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The Determinants of Country Risk: A Selective Survey of the Literature

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I. Introduction

Recently there has been a considerable growth in the literature on the economic and political causes of country (or sovereign) default risk (see, for example, the surveys by Glick (1983) and McDonald (1983)). The general impression gained from reading this literature is that default can have far reaching political, legal and economic ramifications for a sovereign borrower. This paper has the modest aim of analyzing and reviewing recent articles concerned with one aspect of the default calculus, namely, certain economic benefits and costs to the borrower from debt repudiation which lenders will take into account in determining the creditworthiness of a country. This rather narrow approach to country risk analysis views borrowers as rational financial decision makers who periodically calculate and compare the qualifiable economic costs and benefits from declaring default (e.g., the cost to the country from a future loan embargo post-default). While this type of approach does not include all the possible economic costs and benefits of default, nor does it include the political and legal costs, it does provide useful insights into those economic variables that are both to some extent quantifiable and important in determining the degree of country risk. This type of analysis is therefore useful to lenders in assessing the underlying economic riskiness of a sovereign borrower, even if political and legal costs are sufficiently large to prevent default from actually being declared.

This type of economic approach to default, frequently referred to as "rational", is quite well established in corporate finance literature, which has mainly concerned itself with debt sustainability and its measurement. Indeed, the very notion of debt sustainability implies that default is something forced on the country by uncontrollable events such as a shortfall in reserves, adverse changes in terms of trade, etc. rather than being an endogenous investment decision, as in the rational financial paradigm.

In Sections II - V below, the four main approaches to valuing corporate debt in a world where debt is risky and default is a choice of the borrower are outlined and discussed. These approaches are the options pricing model, the agency-signaling model, the risk premium model, and the contingent claims model. Each of these approaches is outlined in detail, and emphasis is placed on the differences between corporate and sovereign risk and how these corporate debt models can be modified to deal with these differences. It is argued that, with certain caveats, variables which are important in sovereign risk evaluations. Further, with certain modifications, some of these models have the potential to be estimable using data that is currently available to the researcher.

In Sections VI - X, the literature on the risk of international borrowing is surveyed. To avoid excessive overlap with other surveys, and to maintain the theme of default as a rational financial decision or investment option available to the borrowing country, only those papers that view sovereign default in a financial-decision paradigm are reviewed in detail (although some of the problems of interpreting debt-indicator and other statistically based models are discussed in Section VI). The papers considered in detail are those by Eaton and Gersovitz (1980), Sachs and Cohen (1982), Freeman (1979), and Guttentag and Herring (1982). The variables suggested by these models, as determining the economic optimality or profitability of default, are discussed and their implications and results compared and contrasted with the corporate debt models.

Finally in Section XI some conclusions are drawn regarding the analytic and empirical usefulness of viewing sovereign risk as an economically rational endogenous investment decision by the borrowing country.

II. The Options Pricing Model

It will be shown below that there is a relationship between the value of a call option and the "value" of a default (or repayment) option. This relationship between option pricing and the default risk on corporate liabilities (debt) has already been noted in the finance literature (see Smith (1976), Galai and Masulis (1976) and Merton (1974, 1977). One advantage of this approach is that there is a direct relationship between the theoretical valuation model and the empirical model. Specifically, this approach not only suggests a novel method of deriving a country risk measure, but the final form is amenable to direct estimation, i.e., there is no need to argue on a priori grounds over the variables which ought to be included in the country risk measure. Rather the model specifies them within an equilibrium setting.

1. The relationship between a call option and default risk

Consider a call-option where the buyer has the right to buy a specified number of shares at a given price (the exercise price) on a specified date in the future. If the stock price (S) is above the exercise price (E) at the expiration date, $S > E$, then the owner would exercise his option and his profit would be $(S - E)$ times the number of shares. If, however, the price of the stock is below E, then the call option should not be exercised and has a value of 0.

Here the value of a call at expiration (the boundary condition) is:

$$C(0) = \text{Max}\,[0, S - E]. \tag{1}$$

Black and Scholes (1973) have shown that this call option can be valued by the following formula:

$$C(\tau) = S\phi(x_1) - Ee^{-r\tau}\phi(x_2) \tag{2}$$

where $\phi(x) = (1/\sqrt{2\pi}) \int_{-\infty}^{x} \exp[-(1/2)z^2]dz$

$$x_1 \equiv \{\ln[S/E] + (r + (1/2)\sigma^2)\tau\}/\sigma\sqrt{\tau}$$

$$x_2 = x_1 - \sigma\sqrt{\tau}$$

where r is the rate of interest (risk-free rate)

τ is the term to maturity, and

σ^2 is the instantaneous price variance of the asset.

Now consider a bank that lends B dollars to a less developed country (LDC). The LDC promises to pay back B dollars on a specified date in the future, T (B can be thought of as a discounted note). The LDC will take these funds and either invest and/or consume them. If at the maturity date, T, the country has insufficient funds to repay the debt and/or the country's collateral, V, is less than B, the face value of the loan, it is optimal for the borrower to declare default 1/ and "turn over" the collateral to the lender. Hence V has a direct analogy to S in the call option formula and B to E (the exercise price). Moreover, the value of the loan is Min [V, B], and as long as there is some probability that $V < B$ then Merton (1974) shows that it is possible to write the value of the option to repay in the form $D(\tau)$:

$$D(\tau) = V\phi(x_1) - Be^{-r\tau}\phi(x_2) \qquad (3)$$

which bears an isomorphic relationship to equation (2). Further, by manipulating equation (3) we can write the "market" value of the risky international loan $F(\tau) = V - D(\tau)$, as

$$F(\tau) = Be^{-r\tau}\{\phi[h_2(d, \sigma^2\tau)] + (1/d)\phi[h_1(d, \sigma^2\tau)]\} \qquad (4)$$

where d is the country's "debt-equity" ratio, $(Be^{-r\tau}/V)$. Alternatively, equation (4) can be rewritten in terms of an interest-rate spread, the size of which reflects an equilibrium premium for default risk, i.e.,

1/ It is argued later in Section XI that it may be optimal for the lender to refinance or reschedule the debt at more favorable terms in order to avoid exercise of the default option.

$$R(\tau) - r = (1/\tau)\ln\{\phi[h_2(d,\sigma^2\tau)] + (1/d)\phi[h_1(d,\sigma^2\tau)] \quad (5)$$

Whether we choose to estimate the value of the "default option", the "market" value of the international loan, or the equilibrium risk premium, the relevant variables needed to estimate equations (3), (4), and (5) for any given country, and therefore to rank different countries, are:

V = the value of the collateral of that country

B = the face (or promised) value of that country's debt

τ = the "average" term to maturity of that debt

σ^2 = the business risk of that country (or the variance of the value of the country's underlying assets), and

r = the risk-free rate.

2. The difference between corporate and sovereign risk

The option pricing model, developed above, requires some modifications before it can be applied to a sovereign rather than (domestic) corporate borrowers. This is because for a sovereign borrower even if the value of the assets underlying the loan (V) are greater than B (the face value of the loan), such that $V > B$, the expropriable portion of those assets if default is declared, V^A may be such that $V^A < B$, and a country may declare default rather than repaying the loan at maturity. Hence, a crucial concern to lenders is the size of V^A rather than V. More specifically, because of the nature of sovereign, as opposed to corporate, power (jurisdictional and legal) we might realistically expect that in most cases, $V_A \simeq 0$ (unless the LDC has used the funds for investment projects in the lender's country). If this is so, it might appear that loans to LDC's should never be made, since B will almost always be greater than V^A (remember that the value of the creditor's claim at T is min [V,B]). Looked at another way, if $V^A = 0$, then in this framework the default option appears to be costless to the debtor and it would seem rational for an LDC to default on any $B > 0$. If such were the case, the supply of international loans would immediately dry up.

However, it is argued here that the lenders' collateral (or insurance against default), broadly interpreted, is not acurately measured by V^A. Indeed, V^A provides a lower bound on the direct and indirect economic collateral backing the loan. This is because any immediate or windfall benefits to the debtor of declaring default have to be offset against the future costs of debt repudiation, where these costs perform an indirect insurance or collateral function for the lender. Specifically, a broader view of collateral (K) would define K as having two components. The first is V^A, any assets that are directly expropriable by the lender if a default occurs, the second (and indirect form) are the economic costs or penalties that will be imposed on the debtor in the future if he declares default today (C). The higher these latter costs the greater the indirect collateral or insurance which the lender has against default. 1/ Here lender collateral will be equal to:

$$K = V^A + C \tag{6}$$

where the second, or indirect component, would tend to dominate. Moreover, this implies that debtors will only declare default if $V^A + C < B$ (i.e., the new boundary condition is min $(V^A + C, B)$).

To better understand the basic nature of the indirect penalty of default consider, for example, a simple deterministic world where an LDC's objective is to maximize its residents' aggregate wealth, or the present value of its current and future stream of GNP (Y_t). 2/ This framework is made overly simple in order to demonstrate the basic benefits and costs (to the borrower) of debt repudiation.

If the country declares default at time $t = 0$, then for each time period in the future, it is assumed that $B_{t+1} = . . . = B_{t+n} = 0$, i.e., to be permanently rationed out of the international loan market. Clearly, such an exclusion would limit a country's growth if the supply of domestic saving (equity) is constrained and thus its future consumption and income streams would be reduced. Specifically, if with foreign loans sustainable economic growth would have proceeded at the rate g^L per period, as in a Gordon (1959) growth framework, then

$$W_L = Y_t^L + Y_t^L(1+g^L)/(1+\rho) + Y_t^L(1+g^L)^2/(1+\rho)^2$$
$$. . . + Y_t^L(1+g^L)^n/(1+\rho)^n . . . \tag{7}$$

where ρ is the LDC's social rate of discount, $Y_t^L = GDP_t - A_t$, and A_t are

1/ These future costs are particularly pertinent to the sovereign borrower since post-default the "firm" does not disappear, unlike in most corporate bankruptcies. Thus, a crucial distinction between the corporate and sovereign borrower is the permanence of the latter.

2/ Note that in international borrowing models it is usual to assume that planners maximize an inter-temporal utility of consumption function rather than a value function as used here.

debt amortization payments 1/, and W_L is the LDC's wealth. As is well known, equation (7) reduces to equation (8) as $n \to \infty$

$$W_L = Y_t^L/(\rho - g^L) \tag{8}$$

as long as $\rho > g^L$. This value of W_L can be compared to W_N, a country's wealth when excluded from the international loan market (i.e., it defaults on outstanding loans at time t = 0). By assumption $g^L > g^N$, where g^N is the sustainable rate of growth without foreign loans. However,

$Y_t = Y_t^N > Y_t^L$ where Y_t^N = GDP (on default $A_t = 0$). That is, the country enjoys a once-and-for-all windfall gain to domestic income on declaring default and eliminating the foreign transfer burden. This has to be weighed against a lower future sustainable growth rate due to future financial autarky. Thus:

$$W_N = Y_t^N/(\rho - g^N). \tag{9}$$

Hence C, the cost to a country of declaring default (lenders' indirect collateral) would be:

$$C = W_L - W_N \tag{10}$$

the difference between the present values of GNP streams, or wealth levels, in the no-default and default cases.

In this extremely simple example, the greater the difference between $g^L - g^N$, the higher is C, and the larger the indirect collateral (or insurance) the creditor has that the LDC will not rationally default at t = 0. By comparison, ceteris paribus, the larger are outstanding debt repayments, R_t (where, in this case, $R_t = A_t$) the smaller is C and the less protection lenders have against default. Alternatively, even if $V_A \approx 0$, as long as $C > 0$ the lender has some protection against default, with an insurance schedule of the form:

$$C = C(g^L - g^N, R); \quad C_g > 0, \quad C_R < 0 \tag{11}$$

1/ Debt repayments are assumed to be amortization payments only, as B (debt outstanding) is valued on a discount basis in the OPM framework. Of course the structure can easily be modified to deal with interest payments as well.

Of course, g^L, g^N, and R are likely to depend on the macroeconomic structure of the LDC, such as the number of potentially profitable investment opportunities, the proportion of investment financed by external debt rather than internal savings, and the size of the desired investment/consumption ratio, etc.

3. Respecification of the options formula

Given the above, and that the collateral of lenders to sovereign countries can best be measured by $K = C + V^A$, we can recast the option valuation equation (3) as:

$$D(\tau) = K\phi(s_1) - Be^{-rt}\phi(x_2) \qquad (12)$$

with similar replacements of V by K in the market value of debt and risk-premium equations. Hence for operational/empirical purposes there is a need to estimate a K (the penalty cost of default) for each country along the lines of the simple example developed in equations (7) - (11) above. 1/

The other variables in equation (12) appear to be more readily measurable. The face value of debt outstanding, B, can be derived from a number of sources, including the World Bank Debt Tables and the BIS Quarterly Survey of International Banking Developments. The basic question here is whether B should include only privately issued debt (bank loans and bonds) or also debt to international agencies, such as the IMF. My feeling is that this model is most appropriate for private debt since it is hard to conceive that a country would default on its loans to the IMF and other governmental agencies. 2/ Data on the average maturity of

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1/ In the discussion above the cost of default is specified as a loss of future investment opportunities due to a loan embargo. Another aspect of future cost that is likely to enter the borrower's decision, and to act as implicit collateral to the lender, is the likelihood of retaliation by lenders in the form of trade disruption. For example, lenders, by refusing new trade credit (e.g., in the form of letters or credit), may prevent the country from importing capital or raw materials essential for domestic production. The size of this type of trade disruption cost will depend on the degree of self-sufficiency (openness) of the country to trade. For example, China is relatively self-sufficient, so that the cost of trade disruption for China, post-default, might be relatively small.

2/ It might be noted here that even if borrowers view only the privately issued debt component of B as being the feasible default option set, when and if the option is exercised, the borrower is likely to face penalties from both private lenders and international agencies (e.g., both private and public lenders may cut back future loans). This jointness or complementarity is another feature of indirect collateral (C) and could be an important factor mitigating against default on private loans.

debt (τ) might be more difficult to obtain, although the World Bank Debt Tables could be used to derive some approximation based on the amortization repayment projections published there (note that the larger is τ the greater the value of the repayment option to the borrower). The σ^2 variable should measure the riskiness of the country's underlying investments (assets). Clearly, countries that embark on large and undiversified investment projects or whose revenues from projects are subject to external shocks such as changes in the terms of trade or internal shocks such as crop failures will have high σ^2 and the value of the repayment option will be greater. A reasonable approximation to σ^2 might be the variance of GNP calculated from current and past levels. Finally, r, the risk-free rate, is probably best measured by the base LIBO rate. 1/

In summary, with appropriate surrogates for K, B, r, σ^2, and τ the options pricing model might prove to be a useful tool with which to analyze sovereign risk, its main advantages being its relatively concrete specification of the underlying variables that impact on the borrower's default decision.

III. Agency-Signaling

Traditional models of borrower-lender relationships assume symmetry of information, that is, the lender has the same information set as the borrower. This is a somewhat restrictive assumption and much of the recent finance-economics literature has sought to deal with situations of asymmetry of information between borrowers and lenders (see, for example, Ross (1976, 1977) and Stiglitz and Weiss (1981)). Specifically with respect to the international loan market, once a loan is made a sovereign borrower may ignore the terms of the contract and use the funds for any of the following four purposes (see Eaton and Gersovitz (1980)):

(1) To smooth out its consumption stream over the long term if income is subject to variation;

(2) To increase the productive capacity of the country, i.e., for investment purposes;

(3) To allow a smoother short-term adjustment of consumption and investment if output is subject to unexpected shocks (e.g., crop damage due to bad weather); and

(iv) For transactions purposes, i.e., as a substitute for international reserves.

Because of the difficulties, both legal and geographic, which a bank (the principal) faces in enforcing loan contracts and in monitoring the borrower's (agent's) behavior, there is a presumption that the bank may choose to ration credit unless the borrower signals his good intentions

1/ The higher is r the greater is the value of the default option.

to the lender. However, only if false signaling is sufficiently costly (see below) will an action convey useful information to the lender regarding the possibility of default. For example, a country which chooses or pre-commits to a high ratio of investment to GNP at the expense of current consumption might be viewed as sending a favorable signal to the lender that this country is a good credit risk and that loans are being put to a productive purpose. A primitive form of this type of signal is implied in the paper by Sachs and Cohen (1982). Elsewhere in a paper by Chan and Kanatas (1983) the size of the (direct) collateral the borrower is willing to commit is viewed as a favorable signal. Alternatively, the interest rate the borrower is "willing" to pay may provide a negative signal to the lender (Stiglitz and Weiss (1981)), since it implies that higher risk investments will be undertaken with the borrowed funds. A further signal might be the country's debt-equity ratio 1/ (d), (see Leland and Pyle (1977) for the case of loans to small firms). In this case, the greater the equity participation of a country in its own development projects, the more favorable is the signal as to the attractiveness of these projects, and the less likely it is to default.

An agency-signaling model is outlined below for the international loan market based on Ross (1977). This model is representative of signaling models and describes the essential nature of the agency-signaling problem. It is shown that some similar conclusions can be drawn from this model, as to when default will be declared, as under the modified options framework developed in Section II above.

In this model it is assumed that managers of government agencies (or the planning agency) in LDCs are responsible for both borrowing and investment/consumption decisions. Moreover, these managers (technocrats) have their compensation (income, perks) linked directly to the economic performance of the country (its wealth). This is not an unreasonable assumption since persistently bad economic performance will usually lead to a managerial reorganization (e.g., a revolution). Given the centrality of the managers' position in the decision-making process, it is assumed that they have important, i.e., valuable, "inside" information regarding the true economic position of that country which is not freely available to lenders. The key assumptions therefore are: (1) managers of LDC government agencies possess inside information regarding the "true" economic position of the country; and (2) managers of LDC government agencies are compensated by a known incentive schedule.

Assumption (2) is rather strong since it implies that lenders, while having imperfect information on the economic performance of that country, do have information (perhaps through repeated experience) on the exact form of compensation scheme facing managers in LDC's. For simplicity it is also assumed that (3) there are two types of LDCs, good performers (type A), and bad performers (type Z).

1/ See equation (4).

It is assumed that there are two points in time 0 and 1, and the borrowing decision will be made at time 0. At time 1, A-type countries (good performers) are assumed to have a GNP level of Y_1^A, that is known 1/ only to type-A managers at time 0. Similarly, Z-type countries (bad performers) have a GNP level of Y_1^Z, that is known only to type-Z managers at time 0. 2/ Further,

$$Y_1^A > Y_1^Z \tag{13}$$

or in terms of wealth or present values at time 0,

$$V_0^A = Y_1^A/(1+\rho) > V_0^Z = Y_1^Z/(1+\rho) \tag{14}$$

where ρ is the appropriate social rate of discount (assumed to be equal across countries).

However, although managers in LDC's know Y_1^A and Y_1^Z, lenders have insufficient information to distinguish between A and Z, i.e., there is asymmetry of information between borrowers and lenders. 3/ The crucial question is, under what circumstances will the managers in good countries (type A) and bad countries (type Z) have incentives to reveal or signal the true nature of their economic situation to international lenders so that the loans made to type A and type Z countries are optimal from a lender's perspective.

Suppose that LDC managers receive compensation according to the following scheme:

$$M \begin{cases} = (1+\rho)\gamma_0 V_0 + \gamma_1 V_1 & \text{if} \quad V_1 > B \\ = (1+\rho)\gamma_0 V_0 + \gamma_1 V_1 - C & \text{if} \quad V_1 < B \end{cases} \tag{15}$$

where B is the face value of loans borrowed by the LDC. This scheme implies that managerial compensation is linked to the perceived wealth

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1/ It is possible to make Y_1^A uncertain, i.e., $\tilde{Y}_1^A$. However, the results the basic model still follow.

2/ Although performance and incentives are specified here in terms of GNP levels, the structure of the problem would remain the same if the problem were recast in terms of reserves or revenues from net exports.

3/ It should also be noted that ordinary LDC residents are placed in the same information class as lenders.

of the country (economic performance) at each point in time (i.e., V_0 and V_1), and γ_0 and γ_1 are shares of that perceived wealth allocated to the managers of the LDC. In this compensation scheme, C is the penalty cost imposed on the LDC, and implicitly on the managers of the LDC, if it defaults on its loans at time 1 (i.e., if $V_1 < B$). Note, therefore, that a high C will significantly reduce M, and thus provide an incentive to LDC managers to avoid default through overborrowing.

Given the form of equation (15), the compensation schedule, where γ_0, γ_1, ρ, and Y_1^j, j = A or Z, are known to the LDC manager, then the manager's only decision variable is B, the size of international loans, in maximizing the size of his compensation (M).

It is now possible to examine the circumstances under which a signaling equilibrium will be established. That is, the circumstances under which managers in low-risk, high-performance countries (type A) choose high debt levels (B) and managers in high-risk, low-performance countries (type Z) choose low debt levels (B). In such an outcome, B (the demand for debt) can be taken by lenders as an unambiguous signal of the true risk-type of the debtor country.

Let B* be some critical level of loans, with

$$Y_1^Z < B^* < Y_1^A \qquad (16)$$

that is, the GNP of the bad performer lies at or below this level (would be unable to repay) while the GNP for the good performer exceeds this level. Hence, if $B > B^*$, international lenders perceive the country to be of type A and if $B < B^*$, to be of type Z.

Suppose at time 0, the manager of an LDC signals that it is type A, and sets $B^A < Y_1^A$--so that it does not overly expose itself to default risk. Then at time 0 it will have a wealth level of

$$V_0 = V_0(B^A) = Y_1^A/(1+\rho) \qquad (17)$$

while for an LDC that gives a type-Z signal by borrowing only $B^Z < Y_1^Z$, wealth would be

$$V_0 = V_0(B^Z) = Y_1^Z/(1+\rho). \qquad (18)$$

Further, the compensation of managers in <u>type-A</u> countries over the period would be given by

$$M_A(B) \quad \begin{aligned} &= (\gamma_0+\gamma_1)Y_1^A \quad \text{if} \quad B^* < B^A < Y_1^A \\ &= \gamma_0 Y_1^Z + \gamma_1 Y_1^A \quad \text{if} \quad B^A < B^* \end{aligned} \tag{19}$$

while the compensation for type-Z managers would be given by

$$M_Z(B) \quad \begin{aligned} &= \gamma_0 Y_1^A + \gamma_1 (Y_1^Z - C) \quad \text{if} \quad B^Z > B^* \\ &= (\gamma_0+\gamma_1)Y_1^Z \quad \text{if} \quad B^Z < Y_1^Z < B^* \end{aligned} \tag{20}$$

Suppose managers in type-A countries choose loan levels

$$B^* < B^A < Y_1^A \tag{21}$$

while those in type-Z countries choose

$$B^Z < Y_1^Z < B^* \tag{22}$$

This would be a signaling equilibrium (see Spence (1974)) since, once B is chosen, neither manager has an incentive to change signals. To show that this is a signaling equilibrium we have to examine the conditions under which equations (21) and (22) dominate choices when other debt levels are chosen.

Consider first a type-A country; suppose instead of equation (21) the manager selected a debt level $B' < B^*$, i.e., below the critical level. Then it is clear that

$$M^A(B^A) = (\gamma_0+\gamma_1)Y_1^A > M(B') = \gamma_0 Y^Z + \gamma_1 Y_1^A \tag{23}$$

a rational manager in a "good" country would have no incentive to choose a debt level below B^*, as this would reduce his compensation by $\gamma_0(Y_1^A - Y_1^Z)$.

However, the case is not so straightforward for the bad, type-Z, country. Suppose at time 0 the type-Z manager chose a debt level higher than the critical level $B' > B^*$. Then

$$M^Z(B') = \gamma_0 Y_1^A + \gamma_1 (Y_1^Z - C) < M^Z(B^Z) = (\gamma_0 + \gamma_1)Y_1^Z \tag{24}$$

or

$$\gamma_0(Y_1^A - Y_1^Z) < \gamma_1 C \tag{25}$$

That is, a manager of the "bad" LDC will only signal truthfully if his gain from sending a false signal to lenders (that the LDC is a good performer) $\gamma_0(Y_1^A - Y_1^Z)$ is outweighed by the penalty cost of default (C) times the manager's share, γ_1 or $\gamma_1 C$. Or, more simply, it implies a trade-off between a gain at time 0 and loss at time 1.

The significance of equation (25) is to emphasize once again the role and importance of penalty costs in default decisions. If we relax the restriction of the two moments in time (one period) framework used above and interpret C broadly as the cost in terms of future GNP (growth opportunities) following a loan repudiation and imposition of credit restraints, then equation (25) implies that the manager of the LDC considering a repudiation has to compare his one-time gain in compensation, due to the perceived increase in GNP, $\gamma_0(Y_1^A - Y_1^Z)$, against the cost of a possibly permanent decrease in future GNP levels and therefore a permanent decrease in his future compensation, $\gamma_1 C$. Clearly, the larger is C, the more protection lenders have against false signaling by LDC "managers" and therefore against LDC default. That is, C will play the role of implicit collateral or insurance for lenders.

If instead we viewed the penalty cost as a loss of expropriable assets on declaration of default, then $\gamma_1 C$ in equation (25) would be very small, since $V^A = C \simeq 0$, and there would be every incentive for managers in type-Z LDCs to send false signals to lenders and to enjoy the one-time increase in compensation that results. In such a world loan applications would result in clear moral hazard and sorting problems for lenders, such that the supply of international loans are likely to be severely rationed in response.

In summary, the agency-signaling framework is useful because it highlights the trade-off between the economic benefits and costs of false signaling to lenders (i.e., eventual repudiation) and suggests that appropriate incentives may exist for borrowers to avoid default. Unfortunately, without precise knowledge of managerial compensation schemes, e.g., the parameters γ_0, γ_1, or the functional forms of the compensation schedules, it is not clear that such models (e.g., equation (25)) are estimable in order to develop an operational country-risk ranking. 1/

1/ The conventional wisdom in this literature is that the compensation schedule, equation (25), is set competitively so that M will equal the opportunity return, if the LDC "managers" were to be employed in their next best occupation.

IV. Conventional Risk Premium or Interest Spread Models

The basic idea of conventional interest-spread or risk premium models is that the "market's" subjective expectation of default is fully impounded in the interest rate charged on the loan, and thus will be reflected in a premium charged over the market risk-free or base rate. This type of risk-spread measure has been widely used in empirical studies on the relative riskiness of different corporate debt issues (see Fisher (1959) for a classic application). Moreover, the interest spread forms the basis of the Euromoney country risk index, and the advantages of the spread, as measure of country risk, have also been advocated by a number of researchers (see Haegele (1980), Feder and Just (1977) and Angeloni and Short (1980) among others). Unfortunately, these studies have been primarily concerned with explaining the size of the risk-premium ex post with a number of a priori specified exogenous variables that are used as surrogates for firm or country risk. However, the view taken in this survey is that these models are of little use as ex ante predictors of country risk without an underlying analytic foundation. Thus in this section an analytic framework for an interest spread model on international loans is developed based on work by Bierman and Hass (1975), Yawitz (1977, 1978), Pye (1974), Ho and Saunders (1981), and John and Saunders (1983).

Below, two cases are considered where: (i) the bank is a risk-neutral lender and (ii) the bank is risk-averse:

1. Risk-neutral case

Let $(1-\rho)$ be the bank's subjective probability that a country will default on its loan, ρ be the probability that it will repay, k be the rate of interest charged (required rate) on the loan, R_f be the rate on risk-free loans, and γ be the collateralized portion of the loan (where $0 < \gamma < 1$). Hence, the larger is γ, the more protection the lender has. Consider the case where collateral on default is only V^A (expropriable assets). As discussed above, since $V^A \approx 0$ for many international loans, then $\gamma \approx 0$. In such a case a risk-neutral bank is just indifferent between making a risky loan to an LDC and investing in risk-free assets when:

$$0(1-\rho) + \rho(1+k) = 1 + R_f \tag{26}$$

Solving for k, the required interest rate on the risky loan is

$$k = [(1 + R_f)/\rho] - 1 \tag{27}$$

with a risk-premium, ϕ, equal to

$$\phi = [(1 + R_f)/\rho] - (1 + R_f). \tag{28}$$

Here ϕ would be a measure of this LDC's default risk. To get some idea of magnitudes: if $R_f = 0.10$ and $\rho = 0.95$, i.e., there is perceived to be a 0.05 probability that the LDC will repudiate its debt (principal plus interest) 1/, then $\phi = 0.058$, or lenders would demand a risk premium, over the risk-free rate, of 5.8 percent. Note that a rational lender should base his subjective probability of repayment estimate, ρ in equation (28), on his evaluation of the probability that the borrower's "costs" of loan default outweigh the benefits. Thus ρ, the probability (Pr.) of repayment, is conditional on the size of the net penalty cost (C) facing the borrower if he repudiates on his commitment at the end of the period, or $\rho = Pr.[1+k > 0] = f(C)$. Here we will ignore contagion effects on ρ, where the perceived value of C for country j adversely affects the ρ for country i, as well as credit rationing, since these effects are discussed in detail in Saunders (1983a) and in Section X.

In the more general case where $\gamma > 0$, some direct collateral or assets of the LDC can be expropriated on default, and the equilibrium relationship between the expected return on the loan and the risk-free loan rate will be

$$\gamma(1+k)(1-\rho) + \rho(1+k) = 1 + R_f \tag{29}$$

Solving for ϕ, the risk-premium, we find

$$\phi = [(1 + R_f)/(\gamma + \rho - \rho\gamma)] - (1 + R_f). \tag{30}$$

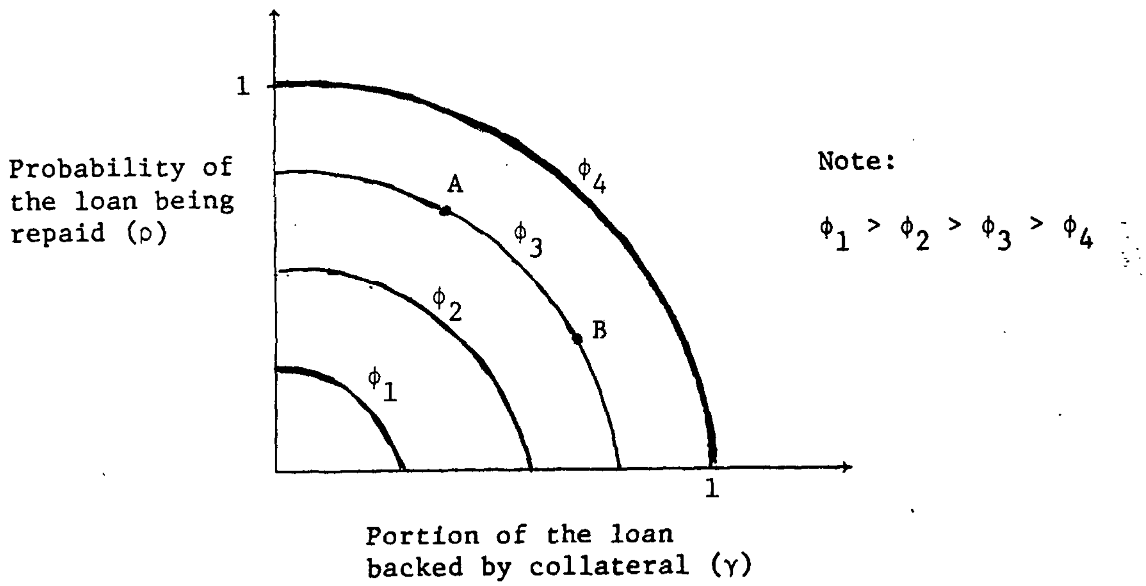
The importance of direct and indirect collateral to the cost of international loans to LDC's can be seen more clearly by comparing equations (28) and (30) and extending the simple numerical example. If $R_f = 0.10$ and $\rho = 0.95$ as before, but $\gamma = 0.9$, then ϕ is only 0.006 or 0.6 percent. Moreover, it might be noted that ρ, the probability of loan repayment, and γ, the directly "collateralized" portion of the loan, enter symmetrically into equation (30). That is, a $\rho = 0.8$ and $\gamma = 0.7$ results in the same ϕ (risk premium) as a $\rho = 0.7$ and $\gamma = 0.8$. For a risk-neutral lender a 0.1 increase in direct collateral (perhaps through a system of external loan guanteees by a third party 2/) is a perfect substitute for a 0.1 increase in the perceived probability of default due to a reduction in indirect collateral (i.e., reduction in the penalty costs of default facing the borrower).

1/ For simplicity it is assumed here that all interest and principal is repaid on maturity of the loan. Of course, the formula can be modified to deal with periodic interest and principal payments (see Yawitz (1977).

2/ This might take the form of guarantees from an agency such as COFAX.

Figure 1

Iso (Risk) Premium Curves on International Loans



This trade-off can be seen in Figure 1 for various iso-premium curves, and where points A ($\rho = 0.8$, $\gamma = 0.7$) and B ($\rho = 0.7$, $\gamma = 0.8$) are as shown.

2. Risk-averse case

It is often argued, in the banking literature, that a bank may price its loans in a risk-averse rather than a risk-neutral fashion. For example, in the presence of incomplete capital markets (see Baron (1981)) risk aversion may be a more appropriate assumption in analyzing equilibrium risk premiums set by banks.

When bank risk aversion is introduced, the relationship between the ϕ (risk premium) on the loan and ρ and γ is more complex. In particular, ϕ will also depend on the size of the loan as well as the form specified for the bank's utility function.

As is well known (e.g., Hammond (1974)) the exponential utility function $U = -e^{-aA}$ is the most widely used and tractable framework within which to analyze risk-sharing problems when an agent is risk averse. 1/ In this specification a is the coefficient of (absolute) risk aversion and A is the size of the loan. For this utility function we can replace the expected value by the certainty equivalent (h) of the risky outcome. That is,

$$-e^{-ahA} = \rho(-e^{-aA}) + (1-\rho)(-e^{-a\gamma A}). \qquad (31)$$

Therefore

$$-e^{-ahA} = \rho(e^{-aA} - e^{a\gamma A}) + e^{-a\gamma A} \qquad (32)$$

and

$$-ahA = \ln[\rho(e^{-aA} - e^{-a\gamma A}) + e^{-\gamma A}] \qquad (33)$$

so that the certainty equivalent (CE) fraction, h, is defined as

$$h = (1/-aA)\{\ln[\rho(e^{-aA} - e^{-a\gamma A}) + e^{-\gamma A}]\}. \qquad (34)$$

1/ Note that the exponential utility function implies constant absolute and diminishing relative risk aversion. If the quadratic form was used instead both absolute and relative risk aversion are increasing. This is one of the major reasons why the exponential form is preferred to the quadratic.

Solving for k, the required interest rate, when h = CE of promised payments 1+k,

$$k = [(1 + R_f)(aA/\ln B)] - 1 \qquad (35)$$

where β is a composite term defined as

$$\beta = 1/[\rho(e^{-aA} - e^{-a\gamma A}) + e^{-\gamma A}] \qquad (36)$$

and the risk-premium, ϕ, is

$$\phi = (1 + R_f)(aA/\ln B) - (1 + R_f) \qquad (37)$$

The general interrelationships between ϕ (the risk premium) on the international loan, a, the coefficient of risk aversion, A, the size of the loan, ρ, the probability of repayment, and γ, the collateralized portion of the loan in equation (37) can be seen from Table 1.

Specifically, we can see that for any risk-free (or base LIBO) rate R_f,

$$\phi = \phi(\underset{+}{a}, \underset{+}{A}, \underset{-}{\gamma}, \underset{-}{\rho})$$

The higher, ceteris paribus, is the bank's coefficient of risk-aversion (a) and the larger the size of the loan (A), the higher is ϕ. Conversely, the larger is the collateral coefficient (γ) and the probability of repayment (ρ) the smaller is the risk premium.

A further important difference between the risk-neutral and risk-averse cases is that an increase in γ, or direct collateral, is no longer a perfect substitute for a fall in the probability of repayment due to a reduction in indirect collateral, ρ. That is, ρ and γ are no longer symmetric or perfect substitutes (as in equation (30) and Figure 1), although it is still possible to partially trade off a higher γ for a lower ρ.

In principle, ex ante country risk measures using either the bank risk-neutrality pricing equation (28) or the bank risk-aversion equation (37) are estimable for individual LDC's. However, as in the options model a crucial input is an estimate of the net benefit or costs to the borrower from choosing default, since it is on such an estimate the lender's subjective probability of repayment (default) is conditional

Table 1. Some Examples of the Relationships Between ρ, γ, A, a, and ϕ

ρ Probability of Repayment	γ Collateralized Portion	A Size of Loan ($1,000's)	a Risk Aversion Coefficient	ϕ Risk Premium on Loan
0.7	0.8	5	.000002	.0714
0.7	0.8	5	.00005	.0851
0.7	0.8	150	.000002	.0725
0.7	0.8	150	.00005	.1171
0.7	0.9	5	.000002	.0345
0.7	0.9	5	.00005	.03757
0.7	0.9	150	.000002	.0347
0.7	0.9	150	.00005	.0445
0.8	0.8	5	.000002	.0467
0.8	0.8	5	.00005	.0570
0.8	0.8	150	.000002	.0475
0.8	0.8	150	.00005	.0842

upon. Moreover, while A, the size of the loan(s) is obviously available, 1/ there are major problems in estimating both a, the bank's coefficient of risk-aversion, and γ, the direct collateral portion.

In summary, the interest spread model demonstrates the importance of the size of the penalty cost relative to the benefits of default on the lender's subjective probability of repayment in determining the equilibrium spreads on international loans. In addition, it provides useful insights into the role of indirect collateral (penalty costs of default) as a substitute for direct collateral on the loan. Thus, even if direct collateral backing the loan is small, loan spreads or risk premiums might be small, as long as the penalty costs of borrower default, as perceived by the lender, are high.

V. State Contingent Claims

Myers (1977) has developed a risky-debt model (for a firm) that provides some very useful insights into the nature of the (penalty) costs of debt repudiation.

As in the simple example in equations (7) - (10), we assume that the LDC's objective is to maximize the country's wealth or the present value of its current and future GNP (V). Following Myers, this aggregate V can be broken down into the present value of the GNP stream that would be generated by assets already in place in the country (V_A) and the present value of the future income stream that will result from exercising future profitable investment (growth) opportunities (V_G)--i.e., investments that could be made by the LDC to yield a social rate of return greater than the cost of capital. Thus in the Myers framework, $V = V_A + V_G$. However, Myers' model implies that the presence of risky debt may result in a country not fully undertaking all its profitable future growth opportunities, so that V_G should be viewed as the present value of options to make future investments.

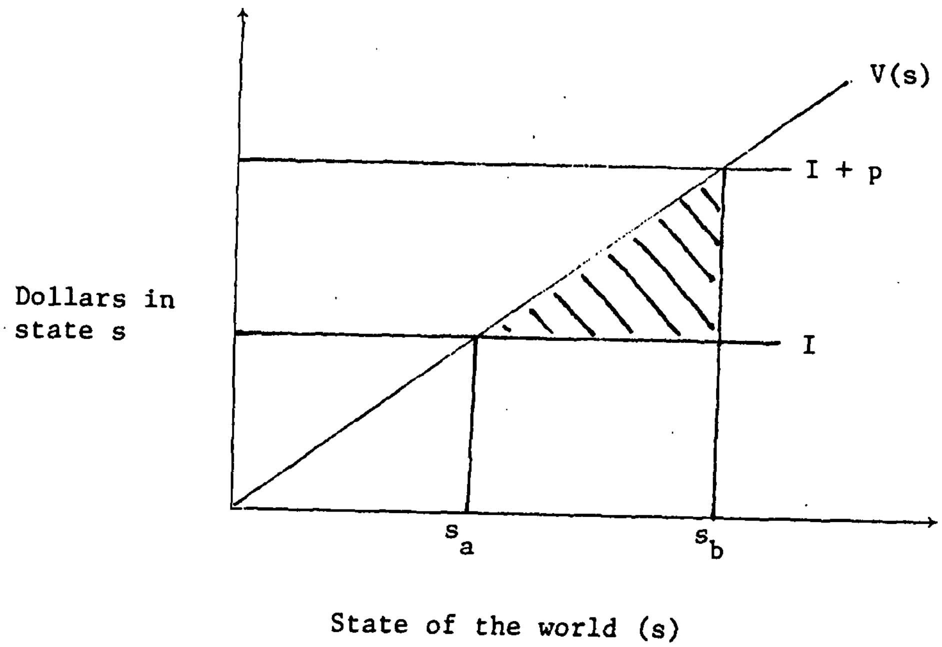
To see why this result may occur, and the costs to the country from repudiating its debt, consider the following two scenarios. The first is that of a country which has sufficiently large savings to self-finance all projects whose net present values are positive. The second is where the country has to rely on external debt to partly finance these projects.

For the sake of simplicity, assume that $V_A = 0$, that the LDC has one future investment opportunity which costs I, and that the project is initially self-financed. Under these conditions an initial investment of

1/ The intuition as to why a larger A leads to a higher risk premium is that the lender's base period or initial wealth (capital) is given. Thus a larger loan size, given initial wealth, suggests that the risk from non-payment is larger. Note that this is true regardless of whether the bank (lender) is a liability manager or a deposit-taker (see Ho and Saunders (1981)).

Figure 2

Investment Decisions in a State Contingent World



I (at t = 0) will produce assets worth V(s) at t = 1, where s is the (uncertain) state of nature that exists at time t = 1. That is, investment I is a state contingent claim. If the LDC decides not to invest, then the investment option expires and the forgone opportunity has no wealth enhancing value to the country. Clearly in this simple world the LDC will invest if:

$$V(s) > I \tag{38}$$

The value of the investment opportunity is greater than its cost. This decision can be seen in Figure 2.

As can be seen, s_a is the break-even state, and the net present value of the investment to the LDC if the investment is made is:

$$V_1 = \int_{s_a}^{\infty} q(s)[V(s) - I]ds \tag{39}$$

where q(s) are the state contingent prices (the equilibrium price of one dollar) received in all states, $s > s_a$.

Next, suppose that the country cannot self-finance the project. Instead it has to partially finance by borrowing from abroad. Note that since for some states of the world the investment will make losses the debt is viewed as risky. It is assumed that the LDC can initially borrow at some rate, r, which makes promised repayments to the LDC lender equal to P, and that the loan has to be repaid (matures) after the country's investment option expires. From the LDC's point of view, the investment option is only now worth exercising if $V(s) > I + P$, i.e., the state contingent value of the investment exceeds the initial outlay plus the promised payments to the lender (the transfer-burden). If $V(s) < I + P$ the initial outlay of resources by the country would be less than the net market value of the project (if debt is repaid), and will only be greater if debt is repudiated (or perhaps partly repaid). In the case where debt is repaid, the break-even state is now $s_b > s_a$ (see Figure 2) where s_b is the state for which

$$V(s) = I + P \tag{40}$$

and if the investment is undertaken, its net present value is

$$V_2 = \int_{s_b}^{\infty} q(s)[V(s) - I]ds \tag{41}$$

where $V_2 < V_1$.

Clearly, there is a direct link between P, the required payments to lender (the transfer burden), the break-even state, and the number of growth opportunities that can be invested in (or options exercised). The loss to the LDC from borrowing as opposed to self-financing the project is the triangular area in Figure 2.

Now consider the case where the country has repudiated its debt at time t - 1. If this takes place, a country might be expected to maintain all its assets in place (V_A), since as noted previously, it is unlikely that outside lenders will be able to expropriate a significant proportion of these assets. However, where lenders will be able to hurt the LDC is in the availability and price of loans at time t = 0 (given that the LDC is subject to a self-financing constraint). In the case where future loans are still made, but at a much higher price, I + P will be large and the number of growth opportunities (options) that the LDC can exercise will be small. In the more extreme case of a total external credit (loan) embargo then, effectively $P = \infty$ and V(s) is less than I + P in all states of nature; so that no growth opportunities will be exercised at all. Hence for such a country financial autarky implies that $V = V_A$ as $V_G = 0$.

Thus, the Myers model is intuitively appealing, implying that the cost of debt repudiation (to an LDC) is its inability to exercise its future (profitable) growth opportunities or options and is therefore forced to make sub-optimal investment decisions. The higher the required repayments (P) imposed by lenders, the larger is the penalty cost imposed on the borrower with, in the extreme case, all its future investment options expiring as valueless due to the cost of external finance. Interestingly, this model results in a similar notion of penalty cost as implied by the simple Gordon growth model developed earlier. Here, as in the Gordon model, the penalty cost of default can be viewed as the difference between two growth paths or present values. In the Myers model, repudiation and a credit embargo will result in $V^D = V_A$, with $V_G = 0$ while non-repudiation results in $V^N = V_A + V_G$, with $V_G > 0$, where the size of V_G is dependent on the level of P.

Clearly, the penalty cost of default (C) to the borrower will be:

$$C = V^N - V^D \tag{42}$$

which is analagous to equation (10) when the windfall benefits to repudiation are added.

VI. International Borrowing Models

The major theme in international borrowing models has been to explain the debt capacity and/or sustainability of borrowing countries. Overwhelmingly, the emphasis has been on developing statistical indicators or empirical models to "explain" debt capacity (these papers are extensively reviewed in McDonald (1982)). To see the problems with the conventional indicator type of approach, consider the five indicator ratios suggested in a recent paper by de Vries (1983): total external debt as a percent of exports, external debt maturing within one year as a percent of exports, external debt service as a percent of exports, gross foreign borrowing as a percent of exports, and liquid foreign exchange reserves as a percent of imports and maturing debt. In all five ratios, the size of debt outstanding in one form or another enters with a negative effect. However, it might be reasonably argued that high debt should be viewed as a good credit signal. This is certainly the theme of the credit-rationing literature which views credit as forthcoming only to good borrowers (i.e., is supply side determined). Alternatively, consider the following question as to which of two countries is more likely to default in a world where default is viewed as a rational financial decision: Country A with large debt outstanding but with extensive future growth opportunities (following Myers (1977)) or Country B with a smaller amount of debt outstanding but with few, if any, future growth opportunities. While Country A has larger benefits from declaring default, compared with Country B, in terms of windfall gains to gross national income (or domestic equity), it also faces larger future costs as it will be unable to exercise a larger subset of its future profitable investment options if credit rationing is imposed by lenders in future periods or the costs of new loans increase. Thus simply comparing the levels of debt outstanding, at any moment in time, is inadequate without also considering the future objectives and investment opportunities of the borrower and therefore the future costs of default.

Perhaps out of dissatisfaction with this "one picture at a moment in time" approach to debt capacity, a separate strand in the literature has been the development of optimal growth models where the size of foreign borrowing is an endogenous decision made by a planner to optimize the allocation of a country's consumption over time.

Thus in these models foreign borrowing is a means to supplement a constrained or limited supply of domestic saving. In early models of this type (e.g., Hamada (1966)) the default option is completely ignored and the country is assumed to be able to borrow an infinite amount of funds at the world rate of interest to reach its golden-age growth path. This type of small-country interest-rate assumption has also carried through to the recent work of Dornbusch (1983) and Obstfeld (1981). In other models, such as Bardhan (1967), Hamada (1969), McCabe and Sibley (1976), and Bruno (1976), the cost of debt is viewed as an increasing function of the level of debt outstanding to the borrower, so that the level of debt is viewed as a proxy for default risk. However, as noted above, a high level of debt outstanding at any moment in time might be indicative of either a high or low level of default risk since its riskiness is relative to the growth opportunities of the borrower. Similar criticisms can be made of the study by Hansen (1974), which views the cost of debt as an increasing function of both the level of debt and the country's debt-equity ratio.

The only optimal borrowing models that explicitly deal with the borrowers' option to default as a rational intertemporal decision, with a well defined stream of benefits and costs and whose likelihood directly affects, in turn, lenders' decisions, are recent models by Eaton and Gersovitz (1980), Sachs and Cohen (1982), Freeman (1979), and Guttentag and Herring (1982). These models are reviewed and compared in the sections below.

VII. The Eaton and Gersovitz (EG) Model

In the EG model, LDC borrowing is seen as a method of smoothing the path of domestic consumption or absorption over time, rather than financing new investment projects. The idea of finance for consumption is analagous to the recent concern about stockholder and bondholder (agency) conflicts in the corporate finance literature. That is, in the absence of direct monitoring and bonding, the claims of bondholders can be dissipated (to the advantage of stockholders) by payments of excessive dividends, leaving the company an empty shell. However, such agency questions are not addressed by the EG model since it assumes symmetry of information between borrowers and lenders, i.e., lenders are assumed to know exactly what borrowers are doing (i.e., using loans for consumption rather than investment purposes). 1/ Consequently, in the EG model lenders can always ration credit in order to avoid default, so that ultimately default is always avoidable if lenders make rational decisions. Hence, the major contribution of the model is the possibility that loans may be used for consumption smoothing purposes rather than investment, and in its endogenous derivation of the costs of default.

Since there is no investment in the EG model (I = 0), the budget constraint facing the country is:

$$c_t = y_t + b_t - p_t \tag{43}$$

where c_t = domestic absorption

y_t = domestic output (GDP)

b_t = funds borrowed from abroad, and

p_t = debt-service repayments (interest plus amortization).

It is assumed that output, y_t, and therefore c_t, are variable (actually, as initially specified by EG, y_t changes in a deterministic fashion over time).

1/ Lenders also know the exact benefits and costs to the borrower from default, i.e., the whole structure of default incentives is known.

The LDC's planner is assumed to maximize an intertemporal expected utility of consumption function of the form:

$$E[\sum_{t=0}^{\infty} \beta^t U(c_t - P_t)] \tag{44}$$

where $U' > 0$, $U'' < 0$, $0 < \beta < 1$, and P_t is an exogenous one-time default penalty imposed by the lender on the borrower (analogous to V^A or directly expropriable collateral). However, this is only part of the penalty cost of default since the EG model assumes that if a country declares default it will face a permanent embargo on future loans, i.e., $b_{t+i} = 0$. The economic cost of this embargo is the second or endogenous part of the penalty cost and is analogous to our C or future penalty costs of default. Note also that as specified in equation (44) the LDC planner's objective function is assumed to exhibit risk-aversion. 1/

It is further assumed that all debt matures in one period, so that the debt repayment (d_t) function is:

$$d_{t+1} = R(b_t) \tag{45}$$

where b_t is the face value of the debt. If a country decides to default at time t it will make payments $p_t < d_t$, on existing debt and will face a permanent embargo on future loans. Hence, in equation (44) we would find

$$\beta^{\tau} = (0)\forall_t > t.$$

The problem for the LDC, then, is to select values of international loans and debt repayment, b and d, respectively, each period such that default will only be chosen when the value of the objective function (44) with default, or V^D, is greater than its value with repayment, V^N (where D implies default and N no-default). That is, with default in period t

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1/ However, since perfect information (no information asymmetry) and perfect competition (complete markets) are assumed, it is unclear why the planner would be risk averse rather than risk neutral. This is a problem encountered in virtually all the optimal borrowing models, despite the fact that nonlinearity of the utility function is crucial in deriving the results. Consequently, one area which future work might improve on is in the motivation for the form of the utility of consumption function selected by the borrowing country's decision maker.

$$V^D = E[\sum_{\tau=t}^{\infty} \beta^{\tau-t} U(y_t - P_t)] \quad (46)$$

and with a decision not to default in period t

$$V^N = \sup \{U(y_t+b_t-d_t) + \beta E \max [V^N(y_{t+1}, d_{t+1}), V^D(y_{t+1})]\} \quad (47)$$

and the probability of a country's declaring default is:

$$\lambda(d_t) = \Pr[V_t^D > V_t^N].$$

Assuming that y_t, and therefore c_t, fluctuate between high and low values over time, the EG model shows that default risk will be smaller:

(1) the larger the deviation of GDP from trend (σ). The idea here is quite simple; since the LDC only borrows to smooth consumption over time, the more volatile the income stream, the more valuable is borrowing. Hence LDCs that face large σ's due to excessive reliance on a few commodities or crops and/or are highly sensitive to changes in the terms of trade, will be relatively good credit risks in the EG paradigm. 1/

(2) the larger the direct penalty costs of default (P_t). This is intuitively reasonable, since as discussed before the more assets or collateral a lender can directly expropriate from a borrower, the less likely it is that the borrower will default.

(3) the smaller the rate of interest (r). 2/ A fall in the rate of interest will tend to increase the present value of future consumption and therefore increase the cost (in terms of forgone consumption) of a future credit embargo. Moreover, a decrease in the rate of interest lowers required payments (p_t) on international debt.

(4) the larger the rate of growth (g) of GDP (y_t), as long as the LDC planner is either risk-neutral or has a relatively low level of risk-aversion. (However, the EG model shows that there is a special case where a high rate of growth combined with a high degree of risk aversion could increase default risk.)

1/ Note that in many cases the size of σ^2 is often due to supposedly endogenously "controlled" factors such as the monetary and fiscal policies the country adopts rather than uncontrollable events such as variations in crop yields and the terms of trade. However, the relationship between policy sources of income variation and default risk has been badly neglected in the literature.

2/ Where r is a component of required payments on debt (p_t).

In summary, while the EG model is rather limited in that it concentrates on borrowing for consumption or absorption purposes only, it is extremely useful in giving further definition to the economic factors that impact an LDC's default decision, especially the elements of the future or penalty costs of default. In the EG model the lenders' "insurance" protection, or direct and indirect collateral against default, will take the form:

$$K = P + C(\sigma, r, g) \tag{48}$$

where $C_\sigma > 0$, $C_r < 0$, $C_g > 0$, and P is identical to V^A discussed in equation (11) (the directly expropriable assets) and r and g act in a similar fashion to R and $g^N - g^L$, respectively, in equation (11). The additional insurance aspect suggested by the EG model is the variance of GDP (assumed to be deterministic). The larger the value of σ the greater the protection lenders have against LDC default. It should be added, however, that σ can only be regarded as providing insurance if the variation of GDP is deterministic or known with relative certainty ex ante (as assumed in the EG model). Specifically, in the EG model a period of high GDP is followed deterministically by a period of low GDP so that there is no uncertainty, as such, regarding the path of future income levels. If GDP is assumed to be ex ante uncertain (i.e., stochastic over time) 1/ then the optimality of default may be largely determined by uncontrollable events. In such a case, while default can still be viewed as a rational endogenous decision, shocks or unexpected variability in GDP, are the prime determinants of this decision. Thus in this scenario high variance in GDP results in an increased probability of default. This is essentially the model considered by Sachs and Cohen (1982) below.

VIII. The Sachs and Cohen (SC) Model

A two-period model is assumed in which the country can only borrow in the first period and may or may not default in the second. Further, default is assumed to be total with no possibility of renegotiating ex post. 2/ The only uncertainty in the model is over the level of the country's output (GDP) in the second and final period; otherwise all other variables and parameters are known to both borrowers and lenders.

Because of this second period output uncertainty, the LDC's planners are viewed as maximizing an expected utility (EU) of consumption function of the form:

1/ For example, a reduction in GDP in one period may be followed by either a further fall or rise in GDP in the next period.

2/ It should be noted that Sachs and Cohen explicitly consider and compare this case with that when the LDC and lender can engage in ex post renegotiation.

$$EU = C_1 + \{[E(C_2|d)]/(1+\delta)\}\pi + \{[E(C_2|n)]/(1+\delta)\}(1-\pi) \qquad (49)$$

where C_1 is consumption in period 1 and C_2 is consumption in period 2, conditional on whether default (d) or repayment (n) is chosen by the "planner". Further, π is the probability of the LCD declaring default in the second period and δ is the LDC's social rate of time preference. Unlike the EG model, borrowing in period 1 (D_1) can be used to finance <u>either</u> current consumption (C_1) or investment (I). While consumption is exhaustive, investment adds deterministically to next period's output (GDP) and can be expected to affect the probability of repayment (note that investment only takes place in period 1). Hence

$$C_1 = Q_1 - I_1 + D_1 \qquad (39)$$

and

$$C_2 = \max\,(C_2^d, C_2^n) \qquad (40)$$

From equations (50) and (51) it is clear that given C_1, default will be chosen according to whether $C_2^d \gtrless C_2^n$.

To give more substance to the default/repayment decision, the Sachs model assumes that if the country defaults on its loan repayments at the end of period 1, its consumption level will be

$$C_2^d = (1 - \lambda)\tilde{Q}_2 \qquad (41)$$

where λ is the <u>known</u> per dollar penalty cost of default. Equation (52) is crucial to the model since it implies that λ, the per dollar penalty cost of default, is held constant or given exogenously at the beginning of period 1, and that it reflects all the possible costs of retaliation a lender can impose on a borrower, including trade disruption, expropriation of goods (assets) and embargos on future credit. As a result, what really drives the default decision are the uncontrollable variations in period 2 output, $\tilde{Q}_2$. This can be seen more clearly from equation (53) below, where $\tilde{Q}_2$ is assumed by the SC model to be determined by the following (stochastic) process:

$$\tilde{Q}_2 = \tilde{Q} + (1+\eta)I. \qquad (53)$$

Although part of period 2's output is endogenously determined by investment (I) in period 1, and η, the known marginal rate of return on this investment, the second component of $\tilde{Q}_2$ is a stochastic variable, $\tilde{Q}$ (reflecting crop failures, changes in terms of trade, etc.) which is assumed to be distributed over the range $[0, Q_1]$. These assumptions effectively imply that the decision to default is determined by output shocks or income variation due, for example, to unexpected (and adverse) changes in the terms of trade.

In the case where the LDC "chooses" not to default, consumption in period 2 is:

$$C_2^n = \tilde{Q}_2 - (1+r)D_1 \tag{54}$$

i.e., the uncertain period 2 output minus loan repayments where lenders in this model are assumed to be risk-neutral and to set the interest rate on loans (r) as in the simple interest spread model discussed in Section IV.

Given equations (52) and (54), the probability of an LDC declaring default will therefore be

$$\pi = \Pr[\lambda\tilde{Q}_2 < (1+r)D_1] \tag{55}$$

or

$$\pi = \Pr[C_2^d > C_2^n] \tag{56}$$

that is, default occurs when the total default costs, equal to λ (the per dollar penalty) multiplied by uncertain period 2 output are less than required repayments on the debt. Again, the implication that the default decision is driven by $\tilde{Q}_2$ is made clear by rewriting equation (56) as

$$\pi = \Pr[\tilde{Q}_2 < [(1+r)D_1]/\lambda = Q^*] \tag{57}$$

then default only occurs when $\tilde{Q}_2 < Q^*$.

Using the distribution assumption that $Q \sim [\underline{0}, \overline{Q_1}]$ and substituting equations (50) - (54) into the EU objective function, the SC model derives an explicit solution for optimal (first-period) borrowing by the LDC. The optimality condition is:

$$(1-\pi)(d/dD_1)[(1+r)D_1] = 1 + \delta = U_{c1}/[dE(U_{c2|n})] \tag{58}$$

The LDC borrows up to the point where the expected marginal cost of funds (LHS) equals the marginal benefit (RHS) of additional borrowing. The expected marginal cost of borrowing is simply the probability that the LDC will be able to repay (since $\tilde{Q}_2$ drives the model) multiplied by the marginal repayments, while the marginal benefit depends on the LDC (marginal) social rate of time preference. Given equation (58) the optimal amount of foreign loans is:

$$D_1 = \lambda Q_1(\delta-p)(1+\delta)/[(1+p)(1+2\delta-p)^2] \tag{59}$$

and the equilibrium probability of default is:

$$\pi = (\delta-p)/(1+2\delta-p) \tag{60}$$

One odd result of the SC model is that the (equilibrium) probability of the LDC declaring default in period 2 (see equation (60)) is independent of λ, the penalty cost of default. The reason for this result can be seen from equations (57) and (59). At first glance, equation (57) appears to suggest that an increase in the per dollar penalty cost, λ (the denominator) will reduce Q* and therefore reduce the probability of default, π. However, as can be seen from equation (59), the mathematics of the model results in λ also entering the optimal demand for LDC loans, D_1. Since D_1 enters both the numerator and denominator of equation (57), λ cancels out and π is independent of the value of the penalty cost parameter. The explanation offered by the SC model is that a high λ not only raises the costs of default but also the borrower's "credit" ceiling. That is, implicitly D_1 is the effective demand for loans determined by lenders acting rationally to known information regarding the size of the penalty costs facing the borrower and the distribution of $\tilde{Q}$.

In summary, the SC model contrasts with the corporate finance models and the EG and Freeman models in that, while still being viewed as optimal decisions, actual defaults are generally caused by exogenous shocks. Consequently, and in diammetric contrast to EG, an LDC with a highly variable (uncertain) stream of income over time, or σ, is viewed as more risky than a country with a low variance of income. In fact, these two studies demonstrate the importance of the initial assumption regarding the use of funds, e.g., consumption and investment, and the nature of the assumptions regarding the sources of income variation in deriving implications regarding the determinants of country risk. 1/

1/ It appears that all of the following questions need to be asked: Is the source of uncertainty endogenous or exogenous to the country? Is it linked to controllable variables of the government (e.g., monetary or fiscal policies? Is it permanent or transitory?

IX. The Freeman Model

Freeman (1979) utilizes a single-sector neo-classical growth model to analyze an LDC's optimal borrowing and default decisions. As in the simple Gordon growth model developed in Section II as well as in the Myers model in Section V, he shows that the optimality of default is intimately linked to the size of the penalty costs of the LDC's being forced off its desired or target growth path after repudiation.

As in the EG and SC models, planners in the LDC are assumed to maximize an intertemporal utility of consumption function. This takes the form:

$$U = c_t^{\beta} e^{-\gamma t} \tag{61}$$

where $0 < \beta < 1$, and $0 < \gamma < 1$, and β is the elasticity of utility with respect to consumption, γ is the social rate of time preference or discount rate, and c is per capita consumption (note that all terms in the Freeman model are expressed per capita).

The population of the country is assumed to grow over time at the constant rate n, and output (GDP) is produced with a standard neo-classic production function:

$$y = f(k) \tag{62}$$

To introduce debt or international loans into the model, the country is assumed to be capital-constrained domestically, so that

$$k = d + b \tag{63}$$

capital (k) is the sum of borrowed debt from overseas (d) and domesticall owned capital or equity (b) all in per capita terms. Thus borrowing here is viewed as being solely for the purposes of investment or capital accumulation. Lenders are assumed to make funds available to LDC's at a constant rate of interest equal to r_N, in a no-default world, and r_D in a default world--where, of course, $r_D > r_N$. Unlike in the EG or Sachs models, actual default leads simply to an increase in the cost of new det rather than an embargo on supply. As a result, the costs of default are the effects on growth of a permanently higher cost of new (future) debt, while its benefits are the windfall gains of converting, through repudiation, part of existing foreign debt into domestic "equity" (defined as b) Hence the familiar trade-off emerges from the Freeman model, which has already been extensively discussed above, i.e. default brings immediate windfall income gains to the borrower which are offset by future penalty costs, which in this case higher interest charges on future borrowings which mitigate against future growth. 1/ Clearly, default will occur only when the gains from default outweigh the gains from repayment.

The optimization problem for the LDC planner in the no-default or repayment case is:

$$\max_{c(t),d(t)} \int_0^T c_t^{\beta} e^{-\gamma} dt \tag{64}$$

subject to

$$b(0) < b_0 \tag{65}$$

$$b(T) < b_T \tag{66}$$

and

$$\dot{b} = f(k) - c - nb - r_N d \tag{67}$$

where b_0 is the initial domestic equity position of the LDC and b_T is its terminal (or desired) equity position. Equation (67) is the LDC's intertemporal budget constraint such that net investment (b) equals GDP(y) minus consumption (c), replacement investment (nb), and debt repayments ($r_N d$).

The optimization problem for the default case is more complex in that equations (65) - (67) are the relevant constraints for the period $t < \tau$, i.e., for that part of the period where default does not occur; however, in the post-default period, $t > \tau$, the relevant problem is:

$$\max_{c(t),d(t),b^{-},\tau} \int_{\tau}^{T} c_t^{\beta} e^{-\gamma} dt \tag{68}$$

$$b(0) < b_0 \tag{69}$$

1/ Obviously, Freeman's assumption that default simply leads to higher interest charges rather than a credit embargo (as in the EG model) sets a lower bound on the penalty costs of default.

$$b(T) \geq b_T + b_p \tag{70}$$

$$\dot{b} = f(k) - c - nb - r_D d \tag{71}$$

$$b^+ = b^- + b_D \tag{72}$$

Note that the Freeman model assumes that the terminal value of the country's equity (b_T) must be at least as high with default as without it, so as to eliminate the possibility of "last moment" defaults--hence the additional positive term, b_p, in equation (70). Also since, by assumption, default increases the cost of international loans, r_D replaces r_N in the intertemporal budget constraint (equation (71)). Finally, the declaration of default leads to some (known) windfall gain at the moment of default (τ) so the new level of domestic equity (b^+) is equal to the pre-default level (b^-) plus b_D, the windfall gain.

Freeman shows, after a number of simplifying assumptions regarding the initial conditions and the behavior of the state or control variables that the solutions to the dynamic control problems in equations (64) - (67) and (68) - (72) have the following general forms:

$$V_i = [-m_{0i}(G_i) + \bar{m}_i]^{\beta}/m_{0i} \qquad i = N,D \tag{73}$$

where m_{0i} and $\bar{m}_i$ are positive constants differing over the default and no-default regimes and G_i is defined as:

$$G_N \equiv b_T e^{-(r_N-n)T} - b_0 \tag{74}$$

under no-default, and as

$$G_D \equiv (b_T+b_p)e^{-(r_D-n)T} - (b_0+b_D) \tag{75}$$

under default. Hence, the relative attractiveness of default to no-default (i.e., the relative sizes of V_D and V_N) depends directly on the composite growth terms, G_D and G_N. Moreover, the effects of growth on the default decision can be seen by directly comparing equations (74) and (75). Assuming that b_p is small (it is only included to exclude last moment defaults) then since default increases the cost of loans, $r_D - n > r_N - n$, the first term on the RHS of the G_i equations will be smaller under default than no-default, i.e., this is the cost of default term. However, offsetting this negative effect on growth is the second term on the RHS of equations (74) and (75), where on declaring default the country enjoys a windfall gain of domestic equity equal to the size b_D, $b_0 + b_D > b_0$, so that the growth of the domestic captial stock is enhanced. As might be expected, because of the offsetting impact of the two terms on G_i, and therefore on V_i, there will be some G where $V_N = V_D$. The relationship between V_D, V_N, and G is also shown in Figure 3.

Note that the larger the economic growth parameter, G, the less attractive the default option becomes, while the reverse holds true for small values of G. More specifically, since G depends on the initial and desired (or terminal) values of domestic equity (see equation (73)) we can derive some insights into the countries most likely to default. For example, a country with a low initial equity position (small b_0) but with a high desired equity target (b_T) will have a large G value (i.e., $G > \hat{G}$). As a result high current borrowers, or low b_0 countries, are not necessarily bad credit risks unless they also have low growth targets (b_T is relatively small compared with b_0).

In summary, the contribution of the Freeman model is to demonstrate again that country default should be viewed as a decision which depends on the trade-off between an immediate windfall gain and future penalty costs. In this case, the size of these penalty costs, and therefore the implicit collateral of lenders, are directly dependent on the growth options or opportunity set of that country. As in the simple Gordon growth model outlined in Section II and implied by the Myers model, the higher an LDC's desired incremental rate of growth the less likely the LDC is to default since the gap between V^N (no default) and V^D (default) functions will be positive. Thus the implicit penalty costs of default can be viewed as an increasing function of an LDC's rate of growth, and a country's growth rates or (feasible) growth targets appear to be a crucial determinant of country risk.

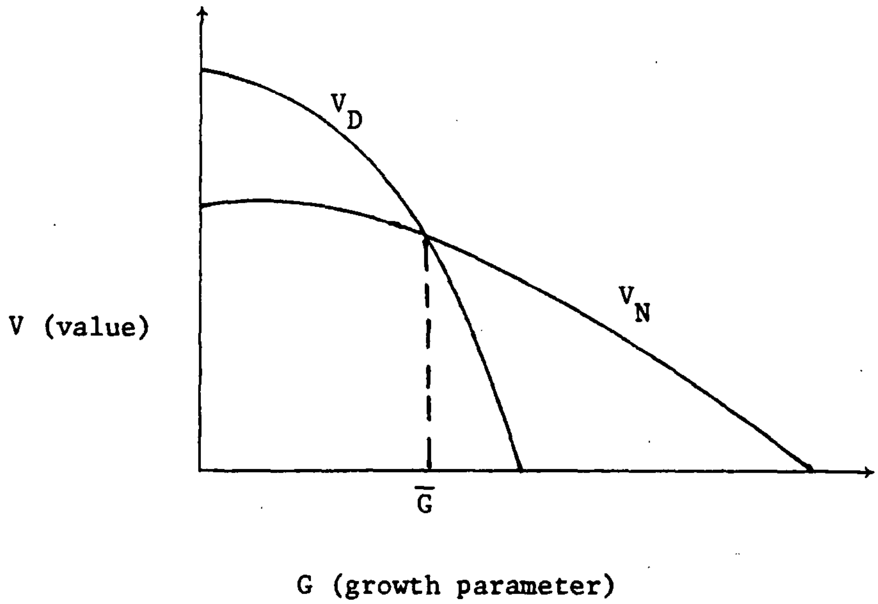
Finally, it might be noted that Saunders (1983b) has also developed an optimal borrowing model along similar lines to Freeman's. This model implies similar benefits to default, i.e., windfall gains from expropriating outstanding debt and forgoing interest payments on that debt while the costs of default are the deviations from the no default optimal growth path due to a future credit embargo (rather than higher interest costs as in Freeman). When this model was used to rank a small sample of countries it confirmed that countries "commonly" regarded as high default risk cases were indeed risky in terms of the optimal default model.

X. The Guttentag and Herring Model

In a recent paper Guttentag and Herring (1982) developed a model which sheds some further light on the determinants of sovereign risk by suggesting that country defaults may be interdependent events. Its basic characteristics can be outlined in the context of the interest spread or risk premium model developed in Section IV.

Figure 3

The Relationship between V_i and G



Consider the "basic" risk premium model where it is assumed that a sovereign borrower's direct or expropriable collateral backing the loan is zero ($\gamma = 0$ since $V_A = 0$) and the lender is assumed to be risk-neutral. In such a case the lender's required return on the loan, k, is

$$k = \{(1 + R_f)/\rho\} - 1 \tag{76}$$

and the risk premium, ϕ, on the loan is

$$\phi = \{(1 + R_f)/\rho\} - (1 + R_f) \tag{77}$$

where ρ, the probability of repayment, is defined as

$$\rho = \Pr[1+k > 0] = f(\tilde{C}) \tag{78}$$

where C are the net penalty costs facing the borrower if he defaults. That is, ρ is the lender's subjective evaluation that the borrower will make the promised payments, 1+k, depends on his perception of the size of the net costs/benefits to the borrower of declaring default, so that $f' > 0$. As discussed above, these costs are likely to reflect the permanent loss of current and future growth or investment opportunities relative to the windfall gains from declaring default. In this framework it is changes in C, due, for example to a shift in the current and future growth opportunities of the borrower that alters ρ, and thus k and ϕ, the required return and risk premiums on loans to this country, respectively. For the purposes of further discussion, we can define f(C) as measuring the <u>country-specific risk</u> of a sovereign borrower.

The first extension of Guttentag and Herring is to argue that pricing equations such as (78) hold only in normal periods. In crisis periods, the probability of a "comprehensive" default or a systematic collapse state occurring is non-zero. Moreover, when such a state occurs the lender's probability of repayment is zero for all loans. Thus equation (78) implicitly takes the form

$$\rho = \Pr[1+k > 0] = (1-\pi)f(\tilde{C}) + \pi(0) \tag{79}$$

where π is the lender's perceived probability that systematic financial collapse will occur. In normal periods, π, the subjective probability of systematic collapse, as viewed by lenders, can be assumed to be zero, so that equation (79) collapses to equation (78) and lenders base their subjective evaluations of ρ on the country-specific risk of the borrower only. Now a crisis can be defined as a state in which $\pi > 0$, that is, lenders perceive that there is now a finite risk of a systematic default by all borrowers--that is, there is perceived to be some possibility of a contagion default effect. A similar idea, that default risk can be divided into a country-specific (or unsystematic) risk component and a systematic risk component, has been expressed in papers by Walter (1981) and Goodman (1981). Using a portfolio theory paradigm, they argue that a risk-averse lender may be able to eliminate much of the country-specific risk by holding a well diversified portfolio of international loans, while the systematic or cross-border risk is, by definition, undiversifiable. Thus an increase in the systematic risk component of loan returns (or the loan beta (β) coefficient) would have a similar effect on spreads as an increase in π in the Guttentag-Herring model. Thus, in a portfolio theory paradigm a normal period may be viewed as when $\beta \sim 0$ (sovereign loan defaults are independent), while a crisis period exists when $\beta > 0$, i.e., the systematic risk of loan returns (default probabilities) is positive. 1/

The perception of contagion or systematic risks between borrowers can be based on either real and financial linkages between countries (through trade, etc.) or it can be purely informational, i.e., the default or debt problems (e.g., negotiated reschedulings, etc.) of one country sends adverse signals to lenders regarding the repayment prospects of all other countries. In the context of equation (79) an increase in π, the systematic or contagion probability, will reduce ρ, even if country-specific risk $f(\tilde{C})$ remains unchanged. Moreover, the larger is π the more the systematic risk component will dominate the country-specific risk component, so that the perception of repayment probabilities for different countries will tend to become isomorphic. Thus the presence of contagion or a crisis should result in a process of rising risk premiums of loans and a narrowing of the range of interest-rate spreads among countries (for a similar argument see Carron (1982) and for a test of contagion effects, Saunders (1983b).

A second aspect of the Guttentag-Herring model is that in a crisis period when $\pi > 0$ credit rationing may be an optimal policy for the lender, whereas in "normal" periods it generally is not. To see this, consider a normal period when $\pi = 0$, i.e., country risks are viewed as independent. In such a state high country-risk loans may still be made by a lender with this risk reflected in risk premiums, since even in the event of a default a lender will normally be able to meet any loan losses by writing them off against its capital reserves (although the margin of safety for many U.S. banks with respect to loans to Mexico and Brazil is rather small). By comparison, even a small probability of comprehensive default due to contagion ($\pi > 0$) might imply such a large expected value to loan losses as to exceed the bank's capital reserves--which are assumed by Guttentag and Herring to reflect capital adequacy levels for normal periods only (i.e., bank capital only tends to be increased after a crisis period has

1/ Note that while the portfolio approach only applies to risk averse lenders, the Guttentag-Herring model can be applied to either risk-averse or risk-neutral lenders.

occurred, rather than before it). 1/ As a result a natural response of lenders in crisis periods will be to ration loans 2/ to reduce the size of expected loan losses relative to their predetermined capital positions.

XI. Conclusions

This paper has analyzed and reviewed the literature on the economic benefits and costs of default when the sovereign borrower (and therefore lenders) view the probability of default as being linked to the economic costs and benefits from default. While this so-called rational financial decision framework is rather narrow, ignoring many other economic, political and legal factors which are likely to impact of the overall default decision, useful insights into some of the more important economic determinants of country-risk emerge. Specifically, by defaulting a borrower may enjoy windfall gains by expropriating the outstanding principal on debt and forgoing interest payments due to lenders. However, a defaulter also faces a stream of current and future costs; these comprise (1) a loss of collateral due to an expropriation of some of the borrower's assets by the lender (probably small, in the sovereign borrower's case), (2) a loss in future growth due to disruption of foreign trade (the cost of which will depend on the degree of openness of the defaulting country's economy), and (3) a loss in terms of future growth opportunities due to an embargo on future loans by lenders and/or an increase in the cost of these loans. The major implication of this survey is that even if (1) or (2) are relatively small, (3) may be sufficiently large to provide the lender with indirect collateral or insurance against default.

A further implication of this financial decision framework is that even if the current level of debt outstanding or required debt payments are high, this does not necessarily mean that a country is a bad credit risk. Specifically, countries with high growth targets or a set of potentially profitable growth options which they would like to exercise, may be more creditworthy than countries with a lower level of debt outstanding and few, if any, profitable growth options--since the former face greater future costs if they default. This suggests that a crucial determinant of a country's default risk is its projected or feasible growth path.

One question that should be addressed here is why, if default is viewed as a rational decision (and ignoring all the political and legal cost of default), have we failed to see any recent defaults and instead have seen lenders and borrowers reaching agreement over rescheduling debt. The reason for this is straightforward (developed in detail in Saunders (1983b)), and can be seen directly by employing the optimal financial

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1/ For a similar idea that there is a critical (catastrophic) relationship between the rate of loan losses and the size of bank capital see Ho and Saunders (1980, 1982).

2/ By not making new loans or rolling-over existing loans, for example.

decision framework developed above. Using this framework, it is clear that lenders have greater incentives to induce the borrower's to avoid default, than borrowers have incentives from repudiation. To see this consider the following illustration. The windfall gains to the LDC from repudiating its debt are assessed by the borrower at $10 billion while the total costs, loss of collateral, trade disruption, and loss of future growth opportunities, are assessed at $9 billion. Thus it appears that the borrower would enjoy a net present value gain of $1 billion by exercising its option to default. Suppose instead that, by agreement, repayments of principal and/or interest to the lender were rescheduled into the future so that the present value of these debt payments (to the borrower) fall from $10 billion to $8.5 billion. Now, while lenders clearly lose $1.5 billion in the value of the principal and interest, this is a far better proposition than seeing the country default and effectively losing the whole $10 billion (assuming direct collateral is insignificant). More importantly, the rescheduling has changed the borrower's incentives to default. Indeed, the LDC now gains more, i.e., $1.5 billion, by not defaulting and having its debt rescheduled than it would have gained if it were to default ($1 billion). Thus rescheduling can be viewed as a Pareto improvement, since both lenders and borrowers gain, compared to the situation when the default decision is exercised. Further, rescheduling will only be a suboptimal proposition for the lender when the borrower's direct collateral (expropriable assets) is sufficiently large to outweigh the "savings" from rescheduling. Nevertheless, if the lender wishes to avoid either default or rescheduling ex ante, it is crucial to evaluate debt outstanding relative to the borrower's growth targets.

As to other determinants of sovereign default risk, these models are less clear. In particular, both the options model and the model developed by Sachs and Cohen imply that an increase in the variance of GDP increases the probability of borrower default, while in the Eaton and Gersovitz model, where borrowing is used for consumption smoothing and changes in GDP are assumed to evolve in a deterministic fashion, a high variance implies a smaller probability of the country defaulting. Hence, while income variance is probably an important determinant of the net costs, and therefore the probability of default, it remains unclear as to which direction this effect works. Clearly, more research is required into the relationship of income variance to the probability of default. This should involve a clearer distinction between, and comparison of, the sources of income disturbance (crop failure, terms of trade, monetary and fiscal policy, etc.), specification as to whether these disturbances are temporary or permanent, and whether they are expected or unexpected by the borrower.

Finally, default risk may be contagious. That is even if a country has high growth targets relative to the volume of debt outstanding, so that when viewed independently it is a good credit risk, default or rescheduling by other countries may alter lenders subjective probabilities regarding the default risk of that country. Thus, in certain states of the world, a systematic risk element may enter into the default risk perceptions of lenders.

Bibliography

Angeloni, I. and B.K. Short, "The Impact of Country Risk Assessment on Eurocurrency Interest Rates Spreads: A Cross-Section Analysis," IMF, DM/80/35, 1980.

Bardhan, P. "Optimal Foreign Borrowing," in K. Shell (ed.) Essays on the Theory of Optimal Economic Growth, Cambridge, MIT Press, 1967.

Baron, D. "The Incentive Problem and Design of Investment Banking Contracts," Journal of Banking and Finance, June 1979, pp. 157-75.

Bierman, H. and J. Hass, "An Analytical Model of Bond Risk Differentials," Journal of Financial and Quantitative Analysis, December 1975, pp. 757-75.

Black, F. and M. Scholes, "The Pricing of Options and Corporate Liabilities," Journal of Political Economy, May-June 1973, pp. 637-59.

Bruno, M., "The Two-Sector Open Economy and the Real Exchange Rate," American Economic Review, September 1976, pp. 566-77.

Carron, A., "Financial Crises: Recent Experience in U.S. and International Markets," Brookings Papers on Economic Activity, 1982, No. 2, pp. 395-423.

Chan, Y.S. and G. Kanatas, "Asymmetric Information and the Role of Collateral in Loan Agreements," Northwestern University, Banking Center Working Paper No. 91, 1983.

Dornbusch, R., "Real Interest Rates, Home Goods and Optimal External Borrowing," Journal of Political Economy, February 1983, pp. 141-53.

De Vries, R., "International Balance of Payments Financing and Adjustment," forthcoming in G. von Furstenberg (ed.) International Money and Credit: The Policy Roles, Washington, D.C., IMF, 1983.

Eaton, J. and M. Gersovitz, "Debt with Potential Repudiation: Theoretical and Empirical Analysis," Review of Economic Studies, February 1980, pp. 389-409.

Feder, G. and R. Just, "An Analysis of Credit Terms in the Eurodollar Market," European Economic Review, May 1977, pp. 221-43.

Fisher, L., "Determinants of Risk Premiums of Corporate Bonds," Journal of Political Economy, June 1959, pp. 217-37.

Freeman, R., "Optimal International Borrowing with Default," Federal Reserve Board of Governors, IFD, Paper No. 129, 1979.

Galai, D. and R. Masulis, "The Option Pricing Model and the Risk Factor of Stock," The Journal of Financial Economics, January/March 1976, pp. 53-82.

Glick, R., "Multiperiod Models of Foreign Borrowing," New York University, mimeo, February 1983.

Gordon, M., "Dividends, Earnings and Stock Prices," Review of Economics and Statistics, May 1959, pp. 99-105.

Goodman, L., "Bank Lending to Non-OPEC LDC's: Are Risks Diversifiable?" Federal Reserve Bank of New York Quarterly Review, Summer 1981, pp. 10-20.

Guttentag, J. and R. Herring, "Credit Rationing and Financial Disorder," University of Pennsylvania, Working Paper, mimeo, 1982.

Haegele, M., "The Behavior and Determination of Spreads in the Medium-Term Eurocurrency Market," Business Economics, September 1980, pp. 41-48.

Hamada, K., "Economic Growth and Long-Term Capital Movements," Yale Economic Essays, Spring 1966, pp. 48-96.

______, "Optimal Capital Accumulation by an Economy Facing an International Capital Market," Journal of Political Economy, July 1969, pp. 684-97.

Hammond, J., "Simplifying the Choice Between Uncertain Prospects Where Preference is Non-Linear," Management Science, 1974.

Ho, T.S.Y. and A. Saunders, "A Catastrophe Model of Bank Failure," Journal of Finance, December 1980, pp. 1189-1208.

______, "The Determinants of Bank Interest Margins," Journal of Financial and Quantitative Analysis, November 1981, pp. 581-600.

______, "Catastrophe Theory in Banking and Finance," in G. Szëgo (ed.) New Quantitative Techniques for Economic Analysis, New York Academic Press, 1982.

John, K. and A. Saunders, "Small Business Loan Guarantees: A Theoretical and Empirical Appraisal," New York University Working Paper, mimeo, 1983.

______, " Asymmetry of Information, Regulatory Lags and Optimal Incentive Contracts," Journal of Finance, May 1983, pp. 391-404.

Leland, H. and D.H. Pyle, "Informational Asymmetries, Financial Structure, and Financial Intermediation," Journal of Finance, May 1977, pp. 371-87.

McCabe, J. and D. Sibley, "Optimal Foreign Debt Accumulation with Export Revenue Uncertainty," International Economic Review, October 1976, pp. 675-86.

McDonald, D., "Debt Capacity and Developing Country Borrowing: A Survey of the Literature," IMF Staff Papers, August 1982, pp. 603-46.

Merton, R., "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates," Journal of Finance, June 1974, pp. 449-70.

_____ , "An Analytic Derivation of the Cost of Deposit Insurance and Loan Guarantees," Journal of Banking and Finance, March 1977, pp. 3-11.

Myers, S., "Determinants of Corporate Borrowing," Journal of Financial Economics, September 1977, pp. 147-76.

Obstfeld, M., "Macroeconomic Policy, Exchange-Rate Dynamics and Optimal Asset Accumulation," Journal of Political Economy, December 1981, pp. 1142-61.

Pye, G., "Changing the Default Premium," Financial Analysts Journal, February 1974, pp. 49-52.

Ross, S., "Some Notes on Financial Incentive-Signalling Models, Activity Choice and Risk Preferences," Bell Labs, mimeo, 1976.

_____ , " "The Determination of Financial Structure: The Incentive-Signalling Approach," Bell Journal of Economics, Spring 1977, pp. 23-40.

Sachs, J. and D. Cohen, "LDC Borrowing with Default Risk," NBER Working Paper No. 925, 1982.

Saunders, A., "An Examination of the Contagion Effect in the International Loan Market," Unpublished Paper, International Monetary Fund, September 1983.

_____ , "Sovereign Borrowing and the Incentive to Default," Unpublished Paper, International Monetary Fund, September 1983.

Smith, C., "Option Pricing Review," Journal of Financial Economics, January/March, 1976, pp. 1-51.

Spence, A.M., "Competitive and Optimal Responses to Signals: Analysis of Efficiency and Distribution," Journal of Economic Theory, March 1974, pp. 23-40.

Stiglitz, J.E. and A. Weiss, "Credit Rationing in Markets with Imperfect Information," American Economic Review, June 1981, pp. 393-409.

Yawitz, J.B., "An Analytical Model of Interest Differentials and Different Default Recoveries," Journal of Financial and Quantitative Analysis, September 1977, pp. 481-90.

_____ , "Risk Premia on Municipal Bonds," Journal of Financial and Quantitative Analysis, September 1978, pp. 475-85.

Walter, I., "Country Risk, Portfolio Decisions and Regultation in International Bank Lending," Journal of Banking and Finance, March 1981, pp. 77-92.