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The Empirical Modeling of Exchange Rates: An Assessment of Alternative Approaches*

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Contents

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I. Summary

The paper first surveys what has been learned over the past decade from the empirical modeling of exchange rates. Studies of forecasting accuracy have revealed that monetary models have performed little or no better than random walks in predicting exchange rates post sample, even when purged of all errors in predicting explanatory variables. Other studies have raised serious doubts about the validity of the uncovered interest rate parity assumption, which is a key building block for the monetary models. Empirical studies have also failed to support the class of portfolio balance models in which deviations from uncovered interest rate parity--generally referred to as exchange risk premiums--are related systematically to relative stocks of assets denominated in different currencies and to the distribution of wealth (or financial net worth) among countries that might have different currency preferences.

After reviewing empirical studies, the paper turns to the shortcomings of the conceptual literature. A variety of models have been developed to explain the simultaneous behavior of the exchange rate, prices, and the balance of payments, but almost all existing models have relied either on the assumption that only one type of asset can be traded internationally (equivalently, that all internationally traded assets are perfect substitutes) or on the premise that the asset preferences of investors derive simply from the institutional fact that transactions for goods and services require (or predominately are settled with) different currency units in different countries.

Based on the limitations of the existing empirical and conceptual frameworks, the paper argues in favor of an alternative approach. The core of the approach is to replace or supplement the emphasis on the financial characteristics of assets with an emphasis on the notion that portfolio preferences are related fundamentally to differences in the prospective returns on capital in different countries, taking account of the extent to which the income streams on assets located in different countries (or held as claims against the residents of different countries) are subject to different macroeconomic outlooks, political environments, and prospects of taxation. Under this approach, the country preferences and the currency preferences of asset holders are simultaneously determined. Exchange rates thus depend both on expectations and uncertainties about exogenous factors influencing the production of goods and the distribution of income in different countries, and on expectations and uncertainties about monetary policies and other factors that influence the absolute levels of prices.

II. What Has Been Learned From Empirical Test Behavioral Models and Parity Assumptio

1. Comparisons of models of systematic and random beha

Although the inaccuracy of exchange rate forecasts had bee... recognized for some time, the extent of the inaccuracy was not adequately appreciated prior to the emergence of two enlightening studies by Meese and Rogoff (1983 a, 1983 b). Those studies found that models of systematic exchange rate behavior could not outperform a naive random-walk model or the forward exchange rate in post-sample forecasting tests, even when the forecasts of systematic behavior were based on the ex post realized values of the explanatory variables. The Meese-Rogoff papers are by now widely known and require only a brief summary. The studies focused on exchange rates of the U.S. dollar against other currencies during the period from March 1973 through June 1981. The tests were performed on three types of models of systematic behavior: a flexible-price monetary model associated with Frenkel (1976) and Bilson (1978, 1979); a sticky-price monetary model associated with Dornbusch (1976) and Frankel (1979, 1981); and a hybrid specification that grafted the trade balance onto the sticky-price monetary model, in close similarity to Hooper and Morton (1982). 1/ The papers employed rolling regressions to construct post-sample forecasts based on combining the estimated parameter values with the realized values of the explanatory variables; in addition, a search over a wide range of parameter values explored and rejected the possibility that the poor performance of the systematic models might be attributable to poor parameter estimates.

Subsequent papers by Backus (1984), Woo (1985), Boughton (1985), and Meese and Rogoff (1985), among others, have extended the forecasting comparisons and clarified the relative performances of the models of systematic and random behavior. Backus concentrated on the exchange rate between the U.S. and Canadian dollars and tested a number of portfolio balance models in which the regressors included stocks of outside assets and net foreign asset positions; his results were qualitatively identical to those of Meese and Rogoff in revealing that a random walk typically produced the best post-sample predictions. Woo examined an alternative specification of the monetary model (based on combining the classic long-run money demand specification with a short-run partial

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1/ This paper follows the practice of using the term "monetary models" in reference to the set of models which impose the uncovered interest rate parity assumption, and using the term "portfolio balance models" in reference to the exhaustive residual set of models.

adjustment hypothesis), which outperformed the random walk model in predicting the exchange rate between the U.S. dollar and the deutsche mark during a forecasting period from March 1980 through October 1981. 1/

Boughton (1985) has extended the comparisons to the portfolio balance models of Artus (1976, 1981, 1984) and Boughton (1984), which assume static expectations about the real or price-level-adjusted exchange rate (i.e., equality between the expected rate of change in the nominal exchange rate and the expected inflation differential); in addition, Boughton tested the monetary model of Shafer and Loopesko (1983). Boughton found that each of those models can explain only a small portion of observed month-to-month changes in exchange rates; consistently, he found strong evidence of instability in each of the reduced-form estimating equations. Nevertheless, in tests of post-sample forecasting accuracy during the period from January 1981 through December 1984, the portfolio balance models generally performed better than a random walk model in predicting the exchange rates of the dollar against both the mark and the SDR currency basket, although they did not generally perform better in predicting the dollar/yen rate. It is of interest to note that the estimated reduced forms of those models specify the real exchange rate as the dependent variable and include among the regressors a lagged dependent variable with an imposed coefficient of 1 in the Artus specification, and with estimated coefficients ranging from 0.89 to 0.97 in both the Boughton specification and a more general "compound" model. It may also be noted that the latter two specifications, with slightly regressive ceteris paribus behavior of the real exchange rate, performed somewhat better than the Artus specification. 2/

Meese and Rogoff (1985), in a sequel to their first two papers, have extended their analysis in a number of directions: to non-dollar exchange rates (mark/yen and mark/pound) as well as dollar exchange rates (dollar/mark, dollar/yen, and dollar/pound); to real exchange rates as well as nominal exchange rates; and to November 1980-June 1984 as a post-sample (Reagan-regime) forecasting period. They have characterized the post-sample forecasting results from their third study as "slightly more

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1/ It may be noted that Woo's forecasting period was about two-thirds as long as the shorter of the two forecasting periods considered by Meese and Rogoff (1983a, 1983b). It is possible that other models of the association between exchange rates, interest differentials and actual or expected inflation differentials would also perform relatively well at predicting the dollar/mark rate during Woo's forecasting period, when U.S. inflation rates were declining relatively rapidly and correlations between exchange rates and real interest differentials appear to have been relatively strong.

2/ The lagged dependent variable enters the models through the assumption that expectations about the real exchange rate are static. This effectively incorporates or comes close to incorporating a random real-exchange-rate walk in the models while also allowing the nominal exchange rate to fluctuate systematically relative to the real exchange rate.

favorable" to the models of systematic behavior than the results of their earlier studies. In concentrating attention on the relationship between real exchange rates and real interest differentials, they found the theoretically anticipated sign in most cases, but a lack of statistical significance and, relatedly, insufficient explanatory power to provide significant improvement over a random walk model when forecasting real exchange rates with real versions of the Dornbusch-Frankel and Hooper-Morton models. 1/ They further investigated the associations between real exchange rates and real interest differentials by subjecting the time series of those variables to tests for cointegration, which are independent of any particular structural hypothesis. These tests also suggest that much of the variability of real exchange rates cannot be associated with variability of real interest differentials. Since real exchange rates and real interest differentials are linked, however, by an "accounting framework" that is developed in Section III.1 below, Meese and Rogoff (1985, page 18) have concluded that their "findings of no cointegration suggest that a variable omitted from the relation, possibly the expected value of some future real exchange rate, must have a large variance as well."

As a summary of the material discussed in this section, the conclusions I draw are: (1) that existing models of systematic behavior explain little of the observed variance of exchange rates over the past decade, during which they have been little or no better than random walks; 2/ and (2) that much of the variability of real exchange rates cannot be associated in any simple way with variability of real interest differentials. Despite those conclusions, however, for purposes of forecasting it seems desirable to exploit whatever weak associations exist between real exchange rates and real interest differentials, and more generally, to exploit the possibility of doing slightly better than a random walk.

In this regard, one way to try to improve the goodness-of-fit and predictive accuracy of existing exchange rate models would be to assemble better data on ex ante expectations about relevant explanatory variables; such efforts would enable econometricians to pursue the opinion that exchange rate equations should turn out to be more stable when estimated in a "news" framework. 3/ A second hope is that models which take account of a complete system of macroeconomic relationships simultaneously

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1/ Meese and Rogoff relied on the uncovered interest rate parity assumption in deriving their real versions of both models.

2/ It should be noted that the performances of the various models presumably depends importantly on the relative prevalence of different types of "news" during the sample period. It is generally believed that the performance of monetary models is much better during hyperinflations than during periods dominated by real shocks.

3/ Hoffman and Schlagenhauf (1985), however, provide some evidence that various models of systematic exchange rate behavior also perform poorly in sample (i.e., are characterized by low R^2 statistics and frequent counterintuitive signs) when estimated in a "news" framework.

will be able to improve on the single-equation semi-reduced-form models in exploiting the associations between real exchange rates, real interest differentials, and other variables. Undoubtedly, the absence of a strongly significant simple association between the variability of real exchange rates and the variability of real interest differentials must to some extent reflect the fact that changes in different "exogenous" factors generate different types of covariation in real exchange rates and real interest differentials. An exogenous fiscal expansion, for example, may lead to an increase in domestic interest rates and an appreciation of domestic currency, while an "exogenous" decline in the demand for claims on the domestic government may lead to an increase in domestic interest rates and a depreciation of the domestic currency. The consideration of simultaneous equation models will be taken up again in Part III.

2. Tests of parity assumptions

The assumptions of uncovered interest rate parity and some form of purchasing power parity have been important building blocks for many exchange rate models. Uncovered interest rate parity (UIP)--that is, the assumption that the forward exchange rate equals the expected future value of the corresponding spot exchange rate--has received considerable testing. To the extent that expectations about future spot rates are not observed directly, the tests have looked for indirect evidence by relying on the assumption that expectations are formed rationally, such that UIP would imply that forward rates were unbiased predictors of future spot rates. A discussion of econometric issues, and a survey and extension of test results, has recently been provided by Cumby and Obstfeld (1984). 1/ They conclude (p. 139): "The test results are on the whole inconsistent with UIP, and they also suggest that forward premia contain little information regarding subsequent exchange rate fluctuations." As Cumby and Obstfeld note, however, one caveat in rejecting UIP on the basis of indirect tests is the "peso problem:" in finite samples, UIP is not necessarily invalidated by the finding that forward rates are biased predictors of future spot rates, since bias can emerge whenever rational market participants had repeatedly expected a policy action or some other event that failed to materialize over a long sequence of observations. 2/

The qualified rejection of UIP has directed interest to the question of whether the magnitudes of deviations from UIP--generally referred to as *exchange risk premiums*--have been large enough to "explain" a substantial part of the observed behavior of exchange rates. That possibility has emerged as one conceivable explanation for the observation of large differences between changes in spot exchange rates and the ex ante levels of forward premiums, since by definition such differences must equal sums of an exchange risk premium plus an unexpected change in the corresponding spot rate. Interest has also focused on whether exchange risk premiums have varied significantly over time.

1/ See also Levich (1985).
2/ See Rogoff (1979) or Krasker (1980).

Two new types of evidence have recently emerged, based on a statistical approach developed by Fama (1984) and on survey data on exchange rate expectations, which have been analyzed by Frankel and Froot (1985 a). 1/ Fama has provided indirect evidence, conditional on the hypothesis of market rationality, that during the period from the end of August 1973 through the end of 1982, the variance of the risk premium exceeded the variance of expected changes (over one-month intervals) in the spot rate for exchange rates of the dollar against each of ten other major currencies. 2/ This ranking of variances is not supported by the direct evidence from the survey data analyzed by Frankel and Froot (which, however, provide a smaller sample size and measure changes over three and six-month intervals), but the survey data do verify Fama's implicit finding that both the magnitudes and the variances of exchange risk premiums have been large. 3/ Table 1 provides summary information on the magnitudes of exchange risk premiums during the 1980s, based on a subset of the data reported by Frankel and Froot. Neither the 13 Economist respondents nor the several hundred Amex respondents came close to expecting, on average, that future spot rates would equal the currently prevailing forward rates. 4/

1/ Frankel and Froot focus on two separate sets of survey data. The Amex Bank Review has published data from eleven surveys conducted between January 1976 and June 1984, including four surveys during the 1981-84 period; in each survey, several hundred financial market participants and economists were asked to record their expectations for the exchange rates of the U.S. dollar against five other major currencies (the mark, the yen, the pound, the French franc and the Swiss franc) at a six month horizon. The Economist has collected survey data from thirteen major international banks on their expectations about the same five dollar exchange rates at three and six month horizons; those surveys began in June 1981 and had been conducted 24 times through March 1985.

2/ See also Hodrick and Srivastava (1986).

3/ Fama's analysis has also discovered empirical evidence of a negative covariance over time between the risk premium and the expected change in the corresponding spot rate, and the survey data reveal similar evidence. Fama finds the evidence puzzling and provides a number of alternative explanations, including the possibility that market participants are irrational. One explanation that he seems to have overlooked is the possibility that central bank behavior tends to hold interest rates and hence the forward premium relatively constant, while variation occurs in the underlying uncertainties that matter to exchange market participants, thereby generating larger changes in the exchange risk premium than in the forward premium, which can only happen if the expected change in the exchange rate declines (increases) whenever the risk premium increases (declines). Whenever changes in uncertainties induce changes in the risk premium that investors must be able to expect if they are to remain indifferent at the margin between holding assets denominated in different currencies, the new market equilibrium will involve a different expected change in the spot rate for any given level of the interest differential.

4/ Frankel and Froot have used the survey data to test a variety of hypotheses about expectations formation.

The magnitude of the exchange risk premiums shown in Table 1 make it difficult to defend the UIP assumption. Unlike indirect tests of the UIP assumption, comparisons of forward exchange rates with direct statements about exchange rate expectations are not distorted by peso problems. 1/ On the other hand, questions can always be raised about the quality of survey data, and it seems particularly relevant to extend or break down the survey evidence in order to check that the apparent aversion to exchange risk indeed applies to the most active participants in exchange markets. In the absence of survey evidence that major exchange market participants do not behave in a risk-averse manner, however, it appears that continuing reliance on the UIP assumption could be counterproductive. 2/

The other type of parity condition that has served as a building block for exchange rate models is the assumption of purchasing power parity (PPP). The flexible price monetary models of Frenkel (1976) and Bilson (1978, 1979) were based on the assumption of continuous or short-run PPP; but evidence rejecting that version of PPP has now been recognized for some time, even by leading proponents of the flexible price models. 3/ A weaker assumption adopted by Frankel (1979, 1981) is that the expected long-run level of the real (or price-level-adjusted) exchange rate is time invariant.

Assessments of the latter assumption have looked for evidence of a tendency for real exchange rates to return toward equilibrium PPP levels over time. Some formal tests have focused on coefficients of serial correlation between deviations of real exchange rates from an assumed equilibrium PPP level, typically represented by the sample mean or a trend line, and have interpreted the coefficient of serial correlation

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1/ This is not to deny the possibility that market participants may have perceived a "peso problem" or "dollar problem" during the 1980s, but only to defend the evidence in Table 1 as a rejection of UIP even in the context of a "dollar problem". See Borensztein (1986) for econometric evidence that supports the hypothesis of a "dollar problem" during the 1980-84 period.

2/ Unlike inferences from indirect tests of UIP, inferences about UIP can be drawn from survey data without relying on the assumption that market participants are rational. Obversely, it is debatable whether the magnitudes shown in column 3 of the table mainly reflect risk aversion that is systematic or apparent risk aversion that is irrational. The possibility of a "peso problem," however, increases the plausibility that systematic risk premiums could be as large as the numbers in the table.

3/ See Frenkel (1981 a), Isard (1977), and the papers by Kravis and Lipsey (1978) and others in the May 1978 issue of the Journal of International Economics. For evidence that rejects the hypothesis of ex ante short run PPP--in particular, the hypothesis that expected exchange rate changes have been unbiased predictors of inflation rate differentials in the short-run--see Cumby and Obstfeld (1984).

Table 1. Exchange Rate Data 1/

(Percentage changes over six month horizons at annual rates)

Non-Dollar Currency Unit	Expected Depreciation of the Dollar, Based on Survey Data	Forward Premium on the Non-Dollar Currency	Exchange Risk Premium on the Non-Dollar Currency
Averages from eight nonoverlapping Economist surveys during 1981-85			
U.K. pound	3.92	0.39	3.53
French franc	4.60	-5.44	10.04
German mark	12.81	4.28	8.53
Swiss franc	12.35	5.87	6.48
Japanese yen	12.71	5.16	7.55
Averages from 4 Amex surveys during 1981-84			
U.K. pound	6.11	2.56	3.55
French franc	2.25	-3.36	5.61
German mark	10.30	5.46	4.84
Swiss franc	6.31	7.56	-1.25
Japanese yen	8.73	6.77	1.96

1/ From Frankel and Froot (1985a), Table 2.

as 1 minus the speed of adjustment toward the equilibrium PPP level. 1/ Such tests could potentially reject the hypothesis that real exchange rates follow random walks, but cannot establish the time invariance of the expected long-run level of the real exchange rate. In particular, such tests cannot reject the "overshooting" hypothesis that "shocks" cause jumps in the level of the real exchange rate that is expected to prevail in the long run, but even greater jumps in the level of the real exchange rate that is observed in the short run. 2/

Although it seems impossible to devise a statistical test that could verify the hypothesis of time-invariant expectations about the long-run level of the real exchange rate, the hypothesis could be rejected if there was clear evidence that real exchange rates follow random walks, or that changes in real exchange rates exhibit no serial correlation. Roll (1979), Frenkel (1981 b), and Cumby and Obstfeld (1984), among others, have found it difficult to reject the hypothesis. By contrast, Frankel (1985 b) succeeds in rejecting the hypothesis with a sample of 116 annual observations on a price-adjusted exchange rate between the U.S. dollar and the U.K. pound. Frankel also finds that for shorter samples in which he is unable to reject the hypothesis, his point estimates of the first-order serial correlation coefficient for the level of the real exchange rate are less than one, as Frenkel (1981 b) also found. Such point estimates are consistent, moreover, with evidence available from Boughton (1985): the real exchange rate equations that performed best in his post-sample tests are equations that include a lagged dependent variable with a coefficient estimated to be somewhat less than one. Thus, the hypothesis that real exchange rates exhibit no regressive tendencies has not been established convincingly.

As a summary of the material discussed in this section, the conclusions I draw from tests of parity assumptions are: (1) that the evidence appears to reject persuasively the assumption of uncovered interest rate parity and the closely related notion that exchange risk premiums are quantitatively unimportant; (2) that there no longer seems to be any dispute over evidence rejecting the assumption of short-run purchasing power parity; and (3) that the assumption of long-run purchasing power parity--in particular, of time invariant expectations about the long-run real exchange rate--seems virtually impossible to support statistically, but has not been rejected convincingly by statistical tests. 3/ With regard to the latter conclusion, however, and to preview some of the discussion in Part III, there is not yet a strong conceptual understanding

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1/ For example, see Frankel (1985 b).

2/ Such tests may also suffer from statistical bias if the equilibrium PPP level is represented by the in-sample mean or trend, which by definition are centers of gravity for the sample. The hypothesis of a tendency to return toward a particular mean or trend line should be tested on observations outside the sample from which the mean or trend line was drawn.

3/ See Hakkio (1984) for additional empirical evidence on the PPP hypotheses.

of the exogenous sources of variability in the equilibrium long-run real exchange rate or the exchange risk premium; and as that understanding develops, it seems likely that conceptual arguments will also emerge for abandoning the assumption of time-invariant expectations about long-run real exchange rates. One basis for this conjecture is Krugman's (1985 b) observation that the appreciation of the dollar during the 1980s has only brought its average real exchange value back to around its 1970 level; yet the U.S. current account has shifted from a surplus in 1970 to large deficits in the mid-1980s, reflecting to an important extent the increased competitiveness of U.S. trading partners. Thus, the real exchange rate that is consistent with current account balance (as one possible property of long-run equilibrium) has not been time invariant. 1/

3. Tests for systematic behavior of the exchange risk premium

Empirical studies of portfolio balance models have been reviewed recently by Tryon (1983) and Rogoff (1984); the discussion here will be limited to a brief overview. Most of the earliest studies 2/ proceeded under the simplifying assumption of one-to-one correspondences between current account imbalances and net flows of capital denominated in given currencies. That assumption was clearly unrealistic, however, which led subsequent studies 3/ to take on the task of constructing data on stocks of assets denominated in different currencies.

A major source of interest in empirical estimates of portfolio balance models has come from the policy issue of whether sterilized exchange market intervention can have a significant influence on the exchange rate. 4/ In addressing this issue, it is important to distinguish between two channels of possible influence: through changes in the exchange risk

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1/ On the other hand, while considerations of changing levels of economic development and competitiveness may suggest that equilibrium long-run real exchange rates are not time invariant, these considerations by themselves do not necessarily imply that equilibrium long-run real exchange rates fluctuate widely over time, as distinct from shifting only gradually.

2/ For example, Artus (1976), Branson, Halttunen and Masson (1977, 1979), Porter (1979), and Martin and Masson (1979).

3/ For example, Dooley and Isard (1982, 1983 a), Obstfeld (1983), and Danker et al (1985).

4/ A study of the effectiveness of intervention was commissioned at the Versailles Summit in June 1982, which led to the release in April 1983 of the Report of the Working Group on Exchange Market Intervention. Henderson and Sampson (1983) summarize both the Report and a set of ten related studies by the staffs of the Federal Reserve System and the U.S. Department of the Treasury. See also Boothe et al (1985) for an empirical study of international asset substitutability by economists at the Bank of Canada.

premium per se; and through changes in interest rates or revisions in expectations about future exchange rates as a result of changes in perceptions about the future levels of monetary policy variables or other relevant factors. It also seems crucial to recognize that the first channel may be impossible to isolate empirically unless the second channel is treated explicitly.

The basic point can be restated as a conjecture that the tests to date for systematic behavior of the exchange risk premium have modelled exchange rate expectations in a manner that may well be too inefficient to isolate the exchange risk premium. Specifically, almost all tests have relied either on the assumption that exchange rate expectations are static, or on a perfect foresight assumption under which the expected future spot rate is represented as the realized value of the future spot rate plus an error term that behaves independently of any revisions in expectations about the future values of exogenous variables. 1/ Reliance on the static expectations assumption can be criticized for ignoring information about the structural model as well as possible inferences about the expected values of exogenous variables. Reliance on the perfect foresight assumption can be criticized to the extent that no attempt is made to take account of the types of "news" that can be presumed to induce revisions in expectations about exogenous variables; the perfect foresight assumption is difficult to reconcile with the notion that much of the variation in asset prices can be attributed to "news." Implicitly, such approaches even assume that revisions in expectations about the future levels of asset stocks and wealth variables play no role in influencing the terms on which portfolio holders are assumed to remain willing to hold the existing stocks of assets under the existing distribution of wealth. Accordingly, the fact that empirical work on portfolio balance models has not found strongly significant evidence that the risk premium behaves systematically may partly reflect the reliance on inefficient approaches for capturing expectations about future exchange rates.

The treatment of expectations, however, is only one of several significant deficiencies of the types of portfolio balance models that have been pursued empirically over the past decade. A second deficiency is the absence of any methodology for treating the perceived degrees of risk or uncertainty as variables; hence, such models have difficulty explaining how the risk premiums on non-dollar currencies (i.e., the expected yields foregone by holding assets denominated in dollars) could have become as large as Table 1 suggests during the 1980s when large U.S. budget and current account deficits were increasing the relative stocks of dollar-denominated assets and also reducing the relative net worth of U.S. residents. And as a third deficiency, which Dooley (1982) has emphasized,

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1/ See Dooley and Isard (1982) for an alternative approach that incorporates expectations about the future values of exogenous variables.

it is difficult to defend the search for a risk premium in models that distinguish assets only by currency denomination when countries that are considered to be relatively high credit risks in market evaluations generally do not denominate their international borrowings in their own currencies. 1/

III. Approaches Toward Integrated Models of Goods Market Equilibrium and Asset Preferences

This part of the paper provides an overview of two important branches of the conceptual literature along with the class of empirical multi-country macroeconomic models in which expectations of financial variables are forward looking and model consistent. It then focuses on the prospect that an extension of conceptual research may lead to improved specification hypotheses for explaining the observed behavior of exchange rates.

1. An accounting framework

It is instructive to combine a number of definitions into an expression that relates the current level of the nominal exchange rate to five types of variables: the current levels of national price indexes, an expected future level of the real exchange rate, and the levels (with consistent time dimensions) of the real interest differential, the premium for bearing exchange risk, and any country premium between the covered yields on similar claims against residents of different countries. For notation, let

s_t = the logarithm of the nominal spot exchange rate prevailing at time t, in units of currency B per unit of currency A

$f_{t,T}$ = the logarithm of the nominal forward exchange rate prevailing at time t for delivery at time t+T, in units of currency B per unit of currency A

$R^J_{t,T}$ = the logarithm of 1 plus the cumulative nominal rate of interest between times t and t+T on claims denominated in currency J against residents of country J, for J=A,B

p^J_t = the logarithm of the level of currency-J prices prevailing at time t in country J, for J=A,B

1/ As additional criticism, Gros (1986) provides evidence that appears to reject the traditional portfolio balance models (and monetary models) on the basis of variance bounds tests, conditional on the assumption of market rationality.

$E_t x$ = the expected future level of any variable x based on information held at time t

Next define the real rates of interest

$$(1) \quad r^J_{t,T} = R^J_{t,T} - (E_t p^J_{t+T} - p^J_t) \qquad \text{for } J = A,B$$

the exchange risk premium

$$(2) \quad ERP_{t,T} = f_{t,T} - E_t s_{t+T}$$

the country premium

$$(3) \quad CP_{t,T} = R^B_{t,T} - R^A_{t,T} + s_t - f_{t,T}$$

and the logarithm of the real exchange rate

$$(4) \quad sreal_t = s_t + p^A_t - p^B_t$$

Now combine conditions (1)-(3) and an expression for $E_t sreal_{t+T}$ from condition (4), with the purpose of substituting out $f_{t,T}$, $E_t s_{t+T}$, and the $R^J_{t,T}$. This yields

$$(5) \quad s_t = (p^B_t - p^A_t) + (r^A_{t,T} - r^B_{t,T}) + E_t sreal_{t+T} + ERP_{t,T} + CP_{t,T}$$

or

$$(6) \quad sreal_t = (r^A_{t,T} - r^B_{t,T}) + E_t sreal_{t+T} + ERP_{t,T} + CP_{t,T}$$

Condition (6) is a relationship between endogenous variables and not a fully specified model of exchange rate determination. It is a condition that holds by definition, even in cases of market irrationality or

rational bubbles. 1/ It is useful to focus on the first-differenced form of condition (6) when T is specified as a horizon over which long-run equilibrium is reached. The interpretation is that any observed change in the real exchange rate over an instant or short period of time can be accounted for--by definition--as the sum of any change in the long-term real interest differential, plus any revision in expectations about the long-run real exchange rate, plus any changes in the long-term exchange risk premium and the long-term country premium. While these definitional concepts, admittedly, are not part of the everyday jargon or calculations of many exchange market participants and may contain components of market irrationality or perhaps even rational bubbles, the accounting framework, together with the stock of empirical knowledge reviewed in Part II, nevertheless provides perspectives on where it may be fruitful to concentrate attention in seeking more powerful systematic explanations of exchange rate variability. 2/

It is useful at this point to recall the Meese-Rogoff (1985) cointegration tests and their finding that much of the variability of real exchange rates cannot be associated with variability of either short-term or long-term real interest differentials. By implication from condition (6), therefore, much of the variability of real exchange rates must be associated with variability in expected future real exchange rates, exchange risk premiums, or country premiums. Moreover, it should be noted that country premiums are observable variables, such as the premium between Eurodollar interest rates and dollar interest rates paid in the

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1/ To clarify both semantics and economics, any market irrationality or rational bubbles would be reflected in the right-hand side variables of condition (6). Obstfeld (1985) provides a model in which $E_t sreal_{t+T}$ is sensitive to bubbles, and it is also possible that irrationality or bubbles might affect $ERP_{t,T}$. Thus, the issue of irrationality or bubbles translates into an issue of how to model the expected long-run real exchange rate and the exchange risk premium based on the postulates of rational behavior. I am inclined to consider those cases as last-resort hypotheses and, for that reason, have not chosen to focus this paper on their implications. On this issue, Obstfeld emphasizes the point, attributed to Flood and Garber (1980), that bubbles may be observationally equivalent to omitted variables.

2/ As Hans Genberg noted in commenting on an earlier draft of this paper, it is possible to define alternative accounting frameworks that might, for example, link exchange rates and interest differentials via the relative prices of tradables and nontradables, among other variables; the usefulness of any particular accounting framework depends on the variables in terms of which one intends to specify behavioral hypotheses.

United States; and in the case of exchange rates between the currencies of the industrial nations, the country premiums that enter the accounting framework are often small enough to ignore in empirical analysis. 1/

It may also be instructive to focus on the evidence that is provided by the currently fashionable regression of a real exchange rate on a corresponding long-term real interest differential. Equation (7) and Chart 1 report evidence for the exchange rate between the Deutsche mark and the U.S. dollar (in marks per dollar), adjusted for relative levels of consumer price indexes. The data are monthly-average observations for the period from July 1981 through March 1985; similar results hold for the full five-year period following the election of President Reagan (November 1980 through October 1985). 2/ The long-term real interest differential is measured as the residual (plus an undetermined constant) from a regression of the nominal interest differential (for long-term government bonds) on the differential between the actual percentage changes in consumer price indexes over the previous 12 months. 3/ The chart shows that the real exchange rate and the real interest differential trended in the same direction over the sample period. The exchange rate regression (t-statistics in parentheses) is:

1/ This is not always the case, however. Country premiums can be generated by differential tax rates or capital controls (even in the absence of any uncertainty), or by uncertainties about how the relative yields on assets may be affected either by future changes in taxes or controls or by other political or macroeconomic developments. See Dooley and Isard (1980) for a study of the country premium during the period of German capital controls from 1970-74. See Dooley and Isard (1983 b) for a formulation of the country premium in terms of political and macroeconomic uncertainties.

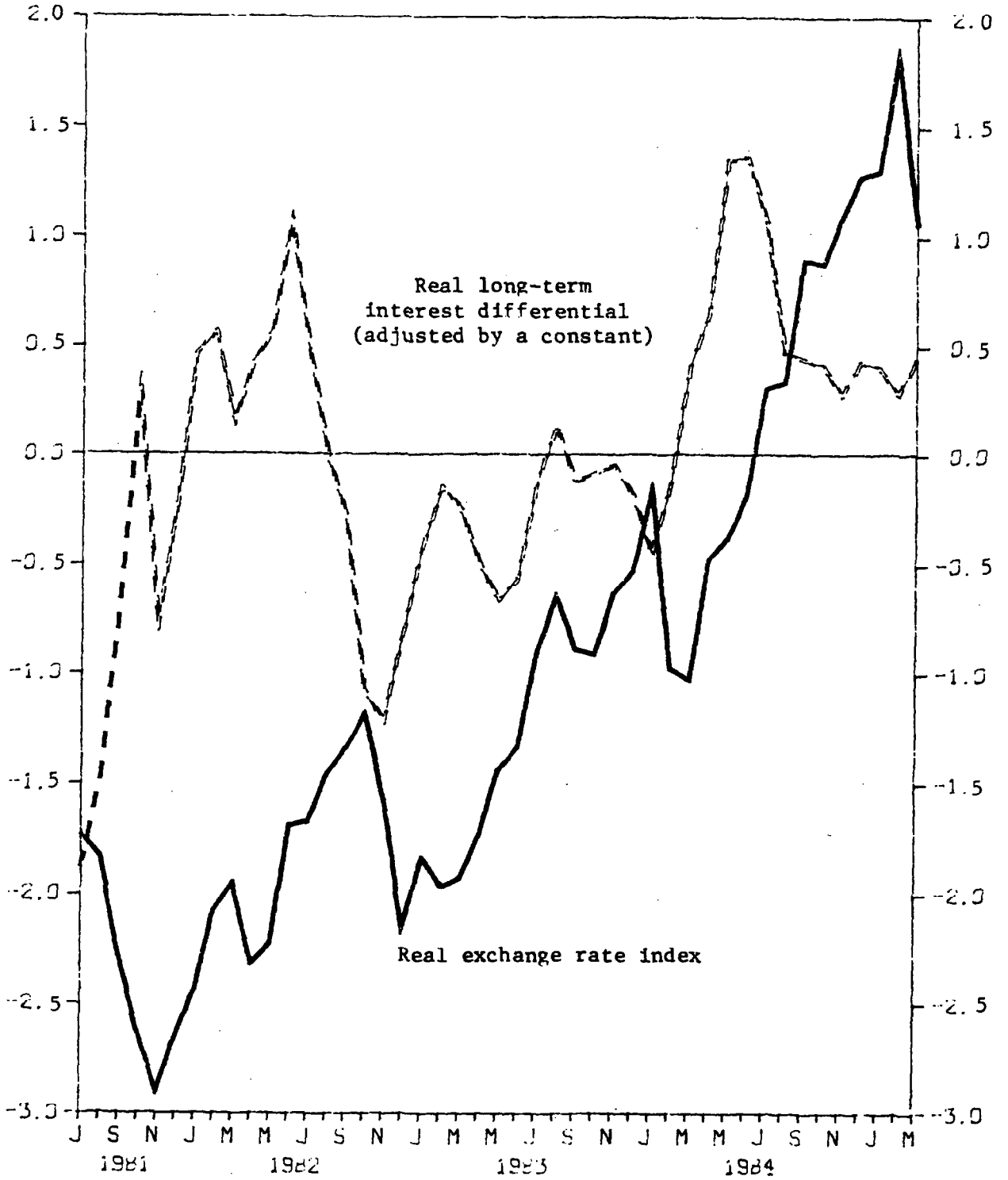
2/ The choice of the shorter period allows the specification hypothesis to be extended in Section III.5 to include regressors on which data are readily available only from July 1981 through March 1985.

3/ A plot of the nominal interest differential and the actual inflation differential reveals parallel cyclical patterns during the period from July 1981 through March 1985; see Dooley and Isard (1986). This makes attractive the hypothesis that the actual inflation differential was a primary "determinant" of the expected inflation differential, which was in turn reflected by the nominal interest differential. The interest rate regression (t-statistics in parentheses) is:

$$(R^{US} - R^{G}) = \underset{(25.1)}{3.71} + \underset{(2.99)}{0.251} * (\Delta p^{US} - \Delta p^{G}) \qquad \bar{R}^2 = 0.153, \quad D.W. = 0.375$$

The slope coefficient suggests that each one percentage point decline in the actual one-year inflation differential reduced the expected long-term inflation differential by 0.251 percentage points.

CHART 1


2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
Real long-term
interest differential
(adjusted by a constant)
Real exchange rate index
J S N J M M J S N J M M J S N J M M J S N J M
1981
1982
1983
1984

$$(7)\quad \text{sreal} = \underset{(65.2)}{1.01} + \underset{(2.73)}{0.0617} * (r^{US} - r^{G}) \qquad \overline{R^2} = 0.128,\ \text{D.W.} = 0.171$$

The slope coefficient suggests that each one percentage point per annum increase in the real interest differential can "explain" a 6.2 percent real appreciation of the dollar, although the t-statistic is biased upward in the presence of a low Durbin-Watson statistic, and estimates of the slope coefficient are fairly sensitive to the choice of sample period. 1/ The $\overline{R^2}$ statistic indicates that the regression "explains" only a small part of the variance of the real exchange rate, while the Durbin-Watson statistic reveals strong persistance of unexplained shifts in the real exchange rate.

Given these perspectives, the next objective in this part of the paper is to focus on what the literature has contributed so far to an understanding of how to model the two most important variables that condition (6) reveals to be omitted from the regression--namely, the expected long-run real exchange rate and the exchange risk premium. For this purpose, *Sections III.2 and III.3 provide an overview of two important branches of the conceptual literature.*

2. Conceptual models of the exchange rate, prices, and the balance of payments

Exchange rate modelling was given a major stimulus by the transition in 1973 from the Bretton Woods regime of fixed-but-adjustable par values to a generalized system of floating exchange rates between major currencies. Prior to that transition, most textbooks on international economics presented a standard "flow" model in which the exchange rate equilibrated at a level that was consistent with achieving a balanced (or prespecified) trade or current account during a single period of time. Implicit in the textbook model was the assumption that net capital flows were negligible (or else predetermined). The exchange rate was driven primarily (if not entirely) by factors affecting the demands for and supplies of imports and exports in goods markets.

1/ Results for similar regressions can be found in Shafer and Loopesko (1983), Hooper (1983) and Sachs (1985). Slope coefficients from re-estimating equation (7) for alternative time periods (using the same methodology for constructing the real interest differential) are (a) 0.051 for April 1973-October 1985; (b) -0.011 for April 1973-October 1980; and (c) 0.075 for November 1980-October 1985; the corresponding $\overline{R^2}$ statistics are (a) 0.315; (b) 0.042; and (c) 0.161. It may be noted that in contrast to the unit coefficient in condition (6), the coefficient in equation (7) must be estimated, because a per annum interest differential has been substituted as a proxy for the cumulative differential interest that would accrue over a long-term horizon.

The magnitude of exchange rate variation during the first few years of generalized floating rejected the notion of single-period equilibrium in international flows of goods. This shifted attention toward exchange-rate models that highlighted equilibrium conditions for stocks of assets. Kouri (1976) made an important contribution to integrating the conditions for goods-market flow equilibrium and asset-market stock equilibrium, focusing attention on the dynamic interactions between the exchange rate and the current account. In particular, Kouri emphasized that the exchange rate must be consistent with conditions of asset stock equilibrium in the short run, that the exchange rate influences the current account balance and hence the change in the net foreign asset position, and that changes in the net foreign asset position in turn feed back to influence the path of the exchange rate that maintains continuous asset equilibrium over time.

Models of the interactions between the exchange rate and the current account depend on the specification of goods and factor markets; see Bruce and Purvis (1985) for a recent survey. Two types of specifications have received particular attention: models of specialized production in which each country produces a single and differentiated tradable good; and models in which each country produces both a nontradable good and a tradable good that is homogeneous across countries. In both types of models, the supply and demand conditions in goods and factor markets lead to a semi-reduced-form equilibrium condition between the current account (or trade balance) and a relative price variable, but the link between relative prices and the nominal exchange rate--and hence, the link between the current account and the nominal exchange rate--depends on the time paths of money supplies and/or other variables that may influence the absolute levels of national price indexes. 1/

In addition to establishing that the association between the current account and the nominal exchange rate depends on the separate links of each of those two variables to relative price levels, the literature has clarified that the joint dynamics of the exchange rate and the current account in responding to a "shock" depends on which "forcing" variable is "shocked," on the degree to which the shock is expected to be transitory or permanent, and on the time lag with which the change in the forcing variable follows the shock from which the change becomes anticipated.

1/ An appreciation of the distinction between changes in relative prices and changes in nominal exchange rates as proximate "causes" of strains in the international economy, as well as an appreciation of the types of policy measures that might affect relative prices and trade flows, may be important in considering the potential effectiveness of proposals for international monetary reform.

These points are illustrated, for example, by Dornbusch and Fischer (1980), and more generally by the dynamic framework provided in Mussa (1984) and Frenkel and Mussa (1985). 1/

Models of the simultaneous determination of the exchange rate, prices, and the current account have also provided some understanding of the types of factors that determine and generate variability in the expected long-run level of the real exchange rate. In the models developed by Kouri (1976), Dornbusch and Fischer (1980) and Mussa (1984), current account imbalances are "settled" with a single type of asset, and conditions are directly or indirectly imposed on the terminal net stock of that asset, to which current account imbalances must accumulate. In that context, the solution for the long-run stationary-state level of the real exchange rate is that constant level that is consistent with a stationary net foreign asset position--and hence a balanced current account--under perfect foresight. Buiter (1981) provides an overlapping generations model which yields insights into the implications of moving from a stationary state to a steady growth state, and into the fact that technologies, rates of population growth and rates of time preference can all influence the long-run equilibrium position. Obstfeld (1985) uses a small two-country model (which does not impose current account balance as a condition of long-run equilibrium) to infer from plausible parameter values that the expected long-run real exchange rate may be quite sensitive to revisions in expectations about the relative long-run levels of national outputs. In addition, a number of multi-country macroeconometric models with forward-looking expectations also treat the expected long-run real exchange rate as a variable; these models will be discussed in Section III.4.

It seems fair to say, nevertheless, that models of the interactions between the exchange rate, prices, and the current account have not provided a deep appreciation of the fundamental determinants of preferences between different types of assets, or of the implications of changes in those determinants for either the expected long-run level of the real exchange rate or the premium for bearing exchange risk. In that regard, the expanding literature on default risk and optimal international borrowing and lending, which appears to have much to say about the fundamental determinants of asset preferences, has received little attention in models of exchange rate determination.

1/ See also Obstfeld and Stockman (1985) for a survey of models of exchange rate dynamics.

3. Conceptual models of international asset preferences and the exchange risk premium

Although a second branch of the conceptual literature has directed considerable attention to models of international asset preferences in recent years, such attention has mainly been restricted to a partial equilibrium framework that also does not explore the fundamental sources of asset preferences in much depth. This branch of the conceptual literature has given rise to several strands of empirical work. Kouri and de Macedo (1978) and de Macedo, Goldstein and Meerschwam (1984), among others, have applied the analysis to the computation of "optimal" international asset portfolios. Frankel (1982) and Frankel and Engel (1984) have extended the formulation and empirical analysis of portfolio balance models of the exchange risk premium, moving from a focus on one exchange rate at a time to a simultaneous focus on the exchange rates between six currencies.

Recent surveys of this branch of the conceptual literature have been provided by Branson and Henderson (1985) and Adler and Dumas (1983). Dornbusch (1983) provides an exposition (for the simple two-period, two-currency case) of the relationship of the exchange risk premium to the stocks of outside assets denominated in different currencies and to the distribution of world wealth. For given perceived variances and covariances of exchange rates and prices, the relationship depends on the coefficient of risk aversion. Krugman (1981) and Frankel (1985a) have provided numerical examples, based on a plausible order of magnitude for the coefficient of risk aversion, which appear to preclude substantial changes in the exchange risk premium in response to the quarterly or annual orders of magnitude that are observed for budget deficits, current account imbalances, or sterilized exchange market interventions--other things constant. 1/

One of the other things that has been held constant in this branch of the literature, however, is the extent of risk or uncertainty itself, as measured by the variances and covariances of exchange rates and prices. Thus, most of the literature has emphasized the role of forward-looking expectations in influencing the behavior of observed exchange rates, but without allowing scope for any changes over time in the variances and covariances that investors perceive to characterize the probability distributions of future exchange rates and prices. As Branson and Henderson (1985) have concluded (p. 800): "a very important item on the research

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1/ In view of the evidence presented in Table 1, such inferences call into question the mean-variance frameworks employed by Krugman and Frankel; see the remark by Nordhaus in the "Comments and Discussion" on Frankel (1985 a), p. 260.

agenda is imbedding ... asset demands based on utility maximization in a general equilibrium model in which the distributions of prices and exchange rate are determined endogenously."

A number of steps have already been taken in the direction proposed by Branson and Henderson. Some involve continuous-time infinite-horizon optimizing models in which financial assets consist of balances of particular currencies that either enter the utility function as inputs in the production of consumption services in corresponding countries 1/ or are required to be obtained and delivered in advance of purchasing goods in the corresponding countries. 2/ There is limited appeal, however, in these approaches to understanding the fundamental basis for asset preferences. No insight is provided by simply assuming that currency holdings enter the utility function directly, and the focus on the transactions role of different currency units in different countries is directly relevant to only a small portion of asset portfolios.

An alternative approach is to cut through the financial characteristics of assets and link international asset preferences to the prospective "after-tax" returns on physical capital in different countries in a traditional and general manner that has not yet attracted much attention in models of exchange rate determination. Before discussing that approach, however, it is useful to focus on some empirical counterparts to the types of simultaneous models of exchange rates, prices, and the balance of payments that have been discussed in Section III.2.

4. Empirical multi-country macroeconomic models with consistent expectations

Most of the published literature on attempts to explain the behavior of exchange rates empirically has focussed either on single-equation estimation of semi-reduced-form models or on simultaneous estimation of systems of no more than half a dozen or so equations. Correspondingly, the documented comparisons of models of systematic and random exchange-rate behavior have not yet been extended to the empirical multi-country or multi-region macroeconomic models of systematic behavior. Such models go well beyond the single-equation semi-reduced form models in explaining the associations between changes in exchange rates, interest differentials, price levels, and balance of payments flows. Moreover, in some of these models, expectations about exchange rates and interest rates are forward-looking and consistent with the models' long-run solutions; in particular, simulations of these models (and in some cases the estimation as well) employ iterative techniques that solve simultaneously for the current and

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1/ See Stulz (1984).

2/ See the references cited by Obstfeld and Stockman (1985, pp. 964-72).

expected future time paths of exchange rates and interest rates. Thus, to the extent that the solution paths for expected real exchange rates converge to long-run steady state values, these models capture the variability of expected long-run real exchange rates in response to shocks to the current or expected future values of exogenous variables.

Like most of the conceptual models of the exchange rate, prices and the balance of payments, however, the existing empirical multi-country macroeconomic models with forward-looking expectations are limited by their menus of assets. In particular, the Liverpool model, Minimod, and the Taylor model 1/ avoid distinguishing the stocks of assets denominated in different currencies by imposing the uncovered interest parity assumption. By contrast, the McKibbon-Sachs model 2/ avoids the uncovered interest parity condition, but is limited in the same way as traditional portfolio balance models in assuming that exchange risk premiums vary only with changes in relative asset stocks and wealth variables.

It is important to emphasize that the implications of these assumptions for the accuracy of the empirical multi-country models may extend well beyond their failure to quantify accurately the deviation from uncovered interest rate parity (UIP). This is because in a forward-looking model, the UIP assumption, or any particular specification hypothesis about the deviation from UIP, plays a major role in selecting the long-run level of the real exchange rate and, accordingly, in influencing the dynamics of adjustment toward long-run equilibrium. The UIP assumption, for example, leads the computer to search for a long-run real exchange rate that generates current account paths such that net international debtor and creditor positions expand at the steady-state growth rate; investors don't care about the long-run composition of their financial portfolios as long as their net international debtor or creditor positions are consistent with steady-state arithmetic. To the extent that the empirical evidence appears to reject the assumption of risk neutrality, however, the UIP assumption must be replaced by a different story about equilibrium long-run timepaths of international debt and credit, and it seems quite plausible that such a change in the conceptual framework might generate substantially different exchange rate behavior in empirical models with forward-looking expectations.

1/ See Minford, Marwaha, Matthews and Sprague (1984) for a description of the Liverpool model, Haas and Masson (1986) for a description of Minimod, and Taylor (1986) for a description of the Taylor model.

2/ See Sachs and McKibbon (1985) and McKibbon (1986) for descriptions of the McKibbon-Sachs model.

5. A direction for research

This section is motivated by the premise that market participants are not risk neutral (as inferred from evidence that appears to reject the UIP assumption) and by the opinion that general equilibrium models with risk aversion are misguided in suggesting that the institutional use of different currency units for transactions purposes in different countries provides the fundamental rationale for the asset preferences of investors (recall the discussion at the end of Section III.3).

An alternative approach, pursued by Dooley and Isard (1983 b, 1986), is to develop a portfolio balance framework in which the traditional emphasis on the different financial characteristics of assets (in particular, their currency denomination and financial interest rates) is replaced or supplemented with an emphasis on the different prospective returns on physical capital in different countries. The general form of such a framework would relate the prospective returns on physical capital in a given country to prospects for factors that influence the size of the country's macroeconomic product and its "after-tax" distribution of income. Financial assets either can be treated explicitly in such a framework at the cost of adding complexity, or can be suppressed under the assumption that redistributions of income through financial valuation gains and exchange losses play a secondary role in the determination of asset prices and rates. A description of nominal exchange rate determination requires a specification of the relationship between exchange rates and the relative prices of goods, perhaps based on the behavioral "reaction functions" of the monetary authorities. 1/ By embedding such a relationship in a general equilibrium framework that imposes the balance of payments identity, solutions can be generated for the simultaneous dynamic adjustment of the exchange rate, relative prices, and balance of payments flows in the aftermath of "shocks" affecting the prospective relative returns on physical capital in different countries.

One appeal of such an approach is its generality, which provides scope for exploring several allegedly-important influences on exchange rates that have not yet received adequate empirical attention. With respect, in particular, to the behavior of dollar exchange rates and international payments imbalances during the 1980s, the approach provides scope for modeling the interrelated influences of the change in U.S. tax laws during 1981, 2/ of the subsequent expansion of U.S. fiscal budget

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1/ See Dooley and Isard (1986).

2/ See Sinn (1985) for an argument relating the appreciation of the dollar to the introduction in 1981 of the Accelerated Cost Recovery System, which reduced the tax depreciation periods for most industrial assets in the United States.

deficits, 1/ of the relatively rapid expansion of the U.S. economy during 1983-84, 2/ and of the passage of the Gramm-Rudman-Hollings bill in 1985. 3/

In addition to being influenced by the factors just listed, dollar exchange rates and international payments imbalances during the 1980s may have been affected to an important extent by the implications of the international debt crisis for the stocks of net claims that investors desired to hold against different countries. This type of phenomenon presents a particular challenge to an understanding of risk perceptions and the concepts of long-run equilibrium real exchange rates and net indebtedness positions.

Without question, some set of events or shifts in economic behavior that had not been anticipated at the beginning of the 1980s--some set of surprises, however they might be represented--has led to a sharp shift in the net stocks of credit that resident and nonresident investors desire to extend to the developing countries. Other noncontroversial facts are that net asset transfers cannot occur internationally without unbalanced current account flows, and that the shift in desired net asset positions has led to associated shifts in the current account positions of the developing countries, in the relative prices of their tradables and nontradables, and in their nominal exchange rates.

The controversial issue is whether those shifts in desired net asset positions have had a substantial impact on exchange rates between the U.S. dollar and the currencies of other industrial countries. Dooley and Isard (1986) have discussed the rationale and modelled the channels for such an impact, 4/ and have also examined the issue empirically using measures of the spreads on dollar-denominated Mexican and Brazilian bonds as proxies for the strength of desired net capital flows vis-á-vis the developing countries as a group. These data, published by Folkerts-Landau (1985) as monthly time series from July 1981 through March 1985, represent

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1/ See Masson and Knight (1986) for an empirical study of the international transmission of U.S. fiscal policy during the 1980s.

2/ See Sachs (1985) for regression evidence that attributes part of the behavior of the dollar/mark exchange rate in recent years to the differential between rates of real activity growth in the United States and Germany.

3/ See Johnson (1986) for an analysis of the anticipatory effects of the Gramm-Rudman-Hollings bill; see also Branson, Fraga and Johnson (1985) for a similar analysis of the U.S. Economic Recovery Act of 1981.

4/ Dooley and Isard argue that such an impact is not inconsistent with a decline in the amount that Eurodollar interest rates exceeded dollar interest rates in the United States, contrary to suggestions by Krugman (1985 a) and Frankel and Froot (1985 b).

differences between the effective yields at secondary-market prices on comparable dollar-denominated claims against the Mexican or Brazilian government on the one hand, and the World Bank on the other hand. Folkerts-Landau has emphasized that the difficulties of making proper allowances for call provisions and other details adds a moderate degree of imprecision to his measures of the spreads, but it seems clear that the wide swings and marked trends in the spreads--as shown in Chart 2--cannot be the result of measurement error.

The solid line in Chart 2 is the residual from the regression of the real exchange rate between the Deutsche mark and the U.S. dollar (adjusted for relative consumer price levels) on the real long-term interest differential, as reported in equation (7) above. The chart suggests that the trends in the spreads can help "explain" trends in the "residual" exchange rate during four periods: from July through October 1981, from October 1981 through October 1982, from mid-1984 through the peak in early 1985, and following the peak in early 1985. Moreover, the remaining period, from October 1982 through mid-1984, was one in which neither the residual exchange rate nor either of the spreads showed much overall trend. Dooley and Isard (1986) have reported the results of a two-step regression experiment in which the real interest differential was first regressed on the spread variable, and the real exchange rate was then regressed on the residual real interest differential and the spread together. With the Brazilian spread measure the explanatory power of the second regression increases by a factor of nearly five (to an $\bar{R}^2$ of 0.61) relative to the explanatory power of equation 7 (which has an $\bar{R}^2$ of 0.13). 1/ With the Mexican spread measure the explanatory power of the regression increases only slightly (to an $\bar{R}^2$ of 0.16), undoubtedly reflecting primarily the fact that the residual exchange rate and the Mexican spread, for reasons that may have been largely specific to Mexico and not to other developing countries, fluctuated widely and in opposite directions during the period between October 1982 and mid-1984. 2/

Needless to say, by itself such evidence of correlations between endogenous variables provides little help in understanding or forecasting the behavior of exchange rates, and the persuasiveness of such a small

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1/ The results reported in this paper refer to regressions in which the dependent variable is the real exchange rate. The results reported in Dooley and Isard (1986) are in fact slightly different, reflecting the use of the nominal exchange rate as the dependent variable.

2/ Given that Mexico faced the most immediate debt crisis after August 1982, it is not surprising that the Mexican spread rose more sharply than the Brazilian spread. It may also be noted that the Mexican spread more-or-less stabilized around the time that Mexico reached an agreement with the International Monetary Fund in December 1982, and turned down after a $5 billion loan was arranged from commercial banks in March 1983.

amount of "evidence" is clearly limited. 1/ Nevertheless, the evidence challenges the logic of dismissing the possible effects of "safe haven" considerations on the mark/dollar rate just because movements in the mark/dollar rate have not coincided in time with perceived changes in relative degrees of economic or political stability in Germany or the United States; in particular, the evidence suggests that to some extent movements in the mark/dollar rate have been induced by, and coincident in time with, perceived changes in the degrees of economic or political stability in "third countries." And more generally, the evidence suggests the possibility of payoffs from developing new portfolio balance approaches in which the traditional emphasis on the currency composition of portfolios is replaced or supplemented with an emphasis on the different prospective returns on capital invested in different countries.

IV. Conclusions

The empirical modelling of exchange rates over the past decade has been predominantly a failure. Most of the modelling has involved single equation estimation of semi-reduced-form models or simultaneous estimation of systems of no more than a half dozen or so equations. The failure of those efforts has become evident from documentation of the poor post-sample forecasting accuracy of the models, from data that appear to reject important building blocks for the monetary models (in particular, the assumption of uncovered interest rate parity), and from the lack of statistically significant in-sample support for existing portfolio-balance models of the exchange risk premium.

In making judgements about directions in which conceptual and empirical research might usefully proceed, a number of possibilities should be considered. One possibility is that existing empirical models have indeed focused on the most important variables for explaining the behavior of exchange rates, but have failed to provide adequate tests of specification forms in which changes in exchange rates are related to "surprises", or to errors in expectations, about explanatory variables. A remedy for this shortcoming requires data or proxy variables that

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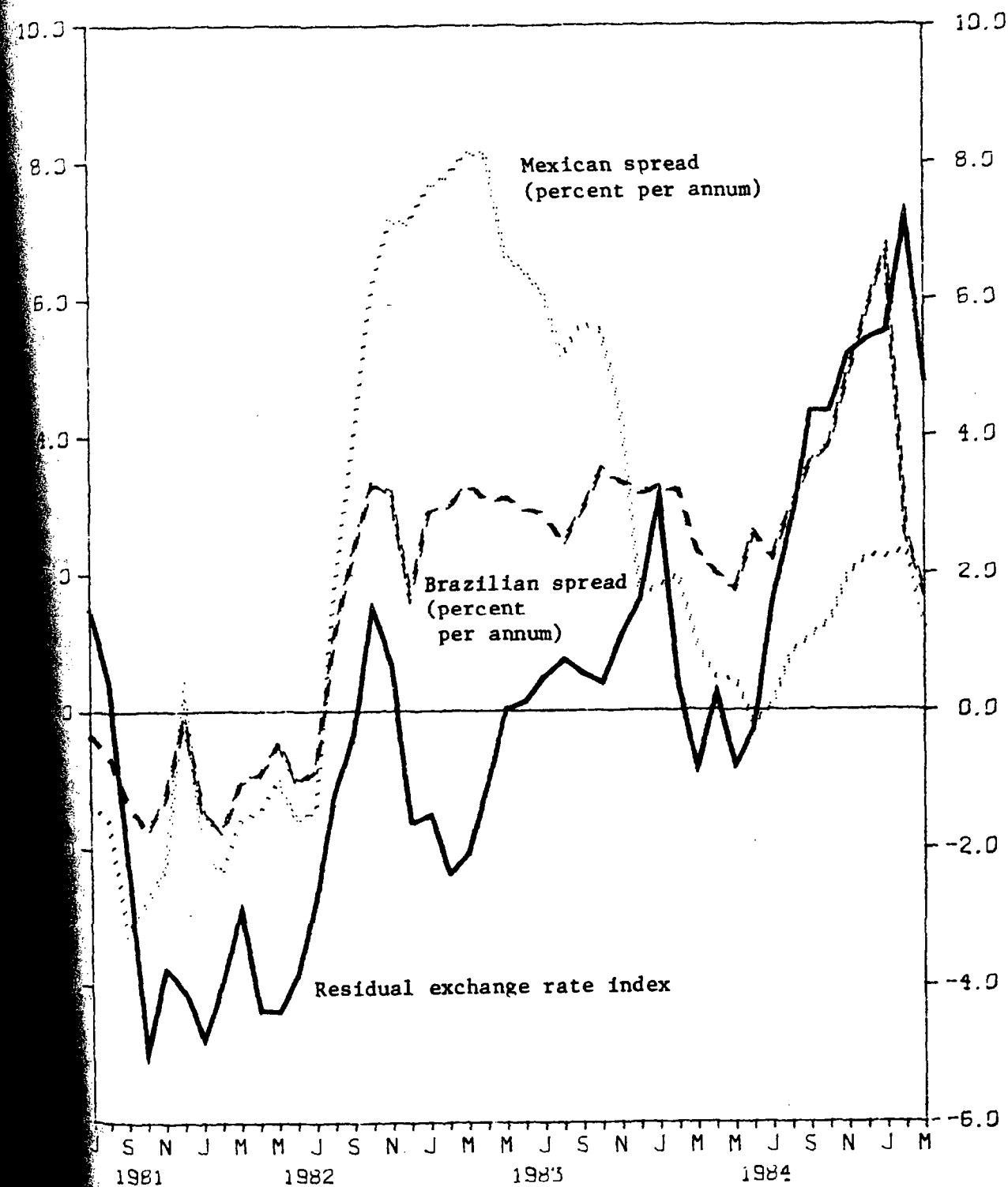
1/ A more complete analysis would explain the spreads on developing country debt--or the strength of desired net capital flows vis-á-vis the developing countries--in terms of variables affecting the relative prospects for the "after-tax" returns on capital in the developing countries. See Edwards (1985) and Melvin and Schlagenhauf (1986) for studies that link such spreads to macroeconomic variables.

CHART 2


10.0
8.0
6.0
4.0
2.0
0.0
-2.0
-4.0
-6.0
Mexican spread
(percent per annum)
Brazilian spread
(percent
per annum)
Residual exchange rate index
J S N J M M J S N J M M J S N J M M J S N J M
1981
1982
1983
1984

ptable for capturing ex ante expectations about the explanatory s, without which it is not possible to quantify "surprises" in table way. 1/

econd possibility, also consistent with the conjecture that empirical models have correctly identified the most important tory variables, is that the lack of empirical success to date may reflect the limitations of single-equation estimation. That lity could be explored by testing the accuracy of the exchange recasts generated by existing simultaneous-equation macroeconomic under realized ex post values of the relevant explanatory variables. s certainly strong support for the view that simultaneous-equation orks are preferable to single-equation semi-reduced-form models for ing the associations between exchange rates, interest differentials, tual or expected inflation differentials in response to different of exogenous shocks.

third possibility, however, is that existing models have not yet tly identified all of the variables or channels of influence that portant for understanding the systematic components of exchange behavior. This conjecture deserves serious attention in light of imitations of the monetary and portfolio balance approaches that been tested over the past decade. Section II.2 has reviewed evidence makes it difficult to defend the assumption of uncovered interest y, which is fundamental to monetary models. Section II.3 has argued almost all empirical studies of portfolio balance models have relied thods for capturing exchange rate expectations that may in fact be inefficient, and in that sense there is some prospect for improve- But other relevant considerations are: (i) the emergence of fairly g prior information that the exchange risk premium should not be cted to vary substantially simply in response to the observed magni- of quarterly or annual changes in the types of asset stock and th variables that have been included in empirical portfolio balance ls; (ii) the fact that both survey data on exchange rate expectations statistical studies using indirect methods to capture exchange rate ctations suggest that exchange risk premiums do indeed vary substan- ly; and (iii) the opinion that the appeal of models of the exchange premium will be inherently limited until specifications are developed distinguish between the risk characteristics of claims against the dents of different countries.

1/ Thus, to rephrase a comment by Jacob Frenkel on an earlier draft of s paper, the fact that models of systematic behavior have failed to perform a random walk in predicting exchange rates from the ex post alized values of the explanatory variables does not necessarily imply at the models of systematic behavior have omitted important explanatory riables.

In addition to assessing the alternative approaches to modelling exchange rates empirically, the paper has focused on some general limitations of existing conceptual models. Section III.2 has reviewed the conceptual literature on simultaneous models of exchange rates, prices, and the current account, noting that most of this branch of the literature has developed under the assumption that only one type of asset can be traded internationally (or that all internationally-traded assets are perfect substitutes), which is equivalent to the UIP assumption in abstracting from substitution effects in international asset markets and from the way those effects can be triggered by revisions in expectations or perceived uncertainties about future conditions in goods markets. Section III.3 has reviewed the conceptual foundations for models of international asset substitution and the exchange risk premium, emphasizing that those foundations consist largely of partial equilibrium analyses that do not adequately explore the exogenous factors that must necessarily underlie expectations and uncertainties about the returns on assets and the exchange rate. Moreover, the development of general equilibrium frameworks with international asset substitution has to date proceeded under the unappealing assumption that the basis for asset preferences simply derives from the institutional role of balances of particular currencies in reducing the transactions costs of goods consumption in corresponding countries.

From these perspectives, a direction that seems attractive for research would focus on general equilibrium models which include a menu of internationally traded assets that distinguishes at a minimum between claims against the residents of different countries. Moreover, as discussed in Section III.5, in taking focus on the basis for asset preferences, an attractive approach would be to replace or supplement the traditional emphasis on the financial characteristics of assets with an emphasis on the prospective real income streams associated with claims on physical capital in different countries. Such an approach would emphasize that revisions in expectations or uncertainties about country-specific exogenous variables--including the exogenous components of output and monetary and fiscal policies--can revise perceptions of the prospective sizes of macroeconomic products and distributions of income, thereby creating ex ante desires to change the net amounts of credit extended to residents of different countries, and hence leading to adjustment through current account flows associated with changes in relative prices and exchange rates. Consistently, it would focus attention on the simultaneous determination of the country preferences and the currency preferences of financial asset holders, taking a macroeconomic perspective of the likely returns from holding net claims against the residents of different countries. Section III.5 has presented evidence from Dooley and Isard (1986) which suggests that such an approach may have some empirical explanatory power.

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