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Tax Avoidance and Exchange Rate Determination

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Summary

This paper develops and provides empirical support for the hypothesis that changes in relative prices, exchange rates and external imbalances are related to shifts in the desired location of asset holdings. A model is presented in which investors' preferences for assets depend on differences in the actual and expected taxation of capital income by different countries. The model distinguishes three regions--the United States, other industrial countries and the developing countries--and explains how a shock that increases the expected "tax" burden on claims against residents of developing countries can lead to an appreciation of the dollar against the currencies of other industrial countries. The explanation involves asymmetries in the strength of preferences at the margin for claims on the United States versus claims on other industrial countries, but does not require the emergence of a significant premium between Eurodollar interest rates and dollar interest rates paid in the United States. The model is consistent with the phenomenon of exchange-rate overshooting and provides a rationale for survey data indicating that market participants expect the dollar to depreciate at a rate significantly faster than its forward discount. Empirical support for the model is derived from data on the interest rate premia attached to the bonds of developing countries, which may be interpreted to reflect the strength of desired net capital outflows from developing countries. It is shown that these data can "explain" a significant part of the behavior of the exchange rate between the U.S. dollar and the deutsche mark in recent years.

I. Introduction and Plan of Study

The model developed in this paper extends the traditional wisdom about international flows of goods and financial capital. According to traditional explanations, international flows of goods and capital primarily reflect differences among countries in their endowments of resources, their comparative advantages in production, or their tastes and time preferences in consumption. By contrast, this paper emphasizes

that international flows of goods and capital may be motivated by differences in the actual or expected levels of "taxation" that different countries impose on resident and nonresident investors, or by differences in the degrees of "tax avoidance" that different countries offer.

The term "taxation" is here defined broadly to reflect the many ways that policy decisions or macroeconomic developments may influence the rates of return on assets. The relative attractiveness of holding assets in different countries depends on assessments of the actual and expected tax burdens that different countries will impose on capital in general, and on capital owned by nonresidents in particular. A satisfactory explanation of why the United States may have become preferred over other industrial countries as a location for storing the wealth that has sought haven outside the developing countries is a matter of speculation. Factors that may be important include the relative ease with which nonresidents can acquire financial assets in the United States, and the lack of reporting requirements on small investment positions that in other countries have been associated with a history of controls. 1/ In addition, the relatively vigorous growth of U.S. output in recent years, which has expanded the traditional tax base in the United States, may make it appear less likely that nonresident financial positions will become attractive to the U.S. authorities as alternative tax bases. The recent changes that have actually been made in the U.S. tax codes may also be interpreted as shifting taxes away from capital income. Explicit U.S. federal insurance on some types of deposits, and perceptions of relatively strong implicit federal insurance against failures of major banks or other private institutions, may be another consideration that favors holding claims on U.S. borrowers. The relative ease with which individuals can immigrate to the United States--particularly wealthy individuals--may have also been an important factor underlying decisions to acquire assets in the United States. Many of these factors can be exploited not only by shifting capital directly into the United States, but also by placing funds with offshore intermediaries that have professional expertise at investing in the United States.

Another rationale and strategic reason for desiring to shift assets to the United States is that U.S. residents hold a relatively large gross stock of assets abroad, against which host countries could retaliate in response to any taxes that the United States levied on capital owned by nonresidents. Even if investors expected that the United States and other industrial countries would impose equal taxes on capital owned

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1/ For a discussion and analysis of the historical experience of penalizing capital inflows in the Federal Republic of Germany, see Dooley and Isard (1980).

by nonresidents, after retaliation the net taxes paid by individual nonresidents would be spread over a wider base in cases where gross claims were large relative to net claims. 1/

Section II develops the central hypothesis of the paper with a model in which the only assets are stocks of physical capital. The model emphasizes the fundamental point that assets cannot be shifted net between the tax jurisdictions of different countries without balance of payments adjustment. The model also emphasizes the importance of distinguishing between the relative prices of tradable and nontradable goods--which directly influence production, absorption and the balance of trade--and nominal exchange rates, which may or may not be correlated with relative prices of tradables and nontradables, depending in particular on the behavior of the monetary authorities.

Section III adds financial assets to the model of Section II in order to address a number of empirical puzzles. It is emphasized that the absence of any particular behavior of the premium between Eurodollar interest rates and dollar interest rates paid in the United States does not contradict the hypothesis that the net capital flows of the developing countries can help explain the appreciation of the dollar against the currencies of other industrial countries during the 1980s.

Section IV provides empirical support for the central hypothesis by demonstrating that dollar exchange rates have been correlated with a proxy variable for the desired net capital flows from developing countries during recent years. Section V then summarizes the conclusions of the paper and discusses how the model begins to address several conceptual deficiencies in the portfolio balance literature on exchange rate determination.

II. A Model With No Financial Assets

This section develops a model in which wealth is allocated between holdings of physical capital in the United States (K) and physical capital in other industrial countries (K*). The capital stock of the developing countries is treated as exogenous to the analysis. The net international indebtedness positions of the United States and other industrial countries (D and D*, respectively), built up through cumulative

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1/ It should be noted that taxes paid by nonresidents, as a group, are assumed to depend only on their net claim position. The given tax, however, might be divided among holders of gross claims in a manner proportional to the size of their gross holdings. It follows that for a given net exposure there is some safety in numbers.

current account deficits, indicate the amounts of the physical capital stocks that are owned by nonresidents, including individuals in the developing countries. In order to emphasize the departures of the model developed here from other "portfolio balance" exchange rate models, it is assumed initially that no independent effects on the economy arise from whatever collection of financial assets may exist to allocate ownership of the returns on K and K*. Such financial assets can be viewed to simply give rise to a variety of "side bets" on outcomes for exchange rates, interest rates and so forth. The outcomes for such variables and the structure of financial assets and liabilities will determine redistributions of wealth, but are assumed for now to leave unaltered the solution to the model. Wealth holders are assumed to "see through" the financial contracts when evaluating their ownership of K and K* and the likely returns they will earn on K and K*.

1. The balance of payments conditions

As in other models of exchange rate determination, the balance of payments identity plays a central role. 1/ In a world in which net capital flows were assumed to be negligible, the exchange rate would be consistent with current account balance, as in the textbook models of the 1960s. More generally, in a world with high international mobility of financial capital and lags in the process of adjusting productive capacity and current account flows to market forces, the exchange rate interacts with goods prices and interest rates to encourage simultaneous adjustment in the current and capital accounts.

The balance of payments constraint implies that changes in preferences for holding assets in different countries--or for claims against the residents of different countries--cannot automatically give rise to net international capital flows; rather, a shift in net international creditor positions requires a current account imbalance. The existence of this constraint cannot be avoided by an individual's ability to shift financial assets quickly. An individual may attempt to shift a bank account from country A to country B, for example, and to the extent that the bank in country A holds or can obtain assets (perhaps from the national authorities) acceptable to the bank in country B, the individual's transfer can be readily achieved. But such attempts are frustrated when the other residents of country A are unwilling to sell their claims on country B. Residents of country A cannot as a group increase their net

1/ See Dornbusch and Fischer (1980) and Mussa (1984) for other models that integrate the behavior of prices, exchange rates and the current account in describing the process by which asset holdings are adjusted following revisions in expectations.

assets held in country B without the development of a current account surplus for country A and a current account deficit for country B.

Now to generate current account imbalances, countries must change their production of tradable goods and services relative to what they absorb in their consumption and investment. For present purposes, it is assumed that countries produce and absorb tradable and nontradable goods, where tradable goods are homogeneous across countries. In each country, an increase in the home currency price of nontradables relative to the home currency price of tradables is assumed to discourage production and encourage absorption of tradables, thereby increasing (reducing) the trade deficit (surplus) and hence the net capital inflow (outflow). The essential features of the analysis can be captured by simply writing the reduced-form relationships as:

$$(1) \quad NCI = B(p_N/p_T) + NIP$$

$$(2) \quad NCI^* = B^*(p_N^*/p_T^*) + NIP^*$$

In these expressions NCI, NCI^* denote net capital inflows into the United States and other industrial countries, measured in units of the tradable good; B, B* denote the trade deficits of the United States and other industrial countries; p_N/p_T, p_N^*/p_T^* denote the relative dollar price of nontradables and tradables in the United States and the relative non-dollar price in other industrial countries; and NIP, NIP* denote the net interest payments to nonresidents that are associated with net external debts, measured in units of the tradable good.

It should be noted that the net capital inflows or current account deficits described by conditions (1) and (2) depend on relative prices but not, directly, on the nominal exchange rate. Thus, current account imbalances will be systematically correlated with the nominal exchange rate only to the extent that the relative prices of nontradables and tradables are correlated with the nominal exchange rate. And in particular, the nature of the correlations between current accounts and the exchange rate will depend critically on the behavior of the monetary authorities, who play a major role in determining the correlations between relative prices and the nominal exchange rate.

2. Monetary policy and price determination

In a flexible exchange rate environment, an increased desire to shift assets from the developing countries into the United States would typically put upward pressure on the exchange value of the dollar in

terms of the currencies of the developing countries, and perhaps also in terms of the currencies of other industrial countries. As a result, the dollar price of tradable goods would be put under downward pressure in the United States, other things equal, and changes in the relative prices of tradables and nontradables would shift the U.S. current account toward deficit.

Needless to say, the behavior of the absolute levels of prices can be influenced by the monetary authorities. One possibility is that the monetary authorities in the United States might choose to resist the upward pressure on the dollar by increasing the U.S. money supply--perhaps via direct unsterilized intervention in foreign exchange markets. Such an increase in the U.S. money supply could neutralize the downward pressure on the dollar price of tradables in the United States, but would at the same time put upward pressure on the dollar price of nontradables. Thus, a relative price change would still occur in the United States, pushing the U.S. current account toward deficit even without any change in the foreign exchange value of the dollar.

To illustrate these points formally, a number of simplifying assumptions are adopted. Under the assumption that countries each produce the same homogeneous tradable good, the nominal exchange rate (s) must equal the nondollar price of tradable goods outside the United States (p_T^*) divided by the dollar price of tradable goods within the United States (p_T):

$$(3) \quad s = p_T^*/p_T$$

The monetary authorities are assumed to stabilize the price levels p and p^* for the United States and other industrial countries, respectively, where: 1/

$$(4) \quad p = p_N^{\alpha} p_T^{1-\alpha}$$

$$(5) \quad p^* = (p_N^*)^{\alpha^*}(p_T^*)^{1-\alpha^*}$$

In general, the links between these price levels and the money stocks in the United States and other industrial countries (denoted by M and M^*,

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1/ The parameters α and α^* may be interpreted as the weights that the monetary authorities choose to assign to nontradables in defining their stabilization objectives. For example, the choice of $\alpha = \alpha^* = 0$ corresponds to the objective of stabilizing the prices of tradable goods.

respectively) are complicated reduced-form functions of many variables, which we simply write as:

(6) $p = p(M, \ldots)$

(7) $p^* = p^*(M^*, \ldots)$

Equations (3)-(7) provide five conditions on seven price variables: p_N, p_T, p_N^*, p_T^*, s, p and p^*. For any given values of the trade deficits $\overline{B}$ and $\overline{B^*}$, two more conditions must be satisfied: namely, $B(p_N/p_T) = \overline{B}$ and $B^*(p_N^*/p_T^*) = \overline{B^*}$. Thus, all the price variables are determined for given levels of $\overline{B}$, $\overline{B^*}$, M and M^*. But the important point, which generalizes beyond our simplified model, is that the reduced-form balance of payments relationships only place direct constraints on the behavior of the relative prices of tradables and nontradables, leaving the monetary authorities to play a major role in determining the absolute levels of the nominal exchange rate and the prices of tradables and nontradables.

The importance of this point can be appreciated by considering its policy implications. The central hypothesis of the paper is that the behavior of exchange rates during the 1980s can be partly understood as a reflection of efforts to shift the location of asset holdings toward the United States. Because of the balance of payments constraint, those efforts have put downward pressure on the relative prices of tradable goods in the United States and--given the nature of the exchange rate system and the orientation of monetary policies toward stabilizing weighted indexes of the prices of tradables and nontradables--the nominal exchange value of the dollar has appreciated against the currencies of other industrial countries. Even under a fixed exchange rate system, however, and under monetary policies consistent with fixed exchange rates, the efforts to shift asset holdings toward the United States would have put downward pressure on the relative prices of tradable goods in the United States and widened the U.S. trade deficit. Fixed exchange rates would have required more rapid monetary growth in the United States and would have led to higher U.S. inflation rates, but might not have moderated the changes in relative prices and the U.S. trade balance, which have been the real sources of strain on U.S. tradable goods industries.

The distinction between the behavior of nominal exchange rates and the behavior of the relative prices of tradable and nontradable goods also has important implications for the broader issue of international

monetary reform. In addressing the sources of international economic problems, it is important to distinguish problems caused by the behavior of absolute price levels and nominal exchange rates per se from problems caused by changes in relative prices and external imbalances that may be the result of efforts to shift the international location of asset holdings. Reforms that focus only on the coordination of monetary and fiscal policies may not be effective for addressing the latter class of problems. Changes in the terms of international competition that result from efforts to shift the international location of asset holdings should be addressed by focusing on international differences in policies and policy attitudes toward capital "taxation," broadly defined, and more generally, by seeking a better understanding of the factors that affect preferences for holding claims on different countries.

3. Country preferences for asset holdings

It is convenient to describe country preferences in terms of the differential yield that leaves asset holders indifferent between incremental units of the two capital stocks. For that purpose, let MPP and MPP^* denote the marginal physical products of capital in the United States and other industrial countries, respectively. The marginal physical products can be expressed as functions of the levels of the capital stocks, and also of the relative prices of tradables and nontradables, which affect the allocation of factors of production between sectors with different technologies and factor intensities. Thus:

$$(8) \quad MPP = MPP(K, p_N/p_T)$$

$$(9) \quad MPP^* = MPP^*(K^*, p_N^*/p_T^*)$$

Because of international differences in the actual and expected rates of taxation of the returns on capital--where the term "taxation" should be interpreted broadly--asset holders will require a differential yield or country premium, denoted by ϕ. The magnitude of ϕ will depend on many factors, including: (a) the attitudes toward taxing capital income in the United States and other industrial (OI) countries; (b) the gross stocks of U.S. and OI capital owned by nonresidents (denoted by G and G^*, respectively) against which host countries could levy taxes in retaliation for any U.S. or OI taxes against capital owned by nonresidents; and (c) the relative sizes of different tax bases in the United States and other industrial countries, including the gross stocks of U.S. and OI capital owned by nonresidents ($G + D$ and $G^* + D^*$, respectively). If ϕ depended only on the gross stocks listed in factors (b) and (c), an appealing functional form would be:

(10) $\phi = \phi(D/G, D^*/G^*)$

The larger are the net external indebtedness positions D and D^*, the greater are the incentives for the U.S. and OI authorities to tax capital owned by nonresidents. But from the perspective of nonresidents, after retaliation the tax on a unit of gross capital in the United States or other industrial countries would also be proportional to $1/G$ or $1/G^*$, respectively, as noted in Section I.

A condition that must hold in long-run equilibrium is

(11) $\phi = MPP^* - MPP$

where we have chosen to define ϕ as a premium that is required to hold capital in other industrial countries. The only significant implication of this choice of "sign" for ϕ is the implication that

(12) $\phi_1 < 0; \quad \phi_2 > 0$

where ϕ_1 and ϕ_2 denote the partial derivates of ϕ with respect to the first and second arguments in condition (10). Condition (11) need not hold in the short run if the process of adjusting capital stocks to arbitrage incentives is slow.

4. Relative price and exchange rate adjustments

We now want to characterize the process of adjustment between equilibrium states in response to an exogenous shift in the desire to move capital out of the developing countries. For that purpose the behavioral relationships of the model are linearized around an initial equilibrium position.

To begin with, the trade deficits are linearized as functions of relative prices. It is assumed that $\overline{p_N/p_T}$, $\overline{p_N^*/p_T^*}$ denote initial equilibrium relative price levels at which trade is balanced, and that $\hat{p_N/p_T}$, $\hat{p_N^*/p_T^*}$ denote the proportionate deviations of relative prices from those equilibrium levels. Thus:

(13) $B = b(\hat{p_N/p_T})$

(14) $B = b^*(\hat{p_N^*/p_T^*})$

where b and b^* are multiplicative constants. Note also that under the assumptions that central banks adjust their money supplies to hold p and p^* constant, conditions (3), (4) and (5) imply

$$(15) \quad \hat{p}_T = -\alpha (p_N/\hat{p}_T)$$

$$(16) \quad \hat{p}_T^* = -\alpha^*(p_N^*/\hat{p}_T^*)$$

and

$$(17) \quad \hat{s} = \alpha (p_N/\hat{p}_T) - \alpha^*(p_N^*/\hat{p}_T^*)$$

Further substitution of (13) and (14) into (17) leads to

$$(18) \quad \hat{s} = (\alpha B/b) - (\alpha^* B^*/b^*)$$

Note that $\hat{s}$ in condition (18) is the amount that s must jump from an initial equilibrium level to be consistent with generating the trade balances B and B^*.

The model is designed to analyze the effects of "shocks" that increase the desire to shift capital out of the developing countries. The analysis is simplified by suppressing the process of relative price adjustment within the developing countries that is necessary to generate a given capital outflow, and merely taking the magnitude of the capital outflow to be an exogenous amount Z. As an additional simplification, the model abstracts from lags in the adjustment of trade balances following jumps in relative prices. (The implications of relaxing this assumption are discussed below.) Thus, we envision an initial state of long-run equilibrium that becomes disrupted by the shock Z. This causes relative prices and the exchange rate to jump instantaneously by amounts that allow the United States and other industrial countries to absorb Z in desired proportions within a single period, with relative prices and the exchange rate expected to change further during that period by the amounts that are consistent with leaving the world in a new state of long-run equilibrium at the end of the period. In general, the model does not require the initial jumps in relative prices and the exchange rate to be exactly offset by the expected subsequent further changes. The differences may be quite important. In order to simplify the analysis, however, they will be neglected in the remainder of this section of the paper.

The capital outflow from the developing countries (Z) must be allocated between inflows into the United States (B) and inflows into other industrial countries (B^*), where they are invested in additions to the physical capital stocks. Thus: 1/

$$(19) \quad Z = B + B^*$$

$$(20) \quad \Delta D = \Delta K = B$$

and

$$(21) \quad \Delta D^* = \Delta K^* = B^*$$

The magnitudes of B and B^* that nonresident investors will choose depend critically on the relative sensitivity of ϕ to B and B^*, as well as on the relative extents to which the marginal physical products of capital diminish as B and B^* are added to the capital stocks. Conditions (8), (9) and (11) can be linearized as:

$$(22) \quad \Delta MPP = -m\Delta K$$

$$(23) \quad \Delta MPP^* = -m^*\Delta K^*$$

$$(24) \quad \Delta\phi = \phi_1 \Delta D/G + \phi_2 \Delta D^*/G^*$$

In the transition from conditions (8) and (9) to conditions (22) and (23), we have assumed that changes in equilibrium relative prices are negligible. The stock adjustment terms in conditions (22)-(24) are understood to represent changes between two equilibrium states. Conditions (11) and (19)-(24) imply:

$$(25) \quad B = \beta Z$$

and

$$(26) \quad B^* = (1 - \beta)Z$$

1/ For simplification, net and gross capital flows are assumed to coincide, and any incremental effects of capital flows on domestic savings flows or net interest payments to nonresidents are assumed to be negligible.

where

$$(27) \quad \beta = (m^* + \phi_2/G^*)/((m^* + \phi_2/G^*) + (m - \phi_1/G)).$$

As is evident from condition (18), the extent to which Z causes the dollar to appreciate against other industrial currencies depends positively on B and negatively on B^*, other things equal. We are particularly interested in whether it is plausible that Z is allocated predominantly to B. For the symmetric, benchmark case in which $\phi_1 = -\phi_2$ and m and m^* are negligible, condition (27) would simplify to $\beta = G/(G + G^*)$. This supports the plausibility of the hypothesis insofar as the gross external claims of the United States far exceed those of any other industrial country. Other considerations that support the plausibility of a relatively large allocation toward B have been discussed in Section I.

It remains to express the initial jump in the exchange rate in terms of the key parameters of the model. Substitution of (25) and (26) into (18) characterizes the jump in the exchange rate as:

$$(28) \quad \hat{s} = ((\alpha\beta/b) - (\alpha^*(1 - \beta)/b^*))Z$$

Thus, $\hat{s}$ depends in general on the size of the shock (Z), the parameters that describe asset preferences (ϕ_1 and ϕ_2), the gross stocks of external assets held by residents of the United States and other industrial countries (G and G^*), the extent to which the marginal physical products diminish with additions to the capital stocks (m and m^*), the responsiveness of the trade balances to relative prices (b and b^*) and the weights of nontradable goods in the price indexes that the monetary authorities choose to stabilize (α and α^*). Note, in particular, that the nominal exchange rate will not jump in response to the shock (i.e., $\hat{s} = 0$) if the monetary authorities choose to stabilize the prices of tradables (i.e., to stabilize price indexes in which $\alpha = \alpha^* = 0$). But note also that the monetary policy choice has no influence on trade balances (according to conditions 25 and 26) or the underlying behavior of relative prices (according to conditions 13 and 14). 1/

1/ The ineffectiveness of monetary policy at influencing trade balances or relative prices is a special feature of the simplications we have adopted in writing down our model. But the extreme case we have illustrated raises important issues for discussions of international monetary reform; recall the discussion on p. 6.

Another notable feature of the adjustment process is that the pattern of exchange rate behavior--namely, a jump (when α, $\alpha^* \neq 0$) followed by movement back toward its initial level--is similar to the pattern of relative price behavior. These "overshooting" patterns generalize beyond our simplified model. It has been emphasized that the transfer of a given stock of capital from the developing countries to industrial countries requires a current account imbalance of equal magnitude. 1/ The current account imbalance, in turn, must generally be induced by changes in the relative prices of tradable and nontradable goods--both in the developing countries, which must be induced into a net export position, and in the industrial countries, which must become net importers. Moreover, once the transfer has been completed, current accounts must return to balance, so relative prices must also readjust toward their initial levels. The model has abstracted from lags in the responses of imports and exports to changes in relative prices and has simply assumed that the transfer is completed in a single period. A more realistic model would spread out the response of trade flows to relative price changes over several periods, with initial jumps in relative prices in response to the "shock" (i.e., in response to the event that created the desire to transfer savings out of the developing countries) and gradual readjustments of relative prices back toward their initial levels. 2/

III. Financial Assets and Some Empirical Issues

This section adds financial assets to the model in order to address several empirical questions that have puzzled international economists and policy authorities. (1) Is it consistent to explain the dollar's appreciation as a "safe haven" or "tax avoidance" phenomenon when comparisons of Eurodollar interest rates with dollar interest rates paid in the United States do not appear to reveal sizable country premiums between the borrowing rates that must be paid by residents of the United States and other industrial countries? (2) Can we make sense of survey data on exchange rate expectations, which suggest a substantial exchange

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1/ This statement abstracts from capital gains or losses that may affect the valuation of the stock of capital if exchange rates and interest rates change during the transfer process.

2/ In our simplified model, conditions (13) and (14) force relative prices to return precisely to their initial equilibrium levels whenever trade balances return to zero, but the return of trade balances precisely to their initial levels is a result of ignoring both how net interest payments change with changes in net external indebtedness positions, and how imports and exports may be affected by variables other than relative prices--for example, by changes in physical capital stocks.

risk premium--in particular, an expectation that the dollar will depreciate considerably more rapidly than its rate of forward discount against the currencies of other industrial countries? (3) Is the net external indebtedness position of the United States on a sustainable course? And (4) can we believe that exchange market participants have behaved fairly rationally in generating such a large overall appreciation of the dollar? Our answer to each of these questions is "yes."

1. Financial assets and relationships between yields

Four types of interest-bearing financial claims are considered: dollar-denominated and nondollar-denominated claims on residents of the United States (with nominal yields of r_{us} and r^*_{us}, respectively) and dollar-denominated and nondollar-denominated claims on residents of other industrial countries (with nominal yields of r_{oi} and r^*_{oi}). The country premium ϕ is defined in a traditional manner as the yield differential that is required to make investors indifferent at the margin between holding an additional dollar-denominated gross claim against U.S. residents or an additional dollar-denominated gross claim against residents of other industrial countries.

$$(29) \quad \phi = r_{oi} - r_{us}$$

It will be shown that conditions (29) and (11) are consistent in long-run equilibrium. The exchange risk premium λ is also defined in a traditional manner as the expected yield differential that is required to make investors indifferent at the margin between holding additional dollar and nondollar-denominated claims against residents of a given country, after taking account of expected changes in the exchange rate

$$(30) \quad \lambda = r^*_{oi} - r_{oi} - \hat{s}^e$$

Arbitrage will establish an identical yield differential on all pairs of assets that differ in an identical way, such that

$$(31) \quad r^*_{oi} - r^*_{us} = r_{oi} - r_{us} = \phi$$

and

$$(32) \quad r^*_{us} - r_{us} = r^*_{oi} - r_{oi} = \lambda + \hat{s}^e$$

The nominal yields on interest bearing assets are linked to the marginal physical products of capital

(33) $r_{us} = MPP + \rho$

(34) $r^*_{oi} = MPP^* + \rho^*$

In these expressions, the variables ρ and ρ^* reflect both the differences between marginal physical products and expected marginal value products, 1/ as well as any risk premiums that may separate nominal interest rates from expected marginal value products.

Conditions (29)-(34) hold at every moment of time. In combination, conditions (29), (30), (33) and (34) imply

(35) $\hat{s}^e + \lambda + \phi = MPP^* + \rho^* - MPP - \rho$

It is important to emphasize that the exchange risk premium can be nonzero only if there is uncertainty about the exchange rate and if investors are not risk neutral. By contrast, the country premium can be nonzero even in the absence of uncertainty if investors expect that countries will impose different tax rates on capital income: the country premium may have nothing to do with risk.

Condition (35) can be shown to be consistent with the long-run equilibrium condition (11) in the absence of uncertainty. With no uncertainty, $\lambda = 0$ would hold in both the short run and the long run. Moreover, in the long run, with constant relative prices and no risk premia, any differences between the expected marginal value products and the marginal physical products of capital would reflect expected inflation rates, and any differences between the expected inflation rates of different countries would be matched by the expected rate of change in the nominal exchange rate. Accordingly, $\hat{s}^e = \rho^* - \rho$ would hold in the long run, which combines with $\lambda = 0$ to establish the consistency of conditions (11) and (35).

2. Empirical puzzles about country premia

The central hypothesis of the paper has been challenged indirectly on the basis of presumptions about its implications for the behavior of the country premium ϕ, which is an observable variable. In particular, Krugman (1985) and Frankel and Froot (1985b) have suggested that the

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1/ These differences incorporate the effects of any expected changes in the prices of traded and nontraded goods.

hypothesis is inconsistant with the direction of change over recent years in the differential between Eurodollar interest rates and dollar interest rates paid in the United States.

These suggestions are based on a narrow interpretation of ϕ and, accordingly, are not convincing. Under a broad interpretation of ϕ, our hypothesis is not necessarily inconsistent with the observed decline since mid-1982 in the excess of Eurodollar rates over dollar interest rates in the United States. 1/ While the behavior of interest rate differentials does not tend to support the model developed here, it would only represent a convincing refutation if ϕ depended only on the net external debts of the United States and other industrial countries (D and D^*); in that case the relatively rapid growth of D since mid-1982 would have implied a rise in ϕ. In general, however, ϕ will reflect many other considerations, as discussed in Section I, and some of those factors may well have changed since 1982 in a direction that would favor the United States as a location for foreign investment, thereby tending to reduce ϕ.

Our model also resolves a different source of confusion about ϕ—namely, that an increased desire to shift assets out of the developing countries can cause dollar exchange rates to jump without inducing any simultaneous jump in ϕ. In the solution to the model, the magnitude of the jump in the dollar exchange rate depends critically on the relative magnitudes of the partial derivatives of ϕ with respect to holdings of assets in the United States and holdings of assets in other industrial countries--that is, on the relative strengths of marginal preferences for the two types of assets. But the solution is independent of the level of ϕ.

3. Other empirical puzzles

The model developed in this paper is consistent with survey data indicating that the dollar is expected to depreciate at a rate considerably more rapid than its discount in forward exchange markets against the currencies of other industrial countries. 2/ Uncertainty about Z would create uncertainty about s in our model, and in reality there remains considerable uncertainty about conditions affecting the strength of the

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1/ After adjusting the data to remove changes in premia due to the interaction of different reserve requirements with changes in the level of interest rates, the difference between a measure of the Eurodollar rate and a measure of the certificate of deposit rate in the United States declined by about 75 basis points between its peak in August 1982 (when the Mexican debt problems were announced) and September 1985.

2/ See Frankel and Froot (1985a) for an analysis of the survey data on exchange rate expectations.

desired net capital outflow from developing countries. If managers of financial portfolios are risk averse, and if a considerable part of the dollar's appreciation to date is attributable to the "tax avoidance" phenomenon, it is plausible that investors may require a large exchange risk discount or premium in the face of uncertainty about the future strength of that phenomenon. 1/

Another empirical puzzle is whether the net external indebtedness position of the United States is on a sustainable course. The answer depends on how rapidly relative prices reverse the movement that has pushed the U.S. trade balance deeply into deficit. Several papers have used extremely simplified models of the U.S. current account to calculate the implications that a steady depreciation of the dollar would have for the U.S. net external indebtedness position. 2/ In those analyses, the question of sustainability is translated into the question of whether market participants (including private creditors and public policy authorities) would eventually find the U.S. net indebtedness position undesirably large relative to foreign net worth or U.S. GNP. The answer can only be subjective. We are prepared to believe that sustainability can be achieved by a 3 percent annual depreciation of the dollar, 3/ and certainly if the dollar depreciated two to four times that rapidly, as predicted by recently reported survey data. 4/

By implication, our model supports the view that exchange market participants have behaved fairly rationally in generating such a large overall appreciation of the dollar. That appreciation did not occur in a single jump, however. In the next section we show that our hypothesis helps to explain the time profile of the dollar's appreciation.

IV. Empirical Support for the Central Hypothesis

The arguments in this paper have been formalized in terms of a skeletal reduced-form model and, in particular, a streamlined representation of the behavior of the country premium, which is a central component of the model. The skeletal model has emphasized, in particular, that a change in the desired net capital outflow from the developing countries--hereafter referred to as a change in Z--can give rise to correlated changes in

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1/ The value of such a discount or premium would depend on relative stocks of outside assets denominated in different currencies, along with other factors not explicitly modeled in this paper. See Dooley and Isard (1983b) or Dornbusch (1983).

2/ Dooley and Isard (1985), Isard and Stekler (1985), Krugman (1985).

3/ See Dooley and Isard (1985) or Isard and Stekler (1985).

4/ See Frankel and Froot (1985a), Table 2.

dollar exchange rates and the relative levels of dollar interest rates. The correlation arises to the extent that jumps in dollar exchange rates are associated with changes in expected future rates of change in dollar exchange rates, and to the extent that there is a strong correlation between changes in expected rates of change in dollar exchange rates and changes in interest differentials.

It is possible that in a more complete model, changes in Z would influence dollar exchange rates through two other channels as well--in particular, by influencing either the long-run equilibrium level of the exchange rate or by influencing the exchange risk premium. The possibility of variation in the long-run equilibrium level of the exchange rate has been suppressed in our model by the oversimplified reduced-form specification of the trade balance. The possibility of variation in the exchange risk premium arises from the possibility that changes in Z may result from changes in uncertainty about levels of "taxation" in developing countries, as well as from changes in the expected levels of taxation.

The hypothesis of the paper can be examined empirically by choosing an observable proxy variable to measure changes in Z, and by investigating how much that variable helps to explain the behavior of dollar exchange rates. The proxy variables that we have chosen for measuring Z--the strength of the desired net capital outflow from the developing countries--are data provided by Folkerts-Landau (1985) on the expected yield premia that investors have required to purchase dollar-denominated Mexican or Brazilian bonds on secondary markets, measured as spreads over the expected yields on comparable World Bank bonds. Although Folkerts-Landau has emphasized that the difficulties of making proper allowances for call provisions and other institutional factors adds a moderate degree of imprecision to his measures of these spreads, the wide swings and marked trends in the spreads over time cannot be attributed to measurement error.

The data on spreads are available monthly for the period from July 1981 through March 1985, and we have chosen to test their power to explain the behavior of the deutsche mark/dollar exchange rate during that period. The first step is to provide a benchmark assessment of the extent to which the variability of the mark/dollar rate can be explained solely by a measure of the real interest differential. The second step is to investigate whether Z provides additional explanatory power, recognizing that changes in Z may influence the exchange rate with or without influencing the real interest differential simultaneously. Accordingly, our procedure in this second step is to extract the influence of Z from the real interest differential in an initial regression, and to then investigate how well the residual real interest differential and Z together can explain the behavior of the exchange rate.

The analysis requires a measure of the real interest differential. Chart 1 shows monthly data on long-term nominal interest differentials and actual inflation differentials (U.S. data minus German data). A striking feature of the chart is that the two series decline roughly in parallel through late 1982, rise roughly in parallel through mid-1984, and decline roughly in parallel thereafter. This makes it attractive to assume that the actual inflation differential was a primary "determinant" of the expected inflation differential, which was in turn reflected by the nominal interest differential. Accordingly, we have adopted the research strategy of regressing the nominal interest differential on the actual inflation differential and extracting the residual as a measure of the real interest differential (up to an additive constant). The regression result is reported as equation 1 in Table 1. The coefficient suggests that each one percentage point decline in the actual one-year inflation differential reduced the expected long-term inflation differential by 0.25 percentage points.

The next step is to regress the nominal exchange rate on the real interest differential, which we have chosen to measure as the residual from equation 1 (plus an undetermined constant). The regression result is reported as equation 2 in Table 1. The real interest differential appears to be significant; its coefficient suggests that each 1 percentage point increase in the interest differential can "explain" a 5.45 percent change in the exchange rate. The adjusted R^2 for the regression is 0.116.

We next consider the additional explanatory power provided by each of two proxy measures of Z. These proxies are the spread on Mexican bonds and the spread on Brazilian bonds, as discussed previously. The first step is to extract the influence of the spreads on the real interest differential. The regression results are reported as equations 3 and 4 in Table 1. It is apparent that the spreads have little power to explain the measure we have adopted for the real interest rate differential. It could be misleading, however, to interpret this as persuasive evidence that the observed changes in Z have not had simultaneous impacts on the exchange rate and the interest differential. The alternative possibility is that changes in Z have led simultaneously to relatively large changes in the exchange rate and relatively small changes in the interest differential, and that the changes in the interest differential have been obscured either by other sources of interest rate variation or by measurement error.

Regressions 5 and 6 provide evidence on the overall impact of changes in Z on the mark/dollar exchange rate. 1/ The estimated coefficient

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1/ It may be noted that the measures of the real interest differential used in equations 5 and 6 are little changed from the measure used by equation 2, since equations 3 and 4 extracted little systematic variance from the measure used in equation 2.

Table 1. Regression Results

Variables:

XR = logarithm of the nominal exchange rate, in deutsche marks per U.S. dollar.

RDIF = differential between U.S. and German long-term nominal yields on government bonds, in percent per annum.

PDIF = differential between the percentage changes in U.S. and German consumer price indexes, where percentage changes are measured from 12 months previous.

ZM = spread on Mexican bonds, in percent per annum. 1/

ZB = spread on Brazilian bonds, in percent per annum. 1/

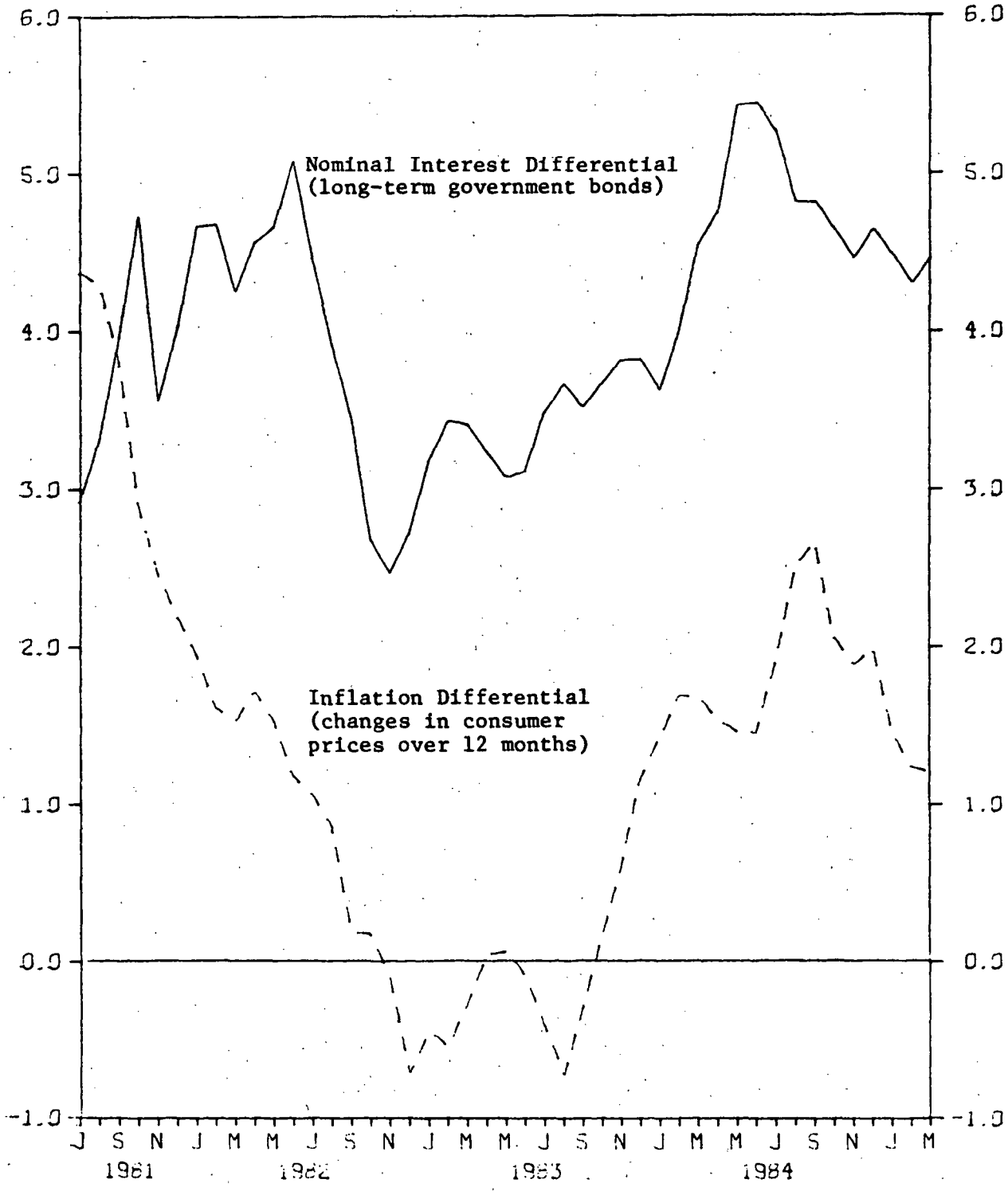
RESID1, RESID3, RESID4 = alternative indexes of real interest differentials, measured by the residuals from equations (1), (3) and (4).

Estimation Results:
(t-values in parentheses)

1.	RDIF =	3.71 (25.1)	+ .251 * PDIF (2.98)			$\bar{R}^2$ =	.153
						D.W. =	.375
2.	XR =	.957 (66.7)	+ .0545 * RESID1 (2.60)			$\bar{R}^2$ =	.116
						D.W. =	.176
3.	RESID1 =	.145 (1.25)	- .0683 * ZM (-2.36)			$\bar{R}^2$ =	.094
						D.W. =	.381
4.	RESID1 =	-.0150 (-.107)	+ .00798 * ZB (.159)			$\bar{R}^2$ =	-.023
						D.W. =	.380
5.	XR =	.950 (57.7)	+ .0681 * RESID3 (3.14)	+ .00346 * ZM (.842)		$\bar{R}^2$ =	.163
						D.W. =	.214
6.	XR =	.892 (70.4)	+ .0519 * RESID4 (3.78)	+ .0349 * ZB (7.72)		$\bar{R}^2$ =	.620
						D.W. =	.535

1/ See page 18 for a more complete definition.

Chart 1


6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
Nominal Interest Differential
(long-term government bonds)
Inflation Differential
(changes in consumer
prices over 12 months)
J S N J M M J S N J M M J S N J M M J S N J M
1981
1982
1983
1984

attached to the spread variable has the "correct" sign in both equations and appears to be highly significant for the Brazilian spread. Moreover, in comparison with equation 2, the explanatory power of the entire regression increases slightly using the Mexican spread and dramatically using the Brazilian spread.

As an alternative presentation of the evidence, Chart 2 superimposes the spread data on the residuals from equation 2. These residuals measure the movements in the exchange rate that are not explained by our measure of the real interest differential. The chart suggests that the trends in the spread can help "explain" sharp trends in the "residual" exchange rate during four periods: (a) from October 1981 through October 1982, (b) from mid-1984 through the peak in early 1985, (c) since the peak in early 1985, and (d) from July through October 1981. The remaining period, from October 1982 through mid-1984, was one in which neither the residual exchange rate nor either of the spreads showed much trend. The fact that the residual exchange rate and the Mexican spread fluctuated widely and in opposite directions during the latter period is undoubtedly the major reason that equation 5 has less explanatory power than equation 6.

V. Conclusions

The model presented in this paper suggests a direction for addressing several conceptual deficiencies of the literature on exchange rate determination. One deficiency of the literature is its failure to provide an adequate model of the factors that anchor the exchange rate in the long run, or correspondingly, its typical treatment of the expected or equilibrium long-run level of the (real) exchange rate as time invariant. A second deficiency is that the portfolio balance literature of asset demands, along with the complementary microtheoretic literature on portfolio selection, have provided descriptions of exchange rate behavior that, in general, are conditional on assumptions about the variance and covariances of the exchange rate itself: it is now recognized that "a very important item on the research agenda is imbedding . . . [the portfolio framework in] a general equilibrium model in which the distributions of prices and exchange rates are determined endogenously." 1/

A useful approach for addressing both of these deficiencies is to build conceptual foundations for understanding the factors that create desires to shift the international location of asset holdings. That approach would link the probability distributions for prices and exchange rates to the joint probability distributions of country-specific exogenous

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1/ Branson and Henderson (1985), p. 800.

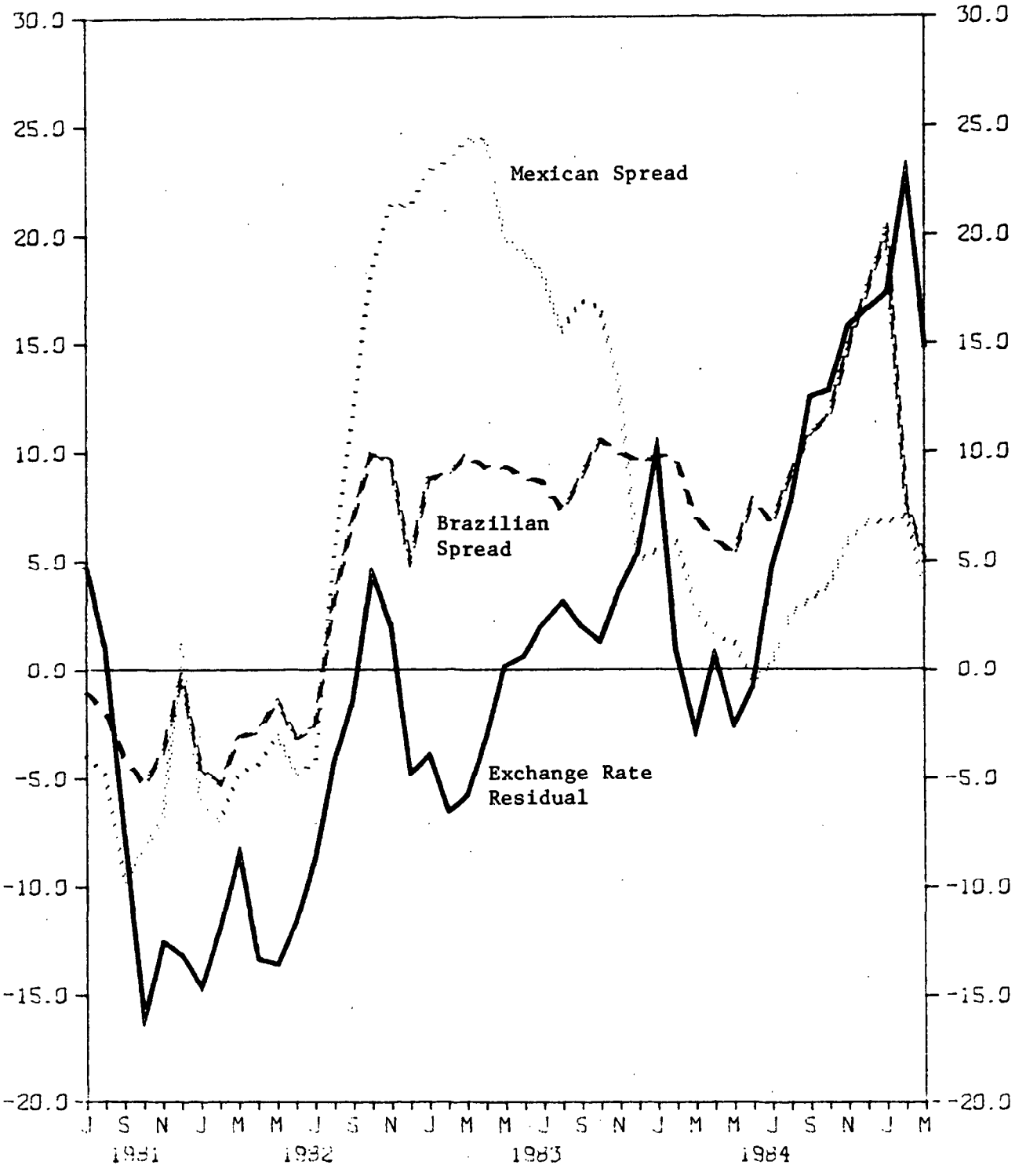
variables, including the probability distribution of how national monetary authorities will behave in attempting to stabilize prices or exchange rates. 1/ To the extent that the exogenous sources of uncertainty about relative returns on alternative assets are viewed as specific to the countries in which the assets are held, or against whose residents the assets claim payments, it seems likely that models with more solid conceptual foundations than we have provided would also lead to a description of portfolio preferences in terms of a country premium that depends, inter alia, on the relative stocks of assets and liabilities of the different countries.

Although this paper has only presented a skeletal model, the model provides answers to empirical puzzles about the behavior of international capital flows and exchange rates during the 1980s. Without question, a major influence on international portfolio behavior during the 1980s can be attributed to unanticipated shocks that made it desirable to shift investments away from holding net claims on the developing countries toward holding net claims on the industrialized countries. Those shocks had country-specific implications in the fundamental sense that they led to changes in perceptions about the extents to which different countries would subject capital and capital income to "taxation," broadly defined.

The more controversial issue in explaining the behavior of international capital flows and exchange rates during the 1980s is developing an understanding for why investors evidently preferred to shift assets toward the United States rather than other industrial countries. We have suggested in Section I that asset holders have had a variety of reasons to perceive that the United States and other industrial countries might subject capital and capital income to different degrees of taxation or subsidization, broadly defined. Based on that central hypothesis, the skeletal model has provided conceptual support for the view that exchange rate movements during the 1980s have reflected changes in desired net capital flows into or out of the developing countries, and Section IV has provided empirical support.

1/ A previous step in that direction has been presented in Dooley and Isard (1983a), which distinguishes between the macroeconomic and political sources of country-specific uncertainty.

Chart 2


30.0
25.0
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
Mexican Spread
Brazilian Spread
Exchange Rate Residual
J S N J M M J S N J M M J S N J M M J S N J M
1981
1982
1983
1984

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