). In a risk-averse world the path can

Figure 1



be viewed, definitionally, as the sum of the term structure of interest differentials plus the term structure of the exchange risk premium.^{2/}

Ceteris paribus, the slope of the path -- the rate at which the dollar is expected to appreciate against the mark -- is an increasing function of the stock of outside dollar-denominated debt in private portfolios, a decreasing function of the stock of outside mark-denominated debt in private portfolios, and (loosely speaking) an increasing function of the extent to which world wealth is distributed toward regions with relatively strong preferences for holding mark-denominated assets rather than dollar-denominated assets; see Dooley and Isard (1979). The intuition is a simple argument about how relative yields must adjust to eliminate excess supplies. The greater the stock of outside dollar denominated debt relative to outside mark-denominated debt, ceteris paribus, the higher is the relative yield on dollars that private sectors must expect in order to be willing to hold the currency mix of outside debt that governments have pushed into their portfolios. Given the relative stocks of outside dollar and mark assets, moreover, the relative yield on dollar assets that private sectors must expect in order to be willing to hold outstanding stocks is an increasing function of their relative preferences for marks (appropriately defined).

^{2/} The premium that asset holders require to bear exchange risk over a given time horizon is in general a function of the length of the horizon.

In Figure 1, path 1 reflects expectations of the exchange rate based on all information available at time t_1 . Thus, expectations (held at t_1) of the future time paths of asset stocks, wealth variables and prices, as well as the term structure of interest differentials, are incorporated into the shape of path 1. Unexpected changes in asset stocks, wealth variables, prices or interest differentials -- and/or revisions in expectations about the future paths of asset stocks, wealth variables and prices, or in the term structure of interest differentials -- will shift the expected path of the exchange rate. Thus, at time t_2 the observed exchange rate s_2 will generally differ from the expectation held at time t_1 of what the exchange rate would be at time t_2 ($E_1 s_2$ in Figure 1).

The distinction between expected movements of the exchange rate (along path 1) and unexpected movements (from path 1 to path 2) has not received adequate attention in the design of empirical models of exchange-rate behavior. To the extent that observed exchange-rate changes are predominantly unexpected, a satisfactory explanation (ex post) of exchange-rate fluctuations requires satisfactory measures or models of the unexpected component of changes in explanatory variables, as well as satisfactory measures or models of how portfolio managers have revised their expectations about future asset stocks, wealth variables, prices and interest rates.

When stripped to its core, the portfolio-balance model only explains the expected path of the exchange rate, given the current spot rate, but does not provide a theory of how portfolio managers revise their expectations about future asset stocks, wealth variables, prices

and interest rates -- and hence does not explain shifts in the path of exchange-rate expectations. To keep our exchange-rate models tractable we must adopt somewhat arbitrary assumptions, directly or indirectly, about how such expectations are revised.^{3/}

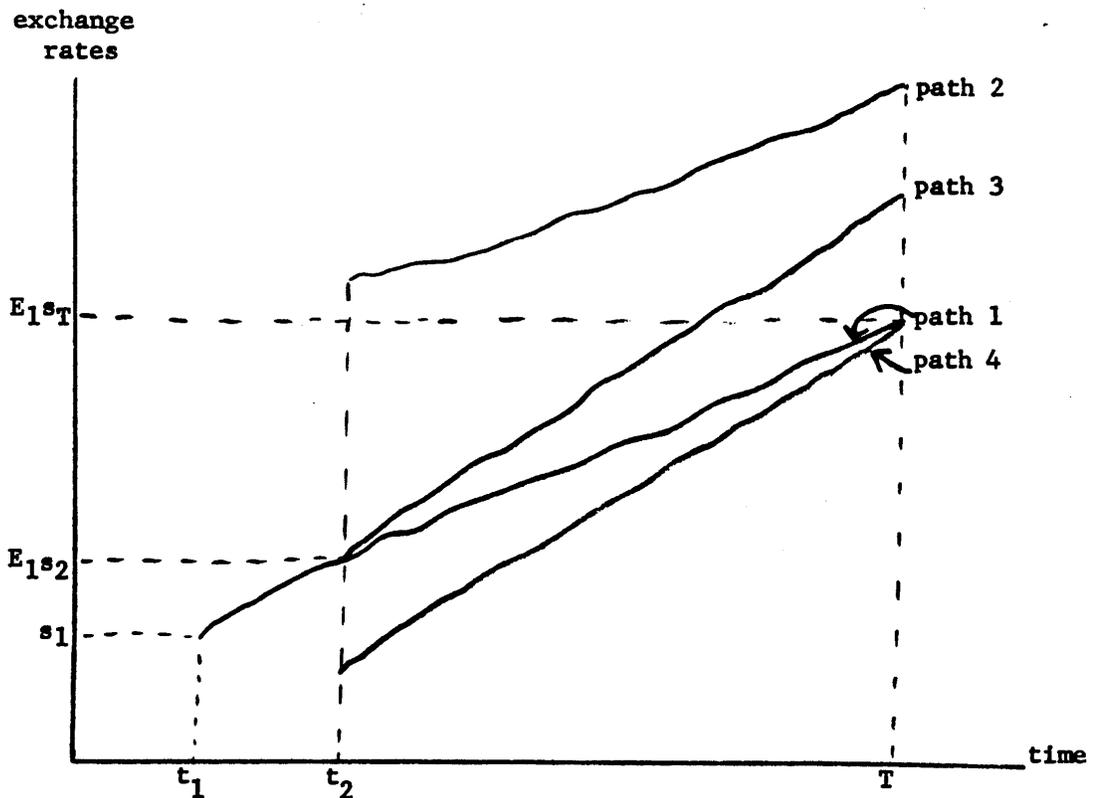
One method of analyzing revisions in expectations is to assume a long-run stationary state in which the real terms of trade is consistent with current-account equilibrium, in which the ratio of national price levels is consistent with the long-run levels of money stocks, income and interest rates, and in which the nominal exchange rate is expected (with long-run perfect foresight) to equal the long-run product of the real terms of trade and the ratio of price levels; e.g. see Kouri (1976), Dornbusch (1976), or Dornbusch and Fischer (1978). Under these assumptions unexpected changes in money stocks or other exogenous variables give rise to unexpected shifts in current exchange rates that are in many cases predictable in direction and in some cases bounded from above or below in magnitude.

A less formal graphical method of analyzing revisions in expectations does not require the assumption of a long-run stationary state. In Figure 2, path 1 represents the term structure of the exchange-rate expectations held at time t_1 , given the spot rate s_1 observed at t_1 .

^{3/} The assumption of rational expectations does not fill the theoretical void and in fact may complicate the empirical problem in two ways. First, to impose the assumption of completely rational expectations we need a complete macroeconomic model. Second, the rational expectations assumption allows us to represent current expectations about variables one period in the future as functions of current expectations about variables two periods in the future, but these latter expectations in turn depend on current expectations about variables three periods in the future, and we are caught in an infinite regress unless we make an arbitrary assumption somewhere along the line.

$E_1 s_T$ is the expectation held at time t_1 of the exchange rate that will prevail at some arbitrary future time T . We cannot explain the level of $E_1 s_T$ except by solving the portfolio-balance model and looking forward from s_1 .^{4/} Our concern, however, is to take path 1 as given and to analyze the types of unexpected events that might lead to unexpected shifts in observed and expected future exchange rates.

Figure 2



^{4/} Neither could we explain the expected nominal exchange rate in a long-run stationary state without observing the current exchange rate and looking forward.

For purposes of analysis we imagine starting out on path 1 at t_1 and encountering our first unexpected shock at time t_2 , perhaps only an instant after t_1 . Figure 2 illustrates possibilities of a shift in the entire term structure to path 2, a rotation to path 3 that occurs without an unexpected jump in the exchange rate observed at t_2 , or a rotation to path 4 that causes the exchange rate to jump unexpectedly at t_2 but does not affect the value of the exchange rate that is expected to prevail at T.

In discussing the types of unexpected shocks that might give rise to such shifts in the term-structure path we begin with the tautology that the expected nominal exchange rate $E_1 s_T$ is the expected product of the real terms of trade and the ratio of price levels that will prevail at time T. Thus, a shift to path 2 could be caused by either a revision in expectations about the real terms of trade or a revision in expectations about the ratio of price levels.^{5/} In the absence of changes in the term structures of nominal interest differentials or risk premiums, a revision in expectations about the real terms of trade would leave path 2 parallel to path 1. Similarly, if expectations about the ratio of future price levels were revised without any shift in nominal interest differentials or risk premiums -- due to an unexpected price change at t_2 that did not lead to revisions in expectations about future inflation rates -- we might observe a jump from path 1 to a parallel path 2. Alternatively, if expectations about the ratio of future price levels were revised to

^{5/} Our discussion ignores covariance.

reflect a shift in inflation expectations that was in turn entirely reflected by an adjustment of nominal interest differentials, with no unexpected changes in prices at t_2 , the term structure of exchange-rate expectations would shift from path 1 to path 3 with no unexpected jump in the observed exchange rate at t_2 . In contrast, an adjustment of nominal interest differentials that is not accompanied by revisions in inflation expectations or unexpected jumps in prices can be viewed as a shift from path 1 to path 4.^{6/} Finally, an unexpected shift in the term structure of risk premiums could also cause a shift from path 1 to path 4 in the absence of any associated shifts in the nominal exchange rate expected to prevail at time T.

The analysis of these cases suggests that unexpected jumps in exchange rates are associated with either (i) revisions in expectations about future real terms of trade, (ii) unexpected jumps in the ratio of domestic and foreign price levels, (iii) unexpected changes in real interest rates, or (iv) unexpected shifts in the term structure of risk premiums. It has also been argued that shifts in nominal interest rates that fully reflect revisions in inflation expectations, unaccompanied by unexpected jumps in prices, do not lead to unexpected shifts in exchange rates.^{7/} In the next section we consider how unexpected current-account imbalances may lead either to revisions in expectations about real terms of trade and/or to unexpected changes in risk premiums.

^{6/} Frankel (1979) has emphasized that the exchange-rate impacts of shifts in nominal interest differentials depend on how much real interest differentials shift.

^{7/} In reality it may be difficult to find the counterpart to this theoretical case. Revisions in inflation expectations are generally catalyzed by unexpected statistics on price changes.

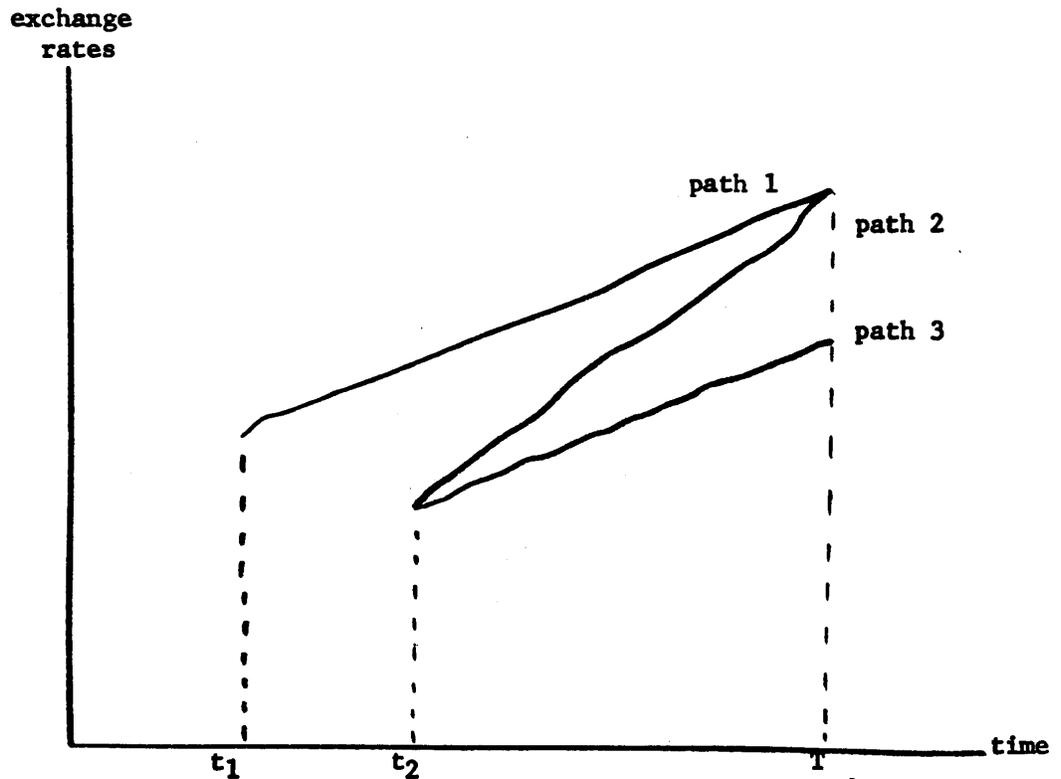
4. The Role of the Current Account

In addition to anecdotal evidence from the financial community, we now have econometric evidence that current-account imbalances "explain" a significant portion of the behavior of exchange rates in recent years; see Branson, Halttunen and Masson (1977), Porter (1977, 1979) and Hooper and Morton (1978). In this section we distinguish between two channels through which current-account imbalances can "affect" exchange rates, and we also distinguish between the "effects" of expected and unexpected current account imbalances.

In the Figures presented above we have implicitly assumed that the expected time path of the exchange rate is continuous. Discrete expected jumps in the exchange rate would offer infinite expected instantaneous rates of return; so discontinuous expected time paths do not qualify as equilibrium solutions to the portfolio-balance model. Since the expected time path of the exchange rate, therefore, is both continuous and fully reflective of all information available, including the information used to form expectations about future current-account positions, it follows that expected current-account imbalances do not lead to unexpected or discrete jumps in the exchange rate. Rather, expected current-account imbalances can be associated with shifts in the risk premium over time -- or more precisely, with a non-constant term structure of risk premiums. Similarly, expected budget deficits, domestic open-market operations and official foreign-exchange interventions -- each of which affects expected wealth variables and/or stocks of outside assets -- may be associated with a fluctuating risk premium but will not generate expectations of discrete jumps in the exchange rate.

Whereas expected current-account imbalances can lead to a non-constant term structure of risk premiums, unexpected current-account imbalances can lead to a shift in the entire term structure of risk premiums. Unexpected current-account imbalances can also lead to a shift in the expected future terms of trade. In Figure 3, the shift from path 1 to path 2 illustrates a revision in the term structure of risk premiums with no change in the nominal terms of trade that is expected to prevail at time T, while the shift from path 1 to a parallel path 3 illustrates a shift in the expected future nominal terms of trade with no change in the term structure of risk premiums.

Figure 3



We are unable to present convincing arguments here about the channel through which unexpected current-account imbalances have had their predominant effects on exchange rates. Dooley and Isard (1979) suggest that month-to-month surprises in the current-account, which are small relative to stocks of wealth, will lead to small revisions in the term structure of risk premiums, although a sequence of current-account surprises in the same direction could conceivably explain a moderate shift in the exchange rate via a sequence of shifts in risk premiums, and independently of any changes in the expected future terms of trade. There are different types of current-account surprises, however -- including those associated with surprises in real activity variables, surprises in price variables, and surprises about the residual in "the current-account equation." We conjecture that a sequence of current-account surprises in the same direction, if associated with shifts in the residual in the current-account equation, will be viewed as permanent and affect observed exchange rates predominantly by leading to revisions in the expected future real terms of trade. Surprises about ratios of national price levels may or may not be accompanied by revisions in the expected future real terms of trade, depending on whether the ultimate causes of the surprises are real or purely monetary shocks; but such surprises will in any case be accompanied by revisions in the expected future nominal terms of trade. Finally, surprises in real activity variables may be viewed as either transitory (over the course of the business cycle) or permanent; and even permanent surprises that shift the entire path of future real activity levels would not necessarily affect the real terms of trade in

the long run if factors of production were sufficiently mobile to establish long-run purchasing-power parity.

5. Conclusions for Empirical Modelling

The analysis above leads to several conclusions for empirical model building. To the extent that exchange-rate fluctuations are predominantly unexpected, we require empirical explanations that distinguish between the expected and unexpected components of explanatory variables. That is, we require ex post explanations that explain the inaccuracy of exchange-rate expectations in terms of the inaccuracy of expectations about explanatory variables, and we should be suspect of models that accurately predict changes in exchange rates from ex ante information about explanatory variables. We can hope to understand history ex post, but to the extent that exchange rates are driven predominantly by unexpected events, we should recognize that accurate forecasting of changes in exchange rates requires foresight of explanatory variables that is more accurate or advanced than what "the market expects."

Our analysis has also suggested that unexpected jumps in exchange rates are associated with either (i) revisions in expectations about future real terms of trade, (ii) unexpected jumps in the ratio of domestic and foreign price levels, (iii) unexpected changes in real interest rates, or (iv) unexpected shifts in the term structure of risk premiums. Several issues need to be addressed in using these associations as a basis for empirical specification. First, most if not all of the "explanatory factors" just listed are appropriately viewed as endogenous and might better be expressed in terms of unexpected changes in underlying exogenous

variables. Second, all but the second factor are unobservable and, accordingly, must be modelled in terms of other explanatory variables. Third, while the unexpected component of the current account may underlie both revisions in expectations about future real terms of trade and unexpected shifts in the term structure of risk premiums, different types of surprises about the current account -- due to surprises about real activity levels, surprises about prices or surprises about the residual in the current-account equation -- will lead to different unexpected jumps in exchange rates; accordingly, the unexpected component of the current account should be disaggregated and/or expressed in terms of different types of exogenous explanatory variables when we seek to explain unexpected jumps in exchange rates.

A final issue is the time horizon of expectations and the pinpointing of when expectations are revised. The problem is that observed changes in explanatory variables may have been expected one month ago but unexpected from the perspective of a year ago. Six years ago, for example, few if any economists accurately foresaw the time paths of current-account imbalances that the major industrial countries have since experienced. Thus, from the perspective of the beginning of a sample period of data, the major portion of subsequent current-account imbalances might be viewed as unexpected, and empirical models of the level of the exchange rate may succeed in picking up the importance of the current account without explicitly distinguishing between its expected and unexpected components.

While models that ignore this distinction are suitable for some purposes, they are unlikely to explain accurately the timing of exchange

rate changes and, therefore, may not be very suitable for purposes of short-term forecasting. The accurate ex post explanation of exchange-rate changes requires accurate measures or models of when and by how much market participants revised their expectations about explanatory variables, which in turn requires accurate measures of the timing and size of the unexpected shocks that led them to revise their expectations. Accurate short-term forecasting requires more. In addition to relying on a model that accurately explains changes in exchange rates ex post, accurate forecasting of changes in exchange rates ex ante requires accurate forecasts of when and by how much market participants will revise their expectations about explanatory variables, which in turn requires relatively-advanced information about the events and/or statistics on which such expectations are based.

References

- Branson, William H., Halttunen, Hannan and Masson, Paul (1977)
"Exchange Rates in the Short Run: The Dollar Deutchemark
Rate." European Economic Review.
- Dooley, Michael P. and Isard, Peter. (1979). "The Portfolio-Balance
Model of Exchange Rates" Washington: Federal Reserve Board,
International Finance Discussion Paper No. 141, June.
- Dornbusch, Rudiger (1976). "Expectations and Exchange Rate Dynamics,"
Journal of Political Economy, December
- _____ and Fischer, Stanley (1978). "Exchange Rates and the
Current Account," processed, M.I.T.
- Frankel, Jeffrey (1979). "On The Mark" American Economic Review, forth-
coming.
- Hooper, Peter and Morton, John (1978): "A Forecasting Model of the Dollar's
Weighted Average Exchange Value," preliminary draft, Federal
Reserve Board, October.
- Kouri, Pentti J.K (1976) "The Exchange Rate and the Balance of Payments
in the Short Run and in the Long Run: A Monetary Approach."
Scandinavian Journal of Economics, 2
- Porter, Michael G. (1971) "A Theoretical and Empirical Framework for
Analyzing the Term Structure of Exchange Rate Expectations,"
IMF Staff Papers, November.
- _____ (1977) "The Exchange Rate and Portfolio Equilibrium"
unpublished manuscript, Monash University.
- _____ (1979) "A Portfolio Model of Exchange Rate Behavior--
Results for Eight Currencies," unpublished manuscript, Yale
and Monash Universities.