

**"SYNDICATED LENDING UNDER
ASYMMETRIC CREDITOR INFORMATION"**

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Syndicated lending under asymmetric creditor information ¹

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Abstract

This paper explores how asymmetric information about borrower quality among syndicated lenders alters the incentive to refinance illiquid borrowers. We use a model in which lenders enter the market sequentially in two rounds of lending. Between the two rounds, a shock separates borrowers into good ones and bad ones, and early entrants acquire information about individual borrower type, while late entrants know only the distribution of borrower types. The asymmetric information structure gives rise to both signaling and screening issues. We show that self-selecting contracts do not exist, and that there is always a pooling Perfect Bayesian Equilibrium in which late entrants lend to both good and bad types, without borrower type being exposed before final clearing at the terminal time. Based on this framework, we argue that prior to the 1982 international debt crisis, it was possible for banks with heavy exposure to troubled debtors to attract rational newcomers in syndicated loans which were, with positive probability, bailout loans.

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1 Introduction

While the 'debt crisis' no longer makes it to the headlines, except in its Eastern European avatar, it can hardly be said that all of its features have been fully explored. As 'debt crises' are a regular part of the economic development process since the *XIV*th century ¹ and are bound to recur, some of their features are still worth exploring twelve years after the Mexican default triggered the latest episode.

Asymmetric information is one such feature. A borrowing country must usually submit lending banks an 'information memorandum' summarizing basic data on the use of the loan requested, the country's economic condition, including its overall indebtedness, and other information pertinent to the determination of the credit risk. In practice, a developing country's external debt is often made of a complex mix of claims on public, para-public and private entities whose individual borrowing policies are hardly coordinated. As a result, creditors typically lend without knowing exactly how much the country has already borrowed, merely imposing seniority or *pari passu* clauses to protect their own claims. ² At least since Kletzer (1984) the literature has recognized this as a central feature of the sovereign lending business. A second type of information asymmetry, *between lenders themselves*, while being recognized as a fact ³ has not been modelled formally. Bank syndicates are not coalitions of symmetric players. Large syndicates lending to Latin American debtors were organized and managed by a couple of large banks who negotiated loan contracts and sold participations to smaller banks worldwide. The same group of banks could be found organizing most of the large syndicates in the late 1970's and early 80's (UNCTC, 1991), and could be considered as the real insiders in the country-risk business. Those large banks, being in close contact with officials of borrowing-country governments, had private – although imperfect – information on the true level of credit risks in any particular country, ⁴ and might even have got advance warning of coming repayment

¹The Bardi bank of Florence failed in 1346 following default by the Kings of England and Sicily on their enormous external debt (Lopez, 1976).

²This type of situation is typical of the pre-1982 period, after which compulsory disclosure by lending banks of data on their exposure improved the market's general information.

³See e.g. Baron (1979); Hayes, Spence and Marks (1983); Berlin and Loeys (1986); and Melnik and Plaut (1991).

⁴Regulatory problems arising from the risk-taking behaviour of banks having private information on the quality of their claims have been examined in the context of domestic lending by Lucas and McDonald (1987).

difficulties. Whether they had any incentive to pass that information around to all participants in the market is another story.

When a country is in a temporary liquidity crisis, lenders may want, under certain circumstances (which we make precise), to relend to the country in order to allow it to invest in new projects and grow out of its difficulties. When the expected return to such a loan is negative, it is called a 'bail out'; according to Guttentag and Herring (1985) "bail-out loans are made only by lenders with outstanding claims on the borrowers". The reason is obvious: a bailout loan is profitable only because it exerts a positive externality on the value of outstanding claims. Lenders with no outstanding claims on the troubled country have no reason to lend at a negative expected profit. Yet, in foreign lending it is not uncommon to observe newcomers being attracted into troubled countries just before a crisis breaks out; such was the case, for instance, in Latin America just before the Mexican default of August 1982.⁵ How is this possible? Although lenders with outstanding claims may be willing to commit some of their own resources to bailout loans, they clearly have an interest in minimizing their participation in such loans. But attracting newcomers is possible only if the market is not scared by bad news; the lenders' problem is thus to avoid the contagion of fear. The model formalizes the following situation. Two successive rounds of lending take place. In the first round, countries are all identical. Because lending opportunities are limited, some banks are left out and will join only in the second round. By then, a shock will have separated countries between good ones and bad ones, depending on their debt-servicing capabilities. ⁶ Banks having lent to a country in the first round, will know the type of that country and that knowledge will be their private information. This setting is meant to capture the difference –

⁵A substantial number of newcomers were attracted in 1981 into large syndicated euroloans to Latin American countries [see UNCTC (1991)]; some of these newcomers, e.g. financial institutions from OPEC countries, being relatively unsophisticated, were not aware of the rapidly deteriorating financial situations of many Latin American debtors.

⁶The issue of default and enforcement has been explored at length by the literature. Since Eaton and Gersovitz (1981), one strand of this literature has stressed the threat of being cut off from future access to capital markets as the basic deterrent against repudiation. The argument has been refined by Chowdhry (1991) who shows that syndication may be a device to overcome coordination problems in applying sanctions. Another strand [see for instance Bulow and Rogoff (1989); Fernandez and Rosenthal (1988), (1990)] has stressed partial default and renegotiation, suggesting that loan contracts to sovereign entities are really contingent claims. In order to focus on hidden information problems, we have chosen to assume away moral hazard by postulating the existence of credible sanctions on the part of creditors [see Cohen (1992) for more details on the enforcement question].

in our view, crucial – between ‘insiders’ and ‘outsiders’, the former being banks with experience in the country-risk business. New lending will take place whatever the quality of countries, but for different reasons: for good countries, new investment opportunities arise, while for bad countries, syndicates will be arranged by ‘insiders’ to attract fresh money (bailout money) from uninformed outsiders. We show that in a pooling equilibrium, those uninformed banks may take syndicate participations knowing that, with positive probability, they are bailing out troubled debtors. The analysis helps explaining an increased aggressiveness of large creditors in pushing loans in the final pre-crisis phase, and is thus complementary to other analyses of ‘loan pushing’ [see Basu (1991)]. In a separating equilibrium, by contrast, banks with claims on good countries signal their type by retaining a larger share of the new loans, à la Leland and Pyle (1977).

The paper is organized as follows. Section 2 sets out the game, section 3 solves it and states the main results (characterization of perfect Bayesian equilibria and their properties), and section 4 concludes.

2 A lending model with asymmetric creditor information

We use a two-period model with dates t_1 , t_2 , and t_3 ; t_3 is the terminal time at which all debts are cleared. At t_1 , nature generates *ex ante* identical investment opportunities (‘projects’) in a number of *ex ante* identical countries who require external financing to carry out these projects. There is one project per country, which is characterized by an initial investment L_1 at t_1 and a random payoff X_1 at t_3 (the subscript refers to the *disbursement* time). The project is financed by a two-period, ‘zero-coupon’ bank loan,⁷ described by a pair (L_1, R_1) , where R_1 is the contractual repayment (principal and interest) at t_3 . All country risk is idiosyncratic and banks, while being risk-neutral, face nontrivial bankruptcy costs; therefore each bank diversifies its portfolio over a number of projects. The optimal share that a representative bank wants to take in any project is determined by maximizing the difference between the loan’s expected payoff and a cost-of-funds function. The initial investment L_1 needed to start each project is large; so bank syndicates are formed to mobilize the necessary

⁷This means that both principal and compound interest are due at t_3 .

funds.⁸ As banks are symmetric players at t_1 , syndicates are at this stage symmetric coalitions without any ‘insiders’ or ‘outsiders’. We assume competition and free entry, so banks which lend in the first round do so at zero expected profit.

At t_2 , a second round of projects appear, requiring a larger investment $L_2 > L_1$ and yielding a random payoff X_2 at t_3 . These projects are financed by a second round of loans (L_2, R_2) also assembled by syndicates, disbursed at t_2 and repayable at t_3 .

At t_3 , the realization of X_i , $i = 1, 2$, is publicly observed. We define default as the state where $X_1 + X_2 < R_1 + R_2$. Unlike in Chowdhry (1991) the return on the investment is observable and default is not a decision variable for the country. In the advent of default, first-round loans are protected by a *pari passu* clause giving all loans equal seniority irrespective of the disbursement date. In general, *pari passu* clauses prevent future loans from having seniority over outstanding ones. Therefore if $X_1 + X_2 < R_1 + R_2$, then $X_1 + X_2$ is pro-rated between all creditors, first- and second-round.

Between t_1 and t_2 , a shock separates countries. In ‘good’ ones, X_1 and X_2 are distributed (on R^+) according to distributions G_1 and G_2 respectively; in ‘bad’ ones, X_1 and X_2 are distributed (also on R^+) according to F_1 and F_2 respectively. The distribution G_i ($i = 1, 2$) dominates the distribution F_i in the first order. In order to simplify the exposition, we assume that $F_1(0) = 1$, i.e. that the return on the first project is zero with certainty in the bad country. By contrast $F_2(z) < 1 \forall z > 0$; in other words, a second loan stands a chance of being repaid even in a bad country, although that chance is lower than in a good country. The proportion of good countries is $0 < q < 1$.

The occurrence of the shock and the proportion of good countries are common knowledge, but only banks that have lent to a country at t_1 know at t_2 whether that particular country is a good one or a bad one. As those banks have private information on country quality, second-round syndicates are no longer symmetric coalitions. We will call banks having participated in first-round syndicates ‘insiders’ while entrants taking participations in second-round syndicates only, without prior exposure, will be called ‘outsiders’. Insider banks are price-setters, meaning that they collusively determine the contractual terms R_2 of second-round loans and their own shares in them, and then offer remaining shares (on the same terms) to outsiders.⁹ *Vis-à-*

⁸A formal rationale for syndication based on bankruptcy costs is provided in the appendix.

⁹As outsiders are faced with take-it-or-leave-it offers, if the terms of those offers were freely set by insiders any surplus would be squeezed out of outsiders; however, all loan participations are typically

vis debtor countries, their price-setting power is limited by free entry of uninformed outsiders who can form competing syndicates of their own. Therefore the terms of second-round loans have to be at least as good for any country as the terms giving zero expected profits to uninformed outsiders.

Since banks are identical players at t_1 , in any symmetric equilibrium all participating banks will hold equal shares in any first-round loan. As far as second-round loans are concerned, that is at t_2 , the only difference between banks is their information; so all insiders (there are n of them) take equal shares in any given loan.¹⁰ Therefore we consider a three-player game of incomplete information played between a borrower country of either type, a representative insider bank and a representative outsider bank. The insider shares in a first-round and second-round loan (as a proportion of the disbursed amount) are respectively α_1 and α_2 . All outsiders participating in the loan (there are m of them) also take equal shares, but these shares may differ from those taken by insiders; we will denote them by β_2 . The minimum dollar amount invested in any loan ($\alpha_i L_i$, $i = 1, 2$, for insiders, $\beta_2 L_2$ for outsiders) is arbitrarily set at unity. At t_2 the present value of a bank's repayment obligations to its own (insured) creditors is $c^I(\alpha_1, \alpha_2)$ for an insider and $c^O(\beta_2)$ for an outsider. Let G be the distribution of the sum $X_1 + X_2$ for a good country. Under certainty about country type, the expected payoff (net of the cost of funds) to an outsider bank from a share β_2 in loan (L_2, R_2) to a good country would be

$$E^G \pi^O(\beta_2, R_2) = \beta_2 R_2 \left[\int_0^{R_1+R_2} \left(\frac{X_1 + X_2}{R_1 + R_2} \right) dG + \int_{R_1+R_2}^{\infty} dG \right] - c^O(\beta_2).$$

The quantity $\beta_2 R_2 (X_1 + X_2) / (R_1 + R_2)$ is the claim of a bank with exposure $\beta_2 R_2$ in case of default when all claims have equal seniority. If the country was known to be bad, the outsider's expected payoff would be

$$E^{F_2} \pi^O(\beta_2, R_2) = \beta_2 R_2 \left[\int_0^{R_1+R_2} \frac{X_2}{R_1 + R_2} dF_2 + \int_{R_1+R_2}^{\infty} dF_2 \right] - c^O(\beta_2),$$

since for a bad country, the return on the first loan is zero with certainty. As country quality is unknown to outsiders, the expected payoff from lending $\beta_2 L_2$, for a representative outsider with beliefs μ (μ being the probability attached to the good type) is $E^\mu \pi^O(\beta_2, R_2) = \mu E^G \pi^O(\cdot) + (1 - \mu) E^{F_2} \pi^O(\cdot)$.

on the same terms, except for fees charged by syndicate organizers, which are not considered here.

¹⁰We ignore the rationing problem for the last participant if the desired shares do not add up to one, and consider only symmetric equilibria.

Turning to insider banks, the expected profit to an insider bank from shares α_1 in loan (L_1, R_1) and α_2 in loan (L_2, R_2) , if the country is good, is denoted by $E^G \pi^I(\alpha_1, R_1, \alpha_2, R_2)$. Written in full, it is:

$$E^G \pi^I(.) = (\alpha_1 R_1 + \alpha_2 R_2) \left[\int_0^{R_1+R_2} \left(\frac{X_1 + X_2}{R_1 + R_2} \right) dG + \int_{R_1+R_2}^{\infty} dG \right] - c^I(\alpha_1, \alpha_2)$$

The corresponding expected profit expression when the country is bad is $E^{F_2} \pi^I(\alpha_1, R_1, \alpha_2, R_2)$ or, written in full,

$$E^{F_2} \pi^I(.) = (\alpha_1 R_1 + \alpha_2 R_2) \left[\int_0^{R_1+R_2} \left(\frac{X_2}{R_1 + R_2} \right) dF_2 + \int_{R_1+R_2}^{\infty} dF_2 \right] - c^I(\alpha_1, \alpha_2)$$

In order to make the informational problem meaningful, we impose four restrictions on the parameters. These restrictions do not drive the results but rather define the problem: if they are not met, there is no informational problem. The first such restriction is that uninformed outsiders would be willing to lend to a country if they knew with certainty that that country was of the good type; *i.e.* that there exists a contract (β_2, R_2) such that $E^G \pi^O(\beta_2, R_2) \geq 0$. The second is that they would *not* want to lend to a country known with certainty to be bad, *i.e.* that $E^{F_2} \pi^O(\beta_2, R_2) < 0$ for all (β_2, R_2) . Third, second-round projects are larger than first-round ones by an amount sufficient to make a syndicate of n insiders with exposure to a good country unwilling at time t_2 to take up the full amount of the new loan L_2 ; *i.e.* $n\alpha_2 < 1$ at the optimal level of α_2 . Clearly the case where this restriction is not met is uninteresting, since it will then be impossible for banks with bad claims to attract new investors in any equilibrium. Finally, it must be profitable for insider banks with exposure to bad countries to mimick the behaviour of insider banks with ‘good exposure’. Note that at t_2 the motivation for new lending is different depending on whether the country is good or bad. If the country is good, insider banks want to take advantage of the second opportunity for investment in the country but wish to share it with new entrants for diversification purposes. If the country is bad, on the other hand, with a *pari passu* clause insider banks may have an incentive to attract new lenders and relend, because doing so would give them an option on the country’s future resources (by allowing the country to invest in a new project). As the expected payoff from the first loan to a bad country is known to be zero, the payoff to an insider bank is $-c(\alpha_1, 0)$ if it does not relend. If it relends an amount α_2 , its expected payoff is $E^{F_2} \pi^I(\alpha_1, R_1, \alpha_2, R_2)$. So an incentive to relend exists if, for some α_2 , $E^{F_2} \pi^I(\alpha_1, R_1, \alpha_2, R_2) \geq -c^I(\alpha_1, 0)$; this is our fourth restriction; it says that for relending to be an attractive choice, the

cost of funds must be low enough. The effect of syndication is to reduce the amount of funds that the insider banks have to provide from their own resources. As the expected gain from relending is negative (although smaller in absolute value than the certain loss if relending does not take place), any reduction in the amount of funds that insiders have to provide increases the attractiveness of relending. The question is whether insider banks can find any willing participants among uninformed outsiders, given that the structure of the market described so far, and hence the informational problem, are common knowledge.

3 Market equilibrium

We analyze the game played at t_2 . The overall timing of the game is as follows: (i) Syndicates of insiders decide on new loan offers to their debtor countries and on the share of those loans they wish to retain; (ii) next, debtor countries accept or refuse the offers, given what is available on the market, i.e. from uninformed outsiders; (iii) finally, outsiders are offered shares in the loan at the given terms, which they can either take (in any feasible amount) or reject. We denote by $\sigma^I(j) = (\alpha_2, R_2)$ the strategy of an insider bank with exposure on a type- j country ($j = g$ means good and $j = b$ means bad). The strategy of a type- j country is $\sigma^j(R_2) = \iota \in \{0, 1\}$, where $\iota = 1$ means acceptance of the insider banks syndicate's offer. Finally, a strategy for an outsider bank is $\sigma^O(\alpha_2, R_2, \iota) = \beta_2$. The game is solved backwards.

PROPOSITION 1 *No self-selecting loan contract exists.*

PROOF See appendix.

Proposition 1 follows from the fact, established in the appendix, that any loan is acceptable to a bad country while not every loan is acceptable to a good country. Specifically, we show that there is an upper bound R_2^g on the set of values R_2 that make a loan (L_2, R_2) acceptable to a good country, while no such value exists for a bad country (the reason is that the bad country is totally insolvent, as $X_1 = 0$ with certainty).¹¹ As a result, any contract with $R_2 \leq R_2^g$ will attract both types, while any contract with $R_2 > R_2^g$ will induce *adverse selection*, attracting the bad type but

¹¹Relaxing this assumption would lead to the existence of an upper bound on the set of loan contracts acceptable to a bad country, but that upper bound would always be higher than that of a good country, so that the analysis would be unchanged.

not the good type. Proposition 1 implies that the terms of the loan offer extended by an insider syndicate to a good country, summarized by R_2 (for given L_2), cannot be used to signal the type of the country credibly.

It remains to be seen whether the share α_2 retained by the insider banks in the new loan (L_2, R_2) can be used to signal the quality of the borrower country. This is done in proposition 2, which establishes by construction the existence of a separating equilibrium. Note first that with free entry, outsiders are willing to lend to any country at a rate which yields zero expected profits given rational beliefs μ . Let $R_2(\mu)$ be the smallest root of the equation $E^\mu \pi^O(\beta, R_2) = 0$. $R_2(\mu)$ defines the competition constraint relevant for syndicates of insiders when making new loan offers to debtor countries of any type, since R_2 must be equal to $R_2(\mu)$ in any equilibrium. Let $R_2(1)$ denote $R_2(\mu)$ evaluated at $\mu = 1$. If $R_2^g < R_2(1)$, no efficient lending can take place (i.e. the only loans acceptable to a good country offer negative expected profits under complete information), so we suppose that $R_2^g \geq R_2(1)$. Let A be a closed subinterval in $[0, 1]$; let $\alpha' = \min A$. Let also $\beta(\mu) = \arg \max_\beta E^\mu \pi^O(\beta, R_2)$ and $\alpha(R_2) = \arg \max_\alpha \pi^I(\alpha_1, R_1, \alpha, R_2)$. Finally, let the function $\mu(\alpha_2, R_2, \iota)$ represent the outsider's beliefs about country type. In any Perfect Bayesian Equilibrium, these beliefs must be consistent with Bayes' rule along the equilibrium path. Consider the following assessment (strategy profile and supporting beliefs) of the game:

$$\mu(\alpha_2, R_2) = \begin{cases} 1 & \text{if } \alpha_2 \in A \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

$$\sigma^O(\alpha_2, R_2, \iota) = \begin{cases} \max\{0, \arg \max_\beta E^{\mu(\cdot)} \pi^O(\beta, R_2)\} & \text{for } \iota = 1 \\ 0 & \text{otherwise} \end{cases} \quad (2)$$

$$\sigma^g(R_2) = \begin{cases} 1 & \text{if } R_2 \leq \min\{R_2^g, R_2(1)\} \\ 0 & \text{otherwise} \end{cases} \quad \text{and } \sigma^b(R_2) = 1 \forall R_2 \quad (3)$$

$$\sigma^I(j) = \begin{cases} (\max\{\alpha', \alpha[R_2(1)]\}, R_2(1)) & \text{if } j = 1 \\ (0, \cdot) & \text{otherwise} \end{cases} \quad (4)$$

We can now derive conditions under which (1) - (4) is a separating Perfect Bayesian Equilibrium (PBE) of the game.

PROPOSITION 2 *If there exists a real number $\tilde{\alpha}$ in $(0, 1/n)$ such that:*

$$E^{F_2} \pi^I[\alpha_1, R_1, \tilde{\alpha}, R_2(1)] \leq E^{F_2} \pi^I[\alpha_1, R_1, 0, 0] \quad (5)$$

$$E^{G_1} \pi^I(\alpha_1, R_1, 0, 0) < E^G \pi^I[\alpha_1, R_1, \tilde{\alpha}, R_2(1)] \quad (6)$$

then (1) - (4) is a separating equilibrium (PBE) of the game for $A = [\tilde{\alpha}, 1]$.

PROOF See appendix.

Proposition 2 describes a strategy profile where insider syndicates holding claims on good countries signal the quality of their claims by retaining a large share of the new loans extended to those countries, à la Leland and Pyle (1977). All information spreads out on the market and individual country quality becomes common knowledge. As a result, bad countries are either rescued by insider syndicates or simply let down, depending on the form of the distribution F_2 .

Now consider the following alternative assessment:

$$\mu(\alpha_2, R_2) = \begin{cases} 1 & \text{if } \alpha^I \in A \\ q & \text{if } \alpha^I = \alpha[R_2(q)] \\ 0 & \text{otherwise} \end{cases} \quad (7)$$

$$\sigma^O(\alpha_2, R_2) = \begin{cases} \beta(R_2) & \text{if } E^\mu \pi^O(\beta(R_2), R_2) \geq 0 \\ 0 & \text{otherwise} \end{cases} \quad (8)$$

$$\sigma^g(R_2) = \begin{cases} 1 & \text{if } R_2 \leq \min \{R_2^g, R_2(q)\} \\ 0 & \text{otherwise} \end{cases} \quad \text{and } \sigma^b(R_2) = 1 \forall R_2 \quad (9)$$

$$\sigma^I(j) = \alpha[R_2(q)] \forall j \in \{0, 1\} \quad (10)$$

Proposition 3 establishes a condition under which (7) - (10) is a pooling Perfect Bayesian Equilibrium of the game.

PROPOSITION 3 *If $E^{F_2} \pi^I[\alpha_1, R_1, \alpha[R_2(q)], R_2(q)] \geq E^{F_2} \pi^I[\alpha_1, R_1, 0, 0]$, then (7) - (10) is a pooling equilibrium (PBE) of the game for $A = [\tilde{\alpha}, 1]$.*

PROOF See appendix.

Proposition 3 describes a strategy profile where insider syndicates with bad claims successfully mimic the lending behaviour of 'good' syndicates. Outsiders who take participation in loans offered by syndicates with unknown quality do so at a risk; that risk is known and the payoff structure ensures that it is worth taking. Note

that the assumption of zero-coupon loans is not crucial. If first-round loans were not zero-coupon, second-round loans in the pooling equilibrium would be used to remain current on interest payments – a strategy which was used on a large scale by debtor countries during the early 80's.

Who bears the cost of pooling? In conventional signaling models, the cost of pooling is borne by the good-type informed agents who cannot reap the benefits of their type. Here, both insider banks and countries are 'informed agents'; it is therefore not obvious how they split this cost. It turns out that it is borne entirely by the good-type countries, while insider banks with claims on them enjoy an informational rent. The reason is that the competition constraint which, under pooling, insider banks with claims on good countries are facing is $R_2 \leq R_2(q)$, while under separation it would be $R_2 \leq R_2(1)$. As $R_2(1) < R_2(q)$ and the constraint is binding in both equilibria, the rate of interest charged by insider banks to good countries is higher under pooling than under separation. While the primary result of the paper (the existence of a pooling equilibrium in this mixed signaling/screening model) does not hinge on the assumption that the cost of funds to banks is independent on the type distribution of their claims, the result that they enjoy an informational rent under pooling does. If ultimate creditors were uninsured, the cost of funds under separation would reflect the type distribution of a bank's claims. Then, in the game played at t_2 , a bank could make larger or smaller profits under separation than under pooling, depending on the realization of its portfolio (although the *ex ante* expected profits of a representative bank at t_0 would always be zero).

The next corollary shows that pooling and separating can be simultaneous equilibria, but that there is a region of the model's parameters where pooling is the unique equilibrium. Let $\tilde{\alpha}_b$ and $\tilde{\alpha}_g$ be defined implicitly by $E^{F_2} \pi^I[\alpha_1, R_1, \tilde{\alpha}_b, R_2(1)] = -c^I(\alpha_1, 0)$ and $E^G \pi^I[\alpha_1, R_1, \tilde{\alpha}_g, R_2(1)] = E^{G_1} \pi^I(\alpha_1, R_1)$.

COROLLARY 1 *If $\tilde{\alpha}_b < \tilde{\alpha}_g$, the game has both a separating PBE defined by (1) – (4), in which $\tilde{\alpha} \in [\tilde{\alpha}_b, \tilde{\alpha}_g]$, and a pooling PBE defined by (7) – (10). If $\tilde{\alpha}_b > \tilde{\alpha}_g$, the unique PBE of the game is the pooling one.*

PROOF See appendix.

It is well-known since Rothschild and Stiglitz (1976) that in a screening model with free entry, it is not possible to have a pooling equilibrium, unless one considers the alternative formulation due to Wilson (1979). The model outlined in this paper

is a free-entry model where both signaling and screening are present. Outsider banks, which are uninformed agents, would be willing to offer self-selecting contracts if such contracts could be found; while insider banks with claims on good countries, which are informed agents, would be happy to use self-selecting contracts as a signal to outside investors (that the proposed loan was extended to a good borrower). However, not only do we show the existence of a pooling equilibrium, but it is also the unique equilibrium for a range of the parameters. The reason lies in proposition 1: the interest rate cannot be used as a screening device; therefore all that remains is signaling through a single instrument, the share of the loan retained by the informed party, which may or may not be an equilibrium strategy depending on the model's parameters.

Solving for optimal contracts at t_1 is not possible in general, since the game played at t_2 has multiple equilibria; but we can derive conditions necessary for lending to take place at t_1 in the region where the pooling equilibrium is unique. This is done in the following corollary.

COROLLARY 2 *When $\tilde{\alpha}_b > \tilde{\alpha}_g$, lending takes place at t_1 if and only if for a given q , there exists a value \tilde{R}_1 of R_1 such that*

$$v^g[\tilde{R}_1, R_2(q)] \geq - \left(\frac{1-q}{q} \right) v^b[\tilde{R}_1, R_2(q)]$$

$$E^G \pi^I[\alpha_1, \tilde{R}_1, \alpha[R_2(q)], R_2(q)] \geq - \left[\frac{1-q}{q} \right] E^{F_2} \pi^I[\alpha_1, \tilde{R}_1, \alpha[R_2(q)], R_2(q)].$$

PROOF See appendix.

The first condition establishes an *ex ante* acceptability condition for a representative country. Not knowing yet how it will be affected by the shock to come (although the coming of the shock is common knowledge)¹² the country must be better off in expected value with a loan than without it. The second condition is a zero-profit condition for the bank. It can be seen that a higher value of q (the probability for any country of being a 'good type' after the shock) makes it easier for the bank to start lending and for the country to accept the loan, as both get higher payoffs when the country is of a good type.

¹²The assumption that the future occurrence of the shock is expected with probability one could be easily relaxed by introducing a probability of occurrence of the shock.

4 Concluding Remarks

Observers of the debt crisis have long suspected that large, heavily exposed banks arranging ‘jumbo’ syndicated loans in the early 1980’s were, in fact, not so optimistic about the creditworthiness of their customers, but instead, were trying to bail them out of difficulties that were at that time perceived to be temporary. In order to do so, without overly increasing their own exposure, these banks were selling participations to relative newcomers who were themselves eager to recycle petrodollars. Such behaviour was, however, never shown rigorously to be possible in a game theoretic model where all agents are rational and where the breakdown of common knowledge is kept to a minimum. This is what we set up to do in this paper.

The results help explain both the willingness of large banks to increase the flow of funds to countries such as Chile in the year immediately before the debt crisis, and their ability to mobilise the necessary funds. Cohen (1992) has shown, using a solvency index computable from readily available data, that Chile, although indebted, was in 1982, technically solvent. His analysis, vindicated by the comparatively high price that Chile’s debt has always fetched on the secondary market, suggests that Chile could be seen in 1981 as fitting our assumptions for the ‘bad country’: fundamentally solvent but illiquid. Although stable politically and richly endowed with natural resources and human capital, the country was in 1981, on the verge of a severe financial crisis, the peso being significantly overvalued. While careful observers of the country could certainly see clouds accumulating, the peculiar nature of the industry-finance links within Chilean conglomerates made it difficult for outsiders to figure exactly what was going on. The analysis of this paper suggests that a rational response in such a situation was for large and heavily exposed banks to try and enlist ‘semi-innocent’ outside investors for refinancing operations.¹³

Note that this type of behaviour has by no means disappeared. It is frequent in foreign lending to observe creditors in difficulty attempting to attract fresh money into a troubled venture by selling it to faraway investors under rosy colours. In fact, the analysis developed in this paper applies equally well to domestic lending, with

¹³As another illustration of the ‘pooling’ scenario, in June 1982 – two months before the Mexican default – the government of Venezuela rejected a jumbo loan offer of 2 billion US dollars assembled by a syndicate of twenty international banks. According to *Euromoney* (July 1982, p. 21), “the deadlock was a disappointing conclusion for *the bankers*” (italics ours). It is hard to believe that none of the large US banks pushing for the deal knew at that time that Venezuela’s economic performance was, in spite of the 1979 oil price hike, not so promising.

the possible limitation that information asymmetries sufficiently severe to drive it are more frequently encountered in foreign than in domestic lending.

Appendix

A rationale for syndication based on bankruptcy costs

This section establishes a simple rationale for syndicated lending. Let a bank have available capital $C = E + D$, where E stands for bank equity and D for bank debt. A bank is said to be bankrupt if its terminal value is less than its debt, in which case it incurs a fixed bankruptcy cost B .

Keeping the notation of the text, at t_1 , a bank faces K country-loan opportunities, whose returns X_k , $k = 1, \dots, K$, are i.i.d., the *ex ante* distribution at t_1 being the mixture $\Psi = qG_1 + (1 - q)F_1$. Letting as usual α_k be the bank's share in loan k , define a new random variable $x_k = \alpha_k X_k$ and denote by ψ^k the joint density of $x_1 \dots x_k$. The probability of bankruptcy is then

$$p(K) = \text{prob}\left(\sum_k x_k < D\right) = \int_0^D \int_0^{D-x_1} \dots \int_0^{D-(x_1+\dots+x_{K-1})} \psi^k(x_1, \dots, x_K) dx_1 \dots dx_k$$

But note that by the i.i.d. property, this can be written as

$$p(K) = \int_0^D \int_0^{D-x_1} \dots \int_0^{D-(x_1+\dots+x_{K-1})} \prod_{k=1}^K \psi(x_k) dx_k$$

where ψ is the marginal distribution of x_k . So

$$p(1) = \int_0^D \psi(x_k) dx_k \text{ and } p(2) = \int_0^D \int_0^{D-x_1} \psi(x_2)\psi(x_1) dx_2 dx_1 < p(1)$$

The argument can be generalized in a straightforward way to show that unless the returns on all loans are perfectly correlated, $p(k) < p(k-1) \forall k \in N$. It follows that since $p(k) > 0 \forall k$, p must be a convex function of k . Since B is fixed, this implies that the bank reduces its expected bankruptcy cost by diversifying over many loans.¹⁴ The effect of increased diversification is that probability mass around the mean value is increased by reducing the probability mass in the tails of the distribution. Thus, the decrease in probability of bankruptcy stems from the decrease in the variance of returns on the portfolio of investments.¹⁵ If the variance of the distribution of returns is denoted by V , the variance of the portfolio of the bank when it invests a fraction α_k in loan k , $k = 1, \dots, K$, is $V(K) = \alpha_1^2 V + \dots + \alpha_K^2 V$. Taking second partial derivative of $V(K)$ with respect to α_k , $\partial^2 V(K) / \partial \alpha_k^2 = 2V > 0$. Therefore, the variance is

¹⁴As $K \rightarrow \infty$, $p(K) \rightarrow 0$.

¹⁵This implies that for diversification to reduce expected bankruptcy cost, it must be true that $D < E(X)$.

a convex function of α_k . This also implies that the expected bankruptcy cost is a convex function of α , as $\partial h(\cdot)/\partial V = B\partial p(K)/\partial V > 0 \forall D < E(X)$, where $E(X)$ is the mean of the distribution.¹⁶

The above analysis thus shows that in the presence of nontrivial bankruptcy costs, a bank will invest its given capital over a diversified portfolio of loans that are not perfectly correlated as this will minimize the variance of its portfolio returns and hence reduce the expected bankruptcy cost by reducing the probability of bankruptcy. Thus, even if each bank has the necessary capital to finance one loan alone, it should rather form a syndicate to lend to all loans jointly, with each bank holding a fraction of each loan.

Proof of proposition 1

Let by $v^j, j = b, g$ the expected payoff of a type- j country taking a loan (L_2, R_2) :

$$v^b(R_2) = \int_{R_1+R_2}^{\infty} (X_2 - R_1 - R_2) dF_2 \quad (11)$$

and

$$v^g(R_2) = \int_{R_1+R_2}^{\infty} (X_1 + X_2 - R_1 - R_2) dG \quad (12)$$

As $X_1 = 0$ with certainty, the acceptance condition for a bad country is $v^b(R_2) \geq 0$ and is necessarily fulfilled. The acceptance condition for a good country is $\sigma^g(R_2) = 1$ if and only if $v^g(R_2) \geq \int_{R_1}^{\infty} (X_1 - R_1) dG_1$. We now show that there exists a finite value of R_2 , called R_2^g , such that $\sigma^g(R_2) = 1$ if and only if $R_2 \leq R_2^g$. Let $v_1^g = \int_{R_1}^{\infty} (X_1 - R_1) dG_1$, and let $R_2^g = \min\{R_2 \in R_+ : v^g(R_2) \leq v_1^g\}$. We establish the existence of R_2^g by showing that

$$\lim_{R_2 \rightarrow \infty} v^g(R_2) < v_1^g \quad (13)$$

$$v^g(0) > v_1^g \quad (14)$$

Let $X = X_1 + X_2$, and let $G(X)$ be its distribution. Using this notation,

$$v^g(R_2) = \int_{R_1+R_2}^{\infty} (X - R_1 - R_2) dG = \int_{R_1+R_2}^{\infty} X dG - (R_1 + R_2) \int_{R_1+R_2}^{\infty} dG$$

¹⁶This can be easily shown, for instance, in the case where returns are normally distributed.

We impose two regularity conditions on the distribution $G(X)$, namely that $\int_0^\infty X dG < \infty$ and $\lim_{X \rightarrow \infty} X^2 dG = 0$. Taking the limit of $v^g(R_2)$ as $R_2 \rightarrow \infty$,

$$\lim_{R_2 \rightarrow \infty} v^g(R_2) = \lim_{R_2 \rightarrow \infty} \int_{R_1+R_2}^\infty X dG - \lim_{R_2 \rightarrow \infty} (R_1 + R_2) \int_{R_1+R_2}^\infty dG$$

Under the first regularity condition, $\lim_{R_2 \rightarrow \infty} \int_{R_1+R_2}^\infty X dG = 0$; under the second, $0 \leq \lim_{R_2 \rightarrow \infty} (R_1 + R_2) \int_{R_1+R_2}^\infty dG < 1$. Together, these imply that $\lim_{R_2 \rightarrow \infty} v^g(R_2) \leq 0$, which establishes (13).

Evaluating $v^g(R_2)$ at $R_2 = 0$, $v^g(0) = \int_{R_1}^\infty X dG - R_1 \int_{R_1}^\infty dG$. Subtracting v_1^G from this gives

$$v^g(0) - v_1^g = \int_{R_1}^\infty X dF^G(X) - R_1 \int_{R_1}^\infty dG - \int_{R_1}^\infty X_1 dG_1 - R_1 \int_{R_1}^\infty dG_1$$

which can be written as

$$v^g(0) - v_1^g = \int_{R_1}^\infty X_2 dG_2 - \left[\int_0^{R_1} \left(\int_0^{R_1-X_1} X_2 dG_2 + (R_1 - X_1) \int_{R_1-X_1}^\infty dG_2 \right) dG_1 \right]$$

For any finite value of R_1 , the right-hand side of this equation is strictly positive; therefore $v^g(R_2)|_{R_2=0} > v_1^g$. This completes the proof. □

Proof of proposition 2

We first show a technical result:

LEMMA A1 (i) $E^{F_2} \pi^I(\alpha_1, R_1, \alpha_2, R_2)$ is a strictly concave function of α_2 . (ii) The function $R_2(q)$ is monotone decreasing on $[0, 1]$.

PROOF (i) Letting $P(\alpha_2)$ be the gross return to an insider bank with exposure to a bad country,

$$P' = \frac{R_2}{R_1 + R_2} \int_0^{R_1+R_2} X_2 dF_2 + R_2 \int_{R_1+R_2}^\infty dF_2 > 0$$

and $P'' = 0$, so that the gross return is linear and increasing in α_2 . The first section of the appendix established that under positive bankruptcy costs, the cost of funds is a strictly convex function of α_2 . The expected payoff function, being the difference between a linear and a strictly convex function, is itself a strictly concave function.

(ii) Recall that $R_2(q)$ is the value of R_2 such that $E^q \pi^O(\alpha^O, R_2) = 0$, i.e.

$$E^q \pi^O[\alpha, R_2(q)] = q E^G \pi^O[\alpha, R_2(q)] + (1 - q) E^{F_2} \pi^O[\alpha, R_2(q)] \equiv 0$$

. By the implicit-function theorem,

$$\frac{dR_2(q)}{dq} = - \frac{\partial E^q \pi^O(\alpha, R_2(q)) / \partial q}{\partial E^q \pi^O(\alpha, R_2(q)) / \partial R_2} \quad (15)$$

But $\partial E^q \pi^O[\alpha, R_2(q)] / \partial q = E^G \pi^O(\cdot) - E^{F_2} \pi^O(\cdot) > 0$ and $\partial E^q \pi^O[\alpha, R_2(q)] / \partial R_2 > 0$, it follows that $dR_2(q)/dq < 0$.

□

We can now prove the proposition.

PROOF OF PROPOSITION 2

It is clear by inspection that (2) - (3) are best response functions given beliefs μ . Therefore it must be shown that (4) is also a best response and that (1) defines rational beliefs. When $j = 1$, clearly $\sigma^I(j) \geq \tilde{\alpha}$ so $\mu = 1$, which implies that $R_2 = R_2(1)$. If $\tilde{\alpha} < \alpha[R_2(1)] = \arg \max_{\alpha} E^G \pi^I(\cdot)$, then the insider's best response is simply the unconstrained maximum of $E^G \pi^I(\cdot)$. If $\tilde{\alpha} > \alpha[R_2(1)]$, then we claim that the maximum of $E^G \pi^I(\cdot)$ is at $\tilde{\alpha}$. Suppose not. Note first that by lemma A1 (ii), any deviation from $\tilde{\alpha}$ must be downward. Then there exists a pair (α', R_2) with $\alpha' < \tilde{\alpha}$ such that $E^G \pi^I(\alpha_1, R_1, \alpha', R_2) > E^G \pi^I[\alpha_1, R_1, \tilde{\alpha}, R_2(1)]$. But if $\alpha' < \tilde{\alpha}$, then by (1) $\mu(\alpha', R_2) = 0 \forall R_2$ so $\sigma^O(\alpha', R_2) = 0$ which implies that either $\alpha' = 0$ or $\alpha' = 1/n$. By lemma A1 (i), $\alpha = 1/n$ cannot be optimal, so it must be that $\alpha' = 0$. But then expected profits are given by $E_1^G \pi^I(\alpha_1, R_1, 0, 0) = \alpha_1 \int_0^{R_1} X_1 dF_1 + \alpha_1 R_1 [1 - F(R_1)]$, which is necessarily less than $E^G \pi^I[\alpha_1, R_1, \tilde{\alpha}, R_2(1)]$, a contradiction. When $j = 0$, in equilibrium, no outsider lends so $\sigma^I(0) \in \{0, 1/n\}$. But $\alpha_2 = 1/n$ cannot be optimal since $E^{F_2} \pi^I[\alpha_1, R_1, \tilde{\alpha}, R_2(0)] \leq E^{F_2} \pi^I[\alpha_1, R_1, 0, 0]$ by hypothesis and $E^{F_2} \pi^I(\cdot)$ is monotone decreasing in α on $(0, 1/n]$. Finally on the equilibrium path, $\sigma^I(1) \geq \tilde{\alpha}$ and $\sigma^I(0) = 0$. Therefore (1) defines rational beliefs for $A = [\tilde{\alpha}, 1]$.

□

Proof of proposition 3

Equations (8)-(9) are again best response functions by construction given beliefs μ . So consider $\sigma^I(j)$ when $j = 1$. The insider bank's payoff on the equilibrium path

is $E^G \pi^I[\alpha[R_2(q)], R_2(q)]$. Since $E\pi^I(\cdot)$ is a continuous and concave function of α on $(0, \tilde{\alpha})$ and is maximized at $\sigma^I(1)$, no deviation is optimal except possibly at $\tilde{\alpha}$ where the insider bank's payoff function is discontinuous. The deviating bank's maximum payoff is then $E^G \pi^I[\tilde{\alpha}, R_2(1)]$. But $R_2(1) < R_2(q)$ by lemma A1 (ii), and $E^G \pi^I[\alpha, R_2]$ is monotone increasing in R_2 on R_+ . So

$$E^G \pi^I[\alpha_1, R_1, \alpha[R_2(q)], R_2(q)] \geq E^G \pi^I[\alpha_1, R_1, \tilde{\alpha}, R_2(q)] > E^G \pi^I[\alpha_1, R_1, \tilde{\alpha}, R_2(1)]$$

which establishes that no deviation is optimal when $j = 1$. Consider now $\sigma^I(j)$ for $j = 0$. The equilibrium payoff is $E^{F_2} \pi^I[\alpha[R_2(q)], R_2(q)]$. By lemma 2 (i), $E^{F_2} \pi^I(\alpha_2, R_2)$ is monotone decreasing in α_2 ; so any deviation must be by way of a lower α_2 . But any $\alpha_2 < \alpha[R_2(q)]$ implies that $\mu = 0$, so that $\sigma^O(\alpha_2, R_2) = 0$; in turn this implies either that $\alpha_2 = 1/n$, which clearly cannot be optimal, or that $\alpha_2 = 0$. But by hypothesis $E^{F_2} \pi^I[\alpha[R_2(q)], R_2(q)] \geq 0$, so a deviation to $\alpha_2 = 0$ cannot be optimal. Finally on the equilibrium path $\sigma^I(1) = \sigma^I(0) = \alpha[R_2(q)]$, so (7) defines rational beliefs for $A = [\tilde{\alpha}, 1]$.

□

Proof of corollary 1

If $\tilde{\alpha}_b < \tilde{\alpha}_g$, any $\alpha_2 \in [\tilde{\alpha}_b, \tilde{\alpha}_g]$ can only be taken when $s = 1$ (i.e. only by an insider with good exposure); hence, any such α_2 can possibly signal the type. However, when $\tilde{\alpha} \in [\tilde{\alpha}_b, \tilde{\alpha}_g]$, from Proposition 2, for $s = 1$, any $\alpha_2 < \tilde{\alpha}$ will imply $\sigma^O(\alpha_2, R_2) = 0$ because $\mu(\alpha_2, R_2) = 0$ and we know that $E^\mu \pi^O[\beta[R_2(\mu = 0)]] < 0$. Therefore, for $s = 1$, $\sigma^I(s) = \max \{ \tilde{\alpha}, \alpha[R_2(1)] \}$. Thus, there will be a separating PBE described by (1) - (4). On the other hand, with $\tilde{\alpha}_b < \tilde{\alpha}_g$, when the condition of Proposition 3 is satisfied, and when beliefs are described by (7), though good insiders can afford to separate by choosing $\alpha_2 \in [\tilde{\alpha}, \tilde{\alpha}_g]$, they will prefer not to, because

$$E^G \pi^I[\alpha_1, R_1, \alpha^I[R_2(q)], R_2(q)] \geq E^G \pi^I[\alpha_1, R_1, \tilde{\alpha}, R_2(q)] > E^G \pi^I[\alpha_1, R_1, \tilde{\alpha}, R_2(1)]$$

For $s = 0$, we know (from Proposition 3) that

$$E^{F_2} \pi^I[\alpha_1, R_1; \alpha[R_2(q)], R_2(q)] \geq E^{F_2} \pi^I[\alpha_1, R_1, 0, 0]$$

Further, $\sigma^O(\alpha_2, R_2(q)) = \beta[R_2(q)]$ since $E^q \pi^O(\beta[R_2(q), R_2(q)]) \geq 0$. Hence, we have a pooling PBE described by (7) - (10).

When $\tilde{\alpha}_b > \tilde{\alpha}_g$, beliefs described by (1) cannot be rational because the subinterval A is empty, as any α_g can be successfully mimicked by α_b . Obviously, insiders with bad exposure will never reveal their type by choosing $\alpha_b \in [\tilde{\alpha}_g, \tilde{\alpha}_b]$, because $\sigma^O(\alpha_b, R_2(\mu = 0)) = 0$. Hence, no separating PBE is possible. However, if conditions of Proposition 3 are satisfied, following the arguments made above, there will be a pooling PBE described by (7) – (10).

□

Proof of corollary 2

It suffices to note that when the only equilibrium of the game played at t_2 is pooling, the lending condition for banks at t_1 is

$$qE^G\pi^I[\alpha_1, R_1, \alpha[R_2(q)], R_2(q)] + (1 - q)E^{F_2}\pi^I[\alpha_1, R_1, \alpha[R_2(q)], R_2(q)] \geq 0$$

and the acceptance condition for countries at t_1 is

$$qv^g(R_1, R_2(q)) + (1 - q)v^b(R_1, R_2(q)) \geq 0$$

and the result follows immediately.

□

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