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# 1  An Introduction to Exchange Rates and International Macroeconomics

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This introduction begins with a reader's guide to the book, containing a summary of each chapter and an outline of the discussants' comments. It concludes with a brief discussion of some open questions in the analysis of exchange rates and international macroeconomics, represented by four examples of suggested research issues.

## 1.1  A Reader's Guide

In chapter 2, Peter Isard develops a useful framework for discussing the limitations of existing empirical models of exchange rate determination. He starts by manipulating the interest parity condition to develop some accounting identities that relate observable exchange rates to three unobservable expectational terms: an expected future real exchange rate, an expected inflation differential, and an expected premium for bearing exchange risk. He then focuses attention on issues relevant for modeling how news is transmitted to exchange rates through revisions in the three expectational terms. Given the presumption that exchange rate movements are predominantly unexpected—or, equivalently, that they predominantly reflect revisions in expectations in response to news—Isard argues that the poor performance of the empirical exchange rate models of the 1970s is not surprising.

To model exchange rate expectations, Isard represents the expected future real exchange rate by a model of the expected *long-run* real exchange rate or purchasing power parity (PPP) level. The question "How long is it expected to take for the real exchange rate to converge to

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its PPP level?'' is viewed to be roughly equivalent (as would be the case under risk neutrality) to the question "How long is it expected to take for real interest differentials to vanish?" The latter question is addressed through several comparisons of nominal interest rate term structures and measures of inflation expectations. Isard presents data which suggest that the adjustment lasts between two and five years. Based on this evidence, he recommends using the five-year forward rate and the long-term (five years) interest differentials as the relevant variables in exchange rate equations. Isard argues that his modeling strategy avoids reliance on arbitrary assumptions about the expected dynamics of adjustment to long-run PPP, which are explicit or implicit in traditional attempts to explain the "response" of exchange rates to changes in short-term interest differentials.

The paper devotes considerable attention to assessing the types of news that contributed to the major swings in the German mark/U.S. dollar (spot and five-year forward) exchange rates during 1980–81. Major swings in the exchange value of the dollar during 1981 coincided strikingly with major shifts in the outlook for U.S. fiscal policy. Isard argues that available survey data on long-term U.S. inflation expectations support the view that revisions in inflation expectations "explained" the major share of the exchange rate response to fiscal policy news. In addition, the arithmetic of the accounting identities suggests that part of the exchange rate response to fiscal policy news may have reflected changes in the risk premium in response to substantial revisions in expectations about the cumulative size of U.S. budget deficits over a five-year horizon.

An important message from the 1980–81 experience is that attempts to quantify the news on the basis of autoregressions may be largely inadequate. In particular, the fiscal policy news during 1981 was not accompanied by contemporaneous jumps in prices, activity levels, money supplies, or budget deficits, so its influence on exchange rates—whether transmitted through revisions in inflation expectations or changes in the risk premium—cannot be captured with autoregressions. Moreover, it is also apparent that long-term nominal dollar interest rates were not a good proxy for long-term U.S. inflation expectations during 1980–81; long-term real dollar interest rates changed considerably. Thus, the quantification of expectations poses a major hurdle for empirical attempts to explain the behavior of exchange rates.

In their comments on Isard's paper Sebastian Edwards and Jeffrey Frankel discuss several conceptual and empirical issues. Edwards demonstrates the numerous channels through which news affects the exchange rate and proposes alternative ways for testing the key empirical relation. Frankel's discussion focuses on the relative qualities of short- and long-

term rates of interest as the relevant variables in exchange rate equations. He argues that since both rates are related to each other, they should both, in principle, be equally acceptable indicators of monetary conditions. Frankel concludes his discussion by pointing out some puzzles in the pattern of the relations among the short-term interest rate, expected inflation, the exchange rate, and the long-term interest rate in the United States during 1981.

In the third chapter, Richard Meese and Kenneth Rogoff analyze the reasons for the poor performance of a variety of exchange rate models. This chapter complements their earlier work in which they have compared the out-of-sample fit of various structural and time series exchange rate models, and have found that the random walk model performs as well as any estimated model at one- to twelve-month horizons for 1970s dollar/mark, dollar/pound, dollar/yen, and trade-weighted dollar exchange rates. The structural models included the flexible-price and the sticky-price monetary models, as well as a sticky-price asset model which incorporates the trade balance. The various models performed poorly, even though their forecasts were purged of all uncertainty concerning the future paths of their explanatory variables by using actual realized values.

Meese and Rogoff present evidence that the poor performance of the structural models may not be attributed to inconsistent or inefficient parameter estimates. They rule out such a possibility on the grounds that these models fail to yield any improvement over the random walk model in mean absolute or root-mean-squared error over one to twelve months out of sample for a broad range of theoretically plausible coeficient values, even when autoregressive error terms are introduced. They argue therefore that it is unlikely that more efficient estimation techniques, such as imposing all the cross-equation rational expectations restrictions, would yield parameter estimates which would perform much better. While the various models do not outperform the random walk model over periods of one to twelve months out of sample, they perform better over longer forecast horizons.

The three models considered by Meese and Rogoff share the same asset market specfication, which is based on uncovered interest parity and a conventional real money demand equation with income and short-term interest rates. The models differ in their assumptions about purchasing power parities. Since all three models perform poorly, their joint failure is likely a result of the asset market specification. While, in principle, the breakdown of empirical exchange rate models may be the result of volatile time-varying risk premiums, volatile long-run real exchange rates, or poor measurement of inflationary expectations, the authors argue that the main problems seem to lie in the specifications of the demand for money. They conclude by noting that if this is indeed the

case, then the same improvements which resuscitate domestic empirical money demand equations should also lead to similar improvements in empirical exchange rate equations.

In his comments on the Meese and Rogoff paper, Nasser Saïdi notes that since the residual errors for various exchange rates are likely to be correlated, a joint estimation of the various exchange rate equations could improve the forecast accuracy of the structural models. He also notes that since forecasts for horizons longer than one period follow a moving average process, tests for evaluating the forecasts of alternative models are more meaningful when based on one-period ahead forecasts rather than on multiperiod forecast horizons. As for the source of the failure of the structural models, Saïdi highlights the inadequate modeling of expectations formation. In particular, he believes that the distinction between anticipated and unanticipated movements in the exogenous driving variables has not been given sufficient attention in existing structural models.

Commenting on the same paper, Michael K. Salemi analyzes Meese and Rogoff's findings by pointing out that in contrast with the results for short-term horizons (up to twelve months), long-term forecasts based on the three structural models are more successful than the forecasts based on the random walk model. Salemi suggests the possibility that in the short run the exchange rate behaves like a speculative asset, but over longer runs the exchange rate is related systematically to a range of economic variables that is broader than the one assumed by the typical asset models. Salemi concludes his comments by noting that the results reported by Meese and Rogoff do not reject the conceptual framework underlying the asset-market approach to exchange rate determination. Rather, they shed doubt on some specific formulations of that approach.

In the fourth chapter, Lars P. Hansen and Robert J. Hodrick study three alternative statistical models of the relationship between expected return and risk in the forward foreign exchange market. If the forward exchange rate deviates from the expected future spot rate, there is expected profit on contracting in the forward market. The risk one bears in writing such contracts is caused by covariance of the nominal profit on the contract in terms of its currency of denomination with the intertemporal marginal rate of substitution of that money which is the nominal counterpart of the intertemporal marginal rate of substitution of consumption. This latter concept is the key ingredient used in defining risk that emerges from real intertemporal asset-pricing models. Each of Hansen and Hodrick's statistical models of the risk-return relationship in the forward foreign exchange market can be viewed as a restriction on linear time series representations, and each is interpreted by examining the first order conditions of the intertemporal optimization problems of international investors under the assumption of rational expectations. Hansen

and Hodrick estimate these models from a semiweekly sample of spot and one-month forward exchange rates for the period from February 1976 to December 1980.

Their first statistical model relies on the auxiliary assumption that exchange rates and the intertemporal marginal rate of substitution of money are jointly lognormally distributed. Under this assumption the expected deviations between the logarithms of future spot rates and current forward rates should be constant. They report empirical results that shed doubts on the adequacy of this model. These results suggest that time variation in risk premiums in the forward market should be taken seriously.

The second statistical model examined by Hansen and Hodrick relies on the assumption that the conditional covariance between the profit on the forward contract and the intertemporal marginal rate of substitution of money is constant. In this case, time variation in the risk-free nominal return should capture the time variation in the risk premiums. Statistical analysis of this model indicates that little, if any, of these movements is explained by movements in the risk-free nominal return.

The authors then examine a final statistical model which is patterned after the single beta capital asset-pricing model that has played an important role in the empirical finance literature. In this model risk premiums are linked to the covariance of the return on an asset with the return on a benchmark asset that is on the mean variance frontier. From the intertemporal asset-pricing models it is known that the return on the aggregate wealth portfolio will not, in general, be an appropriate benchmark. From theory it is known that appropriate candidates for benchmark returns are explicitly linked to the intertemporal marginal rate of substitution of money. Such returns, however, are difficult, if not impossible, to observe. Consequently, in their statistical model Hansen and Hodrick postulate that the "betas" on the forward contracts are constant through time, while they allow the conditional expected return on the unobservable benchmark return to vary over time. Under these assumptions they estimate a time series version of a latent variable model in which severe cross-equation restrictions apply to the parameter estimates. In estimating the statistical model, they are unable to reject these restrictions, and they find evidence for nontrivial risk premiums in at least two and possibly three of the five forward markets considered.

Although the statistical analysis cannot be construed as providing tests for intertemporal equilibrium models of forward foreign exchange markets, because they have placed assumptions directly on endogenous variables, the results are sufficiently encouraging to promote the important endeavor of integrating the theory of intertemporal asset pricing with international monetary theory.

In their discussion of the Hansen-Hodrick paper, Craig S. Hakkio and

Kenneth J. Singleton make econometric and methodological comments. Hakkio notes that Hansen and Hodrick's analysis builds on an intertemporal arbitrage condition derived from a nonmonetary model of a representative individual. He suggests that the application of this framework to a monetary model of the aggregate economy may be sensitive to the way in which money is introduced into the model as well as to the conditions which make aggregation valid. In interpreting the results, Hakkio recommends a more detailed analysis of the specific causes which underlie a rejection of various models. He concludes his discussion by noting that Hansen and Hodrick's findings should be interpreted as evidence against the constant risk premium hypothesis rather than against the efficient market hypothesis.

Singleton elaborates on some theoretical properties of the models investigated by Hansen and Hodrick and discusses ways of testing nonlinear, intertemporal models of exchange rate determination that do not impose the restrictive assumptions underlying their linear relations. Singleton argues that in the absence of more information about the underlying assumptions which lead to the linear exchange rate representations, there are various possible ways of interpreting Hansen and Hodrick's findings. Specifically, Hansen and Hodrick present the nominal risk-free relation and the latent variable representation as if they represent very different theoretical models of exchange rate determination. While admitting this possibility, Singleton notes that since so little structure is imposed on the empirical representations of the theoretical models, one representation could also be interpreted as a special case of the other.

In the fifth chapter, Peter R. Hartley analyzes the hypothesis that expectations of exchange rate movements are formed rationally. He argues that this hypothesis implies that forecasts of future exchange rates are based on any publicly available information which is known to be useful for predicting exchange rate movements, and he tests the hypothesis within the context of the simple monetary model of exchange rate determination.

The simple monetary model predicts that movements in the rate of exchange between two currencies will be determined by current and anticipated future movements in the supplies of, and demands for, the two currencies. Hartley supposes that changes in money supplies and incomes follow stable autoregressive processes, and therefore, if agents use this fact, anticipated future movements in money supplies and incomes depend on past movements in the same variables. Anticipated movements in exchange rates then depend on past movements in money supplies and incomes. If expectations are rational, there are cross-equation restrictions on the autoregressive parameters describing the money supply and income growth processes and on the parameters in the exchange rate equation.

Hartley's equation relating the change in exchange rates to present and past changes in money supplies and incomes has an error term which is an amalgam of the error terms in the money demand functions for two countries and deviations from purchasing power parity, and there is no reason to expect this error term to be white noise. If the error term follows a stable autoregressive process, then unanticipated changes in the exchange rate depend on unanticipated money and income growth rates and an error term which is serially uncorrelated (so long as the forecast horizon and observation interval coincide). Rationality of expectations again implies a set of cross-equation restrictions on the parameters of the forecasting equations for money and income growth rates and on the parameters in the unanticipated change in the exchange rate equation.

Hartley argues that tests of rationality can be strengthened by simultaneously estimating equations explaining unanticipated changes in exchange rates between several overlapping pairs of currencies. If expectations are rational, then the forecast of, for example, U.S. money growth rates that agents use when attempting to predict changes in the dollar/pound exchange rate should be the same forecast they use when attempting to predict changes in the dollar/mark exchange rate. Rationality implies restrictions across the parameters of the forecasting equations and both exchange rate equations. He argues further that the term structure of the forward exchange rate can also be used in exchange rate equations for different forecasting horizons and that the rationality implies another set of cross-equation restrictions.

Hartley applies these tests to data from the 1970s. Although the cross-equation restrictions implied by the model are not rejected, the estimated coefficients have large standard errors, and thus many alternative hypotheses are also consistent with the data. He then estimates joint forecasting equations relating Eurocurrency interest rates to money and income growth, and unanticipated exchange rate movements to unanticipated movements in interest rates. Rationality again implies cross-equation restrictions on the estimated parameters which are not rejected.

In commenting on Hartley's paper, Debra Glassman notes specific aspects of data from the foreign exchange market. She argues that each day of the week has its own characteristics which might be relevant in a detailed empirical study of exchange rates. For example, on Monday there might be substantial catching up with the news of the weekend, while on Friday the weekly U.S. money supply figures are released. In addition, since there are subperiods with differing characteristics of the foreign exchange market, Glassman suggests that a further pursuit of the heteroscedasticity correction is warranted. She concludes her comments by noting that Hartley's procedure tests the joint hypothesis of rational expectations along with a specific specification of the model. To separate the two, she suggests that the expectations hypothesis can be fruitfully

tested by using other data on exchange rate forecasts, like those supplied by professional services and those implicit in futures, options, and stock markets.

Maurice Obstfeld's comments on Hartley's paper focus on alternative strategies for estimating exchange rate equations. Specifically, Obstfeld discusses the trade-off between asymptotic efficiency, on the one hand, and robustness and tractability, on the other, by comparing Hartley's maximum likelihood approach to an alternative, instrumental variables approach. Obstfeld notes that in Hartley's framework consistency of maximum likelihood estimates requires some strong exogeneity assumptions that may not be valid. He argues that under such circumstances it is desirable to have an estimator that is consistent under a broader set of assumptions, even if that estimator is inefficient relative to the maximum likelihood estimate. Obstfeld describes an instrumental variables estimator which permits the weakening of Hartley's assumptions while easing the computational difficulties. In addition, the instrumental variables approach has the attractive feature of taking into account the possible conditional heteroscedasticity of the disturbances.

In the sixth chapter, Stanley W. Black studies the use of monetary policy for internal and external balance in ten industrial countries. Black assumes that the monetary authorities behave as if they maximize an intertemporal welfare function depending on internal and external target variables, such as inflation, unemployment, and the level of reserves, subject to an implicit, perceived econometric model of the private economy. Policy reaction functions then relate the policy instruments directly under the authorities' control to the target variables. The appropriate instruments in each country include discount rates, reserve ratios, open market operations, discount quotas, and credit controls. Black allows for information lags as well as lags in the adjustment of instruments that are adjusted only discretely, such as discount rates and credit controls. These lags are allowed for by using threshold and logit regression models.

Black's results show that the instruments of monetary policy respond significantly in predictable ways to customary measures of internal and external balance. Cross-country comparisons in the context of the discount rate equations, which are reasonably homogeneous across countries, show that inflation receives a relatively high weight in the policy reaction functions of Belgium, Germany, Italy, France, and the United States, while it receives lower weights in Britain, Canada, the Netherlands, Japan, and Sweden. A cross-sectional regression equation shows that, after taking account of orientation of monetary policy toward external targets and differing vulnerability to oil price increases, the observed average inflation rate is negatively correlated with the policy weight that the reaction function assigns to the inflation target. In addition, Black shows that: (i) the importance attached to inflation and

unemployment objectives varies inversely across countries; (ii) there appears to be little relationship across countries between the importance of unemployment objectives and observed rates of unemployment; (iii) there is an inverse correlation across countries between the importance of internal and external objectives for monetary policy; (iv) there is an inverse correlation between the flexibility of the exchange rate and the relative importance of external compared to internal objectives; and (v) conservative election victories have often led to tighter monetary policies.

In commenting on Black's paper, Leonardo Leiderman discusses the robustness of the empirical findings as well as the methodology. His methodological comments raise issues concerning the derivation and the specification of Black's postulated reaction functions. Leiderman points out some difficulties of interpreting the estimated coefficients of the reaction function. These difficulties stem from the fact that each estimated coefficient represents the joint influence of the effect of the policy instrument on a target variable and the weight of the target in the objective function. As a result the estimated coefficients are generally functions of the structural parameters and of the parameters reflecting policy preferences, and disentangling the two may not always be possible.

Alan Stockman's comments on Black's paper also focus on methodological and empirical issues. He argues that the view of policy as an isolated action undertaken in response to a particular set of circumstances may be inappropriate. Instead, policy should be analyzed within a more general framework which views a specific policy action as part of a broader policy rule. On the empirical side, Stockman questions the robustness of the estimates, as well as whether they reflect structural or reduced-form coefficients. He suggests that some of these questions could be resolved by following a procedure that imposes and tests the cross-equation restrictions that are imposed by the model.

The seventh chapter by Guillermo A. Calvo provides an analytical framework for the analysis of exchange rate policies for an economy with staggered contracts. An important methodological innovation in this paper is the development of a continuous time formulation of the staggered contracts model. The model is that of a small open economy that is governed by rational expectations and in which the prices of home goods are set intermittently in a dissynchronized manner. This formulation enables Calvo to analyze in detail the dynamic evolution of an economy with slow price adjustment.

The central concern of the paper is the characterization of circumstances in which unanticipated devaluations exert contractive influences on the economy. As a general rule, circumstances like those must be associated with situations in which there is a multiplicity of rational expectations equilibria. Calvo shows that this characteristic is robust: it

does not depend on the degree of capital mobility, nor on whether the exchange rate is freely flexible or preannounced. Having established the conditions that give rise to the fundamental indeterminacy, Calvo examines the case for which equilibrium is unique and analyzes the short- and long-run effects of an announced future change in policies. The paper concludes with an application of the staggered contracts model to the analysis of monetary policies under a fixed exchange rate regime.

In discussing Calvo's paper, John B. Taylor deals with the specification of the price and contract equations as well as with the nonuniqueness property. He observes that the randomness of contract length in Calvo's specification is exogenous, and thus, even though the length of contracts is not fixed, it is not responsive to endogenous events. Taylor proposes another way of interpreting Calvo's equations in which each individual contract has a given nonrandom length, but there is, because of heterogeneity of markets and products, a distribution of contracts by length across firms. He also suggests an extension of Calvo's price-setting formulation by which foreign prices also influence the aggregate price level. Taylor concludes his comments by noting that the nonuniqueness that arises in Calvo's model is consistent with the general principles underlying nonuniqueness in rational expectations models and does not stem from the existence of contracts.

In discussing Calvo's paper, Michael Mussa deals with the situations in which Calvo finds that a devaluation is contractionary with respect to aggregate demand. Mussa notes that such a situation need not only arise if the equilibrium is "unstable" in the Walrasian sense. A devaluation may be contractionary because it reduces the real value of cash balances. Mussa notes further that in cases of multiple paths of which only one converges to a stable equilibrium, none of the paths converging to the Walrasian-unstable equilibrium represents an economically sensible solution to the relevant system. Mussa suggests focusing attention on the equilibria that are stable in the usual Walrasian sense.

The eighth chapter by Paul Krugman analyzes the influence of oil stocks on exchange rate dynamics. Krugman argues that the effects of oil price increases on exchange rates cannot be studied in a "small country" context. If all oil importing countries were alike, the rates at which their currencies exchange would be unaffected by the price of oil; thus any effects must depend on asymmetries between oil importers. This paper attempts to identify the crucial asymmetries by developing a series of models of a world consisting of three countries: two oil importers, America and Germany, and one oil exporter, OPEC.

The first model is a pure "trade balance" model which puts on one side the issue of recycling: OPEC is assumed to spend all its income, while the exchange rate between America and Germany adjusts to preserve balanced trade. The exchange rate effect of an oil price increase depends on

two offsetting forces. On the one side, higher oil prices place a direct burden on a country's balance of payments, with the magnitude depending on how large the initial oil bill was and on the elasticity of oil demand. On the other side, there is an indirect benefit as OPEC spends its increased income on imports. Whether the dollar appreciates or depreciates depends, first, on whether America's share of world oil imports is more or less than its share of world exports to OPEC and, second, on how its elasticity of demand for oil imports compares with Germany's.

The second model adds the complications introduced by OPEC surpluses and capital flows. OPEC is allowed to hold two assets, dollars and marks, and the two oil importers are also allowed to hold each other's currencies. OPEC's spending is assumed to lag behind its income, so that after an oil price increase there is a temporary surplus which must be invested abroad. The result is that in the short run financial factors play a crucial role: whether the dollar appreciates depends on whether America's share in OPEC asset holdings is more or less than its share in the increase in the world oil bill. In the long run, on the other hand, real factors dominate: whether the dollar ultimately comes to rest at a higher or lower level depends on the variables analyzed in the pure trade balance model. Interestingly, the short-run and long-run effects can run in opposite directions. Loosely speaking, if OPEC likes American investments but prefers German products, an oil shock will cause the dollar to rise now but decline even more later.

The third model adds speculation to the story. If the dollar must eventually decline, won't the expectation of this affect its current value? The model shows that it will. For simplicity, it is assumed that dollars are the only traded asset, so that OPEC surpluses naturally tend to strengthen the dollar; but it is assumed that the long-run real factors favor the mark, and that asset demands depend on the rationally expected rate of change of the exchange rate. The result is that even though the short-run financial considerations tend to cause dollar appreciation, expectations of a future decline can cause the dollar to depreciate at the start.

In his lengthy comment on Krugman's paper, Pentti J. K. Kouri discusses the balance of payments and exchange rate effects of oil price increases from the point of view of the theory of international transfers. Kouri shows that in the context of a general equilibrium model, "oil transfers" can be effected without any changes in international relative prices and interest rates. Thus, he argues, it is basically an empirical question whether oil shocks have important international relative price, interest rate, and exchange rate effects. There is, however, a strong theoretical presumption as far as domestic relative prices and real wages are concerned: the countries paying the "oil transfer" will experience a decline in real wages and an increase in the relative price of traded goods.

Charles Wilson's comments on Krugman's paper examine the implications of the model for exchange rate movements during the course of a worldwide recession. Wilson demonstrates that the impact of decreased business activity in the industrialized countries on exchange rate movements depends critically on how sensitive the level of OPEC expenditure is to its level of wealth. If expenditure merely adjusts to OPEC revenue with a lag, then one should expect the value of the German mark first to rise and then to fall during the course of a recession. If, however, the decline in OPEC wealth induces a significant decrease in its expenditure, then the opposite pattern would emerge.

The ninth chapter by J. Peter Neary and Douglas D. Purvis deals with the interaction between real adjustment and exchange rate dynamics. The authors develop a model that is designed to clarify the nature of macroeconomic responses to sectoral shocks and to provide a basis for investigation of the interaction between resource allocation and exchange rate variability. They first develop the implications for the dynamics of the real exchange rate of a Marshallian distinction between short- and long-run supply responses to an endogenous disturbance. Marshall's partial-equilibrium analysis stressed the overshooting of a relative price because of short-run factor fixity; Neary and Purvis's analysis derives this result in a general equilibrium context, although in a general equilibrium model it is possible that the long-run price response is perverse so that, rather than overshooting, the short-run relative price response would actually be in the "wrong direction."

They then extend the framework to incorporate the behavior of money prices in the face of these changing relative prices. The model focuses on monetary equilibrium combined with rational speculation; the dynamic behavior of the nominal exchange rate exhibits a straightforward dependence on that of the real exchange rate. But the latter is independent of monetary equilibrium and, in particular, of any speculative behavior; any influence of speculators on the nominal exchange rate gives rise to identical movements in the equilibrium nominal price of services. This complete, short-run neutrality of nominal changes vanishes in an extended specification of the Neary-Purvis model which allows for nominal short-term rigidities.

In his comments on the Neary and Purvis paper, Kent P. Kimbrough suggests that a useful extension of the model would allow for discrepancies between income and spending. Such an extension would demonstrate the dynamic link between exchange rate movement, deviations from purchasing power parity, and the current account. Kimbrough indicates that this dynamic link is a consequence of transfer problem criteria applied to goods and assets markets. He concludes his comments by discussing alternative ways by which the model could be modified to allow for exchange rate variability to influence resource allocation. In this

context he outlines a stochastic framework that is characterized by short-run confusion about the sources of shocks.

Jeffrey Sachs's comments on the Neary and Purvis paper focus on possible extensions of the dynamic analysis. He argues forcefully that one of the central channels through which dynamic adjustment is effected is the channel of international borrowing. Thus, the discovery of a natural resource base generates incentives for current account imbalances, and the allocational effects of the shock depend on how much foreign borrowing is encouraged or restricted by the authorities.

The tenth chapter by William H. Buiter and Marcus Miller concludes the volume. This chapter focuses on the interaction between the dynamics of the real exchange rate and the output cost of reducing inflation. In dealing with this issue, Buiter and Miller analyze the proposition that under a floating exchange rate regime restrictive monetary policy results in substantial overshooting of the real exchange rate—a loss of competitiveness.

By considering alternative specifications of the wage-price process, the paper brings out the crucial role in the overshooting phenomenon of nominal stickiness or inertia in domestic money wages and prices combined with a freely floating exchange rate. A further "sensitivity analysis" of the overshooting proposition is performed by generalizing the basic open economy IS-LM model in terms of which earlier analyses have been conducted in a number of directions. First, the long-run real interest rate rather than the short rate is included as an argument in the IS function, and dynamic and static Pigou effects are included as determinants of effective demand. Second, external wealth adjustment via current account deficits and surpluses is incorporated, and general wealth effects on money demand and output demand are added. Finally, gradual rather than instantaneous adjustment of the level of output is considered. The real exchange rate overshooting proposition survives all these model generalizations, although a strong wealth effect on the demand for money reduces its magnitude.

One of the virtues claimed for the sharp initial appreciation of the currency (i.e., the fall in the real and nominal exchange rates in response to an unanticipated tightening of the stance of monetary policy) is its immediate effect on the domestic price level, through a reduction in the domestic currency price of internationally traded goods. The model analyzed in this paper does indeed have the property that tight money reduces on impact both the general price level and the underlying or "core" rate of inflation. Buiter and Miller show, however, that while exchange rate "jumps" induced by restrictive monetary policy do speed up the process of disinflation, they do not reduce the cost, in terms of lost output, of bringing down the rate of inflation. The effect of such exchange rate jumps is merely to redistribute the cost of reducing inflation over

time. Early gains have to be "handed back" later as the equilibrium level of competitiveness is restored. The authors conclude the paper by discussing more efficient ways of bringing down the rate of inflation.

In commenting on this paper, Robert P. Flood notes that Buiter and Miller's formulation presumes that governments may sharply reduce the rate of monetary expansion without significant political opposition. This supposition enables Buiter and Miller to solve their model conditional on the assumption that individuals believe that the current policy regime will last indefinitely. Flood proposes to examine the situation under which this assumption is relaxed. He develops a formal model which allows for the possibility of a stochastic model switching which is used to illustrate the importance of these considerations.

Jürg Niehans's comments on the Buiter and Miller paper deals with its policy implications and with the correspondence between the model and the British experience. As for the policy, Niehans takes issue with Buiter and Miller's recommendation to lower inflation by combining a reduction in the monetary growth rate with an actual one-time rise in the money stock. As for modeling, he suggests that the Buiter-Miller model be extended to take into account the requirement that any trade imbalances arising, for example, from changes in competitiveness, must be consistent with the desired accumulation or reduction of foreign assets.

## 1.2   Further Issues

One of the major advances of the past decade's research in open economy macroeconomics has been the modeling of the foreign sector. By now it is well understood that a proper modeling of the open economy should *not* attach a foreign sector as an appendix to the otherwise closed economy model. Rather, it is now clear that the entire economic system operates in a different way once allowance is made for the openness of the economy, and, therefore, open economy considerations should be incorporated in a consistent manner through the various layers of the open economy macro model. The papers and comments that are included in this volume deal with the frontiers of research in the area of exchange rates and international macroeconomics. It is pertinent to note that there are still numerous conceptual and technical issues that deserve further research. This section outlines four examples of such issues.[1]

1. The following remarks draw on Jacob Frenkel. "Comments on Research Issues on Exchange Rate Economics" in *Annales de L'INSEE*, July–December 1982, forthcoming, and on Jacob Frenkel, "Comments on the Theory of Exchange Rate Determination" in *Exchange Rate Theory and Policy*, ed. J. F. O. Bilson and R. Marston (Chicago: University of Chicago Press, forthcoming).

### 1.2.1   The Peso Problem

One issue relevant for empirical research in the area of exchange rate determination may be referred to as the "peso problem." The original peso problem is characterized by the situation of the Mexican peso which was eventually devalued during the third quarter of 1976. Since this devaluation was expected for several years, the peso was traded at a forward discount in the market for foreign exchange. Obviously, as long as the devaluation did not take place, the forward exchange rate proved (ex post) to have been a biased forecast of the realized future spot exchange rate. But once the devaluation took place it exceeded the prediction that was implied by the forward discount on the peso.

Generally, the peso problem is a situation in which there are many observations but many fewer events. For example, in Mexico's case there were many days (observations) during which the forward discount prevailed, and yet there was only one event—the devaluation itself. These circumstances affect the properties of the statistical distribution of rates of return and raise conceptual and practical difficulties for studies which attempt to examine the efficiency of foreign exchange markets and the biasedness of forecasts of future spot rates based on lagged forward rates. Likewise, in such circumstances it is not clear whether a rise in the number of observations in any sample, brought about by a greater frequency of measurements, should be treated as a corresponding increase in the number of effective degrees of freedom. In a way, the peso problem could be cast in terms of a small samples problem. As such it has much wider applications. However, since the foreign exchange market is strongly influenced by expectations of future events and policies, and since current expectations of future changes in policies (like a devaluation or a specific change in intervention policies) are based on probabilistic evaluations, it is evident that the peso problem is especially relevant in the foreign exchange market.

Another example that falls under the heading of the peso problem relates to the current price of gold. Studies of optimal portfolios have found that gold has a small role in the optimal portfolio of assets. A possible rationale for the observed large holdings of gold can be provided by noting that current holdings and pricing of gold reflect the probability of a sharp rise in its price in the event of a fundamental change in the role of gold in the international monetary system. Again we have a situation where there are many observations but only one (or even no) event.

### 1.2.2   The Role of Innovations

A second issue relates to the role of innovations. One of the central implications of the rational expectations hypothesis is that unanticipated events, news, play a predominant role in affecting real variables and asset

yields. This implication has been embodied in the modern theory of exchange rate determination. Accordingly, exchange rates are presumed to reflect current as well as expected future values of the relevant economic variables. The anticipatory role of exchange rates suggests that empirical research of exchange rate determination should relate changes in exchange rates to the *innovations* in the relevant regressors. While this methodology has a strong theoretical justification, its empirical application is extremely complicated. Since the innovations are intrinsically unobservable, any empirical analysis involves the *joint* examination of the model as well as the measurement of the innovation (i.e., the measurement of the expected values which are used in the construction of the innovations). Since there is no practical way to avoid completely the joint hypotheses problem, it seems that inference from empirical estimates should be made with great care.

A similar difficulty, also relating to the anticipatory nature of exchange rates and the prompt response of asset prices to new information, concerns the implications of different frequencies of data collections for various time series. For example, data on exchange rates and interest rates are available much more frequently than data on national income or on the current account. These different frequencies of data availability are reflected in different patterns of revisions of expectations and may affect systematically the time series characteristics of the innovations of the various data.

### 1.2.3   Structural Models

Recent examinations of the various structural models of exchange rate determination, including the monetary models, the portfolio balance models, the current account models, and others, have shown that they have not performed well in explaining movements in nominal exchange rates. With the benefit of hindsight, it seems that the key reason for the poor performance of the various models is the intrinsic characteristics of exchange rates as asset prices. As indicated above, exchange rates are very sensitive to expectations concerning future events and policies. Periods that are dominated by rumors, announcements, and news which alter expectations are likely to induce a relatively large degree of exchange rate volatility. Since by definition news cannot be predicted on the basis of past information, it follows that by and large the resulting fluctuations of exchange rates are unpredictable. In a way, this asset market perspective suggests that we should *not* expect to be able to forecast accurately exchange rate changes with the aid of the simple structural models. The role of the simple structural models is to account for the *systematic* component of the evolution of exchange rates. In cases where the systematic, predictable component is relatively small, we may expect to account for only a small fraction of the variability of exchange

rates. A potentially productive line of research would examine the implications of the different structural models for the relation among the variance of exchange rates and the variance of the various fundamentals.

### 1.2.4   Lucas Critique

One of the central insights that has affected economic research during the past decade has been the "Lucas critique." The key point of that critique is the observation that the behavior of economic agents reflects the prevailing pattern of policies as well as agents' expectations concerning the future path of policies. As a result, policy actions which attempt to exploit a correlation between two endogenous variables (e.g., the correlation between inflation and unemployment or the correlation between exchange rates and interest rates) may fail since the policy actions themselves might alter the structure of the relation between the two variables in a way that could not have been predicted from the historical correlations. Such an outcome is likely to occur when policies are based on reduced-form relations rather than structural relations.

This critique is of course fundamental for the evaluation of the results of simulations based on parameter estimates that are obtained from historical data. It is pertinent to note, however, that as a practical matter the quantitative importance of the Lucas critique depends on the circumstances: it may be significant for some experiments while negligible for others. It certainly should not discourage further empirical research. Rather, it should encourage the use of an improved research methodology that takes into account the endogeneity of the structural parameters.

The foregoing examples illustrate the type of issues relevant for empirical research. There are of course many more issues that should be fruitfully addressed as part of a research agenda in the area of exchange rates and international macroeconomics. It is hoped that the essays and comments collected in this volume will stimulate further research in that direction.