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AN ACCOUNTING FRAMEWORK AND SOME ISSUES FOR MODELLING
HOW EXCHANGE RATES RESPOND TO THE NEWS

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## An Accounting Framework and Some Issues for Modelling How Exchange Rates Respond to the News

## I. Introduction

This paper develops a framework of approximate accounting identities that is used to discuss the limitations of existing empirical models of exchange rate determination. The poor explanatory power of the empirical models of the Seventies has now been well documented by Meese and Rogoff (1981, 1983) and Backus (1981). In this paper the limitations are first addressed by using the accounting framework to demonstrate that some commonly-adopted behavioral assumptions cannot jointly explain a major portion of exchange rate movements. The middle sections of the paper address some issues in modelling how "news" leads to revisions in the expectational terms that enter the exchange-rate accounting framework. The final sections illustrate the issues by drawing inferences and conjectures about the types of news that contributed to the major swings in mark/dollar exchange rates (spot and forward) during 1980-81. The paper stops short of using the accounting framework as a building block for conducting regression tests of specific behavioral assumptions about the expectational terms.

Most empirical models of exchange rate determination seem deficient in anchoring the "level" of the expected path of the (real) exchange rate. The observed level of an exchange rate can be explained in terms of expectations about the level of the exchange rate that will prevail at any future date, but the exchange rate level expected at some future date must be anchored independently to explain the general level of the expected exchange rate path. This point is clear from interest-rate parity conditions under the assumption of risk neutrality, and the argument extends to finite-horizon portfolio-balance analysis under the assumption of risk aversion, as emphasized by Dooley and Isard (1981a).[1] One feature of the accounting framework is to provide a building

block for using the notion of long-run goods-market or balance-of-payments equilibrium to construct a behavioral model that anchors expectations about the long-run real exchange rate.

The accounting framework also describes the general (non-behavioral) form of the "ropes" that link the observed spot and forward exchange rates to the anchored but unobservable level of the expected long run real exchange rate. Under risk neutrality, the long-term real interest differential is the link between the observed level of the (price-adjusted) spot rate and the expected long run real spot rate. Equivalently, the expected long-term inflation differential is the link between the observed level of the (price-adjusted) long-term forward rate and the expected long-run real spot rate. For the risk-averse case a long-term exchange risk premium is added to the ropes. The general form of the accounting framework can accommodate survey data, macro-model forecasts, auto-regressive forecasts or analytic structural models of inflation expectations. Similarly, it can accommodate either structural models or alternative representations of the risk premium. By characterizing the rope, moreover, the accounting framework suggest that quantitative discussions of exchange rate volatility can benefit from focussing on the length of the rope. In particular, if it is expected to take T years for the real exchange rate to converge to its long-run level, then the percentage change in the spot exchange rate that should be associated with a ceteris paribus shift in the term structure of nominal interest differentials (and hence real interest differentials) is the percentage point change in the compounded T-year interest differential, or roughly T times the change in the T-year interest differential as commonly measured in percentage points per annum.

The accounting framework is developed in section II by manipulating the covered interest rate parity condition and some definitional identities. Attention is focussed on one resulting form of the exchange rate equation in which the observable long-term forward rate, deflated (or price-adjusted) by the observable ratio of current domestic and foreign price levels, is approximately identical (in logrithmic form) to the sum of three unobservable terms: the expected long-run real exchange rate, the expected long-term inflation differential and the expected long-term premium for bearing exchange risk. The framework emphasizes the different channels through which news can lead to changes in observed exchange rates (and/or interest rates and/or price levels) by generating revisions in the unobservable expectations terms.

Section III applies the accounting framework, using a time-series of OECD inflation expectations (forecasts) for 7 industrial countries, to construct measures of the extent to which observed changes in exchange rates (between 6 foreign currencies and the U.S. dollar) can be "explained" under the commonly-adopted assumptions of time-invariant expectations about the long-term real exchange rate (or purchasing power parity level, PPP) and the risk premium. Under these assumptions the substantial observed variability of spot exchange rates can only be explained by substantial variability in long-term real interest differentials. To the extent that real interest differentials are expected to vanish beyond the long run horizon, this in turn suggests that exchange rate variability has been associated with variability in the shape of the term structure of nominal interest differentials (relative to the shape of the term structure of expected inflation differentials), and that the traditional use of short-term interest differentials in exchange rate equations may be a poor substitute for a focus on long-term interest differentials.

Section IV provides some empirical evidence on the length of the horizon over which real interest differentials are expected to persist, which is assumed to be roughly the same as the length of time that is expected to elapse before the real exchange rate converges to its long run value. The evidence compares survey data on long-term inflation expectations, collected at several points in time between early October 1980 and early September 1981, with data on the 2-5 year and 5-10 year forward nominal interest rates that are implicit in the term structures of yields on dollar and mark-denominated Eurodeposits and Treasury issues. The evidence supports the assumption that it is expected to take longer than 2 years, but perhaps less than 5 years, for the real exchange rate to converge to its long run value.

Empirical work on exchange rate determination has made only limited progress in modelling the news (see Dornbusch 1980a; Frenkel 1981; Isard 1980; Longworth 1980), despite the strong presumption that changes in exchange rates predominatly reflect revisions in expectations in response to the news (see Mussa 1979). Sections V-VII focus on some issues in modelling expectations of the long-run real exchange rate, the long-term inflation differential and the premium for bearing exchange risk. Sections VIII and IX illustrate the issues by focussing on the major swings in mark/dollar exchange rates (spot and 5-year forward) during 1980-81 and by drawing inferences or conjectures about the extent to which the swings were "explained" by revisions in each of the three expectational terms. Section X summarizes the main points that emerge from sections V-IX.

An appendix discusses how the accounting framework can be used as a basis for forecasting.

## II. An Accounting Framework

The framework developed in this section can be divided into two parts: an anchor and a rope. The anchor is a theory about the expected long-run real exchange rate based on notions of balance of payments equilibrium and consistent with the conditional expectation of long-run purchasing power parity. The rope that links observed exchange rates to the expected long-run real exchange rate is provided by the interest rate parity framework, as modified to allow for risk premiums.

The rope can be characterized by combining the covered interest rate parity condition

$$(1) \qquad s = f + R_B - R_A$$

with definitions of the risk premium

$$(2) \qquad risk^e = s^e - f$$

and the real exchange rate

$$(3) \qquad sreal = s + P_B - P_A$$

where

$s, f, s^e$      denote the logarithms of the nominal values of the spot, forward and expected long-run spot rates, in units of currency A per unit currency B

$R_A, R_B$      denote nominal own rates of interest on assets denominated in currencies A and B, as compounded over horizons that extend until the long-run is reached

$P_A, P_B$      denote the logarithms of the price levels in countries A and B

and a superscript e labels the variable as an expectation.

Together (1) - (3) imply

$$(4) \qquad s = sreal^e + P_A^e - P_B^e - risk^e + R_B - R_A$$

It is convenient to express the expected future logarithmic price levels in terms of expected rates of inflation $(\hat{P}_A^e, \hat{P}_B^e)$ using the approximations

$$(5) \qquad p_A^e = p_A + \hat{P}_A^e$$

$$(6) \qquad p_B^e = p_B + \hat{P}_B^e$$

It is also convenient to introduce traditional definitions for real interest rates

$$(7) \qquad r_A^e = R_A - \hat{P}_A^e$$

$$(8) \qquad r_B^e = R_B - \hat{P}_B^e$$

Substitution then converts (4) into

$$(9) \qquad s = (p_A - p_B) + (r_B^e - r_A^e) + sreal^e - risk^e$$

Equivalently, when all observable variables are transposed to the left side

$$(10) \qquad fadj = \hat{P}_A^e - \hat{P}_B^e + sreal^e - risk^e$$

where the manipulation uses condition (1) and defines a price-adjusted forward rate

$$(11) \qquad fadj = f + p_B - p_A$$

Condition (11) is analagous to condition (3). It is important to emphasize that the nominal forward rate is adjusted by current price levels rather than forward price levels; in a risk neutral world it would not be an unbiased estimator of the expected future real exchange rate unless the future relative price level was expected to equal the current relative price level.

Much of the discussion below will focus on equation (9), but (10) is more attractive for applying the model empirically since it imposes prior co-efficient values on observable price and nominal interest rate levels. Models in which interest rates or money supplies are treated as "causing" the exchange rate, rather than as jointly endogenous variables, have been shown to involve

specification bias by Glaessner (1979), Caves and Feige (1980), and Meese and Rogoff (1981), among others.

Equations (9) and (10) apply to any horizon for expectations. In this paper they are discussed in terms of a long-term horizon, based on the view that the most plausible behavioral hypotheses for anchoring an expected future exchange rate are hypotheses about the real exchange rate that is consistent with long-run goods-market or balance of payments equilibrium. In empirical analysis based on condition (10), fadj is represented by a price-adjusted 5-year forward rate after Section IV presents evidence suggesting that investors expect it to take longer than 2 years for the real exchange rate to converge to its long-run equilibrium value.

The right-side terms in condition (10) represent unobservable expectations. The spirit of condition (10) is that news about the factors on which expectations are based leads to unobservable revisions in expectations and observable changes in exchange rates (and/or interest rates and/or price levels). The usefulness of condition (10) is for testing behavior hypotheses about the expectational variables. Insofar as the expectational variables are unobservable, the behavioral tests must be implicit or indirect, and given that three expectational variables enter the exchange rate equations the tests are joint or simultaneous tests of three behavioral hypotheses. This paper is oriented toward addressing the inadequacies of commonly-adopted behavioral hypotheses and stops short of subjecting alternative hypotheses to regression tests.

III. The Inadequacy of Some Common Behavioral Assumptions

In principle, all of the expectational terms on the right side of condition (10) should be treated as variables. Sections V-VII will address

the issues of modelling the expectational terms. This section uses the account-ing framework in conjunction with OECD inflation expectations (forecasts) to argue that under the common assumptions of time invariant expectations about the long-run real exchange rate (PPP level) and the risk premium, only a minor portion of observed changes in exchange rates can be explained by focussing on the relationship between exchange rates and short-term interest differen-tials -- as is commonly done -- without explicitly taking account of changes in nominal interest differentials that can be earned on investments beyond a 12-month horizon.[2]

The empirical exercise is to construct a time series of "residual" changes in the spot exchange rate that cannot be "explained" by observed changes in price levels or 12-month nominal interest differentials, or by revisions in the 12-month OECD inflation forecasts. The construction is based on a formula derived by first differencing condition (9), assuming time-invariant values of $sreal^e$ and $risk^e$. Reflecting the limited horizon of the OECD inflation forecasts, the real interest differential is truncated beyond the 12-month horizon. This leads to

$$(12) \quad resid_t = s_t - s_{t-1} + (P_A - P_B)_t - (P_A - P_B)_{t-1} + (R_A - R_B)_{t, \, t+2}$$
$$- (R_A - R_B)_{t-1, \, t+1} - (\hat{P}_A - \hat{P}_B)^e_{t, \, t+2} + (\hat{P}_A - \hat{P}_B)^e_{t-1, \, t+1}$$

where t runs through semi-annual observations, corresponding to the semi-annual dates of the OECD forecasts. Given the assumptions underlying the derivation of condition (12), the proper interpretation is that resid measures the sum of the changes in the expected long-run real exchange rate, the expect-ed return for bearing exchange risk, and the real interest differential beyond a 12-month (i.e., 2 period) horizon. The OECD forecasts are published for

seven countries (Canada, France, Germany, Italy, Japan, the United Kingdom
and the United States) and thus provide time series of "residual" changes in
the exchange rates between the U.S. dollar and six other currencies.

Table 1 shows the observed, explained and residual changes in the
logrithms of exchange rates, which correspond to percentage changes in the
levels of exchange rates. (The explained changes are computed last as the
differences between the observed and residual changes.) For 39 of the 48
entries the residual changes are larger than the explained changes. As
noted above, the residual changes can be viewed as the error terms that arise
from the joint assumptions that the expected long-run real exchange rate and
exchange risk premium are time invariant, and that real interest differentials
are not expected to persist for longer than 12 months. The residuals are
generally too large to attribute to differences between OECD inflation fore-
casts and "true" measures of inflation expectations. Accordingly, the evidence
suggests that at least one of the following propositions must be true. Either (1)
expectations about the long-run real exchange rate (or PPP level) vary widely
over time, or (2) the exchange risk premium is large and variable or (3) sub-
stantial real interest differentials are frequently expected to persist for
longer than 12 months. Thus, to the extent that there is some long run hori-
zon beyond which real interest differentials are expected to vanish, the
assumptions of time invariant expectations of the long-run real exchange
rate and the risk premium would suggest that exchange-rate variability has
been associated with variability in the shape of the term structure of nominal
interest differentials (relative to the term structure of expected inflation
differentials), which in turn suggests that the traditional use of short-term
interest differentials in exchange rate analysis may be a poor substitute for
a focus on long-term interest differentials.

Table 1: Explained and Residual Percentage Changes in U.S. Dollar Price of Foreign Currencies[a]

| | 1977H1 | 1977H2 | 1978H1 | 1978H2 | 1979H1 | 1979H2 | 1980H1 | 1980H2 |
|---|---|---|---|---|---|---|---|---|
| **Japanese yen** | | | | | | | | |
| observed | 10.85 | 11.36 | 9.58 | 12.73 | -10.95 | -12.38 | 12.60 | 3.96 |
| explained | -0.55 | -2.05 | 1.58 | -0.45 | 9.26 | 2.14 | 9.31 | -0.57 |
| residual | 11.40 | 13.41 | 8.00 | 13.18 | -20.21 | -14.52 | 3.29 | 4.53 |
| **German mark** | | | | | | | | |
| observed | 3.19 | 5.39 | 6.34 | 8.51 | 0.68 | 7.90 | -0.89 | -8.63 |
| explained | .69 | -0.52 | 2.24 | -.11 | 8.46 | -.15 | 6.07 | -.44 |
| residual | 2.50 | 5.91 | 4.10 | 8.62 | -9.14 | 3.05 | -6.96 | -8.19 |
| **French franc** | | | | | | | | |
| observed | 1.55 | 1.41 | 5.54 | 4.07 | -.13 | 6.52 | .07 | -8.02 |
| explained | -1.21 | -.44 | -3.34 | -3.99 | 3.12 | -3.67 | 1.84 | -4.68 |
| residual | 2.76 | 1.85 | 8.88 | 8.06 | -3.25 | 10.19 | -1.77 | -3.34 |
| **Italian lira** | | | | | | | | |
| observed | -2.19 | .88 | 1.97 | 1.03 | -.28 | 3.75 | -1.45 | -8.73 |
| explained | -10.61 | -5.50 | -2.43 | -2.83 | -6.41 | -2.57 | -.01 | 9.59 |
| residual | 8.42 | 6.38 | 4.40 | 3.86 | 6.13 | 6.32 | -1.44 | -.86 |
| **Canadian dollar** | | | | | | | | |
| observed | -2.47 | -4.24 | -1.03 | -4.58 | -0.07 | -0.15 | 1.71 | -2.75 |
| explained | -.98 | -.40 | .89 | -1.23 | 1.06 | -1.68 | .39 | -1.40 |
| residual | -1.49 | -3.84 | -1.92 | -3.35 | -1.13 | 1.53 | 1.32 | -1.35 |
| **British pound** | | | | | | | | |
| observed | 3.36 | 5.60 | 0.99 | 6.06 | 6.14 | 4.63 | 7.19 | 3.11 |
| explained | -7.85 | -7.22 | 5.52 | -1.99 | -3.68 | -7.06 | -3.14 | -6.16 |
| residual | 11.21 | 12.82 | -4.53 | 8.05 | 9.82 | 11.69 | 10.33 | 9.27 |

Table 1: (continued)

a.  The half year periods correspond to intervals between the published cut-off dates for material included in the semi-annual issues of the OECD Economic Outlook. These cut-off dates are Dec. 1, 1976, June 29, 1977, Nov. 28, 1977, June 12, 1978, Nov. 23, 1978, June 11, 1979, Nov. 23, 1979, June 4, 1980 and Nov. 17, 1980. Exchange rates and interest differentials (measured as forward premiums) are represented by Federal Reserve data for the cut-off dates. Observed and forecast inflation rates are taken from the OECD Economic Outlook and represent percentage changes in GNP or GDP deflators over corresponding half-year periods.

IV. <u>The Persistance of Real Interest Differentials: How Distant is the Long Run?</u>

Condition (10) provides a useful analytic framework only to the extent that the right-side expectational terms can be modelled, and among these terms, the expected future real exchange rate cannot be easily modelled (or convincingly assumed to be constant) without appealing to the notion of a long-run steady state. For purposes of empirical analysis it is important to focus on forward exchange rate observations for a maturity that exceeds the expected length of the convergence interval over which the real exchange rate moves to its long-run steady-state value (following an isolated, <u>ceteris paribus</u> shock that disrupts an initial steady-state equilibrium).

For many currencies, adequate historical data on forward exchange rates against the U.S. dollar are not available for maturities longer than 1 year. For a few currencies, including the mark, 2-year and 5-year forward rates against the dollar are available (or can be constructed from Eurocurrency deposit rates) on a daily basis. This section argues for using the 5-year forward rate in condition (10), based on evidence suggesting that it is expected to take longer than 2 years, but perhaps less than 5 years, for the real exchange rate to converge to its long run level.

The evidence is presented in table 2. The first two rows of table 2 present time series of Bache survey data on the average annual rates of U.S. inflation expected over the first and second halves of a 10-year horizon. The two series are assumed to provide upper and lower bounds on the U.S. inflation rates that were expected from the end of the second year through the end of the fifth year. The expected 2-5 year U.S. inflation rate declined from early October 1980 through early September 1981, and there is a strong presumption that any revisions in expected long-term German inflation rates

Table 2: <u>Long-term inflation expectations and nominal interest rates</u>[a]

| | Early October 1980 | Early January 1981 | Early May 1981 | Early September 1981 | Early November 1981 |
|---|---|---|---|---|---|
| **Expected U.S. inflation[b]** | | | | | |
| 0-5 years | 9.4 | 8.9 | 8.4 | 7.8 | 7.9 |
| 5-10 years | 8.3 | 7.8 | 7.3 | 7.4 | 7.5 |
| 2-5 years | 8.3-9.4 | 7.8-8.9 | 7.3-8.4 | 7.4-7.8 | 7.5-7.9 |
| **Eurodollar rates[c]** | | | | | |
| 2 years | 12.5-13.1 | 14-14.5 | 16.4-16.8 | 17.5 | 14.6-14.8 |
| 5 years | 12.5-13.0 | 13.9-14 | 15.9-16.5 | 16.8-17.0 | 14.9-15.3 |
| 2-5 years | 12.5-13.0 | 13.5-13.9 | 15.5-16.3 | 16.3-16.7 | 15.0-15.6 |
| **Euromark rates[c]** | | | | | |
| 2 years | 8.3-8.6 | 9-9.3 | 11.1-12 | 12.5 | 11 |
| 5 years | 8.3-8.5 | 9-9.3 | 10.4-11 | 11.9 | 10.6 |
| 2-5 years | 8.3-8.5 | 9-9.3 | 9.9-10.3 | 11.5 | 10.4 |
| **Euro-differential** | | | | | |
| 2-5 years | 4.2-4.6 | 4.5-5.8 | 5.7-6.1 | 4.9-5.1 | 4.7-5.2 |
| **Treasury differential[d]** | Sept./Oct. | Jan. | Apr./May | Aug./Sept. | |
| 2-5 years | 3.7/3.7 | 3.6 | 4.2/3.7 | 4.9/5.6 | |
| 5-10 years | 3.3/3.1 | 3.3 | 3.2/3.0 | 3.1/3.4 | |

a. In percent per annum.

b. Based on survey data on 5 and 10-year U.S. inflation expectations collected quarterly since mid-1980 by Richard B. Hoey, Vice President of Bache Halsey Stuart Shields Incorported. Data represent simple averages of the expectations of about 350 institutional investment decision makers, as published in Bache Institutional Research Letters.

c. The 2 and 5-year interest rates represent yields (paid once a year) on fixed term deposits, as collected daily by the Bank of America and made available through Data Resources Inc. The 2-5 year rates represent implicit fixed-term yields computed in the traditional manner.

d. Based on averages within each month of market yields on U.S. and German Treasury debts, by horizon to maturity, as published in the Federal Reserve Bulletin and the Monthly Report of the Bundesbank (Series 2, Table 8c).

were upward[3], thus implying an even greater decline in the expected inflation differential. By contrast, there were increases over the same period in the differentials between the implicit 2-5 year nominal yields on dollar and mark-denominated assets, as shown for both Eurocurrency deposits and Treasury issues.[4]

Such evidence indicates that real interest differentials beyond a 2-year horizon were not time invariant, which rejects the assumption that real interest differentials were expected to vanish within a 2-year horizon. Unless the substantial changes in 2-5 year real interest differentials were offset by equal and opposite changes in the implicit 2-5 year risk premium, the evidence also rejects the assumption that the real exchange rate was expected to converge to its long-run level within a 2-year horizon.

The bottom row of table 2 presents data on the differentials between the implicit 5-10 year nominal yields on U.S. and German Treasury issues; data are not available on Eurocurrency yields for maurities longer than 5 years. The data on Treasury differentials are constructed from term structures of the average yields within each month. Together, the data in the bottom row and the 2nd row from the top might be judged as a weak rejection of the hypothesis that real interest differentials beyond a 5-year horizon are time invariant; but the evidence does not suggest substantial variation in the 5-10 year real interest differential.

To summarize, the evidence in table 2 argues against the assumption that real interest differentials are expected to vanish within 2 years, and thus argues against using a 2-year (or shorter maturity) forward rate in applying the accounting framework. Furthermore, the evidence is not strongly critical of using a 5-year forward rate, which is the only alternative for which adequate data are available.

## V. Some Difficulties in Modelling Inflation Expectations

With respect to modelling the expected inflation terms on the right-side of condition (10), the traditional use of long-term nominal interest rates as proxy variables for long-term inflation expectations is inadequate, since it implicitly denies any difference between the paths of nominal interest rates and expected inflation rates over the horizon that is required to reach the long run. This point is underscored in section IX below, where it is argued that the sharp appreciation of the dollar in the first half of 1981 was associated with a downward revision in U.S. long-term inflation expectations in response to fiscal policy news; yet long-term dollar interest rates rose in the periods following the arrival of the fiscal policy news.

The apparent responsiveness of inflation expectations to fiscal policy news during 1981 also poses the challenge of modelling inflation expectations in a rational forward-looking context that spells out the channels through which budget deficits are assumed to influence inflation, whether through the money-supply mechanism or the Phillips curve. As section IX will emphasize, the data on prices, monetary aggregates, activity indicators and current budget deficits did not jump contemporaneously with the fiscal policy news of 1981. Thus, to capture the revisions in inflation expectations (without relying on survey data) requires not only a forward-looking rational-expectations model but also measures of expected future values of "explanatory" variables (in the inflation equation) that are not merely generated from autoregressions.

## VI. The Expected Long-run Purchasing-Power-Parity Level

It seems unacceptable to model real exchange rates without relying on some notion of goods-market or balance-of-payments equilibrium. In a

world of two countries, each producing a different good, the domestic price
levels can be related to nominal money supplies, but an additional balance-
of-payments condition is required to explain the relative price level or real
exchange rate.  In a Hechsher-Ohlin-Samuelson world in which the two countries
each produce the same two goods, the production possibilities frontiers and
consumer indifference maps, which together determine the domestic relative
price levels for each country under autarky, must be supplemented with a
balance-of-trade condition (or perhaps a more broadly defined balance of
payments condition) to determine the common relative price level that emerges
under international trade.

Many analytic models of exchange rate dynamics assume that the
world economy is expected to converge to a steady state in which the real
exchange rate is consistent with long-run balance of payments equilibrium;
examples include Kouri (1976), Dornbusch (1976) and Calvo and Rodriguez (1977).
In principle, the existence of a long-run balance-of-payments constraint,
regardless of its particular form, implies that the expected long-run value
of the real exchange rate (if expectations are formed rationally) will vary
over time in response to any shocks that generate revisions in expectations
about the long-run values of other variables that influence the balance of
payments.  Thus the expected long-run PPP level should, in principle, be
viewed as an endogenous variable.[5]

The empirical literature on exchange rate determination has taken
only limited steps to endogenize the expected long-run real exchange rate,
most notably those by Hooper and Morton (1982).  The argument that the long-
run PPP level is in principle a variable, of course, leaves open the question
of whether it varies sufficiently to have a major influence on observed ex-
change rates.

The major shifts in the relative price of oil during the 1970s
provides the strongest case for arguing that revisions in expectations about
the long-run PPP level may have been empirically important over the past
decade. The evidence seems clear (though not scientifically extracted with
formal techniques) that news which leads to small changes in the outlook for
the relative price of oil has a significant and predictable (ex post) impact --
in the hours or days during which the news is digested -- on the exchange
values of the currencies of countries that are relatively well-endowed or
relatively poorly-endowed with energy resources. A major difficulty that
arises, however, in trying to identify such changes in exchange rates with
revisions in expectations about the long-run PPP level is that the economic
stabilization policies pursued by different countries have responded differ-
ently to oil-price shocks. In terms of the accounting framework developed
in section II, empirical evidence that month-to-month movements in exchange
rates reflect significant responses to changes in the expected long-run PPP
level must be extracted from a joint test of behavioral specifications for the
expected long-run PPP level, the expected long-term inflation differential and
the expected long-term return for bearing exchange risk. Identification is
thus complicated by the fact that behavioral specifications for the latter
two expectational factors cannot realistically abstract from the perceived or
expected responses of stabilization policies to the oil-price shocks. In parti-
cular, inflation expectations are sensitive to revisions in expectations about
monetary growth paths, and the risk premium is sensitive to revisions in expect-
ations about fiscal budget deficits.

The difficulties of modelling expectations and quantifying the news
can hardly be avoided, however, in any serious attempt to resurrect faith in
structural exchange rate models. The starting point for modelling the expected

long run real exchange rate is to specify the long-run balance of payments

constraint as a relationship between a constant steady-state level of the

real exchange rate and a list of other variables. In general, the long-run

values of these other variables are not known with certainty but, presumably,

can be described in terms of subjective probability distributions. Consis-

tently, the balance of payments constraint can be viewed to anchor the long-

run real exchange rate in terms of a probability distribution that depends,

under rationality assumptions, on the joint probability distribution of the

other variables. For purposes of estimating an exchange rate model based

on condition (10), the expected value of the long-run real exchange rate must

be characterized to replace $sreal^e$ with a testable behavioral hypothesis,

and the variance of the long-run real exchange rate is an important compo-

nent of the risk premium, as will be discussed in section VII.

Several contributions to the literature have addressed the notion

that unexpected shifts in (variables that influence) the current account lead

to revisions in expectations about the long-run real exchange rate; see

Dooley and Isard (1981a), Hooper and Morton (1982) and Mussa (1980). None

of these contributions, however, has provided a satisfactory description of

the balance of payments constraint. Dooley (1980) has emphasized that the

balance of payments is a concept of net debt flows between geographical

regions and no longer a good measure of net debt flows denominated in any

particular currency unit.[6] This implies that any long-run constraint on

the balance of payments owes its existence to the political risk of default

rather than to exchange-rate risk. In a more recent paper, Dooley (1981)

suggests that market mechanisms impose the long-run balance of payments con-

straint via increases in political risk premiums, and consequent exchange

rate adjustments, which serve to prevent cumulative current account deficits from ever reaching a level at which debt service costs make default optimal for the debtor country.

The general nature of such a bound on cumulative balance-of-payments flows does not impose a rigid constriant on the balance of payments during any particular year in the long-run unless an assumption is made that constrains all years to be similar once the long-run is reached. The latter assumption can be justified, however, not only on grounds of analytic convenience but also by the argument that long-run foresight is too imperfect to place any faith in predictions of how economic variables will fluctuate around their long-run trends. In sum, the assumption of a finite bound on cumulative balance of payments flows together with the steady-state assumption of smooth growth of economic activity after the long-run is reached imply an expected balance of payments of zero over any finite interval of the infinite long-run horizon.[7]

With this justification, it is instructive to provide a simple characterization of the steady state. In the 2 country context, real output can be imagined to grow at the same constant real rate of interest in each country, with balance of trade. If one of the two countries holds net claims on the other, the stock of these net claims also grows at the real interest rate and thereby amounts to a reinvestment of net interest income from abroad. Thus, net interest payments remain a constant proportion of the output of the debtor country, so the incentive to default never increases. Similarly, the wealth of the creditor country, as measured by portfolio size, increases over time in absolute size but remains stationary relative to income, and real transfers never occur.

Such a framework can be described formally in terms of a balance of payments condition

(13) $\Delta NCF_t = X_t - SREAL_t M_t + r_t NCF_t$

an import demand function

(14) $\log (M_t/Y_t) = a_o - a_1 r_t - \sum_{k=o}^{K} a_{2,k} \, sreal_{t-k}$

and an export function (or foreign import demand function)

(15) $\log (X_t/Y_t^*) = b_o - b_1 r_t + \sum_{k=o}^{K} b_{2,k} \, sreal_{t-k}$

where

> M,X    denote import and export volumes
>
> $Y,Y^*$   denote domestic and foreign incomes in real terms
>
> NCF    denotes net domestic claims on foreigners in real terms
>
> r       denotes the domestic and foreign real interest rates (which need not be distinguished for purposes of describing the steady state)
>
> SREAL   denotes the level (as distinct from the logarithm) of the real exchange rate

The steady state is characterized by trade balance, by equal domestic and foreign real interest rates $\bar{r}$, and by constant growth at rate $\bar{r}$ of domestic and foreign output, of net claims on foreigners, and hence of domestic and foreign incomes. Thus, conditions (13) – (15) can be solved for the steady-state logarithmic level of the real exchange rate

(16) $\overline{sreal} = \dfrac{(a_o - b_o) + (b_1 - a_1)\bar{r} + \log(\overline{Y/Y^*})}{a_2 + b_2 - 1}$

where $a_2 = \Sigma a_{2,k}$, $b_2 = \Sigma b_{2,k}$ and $\overline{Y/Y^*}$ is the constant steady-state ratio of domestic and foreign incomes.

Condition (16) translates directly into a rational model of the expected long-run real exchange rate that appears in the spot and forward rate equations (9) and (10). The expected long-run real exchange rate depends, loosely speaking, on expectations of the long-run ratio of domestic to foreign activity levels, on perceived values of the exchange-rate elasticities of import and export volumes, and on expectations or perceptions about $\bar{r}$, $a_o$, $b_o$, $a_1$ and $b_1$. Revisions in $sreal^e$, accordingly, can arise from revisions in expectations about the long-run values of $Y/Y^*$ or $r$, or from revisions in perceptions about the values of the exchange-rate elasticities or the other parameters. It is worth repeating that while $sreal^e$ is the mean of a subjective probability distribution, the range of the distribution may be wide and the variance high. The notion of long-run balance of payments equilbrium need not anchor the long-run real exchange rate at a point.

Condition (16) stops short of modelling how expectations about $\overline{Y/Y^*}$ and $\bar{r}$ and perceptions about the parameter values are formed and/or revised. But together with the Marshall-Lerner condition (i.e., the assumption that its denominator is positive) it provides a place for a number of phenomena that are viewed to influence exchange rates. (1) An oil discovery in country A can be viewed -- within the simple structure of trade equations (14) and (15) -- to raise the perceived long-run value of $b_o$ or lower the perceived value of $a_o$, thereby appreciating currency A. (2) A rise in the relative price of oil can be viewed to raise $b_o$ for oil exporting countries and to raise $a_o$ for oil importing countries, with well-recognized effects on exchange rates. (3) Larger-than-expected trade deficits (surpluses) in the short run that persist and do not merely reflect unexpected changes in the explanatory variables that enter trade equations can lead to revised perceptions of parameter values, to associated revisions in expectations about the long-run real

exchange rate, and thereby to observed currency depreciation (appreciation).

(4) Surprises about the extent to which a country's trade balance is improving (deteriorating) following currency depreciation (appreciation) may lead to upward revisions in perceptions of the elasticity parameters $a_2$ and $b_2$, to an associated revision in expectations about the long-run real value of the currency, and thereby to a change in observed exchange rates.

(5) To the extent that a surprisingly sharp domestic recession (boom) is viewed to permanently lower (raise) the level of domestic output relative to foreign output, the domestic currency should appreciate (depreciate); accordingly, activity shocks that are not expected to be completely offset can generate a positive correlation between shifts in the trade balance toward surplus (deficit) and currency appreciation (depreciation). (6) To the extent that policy actions (e.g., tax measures or other "supply-side" shocks) raise the domestic share of world markets at any given real exchange rate, the $a_o$ and $b_o$ parameters will shift, with $a_o - b_o$ declining and thereby generating an appreciation of the expected long-run real value of domestic currency (i.e., a decline in $\overline{sreal}^e$ ).

VII. The Expected Premium for Bearing Exchange Risk

By its definition in condition (2), the expected long term premium for bearing exchange risk is the difference between the expected long-run nominal spot rate and the observed long-term nominal forward rate. A non-zero risk premium owes its existence to three factors: (i) a non-zero probability, and hence some risk, that the future spot exchange rate may differ from its expected level, (ii) private investors' aversion to that risk, and (iii) a difference between the currency composition of public debts that are forced (at market-clearing prices) into the portfolios of private investors (as an aggregate) and the currency-composition of the aggregate portfolio that would minimize the risk assumed by private investors; (see Dornbusch 1980b). Without any one of these factors the risk premium would vanish.

Attempts to assess the empirical importance of the risk premium can be classified into three approaches. Dooley and Shafer (1976), Hansen and Hodrick (1980, 1983), Cumby and Obstfeld (1981) and Meese and Singleton (1982), among others, have employed a variety of methods to examine the time series properties of spot exchange rates and forward exchange rates (or interest differentials); such studies have generally concluded that the assumption of market efficiency implies that the risk premium is significantly greater than zero, although not necessarily very large. As a second approach, Dooley and Isard (1981a) and Frankel (1981, 1982) have tested the significance of simple structural models of the ex ante risk premium in explaining the ex post change in the exchange rate (over and above the forward premium); these studies have found weak evidence of a small risk premium. As a third approach, Krugman (1981) has derived a structural form for the risk premium and inserted "reasonable" values of the structural parameters to calculate the extent to which the risk premium might be judged to change in association with given changes in asset stocks and wealth variables. Krugman also finds no reason to believe that the risk premium is large.

The Krugman-type exercise is repeated here with "more reasonable" parameter values. The purpose is to challenge Krugman's impression of the order of magnitude of the risk premium and to suggest in particular that changes in the risk premium may have accounted for a substantial portion of the swings in the mark/dollar rate during 1981, which strongly coincided (as documented in section IX below) with shifts in the outlook for U.S. budget deficits. Given the limited objective of being suggestive, the formulation of the risk premium has been simplified in two important ways: by ignoring differencies in the portfolio preferences of U.S. and foreign residents (i.e.,

wealth effects), and by assuming that both U.S. and foreign residents optimize

with respect to the dollar value of their terminal wealths. Under these sim-

plifications the 5-year risk premium can be derived from a utility-maximizing

framework as the product of the coefficient of risk aversion (u), the perceived

variance (v) of the ratio of the 5-years-future spot rate to the current 5-year

forward rate, and the share (Q) of dollar-denominated public debt in global

private holdings of dollar and market denominated public debts; see Dornbusch

(1980b), Isard (1980) or Krugman (1981).

(17)        $risk^e = u \cdot v \cdot Q$

As the optimization problem is generally formulated, the asset-share variable

is a current, beginning-of-period concept. A more realistic formulation for

a rational expectations environment would provide an explicit role for expecta-

tions or subjective probability distributions about the future paths of asset

stocks and wealth variables. In the absence of such a formulation, a third

major simplification in what follows is to interpret Q, heroically, as an end-

of-period concept.

    With this basis and interpretation of condition (17), a Krugman-type

calculation can be generated under the suggestions that u = 4, that v = 1/4

and that Q changed by at least 2 percent during the early months of the Reagan Ad-

ministration. These numbers suggest that changes in the risk premium "explained"

at least a 2 percent appreciation of the dollar against the mark during the

first half of 1981. The value u = 4 is taken from Grossman and Shiller (1981),

who place it within the range of estimates that have been published in the

literature, and who argue as well that a value of at least 4 is suggested by

an empirical application of their model of stock-price variability. The value

v = 1/4 reflects the assumption that the subjective probability distribution

of the 5-year future spot rate is normal, with a mean value of 2 marks per

dollar (roughly equal to the 5-year forward rate), and with 67 percent of the

probability attached to the range between 1 and 3 marks per dollar; hence

the variance of the 5-year future spot rate is 1 and the variance of the ratio

of the future spot rate to the forward rate is 1/4. Finally, the alleged

change of at least 2 percent in Q is based on the perception that the fiscal

policy proposals in the early months of the Reagan Administration, and their

acceptance by a surprising margin-of-victory in a House of Representatives

vote on May 7, reduced the cumulative outlook for U.S. budget deficits over

a 5-year horizon by at least $100 billion. Given an initial value of Q=.8,

based on the initial trillion dollar stock of U.S.-public debt and the 1/4

trillion dollar-equivalent stock of German public debt, a change of at least

$100 billion, or 10 percent, in the expected stock of U.S. public debt suggests

a change of at least 2 percent in the expected ratio of U.S. to U.S. plus

German public debts.

To lend futher support to the suggestion of substantial changes in

the risk premium, section IX will present graphical evidence that movements

in mark/dollar exchange rates during 1981 coincided strongly with fiscal policy

news. As will also be detailed, survey data on long-term U.S. inflation ex-

pectations suggest that revisions in inflation expectations can only explain

about half of the apparent responsiveness of the exchange rate to fiscal

policy news. Such arithmetic raises the possibility that the 5-year risk

premium changed by as much as 5 to 10 percentage points during the early part

of 1981 -- even more than suggested by the calculations based on the over-

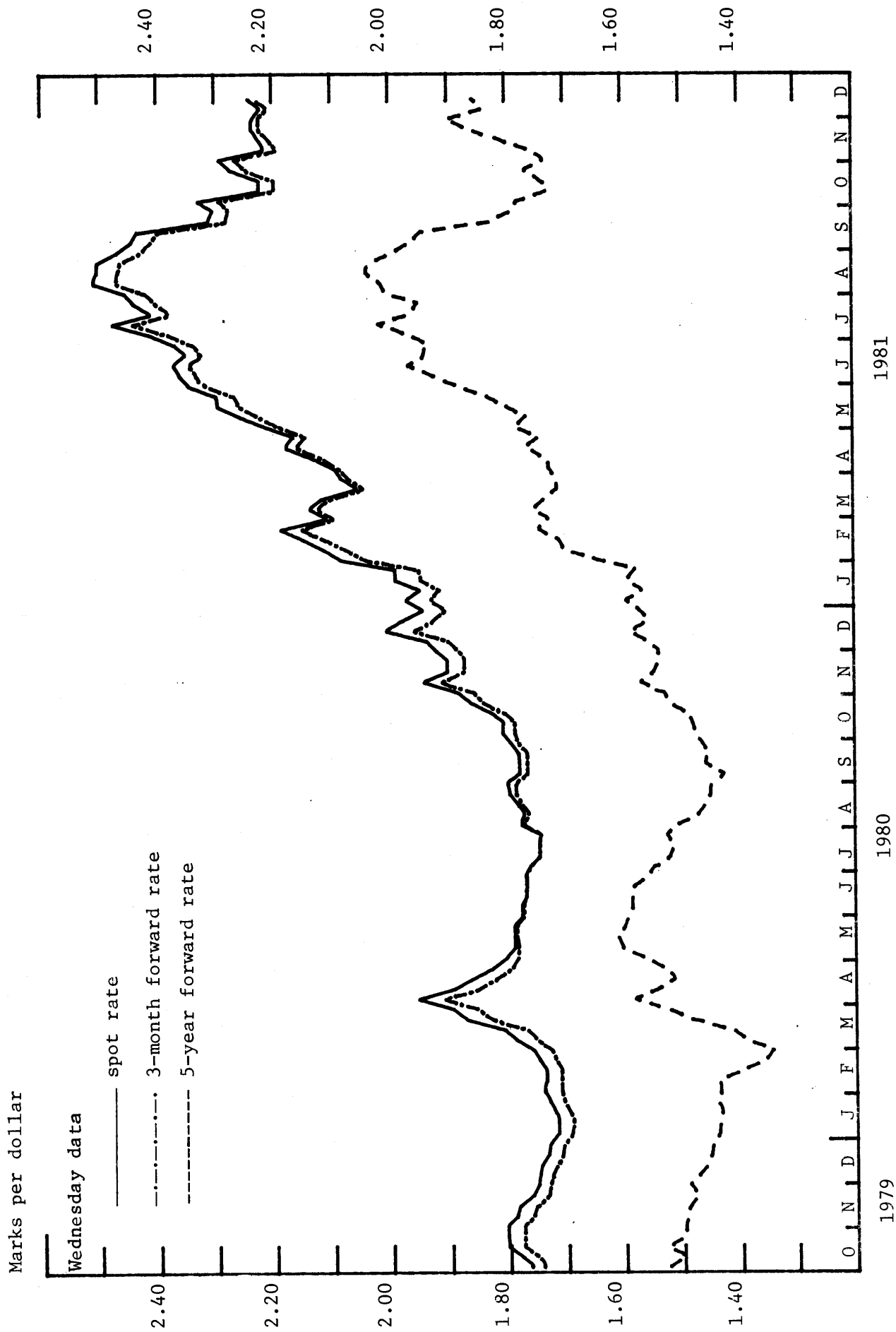simplified condition (17) -- or by as much as 1 to 2 percentage points when

measured in per-annum units. On a priori grounds, it does not seem implausible

that rational investors may have been so uncertain and risk averse to have

required an additional expected long-term yield of 1 to 2 percent per annum

on their mark-denominated portfolio holdings, given the rosy expectations

created early in the Reagan Administration.[8] Unfortunately, there seems to be

no basis for a refined judgement of whether the risk premium could have changed

so much without the analytical equipment of a forward-looking formulation of the

risk premium in terms of expected future asset stocks and wealth variables,

along with a better empirical assessment of parameter values and the extent

to which expectations of future asset stocks and wealth variables have shifted.[9]

VIII.  Explaining the Volatility of the Dollar During Spring 1980

This section and the next focus on the behavior of spot and forward

mark/dollar exchange rates during 1980-81, using the accounting framework as

a basis for drawing inferences and conjectures about hte response of these ex-

change rates to major elements of the news.  In this section the focus is on

the extent to which the rise and fall of the dollar during January-May 1980 can

be "explained" by changes in the compounded long-term real interest differen-

tail.  The assessment involves a straight forward analysis of how much of the

swing can be "explained" by changes in the compounded long-term nominal in-

terest differential and an  informal analysis of whether the magnitude and

timing of changes in the residual can be plausibly attributed to revisions in

expectations about the long-term inflation differential.  The obverse of this

question is whether it is plausible that the risk premium and the expected

long-run value of the real exchange rate remained constant throughout the period.

Figure 1 shows the behavior of the mark value of the dollar from

October 1979 through early December 1981, both on a spot basis and for 3-month

Figure 1

Marks per dollar

Wednesday data

————————— spot rate

—·—··—·· 3-month forward rate

————————— 5-year forward rate



1979      1980      1981

and 5-year forward maturities. It is interesting to note that the correlation

between the spot and 5-year forward rate is high, though not as near-perfect

as the correlation between the spot and 3-month forward rates.

Given the empirical evidence presented in section IV and the fact that

5 years is the longest maturity for which adequate data are available on for-

ward rates (or on differentials between interest rates on Eurodollar and Euro-

mark deposits), the analysis for the most part adopts the assumption that the

long-run is expected to be reached within 5 years. This essentially amounts

to assuming that real interest differentials are expected to vanish in less

than 5 years -- the equivalent (under risk neutrality) of the assumption that

the real exchange rate is expected to converge to its long-run level

in less than 5 years. Some consideration is also given to the assumptions

that the long run is expected to be reached within 1 year or within 2 years --

i.e., that real interest differentials are not expected to persist beyond 1 or

2 years. The data represent time series of Wednesday observations. An alter-

native focus on weekly-average observations conveys virtually the same impres-

sions.

Figure 2 shows cumulative percentage changes since the beginning of

1980 in the spot rate and the 5-year price-adjusted forward rate.[10] Based on

condition (10), in the absence of revisions in expectations about the long-

run real exchange rate or changes in the risk premium, movements in the 5-year

price-adjusted forward rate could be interpreted entirely as revisions in

expectations about the differential between German and U.S. inflation rates

over a 5-year horizon.

To judge the maintained hypothesis that movements in the price-

adjusted forward rate can be interpreted as revisions in the expected 5-year

**Figure 2**



Cumulative Percent Change
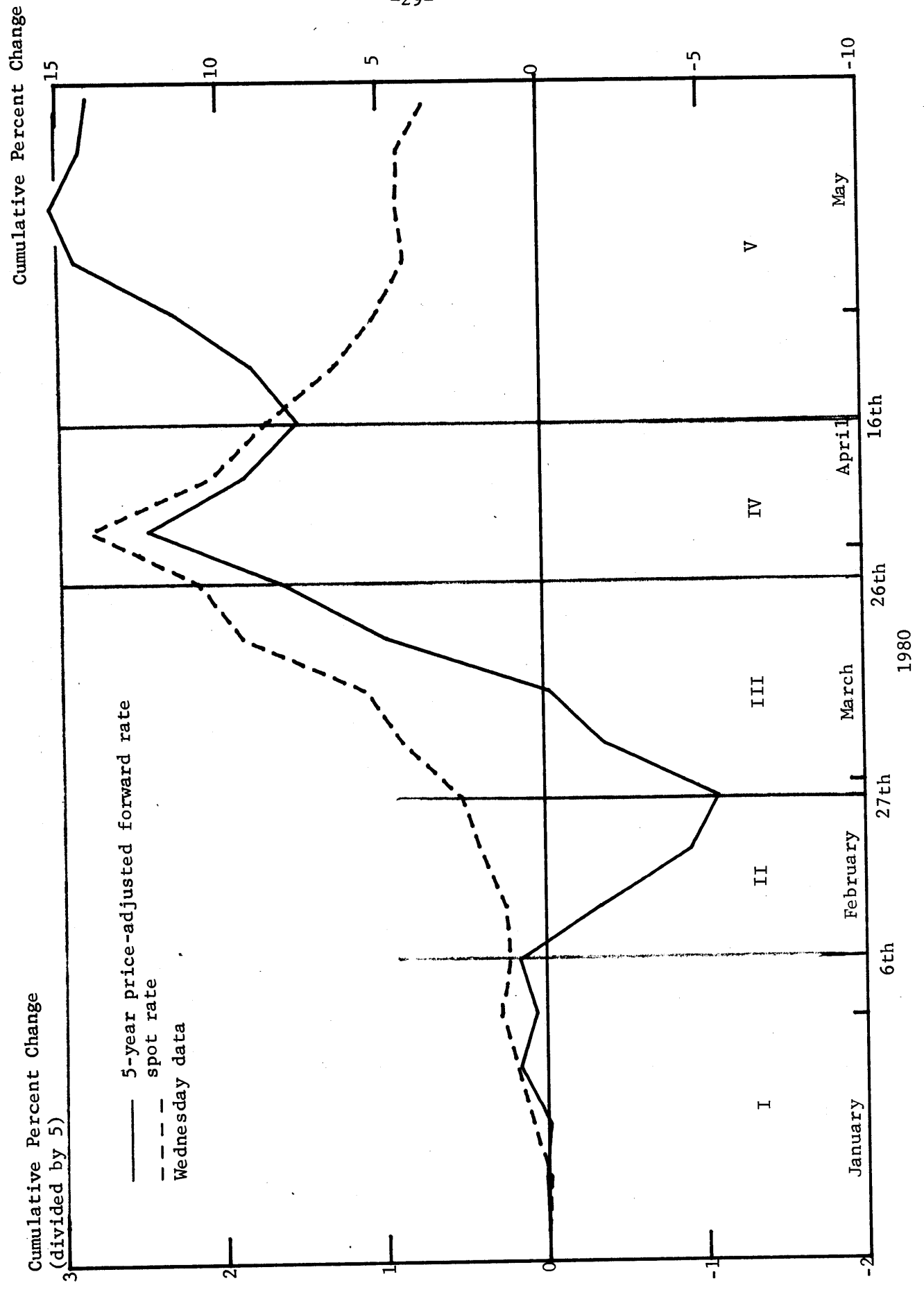
inflation differential (measured per annum on the left scale in Figure 2 and per 5 years on the right scale), the data period is divided into 5 subperiods. During January there was little movement in the two exchange rates. Subperiod II on the graph began right after the U.S. budget proposals and the Economic Report of the President were released on January 28th and 30th, respectively. The subsequent three weeks brought an upward revision in the expected pace of U.S. inflation: by February 6th it had been discovered that the U.S. Budget had substantially underestimated the costs of military outlays for fuel; by February 13th new data showed a strong acceleration in U.S. retail sales during January; by February 20th it had been revealed that U.S. wholesale prices had jumped 1.6 percent during January, a sharp acceleration for December; and on February 22nd it was reported that U.S. consumer prices had also accelerated sharply in January. Consistently, the dollar depreciated forward over this subperiod, while downward pressures on the spot value of the dollar were offset by a 1-1/2 percentage point increase in the Eurodollar rate relative to the Euromark rate (per annum).

The news of the January rise in U.S. consumer prices ushered in subperiod III on the graph as financial markets, according to Reuters, reacted "perversely". The consumer price data strengthened expectations of further anti-inflationary policy measures by the U.S. authorities -- expectations that were confirmed by the new budget proposals and monetary and credit actions of March 14th. Under the maintained hypothesis, the path of the forward rate would imply that the expected U.S. infaltion rate, looking out over a 5-year horizon, was revised downward over the course of a month by roughly 2-1/2 percentage points per annum relative to the expected German inflation rate. The revision in inflation expectations was associated with an increase in real

long-term dollar interest rates relative to real long-term mark interest rates and led to a strong appreciation of the spot dollar, even though nominal Euro-mark rates moved up somewhat faster than Eurodollar rates.

Subperiod IV on the graph began on March 27th with the decision, announced following the fortnightly meeting of the Bundesbank Central Council, that German credit policies would be left unchanged. The apparent upward revision in expectations about the pace of German inflation, relative to U.S. inflation, was supported on April 2nd by the report of a full half percentage point drop in the German unemployment rate during March. Additional support may have been provided by major new banking legislation, passed by the U.S. Congress on March 28th, which strengthened the Federal Reserve's control over money and credit growth. During the first four trading days of April, spanning the long Easter weekend, the spot and forward values of the dollar wavered around levels 4 percent higher than where they had closed on March 26th. Then they dropped the full 4 percent on April 9th. Among the news that may have led to the dollar's drop was the announcement late on April 8th that the German Government had arranged to borrow one billion marks from the U.S. Government, the release of data on April 9th indicating no change in German industrial production during February, and the prediction by a respected U.S. banker that dollar interest rates would soon begin to tumble. The first and second items suggested less pressure on the German money supply, given the authorities' reluctance to push interest rates higher, while the third item may have provided a revised impression of how contractionary a stance the Federal Reserve had taken.

Subperiod V started on April 16th, the day that U.S. prime rates began the rapid descent from their peak. By the end of May the 5-year Euro-dollar rate had fallen by more than 4 percentage points per annum, and by

roughly 2-1/2 percentage points relative to the 5-year Euromark rate. Meanwhile the expected pace of U.S. inflation was revised downward, particularly in response to the May 2nd announcement that U.S. unemployment had skyrocketed from 6.2 percent in March to 7.0 percent in April. Consistently, the 5-year forward dollar appreciated sharply in response to the May 2nd announcement.

The story provides reasonable explanations for the direction of swings in spot and forward rates under the maintained hypothesis. Are the magnitudes of the swings in the 5-year forward rate also plausible estimates of revisions in inflation expectations? Is it plausible that the inflation differential expected over a 5-year horizon could have first increased (during subperiod II) by about 1 percentage point per annum and then declined (through the end of May) to roughly 3 percentage points per annum less than what had been expected during January? Changes of such magnitude in the relative U.S. and German inflation outlooks were discussed by the financial press, although without explicitly looking much further into the future than the end of 1981. A convincing answer seems precluded by the absence of published inflation forecasts that extend as far as 5 years into the future and are revised frequently enough to provide an interesting time series.[11]

A major empirical point about the Spring 1980 example is that changes in real interest differentials, when compounded or integrated over a long-term horizon, can potentially explain a substantial degree of exchange rate volatility.[12] The above analysis has focused on the revisions in expected inflation differentials that are implied by the joint hypothesis that Spring 1980 was explained entirely by changes in real interest differentials and that real interest differentials were not expected to persist beyond a 5-year horizon. For comparison, and despite the evidence to the contrary

presented in section IV, it is interesting to consider what the joint hypothesis would imply if real interest differentials were only expected to persist for a year or two. Accordingly, in Table 3 the third and second columns from the right have been constructed to represent the revisions in expected inflation differentials that are implied when the joint hypothesis is modified by assuming that real interest differentials were not expected to persist beyond horizons, alternatively, of 1 year and 2 years. The joint hypothesis seems implausible under either of these cases.

The issue of the horizon length over which real interest differentials are expected to persist is an important question for assessing the extent to which exchange rate volatility can be associated with changes in real interest differentials. Section IV has begun to address the question empirically, but more extensive evidence and better tests are desirable, in particular to explore the question of whether real interest differentials beyond a 5-year horizon are substantial. Economists who have been inclined to think that real interest differentials are generally expected to vanish within a year or two must confront the reality of 5 to 10 year real dollar interest rates, as traditionally defined, rising well above 7 percent per annum in the first eight months of 1981 when measured with survey data on long-term inflation expectations. In the absence of a satisfactory explanation of the high level of long-term real interest rates it is difficult to conceive of the mechanism that might have been expected to eliminate real interest differentials within a 1 or 2 year horizon.

IX. The Mark/Dollar Rate from June 1980 through December 1981

This section uses the accounting framework to discuss plausible explanations for the major swings in the mark/dollar rate between June 1980

Table 3:  Changes in Spot, Forward, and Price-Adjusted Forward Rates:  January - May 1980

| | Spot Rate | Percent Change Since Jan. 2, 1980 Forward Rates[a] | | | Adjustment for Relative Price Trend[b] | Percent Change Since Jan. 2, 1980 Per Year to Maturity Price-Adjusted Forward Rates[c] | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | | 1-Year | 2-Year | 5-Year | | 1-Year | 2-Year | 5-Year |
| January 9 | 0 | -.05 | .36 | -.05 | .14 | .09 | .25 | .02 |
| 16 | .94 | .98 | 1.28 | -.36 | .29 | 1.27 | .79 | -.01 |
| 23 | .92 | .68 | 1.12 | .43 | .43 | 1.11 | .78 | .17 |
| 30 | 1.14 | .72 | .64 | -.23 | .58 | 1.30 | .61 | .07 |
| February 6 | 1.57 | 1.07 | .68 | .12 | .72 | 1.79 | .70 | .17 |
| 13 | 1.34 | .42 | -.58 | -2.53 | .86 | 1.28 | .14 | -.33 |
| 20 | 1.84 | .55 | -1.22 | -5.48 | 1.01 | 1.56 | -.11 | -.89 |
| 27 | 3.11 | 1.71 | .46 | -6.49 | 1.15 | 2.86 | .80 | -1.07 |
| March 5 | 4.39 | 2.39 | 1.20 | -3.13 | 1.30 | 3.69 | 1.25 | -.37 |
| 12 | 5.09 | 3.04 | 2.16 | -1.56 | 1.44 | 4.48 | 1.80 | -.02 |
| 19 | 9.42 | 7.22 | 7.14 | 3.20 | 1.56 | 8.80 | 4.36 | .96 |
| 26 | 10.25 | 8.07 | 7.60 | 6.33 | 1.73 | 9.80 | 4.67 | 1.61 |
| April 2 | 14.69 | 13.21 | 12.62 | 10.20 | 1.87 | 15.08 | 7.25 | 2.41 |
| 9 | 10.59 | 8.86 | 8.20 | 7.15 | 2.02 | 10.88 | 5.11 | 1.83 |
| 16 | 10.28 | 8.65 | 8.02 | 5.32 | 2.16 | 10.81 | 5.09 | 1.49 |
| 23 | 7.44 | 6.73 | 6.26 | 6.56 | 2.31 | 9.04 | 4.29 | 1.77 |
| 30 | 5.07 | 5.71 | 5.02 | 8.79 | 2.45 | 8.16 | 3.74 | 2.25 |
| May 7 | 4.11 | 6.84 | 6.64 | 11.62 | 2.59 | 9.43 | 4.62 | 2.84 |
| 14 | 4.49 | 7.04 | 7.54 | 12.15 | 2.74 | 9.78 | 5.14 | 2.98 |
| 21 | 4.56 | 7.26 | 7.80 | 11.13 | 2.88 | 10.14 | 5.34 | 2.80 |
| 28 | 3.34 | 6.38 | 6.50 | 10.73 | 3.02 | 9.40 | 4.76 | 2.75 |

Table 3 (continued)

a.  Data on 1 and 2-year forward rates are from the Federal Reserve Bank of New York, in marks per dollar.

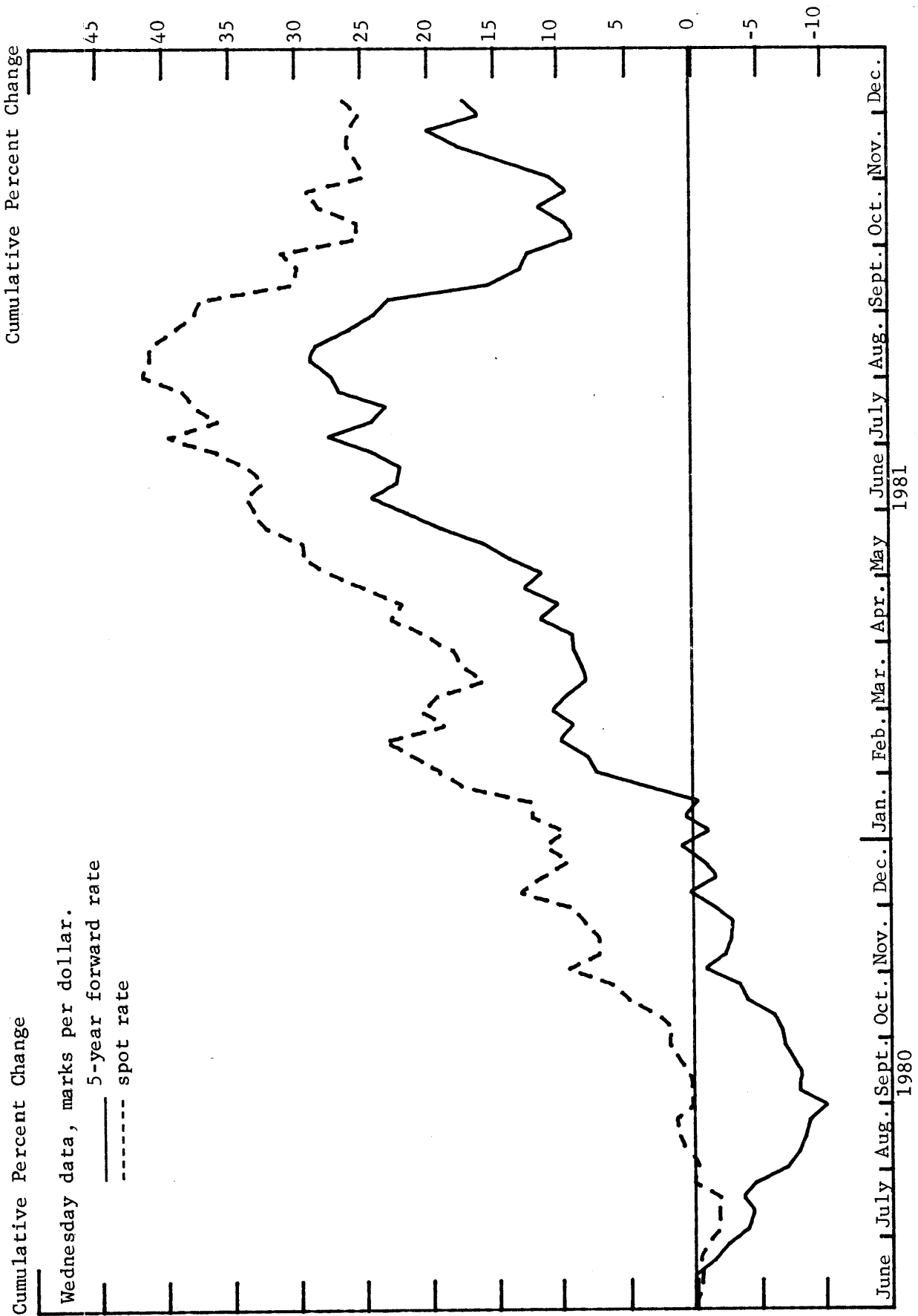Data on the 5-year forward rate are from the Bank of America; see footnote 9.

b.  Reflects trend inflation differential of 7-1/2 percent at an annual rate.

c.  Percent changes in forward rates plus adjustment for relative price trend divided by years to maturity

of forward contract.

and early December 1981. Figure 3 illustrates that the swings in the 5-year

forward rate were concentrated during 6 intervals: (i) mid-June to early

September 1980; (ii) early September to early November 1980; (iii) late

January to mid-February 1981; (iv) late April to early June 1981; (v) mid-

August through September 1981; and (vi) the first half of November 1981.

Percentage changes in the 5-year forward rate during those intervals --

roughly corresponding by construction to percentage changes in the spot rate

after adjustment for associated changes in the 5-year nominal interest differ-

ential -- can be associated either with revisions in expectations about the

ratio of German and U.S. 5-year inflation factors, or with revisions in ex-

pectations (explicit or implicit) about the long-run real exchange rate, or

with changes in the risk premium.[13]

With respect to the 10 percent depreciation of the forward dollar

from mid-June through early September 1980, it seems clear in retrospect that

the major economic surprises during that period led to upward revisions in

expectations about U.S. inflation. Economists may never agree on how to

specify a structural model of inflation, but few structural models would fail

to find a role for either the unexpectedly-sudden bottoming out of the re-

cession, the rapid rate of monetary growth or the dismantling of credit controls.

Whether U.S. 5-year inflation expectations increased by 2 percentage points

per annum, thereby "explaining" the entire depreciation, is subject to dispute.

It does seem clear, however, that expectations about the duration of the reces-

sion began to be revised no sooner than early June but certainly by early July,

consistent with the timing of the downturn in the forward rate. More specifically,

the announcements on May 30 of a 4.8 percent April decline in the leading indi-

cators, and on June 6 of a jump in May unemployment from 7.0 to 7.8 percent,

Figure 3

Cumulative Percent Change

Wednesday data, marks per dollar.
——— 5-year forward rate
------ spot rate



Cumulative Percent Change

suggested a continuing sharp downtrend in activity; while the announcements on July 3 of a 7.7 percent June unemployment rate and on July 10 of a 1.4 percent rise in June retail sales were reported (e.g., by Business Week) to have taken almost all economic forecasters by surprise. A final point that seems clear about this period is that news about the strength of economic activity was not transmitted through only one variable.

This last point may have useful implications for econometric modelling. Information about both the timing and magnitude of activity surprises can be increased by pooling a number of activity indicators rather than relying on a single indicator that is only sampled once a month. This is largely because every indicator of activity contains noise that market participants must sift out by focussing on a cross-section or sequence of indicators, and partly because focussing on a cross-section of indicators increases the frequency with which new information can be received. The same argument for pooling applies to econometric attempts to measure unexpected shifts in price variables, etc.

The second major swing in the 5-year forward rate -- the 10 percent appreciation between early September and early November 1980 -- cannot be clearly attributed to major surprises about the states of the U.S. or German economies. The U.S. economy showed mixed signs of strength and weakness in early September and continued to show mixed signs in early November. The key events during the period were the national elections in both countries, of which the re-election of German Chancellor Schmidt on October 5 was widely expected all along. The

appealing hypothesis, then, is that the rise of the forward dollar during
these 2 months mainly reflected shifts in the perceived probability of a
Reagan victory. Reagan was perceived as good for the dollar in the senses of
being more firmly committed than Carter both to reducing inflation (through
fiscal policy and support for tight monetary policy) and to stimulating U.S.
competitiveness (through tax incentives, removal of regulations, etc.). In
addition, the perception that Reagan was more committed to reducing U.S.
budget deficits may have had implications for the risk premium. At the
beginning of September, Reagan and Carter were fairly even in the polls.
As time passed, and particularly after the polls began to focus on electoral
votes, the probability that Carter could defeat Reagan appeared to shrink
fairly progressively.[14]

It is an exaggeration to say that the 5-year forward rate looks
like a step function during 1981, but it is striking that the major shifts
in the forward rate occurred during four brief intervals, suggesting
that there were 4 major doses of news that were transmitted and digested
fairly quickly. The first three major doses of news during 1981 concerned
the outlook for U.S. budget deficits. The news was conveyed, in particular,
by Reagan's January 29 press conference and February 5 television address;
by his April 28 speech to Congress and the surprising margin-of-victory with
which the budget proposals sailed through the House of Representatives on
May 7; and by large upward revisions in estimated budget deficits that were
officially announced in mid-August, followed by mounting political opposi-
tion to further large budget cuts. The second swing, from late April
through early June, may also have reflected spillover effects of the French
elections on German economic prospects as well as upward revisions in expect-
ations about the size of future German budget deficits. The beginning of

the fourth swing, in early November, coincided with announcements indicating

a strong-than-expected recession in U.S. activity:  in particular, with the

announcements on October 29 of a 2.7 percent September decline in the lead-

ing indicators and on November 6 of a jump in unemployment to an 8.0 percent

rate in October following a 7.5 percent rate in September.[15]

Why should the dollar strengthen in response to a downward shift

in the expected path of U.S. budget deficits?  One view is that a lower

deficit reduces the likelihood that the Federal Reserve will monetize debt

in excess of its money growth targets (or in excess of some prespecified

notion of an appropriate long-run money-growth path); accordingly the pros-

pect of reduced deficits may lower inflation expectations.  A second view

is that lower U.S. budget deficits are likely to imply a slower growth of

the supply of dollar-denominated public debt relative to the supply of

public debt denominated in other currencies.  Accordingly, the risk premium

on the dollar should decline  as was discussed in section VII.  Given

both the expected long-run level of the exchange rate and the interest diff-

erential, a lower risk premium on the dollar implies that markets clear at

a lower expected rate of appreciation of the dollar, and hence implies higher

spot and forward values of the dollar.

The 5-year forward dollar appreciated by nearly 25 percent against

the mark between mid-January and mid-June of 1981, and by another 5 percent

through mid-August.  Under the assumptions that the real exchange rate was

expected to converge to its equilibrium level within 5-years and that ex-

pectations were rational, how much of the appreciation can plausibly be

associated with revisions in each of the three expectational terms in the

accounting framework?

It seems difficult to argue that the expected long run real ex-
change rate was revised substantially in a direction that strengthened the
dollar during this period. The monthly and quarterly data on U.S. and German
trade and current account flows fluctuated erratically but did not appear
to reveal any persistant surprises. Perhaps the Reagan program was perceiv-
ed to have supply-side effects that would allow U.S. businesses to compete
more successfully in world markets at any given level of the real exchange
rate, but it is difficult to associate more than a 5 percent appreciation
of the dollar with such explanations.

A much larger part of the dollar's appreciation can be associated
with revisions in expectations about the long-term inflation differentials.
As was shown in Table 2, the Bache survey suggests that the expected 5-year
U.S. inflation rate per annum declined by 1.6 percentage points between early
October 1980 and early September 1981; the Michigan Survey of Consumer Atti-
tudes suggests a 1.5 percentage point decline between August 1980 and August
1981. Such revisions can "explain" an appreciation of 7-1/2 to 8 percent in
the 5-year forward rate. Forecasts of German inflation over a 1 or 2 year
horizon were revised upward over the same period by 1 or 2 percentage points
per annum, although the increase in German inflation seems generally to
have been viewed as transitory. Thus, revisions in long-term German inflation
expectations may also have "explained" as much as a 7-1/2 percentage apprecia-
tion of the 5-year forward dollar, but not much more.

The accounting arithmetic associates the remaining 10 percent
appreciation of the dollar with revisions in the expected 5 -year premium
for bearing exchange risk. Is this plausible? To the extent that investors
are not rational optimizers, a 10 percentage point change in the risk premium

would have no meaning beyond that of a residual in the accounting framework,
and the question of plausibility would not be meaningful. To the extent
that investors do optimize, section VII has argued that a 2 percentage point
change in the risk premium is plausible, based on an oversimplified repre-
sentation of the portfolio optimization problem. It is an open question
whether a better analytic framework and a reassessment of parameter values
could establish the plausibility of a 10 percentage point change in the
risk premium.

The point that seems most clear about the behavior of the mark/
dollar rate during 1981, as has been illustrated in Figure 3, is that shifts
in the fiscal policy outlook were a major component of the news.[16] This
has important implications for how the news of 1981 must be quantified if
regression analysis is to be useful for telling the story and helping to
separate the effects that were channeled through inflation expectations
from the effects channeled through the risk premium. Some commonly-
employed methods for capturing revisions in expectations are inadequate
for the 1981 experience. In particular, long-term inflation expectations
cannot be adequately represented by long-term nominal interest rates; long-
term dollar interest rates rose by one percentage point from late January
to mid-February and by another percentage point from late April to mid-May,
while the fiscal policy news presumably led to donward revisions in U.S.
long-term inflation expectations. Moreover, the fiscal policy news was
not accompanied by contemporaneous jumps in price levels, activity vari-
ables, monetary aggregates or budget deficits, so that structural or auto-
regressive models of expectations based on current and historically observed
data are inadequate. Thus, to adequately capture the revisions in long-

term inflation expectations would seem to require either a time series of direct survey evidence on inflation expectations or at least a crude time series of future budget expectations or projections. And a crude time series on the budget outlook also seems to be required if regression analysis is to have any hope of adequately capturing revisions in the risk premium.

X. Summary

The evidence is clear that empirical exchange-rate models of the Seventies provide poor explanations of exchange rate behavior out of sample; see Meese and Rogoff (1981, 1983). Such evidence is not surprising in view of the limited attempts that have been made to model the news, given the strong presumption that exchange rate movements are predominantly un-expected, or equivalently, are predominantly a reflection of revisions in expectations in response to news; see Mussa (1979).

The first part of this paper has developed a framework of approxi-mate accounting identities that describe observable spot and forward exchange rates in terms of three expectational terms: an expected long-run real exchange rate, an expected long-term inflation differential and an expected premium for bearing exchange risk. Under the commonly-adopted assumptions of time invariant expectations of the long run real exchange rate (PPP level) and the risk premium, it is evident from the accounting framework that the substantial historical short-run variability of observed spot exchange rates can only be explained by the hypothesis that expectations about long-term inflation differentials have varied substantially relative to observed long-term nominal interest differentials. This point raises the question of how long real interest differentials are expected to persist, and some limit-ed evidence has been presented suggesting that the answer is longer than 2

years but perhaps no longer than 5 years. An implication is that during periods in which the term structure of nominal interest differentials changed shape, exchange rate movements may be highly correlated with changes in long-term interest differentials but not as highly correlated with changes in short-term interest differentials, other things equal, which challenges the tradition of modelling exchange rates in terms of short-term interest differentials.

In principle, all three of the expectational terms in the accounting framework should be treated as variables -- or transmission channels for the news -- and the second part of the paper has discussed some issues in modelling expectations of the long-run real exchange rate, the long-term inflation differential and the long-term risk premium. The third part of the paper has discussed the major observed swings in mark/dollar exchange rates (spot and 5-year forward) during 1980-81, using the accounting framework to draw inferences and conjectures on the extent to which revisions in each of the three expectational terms "explained" the exchange-rate movements. The following summary points have been argued.

It is difficult to model the long-run real exchange rate without some notion of a constraint on the long-run balance of payments; but given an hypothesis about the specific nature of the long run balance-of-payments constraint, it is straightforward conceptually to model how expectations of the long-run real exchange rate (or PPP level) are revised rationally in response to news that revises expectations about whatever variables or parameter values enter the long-run balance of payments constraint.

Quantitative discussions of exchange rate volatility can benefit from focussing on the length of the horizon over which real interest differentials are expected to persist, or on the related question of how long it is

expected to take the real exchange rate to converge to its long run level.
If it is expected to take T years for the real exchange rate to converge to
its long-run level, then the percentage change in the spot exchange rate that
should be associated with a shift in the term structure of nominal interest
differentials, other things equal, is roughly T times the percentage-point
per annum change in the T-year interest differential.

During 1981, major swings in the exchange value of the dollar coin-
cided strikingly with major shifts in the outlook for U.S. budget deficits.
The fiscal policy news may have been transmitted to the long-term forward
rate through both revisions in long-term U.S. inflation expectations and
changes in the expected premium for bearing exchange risk. Long-term nomi-
nal dollar interest rates did not move in the same direction as long-term
U.S. inflation expectations in response to the fiscal policy news, nor was
the fiscal policy news accompanied by contemporaneous jumps in prices,
activity levels, money supplies or budget deficits. Accordingly, the in-
fluence of fiscal policy news on inflation expectations cannot be captured
adequately without either survey measures of long-term inflation expecta-
tions or models linking inflation expectations to measures of expected
future budget deficits (and/or money supplies) that are not generated from
autoregressions.

Available survey data on long-term U.S. inflation expectations
suggest that a major part of the fiscal policy news during 1981 was trans-
mitted to the exchange rate through revisions in expected long-term inflation
differentials. There is also a reasonable presumption, however, that the 5-
year risk premium "explained" changes of at least 2 percent in mark/dollar
exchange rates in response to swings of at least $100 billion in the

expected cumulative flow of U.S. budget deficits over a 5-year horizon. The sequence of budget news that arrived during 1981 may provide enough short-run variability in asset-stock variables to capture the risk premium with a structural model, but existing structural models must first be refashioned into a rational-expectations framework that looks forward at expected future asset stocks. Moreover, autoregressive models are inadequate for capturing revision in expectations about future asset stocks in response to the fiscal policy news that arrived during 1981.

A final point is that news about prices, activity, the balance of payments, the stance of monetary policy and most other classes of variables that enter exchange rate models is transmitted through multiple indicators drawn from each class of variable. Extracting news from pools of indicators enables market participants to filter out noise and to obtain more frequent observations, and econometric techniques that did likewise might prove more efficient.

Appendix:  <u>The Accounting Framework as a Basis for Forecasting</u>

There is an analogy between explaining the observed behavior of exchange rates ex post and forecasting exchange rates ex ante in a context in which changes in exchange rates are associated with revisions in expectations in response to "news".  The ex post problem is to test a structural equation using either direct or proxy measures of expectations or behavioral models of how expectations respond to the news.  The ex ante problem requires predictions of how much expectations will be revised in response to the news.

A forecasting methodology can be illustrated using the accounting framework and focussing on the risk neutral case for simplification.  It is necessary to distinguish between "average market expectations" held at time $t$, $E_t$, and the forecaster's expectations or predictions at time $t$, $\tilde{E}_t$.  It is also useful to define

(18) $\qquad \tilde{E}_t \Delta E_{t+1} = \tilde{E}_t E_{t+1} - \tilde{E}_t E_t$

where the forecaster may or may not be able to observe $E_t$ at time $t$.  Condition (9) of the accounting framework, under the maintained assumption of risk neutrality, implies

(19) $\qquad E_t s_{t+1} = E_t [(p^A - p^B)_{t+1} + (r^B - r^A)_{t+1, \ t+T} + sreal_{t+T}]$

A similar condition can be written with $\tilde{E}_t$ replacing $E_t$.  Combining both of these conditions with definition (18) and the risk-neutrality assumption $E_t s_{t+1} = f_{t, t+1}$, and also using $\tilde{E}_t E_{t+1} s_{t+1} = \tilde{E}_t s_{t+1}$, it can be shown that

(20) $\qquad \tilde{E}_t s_{t+1} - f_{t, t+1} = \tilde{E}_t \Delta E_{t+1} [(p^A - p^B)_{t+1} + (r^B - r^A)_{t+1, \ t+T} + sreal_{t+T}]$

where T exceeds the length of time that it is expected to take for the real exchange rate to converge to its long-run equilibrium level.  Condition (20)

states that the time-t forecast of the spot rate at horizon t+1, if constrained to be consistent with the accounting framework, will equal the 1-period market forward rate at time t adjusted for time-t forecasts of the extent to which "average market expectations" about "explanatory variables" will be revised between times t and t+1. The relevant explanatory variables are the relative price level at t+1, the (T-1) period real interest differential at t+1 and the long-run real exchange rate.

Coming up with numbers to plug into condition (20) as estimates of $E_t(p^A-p^B)_{t+1}$, $E_t(r^B-r^A)_{t+1, t+T}$ and $E_t sreal_{t+T}$ may require some crude sampling and extrapolation of private inflation forecasts. Time-t forecasts for nominal interest differentials at t+1 are implicit in the observable market yield curves and, together with forecasts of the relative price level and long-term inflation differential, can be used to infer $E_t sreal_{t+T}$ from condition (19) and the observed 1-period forward rate, $f_{t,t+1}$. The predictions of what market participants will expect next period, the $\tilde{E}_t E_{t+1}$ terms, involve more extensive ad hoc assumptions. When the forecaster is provided with a macroeconomic model, an arbitrary but appealing set of predictions is that market participants as of time t+1 will have come to expect the outlook for inflation rates, interest rates and the long-run real exchange rate that the model is predicting at time t.

The latter assumption is particularly appealing in a context in which the model forecaster has more advanced information than other market participants about prospective data releases or policy announcements, but it loses appeal to the extent that it may be unrealistic to assume that market participants base their expectations on the same model (or that market participants will come to believe in the forecasting model before the date to

which the forecast applies). The forecasting exercise gets much more complicated once the possibility of two different models is admitted, and questions then arise about how rapidly the models should be assumed to adjust toward each other (or some true model) in response to forecast errors.

Such considerations make clear that it is difficult to avoid some strong ad hoc assumptions in any exchange rate forecasting exercise. Nevertheless, a belief that the structure of an exchange rate equation is correct and that market expectations of variables that "explain" exchange rates are predictably wrong -- or likely to change in a predictable direction -- provides some hope that exchange rate forecasts can be more accurate predictions than forward rates.

Footnotes

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1.  By constrast, Rodriguez (1980) develops a reduced-form exchange-rate
equation for a rational-expectations portfolio-balance framework in which
the coefficient on the exchange rate currently expected to prevail at hori-
zon T converges to zero as T approaches infinity.  The speed of convergence
can be interpreted to depend inversely on the degree of substitutability be-
tween assets denominated in domestic and foreign currencies, and the assump-
tion of imperfect substitutability or risk aversion is a necessary condition
for the rational expectations assumption to "eliminate" the expected future
exchange rate from the model by pushing the future to infinity; see Dooley
and Isard (1981b).

2.  The tradition of focussing on the relationship between exchange rates
and short-term interest differentials partly reflects (and has contributed to)
the fact that data on short-term interest rates that are comparable across
currencies are more readily available than data on comparable long-term in-
terest rates.  The tradition also reflects an infatuation, prior to the
development of Eurocurrency markets, with examining the relative behavior of
spot and short-term forward exchange rates without providing a theory of the
absolute level of either.

3. Forecasts of German inflation, typically extending out over 1 to 2 year horizons, were generally revised upward as the mark depreciated against the dollar from October 1980 through mid August 1981.

4. The trends in the 2-5 year nominal interest differentials, computed for the samples of daily Eurocurrency observations and the 12 observations of Treasury differentials, pass the test of being significantly greater than zero with a high degree of confidence.

5. It is important to distinguish between conditional and time-invariant expectations of purchasing power parity -- i.e., between the relatively weak assumption that the expected PPP level can be shocked by new information, and the stronger assumption that the expected level of the long-run real exchange rate is exogenously given.

6. Many models of exchange rate dynamics assume that current account imbalances are "financed" entirely by assets denominated in one particular currency, which essentially amounts to assuming that residents of one of the two countries only hold assets denominated in their home-currency unit; an exception is Henderson and Rogoff (1981). The unrealistic nature of the assumption is not problematic for models such as Mussa (1980) or Dornbusch and Fischer (1980), in which risk neutrality is assumed and the role of wealth is directed through its influence on the excess demand for goods. The assumption does raise problems, however, for interpreting the class of empirical portfolio balance models represented by Branson, Halttunen and Masson (1977, 1979), Porter (1979) and Martin and Masson (1979) , in which measures of portfolio stock variables have been constructed by equating net holdings of foreign-currency denominated assets to cumulative current account imbalances (in some cases adjusted for direct investment flows).

7.  It is not being assumed that balance of payments fluctuations are expected
to never occur, but rather that the ex ante subjective probability dis-
tribution of the balance of payments (over any interval after the long run
is reached) has a zero mean.

8.  Dooley and Shafer (1976) have computed average profit rates, over and
above opportunity cost and transactions charges, that investors could have
earned during recent years by using filter rules to operate speculative
positions in the foreign exchange markets.  These ex post measures lend
support to the notion of risk premiums on the order of several percentage
points per annum.

9.  Dooley and Isard (1982) have estimated a rational expectations port-
folio-balance model of the exchange rate which explicitly incorporates
the influence of the expected future paths of asset stocks and wealth vari-
ables on the risk premium, but which uses autoregressive representations of
the expected future stocks of assets and wealths.

10. The 5-year forward rate is constructed from interest rates on fixed-
term 5 year Eurodollar and Euromark deposits, as collected by the Bank of
America and made available through Data Resources Inc.  Similar interest
rate data are available for 5-year Eurodeposits in Dutch guiders, Swiss
francs and French francs.  The data have two notable limitations.  Markets
are thin  and on some days deposits are not transacted in each currency.
In addition, to the extent that the term structures of dollar and mark
interest rates are not flat, the data allow only on approximate construction
of 5-year forward rates, since interest on the 5-year deposits is paid at
the end of each year.  The price adjustment is achieved by assuming that the
change in relative price levels over the 5-month period occurred at a con-
stant rate; i.e., the price adjusted forward rate is the forward rate adjusted

for the trend in relative price levels, which was taken to be 7-1/2 percent
at an annual rate during the first half of 1980.

11.  Two sets of survey data are available on long-term U.S. inflation ex-
pectations.  During each February beginning in 1975 the Michigan Survey of
Consumer Attitudes has sampled answers to the question:  "About what per-
cent per year to do you think prices will be (up/down) on the average during
the next 5 to 10 years?"  Beginnning in 1980 the question has also been asked
during August.  A second set of data has been collected quarterly by Bache
beginning in mid-1980; see Table 2, note b.

12.  With the exception of Fellner (1979), few models of exchange rate deter-
mination have focussed explicitly on the arithmetic of compounding interest
rates and expected inflation rates over a long-term horizon.

13.  This statement ignores covariance in implicitly viewing the nominal
forward rate as the product of the expected ratio of price levels (or in-
flation factors), the expected real value of the future spot rate, and a
risk factor.  The 5-year forward rate is not adjusted for relative price
trend, which was quantitatively minor during the period.

14.  Even though Carter's predicted shares of the national and electoral votes
edged up between early October and the Carter-Reagan debate on October 28,
the fact that time was running out appears to have progressively reduced the
perceived probability of a Carter victory.

15.  The activity surprise may have generated a downward revision in long-
term U.S. inflation expectations.  (This hypothesis would be consistent with
the Bache data in Table 2 if U.S. inflation expectations had been revised
upward during September.)  In addition, expectations of the long-run real
value of the dollar might conceivably have been revised upward during November

in response to the activity announcements, consistent with the behavioral
model suggested by condition (16).

16.   When the unexpected components of week-to-week changes in monetary
aggregates are integrated over 1981, it is not clear that the net changes
provided any significant news.   Alternatively stated, the below target growth
of adjusted M1-B and the above target growth of M2 can be viewed to suggest
that monetary policy, on balance, was neither easier nor tighter than expected
over the period as a whole.   This is not to suggest that monetary policy had
no influence on exchange rates.   The dollar would have been weaker had the
Federal Reserve pursued higher monetary growth targets; and dollar exchange
rates did in fact fluctuate week-to-week in response to surprises about the
weekly money supply numbers.   The suggestion that on balance there was no
surprise about U.S. monetary growth, moreover, does not imply that there was
no surprise about the path of dollar interest rates.

## References

Backus, David. 1981. Empirical models of the exchange rate: Separating the wheat from the chaff. Queens University. Manuscript.

Branson, William H., Halttunen, Hanna and Masson, Paul R. 1977. Exchange rates in the short run: The dollar-Deutschemark rate. European Economic Review 10: 303-24.

_____. 1979. Exchange rates in the short run: Some further evidence. European Economic Review 12: 395-402.

Calvo, Guillermo A. and Rodgriguez, Carlos A. 1977. A model of exchange rate determination under currency substitution and rational expectations. Journal of Political Economy 85: 617-26.

Caves, Douglas W. and Feige, Edgar L. 1980. Efficient foreign exchange markets and the monetary approach to exchange rate determination. American Economic Review 70: 120-34.

Cumby, Robert E., and Obstfeld, Maurice. 1981. A note on exchange-rate expectations and nominal interest differentials: A test of the Fisher hypothesis. Journal of Finance 36: 697-704.

Dooley, Michael P. 1980. The implication of the internationalization of banking for the definition and measurement of U.S. credit and monetary aggregates. Economic Forum 11: 54-68.

_____. 1981. Exchange rate determination in a multicountry model: The importance of industrial country and developing country exchange market intervention policies. International Monetary Fund. Manuscript.

References (con't)

Dooley, Michael P. and Isard, Peter. 1981a. The portfolio-balance model
of exchange rates. Federal Reserve Board, International Finance
Discussion Paper, no. 141 (revised).

_____. 1981b. The role of the current account in exchange
rate determination: A comment on Rodriguez. Federal Reserve
Board, International Finance Discussion Paper, no. 191.

_____. 1982. A portfolio-balance rational-expectations
model of the dollar-mark rate. Journal of International Economics
12: Forthcoming.

Dooley, Michael P. and Shafer, Jeffrey R. 1976. Analysis of short-run
exchange rate behavior: March 1973 to September 1975. Federal
Reserve Board, International Finance Discussion Paper, no. 76.

Dornbusch, Rudiger. 1976. Expectations and exchange rate dynamics. Journal
of Political Economy 84: 1161-76.

_____. 1980a. Exchange rate economics: Where do we stand?
Brookings Papers on Economic Activity: 143-85.

_____. 1980b. Exchange risk and the macroeconomics of
exchange rate determination. Massachusetts Institute of Technology.
Manuscript.

Dornbusch, Rudiger and Fischer, Stanley. 1980. Exchange rates and the
current account. American Economic Review 70: 960-71.

References (con't)

Fellner, William. 1979. The bearing of risk aversion on movements of spot
and forward exchange relative to the dollar. In Chipman, John R.
and Kindleberger, Charles P., eds., Flexible exchange rates and
the balance of payments. Essays in memory of Egon Sohmen.
Amsterdam: North Holland.

Frankel, Jeffrey A. 1981. Estimation of portfolio-balance functions that
are mean-variance optimizing: The mark and the dollar. Federal
Reserve Board, International Finance Discussion Paper, no. 188.

_____. 1982. A test of perfect substitutability in the
foreign exchange market. Review of Economics and Statistics,
forthcoming.

Frenkel, Jacob A. 1981. Flexible exchange rates, prices, and the role of
"news": Lessons from the 1970s. Journal of Political Economy
89: 665-705.

Glaessner, Tom. 1979. A test of the exogeneity specifications of models
of exchange rate determination. University of Virginia. Manuscript.

Grossman, Sanford J. and Shiller, Robert J. The determinants of the variability
of stock market prices. Papers and Proceedings of the American
Economic Association 71: 222-7.

Hansen, Lars Peter and Hodrick, Robert J. 1980. Forward exchange rates as
optimal predictors of future spot prices: An econometric analysis.
Journal of Political Economy 88: 829-53.

References (con't)

_____. 1983. Risk averse speculation in the forward

exchange market: An econometric analysis. In this volume.

Henderson, Dale W. and Rogoff, Kenneth. 1981. Net foreign asset positions

and stability in a world portfolio balance model. Federal Reserve

Board, International Finance Discussion Paper, no. 178.

Hooper, Peter and Morton, John. 1982. Fluctuations in the dollar: A model

of nominal and real exchange rate determination. Journal of

International Money and Finance 1: forthcoming.

Isard, Peter. 1980. Factors determining exchange rates: The roles of

relative price levels, balances of pyaments, interest rates and

risk. Federal Reserve Board, International Finance Discussion

Paper, no. 171.

Kouri, Pentti J. K. 1976. The exchange rate and the balance of payments in

the short run and in the long run: A monetary approach. Scandinavian

Journal of Economics 78: 280-304.

Krugman, Paul. 1981. Consumption preferences, asset demands, and distribution

effects in international financial markets. NBER Working Paper,

no. 651.

Longworth, David. 1980. An empirical efficient-markets model of exchange

rate determination. Bank of Canada. Manuscript.

Martin, John P. and Masson, Paul. 1979. Exchange rates and portfolio balance.

NBER Working Paper, no. 377.

References (con't)

Meese, Richard and Rogoff, Kenneth. 1981. Empirical exchange rate models of the Seventies: Are any fit to survive? International Finance Discussion Paper, no. 184.

_____. 1983. Monetary exchange rate models and the predictability of exchange rates. In this volume.

Meese, Richard and Singleton, Kenneth. 1982. A note on unit roots and the empirical modelling of exchange rates. Journal of Finance, forthcoming.

Mussa, Michael. 1979. Empirical regularities in the behavior of exchange rates and theories of the foreign exchange market. In Brunner, Karl and Meltzer, Allan H., eds., Policies for Employment, Prices and Exchange Rates, Carnegie-Rochester Conference Series on Public Policy, vol. 11 (supplementary series to Journal of Monetary Economics).

_____. 1980. The role of the current account in exchange rate dynamics. University of Chicago. Manuscript.

Porter, Michael G. 1979. Exchange rates, current accounts and economic activity: A survey of some theoretical and empirical issues. Monash University. Manuscript.

Rodriguez, Carlos A. 1980. The role of trade flows in exchange rate determination: A rational expectations approach. Journal of Political Economy 88: 1148-58.