

PRINCETON STUDIES IN INTERNATIONAL FINANCE

No. 54, July 1984

Theoretical Issues in  
International Borrowing

Jeffrey Sachs

INTERNATIONAL FINANCE SECTION  
DEPARTMENT OF ECONOMICS  
PRINCETON UNIVERSITY

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## I INTRODUCTION

The current crisis in international lending points up a lesson relearned several times in the past hundred and fifty years: the international loan markets function very differently from the textbook model of competitive lending. In the simple model, borrowers have ready access to loans at a given interest rate; they enter the loan market to finance all investment projects with positive present value at the prevailing interest rate; and they use loans to equate the marginal utility of consumption at various points in time. Actual lending behavior is far from this rosy view. Borrowers are extensively rationed in the international markets: they may be unable to obtain credit at any price, much less the posted market price. Highly profitable investment projects may be blocked for want of foreign capital or, worse, may be abandoned midstream after creditors withdraw capital in a sudden loss of confidence. Various institutions, such as the International Monetary Fund and the Bank for International Settlements, have an acknowledged role in maintaining stability in the loan markets, even though such institutions are superfluous in the simple model.

The large gap between theory and practice has led to a search for new theoretical concepts to explain actual loan behavior. A number of recent models have taken seriously the possibility of debt repudiation (or "sovereign risk") on loans to developing-country governments, and have shown that such a risk radically alters the behavior of borrowers and lenders. (McDonough, 1982, surveys many of these new models.) The presence of sovereign risk can help to explain credit rationing, debt rescheduling, conditionality, and even the maturity structure of international obligations (see Eaton and Gersovitz, 1981; Sachs and Cohen, 1982). Other models (e.g., Stiglitz and Weiss, 1981) have shown that credit rationing may arise for other reasons as well, such as lenders' inability to evaluate the risk categories of potential borrowers. Still other models (e.g., Kharas, 1981) have explored the interaction of the domestic financial systems in

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developing countries with international borrowing in order to derive more useful policy guidelines for international borrowing decisions. These new models help not only to restore the relevance of a central class of economic models but also to shed light on actual loan-market behavior. The theoretical advances can also help us to define the proper role of the IMF in the present debt crisis and of the banks and borrowing countries in a very imperfect market.

This Study discusses some of the elements needed for a richer and more realistic model of international lending to developing-country governments. It draws on recent work and also offers some new results aimed at highlighting what is right and wrong with the standard model of international lending.

The textbook case is both insightful and a natural starting point for discussion. I then proceed to three areas of that model to show how more realistic assumptions can fundamentally alter our views of borrower and lender behavior. The first revision comes in modeling the borrowing country itself. The textbook case treats the borrower as a "representative agent" maximizing utility subject to a budget constraint based on national wealth. Since most international borrowing is by governments or government enterprises, the textbook model implicitly assumes that governments have unlimited taxing power over national wealth. I follow Kharas (1981) in introducing a limit to the government's taxing authority and show that optimal borrowing strategies may be quite different from standard prescriptions. In particular, governments should no longer borrow in order to finance all investment projects with a positive present value at world interest rates. Such a strategy almost surely leads to slow growth and a credit squeeze.

The second extension to the textbook model pertains to the assumption about loan repayments. The standard model assumes that loans are repaid as long as resources are available to repay them. Implicitly, it assumes that the costs to a country of repudiating its debts always outweigh the benefits. There is no doubt that the costs of debt repudiation are high, in both economic and diplomatic terms. Nevertheless, governments have at times preferred unilateral debt repudiation (or at least a unilateral debt moratorium) to the arduous and politically unpopular task of servicing a heavy debt burden, even when the debt servicing was technically feasible. The textbook model is therefore extended by giving the borrower the option of debt repudiation. The costs and benefits of

debt repudiation are made explicit, and all market participants are assumed to understand them.

A number of important implications are then derived. Most obviously, the repudiation risk leads to an upward-sloping supply of funds to the borrowing country, and to credit rationing once a high level of indebtedness is reached. Less intuitively, inefficiencies arise in the dynamic behavior of the borrowing country, since the default risk distorts several of its incentives. From a given set of initial conditions, there typically exists an optimal sequence of policies that maximizes the borrower's utility as viewed from the initial period. However, there are often incentives that make it unlikely that the borrower will actually pursue that optimal sequence over time. Relative to the path that would maximize *ex ante* expected utility, a debtor may be induced (1) to overborrow period to period, (2) to overinvest in risky projects at the expense of safe projects, and (3) to overconsume and underinvest.

The problems arise from the inability of the borrower to pre-commit itself to certain behavior once a loan is arranged. For example, in order to attract large loans at low rates, a borrower may try to convince lenders that it will act prudently and avoid overly risky investments. After the loan is made, however, the borrower can often reduce the expected burden of the debt by going ahead with the risky projects (or by overborrowing, or overconsuming, etc.). Since creditors anticipate these actions, they charge a risk premium for them in the original loan contract. Not surprisingly, a borrower is best off when it can convincingly forswear these actions and thereby reduce its initial cost of borrowing. In domestic capital markets, bond covenants are used for that purpose. In the international markets, convincing ways to forswear such costly behavior have yet to be found.

The third extension to the basic model pertains to loan-supply behavior. The competitive-loan model typically ignores the institutional structure of lending. Credit is assumed to be supplied elastically at a given interest rate, and little attention is paid to whether that credit comes from a bank loan or a bond flotation, a single lender or a syndicate, etc. Actually, the nature of intermediation can be of profound importance. Inherent risk considerations coupled with prudential lending rules for banks have made the syndication the preferred form of lending. A standard loan to a borrowing country may be extended by several hundred participating banks. The problem with the syndication is that member

banks do not necessarily act in their collective best interest when key contingencies arise, as would be the case if the loan were made by a single bank operating in a competitive environment.

Many actions that a syndicate should take have "public good" features. For example, an efficient loan package may require banks to monitor a country's economic performance after a loan is made, but the banks may have no way to share the cost of monitoring. Even if the need for monitoring is clear, each bank may try to be a free rider on the monitoring expenditures of other banks, leading to insufficient supervision. More important, an efficient loan package sometimes requires banks to refinance the debts of a heavily indebted country at below-market rates, in order to keep it from imminent default. Collectively, the need for re-scheduling may be clear, but, once again, each individual bank may try to withdraw its own credits in order to leave the debt burden to the other banks.

The most dramatic breakdown of loan supply comes in a panic, where a fundamentally sound economy is forced into default by a shortage of credit. This type of market failure can result from the rational behavior of a large number of small lenders. Each bank rationally bases its loan-supply decision on the actions of the other banks. Suppose, for example, that a country needs a large loan to tide it over a short-run fall in income. If all banks but one stop lending, only a very large loan from the remaining bank can save the country from default. But such a large loan may be precluded by risk or regulatory considerations. Thus, if no other banks lend to the country, the given bank may also choose to stop lending; if the other banks were to continue their loans, the given bank could safely contribute a share of the total credit line. In such a situation, two equilibria may be present. In the favorable case, all banks continue to lend; in a panic, all banks stop lending because the others have stopped lending, and the "healthy" country finds itself forced into default.

There are several ways to overcome the collective-action problems of the creditors, though none is costless or foolproof. Syndicated loans typically include loan managers who provide public-good services, such as monitoring or legal representation, in return for management fees. Also, in the course of reschedulings informal "fair share" rules have emerged under which various burdens are divided on the basis of the banks' existing shares in the total loans to a rescheduling country. Finally, institutions like the IMF (and, to a much lesser degree, the BIS and leading

central banks) assume some of the public-good aspects of international lending, such as monitoring and enforcement costs.

I illustrate these considerations in a series of models of international lending to a developing-country sovereign borrower. The models are kept simple to illustrate the main points as clearly as possible. I make no attempt at generality and little attempt at putting all the various models together. Each remains a single facet of an evolving general model. Chapter 2 introduces the standard borrowing model. Chapters 3, 4, and 5 consider the three major extensions of that model: imperfections in the borrowing economy, risks of debt repudiation, and collective-action problems of the creditors.

## 2 THE BASIC MODEL OF INTERNATIONAL BORROWING

Consider the standard borrowing problem facing a social planner of a small open economy (for examples, see Bardhan, 1967; Blanchard, 1983; Sachs, 1981). The economy produces a pure traded good in amount  $Q_t$  in period  $t$ , according to a production function  $Q_t$  equal to  $F(K_t, L_t)$ . The labor supply is exogenous (or perfectly elastic with a fixed wage  $w$ ). The capital stock evolves according to the equation  $K_{t+1} = K_t(1-d) + I_t$ , where  $I$  is gross investment and  $d$  is the rate of depreciation. In the closed economy, total spending (the sum of consumption and investment) is equal to output. In the open economy, spending can be augmented by foreign borrowing. It is typical to assume that the economy can engage in one-period international loans at given world interest rates. Let  $D_{t+1}$  be the stock of loans undertaken at time  $t$  for repayment at time  $t + 1$ , and let  $r$  be the real rate of interest on the loan (I will simplify substantially and assume that  $r$  is fixed through time). With national output given by  $Q_t$ , national income (denoted by  $Y_t$ ) is given by  $Q_t$  net of interest payments on debt coming due:  $Y_t = Q_t - rD_t$ . Total consumption in period  $t$  is national income minus investment plus net new borrowing:  $C_t = Y_t - I_t + (D_{t+1} - D_t)$ .

The model is closed by specifying the terms of borrowing. How much can the borrower borrow? The standard assumption here is that the borrower can attract any loan that can feasibly be paid back. The incentive to make the necessary loan repayments is simply assumed. In a finite-horizon version of the model, say  $T$  periods, it is also assumed that there is no last-period debt, so that  $D_{T+1}$  does not exceed zero. The borrower faces the set of constraints:

$$\begin{aligned} D_2 &= (1+r)D_1 + C_1 + I_1 - Q_1, \\ D_3 &= (1+r)D_2 + C_2 + I_2 - Q_2, \end{aligned} \tag{1}$$

$$\begin{aligned} D_{T+1} &= (1+r)D_T + C_T + I_T - Q_T, \\ D_{T+1} &< 0. \end{aligned}$$

By substituting the  $D_2$  equation into the  $D_3$  equation, the  $D_3$  equation into the  $D_4$  equation, and so forth, we can rewrite (1) as

$$\sum_{i=1}^T (1+r)^{-(i-1)} C_i \leq \sum_{i=1}^T (1+r)^{-(i-1)} (Q_i - I_i) - (1+r)D_1. \quad (2)$$

This equation implicitly defines an upper bound to borrowing. Note that

$$\sum_{i=1}^T (1+r)^{-(i-1)} C_i$$

must be nonnegative. Therefore, we can bring  $(1+r)D_1$  to the left-hand side of the inequality in (2) to obtain

$$(1+r)D_1 \leq \max_{I_i} \sum_{i=1}^T (1+r)^{-(i-1)} (Q_i - I_i). \quad (3)$$

In any period  $t$ , we could perform the same manipulations for the remaining  $T - t$  periods, to find

$$(1+r)D_t \leq \max_{I_i} \sum_{i=t}^T (1+r)^{-(i-t)} (Q_i - I_i). \quad (4)$$

Equation (4) states a very important point:

In order for debt repayment to be feasible, that is, for  $D_{T+1}$  not to exceed zero, indebtedness at any time must be less than national productive wealth, where the latter is defined as the maximum discounted value of GDP net of investment in the remaining periods.

If the constraint in (4) is ever strictly binding, it implies that consumption is zero along the *entire* remaining growth path. For that reason, it is unlikely that an optimal borrowing program involves borrowing  $D_t$  up to its maximum feasible level. It is a simple matter to transform (4) to the appropriate expression for the infinite-horizon case. Feasibility conditions for repayment in that case are found simply by replacing  $T$  with  $\infty$  in (4):

$$(1+r)D_t \leq \max_{I_i} \sum_{i=t}^{\infty} (1+r)^{-(i-t)} (Q_i - I_i) \quad (\text{infinite-horizon case}). \quad (5)$$

Now, let us state the full borrowing problem:

*The Borrowing Problem in Finite Horizon* (6)

$$\max U(C_1, C_2, \dots, C_T),$$

subject to

$$Q_t = F(K_t, L_t),$$

$$K_{t+1} = K_t(1-d) + I_t,$$

$$C_t = (Q_t - rD_t) - I_t + (D_{t+1} - D_t),$$

$$D_t \leq \max_{i=t} \sum_{i=t}^T (1+r)^{(t-i-1)}(Q_i - I_i).$$

$K_1, D_1$  are given;  $L_t$  is given for all  $t$ .

The infinite-horizon problem is found simply by substituting  $\infty$  for  $T$  in (6). This problem has been heavily explored, in various guises and degrees of sophistication, in the economics and planning literature. When stated as in (6), the problem results in the following necessary conditions of optimization:

*Optimal Borrowing in the Finite Horizon* (7)

The solution to (6) is a set of sequences  $\{C_1, C_2, \dots, C_T\}$ ,  $\{I_1, \dots, I_{T-1}\}$ , and  $\{D_1, \dots, D_T\}$  that satisfy the conditions in (6) together with

(a)  $U_i = \partial U / \partial C_i = \lambda(1+r)^{-(i-1)},$

(b)  $\partial F / \partial K_i = r + d$  for  $i = 2, \dots, T-1,$   
 $\partial F / \partial K_T = 1 + r,$

(c)  $\sum_{i=1}^T (1+r)^{-(i-1)} C_i = \sum_{i=1}^T (1+r)^{-(i-1)} (Q_i - I_i) - (1+r)D_1.$

$\lambda$  is the marginal utility of wealth, equal to the increase in  $U$  resulting from a unit reduction in initial indebtedness  $(1+r)D_1$ . There are three main conditions for optimal borrowing. First (7)(a) states that the international loan market should be used to equate the marginal utility of consumption in each period,  $U_i$ , with a discounted marginal utility of wealth  $\lambda(1+r)^{-i}$ . Second, (7)(b) states that investments should be undertaken in each period (except the last) in order to equate the marginal product of capital,  $\partial F / \partial K_i$ , with the cost of capital,  $r + d$ . Finally, (7)(c) holds that the discounted value of total consumption equals the discounted value of total productive wealth net of initial indebtedness. We

see from (2) that this condition is equivalent to assuming that  $D_{T+1}$  equals zero.

We have so far interpreted the optimal borrowing problem as that of a social planner choosing  $\{D_1, \dots, D_T\}$  to maximize a social-welfare function. According to standard principles of welfare economics, there is a second interpretation, that (7)(a)–(c) characterize the *market* equilibrium of the economy under conditions of perfect competition. Assuming that  $U(C_1, \dots, C_T)$  is the utility function of the representative household, and that production and investment decisions are undertaken by competitive firms operating with perfect foresight, the decentralized equilibrium will replicate the social planner's policies. (For a formal demonstration of this equivalence in the infinite-horizon case, see Abel and Blanchard, 1983.) In general, the equivalence of centralized and decentralized equilibria will *not* hold once the model is extended to allow for various credit-market imperfections.

The conditions (7)(a)–(c) are also properties of richer models, for example, those that allow for productivity shocks or terms-of-trade fluctuations. When carefully interpreted, they describe many of the standard guidelines in the development literature for foreign borrowing. For example, (7)(a) is really a prescription to smooth consumption over time relative to income by borrowing when output is low relative to trend and paying back loans, on net, when output is high (see Sachs, 1981 and 1982b for this interpretation). The country should borrow in order to finance consumption during a temporary drop in income but not during a permanent drop in the trend of income. On close analysis, (7)(a) makes explicit the IMF dictum to finance temporary shocks but “adjust” to permanent shocks. Equation (7)(b) states the standard cost-benefit condition for investment projects in a small open economy. Regardless of the consumption stream, the planner should invest so as to equate the marginal product of capital, evaluated at world market prices, with the cost of capital, also at world market prices. A nearly equivalent condition is that all projects should be undertaken with positive present value at the world market prices and interest rates.

A useful simplification for solving the borrowing model is to write utility as additively separable:

$$U(C_1, C_2, \dots, C_T) = \sum_{i=1}^T u(C_i)(1 + \delta)^{-i}. \quad (8)$$

That is, total utility (upper-case  $U$ ) is the sum of subutilities (lower-case  $u$ ) based on consumption in each period. These subutilities are discounted according to the subjective rate of time preference,  $\delta$ . With this formulation, (7)(a) becomes  $u_i = \lambda(1 + \delta)^i / (1 + r)^i$ . From this point forward, I will assume additive separability.

A second transformation is also helpful. Let  $V(K_t, D_t)$  be the maximum value of utility that a borrower can achieve starting with  $K_t, D_t$ . It is found by plugging the solution from (6) into the utility function. Then a  $T$ -period or infinite-horizon problem can be reduced to a two-period or three-period problem. Thus, for example, the problem stated in (6) can be written as

$$\max u(c_1) + u(c_2)/(1 + \delta) + V(K_3, D_3)/(1 + \delta)^2, \quad (6')$$

subject to

$$Q_t = F(K_t, L_t) \quad (\text{where } t = 1, 2),$$

$$K_{t+1} = K_t(1 - d) + I_t,$$

$$C_t = (Q_t - rD_t) - I_t + (D_{t+1} - D_t).$$

$K_1, D_1$  are given;  $L_t$  is given for all  $t$ .

The first-order conditions are now

$$u_1(C_1) = -(1 + r)V_D(K_3, D_3)/(1 + \delta)^2, \quad (7')$$

(where  $u_i$  signifies  $\partial u / \partial C_i$ )

$$u_2(C_2) = -V_D(K_3, D_3)/(1 + \delta),$$

$$F_K(K_2) = r + d,$$

$$V_K(K_3, D_3) = -V_D(K_3, D_3).$$

$V_D(K_3, D_3)$  is the marginal disutility of an increment of debt in period 3. Since each unit of debt requires  $1 + r$  in repayment and thus reduces wealth by  $1 + r$ ,  $-(1 + r)V_D(K_3, D_3)$  measures the marginal utility of wealth in period 3. Discounted to the present, the marginal utility of wealth in the first period is therefore  $-(1 + r)V_D(K_3, D_3)/(1 + \delta)^2$ . This is what I called  $\lambda$  in the original solution given in (7). With this interpretation we see that  $U_1(C_1) = \lambda$ , as before. Also  $u_2(C_2)/(1 + \delta)$ , which is  $U_2$  in (7), is equal to  $(1 + r)^{-1}\lambda$ , as before.

### 3 INTERNATIONAL BORROWING WITH DOMESTIC FINANCIAL CONSTRAINTS

I now expand the model to allow for an explicit role for public-sector financial variables. For simplicity I illustrate the results in the three-period version of the model just introduced.

Kharas (1981), Katz (1982), and others have pointed out that the pure borrowing model should differentiate between the private and public sectors and take seriously the empirical fact that most international lending to developing countries is to the public sector, or to the private sector with public-sector guarantees. In these circumstances, debt-servicing capacity depends not only on national wealth but on the public sector's ability to tax that wealth. Moreover, domestic capital markets in the borrowing country tend to be highly segmented and imperfect, so that the public sector must use its borrowing powers to bring about an efficient level of aggregate investment in the economy.

Thus, let us suppose that the private sector in the developing country saves a fixed fraction of post-tax income, which is available for private investment, while the government uses its taxing and borrowing authority to supplement private investment and/or private consumption (see Arrow and Kurz, 1970, Chap. VI, for a similar setup in a closed economy). Private investors have no direct access to the international loan market. The government taxes domestic output at rate  $\tau_t$ , which may change over time. This rate must be less than one and may be less than zero if the government is making net income transfers to the private sector. Also, we allow for the possibility of a ceiling to the tax rate,  $\bar{\tau}$ , so that  $\tau_t \leq \bar{\tau} \leq 1$ . The ceiling may reflect political or economic constraints (e.g., tax evasion at high tax rates) on the government's ability to raise revenues.

With domestic output given by  $Q_t$ , tax revenues are  $\tau_t Q_t$ , and private-sector savings are  $s(1 - \tau_t)Q_t$ . Private consumption is given by  $C_t$  equal to  $(1 - s)(1 - \tau_t)Q_t$ . In any period, the government borrows  $D_{t+1}$  and repays  $(1 + r)D_t$ . Total investment in the economy equals private savings plus tax revenue plus net foreign-resource inflow:

$$I_t = s(1 - \tau_t)Q_t + \tau_t Q_t + [D_{t+1} - (1 + r)D_t]. \quad (9)$$

As written, it appears that all foreign borrowing is used for investment rather than consumption, but this is true only as an accounting matter. Suppose, for example, that the government wants to raise private consumption while holding investment levels fixed. It merely raises  $D_{t+1}$  while reducing  $\tau_t$  sufficiently to keep  $I_t$  constant; in that case, the borrowing finances consumption 100 per cent on the margin.

As in the standard borrowing problem, the government faces a ceiling on external indebtedness. But now the ability to repay debt depends on the government's taxing authority as well as on national wealth. The new constraint is that  $D_t$  must be less than or equal to the maximum level of tax revenues net of government investment. Government investment is  $I_t$  minus private investment,  $s(1 - \tau_t)Q_t$ . Thus, by summing over (9), we derive

$$D_t(1+r) \leq \max_{\tau, I} \sum_{i=1}^t (1+r)^{-(t-i)} [\tau_i Q_i - I_i + s(1-\tau_i)Q_i]. \quad (4')$$

Note that if  $\bar{\tau}$  equals one (i.e., there is no constraint on the maximum tax rate), so that  $\tau_t = \bar{\tau} = 1$  in (4'), the borrowing constraint reduces to (4). For  $\bar{\tau}$  significantly less than one, the borrowing constraint in (4') is likely to be far more restrictive than the constraint based on national wealth alone. Having noted this point, we will now study the general model assuming that (4') does *not* bind along the optimal path for the economy.

Once again, we calculate the optimal financial policy of the government, assuming that it tries to maximize an intertemporal utility function of the form  $u(C_1) + u(C_2)/(1+\delta) + V(K_3, D_3)/(1+\delta)^2$ . In this case, however, the government's policy instruments are taxes and foreign borrowing rather than investment and foreign borrowing, as in the previous model. Taxes are now manipulated to achieve the desired level of national savings, whereas in the previous model that savings rate is chosen directly. (Remember, though, that the equilibrium in the basic model could also be interpreted as the market equilibrium under conditions of perfect competition. The correspondence of market and optimal equilibria will no longer apply here.)

*The Basic Public-Finance Problem with  
International Borrowing*

$$\max_{D_2, D_3, \tau_1, \tau_2} u(C_1) + u(C_2)/(1+\delta) + V(K_3, D_3)/(1+\delta)^2, \quad (10)$$

subject to

$$\begin{aligned}
 Q_t &= F(K_t, L_t), \\
 K_{t+1} &= K_t(1-d) + I_t, \\
 C_t &= (1-s)(1-\tau_t)Q_t, \\
 I_t &= s(1-\tau_t)Q_t + \tau_t Q_t + D_{t+1} - (1+r)D_t, \\
 \tau_t &\leq \bar{\tau} \leq 1.
 \end{aligned}$$

$D_1, K_1$  are given.

As long as tax rates are completely flexible (i.e.,  $\bar{\tau} = 1$ ), the solution to this problem is identical to the social planner's solution of Chapter 2, since the dynamic budget constraint facing the government is no different whether it chooses  $C_t$  and  $I_t$ , as before, or  $\tau_t$  and  $I_t$ , as here.

To show this formally, simply substitute for  $C_1$ ,  $C_2$ ,  $K_3$ , and  $D_3$  in the utility function in (10),<sup>1</sup> to find

$$\begin{aligned}
 U &= u[(1-s)(1-\tau_1)F(K_1)] + u[(1-s) \\
 &\quad \cdot (1-\tau_2)F(K_1(1-d) + I_1)]/(1+\delta) + V(K_1(1-d)^2 \\
 &\quad + I_1(1-d) + I_2, (1+r)^2 D_1 + (1+r)[I_1 - \tau_1 F(K_1) - s(1-\tau_1)F(K_1)] \\
 &\quad + I_2 - \tau_2 F[K_1(1-d) + I_1] - s(1-\tau_2)F[K_1(1-d) + I_1])/(1+\delta)^2.
 \end{aligned}$$

Now, the first-order conditions are given by

$$\begin{aligned}
 \text{(a)} \quad \partial U / \partial \tau_1 &= 0 \Rightarrow u_1 = -(1+r)V_D / (1+\delta)^2, & (11) \\
 \text{(b)} \quad \partial U / \partial \tau_2 &= 0 \Rightarrow u_2 = -V_D / (1+\delta), \\
 \text{(c)} \quad \partial U / \partial I_1 &= 0 \Rightarrow (1-s)(1-\tau_2)F_K(K_2) \cdot u_2 + (1-d)V_K / (1+\delta) \\
 &\quad + (1+r)V_D / (1+\delta) - [\tau_2 + s(1-\tau_2)]F_K(K_2) \\
 &\quad \cdot V_D / (1+\delta) = 0, \\
 \text{(d)} \quad \partial U / \partial I_2 &= 0 \Rightarrow V_K = -V_D.
 \end{aligned}$$

By substituting (11)(a), (b), and (d) into (11)(c), we find that  $F_K(K_2)$  equals  $r + d$ , as before; the conditions (11)(a), (b), and (d) are exactly as before. Thus, the demonstration is complete.

<sup>1</sup>The following substitutions are made:

$$\begin{aligned}
 C_1 &= (1-s)(1-\tau_1)F(K_1), \\
 C_2 &= (1-s)(1-\tau_2)F(K_2) = (1-s)(1-\tau_2)F[K_1(1-d) + I_1], \\
 K_3 &= K_1(1-d)^2 + I_1(1-d) + I_2, \\
 D_3 &= (1+r)^2 D_1 + (1+r)[I_1 - \tau_1 F(K_1) - s(1-\tau_1)F(K_1)] \\
 &\quad + [I_2 - \tau_2 F(K_2) - s(1-\tau_2)F(K_2)].
 \end{aligned}$$

To find the tax rates implied by (11), note that  $C_i$  equals  $(1-s)(1-\tau_i)F(K_i)$ , so that  $\tau_i$  equals  $1 - [C_i/F(K_i)][1/(1-s)]$ . A typical optimal growth path for a developing economy will involve a rising  $\tau$ . Low tax rates in the early period allow households to benefit early on from the growth that will be achieved in periods 2 and 3. Higher taxes later on are necessary to service the international debt.

Now let us suppose that the ceiling on tax rates is less than one, and that the constraint is binding in the sense that the optimal tax rate in period 1 and/or period 2 exceeds the ceiling. Since the optimal tax path tends to involve rising taxes, we examine the natural case in which the tax constraint does not bind in period 1, while it does bind in period 2. By standard principles of optimization, we know that  $\partial U/\partial \tau_i \geq 0$ , with the strict inequality holding when  $\tau_i$  is binding at the constraint  $\bar{\tau}$ . Thus, when  $\tau_1 < \bar{\tau}$  and  $\tau_2 = \bar{\tau}$ ,  $\partial U/\partial \tau_1 = 0$  and  $\partial U/\partial \tau_2 > 0$ . What are the implications of the tax constraint? From (11)(b),  $u_2$  is less than  $-V_D/(1+\delta)$ . The second-period marginal utility of consumption is "too low." The government would like to raise second-period taxes, reduce  $C_2$ , and thereby raise  $u_2$ , but it has already taxed to the limit. Let  $\theta$  be such that  $u_2(1+\theta)$  equals  $-V_D/(1+\delta)$  (clearly  $\theta$  must be positive). Substituting this relationship and (11)(d) into (11)(c), we see that

$$\begin{aligned} F_K(K_2) &= (r+d) \cdot \gamma, \\ \gamma &= (1+\theta)/[(1+\theta) - \theta(1-s)(1-\bar{\tau})] > 1. \end{aligned} \tag{12}$$

We have the key result:

Under a regime of constrained tax levies, the marginal product of capital should no longer be equated with the world market cost of capital but rather should be kept *higher*, to reflect a lower shadow value of second-period output.

The utility value of second-period output may be measured by  $u_2$ . Since this is no longer equated to  $V_D/(1+\delta)$ , second-period returns to investment should be given a weight less than one in project analysis. By following the standard rule  $F_K(K_2) = r + d$ , the country is led to overborrow, with the result that social welfare is reduced.

Let us consider a graphic case of this issue that follows the analysis in Kharas (1981). Suppose that the government only cares about growth, in the sense that  $u(C_1) \equiv u(C_2) \equiv 0$ , and  $V(K_3, D_3) = F(K_3) - (1+r)D_3$ . The

government is trying to maximize third-period national income (net of international indebtedness). If  $\tau_t$  is not constrained,  $\tau_1$  and  $\tau_2$  should be set at one, with government revenue plus net foreign borrowing used to equate  $F_K(K_2)$  with  $r + d$ , according to the classic policy prescription.

Now suppose that  $\tau_1, \tau_2 \leq \bar{\tau} < 1$ . Since consumption has no weight in utility, it is optimal to set taxes at their maximum rate:  $\tau_1 = \tau_2 = \bar{\tau}$ . Then,  $D_3$  and  $K_3$  are given by

$$\begin{aligned} D_3 &= (1+r)^2 D_1 + (1+r)\{I_1 - [s(1-\bar{\tau}) + \bar{\tau}]F(K_1)\} \\ &\quad + \{I_2 - [s(1-\bar{\tau}) + \bar{\tau}]F[K_1(1-d) + I_1]\}, \\ K_3 &= K_1(1-d)^2 + I_1(1-d) + I_2. \end{aligned}$$

Note that  $D_3$  and  $K_3$  are functions of  $I_1$  and  $I_2$ . By setting  $\partial V/\partial I_1 = \partial V/\partial I_2 = 0$ , we find the optimal investment policy. Thus, differentiating  $V = F(K_3) - (1+r)D_3$  with respect to  $I_1$  and  $I_2$ , and using the expressions above, we find

$$F_K(K_2) = \frac{(r+d)}{s(1-\bar{\tau}) + \bar{\tau}} > r + d; F_K(K_3) = (1+r). \quad (13)$$

Once again, the country should not invest enough to equate  $F_K(K_2)$  and  $r + d$ .

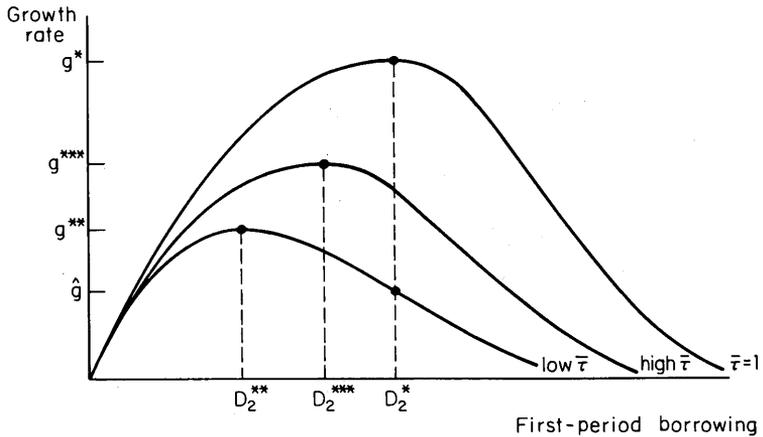
To understand (13), consider how a foreign-financed small change in investment,  $\Delta I_1$ , affects third-period income. (That is all that counts to the government!)  $\Delta I_1$  raises  $K_3$  by  $(1-d)\Delta I_1$ , and so  $\Delta F(K_3)$  equals  $F_K(K_3)$  times  $(1-d)\Delta I_1$ . Since  $F_K(K_3)$  is chosen to equal  $(1+r)$ ,  $\Delta F(K_3)$  equals  $(1+r)(1-d)\Delta I_1$ .  $\Delta I_1$  affects third-period debt in a number of ways: second-period taxes rise by  $\bar{\tau}F_K(K_2)\Delta I_1$ ; second-period savings rise by  $s(1-\bar{\tau})F_K(K_2)\Delta I_1$ ; and second-period debt rises by  $(1+r)\Delta I_1$ . Thus, third-period debt rises by  $(1+r)$  times  $(1+r)\Delta I_1$  minus  $\bar{\tau}F_K(K_2)\Delta I_1$  minus  $s(1-\bar{\tau})F_K(K_2)\Delta I_1$ , or

$$\Delta(1+r)D_3 = (1+r)[(1+r)\Delta I_1 - \bar{\tau}F_K(K_2)\Delta I_1 - s(1-\bar{\tau})F_K(K_2)\Delta I_1].$$

At the optimum,  $\Delta F(K_3)$  is equated to  $\Delta(1+r)D_3$ . Since  $\Delta F(K_3)$  equals  $(1+r)(1-d)\Delta I_1$ , we have

$$(1+r)(1-d)\Delta I_1 = (1+r)[(1+r) - \bar{\tau}F_K(K_2) - s(1-\bar{\tau})F_K(K_2)]\Delta I_1.$$

FIGURE 1  
FOREIGN BORROWING AND GROWTH IN A TAX-CONSTRAINED REGIME



NOTE: Growth is measured by  $F(K_3) - (1+r)D_3$ , as in text.

Dividing both sides of this equation by  $(1+r)\Delta I_1$ , and rearranging, we arrive at (13).

This model is a powerful indictment of foreign borrowing, *even for productive investment projects*, if the domestic fiscal system is not equipped to handle rising debt-service ratios. Figure 1 illustrates how aggregate growth is slowed by excessive borrowing in a tax-constrained regime, for specific parameter values of the model. In the unconstrained regime, optimal borrowing is at  $D_2^*$ ; in the constrained case, with a low tax ceiling, the optimum is at  $D_2^{**}$ , which is less than  $D_2^*$ ; and in the constrained case with a high tax ceiling, the optimum is at  $D_2^{***}$ , which lies between  $D_2^*$  and  $D_2^{**}$ . Note that the resulting growth rates ( $g^{**}$  for low  $\bar{\tau}$ ;  $g^{***}$  for high  $\bar{\tau}$ ; and  $g^*$  for  $\bar{\tau} = 1$ ) increase as the tax constraint is eased. Note also what happens if the government follows the textbook prescription of borrowing to the point where  $F_K(K_2)$  equals  $r + d$ , even though taxing authority is limited (say, low  $\bar{\tau}$ ). Borrowing is at the rate  $D_2^*$ , but growth is given by  $\hat{g}$ , which is much below what could be achieved by more moderate borrowing.

#### 4 INTERNATIONAL BORROWING WITH POSSIBLE DEBT REPUDIATION

So far, in setting debt ceilings for the borrowing country the creditors have considered only the feasibility of debt repayment. In practice, however, a loan must pass two hurdles to make it a reasonable bet: (1) loan repayment must be feasible, and (2) the borrower must have an incentive to pay off the loan when it comes due. In some cases, it may be less onerous for a borrower to repudiate a debt obligation and accept the penalties that may arise than to undertake the task of paying off the debt. In this chapter, we study how the creditors and borrowers operate when such a possibility exists.

A word concerning terminology is useful at this point. In technical terms, a default is any failure to respect the terms of a loan agreement. A default may occur because the loan is mistakenly allowed to rise above productive wealth, or because the government is unable to levy the necessary taxes to service the debt, or, as we shall see in Chapter 5, because the creditors panic and create a liquidity shortage for the borrowing country. In this chapter, I analyze the possibility of a default caused purely by a decision on the part of the borrowing-country government in a situation in which debt repayment is feasible but perhaps unpleasant. I follow Eaton and Gersovitz (1981) in reserving the term "debt repudiation" for this type of default.

##### *The Basic Model of Debt Repudiation*

The key to modeling debt repudiation is an explicit assumption regarding its benefits and costs. The benefits are straightforward: the borrower saves the real value of the outstanding debt, which it no longer services. The costs are far more problematic, to judge from historical experience (see Sachs, 1982a). One cost may be the partial or complete inability to obtain new loans in the world capital markets, at least for some time after the repudiation occurs. Another cost may be a direct seizure of the country's overseas assets, including bank accounts, direct foreign investments, ships, and aircraft. A third, and even more important, cost may be a dramatic decline in the country's capacity to engage in trade, even if no new net borrowing is involved. Modern trade is built on a sophisticated system of revolving trade credits. Even if a country's *net* debt is

zero, its gross stocks of trade-related financial assets and liabilities are likely to be large. Because a borrower would have difficulty arranging trade credits after a repudiation, the mechanics of trade would be impeded. Moreover, merchandise at ports ready to be dispatched to the debtor country could be seized by the creditors.

To introduce these elements, I assume that when a debt is repudiated the creditors retaliate by imposing two costs: first, in all future periods, the borrower's production is reduced, for given  $K$  and  $L$ , by a fixed fraction,  $\lambda$ ; and, second, the borrower is excluded from all further borrowing. I also make the important assumption that this retaliation neither imposes costs nor yields benefits to the creditors (or that the costs and benefits cancel).

As an easy start, we begin with a two-period version of the international borrowing model [we simply drop  $V(K_3, D_3)$ ]. The tax considerations are ignored, so that we implicitly assume that domestic tax levies are not constrained. Loans are made to the sovereign borrower in period 1. If they are not repaid in period 2, the penalty is enforced and second-period output is reduced by  $\lambda Q_2$ . The borrower makes the repudiation decision in the second period (there is no way that it can commit itself to a decision before the second period arrives). Since second-period utility is simply  $u(C_2)$ , the borrower compares consumption levels with and without repudiation. With repudiation,  $C_2$  equals  $Q_2 - \lambda Q_2 = (1 - \lambda)Q_2$ . (I denote this level as  $C_2^R$ .) With no repudiation,  $C_2$  equals  $Q_2 - (1 + r_2)D_2$ , which I denote  $C_2^N$ . The borrower defaults whenever  $C_2^R$  exceeds  $C_2^N$ , and thus whenever  $(1 + r_2)D_2$  exceeds  $\lambda Q_2$ . Note that the interest rate has a time subscript; we can no longer assume a unique world interest rate for all loans, since creditors will now impose an interest-rate premium to allow for default risk.

There are two choices with respect to the timing of loans. Credit  $D_2$  may be extended before or after the investment decision  $I_1$  is made. We shall see shortly that it is a great advantage to the borrowing country to be able to choose  $I_1$  before going to the capital markets, since the investment level can then be chosen to improve the credit terms on a given loan or to increase the total amount that the country can borrow. A more natural assumption, however, is that loans are arranged first and the government then allocates them to consumption and investment. This is more natural because the government's promises concerning  $I_1$  will be unconvincing: generally, the government will have an incentive to renege on a promised level of investment once a loan is arranged,

even if it would have been better off to fix the  $I_1$  initially. I term the case in which  $I_1$  is set first the "pre-commitment equilibrium" and regard the other case as the "standard assumption."

The trick to solving the borrowing problem under certainty is to calculate the loan-supply ceiling  $\bar{D}_2$  beyond which the creditors will not make loans. As long as  $D_2$  is less than or equal to  $\bar{D}_2$ , the country will choose not to default. The loan will be safe, and the interest rate will equal the safe rate of interest, denoted by  $\rho$ . If  $D_2$  exceeds  $\bar{D}_2$ , the country will default for any interest rate greater than or equal to  $\rho$ . No risk premium can compensate for the certainty of debt repudiation. All lending is cut off at the point  $\bar{D}_2$ .

In order to find  $\bar{D}_2$ , we first compute the country's investment choice as a function of  $D_2$ . For each  $D_2$ , we find the level of utility of the borrowing country for alternative values of  $I_1$  and choose the optimal  $I_1$  as a function of  $D_2$ . We thereby derive  $I_1 = I_1(D_2)$ . The borrowing ceiling  $\bar{D}_2$  is found as the point for which the default penalty  $\lambda F[K_1(1-d) + I_1(D_2)]$  just equals  $(1+\rho)D_2$ . In other words,

$$\bar{D}_2 = \lambda F[K_1(1-d) + I_1(\bar{D}_2)] / (1+\rho). \quad (14)$$

It remains to calculate  $I_1(D_2)$ . Note that the borrower defaults if and only if  $\lambda F[K_1(1-d) + I_1]$  is less than  $(1+\rho)D_2$ . Thus, for each  $D_2$  there is a threshold  $\bar{I}_1$  for which *the country defaults if and only if  $I_1$  is less than  $\bar{I}_1$* . To find the best investment policy for given  $D_2$ , the country makes two calculations: its best utility if it heads for default (i.e., with  $I_1 < \bar{I}_1$ ) or if it plans to repay its debt (i.e., with  $I_1 \geq \bar{I}_1$ ). It then picks the strategy that yields the higher utility. Thus

$$I_1(D_2) \text{ is given as the solution to } \max_{I_1} (U^R, U^N), \quad (15)$$

$$\text{where } U^R = \max_{I_1 < \bar{I}_1} U(C_1 + D_2 - I_1) + U[1 - \lambda]Q_2 / (1 + \delta),$$

$$U^N = \max_{I_1 \geq \bar{I}_1} U(C_1 + D_2 - I_1) + U[Q_2 - (1 + \rho)D_2] / (1 + \delta),$$

$$Q_2 = F[K_1(1-d) + I_1],$$

and

$$\lambda F[K_1(1-d) + \bar{I}_1] = (1 + \rho)D_2.$$

Armed with the investment function, equation (14) can be solved for  $\bar{D}_2$ .

Once  $\bar{D}_2$  is known, we can easily specify the borrower's problem:

*Borrower's Problem with Repudiation Risk* (16)

$$\begin{aligned} \max_{C_1, D_2} & u(C_1) + u(C_2)/(1 + \delta), \\ I_1 &= Q_1 - C_1 + D_2, \\ K_2 &= K_1(1 - d) + I_1, \\ D_2 &\leq \bar{D}_2, \\ C_2 &= Q_2 - (1 - \rho)D_2; Q_2 = F(K_2). \end{aligned}$$

The solution to this is readily given as

$$\begin{aligned} u_1(C_1) &= u_2(C_2)(1 + \rho + \gamma)/(1 + \delta), \\ F_{K_2} &= (1 + \rho + \gamma), \\ \gamma &= 0 \text{ for } D < \bar{D}, \\ \gamma &> 0 \text{ for } D = \bar{D}. \end{aligned} \quad (17)$$

The interpretation is as follows. If the credit ceiling is not binding, we are back to the textbook model. Marginal utilities of incomes are equated over time, with  $u_1/[u_2(1 + \delta)]$  equal to  $(1 + \rho)$ . Investments are carried out to the point where the marginal product of capital equals the world interest rate. [Note that in the two-period model, this means  $F_K(K_2) = 1 + \rho$  rather than  $F_K(K_2) = r + d$ , as in the three-period model.] When the credit ceiling binds, it is as if the domestic interest rate exceeds the world market rate. Fewer investments are undertaken, since the marginal product of capital must now equal the higher rate  $1 + \rho + \gamma$ . Then  $u_1(C_1)$  rises relative to  $u_2(C_2)$ , meaning that the consumption path is pushed into the future.

As  $\lambda$  (the default penalty) rises,  $\bar{D}_2$  rises as well, and the credit is more easily obtained. Utility rises, and investment and  $C_1$  increase as well. Thus, *in a world of certainty, borrowers prefer higher penalties for debt repudiation*. The higher the penalty, the less restrictive is the credit ceiling.

Now let us modify the model by allowing the country to pre-commit to  $I_1$  before  $D_1$  is selected. The borrower's problem becomes

*Borrower's Problem with Investment Pre-commitment* (18)

$$\max_{I_1, C_1} u(C_1) + u(C_2)/(1 + \delta),$$

$$\begin{aligned} (1 + \rho)D_2 &\leq \lambda F[(1 - d)K_1 + I_1], \\ Q_1 &= C_1 + I_1 - D_2, \\ C_2 &= Q_2 - (1 + \rho)D_2, \\ Q_2 &= F(K_2); K_2 = (1 - d)K_1 + I_1. \end{aligned}$$

Borrowers now set  $I_1$  knowing that their choice influences the size of loans that they can hope to arrange, since creditors restrict  $(1 + \rho)D_2$  to be less than or equal to  $\lambda Q_2$ . Implicitly, there is a nonlinear constraint on  $C_1$  and  $I_1$ , such that  $(1 + \rho)(C_1 + I_1 - Q_1)$  does not exceed  $\lambda F[(1 - d)K_1 + I_1]$ . The solution to the pre-commitment problem is

$$\begin{aligned} u_1(C_1) &= [u_2(C_2)/(1 + \delta)] \cdot [(1 + \rho)(1 + \theta(1 + \delta)/u_2)], \\ F_K(K_2) &= (1 + \rho) \cdot [1 + \theta(1 + \delta)/u_2]/[1 + \lambda\theta(1 + \delta)/u_2] \geq (1 + \rho), \\ \theta &= 0 \text{ for } D_2(1 + \rho) < \lambda Q_2, \\ \theta &> 0 \text{ for } D_2(1 + \rho) = \lambda Q_2. \end{aligned}$$

Once again, when  $\theta$  equals zero, we are back to an unconstrained optimum, with  $u_1/u_2$  equal to  $(1 + \rho)/(1 + \delta)$  and  $F_K(K_2)$  equal to  $(1 + \rho)$ . When  $\theta$  exceeds zero, we are again in a situation where  $F_K$  should be held above the world cost of capital, as should the ratio of  $u_1$  to  $u_2/(1 + \delta)$ . A key point here, relative to the standard case in (17), is that  $F_K$  is now set below  $u_1/[u_2/(1 + \delta)]$ . That is because there are now *two* benefits of investment: higher second-period income *and* a relaxation of the borrowing constraint. The first motive for investment (second-period consumption) generally leads the planner to equate  $F_K$  with  $u_1/[u_2/(1 + \delta)]$ . The second consideration raises investment and thus lowers  $F_K$  relative to  $u_1/[u_2/(1 + \delta)]$ .

In general, pre-commitment results in a higher level of  $I_1$ , greater debt, and higher utility. The utility level *must* be greater than or equal to utility in the standard case, since the policy-maker in (18) could choose to pre-commit  $I_1$  at the equilibrium level in the standard solution. We see, then, that pre-committing one's country to a high investment profile is a method of enhancing creditworthiness and raising social welfare. Of course, we should not lose sight of the previous chapter's conclusion that

a weak public-finance structure may militate against extensive foreign borrowing for investment purposes.

A linear model offers a vivid illustration of the effects of repudiation risk and of investment pre-commitment. Let

$$\begin{aligned} Q_1 &= \bar{Q}, \\ Q_2 &= \bar{Q}_2 + (1 + \gamma)I_1, \quad I \leq \bar{I}, \\ U &= C_1 + C_2/(1 + \delta), \\ \delta &> \gamma > \rho. \end{aligned}$$

Thus, we assume here a quantity  $\bar{I}$  of investment projects with a rate of return  $\gamma$  exceeding the world interest rate  $\rho$ . The rate of time discount  $\delta$  is also assumed to be greater than the world interest rate. In the textbook model, the borrowing equilibrium involves  $I_1$  equal to  $\bar{I}$  (all investment projects undertaken), with consumption shifted entirely to the first period, and no consumption in the second (since  $\delta$  exceeds  $\rho$  with linear utility). In sum,

*The Textbook Case* (21)

$$\begin{aligned} C_1 &= \bar{Q} + [\bar{Q} + (1 + \gamma)\bar{I}]/(1 + \rho), \\ I_1 &= \bar{I}, \\ C_2 &= 0, \\ D_2 &= C_1 + I_1 - \bar{Q}. \end{aligned}$$

Now we turn to the standard repudiation model. For any given  $D_2$ ,  $I_1$  will be chosen to equal zero, since  $\delta$  is greater than  $\gamma$ . Therefore  $Q_2$  equals  $\bar{Q}$ , and the debt ceiling is given by  $\bar{D}_2$  equal to  $\lambda\bar{Q}/(1 + \rho)$ . The complete solution is

*The Standard Repudiation Case* (22)

$$\begin{aligned} C_1 &= \bar{Q} + \lambda\bar{Q}/(1 + \rho), \\ I_1 &= 0, \\ C_2 &= \bar{Q} - \lambda\bar{Q}, \\ D_2 &= \lambda\bar{Q}/(1 + \rho). \end{aligned}$$

Thus, the risk of repudiation reduces  $D_2$ ,  $I_1$ , and  $C_1$  and raises  $C_2$ .

Finally, we have the pre-commitment case. In this model, the borrow-

ing country will choose to pre-commit to  $I_1$  equal to  $\bar{I}$  when  $\gamma$  is close to  $\delta$  and when  $\delta$  is much greater than  $\rho$ . Specifically, we find

*The Pre-commitment Repudiation Case* (23)

$$\begin{aligned} C_1 &= \bar{Q} + D_2 - I_1, \\ I_1 &= 0 \text{ for } (\delta - \rho)\lambda(1 + \gamma) < (\delta - \gamma)(1 + \rho), \\ I_1 &= \bar{I} \text{ for } (\delta - \rho)\lambda(1 + \gamma) > (\delta - \gamma)(1 + \rho), \\ C_2 &= Q_2 - \lambda Q_2, \\ D_2 &= \lambda Q_2 / (1 + \rho). \end{aligned}$$

Thus, the pre-commitment case *may* be the same as the no-pre-commitment case but might (and generally will) result in an equilibrium somewhere between the textbook model and the standard repudiation model. Pre-commitment allows greater borrowing, greater investment in profitable projects, and higher first-period consumption.

*The Debt-Repudiation Model under Uncertainty*

So far, an actual default never occurs in the model, though the *threat* of default has a profound effect on economic welfare and the nature of macroeconomic equilibrium. Once uncertainty is introduced into the model, debt repudiations will actually occur as random events. The presence of uncertainty has several effects. First, the loan-supply schedule becomes upward sloping rather than perfectly elastic up to a maximum debt level  $\bar{D}$ . Second, and even more important, the incentive structure for macroeconomic management may become perverse, in ways soon to be described. A more complete treatment of debt repudiation under uncertainty can be found in Eaton and Gersovitz (1981) and Sachs and Cohen (1982). Here, I will discuss some simple yet revealing examples.

Consider the linear model just described, but with  $\bar{I}$  equal to zero and  $Q_2$  a random variable equal to  $\bar{Q}$  with probability  $\Pi$  and  $\theta\bar{Q}$  ( $\theta < 1$ ) with probability  $(1 - \Pi)$ . I assume that  $\Pi$  exceeds  $\theta$ , which proves convenient below. Creditors are assumed to be risk-neutral, charging an interest rate  $r_2$  that yields an expected rate of return equal to  $\rho$  (I relax the assumption of risk neutrality in the next chapter). Debtors are assumed to repudiate debt whenever  $(1 + r_2)D_2$  exceeds  $\lambda Q_2$  and to repay debt otherwise.

Let us specify the loan-supply schedule. Let  $\alpha$  be the probability of a debt repudiation. The interest rate  $r_2$  will be set so that  $(1 + r_2)(1 - \alpha)$

equals  $(1 + \rho)$ , assuming risk-neutral creditors. By using the relations  $(1 + r_2)(1 - \alpha)$  equal to  $(1 + \rho)$  and  $\alpha$  equal to  $\text{Pr}[(1 + r_2)D_2 > \lambda Q_2]$ , we can easily derive the following loan schedule:

$$D_2 \leq \bar{D}_2 = \lambda \bar{Q} \Pi / (1 + \rho), \quad (24)$$

with interest rates

$$\begin{aligned} r &= \rho \text{ for } D_2 \leq \lambda \theta \bar{Q} / (1 + \rho), \\ r &= (1 + \rho - \Pi) / \Pi \text{ for } \lambda \theta \bar{Q} / (1 + \rho) < D_2 \leq \bar{D}_2. \end{aligned}$$

The supply schedule is shown in Figure 2, where we see an important point. Though the loan supply is upward sloping (in this case, a step function), there is still a point  $\bar{D}_2$  above which higher risk premia do not compensate for repudiation risk. Creditors will not extend loans beyond  $\bar{D}_2$  at any interest rate. Thus, even in more general models there tend to be credit ceilings, rather than ever-higher risk premia, as a property of the loan-supply schedule.

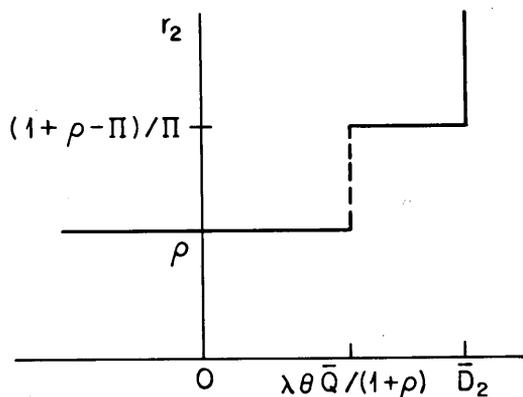
Now suppose that the social-welfare function is  $U = C_1 + C_2 / (1 + \delta)$ , and the goal of the government is to maximize expected utility,  $E(U)$ . Since we are ignoring investment, the only issue is how much to borrow, with  $C_1 = \bar{Q} + D_2$ , and  $C_2 = \max [Q_1 - (1 + r_2)D_2, (1 - \lambda)Q_2]$ . A little algebra yields the following rules:

- For  $\delta < \rho$ , the country lends  $D_2 = -Q_1$ . (25)
- For  $\rho < \delta < [\theta(1 - \Pi) + \Pi\rho(1 - \theta)] / (\Pi - \theta)$ , the country borrows  $D_2 = \lambda \theta \bar{Q} / (1 + \rho)$  at interest rate  $\Pi$ , and with zero probability of debt repudiation.
- For  $\rho < [\theta(1 - \Pi) + \Pi\rho(1 - \theta)] / (\Pi - \theta) < \delta$ , the country borrows  $D_2 = \bar{D}_2$ , at interest rate  $r = (1 + \rho - \Pi) / \Pi$ , and with the probability  $(1 - \Pi)$  of debt repudiation.

Thus, the more "impatient" the country (i.e., the greater is  $\delta$ ), the higher is the borrowing, which comes at a greater cost and a greater risk of default.

There is a simple yet important lesson in (25). The probability of debt repudiation does not depend on  $\lambda$  but rather on comparisons of  $\delta$  and  $\rho$ . Higher penalties ( $\lambda$ ) do not necessarily reduce the frequency of debt repudiation. In a more general model, a rise in  $\lambda$  might actually raise

FIGURE 2  
 LOAN-SUPPLY SCHEDULE UNDER REPUTATION RISK



that frequency! The reason is that, while higher  $\lambda$  makes default more costly, it also makes lenders willing to extend more credit. Thus, when  $\lambda$  rises, both the costs *and* benefits of debt repudiation increase and, in the example, the probability of debt repudiation remains unchanged.

#### *Debt Repudiation and Macroeconomic Incentives*

A recent theme of financial economics is that the various claimants on a firm's income stream (e.g., the shareholders, bondholders, banks, workers) have differing interests regarding the firm's policies, because alternative policies affect the relative valuation of the different claims. Thus, the shareholders may urge policies that raise shareholder wealth at the expense of bondholder wealth, as described in Jensen and Meckling (1976), Myers (1977), and Smith and Warner (1979). Or coalitions of the shareholders and banks may engage in policies at the expense of bondholders, especially in the context of bankruptcy actions (see Bulow and Shoven, 1978). A notable feature of these examples is that the firm may pursue inefficient policies that reduce its overall value, because some groups will benefit even though other groups will be hurt more.

A related theme is that all groups are generally left better off, *ex ante*, if the firm can be constrained from pursuing inefficient policies. As an example, consider the case of risky investments. It is well known that shareholders can sometimes devalue the claims of bondholders on the firm by selecting overly risky investment projects. (A bond is an option on the firm's income stream; an increase in variance of an income stream

reduces the value of the related option.) Since bondholders know this *ex ante*, they may charge a high risk premium in anticipation of the investment policy. This high risk premium reduces shareholder wealth while it allows the bondholder to earn the expected market rate of return. After the loan is made and the risky investment selected, the bond claim is reduced in value (relative to the hypothetical value if a safe investment is selected instead), but the initial risk premium has already compensated for that effect. If the shareholders could somehow have committed themselves to choose safe investments, the initial high risk premium could have been avoided, to their own advantage.

Several direct analogies can be made to macroeconomic behavior by the borrowing country. Like a firm, the country also has various claimants on the income stream, including the government, domestic citizens, and international creditors. And, like the firm, the country may be led to select inefficient policies to transfer income from the creditors to the "shareholders" (the government and the domestic private sector). Generally, the country would like to forswear these policies *ex ante* but may find it difficult to do so.

Let us consider an example in the linear stochastic framework, also involving the riskiness of investment projects. Suppose that there are two choices for an investment project. Choice A yields  $Q_2$  equal to  $(1 + \gamma^A)I_1$  with certainty. Choice B yields  $Q_2$  equal to  $(1 + \gamma^B)I_1$  with probability  $\Pi$ , and  $Q_2$  equal to zero with probability  $1 - \Pi$ . The yield on A is  $\gamma^A$ , and the expected yield on B is  $\Pi(1 + \gamma^B) - 1$ . We will assume that  $\gamma^A$  is greater than  $\Pi(1 + \gamma^B) - 1$ . The government borrows to finance  $I_1$ , so that  $D_2$  equals  $I_1$ . Second-period consumption equals  $Q_2$  minus  $(1 + r_2)D_2$  if there is no default, and  $(1 - \lambda)Q_2$  if there is a default. Default occurs if and only if  $(1 + r_2)D_2$  exceeds  $\lambda Q_2$ . We also assume that  $(1 + r_2)$  is less than  $\lambda(1 + \gamma^A)$  and  $\lambda(1 + \gamma^B)$ .

Now suppose that social welfare is simply the expected value of  $C_2$ ,  $EC_2$ . Which investment project should be selected? If the investment project is selected *before* the loan is made, it is easy to check that choice A is preferred. Under choice A, the borrowing rate is simply  $\rho$ , since there is zero probability of default.  $EC_2^A$  is simply  $(1 + \gamma^A)I_1$  minus  $(1 + \rho)I_1$ . Under choice B, default occurs with the "bad" outcome, which occurs with probability  $1 - \Pi$ . The borrowing rate equates  $\Pi(1 + r_2)$  with  $(1 + \rho)$ . Thus  $(1 + r_2)$  equals  $(1 + \rho)/\Pi$ .  $C_2^B$  equals  $(1 + \gamma^B)I_1$  minus  $(1 + r_2)I_1$  with probability  $\Pi$ , and zero with probability  $1 - \Pi$ . Thus,  $EC_2^B$  equals

$\Pi(1 + \gamma^B)I_1$  minus  $(1 + \rho)I_1$ . By assumption,  $\Pi(1 + \gamma^B)$  is less than  $(1 + \gamma^A)$ , so  $EC_2^B$  is less than  $EC_2^A$ .

If the loan is made *before* the investment project is selected, the country may well choose B instead of A! To see the problem, suppose that the banks lend  $D_2$  equal to  $I_1$  at rate  $\rho$  in anticipation that choice A will be selected. At rate  $\rho$ ,  $EC_2^A$  equals  $(\gamma^A - \rho)I_1$ , as before, while  $C_2^B$  now equals  $(1 + \gamma^B)$  minus  $(1 + \rho)I_1$  with probability  $\Pi$ , and zero with probability  $1 - \Pi$ . Thus,  $EC^B$  equals  $\Pi(\gamma^B - \rho)I_1$ . As long as  $1 + \gamma^A > \Pi(1 + \gamma^B) > (1 + \gamma^A) - (1 + \rho)(1 - \Pi)$ ,  $EC_2^B$  will exceed  $EC_2^A$ . Thus, the country will be induced to select choice B! Since the creditors will recognize the country's *ex post* incentive to choose B, the loan will in fact carry the interest rate  $r_2$  such that  $\Pi(1 + r_2)$  equals  $1 + \rho$ , that is,  $(1 + r_2)$  equals  $(1 + \rho)/\Pi$ . By a similar set of calculations, we find again that project B is preferred at this interest rate.

The problem here is as follows: When the investment project is chosen first, the borrower must consider the effect of his investment choice on the terms of the loan. When the loan is arranged first, the borrower does *not* consider this effect, since the terms of the loan are already set. The borrower would like to promise the creditor that a safe project will be pursued, but such a promise will look unconvincing given the incentive to renege on it once the loan agreement is set.

There are several other areas in which timing and default risk interact to produce bad macroeconomic choices. The earlier discussion of investment pre-commitment can be thought of precisely in these terms. From an *ex ante* point of view, it is best for the country to choose a high level of investment, because high investment relaxes credit ceilings. Once a loan package is arranged, however, the country prefers to raise first-period consumption at the expense of investment. Since creditors understand this, they will tend to discount initial promises of high investment plans, and indeed they will be right.

A similar phenomenon occurs when countries borrow long-term. When a country owes long-term debt, each new amount of borrowing tends to reduce the expected value of the original debt by making its eventual repudiation more likely. In many cases, in order to reduce the risk premium, the borrowing country would like to promise a potential long-term creditor that it will not overborrow once the loan is arranged. The creditor knows, however, that there will generally be strong incentives, *ex post*, for the borrower to do precisely the opposite. The result is that

long-term debt will generally command a high risk premium and that, as expected, overborrowing will occur.

Market participants search for ways to reduce these deleterious incentives. For example, a country may be able to establish a reputation for maintaining macroeconomic policies in line with announced plans. A growing economics literature on establishing a reputation (e.g., Krep and Wilson, 1982) may give insights in this direction. Other specific actions, such as relying on short-term rather than long-term borrowing, may reduce some of the incentive problems. In domestic capital markets, and to a much smaller extent in international lending, bond covenants can be used to pre-commit the borrower to a future line of action. Smith and Warner (1979) provide an excellent survey of such covenants that indicates how they help to enforce an efficient borrowing and investment plan by corporate borrowers. For example, covenants often directly restrict dividend payments, which may be tantamount to requiring the shareholders to invest rather than "consume" their loans. Other provisions include restrictions on new borrowing, maintenance of the firm's existing assets, financial-disclosure requirements, and restrictions on merger activity. Unfortunately, such provisions are typically unenforceable with foreign sovereign borrowers and thus are not part of most syndicated loan agreements in the international markets.

## 5 COLLECTIVE-ACTION PROBLEMS IN SYNDICATED LENDING

So far, all the problems with the textbook model have involved the borrower (whether in connection with its tax system or its incentive to repudiate debt). Problems at least as serious can arise on the creditor side, especially when credit-market imperfections interact with the problems already identified. I have so far treated the creditor side as a "black box" operation extending loans that yield the appropriate rate of return. In fact, on a typical loan, the creditor side tends to be composed of a large number of financial intermediaries who join together as a syndicate on an *ad hoc* basis. While the syndication process helps to diversify risk, it leads to several other problems of great significance.

The amended model of the supply side posits a very large number of banks, each with an upward-sloping schedule of loan supplies to the borrowing country. Let  $Er_i^L$  be the expected return on a loan made to the country by bank  $i$  (the expectation takes account of risks of debt repudiation, insolvency, etc.). Let  $L_i$  be the amount of the bank's total lending to the country, and  $B_i$  be total bank capital. The main hypothesis is that the inverse loan-supply schedule takes the form

$$Er_i^L = \bar{p} + f(L_i/B_i), \quad \begin{array}{l} f(0) = 0 \\ f'(\cdot) > 0 \end{array} \quad (26)$$

According to (26), the bank demands an expected return close to some  $\bar{p}$  when the country loan constitutes a small fraction of bank capital, but demands a higher expected return as the loan constitutes a growing fraction of bank capital. (By standard finance principles, described below, the level of  $\bar{p}$  will depend on the covariance of country  $i$ 's risk with other risks in the bank's portfolio.) There may even be a cutoff point  $\bar{\ell}$  such that  $L_i/B_i$  does not exceed  $\bar{\ell}$ . According to American banking law, for example, no bank can allocate more than 15 per cent of bank capital to a single borrower. While there are many technical ways around such ceilings, banks apparently also impose such ceilings on themselves.

The loan-supply schedule in (26) provides a powerful incentive for loan diversification among a large number of creditors. If a single bank makes a loan of size  $\ell$  equal to  $L_i/B_i$ , the country pays expected return  $Er_i^L$

equal to  $\bar{p} + f(\ell)$ . If the same loan is equally divided among  $N$  banks, the rate is  $\bar{p} + f(\ell/N) < \bar{p} + f(\ell)$ . Indeed, as  $N$  approaches infinity, the cost of borrowing approaches  $\bar{p}$ , and the loan-supply schedule mimics that of the elastic credit supply of earlier models.

A loan-supply schedule like (26) can be derived from the utility maximization of risk-averse banks. Suppose, for example, that expected utility (to bank managers) of the bank portfolio is given by  $E r_i^P - \beta \sigma^2(r_i^P)$ , where  $r_i^P$  is the return on the overall bank portfolio. It is simple to show that the expected return on the country loan will be a linear function of the covariance  $r_i^L$  and  $r_i^P$ . In general, as  $L_i/B_i$  rises, the covariance of  $r_i^L$  and  $r_i^P$  also rises, so that the bank requires a higher risk premium on its loans.

The assumption of risk-averse banks requires some justification. Standard finance theory holds that under certain conditions firms should ignore own-risk in choosing policies, since shareholders can diversify whatever specific risk the firm undertakes. However, these conditions are extremely restrictive, and more general conditions lead to risk-averse behavior. For example, the social costs of bankruptcy mean that a bank's valuation will depend on the riskiness of its portfolio. Also, with imperfect monitoring of managerial decisions by the shareholders, firms will tend to make risk-averse decisions. And in the context of commercial banks, bank regulators impose portfolio requirements limiting risk. Such policies are necessary in light of the moral hazards engendered by official deposit-insurance programs in the United States, Western Europe, and Japan.

### *The Possibility of Panics*

The drive toward diversification also gives rise to the possibility of liquidity crisis or panic in international lending. Suppose that a country has debt obligations due in the first period equal to  $(1+r_1)D_1$ ; current income  $Q_1$  less than  $(1+r_1)D_1$ ; and stochastic second-period income given by  $Q_2 = \bar{Q}$  with probability  $\Pi$ , and  $Q_2 = 0$  with probability  $1 - \Pi$ . Assume further that the existing debt  $D_1$  is held by a large number of creditors who do not act as a unified group engaged in negotiation with the debtor country and whose individual holdings are too small to give rise to any individual bargaining with the debtor country.

There are a number of possibilities at hand. Under the standard assumption that all debt is highly diversified among the creditors,  $E(r_i^L)$  equals  $\bar{p}$  for all banks  $i$ , and for all periods. Since the country cannot

feasibly repay  $(1+r_1)D_1$  out of current income, it must borrow  $D_2$  equal to or exceeding  $(1+r_1)D_1 - Q_1$ . In order to satisfy the new creditors, new loans must be at least at interest rate  $r_2$  such that  $\Pi(1+r_2)$  equals  $1 + \bar{p}$ . Thus,  $(1+r_2)$  equals  $(1+\bar{p})/\Pi$ . Now,

- If  $\bar{Q} < (1+\bar{p})[(1+r_1)D_1 - Q_1]/\Pi$ , the country will be forced into default on the ground of negative net-worth (insolvency). (27)
- If  $\lambda\bar{Q} < (1+\bar{p})[(1+r_1)D_1 - Q_1]/\Pi$ , the country will be forced into default on the ground that repudiation risk precludes new loans, in spite of overall solvency.
- If  $\lambda\bar{Q} > (1+\bar{p})[(1+r_1)D_1 - Q_1]/\Pi$ , the country can obtain new loans on a competitive basis.

A liquidity crisis, as distinct from a solvency or repudiation crisis, occurs when the last condition in (27) is satisfied but the country is nevertheless unable to obtain the requisite loans. The surprising result is that such an outcome can occur in competitive equilibrium. Assume that all banks lend according to (26), and take as given the amount of loans extended by the other banks. If all banks suddenly expect all other banks to stop lending to the country, it will be rational (for certain parameter values) for each bank to stop lending as well on the basis of that expectation, with the result that the expectation becomes self-confirming. To see this, consider a single bank planning its loans under the assumption of no loans from other banks. The bank knows that unless it lends  $D_2$  equal to  $(1+r_1)D_1 - Q_1$ , the country will default. According to (26), a loan of size  $D_2$  requires an expected rate of return  $Er_2^L$  equal to  $\bar{p} + f(D_2/B)$ . Since the debtor can hope to be paid off only with probability  $\Pi$  in the second period, the interest rate  $r_2$  on the loan must at least be such that  $\Pi(1+r_2)$  equals  $1 + \bar{p} + f(D_2/B)$ .

A liquidity crisis can arise when the following condition holds:

$$[1 + \bar{p} + f(D_2/B)]D_2/\Pi > \lambda\bar{Q} > (1+\bar{p})D_2/\Pi, \quad (28)$$

where  $D_2 = (1+r_1)D_1 - Q_1$ .

In this case, it is safe for many banks to lend  $D_2$ , but not safe for any single bank to lend at all. The risk premium required for single-bank

lending is enough to push the country to debt repudiation in the next period, with  $(1+r_2)D_2$  greater than  $\lambda\bar{Q}$ . Therefore, if each bank believes that all other banks will stop lending, *all* banks will stop lending.

Note that a panic requires a fairly high level of initial debt. Let  $r_{\frac{1}{2}}^L(D_2)$  be the loan-supply schedule for a single bank. Then, a panic requires  $[1 + r_{\frac{1}{2}}^L(D_2)]D_2$  to exceed  $\lambda\bar{Q}$ . Clearly, there is a minimum level of debt,  $D_2^{\min}$ , such that any level of  $D_2$  less than  $D_2^{\min}$  will make a panic impossible. Conversely, for  $D_2$  greater than  $D_2^{\min}$ , a panic can occur. Since  $D_2$  equals  $(1+r_1)D_1 - Q_1$ , there is similarly a condition for  $(1+r_1)D_1$ . Figure 3 shows the individual bank's loan-supply schedule; for  $D_2$  greater than  $D_2^{\min}$ ,  $r_{\frac{1}{2}}^L$  is such that  $(1+r_{\frac{1}{2}}^L)D_2$  exceeds  $\lambda\bar{Q}$ . It is precisely because panics occur only at high levels of debt that they are so difficult to distinguish from other forms of default. In every true liquidity crisis, it will seem to some observers that the problem really lies with the risk of debt repudiation or insolvency rather than with the supply of credit.

A good historical candidate for a liquidity crisis is cited in Sachs (1982a); see also Kindleberger (1978). In mid-1930, the international bond markets "shut down" to the developing countries. While about \$411 million of non-Canadian debt was floated from January to July 1930, only \$5 million was floated during the rest of the year. It was six months *after* the bond market collapsed that the first country (Bolivia) defaulted. Remarkably, much of the panic can be traced to a single week when a military coup in Brazil caused bond prices to plummet. Some representative bond prices for that week are shown in the accompanying table.

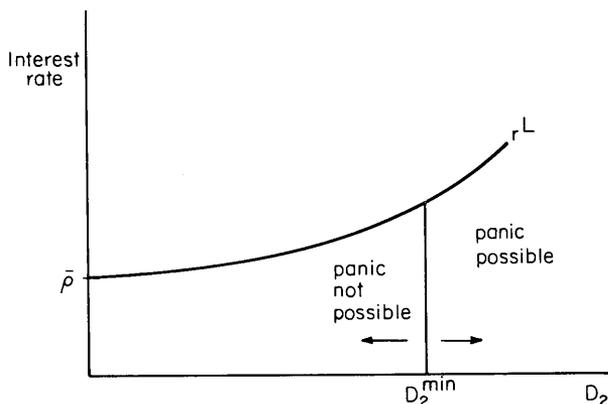
LATIN AMERICAN BOND PRICES, 1930

Country <sup>a</sup>	Closing Price	
	October 3	October 10
Argentina 6s	95	54 $\frac{7}{8}$
Bolivia 8s	76 $\frac{3}{4}$	66
Brazil 6 $\frac{1}{2}$ s	73	48 $\frac{1}{2}$
Chile 6s	83 $\frac{1}{2}$	71
Columbia 6s	66 $\frac{3}{8}$	58
Uruguay	101	88

<sup>a</sup>Numbers after country name refer to percentage coupon.

SOURCE: *Financial Chronicle*, 131 (1930), p. 2264, reported in Sachs (1982a).

FIGURE 3  
THE LOAN-SUPPLY SCHEDULE OF AN INDIVIDUAL BANK AND  
FINANCIAL PANIC IN THE LOAN MARKET



### *Other Collective-Action Problems*

A financial panic is not the only case in which cooperation among creditors can improve the efficiency of the international loan markets. In general, loan contracts can be made more efficient if the creditors are able to act collectively under certain contingencies. For example, an efficient loan contract may require that existing creditors reschedule the debts of the borrower at below-market rates in order to avoid a default. If the creditors are widely dispersed, without an institutional structure to enforce collective action, it may be impossible to arrange the rescheduling. No creditor alone has an incentive to reschedule at below-market rates, while each creditor has an incentive to ride free (by demanding full repayment of his claims) if the others reschedule. This seems to be the historical experience with international lending in the bond market.

When creditors are better organized, as in syndicated bank loans, there is at least the possibility that mutually advantageous collective action can be arranged. According to the evidence cited below, however, even in bank syndicates significant free-rider problems remain.

As an illustration of the role for collective action, consider a simple example in the three-period borrowing model. First-period output is  $\bar{Q}$ . Second-period output is  $\bar{Q}$  with probability  $\frac{1}{2}$ , and zero with probability  $\frac{1}{2}$ . If a second-period default occurs, the country is thrown into autarky, and  $Q_3$  equals zero. If there is no second-period default,  $Q_3$  equals  $\bar{Q}$  (probability  $\frac{1}{2}$ ) and  $Q_3$  equals zero (probability  $\frac{1}{2}$ ), with  $Q_3$  distributed

independently of  $Q_2$ . From the standpoint of efficiency, there is a clear incentive to avoid a second-period default. The safe rate of interest is  $\rho$  greater than zero. We assume that the country defaults only if it runs out of cash (i.e., it never voluntarily repudiates its debt). Also, the country repays as much of its debt as possible [e.g., if  $(1+r_3)D_3$  exceeds  $\bar{Q}$ , the country repays  $\bar{Q}$ ].

The borrower is interested in maximizing  $C_1$ , which equals  $Q_1$  plus  $D_2$ , so that equivalently the borrower is interested in maximizing first-period loans. It is easy to show that the maximum  $D_2$  that creditors will make available is raised by the ability to reschedule second-period debt. In the absence of rescheduling, the maximum first-period loan is given by

$$D_2 = \frac{\Pi\bar{Q}}{(1+\rho)} + \frac{\Pi^2\bar{Q}}{(1+\rho)^2}, \quad (29)$$

with

$$(1+r_2) = (1+\rho)/\Pi.$$

This quantity is found by noting that the country can borrow against expected second-period income  $\Pi\bar{Q}$  and expected third-period income *conditional* on no default in the second period (thus,  $\Pi \cdot (\Pi\bar{Q})$ , or  $\Pi^2\bar{Q}$ ). These magnitudes are discounted by the safe rate of interest. Thus, with  $\rho = 0.10$  and  $\Pi = 0.5$ , the maximum loan is  $D_2$  equal to  $(1.6/2.42)\bar{Q}$  with  $(1+r_2)$  equal to 2.2. To check that this contract satisfies the zero-expected-profit condition for the creditors, note that when  $Q_2$  equals  $\bar{Q}$  (probability  $1/2$ ), the country repays  $(1+r_2) \cdot D_2 (= 1.6\bar{Q}/1.1)$ , by borrowing  $D_3$  equal to  $(1+r_2) \cdot D_2 - \bar{Q} (= 0.5\bar{Q}/1.1)$  at the interest rate  $(1+r_3)$  equal to 2.2, from new creditors. When  $Q_2$  equals zero, the loan is defaulted. [No new creditors will lend the borrower  $(1+r_2)D_2$  to repay the loan, since  $(1+r_2)D_2$  exceeds expected third-period income.] Thus, the return on  $D_2$  is  $-D_2 + \Pi \cdot [(1+r_2)D_2/(1+\rho)] = -D_2 + \Pi[D_2/\Pi] = 0$ . The return on  $D_3$  is similarly computed to equal zero.

When second-period rescheduling is possible, the maximum  $D_2$  is higher. Now the country can commit third-period income  $\Pi\bar{Q}$  *whether or not*  $Q_2$  equals zero. In this case, unlike the previous case,  $Q_2$  equal to zero does not result in a default and consequent reduction in expected third-period income. The maximum loan is given by

$$D_2 = \frac{\Pi \bar{Q}}{(1+\rho)} + \frac{\Pi \bar{Q}}{(1+\rho)^2}, \quad (30)$$

with

$$(1+r_2) = (1+\rho)(1+\rho+\Pi)/(2+\rho)\Pi.$$

With the specific parameter values at hand, we find that  $D_2$  equals  $(2.1/2.42)\bar{Q}$ , which is obviously greater than  $1.6/2.42$  found earlier. The interest rate is  $1+r_2 = 3.52/2.1$ , which is less than 2.2.

To check the zero-expected-profit conditions on this contract, we note the following: If  $Q_2$  equals  $\bar{Q}$ , the loan is repaid, with the country borrowing  $D_3$  equal to  $(1+r_2)D_2 - \bar{Q}$  to repay the loan. If  $Q_2$  equals zero, the loan is rescheduled at the initial interest rate. (Note that *new* creditors would not lend anything to this borrower under the circumstances, since  $(1+r_2)D_2$  exceeds expected third-period income.) If  $Q_3$  equals  $\bar{Q}$ , then, the country repays  $\bar{Q}$ , since  $(1+r_2) \cdot [(1+r_2)D_2] > \bar{Q}$ ; if  $Q_3$  equals zero, it repays zero. Thus the syndicate earns

$$-D_2 + \frac{\Pi(1+r_2)}{(1+\rho)} D_2 + \frac{(1-\Pi)\Pi}{(1+\rho)^2} \bar{Q}.$$

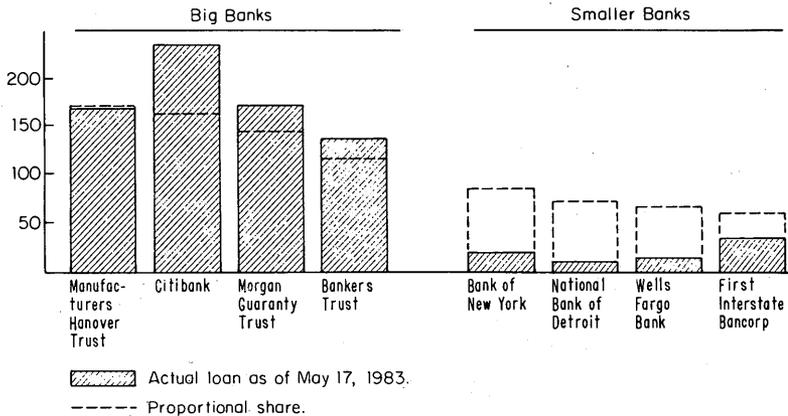
Upon substituting from (30), we find zero expected profits on this loan. The reader can verify that the loan  $D_3$  (in the event  $Q_2$  equals  $\bar{Q}$ ) will be arranged at market interest rate  $1+r_3$  equal to  $(1+\rho)/\Pi$ .

Thus, we find that a syndicate will lend more— $(2.1/2.42)\bar{Q}$  vs.  $(1.6/2.42)\bar{Q}$ —at a better interest rate— $3.52/2.1$  vs. 2.2. But the syndicate depends on the ability to make a second-period loan at the initial interest rate when new creditors would offer nothing at that rate. The risk for the syndicate is that an informal bargain among creditors to relend may break down in the second period, leading to a default rather than a rescheduling. Recent experience with commercial-bank rescheduling points up the tensions with relending. Banks with small participation in a loan agreement try to escape with their credit intact, relying on the larger banks to forestall default. Figure 4 shows this vividly with respect to the current Brazilian rescheduling package, where the U.S. regional banks are contributing new short-term credits at far less than their existing shares in Brazilian debt.

Other types of collective action that a syndicate might engage in in-

FIGURE 4  
RESCHEDULING PACKAGE OF INTERBANK LOANS TO BRAZIL

(in millions of dollars)



SOURCE: *Fortune Magazine*, July 11, 1983. © 1983 Time Inc. All rights reserved.

clude monitoring of existing loans for compliance, enforcement of loan agreements, and retaliatory actions in the event of noncompliance. In each of these cases there is a potential free-rider problem, with resulting inefficiencies in loan supply. Cline (1981, pp. 305–306) has reported the difficulty experienced by the commercial-bank syndicates lending to Peru in exercising all three of these functions, and their ultimate resort to the IMF as a way to escape from this problem:

In March 1976 the Bermudez government sought a large balance-of-payments loan from major U.S. banks, without a prior IMF standby agreement. The government felt that agreeing to IMF conditions would be unacceptable politically, although in its discussion with the banks, the government proposed a program very much like that which might have secured IMF support. Partly out of fear of a more leftist coup if Bermudez lost power, the banks eventually agreed, but only after the regime demonstrated willingness to take unpopular stabilization measures. . . .

The program called for an initial \$200 million in loans with a second \$200 million to follow after several months, contingent on government adherence to the policy package. Signed only by the end of 1976, the package soon demonstrated the frailty of such direct intervention by banks; for reasons of data availability, technical capacity, and political sensitivity, it proved impos-

sible for the banks to enforce their lending conditions, and adverse publicity for the intervention (plus its ineffectiveness) caused the leading banks to resolve that they would not become entangled in similar packages in the future but would rely on the IMF as the monitoring authority.

## 6 CONCLUSIONS AND EXTENSIONS

This study has suggested three areas in which the standard model of international borrowing requires major revision. First, in the typical planning or project-analysis framework, too little attention is generally given to the domestic budgetary implications of foreign borrowing. We saw that in an economy in which the government faces limitations on its ability to raise revenues, official foreign borrowing is often less attractive than standard calculations might suggest. Since the shadow cost of tax revenues is greater than one, claims on tax revenues (like amortization payments on foreign borrowing) must also be given a cost greater than one.

The second area concerned the effects of default risk, particularly repudiation risk, on the nature of international loans. Two phenomena were found to be of great importance: the loan-supply schedule becomes upward sloping, with eventual credit rationing, where the position of the supply schedule depends on the penalties of default; and various incentives are introduced that lead to inefficient borrowing and investment behavior by the debtor country.

The final area involved the supply side of the credit market. Liquidity crises were shown to result from the risk-averse behavior of individual lenders. Situations were identified in which the credit markets in the aggregate would be willing to lend but in which each individual bank withholds loans because of the fear that other banks will do so as well. No individual bank will break the credit squeeze, but a coalition of banks acting cooperatively might be able to restore the flow of lending. In general, the ability to form binding coalitions among creditors allows for more sophisticated, and ultimately more efficient, loan packages. A particularly important example is a loan agreement that guarantees a debt rescheduling at below-market rates in the event of a shortfall in output (or other real income loss) in the borrowing country.

Further research should explore the role of international organizations (such as the International Monetary Fund and the World Bank) in light of the market imperfections we have identified. Without doubt, the Fund has an important function to play with respect to each of the three categories of market breakdown. Its standard country consultations already involve the review of the domestic financial structure of borrowing coun-

tries, where a constant theme has been the intricate connection of budget financing and foreign borrowing.

The more novel Fund involvement in recent years has come in the second and third categories. To an increasing extent, Fund conditionality involves the application of loan covenants to borrowing packages, for the purposes analyzed in Chapter 4. In this regard, Fund programs might do better to emphasize the distribution of spending between investment and consumption rather than the overall level of spending in the borrowing country.

The most visible role of the Fund in recent months has come in the third category, where Fund cajolery has been useful in overcoming a classic panic in the international loan markets. One of the great conceptual weaknesses in that role, however, has been the inability of analysts to distinguish convincingly among the three forms of default risk discussed in Chapter 5—solvency risk, repudiation risk, and panic risk. Better, empirically oriented dynamic models of international lending are still needed to identify the middle-term prospects for the debts of developing countries.

## REFERENCES

- Abel, Andrew, and Olivier Blanchard, "An Intertemporal Equilibrium of Saving and Investment," *Econometrica*, 51 (May 1983), pp. 675-692.
- Arrow, Kenneth, and Mordecai Kurz, *Public Investment, The Rate of Return, and Optimal Fiscal Policy*, Baltimore, Johns Hopkins Press, Resources for the Future, 1970.
- Bardhan, Pranob, "Optimum Foreign Borrowing," in Karl Shell, ed., *Essays on the Theory of Optimal Growth*, Cambridge, Mass., MIT Press, 1967.
- Blanchard, Olivier, "Debt and the Current Account Deficit in Brazil," in P. Armella *et al.*, eds., *Financial Policies and the World Capital Market: The Problem of Latin American Countries*, NBER Conference Report, Chicago, University of Chicago Press, 1983.
- Bulow, Jeremy I., and John B. Shoven, "The Bankruptcy Decision," *Bell Journal of Economics*, 9 (Autumn 1978), pp. 437-456.
- Cline, William R., "Economic Stabilization in Peru, 1975-78," in W. Cline and S. Weintraub, eds., *Economic Stabilization in Developing Countries*, Washington, D.C., The Brookings Institution, 1981, pp. 297-335.
- Eaton, Jonathan, and Mark Gersovitz, "Debt with Potential Repudiation: Theoretical and Empirical Analysis," *Review of Economic Studies*, 48 (April 1981), pp. 289-310.
- Jensen, Michael, and William Meckling, "Theory of the Firm: Managerial Behavior, Agency Costs, and Capital Structure," *Journal of Financial Economics*, 3 (October 1976), pp. 305-360.
- Katz, Menachem, "Government Policy, External Public Indebtedness, and Debt Service," DM/82/19, Washington, International Monetary Fund, 1982, processed.
- Kharas, Homi J., "Constrained Optimal Foreign Borrowing by Less Developed Countries," Washington, World Bank, Development Policy Staff, August 1981, processed.
- Kindleberger, Charles P., *Manias, Phobias, and Crashes*, New York, Basic Books, 1978.
- Kreps, David, and Robert Wilson, "Reputation and Imperfect Information," *Journal of Economic Theory*, 27 (August 1982), pp. 253-279.
- McDonough, Donough, "Debt Capacity and Developing Country Borrowing: A Survey of the Literature," *IMF Staff Papers*, 29 (December 1982), pp. 603-646.

Myers, Stewart C., "Determinants of Corporate Borrowing," *Journal of Financial Economics*, 5 (November 1977), pp. 147-175.

Sachs, Jeffrey, "The Current Account and Macroeconomic Adjustment in the 1970s," *Brookings Papers on Economic Activity*, No. 1, 1981, pp. 201-282.

———, "LDC Debt in the 1980s," in P. Wachtel, ed., *Crises in the Financial Structure*, Lexington, Mass., Heath, 1982a.

———, "The Current Account in the Macroeconomic Adjustment Process," *Scandinavian Journal of Economics*, 84(2, 1982b), pp. 147-159.

Sachs, Jeffrey, and Daniel Cohen, "LDC Borrowing with Default Risk," Cambridge, Mass., NBER Working Paper Series No. 925, July 1982, processed.

Smith, Clifford, and J. Warner, "On Financial Contracting: An Analysis of Bond Covenants," *Journal of Financial Economics*, 7 (June 1979), pp. 117-161.

Stiglitz, Joseph, and Andrew Weiss, "Credit Rationing in Markets with Imperfect Information: I," *American Economic Review*, 71 (June 1981), pp. 393-410.

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