

# Reputation, Renegotiation, and the Choice between Bank Loans and Publicly Traded Debt

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*We model firms' choice between bank loans and publicly traded debt, allowing for debt renegotiation in the event of financial distress. Entrepreneurs, with private information about their probability of financial distress, borrow from banks (multiperiod players) or issue bonds to implement projects. If a firm is in financial distress, lenders devote a certain amount of resources (unobservable to entrepreneurs) to evaluate whether to liquidate the firm or to renegotiate its debt. We demonstrate that banks' desire to acquire a reputation for making the "right" renegotiation versus liquidation decision provides them an endogenous incentive to devote a larger amount of resources than bondholders toward such evaluations. In equilibrium, bank loans dominate bonds from the point of view of minimising inefficient liquidation; however, firms with a lower probability of financial distress choose bonds over bank loans.*

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Recent theories of financial intermediation have focused on the role of banks as information producers [see, e.g., Leland and Pyle (1977) and Diamond (1984)]. The argument is that banks have an advantage over other lenders in producing information about borrowers. There is, however, less agreement on the source of this special monitoring ability of banks. One theory is that there is something intrinsic about the intermediation process that gives banks an advantage in monitoring;<sup>1</sup> another argument is that banks' advantage in monitoring arises because they provide transaction and other intermediary services to their borrowers, thus obtaining access to information not available to other lenders.<sup>2</sup> Related arguments focus on the ability of banks to learn more about borrowers from having a long-term lending relationship with them.<sup>3</sup>

Information production by lenders is particularly relevant when there is a significant possibility that the borrowing firm may be in financial distress. Lenders' evaluation of the firm's future prospects may affect their decisions about whether to renegotiate the debt of a firm in financial distress (and perhaps provide some additional funding to help it over its financial difficulties) or to declare the firm in default and force it into bankruptcy (which may lead to the liquidation of the firm). In this article, we argue that an important reason why banks' treatment of borrowing firms in financial distress may be fundamentally different from that of holders of publicly traded debt is that banks are long-term players in the debt market and therefore have a desire to develop a reputation for financial flexibility.<sup>4</sup> We develop a model in which the ability to acquire a reputation provides banks with an endogenous incentive to devote a larger amount of resources to information production about firms in financial distress

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<sup>1</sup> For example, Diamond (1984) argued that diversification within an intermediary can reduce the cost of providing incentives for delegated monitoring by the intermediary. The literature on financial intermediaries as "delegated monitors" who reduce inefficiencies in the production and transmission of information includes Campbell and Kracaw (1980), Chan (1983), Ramakrishnan and Thakor (1984), Boyd and Prescott (1986), Allen (1990), and Williamson (1986).

<sup>2</sup> Fama (1985) drew a distinction between "inside" and "outside" debt. He argued that bank loans are inside debt, which he defined as a contract where the debtholder gets access to information that is not publicly available; in contrast, outside debt is defined as publicly traded debt (e.g., bonds) where the debtholder relies on publicly available information.

<sup>3</sup> See, e.g., Sharpe (1990)

<sup>4</sup> There is considerable anecdotal and other evidence to indicate that banks tend to be more understanding toward firms in financial difficulties compared to other debtholders [see, e.g., Gilson, John, and Lang (1990) and Hoshi, Kashyap, and Scharfstein (1990)]. The capital market also seems to ascribe significant information content to banks' behavior toward firms in financial difficulties. For instance, a recent article by Lummer and McConnell (1989) documented that announcements of favorable loan renewals are accompanied by positive stock price reactions (with the strongest positive stock-price responses associated with announcements of loan restructurings that allow the borrower to avoid technical default); loan cancellations or reductions are accompanied by stock price declines.

compared to bondholders, whose decisions are based only on considerations related to a specific situation.

The intuition behind our model is that, just as lenders look for sound borrowers, borrowers look for sound lenders: borrowers ask themselves whether lenders will be helpful in hard times. In our model, an entrepreneur has to choose between a bank loan or publicly traded debt to finance his projects. The entrepreneur has private information about the chance of his firm being in financial distress. If a firm is in financial distress, it may reflect, in some cases, the poor quality of its projects; in other cases, it may be due to reasons unrelated to project quality. In the former case the right course is for lenders to liquidate the firm; however, in the latter case it may be optimal for all parties to allow the firm to continue under a debt renegotiation arrangement, since the continuation value of the firm may be greater than its liquidation value. We assume that lenders are unable to distinguish between the two kinds of situations without devoting additional resources to evaluate firms in financial distress; further, the accuracy of lenders' evaluations and, consequently, their ability to make the right renegotiation versus liquidation decision depends on the amount of resources they devote to this purpose.

In the above setting, the ability of banks to acquire a reputation for making the "right" renegotiation versus liquidation decision becomes significant, since it allows them to commit to devote additional resources to evaluating firms in financial distress. We show that, in equilibrium, entrepreneurs who assess a relatively high probability of being in financial distress find it optimal to use bank loans, despite the fact that banks charge a higher interest rate in equilibrium compared to publicly traded debt; those with a lower probability of being in financial distress, however, issue publicly traded debt to take advantage of the lower equilibrium yield on such debt. Further, borrowers are willing to pay higher interest rates for loans from banks with greater reputations for flexibility in dealing with firms in financial distress.

An important aspect of our model is that, even though banks dominate publicly traded debt in terms of their treatment of borrowers in financial distress, some firms still prefer to use publicly traded debt. Since these firms assess a lower probability of being in financial distress, they assign less value than riskier firms to the fact that, compared to bondholders, banks are less likely to make inefficient liquidation decisions. Such firms therefore issue publicly traded debt so as not to pool with riskier firms, thereby borrowing at lower equilibrium interest rates than would be possible if they were to choose bank loans.

Several recent articles have addressed the choice between bank

loans and publicly traded debt. Diamond (1991) developed a model where the focus is on reputation acquisition by *borrowers*.<sup>5</sup> Firms build reputation by taking on costly bank-monitored debt; those that acquire good reputations then switch to publicly traded debt to save monitoring costs. Although our article shares with Diamond (1991) the general notion of reputation as an incentive device, the ideas driving the two articles are quite different. In Diamond's article, the "specialness" of banks arises from the assumption that banks are able to monitor borrowers, while bondholders are unable to do so. In that context, the fear of losing reputation acts as a punishment device that deters firms that borrow in the bond market from engaging in value-reducing actions. In contrast, our article models reputation acquisition by *banks*: in our setting, it is the ability to acquire a reputation that distinguishes banks from bondholders. Here, reputation acts as a commitment device enabling banks to credibly promise borrowers that they will make better renegotiation versus liquidation decisions (compared to bondholders) in the event that the borrowing firm is in financial distress. Thus, in our model, reputation acquisition provides incentives even for a bank without any superiority in its evaluation technology to make a lower proportion of incorrect renegotiation versus liquidation decisions compared to bondholders.<sup>6</sup>

Berlin and Loeys (1988) studied a model in which the choice between bank loans and bonds is driven by the trade-off between the losses from inefficient liquidation under bond contracts and the agency costs of delegated monitoring by banks. However, they made the assumption that bondholders do not find it worthwhile to monitor.<sup>7</sup> Rajan (1992) also studied the choice between bank debt and "arms-length" debt. He assumed that banks obtain access to "inside" information, while bondholders are assumed not to monitor due to high costs. The choice between inside (bank) and arms-length debt is

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<sup>5</sup> Other articles that model reputation acquisition by borrowers (though in somewhat different settings) are Diamond (1989), John and Nachman (1985), and Spatt (1983).

<sup>6</sup> The technology we have adopted to model reputation acquisition is the finite-horizon approach [along the lines of Kreps and Wilson (1982)], and we therefore need to assume the existence of a small proportion of banks with a cost advantage in evaluating firms compared to bondholders. This is, however, only a modeling device: in equilibrium, the desire to acquire a reputation motivates even banks *without* any such cost advantage to devote more resources toward evaluating firms in financial distress (and, consequently, to make more accurate evaluations of such firms) compared to bondholders. Further, the assumption of a certain proportion of banks with a cost advantage in evaluating firms is not crucial for the intuition behind our model to go through: the model can be implemented even without this assumption by adopting the infinite-horizon approach [see, e.g., Allen (1984)] to generate reputation acquisition. Unfortunately, because of the rich strategy space in our setting, using the infinite-horizon approach would make our model extremely cumbersome; therefore, for tractability, we have chosen to adopt the finite-horizon approach here.

<sup>7</sup> Nakamura (1989) argued that banks can use information garnered from checking accounts to declare a borrower in default and thus prematurely intervene in the form of a loan "workout" in the business plans of a borrower if the probability of default becomes high. A related model is that of Berlin (1990), who argued that bank debt reduces agency costs, since, by assumption, bond contracts do not permit the same flexibility as bank loans.

driven by the trade-off between the costs and benefits to the firm arising from the informational advantage of the bank with respect to other lenders. In contrast to the above articles, we do not assume that banks can access information unavailable to bondholders; nor do we assume that bondholders face prohibitively high monitoring costs. In our model it is the banks' longer horizon and the associated desire to acquire a reputation for making the right negotiation versus liquidation decision that results in their devoting more resources to evaluating firms compared to bondholders, with consequences for the entrepreneurs' choice between bank loans and publicly traded debt.<sup>8</sup>

The rest of the article is organized as follows. In Section 1, we describe the basic structure of the model. In Section 2, we derive the equilibrium with reputation acquisition and study its properties. In Section 3, we summarize the empirical implications of the model. We conclude in Section 4. The proofs of all propositions are confined to the Appendix.

## 1. The Model

The model has two dates (time 0 and time 1). At time 0, entrepreneurs enter the debt market. Each entrepreneur (firm) has a single project, which requires an investment of one dollar (a normalization). They can raise this amount by selling publicly traded debt (bonds) to ordinary investors or borrow the amount from a bank.<sup>9</sup> Firms (projects) are of two kinds: "risky" and "safe." Each firm may be in financial distress with some probability; risky firms are those with a greater chance of being in financial distress. In the event of financial distress, lenders (be it banks or bondholders) may devote additional resources to learn whether the borrowing firm should be allowed to continue operation under a renegotiated debt contract or should be liquidated. The crucial difference between banks and bondholders in this context is the following: While banks are multiperiod players (i.e., each bank makes loans at both time 0 and time 1), holders of publicly traded debt are single-period players. This means that, unlike bondholders, banks may develop a reputation for making the "right" renegotiation versus liquidation decision when confronted with firms in financial

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<sup>8</sup> We will not focus here on issues related to the mechanics of debt contract renegotiation or its incentive (and efficiency improving) effects in environments characterized by incomplete contracting or asymmetric information. These important issues have been addressed by a voluminous literature [see, e.g., Hart and Moore (1989), Huberman and Kahn (1988, 1989), Giammarino (1989), and Gertner and Scharfstein (1991)].

<sup>9</sup> To keep the model simple, we will assume that the entrepreneur's choice is between issuing publicly traded debt and borrowing from a given bank; we will not explicitly model the choice of entrepreneurs across banks. However, generalizing the model in this direction is relatively straightforward.

distress. Our objective here is to develop the simplest model that will allow us to examine the effect of such reputation acquisition by banks on their behavior toward firms in financial distress and characterize the resulting effect on the debt market.

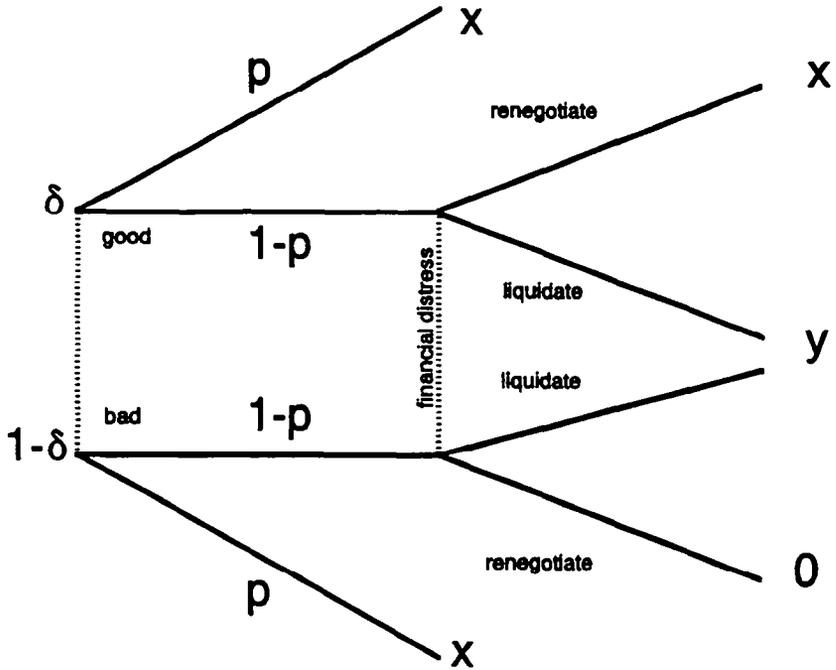
We model the distinction between safe and risky firms as follows. Each firm (project) pays an amount  $x > 1$ , with probability  $p$  (the "the success probability" from now on); the firm may be in "financial distress" with the complementary probability,  $(1 - p)$ . The probability  $p$  can take on one of two values:  $p = p_s$  for safe ("type  $S$ ") firms, while  $p = p_u$  for risky ("type  $U$ ") firms. Since safe firms have a lower probability of financial distress (i.e., a greater success probability),  $0 < p_u < p_s$ . The success probability of a given firm is information private to the entrepreneur; lenders know only the proportion  $f$  of type  $S$  firms in the economy. We use  $p$  to denote the average success probability [given by  $\phi p_s + (1 - \phi)p_u$ ] across type  $S$  and type  $U$  firms.

We model the notion of financial distress as follows. If a firm is in financial distress, it is unable to repay the loan to the lender at the promised time. Lenders (both banks and bondholders) may then choose either to allow the firm to continue functioning under a renegotiated debt contract or to liquidate the firm. Firms may be in financial distress because of one of two possible reasons: Some firms may have intrinsically good projects but may nevertheless be in financial distress due to temporary difficulties, which they will overcome given some time and financial slack ("good" firms,  $f = g$ ); however, other firms may have intrinsically bad projects and should therefore be terminated as soon as possible to minimize further loss in value ("bad" firms,  $f = b$ ). Thus, we assume that good firms yield a cash flow of  $x$  if allowed to continue operation under a debt renegotiation arrangement; bad firms yield zero cash flows if allowed to continue.<sup>10</sup> Entrepreneurs do not have any private information about the payoff from their firm after debt renegotiation; neither do lenders. However, both entrepreneurs and lenders observe the proportion  $\delta$  of good firms in the economy, which is their prior probability assessment of a firm in financial distress yielding a payoff of  $x$  if allowed to continue. Either kind of firm yields a cash flow of  $y$ ,  $y < 1$ , if liquidated (Figure 1).

If a firm is not in financial distress, the entrepreneur repays the loan and interest in full. We will denote by  $R^T$  or  $R^B$  the respective gross interest rates charged for publicly traded debt and for bank loans; since the original investment amount is one dollar, these represent the repayment amounts as well. (Throughout this article, we will use

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<sup>10</sup> We thus assume that the payoff from a good firm in financial distress, if allowed to continue under a debt renegotiation agreement, is the same as that from a firm that is not in financial distress in the first place; assuming that these payoffs are different will only add complication to the model without changing results significantly.



**Figure 1**  
**Uncertainty structure and project payoff**

Each firm (project) yields a cash flow of  $x$  with probability,  $p, p \in (p_l, p_h)$ ; the firm will be in financial distress with the probability  $(1 - p)$ . The probability  $p$  of a given firm is information private to the entrepreneur (firm insiders). Of the firms in financial distress, a fraction  $\delta$  are “good” (i.e., they will yield the cash flow  $x$  if allowed to continue under a debt renegotiation arrangement). The remaining fraction  $(1 - \delta)$  are “bad,” yielding only zero cash flow if allowed to continue. The liquidation value of any firm is  $y$ .

the superscript  $T$  to denote variables associated with publicly traded debt and  $B$  for those associated with the bank.) If, on the other hand, the firm is in financial distress and its debt contract is renegotiated, the lenders receive a fraction  $k$  of the payoff  $x$  from the project (if realized),  $k \in (0, 1)$ . We can think of this fraction  $k$  as being the outcome of bargaining (exogenous to the model) between lenders and borrowers.<sup>11</sup>

If a borrowing firm is in financial distress, lenders can obtain additional information before deciding whether to renegotiate its debt or to liquidate the firm. They may do so by conducting a (noisy) evaluation ( $e$ ) of the firm, which has one of two possible outcomes:

<sup>11</sup> We do not model the bargaining between lenders and borrowers, since this is not the focus of this article; our results do not depend crucially on the specific value of  $k$ . The underlying assumption here is that the entrepreneur’s effort (or cooperation) is required to obtain the output  $x$  after debt renegotiation, and he therefore needs to be motivated by a share  $(1 - k)$  of the output.

“good” ( $e = e_G$ ) or “bad” ( $e = e_B$ ). Evaluating a firm consumes an amount of resources  $c$ . The evaluation technology available to lenders is characterized by

$$\text{Prob}(e = e_G | f = g) = q(c), \quad \text{Prob}(e = e_G | f = b) = 0; \\ q \in [0, q], \quad 0 < \bar{q} < 1. \tag{1}$$

We assume that the function  $q(c)$  is such that  $q(0) = 0$ ,  $q_c \geq 0$ ,  $q_{cc} < 0$ , and  $q_c(c = 0) = \infty$ . Thus, the probability of obtaining a good evaluation for a truly good firm increases (at a decreasing rate) with the amount of resources spent by lenders in evaluating it.<sup>12</sup> Further, there is a certain maximum amount of resources  $\bar{c}$  to be devoted to evaluating firms, beyond which the precision of the evaluation cannot be improved: that is,  $q(c = \bar{c}) = \bar{q}$ . We assume that  $c$ , the amount of resources devoted by banks to evaluate firms in financial distress, is unobservable to entrepreneurs.

We assume that the model parameters satisfy the restriction,  $kx > y > \delta x$ . This allows us to capture several real-world features in our model. First, it implies that lenders will always renegotiate the debt of a firm in financial distress if it is known to be good with probability 1. Second, it implies (along with the assumptions on the lenders’ evaluation technology) that it is always optimal for lenders to liquidate a firm if no resources are devoted to evaluating it (i.e., if they make the renegotiation versus liquidation decision based only on their prior probabilities). Finally, it implies that it is optimal for lenders to liquidate a firm with a bad evaluation ( $e = e_B$ ), while allowing one with a good evaluation ( $e = e_G$ ) to continue operation.<sup>13</sup>

At time 1, a new set of entrepreneurs enter the debt market, and the lending-renegotiation game is repeated. Before loan contracting at time 1, the outcome of the time 0 game (i.e., banks’ renegotiation/liquidation decision, as well as the true type of all firms to which loans were made) becomes known. As discussed before, banks are long-term players in the debt market and can therefore acquire a reputation for making the “right” renegotiation/liquidation decision based on their actions at time 0, which affect their payoffs at time 1. To model such reputation acquisition by banks, we assume that, while most banks and holders of publicly traded debt need to expend resources to evaluate firms according to Equation (1), there is a small

<sup>12</sup> Additional resources may be consumed (for instance) in devoting more of the bank’s analysts’ time to the firm being evaluated or may go toward hiring and using more qualified analysts to better assess the borrowing firm’s prospects.

<sup>13</sup> To see this last point, notice that

$$\text{Prob}(f = g | e = e_B) = \frac{[1 - q(c)]\delta}{[1 - q(c)]\delta + (1 - \delta)} < \delta, \quad \text{Prob}(f = g | e = e_G) = 1.$$

**Table 1**  
**The sequence of events**

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At time 0

1. Banks choose the interest rate at which to lend to entrepreneurs.
2. After the interest rate chosen by the bank is publicly observed, the interest rate in the bond market is competitively determined.
3. Entrepreneurs decide whether to borrow from the bank or to issue publicly traded debt.
4. Project cash flows are realized if the firm is not in financial distress, and the lenders are repaid in full with interest.
5. If the firm is in financial distress, lenders decide on the amount of resources to be devoted to evaluate the firm. Based on the evaluation, the firm is either liquidated or allowed to continue under a renegotiated debt contract.
6. Final project cash flows are realized, and the true types of all borrowing firms become known.

At time 1

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  5. If the firm is in financial distress, lenders decide on the amount of resources to be devoted to evaluate the firm. Based on the evaluation, the firm is either liquidated or allowed to continue under a renegotiated debt contract.
  6. Final project cash flows are realized.
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proportion of banks that can evaluate firms costlessly. We will refer to such banks as “low-cost” banks ( $B = L$ ) and to all other banks as “high-cost” banks ( $B = H$ ). Banks know their own type; however, entrepreneurs observe only the probability  $a_t$  ( $t = 0, 1$ ) that a given bank is a low-cost bank.<sup>14</sup> At time 0, entrepreneurs set this probability ( $a_0$ ) equal to their prior probability assessment of the bank being a low-cost bank.<sup>15</sup> At time 1, they make use of the additional information they obtain about the bank’s treatment of time 0 borrowers in financial distress (if any) to revise this prior probability. Since low-cost banks always adopt the most accurate evaluation technology possible ( $q = \bar{q}$ ), they tend to make the right renegotiation versus liquidation decision more often than high-cost banks (in equilibrium, high-cost banks always set  $q < \bar{q}$ ). Entrepreneurs’ probability assessment  $a_t$  of a bank being of the low-cost type is therefore a measure of its “reputation” for making the right decision when dealing with borrowers in financial distress.

We assume that entrepreneurs, banks, and bondholders are all risk neutral. Further, the riskless rate of interest is 0, which we assume to be the cost of funds to the bank. We also assume that each bank

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<sup>14</sup> Note that, while we simplify the analysis by making the assumption that low-cost banks’ evaluation costs are zero, our results go through in a modified form as long as their costs are lower than that of high-cost banks.

<sup>15</sup> They may compute this prior probability assessment based on various observable features of the bank.

can make only one loan at each date and has access to a large enough pool of entrepreneurs that it can always find a borrower at each date. The sequence of events is as follows. Banks offer loans to entrepreneurs at a certain interest rate, after which the interest rate in the bond market is competitively determined. Entrepreneurs now make the choice between bank loans and publicly traded debt. Project cash flows are then realized if the firm is not in financial distress, and the lenders are repaid with interest. If, on the other hand, the firm is in financial distress, the lenders decide on the amount of resources to be devoted to evaluate the firm. Based on the evaluation, the firm is either liquidated or allowed to continue under a debt renegotiation arrangement. Final cash flows are then realized, after which the true types of all borrowing firms become known. The lending-renegotiation game is repeated at time 1. The sequence of events is depicted in Table 1 (note that each date in our model encompasses a sequence of moves, in the order specified).

We now discuss how the interest rates on publicly traded debt and on bank loans are determined and also the choice by bondholders as well as banks of the amount of resources to be devoted to evaluate firms in financial distress.

### 1.1 The publicly traded debt contract

At each time  $t(t = 0, 1)$ , bondholders choose an interest rate and a level of resources to be devoted to evaluate a borrowing firm in the event of financial distress. They work backward in the spirit of dynamic programming, first determining their strategy in the event of financial distress before arriving at the interest rate to be charged at each date. Let  $\pi_{id}^t$  denote the expected profit of bondholders at time  $t$ , given that the borrowing firm is in financial distress and that bondholders devote an amount of resources  $c_i^t$  to evaluate whether the firm should be allowed to continue under a renegotiation arrangement.

$$\begin{aligned} \pi_{id}^t &= kx \text{Prob}(f = g | e = e_G) \text{Prob}(e = e_G) + y \text{Prob}(e = e_B) - c_i^t \\ &= y + \delta(kx - y)q_i^t(c_i^t) - c_i^t. \end{aligned} \quad (2)$$

Given financial distress, the amount of resources expended by bondholders to evaluate the firm for renegotiation, and the corresponding renegotiation probability  $q_i^t$ , will be such as to maximize  $\pi_{id}^t$ . Denote this level of resources spent on evaluating firms for renegotiation by  $c_i^{t*}$ , the corresponding value of  $q_i^t$  by  $q_i^{t*}$ , and the corresponding expected profit level by  $\pi_{id}^{t*}$ . As long as the expected profit from allowing a firm to continue is positive,  $\pi_{id}^t > 0$ , and [given the assumptions made on the  $q(c)$  function]  $c_i^{t*} > 0$  (i.e., bondholders spend a positive amount of resources to evaluate firms in financial distress). However, since  $k < 1$ , it can be shown that  $c_i^{t*}$

will always be less than the social optimum (the socially optimal value of  $c_t^T$  maximizes the expected payoff from the borrowing firm in financial distress, net of the evaluation cost).

We now characterize the determination of the interest rate on publicly traded debt in equilibrium as a function of the equilibrium beliefs of bondholders about the pool of entrepreneurs issuing publicly traded debt. Denote by  $p_t^T$  the bondholders' inference, given equilibrium beliefs, about the success probability of an entrepreneur issuing publicly traded debt at time  $t$ . Further, let  $R_t^T$  denote the gross interest rate charged on publicly traded debt issued at this date. The expected profit of bondholders at time  $t$  is then given by

$$\Pi_t^T = p_t^T R_t^T + (1 - p_t^T) \pi_{ID}^* - 1. \quad (3)$$

We assume that debt is competitively priced in the bond market, so that the equilibrium interest rate charged at time  $t$  is the lowest one for which  $\Pi_t^T$  is nonnegative.

### 1.2 The bank loan contract

Banks are two-period players in the debt market. Their treatment of borrowers at time 0 becomes common knowledge before loans are made at time 1. This information, which we will capture using the state variable  $s$ ,  $s \in \{n, r, g, b\}$ , affects banks' time 1 reputation (denoted by  $a$ ;) and, through it, their time 1 expected payoff. If the firm that borrowed from the bank at time 0 is not in financial distress, there is no informational event to judge the bank's behavior ( $s = n$ ), so that there is no change in the bank's reputation at time 1 (i.e.,  $\alpha_1^n = \alpha_0$ ). On the other hand, if a time 0 borrower is in financial distress, there are three possibilities: the bank (after suitable evaluation) may renegotiate the loan ( $s = r$ ) or it may liquidate the firm, after which it may turn out to have been a truly good firm ( $s = g$ ) or a bad one ( $s = b$ ). The bank's renegotiation/liquidation decision if a time 0 borrower is in financial distress conveys (noisy) information about whether it is a high-cost or a low-cost bank; entrepreneurs entering the debt market at time 1 use this information to compute the bank's time 1 reputation  $a$ ;, using Bayes's rule:

$$\alpha_1^r = \frac{\bar{q}}{\alpha_0 \bar{q} + (1 - \alpha_0) q_0^H} \alpha_0; \quad (4)$$

$$\alpha_1^g = \frac{(1 - \bar{q})[(1 - \delta) + \delta(1 - q_0^H)]}{(1 - \delta)[1 - (\alpha_0 \bar{q} + (1 - \alpha_0) q_0^H)] + \delta(1 - \bar{q})(1 - q_0^H)} \alpha_0; \quad (5)$$

$$\alpha_1^b = \frac{(1 - \delta) + \delta(1 - q_0^H)}{(1 - \delta) + \delta[1 - (\alpha_0 q_0^H + (1 - \alpha_0) \bar{q})]} \alpha_0. \quad (6)$$

The high-cost bank knows that the higher the value of  $q$  chosen at time 0 (denoted by  $q_0^H$ ), the higher the probability of making the right renegotiation/liquidation decision at time 0. But this requires expending a larger amount of resources  $c_0^H$ , and in equilibrium, the high-cost bank always sets  $q < \bar{q}$ . The low-cost bank, however, chooses the most accurate evaluation technology possible,  $q_0^L = \bar{q}$  [this choice of the low-cost bank is incorporated in Equations (4), (5), and (6)]. Because of this difference in the equilibrium behavior of the two types, a bank's time 1 reputation with entrepreneurs goes up if it is revealed that it has made the right renegotiation/liquidation decision at time 0 and goes down if it has taken the wrong decision. Thus, it is easy to verify that a bank's reputation goes up in equilibrium if it renegotiates the debt of a firm in financial distress ( $\alpha_1^r > \alpha_0$ ) or if a firm it liquidated turns out to be a truly bad firm ( $\alpha_1^b > \alpha_0$ ); its reputation goes down if a firm it liquidated turns out to be a good firm ( $\alpha_1^g < \alpha_0$ ).<sup>16</sup>

We now discuss how each type of bank chooses its strategies in an equilibrium where both types of banks pool by setting the same interest rate. First consider time 1. As in the case of publicly traded debt, we will work backward, initially computing the bank's equilibrium behavior for the case where the borrowing firm is in financial distress. The expected time 1 profit,  $\pi_{1D}^B$  of each type of bank from renegotiating the debt of a firm in financial distress is given by

$$\pi_{1D}^B = y + \delta(kx - y)q_1^B(c_1^B) - c_1^B, \quad \text{for } B \in \{H, L\}. \quad (7)$$

Since there are no reputation effects to consider at time 1, the high-cost bank's equilibrium choice of resources spent on evaluating firms,  $c_1^{H*}$ , maximizes  $\pi_{1D}^H$ . Denote the corresponding value of  $q$  by  $q_1^{H*}$  and the corresponding expected profit from renegotiation by  $\pi_{1D}^{H*}$ . As in the case of publicly traded debt,  $c_1^{r*} > 0$ , as long as  $\pi_{1D}^H > 0$ . The low-cost bank, on the other hand, maximizes  $\pi_{1D}^L$  by setting  $q_1^{L*} = \bar{q}$  (recall that  $c_1^L = 0$ ) and obtains expected profits  $\pi_{1D}^{L*}$ .

Let us now consider the time 1 choice of interest rate by banks. Denote by  $p_1^B$ ,  $B \in \{H, L\}$ , the bank's equilibrium inference at time 1 about the success probability of the entrepreneur approaching it for

<sup>16</sup> It is possible that, in practice, potential borrowers obtain significantly more information ex post about the true value of a firm that has been allowed to continue operation relative to that of a firm that has been liquidated by the bank. Further, real-world evaluation technologies may be prone to two-sided errors (i.e., some bad firms may also be mistakenly allowed to continue under a renegotiation arrangement). Thus, an alternative modeling approach would be to allow banks to make two-sided errors in evaluating firms but to assume that the true types of firms that are liquidated prematurely are never revealed. We choose not to adopt this latter approach, since it adds considerable complication to the model without significantly affecting results. The essential requirement that drives our results is that some information about the correctness or otherwise of the banks renegotiation versus liquidation decision becomes available to entrepreneurs before the next round of lending takes place; the information structure adopted here models this in the simplest possible manner.

a loan. The expected time 1 profit of a bank with reputation  $\alpha_i^B$  is then given by

$$\Pi_1^B(\alpha_i^B) = (1 - p_i^B)\pi_{1D}^{B*} + p_i^B R_1^B(\alpha_i^B) - 1, \quad \text{for } B \in \{H, L\}. \quad (8)$$

The interest rate set in equilibrium by each type of bank at time 1 maximizes Equation (8) (which clearly depends on the bank's time 1 reputation), taking as given the equilibrium time 1 strategies of entrepreneurs. In other words, the highest interest rate that can be set by the bank in equilibrium is constrained by the fact that each entrepreneur has the alternative of financing his project by issuing publicly traded debt (we will discuss the entrepreneur's equilibrium behavior in more detail in Section 2.1).<sup>17</sup> Denote the value of the bank's time 1 expected profit corresponding to this equilibrium interest rate by  $\Pi_1^{B*}$ . Notice that, even when the two types charge the same equilibrium interest rate, their expected profits differ, since the high-cost bank has to incur evaluation costs, so that  $\pi_{1D}^H < \pi_{1D}^L$ .

Consider now time 0. As before, we will first compute the equilibrium behavior of the bank if the borrowing firm is in financial distress. Unlike at time 1, the behavior of the high-cost bank is now affected by considerations of reputation building, since the bank's handling of firms in financial distress at time 0 provides information to entrepreneurs, which they use to compute the bank's time 1 reputation. Denote by  $\pi_{0D}^B$  the bank's expectation of its future (i.e., combined time 0 and time 1) profits given that the entrepreneur who has borrowed from it at time 0 is in financial distress (in other words, the bank's expected profits from the remainder of the game, at the time 0 financial distress node). It is given by

$$\begin{aligned} \pi_{0D}^B = & y + \delta q_0^B(c_0^B)[kx - y + \Pi_1^{B*}(\alpha_i^B)] + \delta[1 - q_0^B(c_0^B)]\Pi_1^{B*}(\alpha_i^B) \\ & + (1 - \delta)\Pi_1^{B*}(\alpha_i^B) - c_0^B, \quad \text{for } B \in \{H, L\}. \end{aligned} \quad (9)$$

The high-cost bank chooses the amount of resources devoted to evaluating firms for renegotiation,  $c_0^{H*}$ , and the corresponding  $q$  value  $q_0^{H*}$ , to maximize  $\pi_{0D}^H$ . On the other hand, it is clearly optimal for the low-cost bank to set  $q_0^{L*} = \bar{q}$ , as at time 1. Denote the expected profits of the two types of banks at these optimal values by  $\pi_0^{H*}$  and  $\pi_0^{L*}$ , respectively.

<sup>17</sup> Unlike bondholders, who are assumed to earn zero expected profits, the ability to acquire a reputation allows the bank to earn a positive expected profit in equilibrium. This arises from the fact that, in any equilibrium with reputation acquisition, entrepreneurs are willing to pay a higher interest rate than the yield on publicly traded debt to borrow from the bank, since they know that the desire to acquire a reputation motivates the bank to make more accurate renegotiation versus liquidation decisions compared to bondholders (who are single-period players); thus, if a bank's reputation at time 1 approaches zero, its time 1 expected profit would also approach zero. Incidentally, the assumption that bondholders earn zero expected profits is not crucial to our analysis: for instance, even if this assumption is replaced by the alternative assumption that bondholders get to retain a fixed fraction of the net present values (NPVs) of the projects funded by them, the equilibrium yield on bank loans can be shown to be higher than that on publicly traded debt.

Denote by  $p_0^B$ ,  $B \in \{H, L\}$ , the bank's equilibrium inference at time 0, about the success probability of an entrepreneur approaching it for a loan. The bank's expectation of its future (i.e., combined time 0 and time 1) profits is then given by

$$\Pi_0^B = (1 - p_0^B)\pi_{0D}^{B*} + p_0^B[R_0^B + \Pi_1^{B*}(\alpha_1^B)] - 1, \quad \text{for } B \in \{H, L\}. \quad (10)$$

The equilibrium time 0 choice of interest rate of each type of bank maximizes Equation (10), taking as given the time 0 equilibrium strategies of entrepreneurs (as at time 1, the highest interest rate the bank can charge at time 0 is constrained by the fact that the entrepreneur has the alternative of borrowing in the bond market).

### 1.3 The entrepreneur's objective

Let  $J_t^B$  and  $J_t^T$ , respectively, denote the expected payoffs of an entrepreneur who enters the debt market at time  $t(t = 0, 1)$ , according as he chooses to borrow from the bank or to issue publicly traded debt. These are given by

$$\begin{aligned} J_t^T(R_t^T, p) &= p(x - R_t^T) \\ &\quad + (1 - p)\delta q_t^T(c_t^T)(1 - k)x, \\ J_t^B(R_t^B, \alpha_t, p) &= p(x - R_t^B) \\ &\quad + (1 - p)\delta x(1 - k)[\alpha_t \bar{q} + (1 - \alpha_t)q_t^H(c_t^H)]. \end{aligned} \quad (11)$$

An entrepreneur's choice between approaching the bank for a loan and issuing publicly traded debt depends on the relative magnitudes of  $J_t^T$  and  $J_t^B$ , which, in turn, depends on his success probability  $p$ ,  $p \in \{p_s, p_v\}$ , and the interest rate charged by the bank.

## 2. Equilibrium

In this section, we will characterize the equilibrium strategies and beliefs of various parties.

**Definition of equilibrium.** An equilibrium consists of a choice of the debt contract by entrepreneurs (bank loans versus publicly traded debt), choices of interest rate and of the level of resources to be devoted to evaluating firms in financial distress by banks and bondholders, at each date, which satisfy the following conditions: (a) Given the equilibrium choices and beliefs of the other players, entrepreneurs' choices maximize their expected payoff at each date; banks' choices at each stage maximize their expected payoff from the remainder of the game. (b) Given the equilibrium choices of banks and

entrepreneurs and given equilibrium beliefs, bondholders' choice of interest rate (at each date) is the lowest that gives them nonnegative expected profits in equilibrium (this reflects our assumption of a competitive bond market); if a borrowing firm is in financial distress, the amount of resources bondholders devote to evaluating the firm maximizes their expected payoff. (c) The beliefs of all players are rational, given the equilibrium choices of others; along the equilibrium path, these beliefs are formed using Bayes's rule. Any deviation from equilibrium strategies by any player is met by other players' beliefs that yield him a lower expected payoff compared to that obtained in equilibrium.

Depending on parameter values, there can be four different kinds of pure strategy equilibria in this model, since, in equilibrium, the two types of banks (high-cost and low-cost) may pool or separate and the two types of entrepreneurs ( $S$  and  $U$ ) may also pool or separate. The objective of this article is to examine the effects of reputation acquisition by lenders (which does not occur when the two types of banks separate by their choice of interest rate) in situations where both bank loans and publicly traded debt exist simultaneously (which will not be the case if both  $S$  and  $U$  entrepreneurs pool by choosing either bank loans or publicly traded debt exclusively). As such, we will focus here on characterizing the range of parameter values for which the equilibrium involves the two types of banks pooling by offering identical debt contracts to entrepreneurs, while the two types of entrepreneurs separate by their choice of bank loans versus publicly traded debt. We will then proceed to develop a detailed analysis of the properties of this equilibrium.

## 2.1 Characterization of the equilibrium at time 1

We now characterize the equilibrium in the subgame starting at time 1.

**Proposition 1.** *There is an  $\underline{\alpha}_t$  (defined by Equation (A3) in the Appendix) such that, if  $\alpha_s \geq \underline{\alpha}_t$  for all  $s \in \{n, r, g, b\}$ , and if*

$$\frac{p_S}{p_U} \leq \left[ \frac{1 - \phi}{\phi} \right]^2, \tag{12}$$

(a) *there exists an equilibrium at time 1 in which type  $S$  entrepreneurs issue publicly traded debt, type  $U$  entrepreneurs borrow from the bank, and both types of banks pool by charging the same interest rate in equilibrium.*<sup>18</sup>

(b) *In this equilibrium, the interest rate on bank loans,  $R_t^{B*}$  is*

<sup>18</sup> If the model parameters do not satisfy these restrictions, either other kinds of equilibria (discussed before) exist or a pure-strategy equilibrium fails to exist.

higher than that on publicly traded debt,  $R_1^{T*}$ . These interest rates are given by

$$R_1^{T*} = \frac{1 - \{1 - \bar{p}\} \pi_B^{T*}}{\bar{p}},$$

$$R_1^{B*} = R_1^{T*} + \frac{1 - p_U}{p_U} [\delta x (1 - k) (\bar{q} - q_1^{H*}) \alpha_1]. \quad (13)$$

(c) Both the high-cost bank and bondholders devote the same amount of resources to evaluating firms in financial distress (i.e.,  $c_1^{H*} = c_1^{T*}$ ).

In the above equilibrium, the interest rate charged by the bank does not convey information about the bank's type, since the high-cost bank mimics the low-cost bank by setting the same interest rate in equilibrium. Consistent with this, entrepreneurs assess a probability  $a$ : that a bank offering a loan at the interest rate given by Equation (13) is a low-cost bank. If, on the other hand, any bank deviates from equilibrium by setting an interest rate different from Equation (13), entrepreneurs infer with probability 1 that such a bank is a high-cost bank.

Since, in equilibrium, type  $S$  entrepreneurs issue publicly traded debt and type  $U$  entrepreneurs choose bank loans, lenders infer that, if an entrepreneur approaches a bank, his private information is that  $p = p_w$  and if he issues publicly traded debt, his private information is  $p = p_s$ . The interest rate charged by lenders in each case reflects this equilibrium inference:  $R_1^{B*}$  is that interest rate that maximizes the bank's time 1 expected profit [Equation (8)], with  $p_1^B = p_U$ ;  $R_1^{T*}$  is the lowest interest rate for which  $\Pi_1^{T*}$  [given by setting  $p_1^T = p_s$  in Equation (3)] is nonnegative.

Since there are no considerations of reputation building at time 1, the amount of resources devoted to evaluating firms in financial distress is the same for both high-cost banks and publicly traded debt. However, type  $U$  entrepreneurs are willing to pay a higher interest rate on bank loans compared to that on publicly traded debt, since there is a positive probability that the bank is a low-cost bank and, consequently, the expected amount of resources devoted to evaluating firms in financial distress is greater in the case of bank loans. Thus, the expected payoff of type  $U$  entrepreneurs is higher if they choose bank loans. Type  $S$  entrepreneurs, on the other hand, have a lower probability of being in financial distress and therefore obtain a higher expected payoff if they fund their projects using publicly traded debt, thereby taking advantage of the lower interest rate charged. Thus, neither type has an incentive to deviate from its equilibrium behavior unilaterally.

$R_1^{B*}$  is the highest interest rate that the type  $U$  entrepreneur is willing to pay for a bank loan, given the bank's reputation; if the bank sets a higher interest rate, entrepreneurs will prefer to issue publicly traded debt and will not borrow from the bank. Condition (12) on  $p_U$ ,  $p_S$ , and  $\phi$  ensures that setting this high interest rate and (as a result) lending exclusively to type  $U$  entrepreneurs is the strategy that maximizes the low-cost's bank's expected payoff (despite the higher probability of type  $U$  entrepreneurs being in financial distress). The requirement that  $\alpha_i^* \geq \underline{\alpha}_1$  ensures that it is profitable for the high-cost type to mimic the low-cost bank by setting this interest rate, rather than deviate from equilibrium by choosing a lower interest rate in an effort to attract type  $S$  entrepreneurs as well. Remember that, if a borrowing firm is in financial distress, the high-cost bank obtains lower expected profits than a low-cost bank; if  $\alpha_i^* \geq \underline{\alpha}_1$ , the bank's reputation is large enough (and consequently,  $R_1^{B*}$  high enough) that it is optimal for the high-cost bank to mimic the low-cost bank, even after accounting for the higher probability of a type  $U$  borrower being in financial distress.

**Proposition 2.** *More reputable banks charge higher interest rates and obtain higher expected profits in the above equilibrium.*

Entrepreneurs are willing to pay a higher interest rate to borrow from banks with a greater reputation, since the probability of a firm's debt being renegotiated is higher for such banks, giving them a larger expected profit.

## 2.2 Characterization of the equilibrium at time 0

We will now demonstrate the existence of the equilibrium at time 0 and study its properties. In the following, we will use  $Q_0^B(\alpha_0)$  to denote the difference between the expected values at time 0 of the time 1 profit of a bank (of reputation level  $a_0$ ) under two alternative scenarios: the case where the firm borrowing from the bank at time 0 is in financial distress and the case where the borrower at time 0 is not in financial distress. (The bank's expected time 1 profit will be different in the two cases: in the former case the bank will have to make a renegotiation versus liquidation decision at time 0, so that its reputation will change from time 0 to time 1; in the latter case, since the borrowing firm is not in financial distress, the bank does not have to make any such decision and, consequently, the bank's time 1 reputation will equal  $a_0$ .) Thus,

$$Q_0^B(\alpha_0) = \{\delta[q_0^{B*}\Pi_1^{B*}(\alpha_i^*) + (1 - q_0^{B*})\Pi_1^{B*}(\alpha_i^*)] + (1 - \delta)\Pi_1^{B*}(\alpha_i^*)\} - \Pi_1^{B*}(\alpha_i^*). \quad (14)$$

**Proposition 3.** Let  $\alpha_s^i \geq \underline{\alpha}_i$ , for all  $s \in \{n, r, g, b\}$ , and let condition (12) hold, so that the equilibrium in the subgame starting at time 1 is as characterized in Proposition 1. Then, there is an  $\underline{\alpha}_0$  defined by Equation (A11) in the Appendix] such that, if  $\alpha_0 \geq \underline{\alpha}_0$  and  $Q_0^g(\underline{\alpha}_0) \geq 0$ :

(a) there exists an equilibrium such that, at time 0, type *S* entrepreneurs issue publicly traded debt, type *U* entrepreneurs choose bank loans, and both types of banks pool by charging the same interest rate in equilibrium.

(b) The equilibrium time 0 interest rate on publicly traded debt,  $R_0^{T*}$ , and that on bank loans,  $R_0^{B*}$ , are given by

$$R_0^{T*} = R_1^{T*} = \frac{1 - (1 - \bar{p})\pi_D^{T*}}{\bar{p}},$$

$$R_0^{B*} = R_0^{T*} + \frac{1 - p_U}{p_U} \delta x (1 - k) [\alpha_0 \bar{q} + (1 - \alpha_0) q_0^{H*} - q_0^{T*}]. \quad (15)$$

The equilibrium described above involves behavior by the two types of banks at time 0 that is similar to their behavior at time 1 (described in Proposition 1), with the important difference that considerations of reputation building become crucial at time 0. When evaluating firms in financial distress, the high-cost bank takes into account the potential effects on its time 1 reputation: its reputation goes down if it makes an incorrect liquidation decision; it goes up if it renegotiates a firm's debt or makes a decision to liquidate that turns out to be the right one. In equilibrium, the high-cost bank sets the same interest rate as the low-cost bank, given by Equation (15). Consistent with this equilibrium behavior of the high-cost type, entrepreneurs assess the probability  $\alpha$ , that any bank setting the equilibrium interest rate is a low-cost bank; they set this probability to zero if the bank deviates by setting a different interest rate.

As in the time 1 equilibrium, type *S* entrepreneurs, who are relatively less concerned about the behavior of lenders in the event of financial distress, issue publicly traded debt, taking advantage of the lower equilibrium yield on such debt. Type *U* entrepreneurs, on the other hand, are willing to pay the higher interest rate charged on bank loans, since banks devote a larger amount of resources to evaluating firms in financial distress, thus lowering the probability of incorrect liquidation. Consistent with this equilibrium behavior, lenders infer that entrepreneurs approaching banks are type *U*, while those issuing publicly traded debt are type *S*, setting the interest rate accordingly [i.e., in equilibrium, bondholders set  $p_0^T = p_S$  in Equation (3), while banks set  $p_0^B = p_U$  in Equation (8)]. Thus, bank loans and publicly traded debt coexist in equilibrium, despite the fact that bank

loans dominate publicly traded debt in terms of lender-behavior toward firms in financial distress.

In addition to the considerations reflected in Condition (12), which ensures that it is optimal for the low-cost bank (from the point of view of maximizing the expected profit from the current period) to set a high interest rate and cater exclusively to type  $U$  borrowers at time 1, considerations of reputation building become crucial to the banks' choice of interest rate at time 0. Since type  $U$  borrowers are more likely to be in financial distress, banks are more likely to have to make a liquidation versus renegotiation decision (and incur the consequent gain or loss in reputation) if their borrowers are type  $U$  entrepreneurs exclusively (rather than a pool consisting of type  $S$  and type  $U$  entrepreneurs). The requirement that  $Q_0^B(\alpha_0) \geq 0$  ensures that such a strategy of catering exclusively to type  $U$  entrepreneurs is optimal from the point of view of reputation building as well.

Finally, the requirement that  $\alpha_0 \geq \underline{\alpha}_0$  ensures that the high-cost bank's expected profits are maximized by setting the same interest rate as that of the low-cost bank in equilibrium. If the time 0 reputation of the high-cost bank is great enough (and consequently,  $R_0^B$  high enough), then it is optimal for it to mimic the low-cost bank, rather than deviate from equilibrium by choosing a lower interest rate in an attempt to attract type  $S$  entrepreneurs as well.

### **2.3 Properties of the equilibrium**

We now develop the properties of the equilibrium characterized in Propositions 1 and 3. First, we show that the equilibrium survives tests of robustness in the spirit of the Cho-Kreps argument.<sup>19</sup> As applied to our model, such a test of robustness translates to checking whether there are out-of-equilibrium moves that the low-cost bank may make in an attempt to separate (i.e., to reveal its type) credibly. We describe an out-of-equilibrium move to be *credible* in this sense of it satisfies the following two conditions simultaneously:

1. If the bank is of the *low-cost* type and, by making the move, it can convince entrepreneurs that it is of the low-cost type, its payoff

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<sup>19</sup> The Cho-Kreps argument was developed originally as a test of robustness of equilibria in signaling games (Cho and Kreps 1987) and later extended (with some modifications) to apply to extensive form games in general (Cho 1987). In our context, this consists of checking whether the low-cost bank can make an out-of-equilibrium move, accompanied by the following speech (in essence) to entrepreneurs: "You have to believe that I am a low-cost bank, because you know that a high-cost bank could not possibly benefit from making such an out-of-equilibrium move (regardless of what you infer about my type from my making this move); only a truly low-cost bank could possibly benefit from doing this." If there are out-of-equilibrium moves for which the above speech would be valid (and which would therefore allow the low-cost bank to reveal its type credibly), the equilibrium fails this test of robustness, since the low-cost bank may destabilize the equilibrium by attempting such a move.

from making the move is strictly *higher* than that it would obtain in equilibrium;

2. If the bank is of the *high-cost* type, then, irrespective of what entrepreneurs infer about its type from its making the move, its payoff from making the move is lower than that it would obtain in equilibrium.

If there is no such credible out-of-equilibrium move, then the equilibrium survives the test of robustness; if there is such a move, the equilibrium fails the test.

**Proposition 4 (robustness).** *There are no credible out-of-equilibrium moves that allow the low-cost bank to reveal its type.*

Thus, the low-cost bank cannot credibly reveal its type by setting an arbitrary out-of-equilibrium interest rate (either at time 0 or time 1) that is higher or lower than the equilibrium values specified, nor can it separate by allowing all firms in financial distress at time 0 to continue operation (under a debt renegotiation arrangement) in an attempt to reveal its type and thereby make larger profits at time 1. (We demonstrate in the proof of Proposition 4 that the incremental expected profit to the low-cost bank from such out-of-equilibrium moves is always lower or at most equal to that for the high-cost bank, so that such moves do not allow the low-cost bank to credibly convey to entrepreneurs that it is of the low-cost type.)

We now develop comparisons between the equilibrium properties of bank loans and publicly traded debt.

**Proposition 5 (bank loans versus publicly traded debt).**

(a) *The equilibrium yield on bank loans at time 0 is higher than that on publicly traded debt ( $R_0^{B*} > R_0^{T*}$ ).*

(b) *Because of its concern for reputation building, the high-cost bank devotes a larger amount of resources to evaluating firms in financial distress at time 0 relative to the amount devoted at time 1; this amount is also larger than that devoted by bondholders at either date (i.e.,  $c_0^{H*} > c_1^{H*} = c_0^{T*} = c_1^{T*}$ ).*

(c) *Bank debt improves efficiency.*

The intuition behind this proposition is straightforward. Type *U* entrepreneurs, who have a greater chance of being in financial distress, will clearly benefit from paying a higher interest rate if lenders can commit to devote a larger amount of resources to renegotiation in the event of financial distress. Since the amount of resources devoted by lenders to evaluate firms is unobservable and bondholders are

single-period players, they cannot make any such commitment. However, banks, being long-term players in the debt market, can (in effect) make such a commitment, since entrepreneurs know that they are motivated to acquire a reputation for making the right renegotiation/liquidation decision. Type  $U$  entrepreneurs therefore (optimally) borrow from banks, thus reducing the probability of their firms being incorrectly liquidated in the event of financial distress (even though banks charge them a correspondingly higher rate of interest than that for publicly traded debt). Further, since considerations of reputation building induce banks to devote a larger amount of resources and obtain more informative evaluations of firms in financial distress, the probability of liquidating a good firm is lower for bank debt, improving efficiency.<sup>20</sup>

We now study how the characteristics of bank loans vary with the bank's reputation for financial flexibility.

**Proposition 6 (effect of differences in bank reputation).** *For  $a_0$ , values lower than a certain value  $\bar{a}_0$ , [defined by Equation (A29) in the Appendix]:*

(a) *The greater the time 0 reputation of a high-cost bank, the larger the equilibrium amount of resources  $c_0^H$  devoted by it for evaluating firms in financial distress.*

(b) *The greater the time 0 reputation of a bank, the higher the time 0 interest rate charged by it in equilibrium.*

The intuition behind Proposition 6 is as follows. For  $a_0$  values lower than  $\bar{a}_0$ , the greater the reputation of the bank, the larger the loss from making an incorrect liquidation decision. Consequently, the amount devoted in equilibrium by the high-cost bank to evaluate firms in financial distress is increasing in its time 0 reputation. This equilibrium behavior of high-cost banks implies that entrepreneurs entering the equity market at time 0 are willing to pay a higher interest rate in equilibrium for a loan from a bank with a greater reputation;

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<sup>20</sup> It is useful to place this result in the context of the "soft budget-constraint" arguments made (among others) by Dewatripont and Maskin (1990) against excessive ease of refinancing. They argue that the inability of lenders to commit ex ante not to refinance long-term projects in financial difficulties may encourage entrepreneurs to seek funding even for projects that have negative NPVs: if the continuation value of a project in financial distress is known to be greater than its liquidation value, rational lenders have an incentive to refinance a project in financial difficulties, regardless of the advisability or otherwise of starting the project in the first place. In contrast to such arguments, in our model we focus on the benefits of making the right renegotiation versus liquidation decision (arising from minimizing the social losses due to inefficient liquidation in a setting of asymmetric information). Recall that, in our set-up, entrepreneurs do not choose the probability of their firm being in financial distress, and both type  $U$  and type  $S$  projects are positive NPV projects. Trading off these two complementary aspects of the renegotiation versus liquidation decision, namely, minimizing the ex ante incentives to undertake bad projects on the one hand, while minimizing the social waste arising from inefficient liquidation in the event of financial distress on the other, can perhaps lead to a theory of optimal renegotiation design.

Table 2  
 Numerical illustration of the model for square root evaluation cost function  $q(c) = 6\sqrt{c}$

Parameter values	Case 1			Case 2			Case 3		
	$p_U = .8$ $y = .99$ $\bar{q} = .9$	$p_S = .9$ $\delta = .1$ $\phi = .4$	$x = 7$ $k = .15$	$p_U = .4$ $y = .98$ $\bar{q} = .6$	$p_S = .6$ $\delta = .35$ $\phi = .4$	$x = 2.5$ $k = .4$	$p_U = .3$ $y = .98$ $\bar{q} = .7$	$p_S = .4$ $\delta = .25$ $\phi = .3$	$x = 5.5$ $k = .2$
$\alpha_0$	.1	.2	.1	.2	.1	.2	.1	.2	
$\alpha_1$	.012	.012	.055	.055	.029	.029			
$\bar{\alpha}_0$	0	0	0	0	0	0			
$\bar{\alpha}_0$	.546	.559	.454	.469	.515	.514			
$Q(\alpha_0)$	+	+	+	+	+	+			
$q_t^{H*} = q_t^{L*}$	.108	.108	.126	.126	.540	.540			
$R_t^{H*}$	1.002	1.002	1.021	1.021	1.024	1.024			
$R_t^{H*}(r)$	1.046	1.065	1.098	1.144	1.074	1.119			
$R_t^{H*}(g)$	1.004	1.006	1.045	1.073	1.055	1.088			
$R_t^{H*}(b)$	1.014	1.027	1.064	1.103	1.067	1.109			
$R_t^{H*}(n)$	1.014	1.025	1.059	1.096	1.065	1.106			
$\alpha_1^r$	.372	.537	.205	.330	.121	.231			
$\alpha_1^g$	.014	.037	.065	.140	.074	.156			
$\alpha_1^b$	.107	.021	.113	.220	.104	.206			
$\alpha_0^{H*}$	.169	.194	.258	.305	.566	.581			
$\alpha_0^{L*}$	1.022	1.036	1.152	1.208	1.125	1.191			

$p_U$  and  $p_S$  are the success probabilities of type  $U$  and type  $S$  firms, respectively.  $\phi$  is the proportion of type  $S$  firms.  $x$  is the cash flow from each firm if it succeeds, and  $y$  if it is liquidated.  $\delta$  is the prior probability that a firm in financial distress is good.  $q_t(c)$  is the probability that a lender devoting an amount of resources at time  $t$  to evaluate a firm in financial distress receives a good signal, conditional on the firm being truly good ( $\bar{q}$  is the highest achievable value of this probability;  $q_t^{H*}$  and  $q_t^{L*}$ ,  $t \in \{0, 1\}$ , denote the equilibrium values of this probability for bond holders and for the high-cost bank, respectively).  $k$  is the fraction of the payoff from a firm in financial distress followed to continue under debt renegotiation) retained by lenders.  $R_t^{H*}$  and  $R_t^{L*}(s)$  are the equilibrium interest rates charged by bond holders and by the bank, respectively, at time  $t$ ,  $t \in \{0, 1\}$ ,  $s \in \{r, g, b, n\}$ .  $\alpha_0$  and  $\alpha_1^s$  are the reputation levels of the bank at time 0 and time 1, respectively. The conditions  $Q(\alpha_0) \geq 0$ ,  $\alpha_0 \geq \bar{\alpha}_0$  and  $\alpha_1^s \geq \underline{\alpha}_1^s$  need to be met for the existence of equilibrium.

a larger amount of resources devoted to evaluating their firm increases the expected payoff from their projects by reducing the probability of inefficient liquidation. [The restriction that  $\alpha_0 \leq \bar{\alpha}_0$  is required, since, for very high reputation values (close to 1), high-cost banks have an incentive to milk their reputation by choosing a lower  $\alpha_0^{H*}$  corresponding to a higher  $\alpha_0$  and, consequently, in this range of  $\alpha_0$ , the equilibrium interest rate that type  $U$  entrepreneurs are willing to pay is no longer increasing in bank reputation.]

Table 2 presents numerical illustrations of our model, assuming a square-root evaluation cost function. The table presents the various interest rates and other equilibrium values for three different cases that involve widely varying model parameters; for each case, the various values are presented for two different bank reputation levels,  $\alpha_0 = 0.1$  and  $\alpha_0 = 0.2$ . Table 2 also gives the bounds on the various values that need to be satisfied for the existence of equilibrium; it can be seen that the conditions for existence are easily met for a wide

range of model parameters.<sup>21</sup> It is easy to verify from the table that, other things remaining the same, the interest rate differential between bank debt and publicly traded is greater for the case where the bank has a greater reputation.

### 3. Empirical Implications

We now summarize the empirical implications of our model.

**Implication 1.** Firms using bank loans will, on average, have a greater probability of being in financial distress compared to those issuing publicly traded debt. Using firm size as a proxy for the probability of financial distress, this implies that smaller firms will use bank loans to fund their projects, while larger firms issue publicly traded debt. Consistent with this, James (1987) documented that the average firm size in their bank loan sample is about 25 percent of that in the straight (publicly traded) debt sample.

**Implication 2.** The yield on bank loans will be higher than that on publicly traded debt of equivalent maturity.<sup>22</sup> Further, firms will be willing to pay higher interest rates on loans from banks with a greater reputation for flexibility in case of financial distress. The latter implication is unique to our model and not generated by any other model of the choice between banks loans and publicly traded debt.

**Implication 3.** Bank loans will be renegotiated more often than publicly traded debt of equivalent maturity. This is because, in equilibrium, banks devote more resources to evaluate firms in financial distress compared to holders of publicly traded debt. Some support

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<sup>21</sup> If the model parameters satisfy the conditions for the existence of the kind of equilibrium we have studied here (as is the case for the examples presented in Table 1), then two other possible equilibria of some interest, namely, an equilibrium in which both types of banks and both types of entrepreneurs pool and one in which both types of banks and both types of entrepreneurs separate, will not exist. Consider first the candidate equilibrium in which both types of banks pool by charging the same interest rate, while both safe and risky entrepreneurs pool by borrowing from the bank. Such an equilibrium will not exist if condition (12) is satisfied; this condition, which ensures that it is always more profitable for banks to charge a higher interest rate and cater only to type *U* entrepreneurs, clearly holds for the examples in Table 1. Consider now the second candidate equilibrium, in which the high-cost and low-cost banks separate by charging different interest rates (the high-cost bank charges the same interest rate as bondholders, while the low-cost bank charges a higher interest rate), while the two kinds of entrepreneurs also separate (the safe entrepreneur borrows either by taking a loan from a high-cost bank or by issuing publicly traded debt, while the risky entrepreneur borrows from the low-cost bank). This type of equilibrium will not exist if the two conditions,  $\alpha_1 \geq \alpha_0$  and  $\alpha_0 \geq \alpha_0$ , are satisfied; these conditions, which imply that it is always more profitable for the high-cost bank to mimic the low-cost bank (by charging the same interest rate), can also be seen to hold for the examples in Table 1.

<sup>22</sup> Consistent with this implication, Brealey and Myers (1991) pointed out that, using commercial paper, major companies are able to borrow at interest rates 1 to 1.5 percent below the prime rate charged by banks.

for this implication is provided by Gilson, John, and Lang (1990), who found that financially distressed companies that borrow principally from banks are more prone to restructure efficiently (out of court). Also, Hoshi, Kashyap, and Scharfstein (1990) documented that Japanese companies that have borrowing relationships with banks are more likely to restructure efficiently in the event of financial distress.

**Implication 4.** Renewals of bank loans will convey more favorable information compared to those of other kinds of debt (e.g., debt privately placed with insurance companies). Further, loan renewals from more reputable banks convey more favorable information compared to those from less reputable ones [since, as shown under Proposition 6(a), more reputable banks devote more resources toward evaluating firms and consequently obtain more accurate evaluations of firms]. Consistent with this, James (1987) documented that the stock price reaction to announcements of bank loan agreements is positive, while it is negative for announcements of public offerings of straight debt and of privately placed debt.

#### **4. Conclusion**

The contribution of this article has been to develop a model of the choice of firms between bank loans and publicly traded debt, taking into account the possibility of renegotiating the debt contract in the event of financial distress. Unlike earlier work (e.g., Diamond 1991), in our model the advantage of banks over bondholders arises from their ability to acquire a reputation for financial flexibility when confronted with firms in financial distress. Banks are able to use reputation as a commitment device to promise entrepreneurs credibly that they will devote more resources toward evaluating their firm and thereby make better renegotiation versus liquidation decisions if their firm is in financial difficulties. As a result, firms that assess a greater probability of being in financial distress choose bank loans over publicly traded debt, even though the equilibrium interest rate on bank loans is higher. On the other hand, those firms with a smaller probability of being in financial distress issue publicly traded debt; this enables them to avoid pooling with higher risk firms and thus borrow at a lower equilibrium interest rate.

#### **Appendix: Proofs of Propositions**

*Proof of Proposition 1.* We prove (b) first. In the proposed equilibrium profits of both types of banks are maximized by choosing the highest

interest rate consistent with separation of entrepreneurs and preventing traded debt from making positive expected profits when lending to both types of entrepreneurs, leading to expressions (13). Part (c) follows immediately from comparison of the first-order condition (3) for  $c_1^T$  and (9) for  $c_1^H$ . To prove part (a) we need to show that: (1) bank  $L$  prefers to separate entrepreneurs of type  $S$  and  $U$ , rather than pooling them; (2) given the equilibrium interest rates, type  $U$  prefers to borrow from a bank and type  $S$  to issue traded debt; (3) both banks and traded debt holders earn nonnegative profits, and (4) bank  $H$  prefers to charge the same interest rate as bank  $L$ , so as to pool with it, rather than to separate by charging the same interest rate as traded debt.

We start with (3): if bank  $H$  pools with bank  $L$  and charges  $R_1^{B*}$ , expected profits are

$$\Pi_1^{H*} = (1 - p_U)\pi_{1D}^{H*} + p_U R_1^{B*} - 1. \quad (A1)$$

Let  $\xi_1 \equiv \delta x(1 - k)(\bar{q} - q_1^{H*})\alpha_1^s$  and  $\bar{p} \equiv \phi p_S + (1 - \phi)p_U$ . Noting that  $\pi_{1D}^{H*} = \pi_{1D}^{T*}$ , bank  $H$  will earn nonnegative expected profits if

$$R_1^{B*} \equiv \frac{1 - (1 - \bar{p})\pi_{1D}^{T*}}{\bar{p}} + \frac{1 - p_U}{p_U}\xi_1 \geq \frac{1 - (1 - p_U)\pi_{1D}^T}{p_U}. \quad (A2)$$

Inequality (A2) is satisfied if  $\alpha_1^s \geq \underline{\alpha}_1$ , where

$$\underline{\alpha}_1 \equiv \frac{p_S - p_U}{\bar{p}(1 - p_U)} \frac{1 - \pi_{1D}^{T*}}{\delta x(1 - k)(\bar{q} - q_1^{T*})}. \quad (A3)$$

Furthermore, since  $\pi_{1D}^{T*}$ , bank  $L$  will earn nonnegative profits as well. Finally, at the equilibrium rate  $R_1^{T*}$ , holders of traded debt will also earn nonnegative expected profits.

(2): From expressions (11), it can immediately be verified that at these rates we have  $J_1^T(R_1^{T*}, p_U) = J_1^B(R_1^{B*}, p_U)$  and  $J_1^T(R_1^{T*}, p_S) > J_1^B(R_1^{B*}, p_S)$ . Hence, entrepreneurs of type  $U$  weakly prefer bank to traded debt, while type  $S$  strictly prefers traded debt.

(4): Bank  $H$  must choose between charging  $R_1^{B*}$  and pool with  $L$ , or charging  $R_1^{T*}$ , and separate. The bank will attract entrepreneurs of type  $U$  in the first case and type  $S$  in the second case. Expected profits under these two strategies are

$$\begin{aligned} \Pi_1^H(R_1^{B*}) &= (1 - p_U)\pi_{1D}^{H*} + p_U R_1^{B*} - 1 \\ &= (1 - p_U)\pi_{1D}^{H*} + p_U \frac{1 - (1 - \bar{p})\pi_{1D}^{T*}}{\bar{p}} + (1 - p_U)\xi_1 - 1, \end{aligned}$$

$$\begin{aligned} \Pi_1^H(R_1^{T*}) &= (1 - p_s)\pi_{1D}^{H*} + p_s R_1^{T*} - 1 \\ &= (1 - p_s)\pi_{1D}^{H*} + p_s \frac{1 - (1 - \bar{p})\pi_D^{T*}}{\bar{p}} - 1. \end{aligned} \tag{A4}$$

Hence a type *H* bank will prefer to charge  $R_1^{B*}$  and pool with a type *L* one if

$$\begin{aligned} \Pi_1^H(R_1^{B*}) - \Pi_1^H(R_1^{T*}) \\ = (p_s - p_u) \left( \pi_{1D}^{H*} - \frac{1 - (1 - \bar{p})\pi_D^{T*}}{\bar{p}} \right) + (1 - p_u)\xi_1 \geq 0, \end{aligned} \tag{A5}$$

which is the case for  $\alpha_1^i \geq \underline{\alpha}_1$ .

(1): Finally, if banks pool entrepreneurs of type *S* and *U*, the maximum interest rate (denoted  $R_{1p}^B$ ) that they will be able to charge is the one preventing traded debt from making positive expected profits from lending to entrepreneurs of type *S*, that is,

$$R_{1p}^B \equiv \frac{1 - (1 - p_s)\pi_D^{T*}}{p_s} + \frac{1 - p_s}{p_s}\xi_1. \tag{A6}$$

Expected profits under the two strategies are

$$\begin{aligned} \Pi_1^H(R_1^{B*}) &= (1 - p_u)\pi_{1D}^{B*} + p_u R_1^{B*} - 1, \\ \Pi_1^H(R_{1p}^B) &= (1 - \bar{p})\pi_{1D}^{B*} + \bar{p}R_{1p}^B - 1. \end{aligned} \tag{A7}$$

Incremental expected profits from separating entrepreneurs of type *S* and *U*, rather than pooling them (denoted  $\Delta_1^B$ ), are

$$\equiv \Pi_1^H(R_1^{B*}) - \Pi_1^H(R_{1p}^B) = (\bar{p} - p_u)\pi_{1D}^{B*} + p_u R_1^{B*} - \bar{p}R_{1p}^B. \tag{A8}$$

Note that  $\pi_{1D}^{B*} > \pi_{1D}^{H*}$  implies  $\Delta_1^L > \Delta_1^H$ . For a bank of type *H*,  $\Delta_1^H > 0$  if

$$\alpha_1^i \geq \frac{\bar{p}^2 - p_u p_s}{\bar{p}[(1 - p_u)p_s - \bar{p}(1 - p_s)]\delta x(1 - k)(\bar{q} - q_1^{H*})}. \tag{A9}$$

Since condition (12) implies that  $\bar{p}^2 - p_u p_s < 0$ , then  $\Delta_1^L > \Delta_1^H > 0$  for all  $a_p$ , and both types of banks will prefer to separate *S* and *U* rather than pool them. Finally, either type of bank has no incentive to deviate unilaterally by setting an interest rate higher than the equilibrium one, since this will induce entrepreneurs of type *U* to switch to publicly traded debt, reducing bank's profits to zero.

Q.E.D.

*Proof of Proposition 2.* From the expression for  $R_1^{B*}$  in Proposition 1, the interest rate charged by banks at  $t = 1$  is increasing in reputation level  $a_p$ , and  $\partial \Pi_1^{B*} / \partial \alpha_1 = (1 - p_u)\delta x(1 - k)(\bar{q} - q_1^{H*}) > 0$ . Q.E.D.

*Proof of Proposition 3.* In this proof we will follow a procedure similar to the one adopted in the proof of Proposition 1. We begin with (b). Again, in the proposed equilibrium, bank profits are maximized by charging the highest interest rate consistent with separation of entrepreneurs and that prevents traded debt holders from making positive expected profits by lending to both type of entrepreneurs, leading to Equation (15). To prove part (a), again we need to show that: (1) banks of type  $L$  prefer to separate entrepreneurs of type  $S$  and  $U$ , rather than pooling them; (2) at these rates entrepreneurs of type  $U$  prefer to borrow from the bank and those of type  $S$  prefer to issue publicly traded debt; (3) banks of both types and traded debt holders earn nonnegative profits; and (4) banks of type  $H$  prefer to charge the same interest rate charged by type  $L$ , and pool, rather than charging the same rate as traded debt, and separate.

We start with (3). From definition (11) of  $\pi_0^H$ , note that  $\pi_{0D}^{H*} \geq \pi_{1D}^{H*} = \pi_D^{T*}$ . Hence, as in the proof of part (3) of Proposition 1, we obtain that  $\Pi_0^{H*} > 0$ !

$$R_0^{B*} \geq \frac{1 - (1 - p_U)\pi_D^{T*}}{p_U}. \quad (\text{A10})$$

Inequality (A10) is satisfied if  $\alpha_0 \geq \underline{\alpha}_0$ , where

$$\underline{\alpha}_0 \equiv \max \left\{ \frac{p_S - p_U}{\bar{p}(1 - p_U)} \frac{1 - \pi_D^{T*}}{\delta x(1 - k)(\bar{q} - q_0^{H*})} - \frac{q_0^{H*} - q_0^{T*}}{\bar{q} - q_0^{H*}}; \quad 0 \right\}. \quad (\text{A11})$$

Part (2) can be immediately verified by noting that, at these rates, we have again  $J_0^T(R_0^{T*}, p_U) = J_0^T(R_0^{B*}, p_U)$  and  $J_0^T(R_0^{T*}, p_S) > J_0^B(R_0^{B*}, p_S)$ .

(1): Define  $\xi_0 \equiv \delta x(1 - k)[\alpha_0 \bar{q} + (1 - \alpha_0)q_0^{H*} - q_0^T]$ . If banks pool entrepreneurs of type  $S$  and  $U$  together, the maximum interest rate that now they will be able to charge (denoted  $R_{0p}^B$ ) is

$$R_{0p}^B \equiv \frac{1 - (1 - p_S)\pi_D^{T*}}{p_S} + \frac{1 - p_S}{p_S} \xi_0, \quad (\text{A12})$$

which is the maximum interest rate preventing bondholders from breaking even when lending to entrepreneurs of type  $S$ . The gains for a bank  $B$  from separating entrepreneurs of type  $S$  and  $U$ , rather than pooling them, now are

$$\Delta_0^B \equiv (\bar{p} - p_U)[\pi_{0D}^{B*} - \Pi_1^{B*}(\alpha_1^n)] + p_U R_0^{B*} - \bar{p} R_{0p}^B, \quad (\text{A13})$$

where again  $\bar{p} = \phi p_S + (1 - \phi)p_U$ . From the definition of  $\pi_{0D}^{B*}$ , we have that  $\pi_{0D}^{B*} - \Pi_1^{B*}(\alpha_1^n) \geq \pi_{1D}^{B*}$  if

$$Q^B(\alpha_0) \equiv \delta q_0^{B*} \Pi_1^{B*}(\alpha_1^r) + \delta(1 - q_0^{B*}) \Pi_1^{B*}(\alpha_1^f) + (1 - \delta) \Pi_1^{B*}(\alpha_1^b) - \Pi_1^{B*}(\alpha_1^n) \geq 0. \tag{A14}$$

In this case

$$\Delta_0^B \geq (\bar{p} - p_U) \pi_{1D}^{H*} + p_U R_0^{B*} - \bar{p} R_{0p}^B \equiv \bar{\Delta}_0^B. \tag{A15}$$

Note again that  $\pi_{1D}^{L*} > \pi_{1D}^{H*}$  implies  $\bar{\Delta}_0^L > \bar{\Delta}_0^H$ . By substituting the expressions for  $R_0^{B*}$  and  $R_{0p}^B$ , we obtain that for a bank of type  $H$ ,  $\bar{\Delta}_0^H > 0$  if

$$\alpha_0 \geq \frac{\bar{p}^2 - p_U p_S}{\bar{p}[(1 - p_U) p_S - \bar{p}(1 - p_S)] \delta x(1 - k)(\bar{q} - q_0^{H*})} - \frac{1 - \pi_D^{T*}}{\bar{q} - q_0^{H*}} - \frac{q_0^{H*} - q_0^{T*}}{\bar{q} - q_0^{H*}}. \tag{A16}$$

Condition (12) implies again that  $\bar{p}^2 - p_U p_S < 0$ , and hence  $\Delta_0^B \geq \bar{\Delta}_0^H > 0$  for all  $\alpha_0$ . Hence, both types of banks will prefer to separate entrepreneurs of type  $S$  and  $U$  rather than pooling them.

(4): Finally, bank  $H$  must choose again between charging  $R_0^B$ , and pool with  $L$ , or charging  $R_0^{T*}$ , and separate. Note that if bank  $H$  separates now, it will lose all the value of reputation the next period. Expected profits in the two cases would be

$$\begin{aligned} \Pi_0^H(R_0^{B*}) &= (1 - p_U) \pi_{0D}^{H*}(\alpha_0) \\ &+ p_U \left[ \frac{1 - (1 - \bar{p}) \pi_D^{T*}}{\bar{p}} + \Pi_1^{H*}(\alpha_1^n) \right] + (1 - p_U) \xi_0 - 1, \\ \Pi_0^H(R_0^{T*}) &= (1 - p_S) \pi_{0D}^{H*}(0) + p_S \frac{1 - (1 - \bar{p}) \pi_D^{T*}}{\bar{p}} - 1, \end{aligned} \tag{A17}$$

Since  $\Pi_1^{H*}(0) = 0$ . Analogously,  $\pi_{0D}^{H*}(\alpha_0) > \pi_{0D}^{H*}(0)$ . Hence,

$$\begin{aligned} \Pi_0^H(R_0^{B*}) - \Pi_0^H(R_0^{T*}) &\geq (p_S - p_U) \left[ \pi_{0D}^{H*}(\alpha_0) - \Pi_1^{H*}(\alpha_1^n) - \frac{1 - (1 - \bar{p}) \pi_D^{T*}}{\bar{p}} \right] + (1 - p_U) \xi_0 \\ &\geq (p_S - p_U) \left[ \pi_{1D}^{H*} - \frac{1 - (1 - \bar{p}) \pi_D^{T*}}{\bar{p}} \right] + (1 - p_U) \xi_0, \end{aligned} \tag{A18}$$

where the second inequality follows from  $Q(\alpha_0) \geq 0$ . A bank of type  $H$  will prefer to pool with one of type  $L$  if  $\Pi_0^H(R_0^{B*}) > \Pi_0^H(R_0^{T*})$ , which is implied by  $\alpha_0 \geq \alpha_0$ , completing the proof. Q.E.D.

*Proof of Proposition 4.* In this proof we will show that banks of type  $L$  may not credibly convince (in the sense discussed in the text) entrepreneurs borrowing at  $t = 1$  that they are of type  $L$  (so that they may charge them a higher interest rate) by either charging at  $t = 0$

an interest rate different from  $R_0^{B*}$  or by adopting the policy of renegotiating all loans that are in financial distress. In particular, we will show that if a bank of type  $L$  has a potential gain from deviating from equilibrium behavior [so that condition (1) in Section 2.3 is satisfied], then a bank of type  $H$  will be willing to imitate bank  $L$  behavior [so that condition (2) in Section 2.3 cannot be satisfied]. We start by computing the benefits that a bank of type  $B$  derives at  $t = 1$  by being perceived as of type  $L$  with probability 1. Since, in this case,  $\alpha_1 = 1 > \alpha_1^*$ , from the proof of Proposition 1 we know that at  $t = 1$  it still pays to separate entrepreneurs of type  $U$  and  $S$ , rather than to pool them. A bank with a reputation  $a_1 = 1$  will then be able to charge the interest rate  $\hat{R}_1^B$  given by

$$\hat{R}_1^B \equiv R_1^L + \frac{1 - p_U}{p_U} \delta x (1 - k) (\bar{q} - q_1^{H*}). \quad (A19)$$

Let  $\hat{\Pi}_1^B \equiv p_U \hat{R}_1^B + (1 - p_U) \pi_{1D}^{B*} - 1$  be the corresponding period 1 profits. Letting  $R_1^{B*}(s)$  be the equilibrium interest rate in state  $s$  [as given in Equation (A2)], the incremental profits that a bank makes if it increases its reputation from  $\alpha_1^*$  to  $\alpha_1 = 1$  are

$$M_1^B(s) \equiv \hat{\Pi}_1^B - \Pi_1^{B*} = p_U [\hat{R}_1^B - R_1^{B*}(s)]. \quad (A20)$$

Note that incremental profits for the two types of banks are the same:  $M_1^L(s) = M_1^H(s)$ .

At time  $t = 0$ , bank  $L$  may try to separate from bank  $H$  by adopting one of the following strategies: (i) charge an interest rate higher than  $R_0^{B*}$ ; (ii) charge an interest rate lower than  $R_0^{B*}$ ; (iii) renegotiate all loans that are under financial distress. Consider candidate deviation (i): if bank  $L$  charges in the first period an interest rate greater than  $R_1^{B*}$ , all borrowers will use traded debt. In this case, overall profits  $\hat{\Pi}_0^B$  for a deviating bank are  $\hat{\Pi}_0^B = \hat{\Pi}_1^B$ . Incremental profits are then equal to

$$\begin{aligned} \hat{\Pi}_0^B - \Pi_0^{B*} &= -(1 - p_U) [y + \delta q_0^{B*} (kx - y) - c_0^{B*}] \\ &\quad - p_U R_0^{B*} + 1 + p_U M_1^B(n) + (1 - p_U) M_{0D}^B, \end{aligned} \quad (A21)$$

where

$$\begin{aligned} M_{0D}^B &\equiv (1 - p_U) [\delta M_1^B(g) + (1 - \delta) M_1^B(b) \\ &\quad - \delta q_0^B (1 - p_U) \delta x (1 - k) (\alpha_1^* - \alpha_1^g) (\bar{q} - q_1^{H*})], \end{aligned} \quad (A22)$$

and  $q_0^B$  is the optimal choice of  $q$  for the continuation. In this case,  $\alpha_1^L > \alpha_1^g$  and  $q_0^L > q_0^g$  together imply  $M_{0D}^L < M_{0D}^B$  and that  $\hat{\Pi}_0^L - \Pi_0^{L*} < \hat{\Pi}_0^B - \Pi_0^{B*}$ . Hence, type  $H$  will be willing to imitate the type  $L$  deviation.

Consider now (ii). In this case, bank  $L$  charges an interest rate deviation  $\hat{R}_0^B < R_0^{B*}$ . At this lower interest rate, entrepreneurs of type  $U$  and  $S$  may still separate or may instead both borrow from the bank and pool. If they still separate, then now

$$\hat{\Pi}_0^B - \Pi_0^{B*} = p_U(\hat{R}_0^B - R_0^{B*}) + p_U M_1^B(n) + (1 - p_U) M_{0D}^B. \quad (A23)$$

Hence, from case (i), again  $\hat{\Pi}_0^L - \Pi_0^{L*} < \hat{\Pi}_0^H - \Pi_0^H$  and type  $H$  would be willing to imitate type  $L$ . If, instead, at this interest rate both types of entrepreneurs are willing to borrow from the bank, then

$$\begin{aligned} \hat{\Pi}_0^B - \Pi_0^{B*} = & -(\bar{p} - p_U)[y + \delta q_0^{B*}(kx - y) - c_0^{B*}] \\ & + \bar{p}\hat{R}_0^B + M_1^B(n) - (1 - p_U)Q_0^{B*}(\alpha_0). \end{aligned} \quad (A24)$$

Since

$$\begin{aligned} Q_0^{B*} = & p_U\{\delta R_1^{B*}(g) + (1 - \delta)R_1^{B*}(r) - R_1^{B*}(n) \\ & + \delta q_0^{B*}[R_1^{B*}(r) - R_1^{B*}(g)]\}, \end{aligned} \quad (A25)$$

the inequalities  $R_1^{B*}(r) > R_1^{B*}(g)$  and  $q_1^{L*} > q_1^H$  together imply that  $\hat{\Pi}_0^L - \Pi_0^{L*} < \hat{\Pi}_0^H - \Pi_0^H$  so that type  $H$  would again be willing to imitate type  $L$ .

Finally, consider (iii), the case in which type  $L$  attempts to separate by renegotiating all loans. Type  $H$  banks are willing to imitate type  $L$  ones again, because  $M_1^B(s)$  are the same for the two types of banks, while type  $H$  will save on current monitoring costs  $c_0^{H*}$ . Q.E.D.

*Proof of Proposition 5.* Part (a) follows immediately from expressions (15) of Proposition 3; (b) consider the first-order conditions for  $c_0^H$  and  $c_0^L$ , given by

$$\delta[kx - y + \Pi_1^{H*}(\alpha_1^L) - \Pi_1^{H*}(\alpha_1^H)]q_c = 1 \quad (A26)$$

respectively. Concavity of  $q(c)$  implies that  $c_0^{B*} > c_0^{L*} = c_1^{H*}$  iff  $\Pi_1^{H*}(\alpha_1^L) > \Pi_1^{H*}(\alpha_1^H)$ . The last inequality follows from Proposition 2 and  $\alpha_1^L > \alpha_1^H$ . (c) follows immediately from part (b) and monotonicity of  $q(c)$ . Q.E.D.

*Proof of Proposition 6.* (a) From implicit differentiation of the first-order condition for  $c_0^H$ , given in (A26) and, given the second-order condition, we have that the sign of  $\partial c_0^{H*}/\partial \alpha_0$  will be positive if

$$\delta q_c \frac{\partial[\Pi_1^{H*}(\alpha_1^L) - \Pi_1^{H*}(\alpha_1^H)]}{\partial \alpha_0} = \delta q_c p_U \frac{\partial R_1^{B*}}{\partial \alpha_1^L} \left[ \frac{\partial \alpha_1^L}{\partial \alpha_0} - \frac{\partial \alpha_1^H}{\partial \alpha_0} \right] > 0, \quad (A27)$$

where

$$\frac{\partial \alpha_1^i}{\partial \alpha_0} = \frac{\psi_s}{[\alpha_0 + \psi_s(1 - \alpha_0)]^2}. \quad (A28)$$

After some algebra, it can be verified that Equation (A27) holds if  $\alpha_0 < \bar{\alpha}_0$ , where

$$\bar{\alpha}_0 \equiv \frac{\sqrt{\psi_g \psi_r}}{1 + \sqrt{\psi_g \psi_r}}. \quad (A29)$$

(b) From the equilibrium interest rate  $R_0^{B**}$  given in Proposition 3, we have

$$\frac{\partial R_0^{B**}}{\partial \alpha_0} = \frac{1 - p_U}{p_U} \delta x (1 - k) \left[ \bar{q} - q_0^{H**} + (1 - \alpha_0) \frac{\partial q_0^{H**}}{\partial \alpha_0} \right], \quad (A30)$$

which is positive, from part (a) above. Q.E.D

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