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SOVEREIGN DEBT, REPUTATION, AND CREDIT TERMS

Jonathan Eaton

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ABSTRACT

I develop a model in which sovereign debtors repay debt in order to maintain a reputation for repayment. Repayment gives creditors reason to think that the debtor will suffer adverse consequences if it defaults, so they continue to lend. I compare a situation in which competitive lenders earn a zero profit on each loan with one in which they can make long-term commitments to individual borrowers, so that the zero-profit condition applies only in the long run. In many circumstances a borrower benefits, *ex ante*, if lenders commit to denying credit to a borrower in default even if at that point a subsequent loan is profitable. Furthermore, a "debt overhang," while possibly altering credit terms, does not cause profitable investment opportunities to go unexploited.

Jonathan Eaton
Department of Economics
Rouss Hall
University of Virginia
Charlottesville, VA 22901

I. Introduction

The phenomenon of sovereign lending raises the paradox that, even though a creditor usually lacks the ability to seize much of a debtor's assets if it defaults, creditors do make loans, and debtors often repay them.[1] The question arises as to what incentive a sovereign borrower has to repay debt.

One answer is that default impairs a country's subsequent access to world credit markets, and this impairment reduces its welfare.[2] The country thus repays to maintain favorable credit and investment terms in these markets. But the question then arises as to why a competitive capital market would provide a borrower who had defaulted previously worse credit and investment opportunities than one who had always repaid.

Bulow and Rogoff (1989b) argue that the creditor's legal rights in the creditor community are necessary for this outcome. These rights give the wronged creditor the ability to seize any investment that the sovereign attempts to make abroad, or any payment that the sovereign would make to a

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[1]The World Bank (1989) estimates that in 1988 the set of seventeen highly indebted countries transferred 4.7 per cent of their GNP to creditors.

[2]Eaton and Gersovitz (1981) develop an infinite-horizon model in which a country's output is a perpetually fluctuating endowment. National period utility is a strictly concave function of consumption. As long as a borrower has never defaulted on a previous loan, it has some access to credit markets, but repudiation leaves it unable to borrow again. In the limiting case in which the rate of return on investment subsequent to default equals -100 per cent, the economy must consume its endowment thereafter. Maintaining access to the credit market in order to borrow subsequently provides an incentive to repay as long as the rate of return on investment subsequent to default is sufficiently low. Creditors can calculate the strength of this incentive and only make loans that ensure a competitive expected return, given the incentive to repay. Manuelli (1986), Craig (1988), and Kehoe and Levine (1990) provide general equilibrium analyses in which default entails partial or complete loss of access to world capital or contingent-claims markets.

subsequent lender, so that other lenders would be unwilling to lend. They claim that "those legal rights are necessary if the country is to obtain any loans at all" (1989b, p. 49), and elsewhere that "no debt contract can be a sequential equilibrium if the only adverse consequence is the loss of a 'reputation for repayment'... Furthermore, even if some lending is feasible because of direct sanctions, having a reputation for repayment in no way enhances a small LDC's ability to borrow." (1988a, p. 158). This is so even though "an influential body of research holds that a small country can enjoy at least some access to world capital markets by maintaining a reputation for repaying its loans," citing papers by Eaton, Gersovitz and Stiglitz (1986). Grossman and van Huyck (1988), Manuelli (1986), and English and Cole (1987), (1989b, p. 43).

Bulow and Rogoff support this claim with a partial equilibrium analysis of a small country facing a given world interest rate. They define a "reputation-for-repayment contract" as one which, among other things, allows a borrower in default to invest abroad and earn the competitive world interest rate.[3] This assumption is at variance with the papers cited, and is responsible for their result that reputation for repayment does not enhance an LDC's ability to borrow: If a country can earn the same yield investing abroad as it pays borrowing abroad then at some point it can do at least as well redirecting any net transfer to a creditor toward its own investment.

The question of whether a borrower's past repayment performance affects subsequent credit terms is important for the issue of debt relief. If reputation matters then nonpayment by an LDC debtor (whether it takes the form

[3]Hence Bulow and Rogoff's "reputation for repayment contract" assumes an exogenous enforcement mechanism, since a small country in default can itself enforce a loan contract with the rest of the world.

of outright default, debt relief, or perpetual reliance on "new money" to finance debt-service) will worsen the terms on which credit is subsequently available, either to itself or to LDCs generally. If, however, as Bulow and Rogoff argue, reputation is irrelevant, then, as they claim, "debts which are forgiven will be forgotten." (1989b, p. 49.)

This conclusion contrasts with two empirical observations of Ozler: first, that during 1968-1981, countries that had defaulted in previous periods "paid higher spreads than nondefaulters" (1989a); second, that, within this period, the credit terms of a country with given characteristics improved with its previous experience of borrowing and successful repayment (1989b).

In this paper I develop a general-equilibrium model of borrowing and lending in which maintaining a reputation for repayment is the only reason some borrowers repay. As in Kletzer (1984), borrowers periodically have investment opportunities that are expected to yield more than the world interest rate. Between periods in which these projects are available they lack remunerative domestic investment opportunities. Some borrowers repay only in order to borrow later to finance future projects.

Rather than considering an infinite-horizon situation, in which reputation may have value because lenders adhere to a "trigger strategy" (never lending again if the borrower ever defaults), I instead analyze a finite-horizon model with two types of borrower. One type is "good" in that it can be punished directly for nonpayment. The punishment is so severe that it will always repay a loan if it has enough resources. In contrast, a "bad" borrower suffers no direct penalty if it defaults, and may choose to do so. The borrower's type does not change, but lenders cannot observe it directly.

If lenders ignore or do not know a borrower's repayment history, so that it cannot develop a reputation, then the only equilibrium outcome is that of the one-period Nash game in which a bad borrower defaults on any loan.

But if lenders observe history, they may be able to learn about a borrower's type from what it did before. Equilibria emerge in which, as in Stiglitz and Weiss (1983) and Diamond (1989), default leads to worsened credit terms. In some of these, a bad borrower might repay in order to mimic a good borrower, that is, to maintain a reputation for repayment.

I first assume that this negative consequence of default does not arise because of any commitment on the part of lenders. Default simply reveals that the borrower is more likely to default again, so that competitive lenders raise the interest rate or deny credit to avoid loss. I then allow individual lenders to have multiperiod relationships with individual borrowers, and to commit to particular credit terms in a later period contingent upon repayment or default in an earlier period. I find that a commitment by a competitive lending community to deny loans to a borrower in default can raise the *ex ante* utility of both good and bad borrowers.

I first consider a situation with no extrinsic uncertainty. Reputation by itself can enforce full repayment by bad borrowers for an arbitrarily long period of time. In this version of the model default is always "inexcusable" in the sense of Grossman and van Huyck (1988), since the implicit loan contract calls upon the borrower to repay in all states of nature.

I then assume that the return on the investment project is uncertain, independent across time, and unobservable by lenders. One outcome leaves the borrower no resources to repay. Default is in this case "excusable" in Grossman and van Huyck's sense: Given the realization of the state of nature, default by either type of borrower is anticipated by the implicit loan contract. Lenders must then infer whether a particular default is excusable or not.[4]

There are a variety of equilibria, some of which are consistent with Ozler's empirical finding: Borrowers who repay find their credit terms improve, while those who default pay more in interest, or are denied loans.

In some of these equilibria bad borrowers always default. In others, however, bad borrowers repay in order to improve their subsequent credit terms; i.e., they repay in order to maintain a reputation for creditworthiness. But if lenders cannot precommit to credit terms, it cannot be an equilibrium outcome for bad borrowers always to repay: If they did, default would reveal nothing about a borrower's type, only that its investment project failed. Lenders would then have no reason to provide defaulters credit terms that are any worse than what they provide repayers.

However, if lenders can commit not to lend again to a borrower who defaults, even if lending to that borrower is *ex post* profitable, then lenders

[4]Several recent papers relate to the analysis here. O'Connell (1987) models the role of reputation in managers' efforts to avoid bankruptcy. Asilis (1988,1989) models the interaction of competitive, infinitely-lived lenders who can observe each others credit terms only imperfectly. He characterizes an equilibrium in which the group of creditors can (imperfectly) enforce repayment. Kahn (1989), as I do here, considers a credit market in which creditors do not know the borrower's cost of default. In an early period a borrower with a low cost of default may repay in order to mimic one with a high cost to improve its subsequent credit terms. Kahn precludes the possibility of illiquidity, however. Soarez (1988) also considers a borrower who suffers a low direct cost of default who might repay in order to mimic one with a high cost in order to improve its credit terms. Default can occur either because of illiquidity or unwillingness to pay. Unlike the analysis here, borrowing is to smooth consumption rather than to finance investment. Gale and Hellwig (1989) also consider a creditor who does not know a borrower's cost of default. Their focus is on debt renegotiation rather than on the role of reputation in repeated borrowing. Detragiache (1990) and Cole, Dow, and English (1989) develop a reputational model of sovereign loan default and settlement in which the borrower's own discount factor is private information. A borrower may partially repay a loan to signal a higher discount factor. Finally, Fernandez and Kaaret (1988) model debt renegotiation in which debtors are uncertain about how much leverage large banks have over small banks.

can better enforce repayment and thereby charge good borrowers lower interest rates. Good borrowers may, ex ante, find lower rates worth certain exclusion from subsequent borrowing if their early project fails. In such circumstances, then, creditors do not lend to borrowers in default even though they are known to have exactly the same characteristics, on average, as those who repay. In this equilibrium all bad borrowers repay early loans in order maintain their reputation for creditworthiness.

The paper proceeds as follows: Section II describes the environment. Section III considers the deterministic case, while Section IV introduces a random return on investment. Section V examines an alternative legal arrangement which raises the possibility of a "debt overhang." These sections all assume that lenders cannot make long-term commitments. I introduce long-term borrower-lender relationships in Section VI. Section VII concludes.

II. The Environment

Features of the model resemble those in Diamond (1989):

Endowments and Technology

Each period t, $t=0,\ldots,T$, a borrower has access to an investment project that requires an investment of one unit at the beginning of the period to yield y at the end of the period with probability π and 0 with probability $1-\pi$. Borrowers have no other endowments. Lenders begin each period with an endowment of 1 and a storage technology that yields $r \geq 1$ at the end of the period, where $r < \pi y$. There are more lenders than borrowers, and the number of borrowers is normalized at one. I first follow Atkeson (1988) and Diamond (1989) in assuming that lenders survive only one period. Long-lived lenders appear in Section VI.

As in Diamond, the lender can costlessly destroy the output of a "good" borrower if it defaults, and will always do so.[5] In contrast with Diamond, however, there are also "bad" borrowers whose output the lender cannot affect in the event of default. Good borrowers constitute a fraction θ of the population of borrowers. The outcome of each investment and its identity as good or bad is the private information of the borrower.

Preferences

Agents are risk neutral and have a unit discount factor. Hence each agent seeks to maximize the expected sum of lifetime consumption.

Note that there is no technology to transfer endowments between periods. Borrowers must consequently borrow from lenders to finance investment. This restriction can be relaxed by introducing an additional type of agent, a "repository," which has access to a technology that transfers a unit of output at the end of the period t to r' units of output at the beginning of period t+1. If borrowers have access to this technology and r' is large enough then a bad borrower would at some point want to default and self-finance subsequent investment. The technology might be unavailable to borrowers who defaulted for either of two reasons, however.

First, if direct enforcement power in the economy is limited to that of lenders over good borrowers then borrowers themselves have no power to enforce

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[5]In the context of sovereign debt, destruction could mean that the borrower might not benefit from the output unless it exports it, and that the creditor can seize exports. An equilibrium outcome is for the borrower not to attempt to export if it defaults, so that the creditor receives no return. The creditor may not know if the borrower can consume its own exports or not.

loan contracts with repositories, who would then always choose to default.

Second, lenders and repositories might be subject to the same legal system, which would enforce the lender's claim by intercepting transfers from a borrower in default to any repository.

I first assume that default on a previous loan does not prevent another lender from extending a loan subsequently and receiving payment on that loan, given that the borrower is liquid and chooses to repay. This assumption is relaxed in Sections VI and VII.

III. A Deterministic Model in which Default is Always Inexcusable

If investments are always successful ($\pi = 1$) then there are two one-period Nash equilibria: If $y/r \leq 1/\theta$ then no lending is an equilibrium, while if $y/r \geq 1/\theta$ then lending at rate $R = r/\theta$ is an equilibrium.

A lender who observes history, however, will never lend to a borrower who has ever defaulted: Default reveals that the borrower is bad. Since a bad borrower will default at the end of period T, it will not get a loan at the beginning of that period. It therefore has no reason to repay at the end of period T-1, and so will get no loan at the beginning of that period either. By induction, it never gets any loans once its identity is known.

In any period t the population of borrowers can be divided into those who have never defaulted, which includes all good borrowers, and those who have. Denote by λ_t the number of borrowers who have not defaulted before period t, and by ϕ_t the fraction of bad borrowers with loans in period t who repay. If all borrowers who have not previously defaulted get loans in period t then there are $\lambda_t - \theta$ bad borrowers with loans. The fraction of loans repaid at the end of period t is thus $[\theta + \phi_t(\lambda_t - \theta)]/\lambda_t$.

Short-Term Competition in Lending

Competition among lenders each period will ensure that loans in period t are available to a fraction ω_t of borrowers who have not defaulted before at an interest rate R_t, where:

$$R_t = \frac{r\lambda_t}{\theta+\phi_t(\lambda_t-\theta)}, \tag{1}$$

and where $\omega_t = 1$ if $R_t < y$, so that a successful project yields the resources to repay, $\omega_t = 0$ if $R_t > y$, so that any borrower would be illiquid at the end of the period t, and where $\omega_t \in [0,1]$ if $R_t = y$.

Optimal Default

Let V_t denote the value to a bad borrower of having concealed its identity up to the beginning of period t. It is defined recursively by the relationship:

$$V_t = \omega_t \max[y-R_t+V_{t+1}, y] + (1-\omega_t)V_{t+1}$$

and the terminal condition:

$$V_T = \omega_T y.$$

Default in period t yields the borrower y and repayment $y - R_t + V_{t+1}$. Hence a bad borrower will repay with probability $\phi_t = 1$ if $R_t < V_{t+1}$, with probability $\phi_t = 0$ if $R_t > V_{t=1}$, and with probability $\phi_t \in [0,1]$ if $R_t = V_{t+1}$.

A <u>perfect Bayesian competitive equilibrium</u> is a series $\{\ldots\omega_t, \phi_t \ldots\}$, $t = 1,\ldots,T$ that satisfy the conditions for short-term competitive lending and optimal default.

A Reputational Equilibrium with Lending

For $T \geq N$ defined by:

$$(r/y)^N \leq \theta \leq (r/y)^{N-1},$$

a perfect Bayesian competitive equilibrium is $\phi_t = 1$ and $R_t = r$ for $t \leq T\text{-}N$,

$$\phi_t = \frac{(r/y)^{t-T+N} - \theta}{(r/y)^{t-T+N-1} - \theta}$$

and $R_t = y$ for $T\text{-}N\text{+}1 \leq t \leq T\text{-}1$, and $\phi_T = 0$ and $R_T = r(r/y)^{N-1}/\theta$.

If $N > T$ then no lending is an equilibrium.

Appendix A provides a derivation.

As long as θ, the fraction of good borrowers, is strictly positive and the number of periods sufficiently large then there is lending with no default until period T-N. The interest rate is r, which bad borrowers strictly prefer to pay in order to maintain access to credit. In periods T-N+1 through T-1 the interest rate rises to y, at which bad borrowers are indifferent between default and repayment. Default occurs on a fraction 1-r/y of loans, supporting y as the competitive interest rate. This fraction equates the return to default and the return to repayment: More defaults, by improving the pool of repayers, would improve subsequent credit terms, so that default would not be optimal; fewer defaults would worsen future credit terms, so that repayment would not be optimal.

In this equilibrium default always leads to permanent exclusion from the market. Introducing the possibility that a project can fail leads to a wider range of possible outcomes.

IV. A Stochastic Model with Excusable Default

If there is a chance that an investment project fails, leaving the debtor illiquid, then default no longer reveals that the borrower is necessarily bad.

Again, there are two one-period Nash equilibria. For $\pi y/r \leq 1/\theta$, no lending is an equilibrium, while for $\pi y/r \geq 1/\theta$ lending at a rate $R = r/\pi\theta$ is an equilibrium. The first, but not the second, can also be a multiperiod Bayesian equilibrium, but there are others as well.

I restrict attention to the case T=2. Lenders' beliefs about the proportion of good borrowers among those who repaid in period 1, denoted θ_1^P, and among those who defaulted, denoted θ_1^D, follow from Bayes' Rule:

$$\theta_1^P = \frac{\theta}{\theta + \phi_1(1-\theta)} \tag{2}$$

$$\theta_1^D = \frac{(1-\pi)\theta}{1-\pi\theta-\phi_1\pi(1-\theta)}. \tag{3}$$

Note that $\theta_1^P > \theta_1^D$ unless either $\theta = 1$ or $\phi_1 = 1$, in which case $\theta_1^P = \theta_1^D$.

Short-Term Competition in Lending

Competition among lenders implies the following about credit terms:

(i) Loans will be available at a rate:

$$R_2^P = r/\pi\theta_2^P \tag{4}$$

to a fraction ω_2^P of borrowers who repaid in period 1, where $\omega_2^P = 1$ if $R_2^P < y$, $\omega_2^P = 0$ if $R_2^P > y$, and $\omega^P \in [0,1]$ if $R_2^P = y$.

(ii) Loans will be available at a rate:

$$R_2^D = r/\pi\theta_2^D \tag{5}$$

to a fraction ω_2^D of borrowers who defaulted in period 1, where $\omega_2^D = 1$ if $R_2^D < y$, $\omega_2^D = 0$ if $R_2^D > y$, and $\omega^D \in [0,1]$ if $R_2^D = y$.

(iii) Loans will be available at a rate

$$R_1 = \frac{r}{\pi[\theta + \phi_1(1-\theta)]} \tag{6}$$

to a fraction ω_1 of borrowers period 1, where $\omega_1 = 1$ if $R_1 < y$, $\omega_1 = 0$ if $R_1 > y$, and $\omega_1 \in [0,1]$ if $R_1 = y$.

Optimal Default

A bad borrower defaults in period 1 with probability ϕ_1, where $\phi_1 = 1$ if $R_1 > (\omega_2^P - \omega_2^D)\pi y$, $\phi_1 = 0$ if $R_1 < (\omega_2^P - \omega_2^D)\pi y$, and $\phi_1 \in [0,1]$ if $R_1 = (\omega_2^P - \omega_2^D)\pi y$.

A perfect Bayesian competitive equilibrium is a solution for ω_1, ω_2^P, ω_2^D, and ϕ_1 that satisfies conditions (i), (ii), and (iii) for short-term competitive lending and the condition for optimal default.

Define $\rho = \pi y/r$. The following are perfect Bayesian competitive equilibria for the values of ρ, π, and θ indicated:

1. Full Credit Availability

If $\rho \geq (1-\pi\theta)/(1-\pi)\theta$ then it is an equilibrium for lenders to lend to all borrowers, regardless of their default history ($\omega_2^P=\omega_2^D=\omega_1=1$). Bad borrowers always default in the first period ($\phi_1=0$).

Substituting these values into equations (4), (5), and (6) indicates that, between periods 1 and 2, the interest rate charged those who repay falls ($R_2^P < R_1$) while that charged those who default rises ($R_2^D > R_1$), consistent with Ozler's (1989b) empirical finding. The reason, of course, is that the fraction of bad borrowers is larger in the second group.

2. Perfect Discrimination with Full Separation

If $(1-\pi\theta)/(1-\pi)\theta \geq \rho \geq 1/\theta$ and $1-2\pi+\pi^2\theta \geq 0$ or if $1/\pi\theta \geq \rho \geq 1/\theta$ and $1-2\pi+\pi^2\theta \leq 0$ then it is an equilibrium for lenders to lend to all borrowers in period 1 and, in period 2, to those who repaid previously ($\omega_1=\omega_2^P=1$), and to deny loans to those who defaulted ($\omega_2^D=0$). Bad borrowers always default in the first period ($\phi_1=0$).

As when lending always occurs, the interest rate charged to those who do repay falls between periods 1 and 2.

3. *Perfect Discrimination with Some Repayment By Bad Borrowers*

If $1 \geq 4(1-\pi)\theta$ then in the five cases in which:

(i) $1/\pi\theta \geq \rho \geq 1/\sqrt{\pi\theta}$, $1-2\pi+\pi^2\theta \leq 0$, $\theta \leq \pi$;

(ii) $1/\pi\theta \geq \rho \geq (1-\alpha)/2(1-\pi)\theta$, $1-2\pi+\pi^2\theta \leq 0$, $\theta \geq \pi \geq 1/2$;

(iii) $(1+\alpha)/2(1-\pi)\theta \geq \rho \geq 1/\sqrt{\pi\theta}$, $1-2\pi+\pi^2\theta \geq 0$, $\theta \leq \pi$;

(iv) $(1+\alpha)/2(1-\pi)\theta \geq \rho \geq (1-\alpha)/2(1-\pi)\theta$, $1-2\pi+\pi^2\theta \geq 0$, $\theta \geq \pi \geq 1/2$;

(v) $(1+\alpha)/2(1-\pi)\theta \geq \rho \geq 1/\pi$, $\theta \geq \pi$, $\pi \leq 1/2$;

where $\alpha = \sqrt{1-4(1-\pi)\theta}$, it is an equilibrium for lenders to lend to all borrowers in period 1 and, in period 2, to those who repaid previously ($\omega_1=\omega_2^P=1$), and to deny loans to those who defaulted ($\omega_2^D=0$). Bad borrowers repay in period 1 with probability $\phi_1 = (1/\pi\rho - \theta)/(1-\theta)$.

In this equilibrium, then, some bad borrowers repay at the end of period 1 in order to obtain loans in period 2. As a consequence, the interest rate charged in period 2 to those who repaid in period 1 may exceed the interest rate in period 1.

4. *Some Lending to Defaulters with Some Repayment by Bad Borrowers*

If $1 \geq 4(1-\pi)\theta$ then in the four cases in which:

(i) $(1-\pi\theta)/(1-\pi)\theta \geq \rho \geq 1/\theta$, $1-2\pi+\pi^2\theta \leq 0$ or $\pi\theta \geq 1/2$, $\theta \leq \pi$ or $\pi \leq 1/2$;

(ii) $(1-\pi\theta)/(1-\pi)\theta \geq \rho \geq (1-\alpha)/2(1-\pi)\theta$, $1-2\pi+\pi^2\theta \leq 0$ or $\pi\theta \geq 1/2$, $\theta \geq \pi \geq 1/2$;

(iii) $(1+\alpha)/2(1-\pi)\theta \geq \rho \geq 1/\theta$, $1-2\pi+\pi^2\theta \geq 0$, $\pi\theta \leq 1/2$, $\theta \leq \pi$ or $\pi \leq 1/2$;

(iv) $(1+\alpha)/2(1-\pi)\theta \geq \rho \geq (1-\alpha)/2(1-\pi)\theta$, $1-2\pi+\pi^2\theta \geq 0$, $\pi\theta \leq 1/2$, $\theta \geq \pi \geq 1/2$;

it is an equilibrium for lenders to lend to all borrowers in period 1 and, in period 2, to those who repaid previously ($\omega_1=\omega_2^P=1$), and to lend to a fraction $\omega_2^D = 1 - 1/\rho[1-(1-\pi)\theta\rho]$ of those who defaulted. Bad borrowers repay in period 1 with probability $\phi_1 = [1-\pi\theta-(1-\pi)\theta\rho]/\pi(1-\theta)$.

Again, some bad borrowers repay at the end of period 1 in order to get loans in period 2. But here some borrowers who defaulted are given loans in period 2. The interest rate on these is above the period 1 interest rate, while the interest rate charged those who repaid could be higher or lower.

5. Some Exclusion of Repayers with Some Repayment by Bad Borrowers

If $1/\theta \geq \rho \geq 1/\sqrt{\pi\theta}$ then it is an equilibrium for lenders to lend to all borrowers in period 1 (ω_1=1) and, in period 2, to those who repaid previously with probability $\omega_2^P = r/\pi\theta\rho^2$, and to deny loans to those who defaulted (ω_2^D=0). Bad borrowers repay with probability $\phi_1 = \theta(\rho-1)/(1-\theta)$.

In this case the interest rate charged those who repaid and do obtain loans is higher than the period 1 interest rate.

6. No Lending

If $1/\theta \geq \rho$ then no lending (ω_1=0) with ϕ_1=0 is an equilibrium.

While different equilibria can be consistent with given parameter values, at least one equilibrium exists for any given set of parameters.[6]

A key parameter determining what equilibrium emerges is ρ, the ratio of the expected return on an investment to the interest rate. If it is high enough, loans will always be extended while if it is too low they will never be. For intermediate values loans may be denied those who default but available to those who repay. The model is therefore consistent with the

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[6]To verify this, note that full credit availability (1) is always an equilibrium for $\rho \geq (1-\pi\theta)/(1-\pi)\theta$, and no lending (6) is always an equilibrium for $\rho \leq 1/\theta$. For $(1-\pi\theta)/(1-\pi)\theta \geq \rho \geq 1/\theta$ consider three separate cases:
(i) If $1-2\pi+\pi^2\theta \geq 0$ then equilibrium 2 prevails throughout this range.
(ii) If $1-2\pi+\pi^2\theta \leq 0$ and $\theta \leq \pi$ or $\pi \leq 1/2$ then equilibrium 4 prevails.
(iii) If $1-2\pi+\pi^2\theta \leq 0$ then equilibrium 4 prevails for $(1-\pi\theta)/(1-\pi)\theta \geq \rho \geq 1/\pi\theta$ while equilibrium 2 prevails for $1/\pi\theta \geq \rho \geq 1/\theta$.

reduction in loan availability to developing countries that accompanied the increase in world interest rates in the early 1980s.

Note that only equilibrium 6 corresponds to the one-period Nash equilibrium. In the remaining ones default in period 1 worsens period 2 credit terms, through some combination of restricted credit or higher rates. In equilibria 1 and 2 the change in credit terms does not entice any bad borrowers to repay. In equilibria 3, 4, and 5, however, some bad borrowers do repay in order to maintain access to credit. But in no case do all bad borrowers repay: If they did then the share of bad borrowers among those in default would be the same as among those who repay. Lenders would then have no reason to discriminate in setting period 2 credit terms.

VI. A Debt Overhang

So far in the analysis, a previous default has not affected a creditor's ability to collect payment on a subsequent loan. I now assume that default creates an outstanding claim that entitles the bearer to impose a penalty, in the form of destruction of the output of a good borrower's subsequent project, if it fails to pay it some amount a from the revenue. Hence at most y-a remains for the lender who financed the subsequent project. The claim, of course, has value only if a subsequent loan is made to finance the project. But the existence of the claim can interfere with a subsequent lender's ability to extract a competitive return: If $y-a < R_2^D = r/\pi\theta_2^D$ then anyone lending to a borrower who had defaulted previously would want to purchase outstanding claims before lending itself. Otherwise, the senior claim would force a new lender to take a loss.

In the deterministic case, claims on borrowers in default are worthless. Default reveals the borrower's badness, so any subsequent loan is uncollectable anyway. These claims consequently have no effect.

In the stochastic case, however, a borrower who defaults may nevertheless repay a subsequent loan. Denote by v the value of a claim at the beginning of period 2, where $v = \min[\pi\theta_2^D a, \pi\theta_2^D y - r]/r$. In all the equilibria except full credit availability $v = 0$. In these, any new lender can buy outstanding claims at a negligible price. (By refusing to sell, a claim holder would ensure that its claim was worthless.) Equilibria 2 through 5 are thus unaffected by the introduction of long-lasting claim.

With full credit availability, however, v can exceed zero. Nevertheless, a prior claim does not affect a bad borrower's default decision: Credit is available in period 2 regardless, and the cost of credit is irrelevant, since it does not plan to pay anyway. Hence all bad borrowers continue to default at the end of period 1, and R_2^P is unaffected. What is different is R_1. If r' is the gross interest rate between the end of period 1 and the beginning of period 2 then loans in default at the end of period 1 have a scrap value v/r'. Competition in lending at the beginning of period 1 thus ensures that:

$$R_1 = \frac{r}{\pi\theta} - \frac{(1-\pi\theta)v}{\pi\theta r'},$$

which is less than the interest rate in the absence of such claims.

The condition that $v \geq 0$ continues to imply that $\pi y/r \geq (1-\pi\theta)/(1-\pi)\theta$. The claims do not, therefore, affect the region over which lending always occurs. Hence, surviving claims on loans in default in no case affect how much lending or investment occurs.

V. Lending with Long-Term Commitment to Credit Terms

I now introduce lending institutions that survive two periods, and in period 1 commit to credit terms for both periods. Borrowers cannot change lenders between periods, which turns out to be implied by no lending to borrowers in default to a different lender.

Long-Term Competition in Lending

A lender must, with positive probability, attract a good borrower in order to ensure a nonnegative expected return. Competition among lenders for good borrowers thus implies that long-term credit terms $\{R_1, R_2^P, R_2^D, \omega_1, \omega_2^P, \omega_2^D\}$ maximize the expected utility of a good borrower as of the initial period:

$$W^{GB} = \omega_1[\pi(y-R_1) + \omega_2^P\pi^2(y-R_2^P) + \omega_2^D(1-\pi)\pi(y-R_2^D)],$$

subject to the long-term zero-profit constraint:

$$\omega_1\{\pi[\theta+\phi_1(1-\theta)]R_1 - r + \omega_2^P\pi[\theta + \phi_1(1-\theta)](\pi\theta_2^P R_2^P - r) \\ + \omega_2^D[1-\pi\theta-\phi_1\pi(1-\theta)](\pi\theta_2^D R_2^D - r)\} = 0.$$

A perfect Bayesian competitive equilibrium is now a set of credit terms $\{R_1, R_2^P, R_2^D, \omega_1, \omega_2^P, \omega_2^D\}$ and a default probability ϕ_1 that satisfy the conditions for long-term competition in lending and optimal default (which remains as before).

There are now three kinds of equilibria:

1. *Full Credit Availability*

If $\theta > \pi$ and $\rho \geq (1-\pi)/(\theta-\pi)$ then it is an equilibrium for lenders always to lend ($\omega_1=\omega_2^P=\omega_2^D=1$). Bad borrowers always default in period 1 ($\phi_1=0$). Any pattern of interest rates consistent with the long-term zero-profit condition, including those implied by short-term competition, can occur.[7] In this region the utility outcome is thus the same as under short-term competition.

2. *Perfect Discrimination and Full Repayment by Bad Borrowers*

If $\rho \geq (1+\pi)/(\theta+\pi)$ and either $\pi \geq \theta$ or $\rho \leq (1-\pi)/(\theta-\pi)$ then it is an equilibrium for lenders to lend in period 1 and, in period 2, to those who repay ($\omega_1=\omega_2^P=1$) and to deny loans to those who default ($\omega_2^D=0$). Bad borrowers always repay in period 1 ($\phi_1=1$). The interest rate on first period loans is the highest that bad borrowers will repay, i.e., $R_1 = \pi y$, while $R_2^P = (1+\pi)r/\pi^2\theta - y/\theta$.

In this equilibrium lenders discriminate between borrowers in default and those who repay even though each group ends up having the same share of bad borrowers. Discrimination ensures that solvent bad borrowers repay in period 1. The profit earned by lenders on these loans is passed on to successful good borrowers in the second period. Ex ante, the gain to good borrowers from better credit terms in the event of first-period success is worth the cost of exclusion in the event of first-period failure.

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[7]An equilibrium with the same utility outcome has $R_1=0$, $\omega_1=\omega_2^P=\omega_2^D=1$, and ϕ_1 taking any value in [0,1]. Lenders lose on first-period loans, but make up these losses in the second period.

3. *No Lending*

If $\rho \leq (1+\pi)/(\theta+\pi)$ then no lending with $\phi_1=0$ is an equilibrium.

By enforcing full repayment by bad borrowers, a commitment by lenders to discriminate perfectly can strictly increase the ex ante utilities of all borrowers. In particular, such a commitment reduces the region over which no lending is an equilibrium outcome.

Discrimination requires that lenders resist lending to a borrower in default, even thought such lending is profitable ex post. Denying these loans means both that lenders not lend to a borrower in default to itself, and that they not lend to a borrower in default to another lender. Giving senior creditors first claim to any payment by a borrower in default is one means of discouraging lending to a borrower in default to someone else. In this sense lenders' legal rights within the creditor community facilitate lending, and enhance efficiency. For most parameter values, however, such legal rights are not necessary to sustain some amount of lending.

VI. Extensions and Conclusion

At least two issues merit further investigation. One is the role of randomness in project returns in a longer-horizon model. The problem is much more complex than the two-period case since a borrower's default history becomes potentially so varied. The other issue is the possible correlation across individual borrowers in the effect that sanctions against default are likely to have. Lindert and Morton (1989) and Eichengreen (1989) have found that default by some sovereign debtors worsened credit terms for developing countries with good repayment records. This finding suggests that creditors perceive sovereign borrowers as similar in terms of their willingness to pay. News that some borrowers are less willing to pay than lenders initially thought lowers lenders' assessment of the creditworthiness of other sovereign borrowers as well. This effect introduces an externality into the default decision that the analysis above could be extended to incorporate.

In the deterministic model developed here, in the limit as the horizon becomes infinite, direct sanctions are unnecessary to enforce any repayment at all. Most likely, avoiding direct sanctions as well as maintaining a reputation are important incentives to repay. The models here suggest how reputation can reenforce the effect of direct sanctions.

In summary, maintaining a reputation for repayment is at least one reason for a sovereign debtor to pay its debts. The extent to which outstanding sovereign loans prove profitable indicates how much power creditors have to collect repayment from sovereign governments. A very likely consequence of losses on these loans is that less will be lent henceforth. There may be good reasons for a sovereign debtor not to pay what it owes, but a likely consequence is less lending in the future.

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Appendix A:

Derivation of the Equilibrium for the Deterministic Case

First assume that $\lambda_T \in [\theta, \theta y/r]$. Loans will then be available in period T to borrowers who have not defaulted up to then at $R_T = r\lambda_T/\theta$.

In period T-1 a bad borrower with a loan must decide whether to repay R_{T-1} and remain eligible to borrow in period T, or else to default and become ineligible to borrow or invest in period T. There are three cases:

(i) The case $R_{T-1} > y$, in which $\phi_{T-1} = 0$, is excluded by the solvency requirement for period T-1. No loans would have been extended in period T-1 on which to default.

(ii) In the case $R_{T-1} < y$, $\phi_{T-1} = 1$, implying that $R_{T-1} = r$ and that $\lambda_{T-1} = \lambda_T$. A borrower will default in period T-2, then, only if $R_{T-2} \geq 2y-r > y$, which again is excluded by the solvency requirement. If $R_{T-2} < y$ then $\phi_{T-2} = 1$, so that $\lambda_{T-1} = \lambda_{T-2}$. By backward induction, the benefit to a bad borrower of repaying in period T-i is $i(y-r) + r$, which strictly exceeds y. The solvency requirement $R_{T-i} \leq y$ therefore implies that $\phi_t = 1$ and $R_t = r$ for all t<T. Hence $\lambda_t = \lambda_T$ for all t as well. Since there is never any default before period T, $\lambda_T = 1$. The period T solvency constraint is therefore satisfied if and only if $\theta \geq r/y$. If this condition holds then there exists an equilibrium in which all borrowers receive loans every period, and bad borrowers default only in period T.

(iii) Finally, in the case $R_{T-1} = y$, a bad borrower is indifferent between default and repayment, so any fraction ϕ_{T-1} may default. Condition (1), however, implies that:

$$\phi_{T-1} = \frac{r\lambda_{T-1} - \theta y}{(\lambda_{T-1} - \theta)y}. \tag{A1}$$

Since $r \leq y$, if $\theta \leq r/y$ then $\phi_{T-1} \in [0,1]$. The updating relationship:

$$\lambda_T = \theta + \phi_{T-1}(\lambda_{T-1}-\theta), \tag{A2}$$

together with (A1), gives:

$$\lambda_T = r\lambda_{T-1}/y. \tag{A3}$$

Consider now a bad borrower's repayment decision in period T-2. Repaying gives it $2y - R_{T-2}$, while default gives it y. Analogous to the situation at the end of period T-1 there are three cases to consider:

(i) The case $R_{T-2} > y$, which implies that $\phi_{T-1} = 0$, violates the period T-1 solvency constraint.

(ii) The case $R_{T-2} < y$ implies that $\lambda_t = 1$ for all $t < T$, so that, from (A3), $\lambda_T = r/y$. The period T solvency constraint is then satisfied if and only if $\theta \geq (r/y)^2$. Hence, if

$$r/y \geq \theta \geq (r/y)^2$$

then there exists an equilibrium in which $\phi_t = 1$ and $R_t = r$, $t < T-1$, and $\phi_{T-1} = (r-\theta y)/(1-\theta)y$, $R_{T-1} = y$, and $R_T = r^2/\theta y$.

(iii) Finally, in the case $R_{T-2} = y$, a bad borrower is indifferent between default and repayment, so any fraction ϕ_{T-2} may default. Condition

(1), however, implies that:

$$\phi_{T-2} = \frac{r\lambda_{T-2} - \theta y}{(\lambda_{T-2} - \theta)y}. \tag{A4}$$

Since $r \leq y$, $\phi_{T-2} \in [0,1]$ if $\theta \leq (r/y)^2$. The updating relationship:

$$\lambda_{T-1} = \theta + \phi_{T-2}(\lambda_{T-2} - \theta), \tag{A5}$$

together with (A4), gives:

$$\lambda_{T-1} = r\lambda_{T-2}/y. \tag{A6}$$

Proceeding backwards gives, by induction, ϕ_t and ω_t as in the text.