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COUNTRY RISK, INTERNATIONAL LENDING, AND EXCHANGE RATE DETERMINATION

by

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(substantially revised)

I. Introduction and Summary

The subject of international lending in the presence of default risk has attracted renewed attention during recent years. Insightful papers by Eaton and Gersovitz (1981, 1982), Sachs (1982), Sachs and Cohen (1982) and others have emphasized that a debtor country's ability to attract or retain capital in the short run depends on its creditors' perceptions of its ability and desire to meet its debt payments in real terms by generating trade surplusses over time. To date, this literature has developed within the confines of a one-good framework in which there is no place for real or nominal exchange rates.

The purpose of this paper is to emphasize the importance of credit risk in a model that integrates the determination of international lending and exchange rates. The literature on exchange rate determination contains a number of models that integrate an equilibrium condition on stocks of assets or debts with an equilibrium condition on goods flows or the international trade balance; together, these conditions anchor the (long-run) level of the real exchange rate, defined either as a relative price of domestic and foreign goods or a relative price of nontradable and tradable goods. Models of this type include Dornbusch (1976), Calvo and Rodriguez (1977), Dornbusch and Fischer (1980), and Mussa (1980, 1982). A restrictive feature of these models, however, is the small-country assumption that concentrates attention on the portfolio-adjustment behavior of domestic residents, who are assumed able to borrow or lend freely at a fixed foreign interest rate. A second limitation of these models is the lack of attention to credit risk, and in many cases to exchange risk as well. Needless to say, such abstractions don't square well with a world in which debt rescheduling has become commonplace and few countries can be found whose liabilities are either small or riskless from the perspective of their international creditors.

The next two sections of the paper outline comparative static models for analyzing the joint determination of international lending and exchange rates when debts are large and risky. The determination of the country risk premium is also described.[1/] The models are oriented primarily toward analyzing credit flows between countries like the United States and Mexico, and toward understanding the corresponding exchange rate between the Mexican peso and the U.S. dollar. Section II relaxes the small-country assumption but continues to abstract from uncertainty. The analysis emphasizes the stationary-state identity between the Mexican trade surplus and the stream of Mexico's net interest payments to U.S. creditors. Together, the "credit supply function" and the reduced-form relationship between the trade balance and terms of trade determine the long-run stationary-state value of the terms of trade. In particular, the terms of trade required to produce long-run equilibrium in the goods market must be consistent with the balance of international goods flows required to pay interest on the outstanding stock of debt. Thus, the path of adjustment that a country follows in the short run may influence its terms of trade in the long run, to the extent that it influences its stock of debt outstanding in the long run. The extent to which debt can exist in a stationary-state equilibrium, however, is constrained by the costs of default to the debtor country. Moreover, the extent to which the terms of trade will shift in response to a shock that changes the stock of debt depends critically on the elasticity of the trade balance to the terms of trade. These considerations apply to whatever definition of the terms of trade is appropriate for analyzing the trade balance, whether it is the relative price of domestic and foreign goods or the relative price of nontradable and tradable goods. It is important to emphasize, in addition, that a determinate relationship between the terms of trade and the nominal exchange rate requires an assumption that pins down some nominal variable in the model.

Section III introduces uncertainty and credit risk. A two-period model is developed in which lending and investment decisions in period 1 determine the availability of goods and relative prices in period 2, up to several stochastic components. The two-period framework is viewed as a segment of a stationary-state overlapping-generations model, which enables discussion of how the introduction of uncertainty alters the stationary-state analysis of Section II. U.S. residents extend loans to Mexican entrepreneurs, who use the funds to purchase investment goods. The returns to U.S. residents in the aggregate, measured in real terms, depend broadly on all factors that may influence the gap between Mexican production and absorption. The model characterizes ex ante uncertainty about the realized size of this gap in terms of uncertainty about "taxes on nonresident creditors." A distinction is made between autonomous taxes whose variance reflects pure political uncertainty, and induced taxes whose variance reflects uncertainty about the size of the gross Mexican domestic product that is available for distribution among the competing groups of resident and nonresident claimants. Revisions in expectations (as in the first model) or changes in perceived levels of uncertainty influence the level of credit that U.S. residents extend to Mexico, which influences the relative availability of tradable and nontradable goods and leads to an adjustment in the terms of trade. To the extent that the peso wage rate and the peso price of nontradable goods are fixed or sticky, the terms of trade adjustment corresponds to an adjustment in the dollar/peso exchange rate.

Two important points emerge from Section III. First, even when all assets are denominated in a common currency, risk can have an important influence on the values of the terms of trade and the nominal exchange rate that are consistent with asset equilibrium. Second, to the extent that credit risk reflects uncertainties about both exogenous economic outcomes and political attitudes or outcomes (as relevant to the size of the gross product and its distribution), the ex ante probability distribution of the exchange rate will reflect the ex ante probability distributions of both exogenous economic and political outcomes: exchange risk will reflect both exogenous economic uncertainty and political uncertainty.

In the model of Section III, nonresident creditors are assumed to predict the "taxes" on their earnings as an ad hoc function of real and political outcomes, rather than on the basis of a convincing model of how the Mexican government would rationally behave under alternative real and political outcomes. Section IV discusses some issues that seem critical for developing a more sophisticated model. The default option is cast as one of many time-inconsistent choices through which the government may arbitrate a set of mutually excessive claims to the aggregate domestic product, and it is argued that in some circumstances all parties involved may become better off if the government acts to alter the terms of financial contracts between domestic debtors and nonresident creditors.

II. A Stationary-State Model Without Credit Risk

Although most of the analysis can be generalized to any pair of countries or currencies, the model features a menu of assets and goods that seems particularly appropriate for a world in which the two countries are considered to be Mexico and the United States. All lending between the two countries involves interest-bearing dollar-denominated claims. Mexico is assumed to produce three types of composite goods: tradable manufactures (M) that are perfect substitutes for manufactures produced in the United States, nontradables (N) and primary products (P).[2/] Mexican residents divide their consumption betwen M and N, while P is produced only for export.[3/] It is convenient to treat tradable manufactures as the numeraire, with a price of one dollar, and to describe the structure of relative prices in terms of the dollar price of the peso (e), the peso price of nontradables (p) and the dollar price of primary products (q^*). The dollar-equivalent price of nontradables (p^*) will be referred to as the terms of trade:

(1) $p^* = ep$

For the present, the model is concerned with explaining p^*, but not with the absolute levels of e and p, so there is no need at this point to complicate the analysis by introducing money markets, or by adopting other assumptions that tie down some nominal magnitude. Under the choice of numeraire, the dollar-denominated claims can be viewed as claims denominated in real units of manufacturered goods.

A realistic specification of the extent to which and terms on which U.S. (foreign) residents will lend to Mexico must take account of the fact that repayment of international debts on schedule is not strictly enforceable. In this section, however, uncertainty about repayment streams is ignored and the stationary-state framework provides an identity between the Mexican trade surplus and the flow of net interest payments from Mexicans to U.S. residents. Accordingly, when U.S. residents are treated as a single aggregate creditor, it is appealing to assume that the stock of credit supplied (B^S) in the stationary-state will be an increasing function of the stationary-state level of Mexican trade balance (TB).

(2) $B^S = B(TB)$ with $B' > 0$

The combination of this stationary-state "credit supply function" with a reduced form relationship between the trade balance and the terms of trade provides a relationship between the long-run value of the terms of trade and the stock of assets (debts) outstanding in the long run. The remainder of this section illustrates this result and several corrolaries, under behavioral assumptions that lead to a particular reduced form relationship between the trade balance and the terms of trade. Three important points should be appreciated at the outset. First, the question of whether the trade balance is positively or inversely related to the terms of trade has been long debated and never resolved in the transfer problem literature.[4/] Second, the analysis stops short of attempting to convert the relationship between the terms of trade and stock of debt into a relationship between the nominal exchange rate and stock of debt, which requires assumptions that tie down some nominal magnitude. And third, the analysis implicitly assumes that it is rational for Mexico to pay interest on its debt in the stationary state; obversely, the analysis implicitly constrains the stock of debt outstanding in the stationary-state to be below the level at which it would be rational for Mexico to default.[5/]

In the model we now consider, tradables consumption happens to be more sensitive than tradables production to changes in the terms of trade, such that the trade balance declines when the relative price of nontradables increases. Denote the steady-state levels of Mexican outputs by X_M, X_N, and X_P. Nontradables are assumed to be produced with a fixed labor/output ratio a_N, while employment in the two tradable-goods sectors (L_T) is represented as a general function of the levels of X_M and X_P. Total employment is thus described as

$$(3) \quad L = a_N X_N + L_T(X_M, X_P)$$

with labor in all three sectors assumed to earn a wage rate of w pesos per unit labor. Labor is assumed to be the only factor in nontradables production, and w is assumed to be consistent with distributing the entire value of nontradables output to labor.[6/] Thus

$$(4) \quad w = p/a_N$$

X_M is assumed to be produced with labor and capital as a function of the steady-state level of the capital stock (K).

$$(5) \quad X_M = f(K) \text{ with } f' > 0,\ f'' < 0$$

X_P is assumed to be non-negatively related to the relative price of primary products[7/]

$$(6) \quad X_P = X_P(q^*) \text{ with } X'_P > 0$$

To the extent that the capital stock depreciates it must be maintained at its stationary-state level through gross investment purchases of I units of manufactured goods per period.

Following the classical hypothesis, it is assumed that wage income is entirely consumed while other income (net of interest payments to nonresidents) is entirely saved. In contrast with the Dornbusch-Fischer formulation, the value of Mexican debt is assumed to have no direct influence on the Mexican savings decision; rather, the constraint that relates the value of production minus absorption to the outstanding stock of debt is viewed to be imposed by U.S. creditors, as represented by condition (2). Mexican residents are assumed to spend a proportion (c) of their wage income on consumption of manufactures, and the remainder on nontradables consumption, where

(7) $c = c(p^*)$ with $c' > 0$

Thus, the market clearing condition for nontradables requires

(8) $X_N = (1 - c)wL/p$

while the trade balance, measured in dollars, is

(9) $TB = X_M + q^* X_p - I - ecwL$

By substituting condition (8) into (3), the level of employment can be expressed as

(10) $L = L_T/(1 - a_N(1 - c)w/p)$

For the case in which labor is the only factor to which the value added in nontradables production is distributed, as described by condition (4), condition (10) collapses to

(11) $L = L_T/c$

Substitution of (4), (5), and (11) into (9) then yields

(12) $TB = f(K) - I + q^* X_p - (p^*/a_N)L_T$

In condition (12) the stationary-state trade balance is related negatively to the terms of trade ($p^* = ep$): other things equal, an increase in the Mexican trade balance requires either a depreciation of the peso or a reduction in the peso price of nontradables. Each of these alternatives is associated with a reduction in the Mexican (real) wage rate measured in terms of manufacturers (ew).

Conditions (2) and (12) represent the reduced-form model for comparative stationary-state analysis. Denote initial stationary-state values of the variables entering these two conditions by B^o, TB^o, K^o, I^o, X_p^o, L_T^o, p^{*o}, and q^{*o}. Now consider a shock in the form of a transitory decline in q^* associated with an unanticipated foreign recession. Figure 1 describes the shock and Figures 2-4 contrast two of the many possible adjustment paths. The transitory shock to q^* is shown to last from times t_0 to t_1. Figures 2-4 are based on the case in which outputs and the capital stock are maintained at their initial stationary- state levels throughout. Figures 2a-4a illustrate an adjustment path that maintains the trade balance and stock of debt at their initial stationary-state levels thoughout; essentially, the transitory decline in revenue from primary product exports is absorbed through a matching decline in consumption of tradables that, in turn, is induced by a transitory decline in the relative price of nontradables. Such adjustment does not require a permanent change in the terms of trade; after time t_1 all of the variables have returned to their initial values.

By contrast, Figures 2b-4b illustrate the case in which p^* remains at its initial stationary-state value for a period of time after

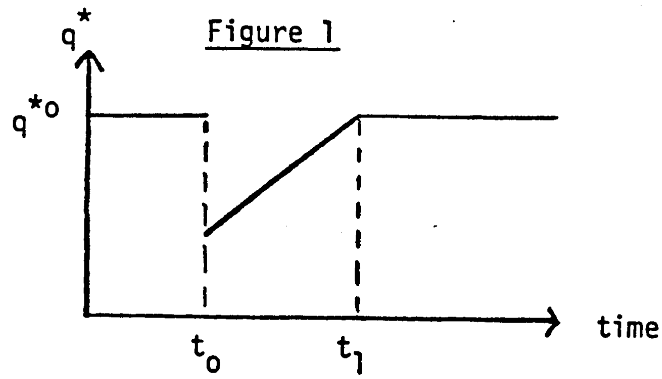

Figure 1

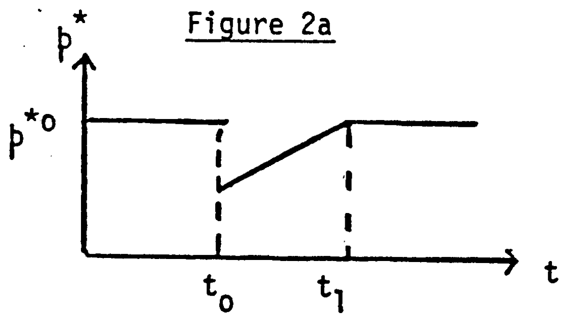

Figure 2a

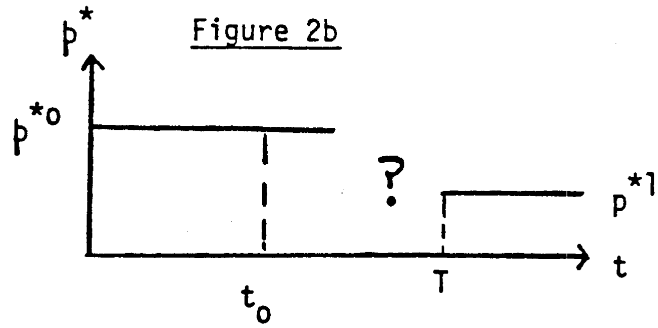

Figure 2b

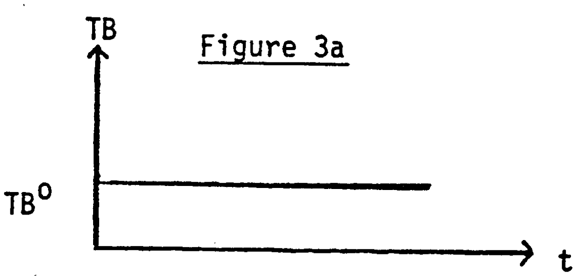

Figure 3a

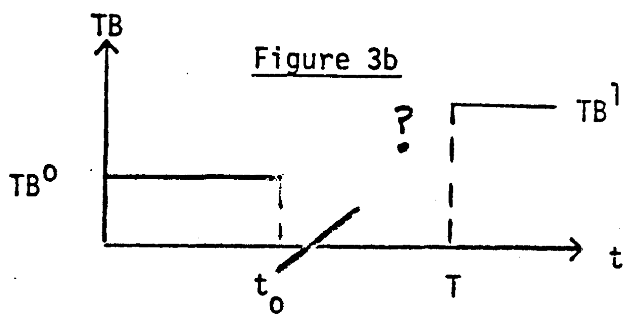

Figure 3b

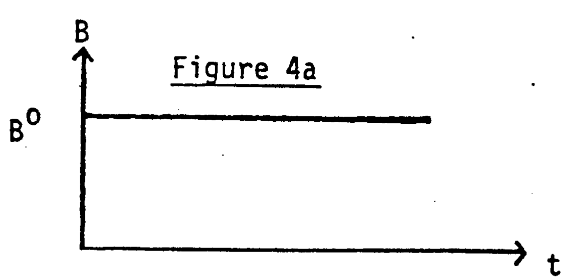

Figure 4a

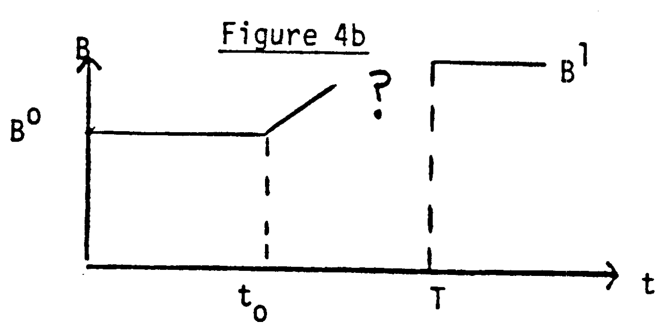

Figure 4b

t_0. During that period, the trade balance is less than sufficient to meet scheduled interest payments on the initial stock of debt, so debt increases. If it is assumed that new stationary-state values p^{*1}, TB^1, and B^1 are reached at some time T, and that p^* and TB approach their new stationary-state values monotonically, it must be that $p^{*1} < p^{*0}$ in order to be consistent with $TB^1 > TB^0$ in order to meet payments on $B^1 > B^0$.

The illustration conveys the notion that an unanticipated transitory decline in Mexico's export revenues, unless offset by a matching reduction in absorption to prevent the trade balance from declining in the short run, may well require a permanent reduction in the terms of trade to restore portfolio equilibrium from the viewpoint of Mexico's creditors. The illustration is based on the assumption that a reduction in the terms of trade leads to an improvement in the trade balance, and it ignores the case in which a transitory "overadjustment" of the terms of trade obviates the need for a permanent reduction.

More generally, the illustration emphasizes that many stationary-state equilibria can exist, consistent with different levels of the trade balance and terms of trade. An important corrolary is that the path that a country chooses to follow in adjusting to a "shock" is likely to influence the long-run value of its terms of trade. The corrolary hinges, of course, on whether the long-run elasticity of the trade balance to the terms of trade is finite. And implicitly, the possibility of stationary-state equilibria with non-zero stocks of debt outstanding is based on the assumption that there are positive costs of default in the stationary-state, such that it is rational for debtor countries to continue paying interest (and for creditor countries to continue expecting interest receipts).

III. A Model With Credit Risk

We are now ready to relax the assumption that creditors are certain of receiving the payments they expect. International lending behavior is described in the context of an overlapping generations model in which each generation of creditors solves a two-period intertemporal consumption problem. Conclusions about the sensitivity of international lending and the terms of trade to various parameters are again restricted to inferences drawn from comparative static analysis. The overlapping generations paradigm is used in a very limited way, which does little to enrich or complicate the two-period problem, but which facilitates comparison of the uncertainty case with the previous stationary-state analysis under certainty.

The paradigm is that each generation of U.S. residents lives for two periods, working to earn an income Y^* in the first period, which must be divided between first-period consumption (C_1^*) and purchases of financial claims that can be sold to finance consumption during their retirement in the second period. Two types of financial claims can be purchased: dollar-denominated claims on U.S. entrepreneurs (B^*) and dollar-denominated claims on Mexican entrepreneurs (B). Entrepreneurs use the funds obtained from issuing claims to purchase investment goods, which are employed in producing the U.S. and Mexican domestic products. Given Y^*, a choice of B and B^* by the younger generation of U.S. residents implies first and second-period consumption levels

(13) $C_1^* = Y^* - B^* - B$

and

$$(14) \quad C_2^* = (1+r^*)B^* + (1+r)B$$

where r and r^* denote average "after-tax" yields on the two types of claims.

A key assumption of the analysis is that U.S. creditors view their returns on loans to Mexican entrepreneurs as uncertain, and view loans to U.S. entrepreneurs as a "safe asset." This assumption helps simplify the analytic framework to a model in which the implications of the different sources and relative degrees of uncertainty can easily be isolated. A second simplyfying assumption is that only U.S. residents lend internationally, while Mexican residents do not hold claims on U.S. entrepreneurs, so that net and gross U.S. lending to Mexico coincide. In addition, the analysis abstracts completely from the effects of uncertainty on Mexican savings behavior. Thus, attention is concentrated on how the sources and degrees of uncertainty about the returns on claims on Mexican entrepreneurs influence the aggregate savings and international lending decisions of U.S. residents, and thereby influence the terms of trade.

With this orientation we now describe the aggregate levels and distributions of U.S. and Mexican domestic products, expressed as functions of the amounts which U.S. creditors lend to U.S. and Mexican entrepreneurs. The analysis is restricted to stationary-state solutions within the overlapping generations framework, which is equivalent to assuming that population sizes are constant and that each generation behaves identically over its two-period lifespan. (Although the stationary-state is characterized by each generation choosing the same values for its choice variables, certain outcomes can vary from period to period, reflecting the variance of two stochastic exogenous variables.) Physical capital stocks remain constant from period to period, with each generation desiring to sell in its old age the exact portfolio of claims that the next generation desires to purchase.[8/] Under these assumptions the capital stocks residing in Mexico and the United States are, respectively,

$$(15) \quad K = K_o + B$$

and

$$(16) \quad K^* = B^*$$

where K_o is the amount of the Mexican capital stock financed out of Mexican savings.[9/] These capital stocks are assumed to be employed in the manufacturing sectors of the two countries, yielding the outputs

$$(17) \quad X_M = f(K) \text{ with } f' > 0,\ f'' \leq 0$$

and

$$(18) \quad X_M^* = f^*(K^*) \text{ with } f^{*'} > 0,\ f^{*''} \leq 0$$

Each of these production relations is treated as nonstochastic, but uncertainty about the aggregate Mexican domestic product is introduced by assuming that Mexico's revenue from primary product exports is stochastic.

The distribution of the value added in the U.S. manufacturing sector is known with certainty ex ante, with capital receiving its marginal product, to which entrepreneurs bid up the interest rate on debt.

$$(19) \quad r^* = f^{*'}(K^*)$$

The remainder of U.S. manufacturing output is the income of the younger generation of laborers.[10/]

$$(20) \quad Y^* = X_M^* - r^*B^*$$

The distribution to U.S. creditors of value added in the Mexican manufacturing and primary-product sectors can be described as

$$(21) \quad rB = GDP_T - ewI_T - Q + \Delta B$$

Here, GDP_T denotes the gross domestic product of the two tradable goods sectors, ewL_T represents the dollar value of the goods that must be sold to pay workers employed in the tradable goods sectors, and Q includes returns to all Mexican non-labor factors of production, as well as the tax revenues collected by the Mexican government.[11/] The ΔB term on the right side of condition (21) recognizes that interest payments can always be met by borrowing more. The analysis below, however, will focus on stationary-state solutions in which ΔB is zero and rB corresponds to Mexico's trade surplus, as in condition (9) of the previous section.[12/]

Although the return on U.S. loans to an individual Mexican entrepreneur may be subject to the risks associated with the particular projects undertaken by the entrepreneur (depending on the nature of any guarantees provided by the Mexican government), condition (21) emphasizes that returns are also subject to macroeconomic risks associated with uncertainty about the size of Mexico's gross domestic product and uncertainties about the extent to which that product will be claimed by Mexican residents. Even with a prespecified peso wage rate, the dollar value of labor's claims to GDP_T will be uncertain ex ante to the extent that the dollar/peso exchange rate is uncertain. Moreover, taxes are generally uncertain ex ante, reflecting both political uncertainty about the parameters relating the level of taxes to GDP and/or other economic magnitudes, and economic uncertainty about the levels of GDP and/or whatever other economic variables enter the tax function.

Broadly viewed, the calculation of an optimal level of B for U.S. creditors in the aggregate requires an assessment of the probability distribution of the right hand side of condition (21), conditional on B. (The discussion here is restricted to the stationary-state case with $\Delta B = 0$.) As suggested by Hanson (1974), the extent to which creditors believe that their loans will finance investment in productive capacity has an important bearing on the optimal choice of B. Moreover, as suggested by Eaton and Gersovitz (1981, 1982), the extent to which taking a tax bite out of the expected earnings of nonresident creditors would impose costs (in subsequent time periods) on the debtor country has an important influence on the creditor's assessment of how widely Q might vary, which in turn affects the optimal level of B. And in general, assessments of price distortions, commercial policies, the monopsony power of labor, government corruption and a myriad of other factors may influence creditor assessments of the probable returns on their loans.

The analysis below abstracts from many of these considerations under the simplifying assumptions

(22) $GDP_T = f(K) + V_P$

(23) $L_T = L_O + bB$

and

(24) $Q = V_P + T_A - tV_P$

Here, V_P denotes the value of Mexico's primary product output and exports ($V_P = q^* X_P$), which will be treated as the stochastic component of GDP_T. Employment in the tradables sectors is assumed to increase with the size of the manufacturing sector, which increases with the level of B, as assumed in condition (15). Condition (24) includes V_P in the revenues of the combined Mexican government/capitalist sector. T_A denotes an "autonomous" component of taxes on nonresidents, the variance of which reflects pure political uncertainty, while the parameter t is treated as a constant that reflects the extent to which shortfalls in V_P (i.e., the stochastic component of GDP_T) induce increases in taxes on nonresident earnings. T_A and V_P are the only two stochastic exogenous variables in the model. Taxes are used by the Mexican authorities to purchase manufactured goods, which are distributed to Mexican consumers through public expenditure and transfer programs. In the stationary-state, moreover, Mexican capitalist income and hence all of Q is consumed. Thus, the parameter (1-t) can be interpreted as the extent to which Mexico reduces its aggregate stationary-state consumption of manufactures (given its production) in proportion to any change in the value of its primary product exports.

Having characterized the uncertainties that influence the size and distribution of aggregate income, we now argue that the influence of uncertainty on both intertemporal allocations and the composition of lending affects the relative availability of goods in each period, which in turn affects the terms of trade (and, under certain conditions, the nominal exchange rate). The illustration we provide to support this argument is one in which U.S. residents make intertemporal consumption decisions involving only the manufactured good, while Mexican residents make strictly intratemporal consumption decisions involving two goods and leisure. Although the two Mexican consumption goods are taken to be nontradables and tradables, with relatively minor modifications we could adapt the framework to the case of two tradable goods distinguishable by country of production.

The intertemporal allocations and composition of lending are characterized by assuming that U.S. creditors choose B and B^* to maximize a preference function of the form

$$(25) \quad U = C_1^* + \frac{1}{1 + d}(EC_2^* - uVarC_2^*)$$

subject to conditions (13), (14), etc., where the perceived ex ante probability distribution of C_2^* is symmetric. The parameter d is a measure of the rate of time preference, while u summarizes the trade-off between the expected value and the variance of C_2^*. Conditions (21)-(24) and (15) can be shown to imply

$$(26) \quad rB = f(K_o+B) - ew(L_o+bB) - T_A + tV_P$$

Conditions (13) and (14) can be transformed, under conditions (16)-(20) and (26), into

$$(27) \quad C_1^* = f^*(B^*) - (1+r^*)B^* - B$$

and

$$(28) \quad C_2^* = f(K_o+B) - ew(L_o+bB) - T_A + tV_P + (1+r^*)B^* + B$$

The intratemporal decision of Mexican consumers is described in the appendix under the assumption that preferences for consumption bundles of manufactures, nontradables, and leisure have a Cobb-Douglas form. In general, the intratemporal decision provides solutions for the terms of trade, and hence ew, as a function of the two exogenous stochastic terms (T_A and V_P) and the choice variables from the intertemporal problem (B and B^*). Under the rational expectations assumption that U.S. creditors have knowledge of the solution form for ew, the problem of maximizing (25) subject to their budget constraint reduces to a choice in the context of only the two unknown exogenous variables: T_A and V_P.

The solutions for the terms of trade (p^*) and ew in the appendix illustration are

$$(29) \quad p^* = ewa_N = h(B)[Q/((L_o+bB)/a_N)]$$

where h is a positive and increasing function of B.[13/] The interpretation of the square-bracketed term is that the relative price of nontradables rises with the quantity of Mexico's nonwage "income" of tradable goods (Q), expressed as a proportion of the output of nontradables that is foregone by employing labor in the tradables sectors.

The appendix also characterizes the values of B and B^* that maximize (25) subject to conditions on C_1^*, EC_2^* and $VarC_2^*$. The necessary condition on B^* is that the marginal return on loans to U.S. entrepreneurs must equal the marginal rate of consumer time preference. The necessary condition on B has the general form

(30) $$B = g(\overset{-}{VarT_A}, \overset{-}{VarV_P}, \overset{-}{ET_A}, \overset{-}{EV_P}, \overset{+}{t}, \overset{-}{d}, \overset{-}{u})$$

where the sign above each argument is the sign of the partial derivative of B with respect to that argument under assumptions that are taken to describe "the normal case." The signs of the partial derivatives with respect to $VarT_A$, $VarV_P$, d and u are intuitively clear: under the assumption of diminishing marginal productivity of the Mexican capital stock, it is optimal to reduce B whenever the perceived variability of the return on B increases, whenever future consumption becomes less desirable relative to current consumption, or whenever consumers become more averse to the riskiness of future consumption levels. The partial derivatives with respect to ET_A, EV_P, and t reflect the fact that an increase in ET_A or EV_P or a decline in t directly reduces the expected return on any given level of B after taxes and wages.[14/]

Finally, the appendix shows that the conditions on B and B^* lead to an expression for the country risk premium (CRP), defined as the difference between the expected marginal return on loans to Mexican entrepreneurs and the (certain) marginal return on loans to U.S. entrepreneurs

(31) $$CRP = m_1 VarT_A + m_2 VarV_P$$

Under normal assumptions m_1 and m_2 are each positive and increasing functions of B.

Conditions (29)-(31) allow a comparative static analysis of the effects of various "shocks" on the level of U.S. credit to Mexico, the exchange rate and the country risk premium. Subject to the usual caveats about using comparative static frameworks to analyze responses to shocks, the model suggests that an increase in uncertainty about either revenues from primary product exports or political attitudes toward taxing nonresidents ($VarV_P$ or $VarT_A$) raises the country-risk premium associated with any level of B, and leads U.S. residents to reduce their outstanding stocks of financial claims on Mexican entrepreneurs, other things equal. For a given peso wage rate this will depreciate the dollar value of the peso (since h(B) and hence ew decline as B declines).[15/]

These results illustrate several important points. First, independently of the currency denomination of assets, risk can have an important influence on the values of the terms of trade and nominal exchange rate that are consistent with asset equilibrium. Second, to the extent that credit risk reflects uncertainties about both exogenous economic outcomes and political attitudes or outcomes, the ex ante probability distribution of the exchange rate will reflect the ex ante probability distributions of both exogenous economic and political outcomes: exchange risk will reflect both exogenous economic uncertainty and political uncertainty.

In Section II the stationary-state analysis under certainty emphasized that an unanticipated transitory decline in Mexico's export revenues, unless offset by a matching reduction in domestic absorption to prevent the trade balance from declining in the short run, might well require a permanent depreciation of the peso to restore portfolio equilibrium from the viewpoint of Mexico's creditors. The companion argument developed in this section is that an increase in uncertainty about Mexico's export earnings (or political attitudes), unless compensated for by a reduction in domestic absorption in order to raise the returns that nonresidents can expect on their loans to Mexico, might also require a permanent depreciation of the peso to restore asset equilibrium.

Although the stationary-state framework is inappropriate for analyzing the impact effects of shocks on the terms of trade, it seems clear from historical experience that the response of domestic savers and foreign creditors to shocks plays a major role in conveying pressures to exchange rates. The "shock" of high real interest rates and the 1981-82 world recession on the ability of Mexico to meet its debt payments has driven the country risk premium for Mexico (as measured by spreads over LIBOR) from levels of around 1/2 percentage point prior to the Autumn of 1981 to 2-1/4 percentage points on the $5 billion credit that the Mexican government negotiated with international banks in March 1983. Considering the associated increases in negotiating fees, the effective widening of the spread has exceeded 2 percentage points. With LIBOR rates in the range of 3 to 5 percent in real terms (9 percent nominal), the addition of a 2 percentage point spread suggests a substantial decline in the desired stock of claims on Mexico. (To the extent that the terms on loans at the margin reveal the market price of existing debt, the decline in the desired stock of nonresident claims on Mexico might be estimated as the fraction of lending at 5 to 7 percent that offers a payments stream with the same present discounted value as a loan at 3 to 5 percent.)

IV. Credit Availability and the Default Option

The previous section has emphasized that the jointly determined levels of U.S. credit to Mexico, the relative prices of Mexican and U.S. goods, and the dollar/peso exchange rate depend critically on how U.S. creditors perceive the nature of the Mexican "tax" structure and on the manner in which contracts to Mexican factors of production are written. The formal representation of Mexican taxes on nonresident earnings is an analytically convenient method of addressing default or rescheduling risk. In this regard the uncertain level of the tax burden on nonresident creditors has been viewed to depend both on purely political attitudes and on the uncertain level of Mexico's domestic product. Beyond this, however, the specific hypothesis about how nonresident creditors assess their tax burden is ad hoc, rather than based on perceptions of rational Mexican behavior.

This section presents some perspectives on default issues that we consider critical for improving the specification of the uncertainties perceived by nonresident creditors. The term "default" is used to refer in a general sense to any alteration of a financial contract between a domestic debtor and a nonresident creditor. We discard the particular specification of the Mexican tax structure used in the previous section but retain the general notion that the domestic government has some degree of power to reduce the income of nonresidents in order to mitigate the effects on domestic income of "unusually" low levels of domestic output or the relative price of exports. In particular, we view the domestic government to have a "default option" to unilaterally adjust the terms of Mexico's financial contracts with nonresident creditors.

Using the default option can be thought of as acting inconsistently over time. The subject of time inconsistent policies has received considerable attention in recent years, generally in the context of domestic policy rules. For example, a simple rule for monetary policy, such as constant growth of a monetary aggregate, can be thought of as a policy contract between the government and the private sector. Although policy contracts are rarely specified in detail, implicit policy contracts have an important bearing on the nature of explicit contracts that private economic agents enter into, such as nominal wage agreements or debt contracts, the usefulness of which depend in part on a consistent application of the implicit policy contract. The government can in some circumstances achieve important goals by violating a policy contract; for example, unemployment might be reduced temporarily by increasing the growth of the monetary aggregates above the rates specified in a policy contract. The effects of violating a policy contract include a subsequent reduction in the usefulness of contracts, as well as an immediate redistribution of income among debtors and creditors. Trade offs between the immediate and long run benefits and costs of breaking policy contracts are very difficult to quantify or predict.

Several factors seem important in shaping our understanding of default as a time inconsistent policy. The default tax is only one of the many elements of time inconsistent behavior that the government is likely to consider following an unusually bad draw from the economic environment. Different groups have entered into contracts from which they expect to obtain income. These include wage contracts, taxes, and transfers denominated in domestic currency; bond contracts denominated in both domestic and foreign currencies, and held by both residents and nonresidents; and equity contracts. The existing assortment of contracts reflects the expected level and perceived variability of output, as well as attitudes toward bearing risk. Some contracts, for example equity ownership, specialize in providing the holder with a residual of income after prior claims have been settled. Other contracts are protected from particular sources of uncertainty by indexing their value explicitly to future outcomes for uncertain variables. In "normal" times, all contracts can be jointly fulfilled. However, the event of an unusually low outcome for aggregate real income may make it undesirable for all claimants to exercise their contractual rights. Indeed, if the outcome for aggregate income is sufficiently low, the simultaneous satisfaction of all claims may become infeasible. The government in this event acts as an arbiter that allocates the shortfall in aggregate income among competing groups. This function of government is crucial, since without effective arbitration the attempt of one group to exercise its individual rights may force other groups into bankruptcy or revolution. The general decline in asset values that can follow would impose costs on everyone without helping to allocate the loss of income.

Accordingly, when faced with the prospect of catastrophe, the use of the default tax to break loan agreements along with other time inconsistent policies to break other claims on aggregate output may increase the welfare of each group of claimants to the aggregate output. Alternatively stated, in some circumstances the default tax should be compared to even more disruptive alternatives. For this reason it is not valid to argue that a debtor country would never default because it would suffer costs over time through its reduced access to international credit markets. The alternative to default can also involve major economic and political costs. An appealing assumption is that the government will choose a portfolio of "defaults" on international and domestic contracts that does the least harm to the long term interests of its constituents.[16/]

In the case of international debts, one of the claimants on income, the foreign creditor, is not directly represented in the political process that administers the default tax. The fact that the nonresident creditor is more vulnerable than resident claimants on income provides an incentive for the creditor to attempt to strengthen its claims by channeling its investments through financial intermediaries. In this respect an insured financial sector, or one for which a failure would spread costs to a set of taxpayers in a third country whose government has some influence over the political process in the debtor country, would appear to be particularly likely to emerge as an intermediary in the international lending process.

V. Conclusions

Much of the recent literature on exchange rate determination is based on the unrealistic assumptions that international lending occurs on a small scale (i.e., at a fixed foreign interest rate), with no uncertainty about interest and repayment streams. Some models, while abstracting from credit risk, have emphasized the role of exchange risk when assets are denominated in different currencies. In our opinion, however, models with exchange risk have not provided satisfactory explanations of the exogenous factors that underlie the probability distribution of the exchange rate.

This paper has emphasized the importance of country-specific degrees of credit risk in the joint determination of international lending and exchange rates. Country risk has been described in terms of uncertainties about outcomes for both exogenous economic variables and political factors. Together these types of exogenous uncertainties translate into uncertainties about both the size of the country's domestic product and the distribution of income among competing groups of claimants, including nonresident creditors.

The focus on credit supply behavior provides several insights about the behavior of real and nominal exchange rates. Although this paper has chosen to model the nominal exchange rate between the Mexican peso and the U.S. dollar, and to focus on the terms of trade between (Mexican) nontradables and tradables as the relative price that best represents a real exchange rate in that context, the basic insights extend to nominal exchange rates between pairs of "hard" currencies when real exchange rates refer to relative prices between composites of tradable goods distinguished by country of origin. A creditor who lends (domestically or internationally) to a private entrepreneur or government agency in a hard-currency country cannot be certain that the real after-tax interest and repayment streams he will receive are independent of the outcomes for macroeconomic variables and political factors specific to the borrowing country. Every country faces different and time-varying degrees of uncertainty about macroeconomic and political prospects, which can be translated, by modelling the rational behavior of credit suppliers, into time-varying degrees of uncertainty about real and nominal exchange rates between pairs of currencies, whether hard or soft. In turn, changes over time in degrees of uncertainty about future exchange rates lead to whatever changes in observed exchange rates are necessary to adjust the relative expected returns on different assets to market-clearing levels.

Appendix

The first objective of this appendix is to illustrate the solutions for the terms of trade and the dollar/peso exchange rate that clear the Mexican markets for goods and labor. The goods and labor markets are linked by the assumption that a_N units of leisure can be transformed at constant returns to scale into one unit of nontradables output and consumption

$$\text{(A1)} \quad C_N = L_N/a_N$$

Consumption of manufactures is constrained by the difference between the value of Mexican production of tradables, $X_M + V_P = f(K) + V_P$, and payments to nonresidents, rB, which from conditions (21)-(23) can be expressed as

$$\text{(A2)} \quad C_M = ew(L_O+bB) + Q$$

If L denotes the available combined supply of leisure and labor, consumption of leisure can be expressed as

$$\text{(A3)} \quad C_L = L - a_N C_N - bB - L_O$$

For purposes of illustration it is assumed that Mexican behavior maximizes a Cobb-Douglas utility function

$$\text{(A4)} \quad U(C_L, C_M, C_N) = C_L^x \, C_M^y \, C_N^z$$

subject to constraints (A1) - (A3). One of the necessary optimization conditions is that the marginal rate of substitution between leisure and nontradables in consumption must equal the marginal rate of transformation through production.

$$\text{(A5)} \quad (zC_L/xC_N) = a_N$$

A second condition is that the marginal rate of sustitution between manufactures and nontradables must equal the market clearing terms of trade

(A6) $(zC_M/yC_N) = p^*$

where

(A7) $p^* = ep = ewa_N$

Together, conditions (A3) and (A5) imply

(A8) $C_N = z(L - bB - L_O)/(x + z)a_N$

Substitution of (A8) into (A6) leads to

(A9) $p^* = (x+z)C_M/y((L-L_O-bB)/a_N)$

which states that the relative price of nontradables varies in direct proportion to the quantity of tradables available for consumption relative to the amount of nontradables that could potentially be consumed if all labor/leisure not employed in the two tradables sectors were devoted to producing nontradables. Substitution of (A2) into (A9), using (A7), leads to

(A10) $p^* = hQ/((L_O+bB)/a_N)$

and

(A11) $e = hQ/w(L_O+bB)$

where

(A12) $h = (x+z)(L_O+bB)/(yL - (x+y+z)(L_O+bB))$

It is assumed that the denominator of h is positive, in which case it is easily shown that h is a positive and increasing function of B.

The next objective is to compute the mean and variance of C_2^*. From conditions (28) and (A11) it follows that

(A13) $C_2^* = (1+r^*)B^* + B + f(K_O+B) - T_A + tV_P - hQ$

From conditions (A13) and (24) it follows that

(A14) $C_2^* = (1+r^*)B^* + B + f(K_O+B) - (1+h)T_A - ((1-t)h-t)V_P$

Accordingly, if T_A and V_P are each symmetrically and independently distributed, C_2^* will be symmetrically distributed with mean and variance

$$\text{(A15)} \quad EC_2^* = (1+r^*)B^* + B + f(K_o+B) - (1+h)ET_A - ((1-t)h-t)EV_P$$

$$\text{(A16)} \quad VarC_2^* = (1+h)^2 VarT_A + ((1-t)h-t)^2 VarV_P$$

Attention now turns to characterizing the values of B* and B that maximize (25) subject to conditions (13), (A15), and (A16).17/ Necessary conditions are that B* must satisfy

$$\text{(A17)} \quad \frac{d}{dB^*}((1+r^*)B^*) = 1+d$$

while B must satisfy

$$\text{(A18)} \quad f' = d + h'(ET_A+(1-t)EV_P) + m_1 VarT_A + m_2 VarV_P$$

$$\text{where} \quad m_1 = 2uh'(1+h) > 0$$

$$m_2 = 2uh'(1-t)((1-t)h-t)$$

Condition (A17) requires that the marginal return on loans to U.S. entrepreneurs must equal one plus the marginal rate of time preference. In condition (A18), the second term on the right hand side is the expected marginal cost of labor (per incremental unit of B), as can be seen from conditions (A11) and (24). Thus, since labor is the only cost of production that varies at the margin, condition (A18) can be interpreted as requiring that the marginal product of capital in Mexico must exceed the opportunity cost of lending to U.S. entrepreneurs (d) by an amount that covers marginal cost and also compensates the risk-averse creditors for the two sources of uncertainty ($VarT_A$ and $VarV_P$). The value of B that solves (A18) will be unique under the assumptions that: (i) the marginal product of capital diminishes as K_o+B increases (i.e., $f'' < 0$); (ii) manufacturing employment is small relative to the potential supply of labor such that the denominator of h is positive in condition (A12); (iii) the tax parameter t is sufficiently small such that m_2 is non-negative in condition (A18); and (iv) $ET_A > 0$. Under these assumptions, which will henceforth be considered "the normal case," uniqueness follows from the fact that the right hand side of condition (A18) is an increasing function of B,[18/] while the left-hand side is a decreasing function of B. The optimal level of B can be represented as having the general form

$$\text{(A19)} \quad B = g(\overset{-}{VarT_A}, \overset{-}{VarV_P}, \overset{-}{ET_A}, \overset{-}{EV_P}, \overset{+}{t}, \overset{-}{d}, \overset{-}{u})$$

where the sign above each argument describes the sign of the partial derivative of B with respect to that argument in the normal case.[19/]

Conditions (A17) and (A18) can now be used to derive an expression for the country risk premium (CRP), defined as the difference between the expected marginal return on loans to Mexican entrepreneurs and the (certain) marginal return on loans to U.S. entrepreneurs. The expected marginal return on loans to Mexican entrepreneurs, as a function of B, is obtained from substituting (A11) and (24) into (26), which yields

$$\text{(A20)} \quad rB = f - (1+h)T_A - ((1-t)h-t)V_P$$

Differentiating (A20) leads to

$$\text{(A21)} \quad E\frac{d}{dB}(rB) = f' - h'ET_A - (1-t)h'EV_P$$

which can be combined with (A17) and (A18) to yield

$$\text{(A22)} \quad CRP = m_1 VarT_A + m_2 VarV_P$$

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Footnotes

*/ This paper represents the views of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or other members of its staff.

1/ In discussing credit risk it has become natural to aggregate international indebtedness across the residents of individual debtor countries, reflecting the fact that the country is the fundamental unit for distinguishing macroeconomic policies, financial regulations and legal jurisdictions.

2/ The separation of tradable-goods output into M and P does not greatly complicate the analytic framework and is useful for differentiating the effects of global activity shocks on the U.S. and Mexican economies.

3/ Material inputs to production are ignored.

4/ See Chipman (1974).

5/ The costs of default might include restrictions on exports (possibly reflecting increased difficulties of obtaining export finance), confiscation of property owned abroad, withdrawals or embargoes of essential foreign inputs to domestic production, loss of foreign military and technical assistance, etc. Notice that in this model the cost does not include restriction of access to further net borrowing, which is ruled out by definition of the stationary state.

6/ These assumptions can be viewed to describe an economy with a "surplus" of labor. Alternatively, unemployment can be viewed to reflect a voluntary choice about the amount of leisure to transform into nontradables consumption at the fixed labor/output ratio a_N.

7/ X_P and q* will be treated as predetermined throughout this paper, and the particular form of condition (6) has little relevance to the of analysis.

8/ One of the many difficulties of extending the analysis beyond the stationary-state framework is the complication arising from immobility of physical capital.

9/ As mentioned above, this treatment abstracts from the extent to which Mexican savings behavior is affected by uncertainties analogous to those that influence the behavior of U.S. creditors.

10/ Although labor has not been specified explicitly as an argument of the U.S. production function, income distribution can be viewed as neoclassical under the assumption that the fixed stock of labor is fully employed. Other assumptions that are also consistent with distributing Y* to labor include the assumption that labor receives a fixed dollar wage plus (minus) transfers (taxes) from goverment that equal the excess of X_M^* over the sum of the wage bill and the marginal-product rewards to capital.

11/ Value added in the Mexican nontradable goods sector is distributed entirely to Mexican workers.

12/ Condition (21) ignores stationary-state investment for purposes of replacing depreciated capital.

13/ Since Q is a linear combination of T_A and V_P, it can be seen from conditions (28) and (29) that C_2^* has a symmetric distribution, given B and B*, whenever T_A and V_P are independently and symmetrically distributed.

14/ These signs are clarified in the Appendix. An increase in ET_A or a decline in t directly reduces the expected return on any given level of B after taxes (recall condition 26), and this effect is magnified by an induced increase in the extent to which the wage bill is expected to cut into earnings (recall conditions 29 and 24). An increase in EV_P reduces the expected tax bite, but in our particular model the associated effect on the expected return on B is outweighed by the increase in the expected wage bill.

15/ To the extent that the peso wage rate rises as the peso depreciates, the depreciation will be magnified (in order to achieve the required change in the terms of trade).

16/ An interesting possibility is that domestic money creation might be one such time inconsistent policy. This would provide an alternative link between unusually poor outcomes for economic activity and nominal exchange rates.

17/ U.S. creditors take Y* as given in the first period of their lives and, accordingly, optimize (25) subject to (13), (A15), and (A16) rather than (27), (A15), and (A16).

18/ The proof involves showing that h(B) has positive first and second derivatives.

19/ The signs can be derived by totally differentiating condition (A18) and noting that f' is a positive and decreasing function of B while h', m_1, and m_2 are each positive and increasing functions of B.