What Is Different about International Lending?

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An attempt is made to explain bow enforceability is achieved in international debt contracts. Each bank announces the policy of denying credit to borrowers who default and chooses to adhere to it to maintain its reputation of being a tough bank to discipline its other borrowers. Loans are made by syndicates of banks in order to make the penalty for default severe enough so borrowers would choose not to default voluntarily. The model predicts that thee interest rate charged on loans is smaller for the larger borrowers. Also, for any given borrower, the interest rate may fall after each successive default.

In the last decade, we witnessed a phenomenal growth in commercial bank lending to many developing countries. Most of the commercial bank lending was syndicated Eurocurrency loans, arranged by a core of 25 to 50 large commercial banks in the industrial countries. Nearly 3000 other smaller banks participated in the syndications from time to time.

Why are international loans often syndicated? One of the explanations often advanced is that these loans

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are too large for any one bank to handle. While that may indeed be true for some of the largest borrowers, such as Mexico and Brazil, it does not explain why loans are also syndicated for smaller borrowers, such as Bolivia. The amount of the loan to a single major borrower by a single bank often far exceeds the *total* private borrowing by smaller borrowers, such as Bolivia.

Another potential explanation for syndication is the diversification motive of the banks. However, a casual examination of the lending behavior of the banks seems to indicate a concentration of lending to the very large borrowers. Exposures of major banks to the larger borrowers are strikingly substantial. For instance, Citicorp's loan to Brazil was nearly 96 percent of shareholders' equity at the end of 1983 (*The Economist,* June 2, 1984). Much of the developing-country lending during the last decade was directed toward relatively large borrowers, with nearly 70 percent of it going to the upper-middle-income countries over the 1978-1983 period. The five largest borrowers alone accounted for 53 percent of developing-country borrowing (World Development Report, 1985). Even after making an adjustment for size, there is evidence for concentration of borrowing by the larger borrowers (Chowdhry, 1989). Furthermore, Kletzer (1984) points out that many small and poor less-developed countries are not able to access the private capital markets at all.

Fixed costs in information acquisition about economic conditions and policies of a given country may lead to concentration of lending. It has also been argued that banks, anticipating a bailout by the government in case of bankruptcy, may have accumulated high levels of 'debt leading to high exposures. However, we fail to see concentration of lending for smaller borrowers, such as Bolivia, for whom the loans are also syndicated. One seems to be left with the anomaly that there is "too little" diversification for the larger borrowers and possibly "too much" diversification for the smaller borrowers.

We develop a rational expectations model with maximizing behavior both by the commercial banks and the developing country borrowers that is able to explain a motive for syndication by banks apart from the diversification reasons. (However, we show that an equilibrium with syndicated lending may not exist for small countries.)

We start by asking the following fundamental question. What ensures that the borrowers would not *voluntarily* default on their loans to the private creditors? In the case of international debt contracts, the possibility of judicial sanctions is of little practical use since the only effective way to enforce a judgment is to seize the debtor's assets, which in the international context are restricted to only those assets that are not in the debtor's country.

Diplomatic protections cannot, in general, be taken for granted.[1] Diplomatic intervention, in general, seems to depend more on the foreign-policy objectives and the strategic interests of the creditor governments than on the extent of damage suffered by the creditors. Gunboat diplomacy is a thing of the past and, in practice, during the past half century, the creditor governments have adopted the policy of nonintervention.

Legal or coercive methods of enforcing contracts being of little use, the only effective way of inducing compliance is to rely on self-enforcing mechanisms. One such mechanism may be to exclude the borrowers who repudiate their debt from capital markets, Would it be in the interests of the banks, ex post, to deny credit to the borrower? [See Hellwig (1977).] Can the banks credibly commit themselves to follow such a strategy? Would all banks deny. credit to a borrower who defaults against any bank? [See Span (1985) and references therein.] Stiglitz and Weiss (1983) argue that banks can place a provision in their loan contracts that gives the loanseniority over all later loans, and thus reduces the expected returns for future lenders. One could argue that since this is, in effect, a contractual agreement among the current and the potential lenders, it could be enforced by the courts in the lenders' country. The overhang of the unpaid debt claims would thus act as a powerful restraint on fresh lending to the defaulting country. If this were true, it is easy to see that it could lead to an outcome that was far from efficient because the penalty for default may be too severe. That leads one to wonder whether there is any way the borrower may be able to discharge its old liabilities and start afresh. In case of domestic lending, the bankruptcy procedures allow the borrowers to do precisely that. The legal position, in case of

[1] There have been instances when the governments of the creditors retaliated with full-scale military intervention. For instance, in 1879, Egypt attempted to default on its loans to its European creditors. Khedive Ismail declared a unilateral partial default on the outstanding bonds. In response, the British and the French government pressured the Ottoman Sultan to depose Ismail and replace him with Tewfik, his mote compliant son. Egypt ended up losing its national sovereignty, which was regained only after World War II. British and French officials took control of government revenue, managing it in the interests of the private creditors. Venezuela's attempt to default in 1902 was met by an invasion by the U.S. Marines and a takeover of the country's customs revenue in 1903. Nicaragua also lost her sovereignty to the Marines and to U.S. customs supervisors in 1911-1912.

On the other hand, there have been numerous occasions when the creditor governments did nothing. Kaletsky (1985) reports a case when an American president even offered a public apology to the defaulting country for the greed and "supersalesmanship" of the U.S. banks. The incident is cited in Borchard and Wynne (1951). President Roosevelt, according to the *New York Times* of May 8, 1943, took the occasion of a state visit by General Penarada, president of Bolivia, to offer an apology for "some Americans [who] sold to the Bolivian government through supersalesmanship the idea that it needed a loan." After deducting the banker's commissions, Bolivia received only 92 percent of the proceeds. "Of course, Bolivia was unable to pay either the interest or the principal," the President declared.

sovereign borrowers, is not clear. Wood (1981) argues that courts may, as a matter of fact, allow the borrower to give priority to "new debt," recognizing the fact that otherwise "creditors would not be willing to provide fresh finance which could be used to rehabilitate confidence and finance arrears" (Wood, 1981, pp. 4-129).

We argue that, in practice, there are many other mechanisms, such as debt-equity swaps, exit bonds, rescheduling of debt at below-market rates and with longer maturities, by which the borrowers are able to discharge the overhang of debt, allowing them to seek fresh financing. All of these involve a partial default by the borrower. Lenders, faced with the possibility of total repudiation by the borrower, are not able to turn down these offers ex post. Although repudiation of debts by sovereign nations has been infrequent, the history of international lending is replete with instances of partial default and reentry into the capital markets by the defaulting nation (Borchard and Wynne, 1951; Linden and Morton, 1987).

Eaton and Gersovitz (1981) construct a model in which lenders are competitive, each occupying a small share of the market, earning zero profit on any loan. Therefore, It costs the lenders nothing to refrain from future lending. Thus, a borrower who repudiates his debt faces a permanent embargo on all future loans by all lenders. This description of the international Eurocredit markets seems far from reality. The share of the market held by the large money center banks is quite significant. World Development Report (1985) indicates that by 1977, the 12 largest U.S. banks derived almost half their total earnings from international lending,[2] the bulk of which came from developing-country loans, which we saw earlier were concentrated to a few large borrowers. More importantly, we do not believe that the assumption of zero profit captures the dynamics of the incentives faced by the banks in the Euroloan market.

The model we propose attempts to address some of the above reservations we raised about the previous approaches. We analyze an endogenous mechanism that makes reentry into private capital markets difficult for borrowers who repudiate their debts. We do not assume that all banks refuse credit to those who have repudiated their debts.

1. The Central Idea

We assume that a bank must incur fixed costs the very first time it decides to make a loan to a given borrower, Thus, if the bank makes

[2] This perhaps reflects the relative absence of defaults on international loans in this period.

zero expected profits ex ante, because of the fixed costs incurred at the very beginning, it must make positive expected profits in the future to recover these fixed costs. Therefore, the bank forgoes the possibility of realizing these profits if it decides to cut off future credit for the borrower who defaults. Thus, it is costly for the bank to deny credit to a borrower who defaults.

Therefore, why would a bank, ex post, find it in its interests to carry out its threat of not making any more loans to a borrower who defaults? If the bank has other borrowers to whom it has made loans, it may well be in its interests to adhere to its announced policy of denying credit to its defaulters. The reason is that if it deviates from its policy of denying credit to defaulters, some of its other borrowers would now choose to default also, realizing that they are going to get away with it without suffering any penalty of cutoff of future credit by the bank. The multiplicity of the borrowers provides a reason for the bank to acquire and maintain its reputation of being a tough bank.

That does not, however, prevent the borrower from going to another bank for credit. Would banks also deny credit to the borrower who. has defaulted on some other banks loans? There is no reason to believe that they would.[3] To send a signal to its own borrowers that it is a tough bank, all that the bank has to do is punish only those borrowers who default on the loans to this bank by denying them further credit. Since it may be costly for banks to deny credit to a prospective borrower, they will choose not to do so since it does not affect their reputation of being a tough bank, and thus does not change the incentives of their own borrowers to default. Given the large number of banks, and an intense competition among these banks in the Eurocredit markets, there may be several banks willing to make new loans to a borrower who has defaulted on some other bank's loans. However, this implies that the first bank, rationally anticipating this outcome, would not have made a loan in the first place, which makes the existence of international lending somewhat of a paradox. We argue that this phenomenon can be understood by making the following observations.

International loans are often made by *syndicates,* in which several banks share a loan to a foreign borrower. The presence of various *cross-default* and *sharing clauses* ensures that the borrower is not able to repudiate selectively its debt to some banks. If the borrower does repudiate its debt, it must repudiate its debt to *all* the banks. That makes the penalty for repudiating its debts quite severe, since now

[3] This is strictly true only under the assumption of out model that there is no asymmetric Information about the borrower's characteristics and thus default conveys no information to the lenders. This is further discussed in the following sections.

a significantly large number of lending institutions would deny credit to the borrower in the future. After a small number of defaults, the borrower would exhaust all sources of credit in the international market. For many borrowers, that is a severe penalty; and it is this penalty that provides an incentiveto repay the loan amounts, and to choose actions that make it more probable for them to be able to make those repayments. Notice that since the lenders cannot observe the borrowers' actions, the penalty of denying credit to defaulters is imposed even though the default may be a result of a bad state of the world.

To make the contracts incentive compatible, the number of banks in the first syndicate must be large enough so that the number of times the borrower could default and reenter the capital markets is small even if the remaining banks lend the maximum possible amount, which is limited by regulation (or by diversification arguments) to a fraction of the bank capital. This argument explains the large number of banks in syndicates making international loans even when the loans are not too large for a much smaller number of banks to handle. This analysis also implies that for a small borrower the number of banks in the first syndicate may be quite large. It is reasonable to conjecture that it may be prohibitively expensive to put together a very large syndicate for a relatively small loan, which explains why no equilibrium with syndicated lending exists for small borrowers.

The model provides further testable implications. In particular, the model predicts that the interest rate charged on the loans is less for the larger borrowers than it is for the smaller borrowers. The reason for this is that the larger borrowers get fewer chances to default and reenter the private capital markets than do the smaller borrowers. Consequently, they choose economic policies such that they are less likely to be in a situation in which they must default on their loans. Lenders, rationally anticipating this, charge a smaller default premium to the larger borrowers. Also, for any given borrower, the interest rate may fall after each successive default. The reason is that the borrower chooses safer and safer projects after each successive default.[4]

The following section develops the model formalizing the arguments presented above.

[4] This is analogous to a hypothesized effect of declaring bankruptcy. In particular, while bankruptcy may reveal an adverse borrower type, it also removes downside protection for the borrower. If the latter effect dominates, bankruptcy may lead to a lower rate for the borrower because he switches to safer projects. (I thank Chester Spatt for pointing this out to me.)

2. The Model

We start by making the following assumptions.

Assumption 1. *The borrower is risk-neutral and lives for an infinite number of periods.*

Assumption 2. *Each period the borrower has a continuum of mutually exclusive feasible projects, each of which requires an investment of I. The project returns IR if successful and nothing if it fails. Each project is thus uniquely characterized by R.*[5]

Assumption 3. *The borrower consumes all his residual resources each period so that be will not be able to undertake any projects if no credit is available to him for the initial investment of I.*

This assumption is a convenient way of modeling the notion that it is costly for the borrower to substitute the benefits of having access to the international capital markets by savings: if the borrower faces no costs in being able to finance his investment projects by his savings, then he has no incentive to repay.

Let $p(R)$ denote the probability of success for the project.

Assumption 4. *$p(R)$ is continuous and twice differentiable with*

$$p'(R) < 0 \quad \text{and} \quad p''(R) < 0.$$

This assumption implies that projects with higher payoffs, if successful, have lower probability of success. This must obviously be true since a project with lower payoff, if it also has a lower probability of success, will never be chosen. The second part of the assumption implies that the probability of success decreases at an increasing rate.

Thus, the borrower is uniquely characterized by I and $p(R)$.

Assumption 5. *I and $p(R)$ for each borrower are common knowledge.*[6]

We now characterize the banks.

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[5] Following Stiglitz and Weiss (1983).

[6] It may be more realistic to assume that the borrowers know more about the projects available to them. Each event of default or repayment by the borrower, then, convey information to the lenders. However, in this section, we abstract away from the effects of asymmetric information so as to distinguish the Implications of this framework from that of a reputation model. In the next section, we will discuss the implications of Including reputation effects for the borrower.

Assumption 6. *The banks are risk neutral.*

Assumption 7. *To make a loan of* $\theta > 0$ *for the first time to a borrowing country, the bank must incur a fixed cost of* $f(\theta)$. *We further assume that these fixed costs are nondecreasing in the amount of the loan but at a decreasing rate. In other words,*

$$f(\theta) > 0, \qquad f'(\theta) \geq 0, \qquad f''(\theta) \leq 0, \qquad \forall \theta > 0.$$

These fixed costs represent the initial costs of setting up a department dealing with the particular country, costs of collecting information about the country, etc.[7] This assumption is made to model the notion that it is costly for banks to cut off credit to a borrower who defaults. Since fixed costs are incurred at the beginning, the banks must expect to make positive expected profits to recover these costs. By denying credit to a borrower who defaults, banks forgo the possibility of making positive profits.

The borrower solves the following backward optimization problem. We will later show that in equilibrium, the borrower. is allowed to default only a finite number of times before exhausting all sources of credit in the capital markets. Consider the case when the borrower has n more chances to default before he gets completely. excluded from the capital markets. Let

R_n = project choice when the borrower has n chances left for default,

r_n = interest rate on the loan when the borrower has n chances left for default,

$V_n(R_n, r_n)$ = present value of expected future cash flows per dollar of investment when the borrower has n chances left for default.

With probability $p(R_n)$ the project is successful. If the borrower repays the loan, his cash Bow (per dollar of investment) is equal to $\{R_n - (1 + r_n)\}$ and he still has n chances left for default; thus, the situation is exactly the same as this period. With probability $1 - p(R_n)$ the project fails, the borrower's cash flow is zero, he Is forced to default, and now has only $(n - 1)$ chances left for default. Therefore, if the borrower does not default voluntarily, then

$$V_n(R_n, r_n) = \delta[p(R_n)\{R_n - (1 + r_n) + V_n(R_n, r_n)\} + \{1 - p(R_n)\}V^*_{n-1}],$$

where δ is the borrower's discount factor and V^*_{n-1} denotes the value

[7] It is common In international lending for banks to have departments that specialize in dealing with borrowers from specific countries or regions of the world.

of $V_{n-1}(R^*_{n-1}, r^*_{n-1})$ with R^*_{n-1} and r^*_{n-1} denoting the optimal values of R_{n-1} and r_{n-1}, respectively. Clearly, $V^*_0 = 0$. Therefore, solving the above equation, we get

$$V_n(R_n, r_n) = \frac{\delta}{1 - \delta p(R_n)} \cdot [p(R_n)\{R_n - (1 + r_n)\} + \{1 - p(R_n)\}V^*_{n-1}]. \quad (1)$$

We now analyze the banks' problem. Let θ_n denote the amount of loan made by a given bank, when the borrower has n chances to default. If the project fails, the borrower repudiates the loan and the bank refuses to provide further loans to the borrower.[8] If the project is successful, the borrower pays $\theta_n r_n$ Interest on the loan and the loan is automatically renewed at the same interest rate,[9] and the game is repeated. Let $X_n(\theta_n, r_n R_n)$ denote the present value of the cash flows received by the bank.

Assumption 8. *The risk-free rate is constant and known.*

Let ρ denote 1 plus the risk-free rate. The bank discounts next period's cash flows by l/p. Therefore,

$$X_n(\theta_n, r_n, R_n) = (1/\rho)[p(R_n)\{\theta_n r_n + X_n(\theta_n, r_n, R_n)\}].$$

Solving, we obtain

$$X_n(\theta_n, r_n, R_n) = \frac{\theta_n r_n p(R_n)}{\rho - p(R_n)}. \quad (2)$$

The expected profits from the loan at date 0 are given by

$$\pi^0_n(\theta_n, r_n, R_n) = X_n(\theta_n, r_n, R_n) - [\theta_n + f(\theta_n)]. \quad (3)$$

Since the fixed costs are incurred only in the first period, the expected profits from continuing the loan at any date in the future are given by

$$\pi^t_n(\theta_n, r_n, R_n) = \pi^0_n(\theta_n, r_n, R_n) + f(\theta_n), \qquad \forall t \geq 1. \quad (4)$$

[8] That banks follow such a strategy, In equilibrium, is shown later.

[9] This assumption is imposed for analytical tractability. Boot and Thakor (1989), in a two-period model with uncertainty about borrower type and use of collateral as an additional instrument, show optimality of a scheme in which the bank charges a higher interest rate In the beginning and a lower interest rate later.

Therefore, if all banks make zero expected profits on any given loan, the expected profits from continuing the loan at any date in the future are positive.[10]

The number of banks in the syndicate *ln* is determined endogenously. For analytical simplicity, we make the following assumption.

Assumption 9. *All banks in the syndicate offer the same contract to the borrower.*

The implication of this assumption is the following.

Lemma 1. *In equilibrium, a loan to any given county is divided equally among the banks in the syndicate. In other work,*

$$\theta^*_{nl} = I/l_n = \theta^*_n, \quad \forall l. \tag{5}$$

Proof. See the Appendix.

The intuition for this result is as follows. We-have assumed an identical cost function $f(\theta)$ for all banks. All banks are charging the same interest rate. It is implicitly assumed that there is no possibility of side payments among the banks in the syndicate. It is also being assumed that each bank in the syndicate must incur the fixed costs on its own. Thus, Information sharing among the banks is ruled out.[11] Since fixed costs as a percentage of the size of the loan are monotonic and in equilibrium, all banks must expect to make zero profits; thus, it follows that the size of the loan must be identical for all banks in the syndicate.

This provides a great deal of simplification without much loss of generality in the main results of the article, since we can now treat all banks in the syndicate identically. Moreover, as the next proposition spells out, it allows us to model an economically meaningful notion that is intuitively plausible.

Proposition 1. *For a given borrowing country, the larger the number of banks in the syndicate, the greater the total fixed costs that must be incurred.*

[10] This profit is not competed away to zero because in any bank that has not made a loan to this borrower in the past would have to incur the fixed costs if it decided to do so. Any of the old banks would not undercut the other old banks to steal away their business beaux, as we shall see., to prevent the borrower from defaulting, all the banks that are currently lending to the borrower need to stay in the pool.

[11] We only need to assume that information sharing is not perfect (Le., each bank must Incur some cost on its own). See Chan, Greenbaum, and Thakor (1986) for an analysis of information reusability in credit markets.

Proof. Since the loan is divided equally among all banks in the syndicate, as you increase the number of banks in the syndicate, the size of the loan made by each bank decreases proportionately. However, since f (θ) is concave and strictly positive, the fixed costs incurred by each bank decrease less than proportionately making the total fixed costs incurred by all banks higher when the number of banks in the syndicate is larger. Q.E.D.

Thus, our formulation captures the idea that the total direct and indirect costs of putting together a syndicate for a given size of the loan increase as the number of banks involved in the syndicate is increased.

Proposition 2. *The optimal project choice* R_n^* *is unique and is given by*

$$p'(R_n^*)\left\{R_n^* - \frac{\tilde{\rho}(R_n^*, \theta_n^*)}{p(R_n^*)} - (1-\delta)V_{n-1}^*\right\} + p(R_n^*)\{1 - \delta p(R_n^*)\} = 0, \tag{6}$$

and the optimal interest rate r_n^* *is given by*

$$1 + r_n^* = \frac{\tilde{\rho}(R_n^*, \theta_n^*)}{p(R_n^*)}, \tag{7}$$

where

$$\tilde{\rho}(R_n^*, \theta_n^*) \equiv \rho + [\rho - p(R_n^*)]\frac{f(\theta_n^*)}{\theta_n^*}. \tag{8}$$

Proof. See the Appendix.

The borrower chooses a project so as to maximize V_n^*. The banks choose the interest rate such that they expect to make zero profits. The borrower takes the interest rate as given. That creates a moral hazard problem for the borrower, which pushes him to choose a riskier project. Banks rationally anticipate this and price their loans appropriately. The countervailing force on the borrower's project choice is that the riskier the project, the more likely it is that it will fail, forcing the borrower to default, leaving him only $(n-1)$ chances to default in the future.

The other important factor in determining the trade-offs for the borrower is the size of V_{n-1}^*. Since the discount factor δ is less than 1, the size of V_{n-1}^* matters since the more he delays the default, the smaller is the present value of V_{n-1}^*. Therefore, a large value of

V^*_{n-1} induces the borrower to choose a riskier project, which makes it more likely that the project will fail, forcing the borrower to default.[12] We will come back to this later when we do the comparative statics exercise.

Proposition 3. *If the size of the loan by each bank in the syndicate, θ^*_n, is smaller than a critical size, θ_{min}, then there exists no combination of R^*_n and r^*_n that solves the borrower's maximization problem and satisfies the zero-expected-profits condition for banks.*

Proof. See the Appendix.

The intuition for this result is that fixed costs as a percentage of the loan become too high when the size of the loan is too small. Given that there is a moral hazard problem that the borrower faces, the interest rate on the loan is so high that even the project with the highest expected value is not sufficient to meet the interest expenses. Banks, aware of this fact, will refuse to lend to this borrower. We will use this result later to show why we fail to obtain an equilibrium for small countries.

For the remainder of this article, we focus our analysis only on those borrowers for whom the amount loaned by each bank in the syndicate, θ^*_n, is large enough to make the fixed costs as a percentage of the loan negligible. Notice that we are not assuming that fixed costs are small but only that they are small in proportion to the size of the loans, In other words, we assume that $f(\theta^*_n)/\theta^*_n \simeq 0$, which implies that $\tilde{\rho}(R^*_n, \theta^*_n) \simeq \rho$.

We now get to the incentive-compatibility condition. The borrower will not *voluntary* default if the penalty for default is greater than the principal and interest due that period. The endogenous penalty for default is $V^*_n - V^*_{n-1}$ since with every default, the borrower loses a chance to reenter the capital markets for credit. Let

$$M \equiv \text{Max}\{m: V^*_n - V^*_{n-1} > 0, \forall n \leq m\}.$$

M is an upper bound on the number of times a borrower would be allowed to default in equilibrium.

We now obtain some comparative statics results.

[12] Notice that if the discount factor δ is equal to 1, then V^*_{n-1} does not enter the borrower's calculations at all. The intuition is that since the borrower does not discount the future at all, it does not matter to him *when* he reaches the point when he has $(n-1)$ chances left for default, since he is going to get to that situation anyway.

Lemma 2.

$$\frac{\partial R_n^*}{\partial V_{n-1}^*} > 0. \tag{9}$$

Proof. See the Appendix.

Since $\delta < 1$, the higher is the value of V_{n-1}^*, the lower is the cost of defaulting sooner, other things being equal. That reduces the cost of choosing a riskier project. The next proposition follows immediately from this.

Proposition 4. *The borrower chooses safer and safer projects after each successive default. In other words,*

$$R_n^* > R_{n-1}^*, \qquad \forall n \leq M. \tag{10}$$

Proof: From (9), R_n^* is an increasing function of V_{n-1}^*, and since

$$V_n^* > V_{n-1}^*, \qquad \forall n \leq M,$$

we get the desired result. Q.E.D.

The intuition for this proposition is straightforward. After each successive default the value of V_{n-1}^* decreases. This causes the borrower to be more and more cautious in the current round, resulting in safer and safer project choices. Banks rationally anticipate this, and charge smaller and smaller interest rates. That is our next proposition.

Proposition 5. *The interest rate charged on loans to the borrower decreases after each default. In other words,*

$$r_n^* > r_{n-1}^*, \qquad \forall n \leq M. \tag{11}$$

Proof. Writing (7) as an identity and differentiating with respect to R_n^*, we get

$$\frac{\partial r_n^*}{\partial R_{n-1}^*} = \frac{-p'(R_n^*)(1 + r_n^*)}{p(R_n^*)} > 0.$$

Thus, r_n^* is an increasing function of R_n^*, and since

$$R_n^* > R_{n-1}^*, \qquad \forall n \leq M,$$

we get the desired result. Q.E.D.

This result may sound counterintuitive. The reason for this is that a model in which the borrower establishes a credit history, and the

interest rate charged by the banks is determined by the borrower's credit rating, would lead to the opposite conclusion [see Spatt (1985)]. In that scenario, each default by the borrower conveys some information to the banks that they did not already possess. Recall that in our model, however,. the lenders know the entire schedule of the risk-return characteristics of the feasible set of projects. Therefore, no information is conveyed to the lenders if the borrower defaults on his loan. However, since the borrower chooses safer and safer projects after each successive default, the zero-profit condition for the lenders implies that, in equilibrium, the interest rate charged on the loan must also fall.[13]

Proposition 6. *After each successive default the penalty for default becomes more and more severe. In other words,*

$$V^*_{n-1} - V^*_{n-2} > V^*_n - V^*_{n-1}, \qquad \forall n \leq M. \tag{12}$$

Proof. See the Appendix.

The intuition for this proposition is as follows. V^*_{n-1} becomes smaller and smaller after each successive default. Consequently, the borrower begins to rely more and more on the surplus from the current round, causing $V^*_n - V^*_{n-1}$ to increase successively.

We now define

$$N \equiv \text{Max}\{n \leq M: V^*_n - V^*_{n-1} \geq 1 + r^*_n\}.$$

In other words, N denotes the largest value of $n \leq M$ for which the incentive-compatibility condition is satisfied.[14] It is easy to see that the incentive-compatibility condition will also be satisfied for all values less than N. The reason is that the penalty for default $(V^*_n - V^*_{n-1})$ increases with each default (Proposition 6), and at the same time the benefits from a voluntary default-the principal and the interest payments due–decrease since the interest payments decrease after each successive default (from Proposition 5). Thus, if it could be ensured that the borrower is allowed to default no more than N times, then the borrower would never repudiate his debt voluntarily, since the endogenous penalty for default always exceeds the principal and interest payments.

We now make the following assumptions.

[13] Empirical evidence that supports this prediction is discussed in section 3.

[14] Chowdhry (1989) examines how N is related to the borrower's discount factor δ and the characteristics of the project schedule, $p(R)$.

Assumption 10. *There are L banks in the economy, each with capital of 1.*

This assumption is made to capture the notion that the number of banks that a country can gain access to for its borrowing is finite.[15]

Assumption 11. *Default by the borrower against any of its lenders constitutes an automatic default against all its lenders.*

This assumption is crucial. Almost all international loan contracts contain various cross-default and sharing clauses (Delaume, 1984; United Nations Center on Transnational Corporations, 1983; Wood, 1981). In our model, all loans to a given borrower were made by a single syndicate of banks. Thus, the effectiveness of these clauses is redundant. However, in practice, there are several loans made to different agents in the country by several different syndicates. In that case, these clauses effectively link these various syndicates into one coalition from the point of view of the borrower.

We also make an assumption that reflects the existing regulatory environment quite accurately [see Dale (1984)].

Assumption 12. *All banks are regulated. The regulatory authorities require that the total amount of loans by any given bank to a given country must not exceed* θ_{max} *of the capital for the bank.*[16]

This assumption puts a limit on the minimum number of banks required to make a loan of certain size. Thus, for borrowers with larger loans, the minimum number of banks needed in the syndicate is higher.

That brings us to our next proposition.

[15] At first blush, this assumption may seem inconsistent with zero expected profits for banks. One might argue that when the borrower has the last chance left for default, all of the borrower's surplus might be captured by the lenders. But it is important to notice that even though the borrower has only one chance left for default, the number of lenders left in the last group may be more than 1. In that case, we may be able to argue that the outcome Is a Bertrand equilibrium in which all potential profits ate competed away to zero by the lenders.

Another potential problem with the above assumption is that the finite number of banks in the economy is inconsistent with free entry. Would not new banks spring up to provide loans to those borrowers who have exhausted all sources of credit? As we are going to see, a bank involved in International lending has to have several borrowers to be able to make its threat of denying credit to defaulters credible. Thus, only after a large number of borrowers who have exhausted all sources of credit have been accumulated In the economy would entry by banks seem feasible. Until then, the borrowers would be excluded from the capital markets. If this period of exclusion is long enough, It would provide the same qualitative results as the assumption of permanent exclusion from the capital markets.

[16] In practice, banks have been able to circumvent this regulation to some extent. Thus, the actual levels of loans to some countries by some of the banks may be larger than the regulatory limit. It is reasonable to assume, however, that some limit must be Imposed by banks themselves for diversification reasons alone.

Proposition 7. *The number of times the borrower is allowed to default before exhausting all sources of credit is given by*

$$N^* = \begin{cases} \text{no equilibrium}, & \text{if } I < I^*, \\ N, & \text{if } I^* \le I \le I^{**}, \\ L\theta_{\max}/I, & \text{if } I > I^{**}, \end{cases}$$

where

$$I^* \equiv \frac{L}{1/\theta_{\min} + (N-1)/\theta_{\max}},$$

$$I^{**} \equiv L\theta_{\max}/N.$$

Proof. To ensure that the borrower is not allowed to default more than N times before exhausting all his sources of credit, the number of banks in the syndicate, l_{N^*}, that lends to a given borrower the first time must be large enough that the remaining $(L - l_{N^*})$ banks cannot allow him to default more than $(N - 1)$ times even if they want to. The reason for this is that the borrower prefers to get N chances. Moreover, perfect competition among the remaining banks ensures that if the remaining banks can allow him N chances to default, then they will allow him N chances since the incentive-compatibility condition is satisfied.

Since each bank lends at most an amount equal to $\theta_{\max}$, it follows that l_{N^*} must satisfy the following condition:

$$(L - l_{N^*})\theta_{\max}/I \le N - 1.$$

Rearranging, we get

$$l_{N^*} \ge L - (N-1)I/\theta_{\max}. \tag{13}$$

From Proposition 3, we also know that the amount loaned by each bank in the syndicate must be at least $\theta_{\min}$, otherwise the fixed costs as a percentage of the total loan become so high that there may not be an equilibrium. Therefore, the following condition must also hold:

$$\theta^*_{N^*} = I/l_{N^*} \ge \theta_{\min}.$$

This is equivalent to

$$I/\theta_{\min} \ge l_{N^*}. \tag{14}$$

From (13) and (14), it follows that

$$I/\theta_{\min} \ge L - (N-1)I/\theta_{\max}.$$

Therefore, solving for I, we get

$$I \geq \frac{L}{1/\theta_{\min} + (N-1)/\theta_{\max}} = I^*. \tag{15}$$

For, $I \geq I^*$, the borrower prefers that he gets as many as N chances. Therefore, constraint (13) would be satisfied as an equality, which can be rewritten as follows:

$$(L - l_N^*)\theta_{\max}/I = N - 1. \tag{16}$$

As I increases, (16) can still be satisfied by decreasing l_{N^*}. As l_{N^*} decreases, the amount lent by each bank in the syndicate increases until it reaches the limit $\theta_{\max}$. At that point, $I = l_{N^*}\theta_{\max}$. Substituting for l_{N^*} in (16), we get

$$I = L\theta_{\max}/N = I^{**}.$$

That proves the second part of the proposition:

$$N^* = N, \qquad \text{if } I^* \leq I \leq I^{**}.$$

For $I > I^{**}$, each bank in the syndicate loans the maximum possible amount $\theta_{\max}$ to keep the syndicate size as small as possible:

$$l_{N^*} = I/\theta_{\max}.$$

Therefore,

$$N^* = L\theta_{\max}/I, \qquad \text{if } I > I^{**}. \qquad \text{Q.E.D.}$$

The intuition for this result is as follows. If the size of the loan is too small, a large number of banks must be included in the first syndicate to ensure that the borrower could not default on the remaining banks more than $(N - 1)$ times. Since each bank in the syndicate lends only a small amount, the fixed costs of making the loan become too high, causing the interest rate charged on the loan to be so high that the equilibrium fails to exist. It is important to emphasize here that the size of the loan, I, may be large enough that, if fewer banks were to make the loan, the fixed costs as a percentage of the loan would be small enough that the conditions for an equilibrium in Proposition 3 could be satisfied.

We now show why, in equilibrium, any given bank would permanently deny credit to a borrower country that repudiates its loan to the bank. We follow Kreps and Wilson (1982a) and Milgrom and Roberts (1982) to demonstrate that the banks may want to acquire a reputation of being a "tough" bank. Two conditions are sufficient for reputation effects to come alive. First, there must be a slight suspicion

in the mind of the borrowers that any given bank is a tough bank. A tough bank is different from other banks in that its payoffs from denying credit to defaulters are different. We saw earlier that the cost of denying credit to a defaulter was the forgone expected profits-which equal f (θ) in our model-the bank could have made by continuing to extend credit to the borrower. We assume that a tough bank, however, loses more than f (θ) if it does not carry out the policy of denying credit to defaulters.[17] Second, each bank must have several borrowers so that even those banks that are not tough would mimic the actions of the tough bank to acquire a reputation of being a tough bank so as to discipline other borrowers that the bank has. Both these conditions are intuitive and realistic. We, therefore, make the following assumption.

Assumption 13. *There is a small probability* ε *that any given bank is tough (T). A tough bank is one that suffers a loss of more than f* (θ) *if it fail to deny credit to a defaulter. All other banks that are not tough are called "weak" (W) banks.*

Proposition 8. *The following strategies and beliefs constitute a sequential equilibrium (Kreps and Wilson, 1982b) of the extensive form game in which nature chooses the type for each bank and whether the project is successful. If the project is successful, the borrowers choose whether to default, and the banks choose whether to cut off credit permanently.*

- *Strategy of the borrowers*
  1. *Do not default in equilibrium.*
  2. *If an out-of-equilibrium move by banks is observed, then default on a syndicate that contains enough of these banks who deviate; otherwise, do not default.*
- *Strategy of the banks*
  1. *Deny credit to a borrower who defaults.*
  2. *Continue to loan otherwise.*

[17] This is a convenient way of modeling that some banks may choose to cut off credit to defaulters for reasons not modeled here explicitly. One plausible story we could Imagine is that there is a alight possibility of nepotism or other unethical behavior by the lending officer, along with a slight possibility that there are real lemons among borrowers who are all observationally identical. Then default could imply that the borrower may be a lemon and by continuing to lend to the borrower the officer may signal that he or she is unethical. The lending officers, not wanting to lose their jobs, thus rationally refuse to continue lending to defaulters. (I am grateful to the referee for suggesting this story.) Assuming the existence of such a bank (tough) with such an exogenous structure may seem contrived and restrictive, although it is not. The point is that it is not that this very form of toughness is the most compelling one, but that it is this particular form that is exploited by all banks in mimicking this specific "tough" type. We do not even need the existence of such tough banks. All we need is that some borrowers think that some banks are tough or that some banks think that some borrowers think that some banks are tough, and so on.

3. *Refuse to include a bank in the syndicate that has already been identified to be a weak bank.*

- *Beliefs of the Borrower*

$$\Pr[\, W \mid \text{No deviation}] = 1 - \varepsilon, \qquad \Pr[\, T \mid \text{No deviation}] = \varepsilon,$$
$$\Pr[\, W \mid \text{Deviation}] = 1, \qquad \Pr[\, T \mid \text{Deviation}) = 0.$$

Proof. Since both types of banks follow the same strategy, nothing is learned about the type of the bank if they both do not deviate from their equilibrium strategies. We assign the beliefs that if a bank fails to deny credit to a defaulter, then it is taken to be a sure sign that it is a weak bank.[18]

If the banks play their optimal strategy, then it is clear that the borrowers would not want to deviate since N^* was chosen such that the incentive-compatibility condition is satisfied. Finally, we verify the banks' strategy. If a given bank decides to continue to lend to a defaulter, it is recognized as being weak. Other banks would now refuse to include this weak bank in any syndicate. Therefore, the bank would lose all profits it was expecting to make on all those borrowers for whom it had already incurred the initial fixed costs. This provides an incentive for the bank not to extend credit to a defaulter. Also, banks would indeed refuse to include a bank identified to be weak in any syndicate for the following reason. The only reason that the marginal bank is included in a syndicate is to discipline the borrower by making the penalty for default sufficiently high. If a bank is identified to be weak, it fails to provide any disciplining effect on the borrower. Therefore, the syndicate would find it in its interest to expel the bank that deviates from its announced policy of denying credit to defaulters. So, the banks have no incentive to deviate from their equilibrium strategy either. Q.E.D.

[18] There are other equilibria that are sequential that are supported by different out-of-equilibrium beliefs of the borrower. But many of the unintuitive equilibria arc eliminated by applying refinements of sequential equilibria that impose restrictions on out-of-equilibrium beliefs. Consider, for instance, the following sequential equilibrium. All banks extend credit to a borrower who defaults because the out-of-equilibrium beliefs of the other borrowers are that if they observe any bank denying credit to a defaulter, it is believed to be a weak bank that will continue to extend credit to future defaulters. This patently unreasonable assignment of out-of-equilibrium beliefs is eliminated by applying the Cho-Kreps (1987) intuitive criterion. The tough bank sends an out-of-equilibrium message by denying credit to the defaulter and makes the following argument.

> You should believe that I am tough, because if I were not, it would not be in my interest to deny credit to this defaulter and forgo expected profits; whereas If you arc convinced that I am rough, then it is in my interest to send this message because, by not denying credit to defaulters. I lose even more.

Thus, this unintuitive equilibrium is eliminated by restricting the out-of-equilibrium beliefs of the borrowers. The application of the Cho-Kreps criterion does not, however, eliminate the equilibrium described In the proposition.

We now turn to some other empirical implications of the model in our next proposition.

Proposition 9. *Everything else being equal, larger borrowers are less likely to default and would be charged a smaller interest rate, compared to the smaller borrowers*

Proof. From Proposition 7, larger borrowers get fewer chances to default. Consequently, they choose less risky projects (from Proposition 4), leading to a smaller probability of default (since they do not default voluntarily). Banks rationally anticipating this charge smaller interest rates (from Proposition 5). Q.E.D.

The intuition for this result is as follows, The loan size for some borrowers is so large that even when all banks in the syndicate loan their maximum possible amounts, the syndicate size is so large that the maximum number of times the borrower can default before exhausting all sources of credit is smaller than the number of times smaller borrowers are allowed to default. Consequently, the penalty for default is higher for the large borrowers, causing them to choose safer projects. This makes the large borrowers a better credit risk, causing the interest rate charged to be lower.

3. Extending the Model

In the model we have considered so far, the borrower has no incentive to default partially, since the penalty for default-denial of future credit by its current lenders— is not sensitive to the degree of default by the borrower. Also, the borrower cannot selectively repudiate his debt to some banks because of the cross-default clause. This implication of the model is not consistent with the history of defaults in international lending. Repudiation of international debt obligations by sovereign nations has been infrequent, whereas instances of partial default are numerous. We argue that the extremity of this implication of the model Is because of the extremity of the following assumption.

We assumed that the lenders have all relevant information concerning the borrower. It may be more realistic to assume that there are some relevant characteristics of the borrower that are not completely known to the lenders. For instance, the borrower's discount factor, δ, or the schedule of the projects available to the borrower, $p(R)$, may not be observed by the lenders. Each instance of default and repayment by the borrower, then, provides information that could be used to revise one's beliefs about δ or $p(R)$. This leads to reputation

effects for the borrower, implying that the penalty for default is sensitive to the degree of default.[19]

A default by the borrower signals negative information to the lender. The implications for the interest-rate dynamics, however, are not that straightforward. There clearly are forces [see Chowdhry (1989)) that would tend to increase the interest rate charged to the borrower. The received view seems to consider this to be the obvious conclusion. However, as we have also seen earlier in Proposition 5, because the borrower may now switch to safer projects, there is an opposing force that may cause the interest rate to fall. The net result of these opposite effects is ambiguous.

Empirical evidence by Lindert and Morton (1987) does seem to suggest that the effect causing the interest rates to fall may be strong enough to dominate the opposite effects on the interest rate. Notice that even though the borrower may face smaller interest rates after default, he is not better off, since his access to the private capital markets is reduced as a result. The point we are trying to make here is that we cannot simply look at the level of interest rates faced by the borrowers to judge their creditworthiness.

Linden and Morton (1987), however, find this result puzzling. They argue,

> . . . creditors . . . have taken little note of history in the 1970's. . . . One would expect major banks to charge higher premia, or lend at shorter term, or lend less, to governments with a default history. They did slightly the opposite in 1976-1979. . . . Governments with histories of default and rescheduling paid about 0.04 percent *less* in interest, on slightly longer term loans, than governments with unblemished repayments records. Repayments history, which helps predict subsequent repayments crisis in the international cross-section, was ignored. (pp. 22-23)

Empirical evidence in Chowdhry (1989) is also consistent with the predictions of the model. There I control for various risk characteristics, regional effects, and other systematic effects and find evidence consistent with the Lindert and Morton (1987) observation that countries with a history of default faced smaller spreads than ones with no history of default. Evidence also supports the prediction that larger borrowers are perceived to be less risky and to face smaller spreads. Ozler (1988), on the other hand, finds that countries with histories of default faced higher spreads.

[19] Notice that this generalization makes the formulation time dependent, since the entire history of defaults and repayments by the borrower now becomes relevant as opposed to just the number of defaults.

4. But, What Is the Crisis Everyone Is Talking About?

We have argued, in this article, that enforceability is achieved in international debt contracts by the ability of the lenders to impose an endogenous penalty on the borrowers who default on their loans by denial of future credit to the borrowers by its current lenders. There are two conditions that are crucial for such a mechanism to work. First, the reputation of lenders is important, which means the nature of the institutions that are involved in international lending must be such that they are sustained for a long period of time. The involvement of commercial banks in international lending is consistent with this observation. Second, borrowers are induced not to default voluntarily only if the borrowers who default suffer a penalty of denial of future credit, and those who do not default do not suffer this penalty. We argue that the current situation in international lending may be dangerously close to the failure of one or both of these two conditions, which may lead to mass-scale defaults by several countries contemporaneously-this is the crisis in international debt we are facing today.

The exposure of the largest U.S. banks to the four largest Latin American borrowers is strikingly large. The total amount of loans to just Mexico and Argentina exceeds the total amount of shareholder equity for these banks (*Economist,* June 2, 1984). Thus, if an exogenous shock were to force a number of major borrowers into defaulting a substantial portion of their loans, the very existence of the banks would be in peril.

The situation would stay precarious even if the banks did not fail but suffered huge losses substantially eroding their equity base. This would cause the capital-to-assets ratio of banks to fall substantially. To raise the capital-to-assets ratio back to the required regulatory level,[20] the banks would have. to sell substantial amounts of equity. Information asymmetry in the market for issuing equity may somewhat limit the use of this alternative. The other alternative for the banks is to reduce their assets by selling off some of them, thus curtailing their lending activity sharply. This would mean that even the borrowers who did not default on their loans would suffer credit contraction. Such a situation may induce some of the borrowers on the margin, who would not have chosen to default otherwise, to default now since the benefit from not defaulting-continued access to the capital markets–is curtailed.

Recent events concerning international debts could be interpreted in this framework. A sharp fall in the commodity prices affected the

[20] The regulatory definition of bank capital may differ from country to country but a large part of it is shareholder equity. See Dale (1984).

ability to repay the loans for several developing countries. Brazil depends heavily on coffee exports. In the case of Chile, the prices of copper were crucial. Thus, several major banks are potentially threatened by the prospect of default by several countries. A recent move by Citibank that was followed by all other major banks was to make provisions for losses on its third-world debt. The move was followed quickly by issuing equity a few weeks later *(Wall Street Journal,* various issues). This could be seen as a move to resolve the uncertainty about whether or not the banks would be able to bolster their equity base, and thus raise the capital-to-assets ratio back to an acceptable level. This would assure those borrowers who have not defaulted that the banks will be able to continue to provide credit to them. A closely watched case was that of Colombia, the only major Latin American borrower that has not had to reschedule its foreign bank debt *(Wall Street Journal,* September 14, 1987). Several banks were eager to arrange a new loan of nearly $1 billion for Colombia *(Wall Street Journal,* July 21, 1987).

An intriguing implication that arises from this framework is the following. The borrowers would seem to have an incentive to form a debtors' cartel and default simultaneously. One hears of proposals to form such a cartel from time to time. What economic forces prevent formation of the debtors' cartel? We leave this problem for future research.

Appendix

Proof of Lemma 1

Since all banks in the syndicate make zero expected profits in equilibrium, we have

$$X_n(\theta^*_{ni}, r^*_n, R^*_n) = \theta^*_{ni} + f(\theta^*_{ni}), \qquad \forall i.$$

Substituting from (2) and rearranging, we have

$$\frac{r^*_n p(R^*_n)}{\rho - p(R^*_n)} = 1 + \frac{f(\theta^*_{ni})}{\theta^*_{ni}}, \qquad \forall i. \tag{A1}$$

Since the left-hand side of the above equation is independent of i, we get

$$\frac{f(\theta^*_{ni})}{\theta^*_{ni}} = \frac{f(\theta^*_{nj})}{\theta^*_{nj}}, \qquad \forall i, j. \tag{A2}$$

Since the function $f(\theta)$ is concave and bounded away from zero, $f(\theta)/\theta$ is strictly decreasing in 8. Therefore, (A2) implies that $\theta^*_{ni} = \theta^*_{nj}$, $\forall i, j$, and since $\sum_{i=1}^{k} \theta^*_{ni} = I$, we get the desired result. Q.E.D.

Proof of Proposition 2

From Lemma 1, since the loan is divided equally among the banks, $\theta^*_{nt} = I/l_n \equiv \theta^*_n$, $\forall t$. In equilibrium, each bank makes zero expected profits. Therefore, substituting in (A1) and rearranging, we get

$$1 + r^*_n = \frac{\tilde{\rho}(R^*_n, \theta^*_n)}{p(R^*_n)},$$

where

$$\tilde{\rho}(R^*_n, \theta^*_n) \equiv \rho + [\rho - p(R^*_n)]\frac{f(\theta^*_n)}{\theta^*_n}.$$

The first-order condition for the borrower's maximization problem gives the optimal project choice R^*_n

$$p'(R^*_n)\{R^*_n - (1 + r^*_n) - (1 - \delta)V^*_{n-1}\} + p(R^*_n)\{1 - \delta p(R^*_n)\} = 0. \quad \text{(A3)}$$

Notice that if R^*_n and r^*_n satisfy (A3), then

$$\{R^*_n - (1 + r^*_n) - (1 - \delta)V^*_{n-1}\} \geq 0, \quad \text{(A4)}$$

and, thus, the second-order condition for a *maximum* is also satisfied, since

$$\frac{\partial^2 V_n}{\partial R_n^2}(R^*_n, r^*_n) = \frac{\delta}{\{1 - \delta p(R^*_n)\}^2}[2p'(R^*_n)\{1 - \delta p(R^*_n)\} + p''(R^*_n)\{R^*_n - (1 + r^*_n) - (1 - \delta)V^*_{n-1}\}] < 0.$$

Since there are no local minima, the maximum must be unique.

Q.E.D.

Proof of Proposition 3

Let R^* be the value of R that maximizes $p(R)R$ It is easy to see that such an R^* exists. Since $p'(R) < 0$ and $p''R) < 0$, there is some value of R, say $\bar{R}$, such that $p(\bar{R}) = 0$. Now, since the function $p(R)\,R$ is continuous over a closed and bounded interval $[\rho, \bar{R}]$, it does attain a maximum for some value of R

We have also seen in the proof of Lemma 1 that $f(\theta^*_n)/\theta^*_n$ increases as θ^*_n decreases. Moreover, since $f(\theta^*_n)$ is bounded away from zero, we can make $f(\theta^*_n)/\theta^*_n$ as large as we want by choosing a small enough θ^*_n.

Since $p(R^*_n)R^*_n$ is bounded, there exists θ^*_n such that

$$p(R^*_n)R^*_n - \tilde{\rho}(R^*_n, \theta^*_n) < 0.$$

If banks make zero expected profits, then (7) must be satisfied. Substituting, we get

$$R_n^* - (1 + r_n^*) < 0.$$

But that violates (A4), which is a necessary condition for the first-order condition for the borrower's maximization problem to be satisfied. Q.E.D.

Proof of Lemma 2

Writing (6) as an identity and differentiating with respect to V_{n-1}^*, we get

$$\frac{\partial R_n^*}{\partial V_{n-1}^*} = \frac{(1 - \delta)p'(R_n^*)}{a_n^* + b_n^*},$$

where

$$a_n^* \equiv 2p'(R_n^*)\{1 - \delta p(R_n^*)\} + p''(R_n^*) \cdot \left\{R_n^* - \frac{\rho}{p(R_n^*)} - (1 - \delta)V_{n-1}^*\right\} < 0,$$

$$b_n^* \equiv \left\{\frac{p'(R_n^*)}{p(R_n^*)}\right\}^2 \rho > 0.$$

The sign of the numerator in the above expression for $\partial R_n^*/\partial V_{n-1}^*$ is negative. We now show that the sign of the denominator is also negative.

Let r_n^b denote the interest rate faced by the borrower. For any given project choice R_n, the value of r_n^b that satisfies the first-order condition is given by

$$(1 + r_n^b) = R_n + \frac{p(R_n)\{1 - \delta p(R_n)\}}{p'(R_n)} - (1 - \delta)V_{n-1}^*$$

$$\equiv F(R_n, V_{n-1}^*).$$

If $p'(\rho)$ is finite, then

$$F(\rho, V_{n-1}^*) < \rho.$$

Let r_n^l denote the interest rate charged by the banks. If banks make zero expected profits, then

$$(1 + r_n^l) = \rho/p(R_n) \equiv G(R_n) \geq \rho, \qquad \forall R_n.$$

Therefore,

$$F(\rho, V^*_{n-1}) - G(\rho) < 0.$$

In equilibrium, $r^b_n = r^l_n \equiv r^*_n$; therefore,

$$F(R^*_n, V^*_{n-1}) - G(R^*_n) = 0.$$

The continuous function $F - G$ goes from a negative value at ρ to zero at R^*_n. From Proposition 2, we know that there is a unique value for which the function $F - G$ is equal to zero, and since $\rho < R^*_n$ we get

$$\frac{\partial}{\partial R_n}[F(R^*_n, V^*_{n-1}) - G(R^*_n)] > 0.$$

Multiplying both sides by $p'(R^*_n)$, we get

$$p'(R^*_n)\frac{\partial}{\partial R_n}[F(R^*_n, V^*_{n-1}) - G(R^*_n)] < 0.$$

However,

$$\begin{aligned} &p'(R^*_n)\frac{\partial}{\partial R_n}[F(R^*_n, V^*_{n-1}) - G(R^*_n)] \\ &= 2p'(R^*_n)\{1 - \delta p(R^*_n)\} + p''(R^*_n) \\ &\quad \cdot\left\{R^*_n - \frac{\rho}{p(R^*_n)} - (1-\delta)V^*_{n-1}\right\} + \left\{\frac{p'(R^*_n)}{p(R^*_n)}\right\}^2 \rho \\ &= a^*_n + b^*_n < 0. \end{aligned}$$

Q.E.D.

Proof of Proposition 6

$$\begin{aligned} &V^*_{n-1} - V^*_{n-2} \\ &= \frac{\delta}{1 - \delta p(R^*_{n-1})} \\ &\quad \cdot[p(R^*_{n-1})\{R^*_{n-1} - (1 + r^*_{n-1})\} + \{1 - p(R^*_{n-1})\}V^*_{n-2}] - V^*_{n-2} \\ &\geq \frac{\delta}{1 - \delta p(R^*_{n-1})} \\ &\quad \cdot[p(R^*_n)\{R^*_n - (1 + r^*_{n-1})\} + \{1 - p(R^*_n)\}V^*_{n-2}] - V^*_{n-2} \\ &= \frac{\delta}{1 - \delta p(R^*_n)}[p(R^*_n)\{R^*_n - (1 + r^*_{n-1})\}] - \frac{1-\delta}{1 - \delta p(R^*_n)}V^*_{n-2} \end{aligned}$$

$$> \frac{\delta}{1-\delta p(R_n^*)}\left[p(R_n^*)\{R_n^* - (1+r_n^*)\}\right] - \frac{1-\delta}{1-\delta p(R_n^*)} V_{n-2}^*$$

$$> \frac{\delta}{1-\delta p(R_n^*)}\left[p(R_n^*)\{R_n^* - (1+r_n^*)\}\right] - \frac{1-\delta}{1-\delta p(R_n^*)} V_{n-1}^*$$

$$= V_n^* - V_{n-1}^*.$$

Q.E.D.

References

Boot, A., and A. V. Thakor, 1989, "Dynamic Equilibrium in a Competitive Credit Market: Intertemporal Contracting as Insurance Against Rationing," Discussion Paper no. 413, Indiana University, Bloomington.

Borchard, E., and W. H. Wynne, 1951, *State Insolvency and Foreign Bondholders*, Yale University Press, New Haven, Conn.

Chan, Y.-S., S. I. Greenbaum, and A. V. Thakor, 1986. "Information Reusability, Competition and Bank Asset Quality," *Journal of Banking and Finance*, 10, 243-253.

Cho, I.-K., and D. M. Kreps, 1987, "Signalling Games and Stable Equilibria," *Quarterly Journal of Economics* 102, 179-221.

Chowdhry, B., 1989, 'What Is Different about International Lending?" Ph.D. dissertation, Graduate School of Business, University of Chicago, Chicago.

Dale, R.. 1984, *The Regulation of International Banking*, Prentice-Hall, Englewood Cliffs, N.J.

Delaume, G. R., 1984, *Transnational Contracts*, Oceana, Dobbs Ferry, N.Y.

Diamond, D. W., 1989, "Reputation Acquisition In Debt Markets," *Journal of Political Economy*, 97.828-862.

Eaton, J.. and M. Gersovitz, 1981, "Debt with Potential Repudiation: Theoretical and Empirical Analysis," *Review of Economic Studies*, 48, 289-309.

Hellwig, M. F., 1977, "A Model of Borrowing and Lending with Bankruptcy," *Econometrica*, 45, 1879-1906.

Kaletsky, A, 1985, *The Costs of Default*, Priority, New York.

Kletzer, K. M., 1984, "Asymmetries of Information and LDC Borrowing with Sovereign Risk," *Economic Journal*, 94, 287-304.

Kreps, D. M., and R. Wilson, 1982a, "Reputation and Imperfect Information," *Journal of Economic Theory*, 27, 253-279.

Kreps, D. M., and R. Wilson, 1982b, "Sequential Equilibria," *Econometrica*, 50, 863-894.

Lindert, P. H., and P. J. Morton, 1987, "How Sovereign Debt Has Worked," Working Paper No. 45, Institute of Governmental Affairs, Research Program in Applied Macroeconomics and Macro Policy, University of California, Davis.

Milgrom, P., and J. Roberts, 1982, "Predation, Reputation and Entry Deterrence," *Journal of Economic Theory*, 27, 280-312.

Ozler, S., 1988, "Have Commercial Banks Ignored History?" working paper, Department of Economics, University of California, Los Angeles.

Spatt, C., 1985. "Credit Reputation Equilibrium and the Theory of Credit Markets," working paper, Carnegie Mellon University, Pittsburgh.

Stiglitz, J. E., and A. Weiss, 1983, "Incentives Effects of Terminations: Applications to the Credit and Labor Markets," *American Economic Review*, 73, 912-927.

United Nations Center on Transnational Corporations, 1983, *Issues in Negotiating International Loan Agreements with Transnational Banks*, United Nations, New York.

Wood, P., 1981, *Law and Practice of International Finance*, C. Boardman, London.

World Bank, The, *World Development Report*, 1985, Oxford University Press, New York.