



American Finance Association

Covenants and Collateral as Incentives to Monitor

Author(s): Raghuram Rajan and Andrew Winton

Source: *The Journal of Finance*, Vol. 50, No. 4 (Sep., 1995), pp. 1113-1146

Published by: Blackwell Publishing for the American Finance Association

Stable URL: <http://www.jstor.org/stable/2329346>

Accessed: 25/11/2009 10:30

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at <http://www.jstor.org/page/info/about/policies/terms.jsp>. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at <http://www.jstor.org/action/showPublisher?publisherCode=black>.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



Blackwell Publishing and American Finance Association are collaborating with JSTOR to digitize, preserve and extend access to *The Journal of Finance*.

<http://www.jstor.org>

Covenants and Collateral as Incentives to Monitor

RAGHURAM RAJAN and ANDREW WINTON*

ABSTRACT

Although monitoring borrowers is thought to be a major function of financial institutions, the presence of other claimants reduces an institutional lender's incentives to do this. Thus loan contracts must be structured to enhance the lender's incentives to monitor. Covenants make a loan's effective maturity, and the ability to collateralize makes a loan's effective priority, contingent on monitoring by the lender. Thus both covenants and collateral can be motivated as contractual devices that increase a lender's incentive to monitor. These results are consistent with a number of stylized facts about the use of covenants and collateral in institutional lending.

MODERN FINANCE THEORY SUGGESTS that financial intermediaries such as commercial banks, insurance companies, and finance companies monitor and control their borrowers on behalf of other investors.¹ This article investigates how the loans made by these institutions can be structured so as to best enhance the institutions' role as delegated monitors.

Covenants and collateral are common features of loans made by financial institutions, but these features are somewhat difficult to justify. Consider loan covenants—clauses in a loan contract that require the borrower to take or refrain from various actions. Berlin and Mester (1992), Magee and Sridhar (1994), and Park (1994) show that by giving institutions the right to renegotiate or call loans when covenants are violated, covenants serve as tripwires that enhance the flexibility and efficiency of financial contracting. Also, as documented in Smith and Warner (1979), control rights from covenants reduce borrower adverse selection or moral hazard. Nevertheless, by allowing institutions to demand repayment based on *any* information, contractible or not,

* Rajan is at the Graduate School of Business, University of Chicago. Winton is at the J.L. Kellogg Graduate School of Management, Northwestern University. Part of our research was funded by a grant from the Banking Research Center at Northwestern University. Rajan also thanks the Center for Research on Securities Prices and the William Ladany Fellowship for financial support. Ben Wilner provided valuable research assistance. In addition, we are grateful to Daniel Beneish, Dave Brown, Mike Fishman, Mark Flannery, Stuart Greenbaum, Joe Haubrich, Chris James, Jeff Lacker, Stan Longhofer, Helena Mullins, Anjan Thakor, Subu Venkataraman, John Weinberg, and seminar participants at Duke University, Northwestern University, the Universities of Florida and Minnesota, the Federal Reserve Banks of Philadelphia and Richmond, and the 1994 Northern Finance Association and Western Finance Association Meetings for their comments and advice. All errors remain our responsibility.

¹ Seminal papers on this topic are Leland and Pyle (1977), Campbell and Kracaw (1980), Diamond (1984), and Fama (1985).

loans that are payable on demand or have short fixed maturities give institutions even greater flexibility and control. Why then do lenders go through the more complex route of lending long term and obtaining control rights through covenants?²

Now consider collateral-specific assets pledged as security for a loan. A collateralized lender's claim to specific assets reduces its losses if the borrower becomes bankrupt. Some have argued that a secured lender has greater incentive to liquidate failing firms, increasing overall efficiency. Others suggest that the inspection of the collateral itself gives the lender additional information about the borrower (see the references in Picker (1992)). If these arguments are correct, why are roughly one-third of all long-term bank loans unsecured, and why does this percentage vary inversely with business conditions?³

Our article argues that the selective use of longer-term loans coupled with covenants and the varying use of collateral is not puzzling so long as one realizes that institutional lenders must be given incentives not only to take appropriate actions based on their information, but also to gather that information in the first place. When a bank lends to a firm, some stakeholders, such as other investors, trade creditors, employees, and the government, free-ride on the benefits of the bank's control function.⁴ This externality obviously reduces the bank's incentives to acquire and use additional information. By giving the bank the most flexibility to use its information, a short-term loan maximizes the value the bank receives from this information. Nevertheless, this is not the same as maximizing the difference between the value (to the bank) of public information and the value of private information. As a result, a bank with a short-term loan may not monitor the borrower even when monitoring is socially beneficial.

In this case, long-term debt with covenants may be preferable, as long as the covenants depend on information that is not costlessly available to the public. Although covenants restrict the ability of the bank to act, the bank will not be able to act at all unless it acquires enough information to show that the covenants have been violated. Even though a bank which *has* monitored might prefer short-term debt to long-term debt with covenants, long-term debt with covenants increases the bank's incentive to monitor by decreasing the bank's payoff if it does not monitor. By linking the effective maturity of a bank loan to how informed the bank is, covenants perform a valuable function.

² For example, Carey, Prowse, Rea, and Udell (1993) find that 94 percent of private placements, 80 percent of which are held by insurance companies, have maturities of three years or more. The authors argue that insurance companies have strong credit monitoring units and that they exercise control through covenants.

³ The percentage is drawn from the Federal Reserve's *Survey on Terms of Lending*. Evidence that the percentage varies with business conditions is discussed in Section V.

⁴ For example, James (1987) presents evidence that shareholders view bank loans as positive signals, while their response to public debt is insignificant. Further work by Lummer and McConnell (1989) suggests that much of the positive response to bank loans is linked to favorable renegotiations of existing loans.

One drawback to long-term loans with covenants is that, *ex post*, they are less efficient than short-term bank loans. Short-term loans give the bank unlimited power to act, but long-term loans with covenants only allow the bank to act if a covenant has been violated. Covenants can only concern verifiable information, but monitoring may reveal information that is unverifiable and imperfectly correlated with covenant terms. Thus, a bank that makes long-term loans with covenants will not always be able to act on the information it gathers, even if action is socially optimal.

Paradoxically, giving such a bank an *unrestricted* right to claim a fixed amount of additional collateral may allow the effective use of unverifiable private information, so long as there are other investors whose claims are at least as senior as the bank's initial loan agreement. Although, all else equal, the bank prefers more collateral to less, the act of perfecting a security interest takes place through public filings. Since the bank generally has greater incentive to obtain collateral when the borrower's prospects are poor, public investors and creditors may take increased collateralization as a sign that the borrower is in difficulty. They may then impose significant costs on the firm, such as refusing to roll over loans, demanding higher rates, or refusing to supply without advance payment, which increase the likelihood of liquidation. Under certain circumstances, public beliefs such as these are the only credible ones, and the bank acquires additional collateral only when its private information (verifiable or not) suggests that the borrower should be liquidated. As a result, the bank's ability to collateralize loans selectively makes the loan's effective priority contingent on monitoring.

Although we call the monitoring lender a bank for simplicity, in practice it could be any financial institution. Our paper describes the contractual features of institutional loans and how they vary with the degree of information asymmetries about the firm and with the nature of the firm's assets. If we further recognize that the (unmodeled) liabilities of financial institutions can give them a natural preference for assets of different maturities, we obtain a characterization of loan maturity and sourcing that accords well with the stylized facts. If public signals are much less informative than the knowledge gained by monitoring, as in the case of small and lesser known firms, short-term loans may well provide sufficient incentives for institutional lenders to monitor. Since banks have short-term liabilities and face sudden liquidity demands, it makes sense for them to specialize in this segment of the market (see the evidence in Section III). If public signals are more informative, but there is still value to monitoring, long-term loans with covenants are optimal. Since insurance companies have relatively long-term liabilities, they should specialize in making these loans. This accords well with the evidence that medium-sized firms predominantly use the private placement market for their funding needs. Finally, when the public signal is extremely informative, as is true for large and highly rated firms, there is no need for private monitoring, and the firm can be funded with short-term commercial paper.

With regard to collateral, our model predicts that the collateralization of private debt will be correlated with financial distress at the firm level and poor

business conditions at the aggregate level, both of which have empirical support. Our model also predicts that the signal of borrower difficulty sent when a lender demands collateral is stronger when the collateral either depreciates quickly or is quite risky in the short-run (e.g., accounts receivables or inventory) than when the collateral is relatively stable or long-lived (e.g., plant and equipment or land).

More generally, our article is an example of how, by creating and manipulating a game between different claimants, a firm's capital structure can be used to achieve outcomes that cannot be contracted for directly. Several recent articles also build on this idea. Harris and Raviv (1995) examine the design of bankruptcy procedures as "rules of the game" to achieve efficient liquidation when a borrower's returns are observable but unverifiable. Bolton and Scharfstein (1992), Dewatripont and Tirole (1992), Berkovitch and Israel (1993), and Berglöf and von Thadden (1994) all show that introducing multiple classes of investors can harden ex post incentives to renegotiate contracts, enhancing a manager's ex ante incentives to take actions that are not directly enforceable. Diamond (1991a, 1993) and Green and Juster (1993) show how mixing debt issues of different seniority, maturity, or concentration alters the chance and nature of default outcomes, allowing a firm to signal its unverifiable prospects ex ante.

Our article differs from these by focusing on the use of financial structure to provide incentives not for borrowers, but for the investors themselves. In this respect it resembles Besanko and Kanatas (1993), but the loan features that we focus on are quite different. Like our article, Longhofer (1993), Winton (1995), Persons (1995), and Park (1994) examine how multiple classes of securities with varying seniority can be used to improve monitoring by investors. Longhofer's analysis of the impact of contingent seniority on monitoring is close to the second part of our article; we differ by focusing on a delegated monitor rather than many identical investors.

The rest of our article proceeds as follows. Section I outlines the assumptions and framework of our model. Section II analyzes social incentives for monitoring. Section III analyzes the bank's incentives to monitor under both short-term debt and long-term debt with covenants. Section IV analyzes the use of collateral and an additional class of creditors to achieve better monitoring and liquidation incentives for the bank. Section V discusses our results in light of the theoretical and empirical literature on the use of covenants and collateral and concludes.

I. Model and Assumptions

The model has three periods. At time 0, an entrepreneur needs to finance her firm's required investment of I dollars. Once the financing is obtained, she turns effective control of the firm over to a manager. At time 1, interim signals of the firm's chance of success may be observed. Based on these signals, the firm's assets may be liquidated for a total value of γL_1 , where $\gamma > 1$ is a scale parameter. If the firm is not liquidated, then at time 2 it either succeeds,

yielding cash flows of γX , or fails, yielding nothing; in both cases, the firm's assets have a salvage value of γL_2 . We assume that $L_2 < L_1 < X + L_2$, so that a sufficiently low chance of success makes liquidation at time 1 preferable. All cash flows and asset values are costlessly verifiable, and all agents are risk neutral with a required return of zero.

The manager receives so much gratification from running the firm that she cannot be paid enough to liquidate it under any circumstances. This is simply an extreme form of the notion that money isn't everything. The power and perquisites associated with running the firm may be difficult to replace, particularly if early liquidation is seen as a signal of the manager's lack of ability. ("The manager" may proxy for other employees of the firm if these employees also gain some irreplaceable personal satisfaction from their present jobs.)⁵ Although we focus on the liquidate/continue decision, our analysis could easily be extended to conflicts between management and owners over other operational decisions.

In this framework, the entrepreneur's concern is to structure the firm's financing arrangements so as to force liquidation as efficiently as possible. We limit our analysis to debt contracts; one justification would be that a controlling equity interest requires greater risk than any imperfectly diversified agent or institution can take on.

We assume that part of the project's cash flows and salvage values are pledged to various small or uninformed claimants ("stakeholders"). Apart from managers themselves, these stakeholders could be employees or the government, both of whom have statutory priority for certain claims; trade creditors, who typically have equal standing with unsecured creditors; or small shareholders, who are the most junior claimants, but often receive some protection in bankruptcy court. Rather than specify the exact type of stakeholder, we simply assume that they receive payments such that the amounts left over for other investors are L_1 in the case of liquidation at time 1, $X + L_2$ in the case of success at time 2, and L_2 in the event of failure at time 2; thus, γ^{-1} represents the fraction of the firm's cash flows and asset values not pledged to other stakeholders.⁶ In addition, although some of the firm's inputs undoubtedly come from these stakeholders, we normalize their required investment to

⁵ Although we have excluded the manager's control value from the firm's contribution to social value, including it would not change our qualitative results. Ex post, the manager would always wish to continue the firm; if she were bribed ex post to allow liquidation, her limited wealth might prevent her from paying for the expected value of this payment ex ante, and such an arrangement would undermine her incentives to manage the firm effectively.

⁶ Earlier drafts of this article permitted investors' share of firm proceeds to vary depending on whether or not the firm was liquidated, was successful, etc. As noted below, these more relaxed restrictions might cause the bank's liquidation rule to deviate from the socially optimal rule, which could lead to a role for additional classes of investors—see Diamond (1991a, 1993), Berglöf and von Thadden (1994). Since our primary focus is on providing incentives for lenders to gather information rather than incentives for them to "do the right thing" with respect to liquidation, we have chosen the simpler framework. Exploring the interaction between these two sets of concerns is left for future research.

zero; they are assumed to pay a fair price for the value of their claims, which the entrepreneur consumes.

The key information in our model is the chance that the project will succeed at time 2. As of time 0, all agents believe that this chance is $p \in (0, 1)$. At time 1, the manager of the firm gets a more precise signal θ of the project's chance of success, where $\theta \in \{\theta_1, \theta_2\}$ and $0 \leq \theta_1 < \theta_2 \leq 1$. (In our notation, the value of a signal is also the firm's chance of success given that signal.) To simplify matters, assume θ_1 and θ_2 are equally likely, so that $p = (\theta_1 + \theta_2)/2$.

If outsiders monitor the firm, they too may observe θ , but monitoring has an ex ante cost of c . A noisy signal of θ is freely and publicly observable. This public signal π has values of π_1 or π_2 . The probability of π_i conditional on the true signal being θ_i is β , where $1/2 < \beta < 1$. From Bayes' Rule and the symmetry of the problem, $\Pr[\theta = \theta_i | \pi = \pi_j] = \Pr[\pi = \pi_j | \theta = \theta_i]$, and the unconditional probabilities of both π_1 and π_2 are $1/2$. Also, $\pi_1 = \beta\theta_1 + (1-\beta)\theta_2$, $\pi_2 = (1-\beta)\theta_1 + \beta\theta_2$, and $\theta_1 < \pi_1 < \pi_2 < \theta_2$.

Neither the private signal θ nor the public signal π is verifiable in a court of law, so they cannot be contracted upon directly. However, if an investor monitors, then in the process of observing θ she also obtains a signal $\phi \in \{\phi_1, \phi_2\}$ which is verifiable.⁷ For $i = 1$ or 2 , the probability of ϕ_i given θ_i is assumed to be $\alpha \in (1/2, 1)$. This implies that $\Pr[\theta = \theta_i | \phi = \phi_j] = \Pr[\phi = \phi_j | \theta = \theta_i]$, the unconditional probabilities of both ϕ_1 and ϕ_2 are $1/2$, $\phi_1 = \alpha\theta_1 + (1-\alpha)\theta_2$, $\phi_2 = (1-\alpha)\theta_1 + \alpha\theta_2$, and $\theta_1 < \phi_1 < \phi_2 < \theta_2$.

In this framework, the entrepreneur's goal is to raise I dollars from outside investors with a contractual structure that maximizes the total value of the firm, including the stakeholders' claims. Since it is impossible to contract directly on either π or θ , and investors cannot directly control the manager, contracts can force liquidation in one of two ways: either an investor proves a verifiable state has occurred, or the manager is unable to repay or refinance a payment due at time 1. Of course, the manager may be able to renegotiate with the investors so as to prevent actual liquidation. The entrepreneur must also take into account investors' incentives to monitor, since the information they acquire may enhance the efficiency of liquidation.

II. Liquidation Decisions and the Value of Monitoring: Social Optima

Before proceeding to the entrepreneur's design problem, we examine first-best liquidation policies and the social value of monitoring. Letting q be the firm's conditional probability of success at time 1, the socially efficient decision

⁷ This is equivalent to allowing ϕ to be obtained at cost c , with the additional cost of acquiring θ (the true state) equal to zero. Although this assumption is extreme, the main point is that obtaining and processing reasonably detailed verifiable information also privately reveals much unverifiable information; for simplicity, we have assumed that it reveals *all* possible information.

is to liquidate if and only if $\gamma L_1 \geq q(\gamma X) + \gamma L_2$, which is equivalent to liquidating if and only if

$$q \leq (L_1 - L_2)/X \equiv \theta^*.$$

The value of the firm under private information is $\gamma \cdot E_\theta[\max\{\theta X + L_2, L_1\}]$, and the value of the firm under public information is $\gamma \cdot E_\pi[\max\{\pi X + L_2, L_1\}]$. The social value of information is Δ_{FB} , where

$$\Delta_{FB} = \gamma \cdot E_\theta[\max\{\theta X + L_2, L_1\}] - \gamma \cdot E_\pi[\max\{\pi X + L_2, L_1\}].$$

If $\Delta_{FB} \geq c$, the value of information outweighs its cost and monitoring is socially efficient; otherwise it is inefficient. We have the following lemma (all proofs are in the appendix unless otherwise noted):

LEMMA 1. (i) If either $\theta^* \leq \theta_1$ or $\theta^* \geq \theta_2$, then the social value of information Δ_{FB} is zero. (ii) Otherwise, the social value of information is given by

$$\Delta_{FB} = \begin{cases} (\theta^* - \theta_1)\gamma X/2, & \text{if } \theta^* \in (\theta_1, \pi_1), \\ (\theta_2 - \pi_2)\gamma X/2, & \text{if } \theta^* \in [\pi_1, \pi_2], \\ (\theta_2 - \theta^*)\gamma X/2, & \text{if } \theta^* \in (\pi_2, \theta_2). \end{cases}$$

Its maximum value is $(\theta_2 - \pi_2)\gamma X/2$, which also equals $(\pi_1 - \theta_1)\gamma X/2$.

More precise information enhances the firm's value by improving the correlation between the decision to liquidate or continue and the firm's true prospects. When the liquidation threshold θ^* is very small, the firm is never liquidated, regardless of information; likewise, when θ^* is very large, the firm is always liquidated. In both cases, better information has no value because it does not affect the decision to liquidate or continue. For intermediate values of θ^* , the decision to liquidate is influenced by better information. When θ^* is close to p , information about the firm's prospects is most likely to affect the decision to liquidate or continue, and better information has its greatest impact.

Some simple comparative statics results follow:

LEMMA 2. Holding the prior probability of success p constant, (i) an increase in $\theta_2 - \theta_1$ weakly increases the social value of information Δ_{FB} , while (ii) an increase in $\pi_2 - \pi_1$ weakly decreases Δ_{FB} . (iii) Suppose $L_1 = L_2$. Then increasing L_1 (decreasing L_2) weakly increases Δ_{FB} until $L_1 = pX + L_2$, beyond which increasing L_1 (decreasing L_2) weakly decreases Δ_{FB} . (iv) Suppose $X \leq L_1 - L_2$, so that $\theta^* \geq 1$. Increasing X weakly increases Δ_{FB} until $X = (L_1 - L_2)/p$, beyond which increasing X weakly decreases Δ_{FB} .

The intuition for (i) and (ii) follows from the option value of liquidation: the greater the dispersion caused by obtaining more precise information, the greater the value of this additional information. Conditions (iii) and (iv) follow

from the result that the value of information is greatest when the liquidation threshold θ^* is close to the prior chance of success p .

III. Liquidation Decisions and the Value of Monitoring: The Bank's Perspective

A. Short-Term Bank Debt

In what follows we assume that it is socially optimal to monitor, which requires that $\theta^* \in (\theta_1, \theta_2)$ and that $\Delta_{FB} \geq c$. We then examine the effect of various capital structures on the firm's value.

First, suppose the entrepreneur finances the firm by issuing short-term debt to a single investor (henceforth "bank"). The bank invests at least I dollars today in exchange for a promised payment of D_1 at date 1. Because the firm has no money with which to pay at that time, the bank has to decide whether or not to demand repayment at date 1 and whether or not to renegotiate with the manager. Although there are many ways to model the renegotiation process, we have chosen the following for its simplicity. Given its estimate q of the firm's chance of success, the bank either asks for repayment or rolls over the debt at the original face value D_1 . Since her main concern is to avoid liquidation, and the discount rate is zero, the manager will not contest a rollover. If repayment is requested, the manager makes a take-it-or-leave-it offer of D_2 , where D_2 is the new promised value of the firm's debt if it is rolled over. The bank can refuse the offer, forcing liquidation, or accept the offer, allowing continuation. We assume the manager knows whether or not the bank has monitored; thus, she knows q .

If the bank is to have any hope of breaking even, D_1 must exceed I . Since I exceeds L_1 , the bank receives L_1 if the firm is liquidated. Thus, if the bank asks for repayment, it will accept any offer that gives it an expected value of L_1 . The manager will always make such an offer if it is feasible, i.e., if the offered face amount D_2 is no more than $X + L_2$, beyond which the firm can not possibly pay.⁸ This implies that the bank liquidates whenever $L_1 > qX + L_2$; i.e., whenever $q < \theta^*$.

The bank receives $\max\{q(D_1 - L_2) + L_2, L_1\}$. If $q < \theta^{ST} \equiv (L_1 - L_2)/(D_1 - L_2)$, this equals L_1 ; otherwise, the bank rolls over its debt at the original amount D_1 . Notice that $\theta^{ST} \geq \theta^*$. The bank's value of additional information is

$$\Delta_{ST}(D_1) = E_\theta[\max\{\theta(D_1 - L_2) + L_2, L_1\}] - E_\pi[\max\{\pi(D_1 - L_2) + L_2, L_1\}],$$

and the bank monitors if and only if $\Delta_{ST} - c \geq 0$. The next lemma evaluates Δ_{ST} .

LEMMA 3. (i) If $\theta^{ST} \leq \theta_1$, the bank always rolls over its debt at D_1 , and its value of information Δ_{ST} is zero. (ii) If $\theta^{ST} \geq \theta_2$, the bank never lends, and Δ_{ST} is zero.

⁸ The manager cannot credibly signal her type via the offer, since even a firm with low chance of success at $t = 2$ is willing to offer $D_2 = X + L_2$.

(iii) Otherwise,

$$\Delta_{ST}(D_1) = \begin{cases} (\theta^{ST} - \theta_1)(D_1 - L_2)/2, & \text{if } \theta^{ST} \in (\theta_1, \pi_1), \\ (\theta_2 - \pi_2)(D_1 - L_2)/2, & \text{if } \theta^{ST} \in [\pi_1, \pi_2], \\ (\theta_2 - \theta^{ST})(D_1 - L_2)/2, & \text{if } \theta^{ST} \in (\pi_2, \theta_2). \end{cases}$$

(iv) Δ_{ST} is maximized when $D_1 = \min\{X + L_2, D_1^{ST*}\}$, where $D_1^{ST*} \equiv (L_1 - L_2)/\pi_1 + L_2$. When $D_1 = D_1^{ST*}$, $\theta^{ST} = \pi_1$ and $\Delta_{ST} = (\pi_1 - \theta_1)(L_1 - L_2)/2\pi_1 = (\theta_2 - \pi_2) \cdot (L_1 - L_2)/2\pi_1$.

Since the incentive to monitor depends on the degree to which better information increases the value of the bank's claim, it might seem that this incentive is always maximized when this claim is as large as possible, i.e., at $D_1 = X + L_2$. Result (iv) suggests that this intuition is wrong. One way to think about this is as follows: if the face value of debt is below D_1^{ST*} and the bank does not monitor, it will liquidate whenever it sees the public signal π_1 . Thus the probability that the bank gets repaid the full face value is only $\pi_2/2$. By contrast, if it monitors, the probability is $\theta_2/2$. Since $\theta_2 > \pi_2$, the value of monitoring relative to not monitoring increases in the face value. But if the face value of debt is above D_1^{ST*} , θ^{ST} is less than π_1 . This means that if the bank does not monitor, it will roll over its debt at face value regardless of the public signal. Then the probability the bank recovers the face value is $\theta_1/2 + \theta_2/2$. By contrast, when the bank does monitor, it will continue to liquidate if it sees θ_1 . So the probability it recovers the face value is still $\theta_2/2$. Since $\theta_1 + \theta_2 > \theta_2$, the value of monitoring relative to not monitoring decreases in the face value. This is why D_1^{ST*} is optimal.

More generally, an increase in the size of the delegated monitor's claim increases both the value of monitoring and the value of not monitoring. Whether the difference increases depends on the actions the lender expects to take in each situation. When the size of the claim increases beyond a certain level, if the lender has not monitored, it always prefers to let the firm continue. Since the claim can only be paid in full if the firm continues, further increases in the claim's size decrease the value of monitoring.

PROPOSITION 1. (i) Suppose the following conditions hold for some D_1 :

$$\Delta_{ST}(D_1) \geq c \quad (1)$$

$$X + L_2 \geq D_1 \quad (2)$$

$$D_1 \geq [2(I + c) - L_1 - L_2]/\theta_2 + L_2. \quad (3)$$

Then it is possible to achieve socially optimal liquidation and monitoring by financing the firm with short-term bank debt with face value D_1 . (ii) Suppose either of the following conditions hold:

$$X < [2(I + c) - L_1 - L_2]/\theta_2. \quad (4)$$

$$(\pi_1 - \theta_1)(L_1 - L_2)/2\pi_1 < c \quad (5)$$

Then short-term bank debt cannot achieve socially optimal liquidation and monitoring.

Condition (1) is the incentive compatibility condition that the bank's gains from monitoring exceed its cost of monitoring. Condition (2) ensures that the debt's face value D_1 can be repaid when the firm is successful. Condition (3) follows from the bank's individual rationality condition that the bank find it worthwhile to lend the firm money in the first place. Notice that if this condition holds strictly, the bank can lend more than 1 up front, letting the entrepreneur pocket the slack.

Part (ii) of the proposition is a straightforward corollary of the necessary conditions in part (i). When condition (4) holds, the bank cannot cover its costs of lending and monitoring. The crucial inequality is condition (5). The left hand side is the maximum incentive to monitor with short-term debt (which is immediate from Lemma 3 (iv)). The inequality holds if this is not enough to overcome the cost of monitoring. Intuitively, the closer the public and private signals are (the smaller is $\pi_1 - \theta_1$), the less the gains to monitoring. Similarly, the smaller the difference between liquidating now and tomorrow (the smaller is $L_1 - L_2$) the less the gain to early liquidation, and thus, the less the gain to monitoring. Finally, the higher the probability of success given the bad public signal, π_1 , the smaller the optimal face value of short term debt, D_1^{ST*} , which reduces the maximum value of monitoring.

As we show in a later example, even when monitoring is socially optimal, it may be impossible to give a short-term bank lender incentive to monitor. Along with the generic problem that others free-ride on the bank's monitoring, short-term bank debt may give the bank "too much power." The bank can always base its decision to demand repayment on the public signal; since this ability increases the value of being uninformed, it may reduce incentives to monitor. If the terms of the bank loan can be changed so that the bank's power when it is uninformed is much more restricted than its power when it is informed, the bank's incentives to monitor can be increased. We now show how long-term bank debt with covenants can help to accomplish this.

B. Long-Term Bank Debt and Covenants

Suppose that the bank is given long-term debt with a face value of D_2 , with $D_2 \geq I > L_1$. If this debt has no covenants, the bank's expected return is $pD_2 + (1 - p)L_2$. Since the bank has no power to demand early repayment, it has no incentive to monitor. By adding covenants, the bank will be given some power to demand early repayment, but only if it can prove that the covenant has been violated. This is precisely the sort of conditional power just discussed.

To be enforceable, covenants must be based on verifiable information; to add value, they must lead to the acquisition of information that is better than that which is publicly available. In our model, we have made the simplifying assumption that collecting evidence for the verifiable private signal ϕ allows one to observe the *unverifiable* private signal θ at no additional cost.

Nevertheless, the verifiable signal itself need not be more precise than the public signal π , and it might even be less precise.

Suppose the bank debt incorporates the following covenant based on this verifiable signal ϕ : if the bank can prove ϕ_1 has occurred, it has the right to demand repayment of the loan, forcing liquidation if it so chooses.⁹ If the bank is to have any hope of using the covenant, it must monitor.

Since covenant violations are ex post verifiable, it may seem unreasonable to assume that monitoring cannot be contracted upon directly. Several factors support our assumption. First, if a covenant has not been violated and the bank claims it has, the firm's management has an immediate incentive to challenge the claim in court, using fresh information. By contrast, monitoring is a process rather than an outcome. If the firm fails without warning, this is merely consistent with lack of monitoring, and additional costly evidence will have to be unearthed to prove that monitoring failed. Second, in equilibrium, covenant violations do not need to be verified by the courts. By contrast, monitoring will have to be verified (even if randomly), so contracting on monitoring is likely to be more costly. Third, management has direct incentives to challenge the bank over an incorrect claim of a covenant violation, while it is other stakeholders who have incentive to enforce monitoring contracts; clearly, management is likely to be less diffuse and better-informed than other stakeholders. For all these reasons, contracting on covenants is likely to be easier than is contracting directly on monitoring.

Returning to the model, suppose the bank lends and monitors. If ϕ_2 occurs, the bank must let the debt stay in place until time 2. However, if ϕ_1 occurs, the bank now has the same decision it faced with short-term debt: based on the value of θ , it can either let the debt stay in place or ask for immediate repayment and renegotiate with the manager. When $\theta X + L_2 < L_1$, (i.e., $\theta < \theta^*$), the bank demands repayment and refuses any feasible offer from the manager, forcing liquidation. When $\theta \geq \theta^*$, the bank receives expected payments equal to the greater of L_1 (if it demands repayment) and $\theta(D_2 - L_2) + L_2$ (if it simply keeps its debt in place). Thus the bank demands repayment when $\theta < \theta^{CV} = (L_1 - L_2)/(D_2 - L_2)$.

If the bank monitors, its expected payoff (before subtracting the monitoring cost c) is

$$\begin{aligned} \frac{1}{2}\{\alpha \cdot \max[\theta_1(D_2 - L_2) + L_2, L_1] + (1 - \alpha) \cdot \max[\theta_2(D_2 - L_2) + L_2, L_1]\} \\ + \frac{1}{2}\{\phi_2(D_2 - L_2) + L_2\}. \quad (6) \end{aligned}$$

⁹ In practice, an initial demand for repayment may not require formal proof of covenant violation, but as we detail later on, the courts impose penalties when a bank or other large investor cannot prove its actions were allowed by the loan contract and warranted by the circumstances.

In this simple model, a covenant cannot be violated for both realizations of ϕ , because then the bank would not have to monitor in order to prove a violation had occurred. Since covenant violations allow the bank to demand repayment, it makes the most sense to have the violation occur for ϕ_1 , which is correlated with the poor state θ_1 .

If the bank does not monitor it gets $p(D_2 - L_2) + L_2$. The bank's increase in value from better information, Δ_{CV} , is the difference between these expressions. It will monitor if $\Delta_{CV} \geq c$.

LEMMA 4. Suppose the bank's loan is long-term with face value D_2 and has a covenant which is violated when $\phi = \phi_1$. (i) If $\theta^{CV} \leq \theta_1$, the bank never enforces a covenant violation, and its net value of information Δ_{CV} is zero. (ii) If $\theta^{CV} \geq \theta_2$, the bank never lends (it would get no more than L_1 if it did), and Δ_{CV} is zero. (iii) If $\theta^{CV} \in (\theta_1, \theta_2)$, $\Delta_{CV} = \frac{1}{2}\alpha \cdot \{L_1 - L_2 - \theta_1(D_2 - L_2)\} = \frac{1}{2}\alpha(\theta^{CV} - \theta_1) \cdot (D_2 - L_2)$. (iv) Δ_{CV} is maximized when $D_2 = D_2^{CV*}$, where

$$D_2^{CV*} = \frac{2(I + c) - \alpha L_1 - (1 - \alpha)L_2 - L_2}{\theta_2 + (1 - \alpha)\theta_1} + L_2 \quad (7)$$

is the smallest value of D_2 such that, ex ante, the bank is willing to lend and monitor. (v) D_2^{CV*} is decreasing in α , and $\Delta_{CV}(D_2^{CV*})$ is increasing in α .

The first three results follow the same logic as the analogous statements in Lemma 3. Result (iv) says that the optimal face value of the bank's claim is the smallest value consistent with individual rationality. When the bank monitors, it sometimes demands repayment and receives an expected value of L_1 , which is independent of the claim's initial face value. When the bank does not monitor, however, the firm always continues into the second period, and the debt's initial face value becomes the bank's payment whenever the firm is successful. Thus, increases in the face value of the bank's claim help it less when it monitors than when it does not. Result (v) is straightforward: as covenants become more precise, the bank gets more conditional on monitoring, and its individual rationality condition is met with a lower face value. Also, from (iv), the lower face value improves its incentive to monitor. Finally, note that, because the bank's actions cannot depend on the public signal π , its incentive to monitor is unrelated to the informativeness of the public signal.

PROPOSITION 2. Suppose it is socially optimal to monitor, and the following conditions hold:

$$c \leq \Delta_{CV}(D_2^{CV*}) \quad (8)$$

$$X + L_2 \geq D_2^{CV*} \quad (9)$$

then long-term bank debt with covenants and face value D_2^{CV*} achieves monitoring. If either condition is violated, it is impossible to achieve monitoring through long-term bank debt with covenants.

Condition (8) guarantees that, once the bank has made the loan, it will find it incentive compatible to monitor. Condition (9) guarantees that the minimum face value that fulfills the bank's individual rationality constraint is in fact feasible.

Comparing these results with those of Proposition 1 leads to several insights. One can show that the bank's individual rationality constraint for short-term debt (condition (3)) is less stringent than that for long-term debt (condition (7)). On the other hand, because $\Delta_{ST}(D_1)$ increases in D_1 over part of its range, the bank's incentive compatibility condition (1) for monitoring with short-term debt may require a face value that is not feasible. Because $\Delta_{CV}(D_2)$ decreases in D_2 , this never happens with long-term debt. As a result, there are circumstances where long-term bank debt with covenants implements monitoring while short-term bank debt with a much higher face value cannot do so, and long-term bank debt with covenants may be able to implement monitoring with less investment and exposure to the firm's risk than short-term bank debt.

This is illustrated by the following example. Let $X = 1.6$, $L_1 = 0.9$, $L_2 = 0.5$, $\gamma = 2.5$, $I = 1$, and $c = 0.09$. Also, let $\theta_1 = 0.15$, $\theta_2 = 0.85$, $\alpha = 0.80$, and $\beta = 0.857$. Thus $\theta^* = 0.25$ and $\Delta_{FB} = 0.20$. Since Δ_{FB} exceeds c , monitoring is socially optimal. Short-term bank debt cannot achieve monitoring: $D_1^{ST*} = 2.10$, but $\Delta_{ST}(D_1^{ST*}) = 0.08$, which is less than c . Nevertheless, long-term bank debt with covenants does achieve monitoring: $D_2^{CV*} = 1.48$, and $\Delta_{CV}(D_2^{CV*}) = 0.10$, which exceeds c . Notice that the verifiable signal that covenants are based on is less accurate than the public signal ($\alpha < \beta$).

In effect, the maturity of the long-term loan with covenants is always long-term when the bank does not monitor but possibly short-term if it does monitor. This penalizes the bank for not monitoring by limiting its ability to act on the basis of public information alone. The fact that long-term debt with covenants exacts a greater penalty for not monitoring can make it a better vehicle than short-term debt for achieving monitoring. The obvious drawback of long-term debt is that even if the bank does monitor, it can only liquidate the firm when the covenant is violated. Since the verifiable signal ϕ is imperfectly correlated with the private information θ (i.e., $\alpha \neq 1$), the lender cannot achieve first-best liquidation. Thus, in our example, the social value of the firm (net of any monitoring costs) is 3.36 under the first best, 3.32 with long-term covenanted debt, and 3.25 with short-term bank or public debt.

In Figure 1, we plot the welfare-maximizing debt contract as a function of the accuracy β of the public signal π , and the precision α of the verifiable signal (or covenants) ϕ . When the public signal is very imprecise, the financial institution has an incentive to monitor even with short-term debt, and therefore first-best liquidation is achieved. As the public signal becomes more accurate, only long-term private debt with covenants provides enough incentive to monitor. Finally, when the public signal is very accurate (β close to 1), short-term debt (either private or public) dominates: monitoring is no longer worth the cost, while a short maturity allows the lender to act freely on the basis of public information.

These predictions find some support in the stylized facts. Petersen and Rajan (1994) find that the single largest source of external finance for small U.S. firms (firms with less than 500 employees) is bank debt. Given the gap

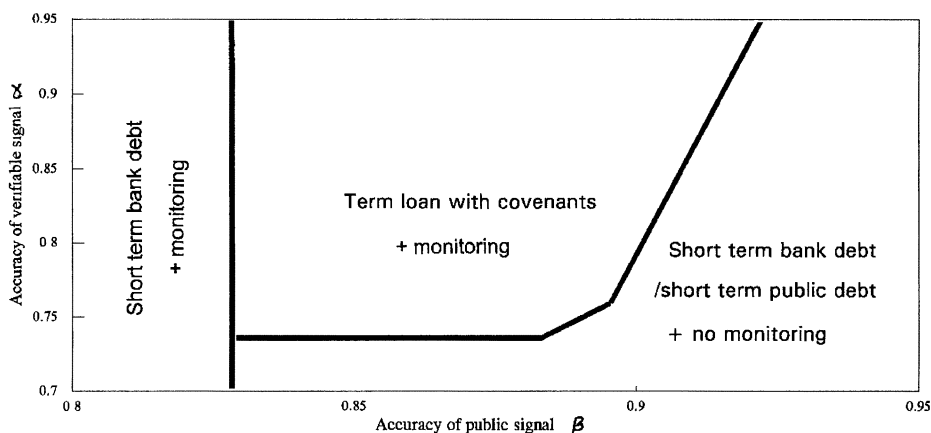


Figure 1. Optimal debt contracts. This figure shows which of several debt contracts are optimal for various values of β (the accuracy of the public signal) and α (the accuracy of the verifiable information on which covenants are based). The debt contracts include short-term bank debt with monitoring, long-term bank debt ("term loan") with covenants and monitoring, and short-term debt (bank or public) with no monitoring. Other parameter values are as in Example 1 in the text.

between public and private information for such firms, it is clear that banks have the incentive to monitor, which is why much of this debt is short term.¹⁰ For medium-sized firms, the gap between private and public information is likely to be much smaller. These firms typically borrow in the private placement market from institutions such as life insurers and banks. Private placements are typically medium term, with 50 percent of them being between three and seven years in maturity (see Carey et al. (1993)). For very large firms, public information is almost as good as private information, which is why they can issue short-term public debt such as commercial paper for their financing needs.¹¹ Finally, to the extent that the gap between private and public information is negatively correlated with credit rating, our theory predicts an inverse U-shaped relationship between debt maturity and credit rating, which is consistent with the evidence in Barclay and Smith (1995).

IV. Multiple Creditors, Collateral, and Incentives to Liquidate

As just noted, the problem with long-term bank debt is that, because covenants are imprecise measures of the firm's true state of affairs, the bank is prevented from liquidating the firm in some situations where liquidation is

¹⁰ Carey et al. (1993) report that approximately 80 percent of bank loans originated in 1989 had maturities of one year or less. Of course, since loans with shorter terms mature and are refinanced more frequently than those with longer terms, short-term loans are probably less than 80 percent of *outstanding* bank loans.

¹¹ Carey et al. (1993) find that firms that borrow from banks have average sales of \$40 million, while firms that issue privately-placed debt have average sales of \$1 billion. Calomiris et al. (1994) find that firms that issue commercial paper have average sales of \$1.5 billion.

desirable. On the other hand, short-term bank debt may not give the bank enough incentive to monitor in the first place. In such instances, there would be social gains to a financing structure that not only gave the bank sufficient incentive to monitor, but also ensured that the bank's information was used more efficiently than covenants allow. We now show how such a structure can be accomplished by introducing another class of creditors and giving the bank the ability to collateralize its debt.

Suppose that, in addition to the bank, the firm can borrow from "the public"—i.e., any relatively diffuse group of investors. Let the amount of required investment raised from the bank be I^B and the amount of required investment raised from the public be $I^P = I - I^B$. Although public investors can act on any public information, the diffusion of these investors causes free-riding and coordination problems that make it impossible for them to monitor the firm. Thus, if any creditor monitors, it will be the bank.

With multiple creditors, the priority of claims must be specified. We assume that senior creditors receive absolute priority over the firm's cash flows and unsecured assets, but secured creditors receive absolute priority over the assets that make up their collateral. Thus, collateral provides a way for the firm to promise the liquidation value of certain assets to a creditor, overriding the existing seniority structure. It is essential that other creditors be able to observe the bank's actions. In fact, the act of "perfection" is a matter of public record. Although it might be argued that diffuse public creditors do not monitor court records, credit monitors do report such information. For example, Dun and Bradstreet, the trade credit rating agency, reports information on the status and collateralization of a firm's bank loans in its Credit Advisory System and Business Information Reports (see Cole (1984), pp. 346–354).

In structuring public debt and bank debt, the entrepreneur wishes to give the bank sufficient incentive to monitor and force liquidation when it is efficient. Suppose first that public debt is unconditionally junior to bank debt. In this case, results are not significantly different from those of the previous section: whenever the bank demands repayment, the manager can make the bank a take-it-or-leave-it offer at the public's expense. On the other hand, if bank debt is unconditionally junior to the public, the bank's incentives to seek repayment are limited: since the public debt is paid first, the bank's threat to force liquidation rings somewhat hollow. Since the bank is more likely to favor continuation regardless, its incentives to monitor should be limited as well.

In order to balance these concerns and give the bank incentive to monitor, the bank should have conditional seniority: the bank should be senior when it gets bad news about the firm, so that it does not allow the firm to continue excessively, and junior when it gets good news about the firm, so that it does not have an incentive to liquidate excessively. The structure should also be robust to attempts by the bank and the firm manager to jointly dispossess the public creditor. Since such a structure would make the bank's payoff sensitive to the firm's situation, it should also increase the bank's incentives to monitor and obtain finer information.

Since the private information θ is not verifiable, the conditional seniority just proposed cannot be directly built into the bank's loan contract. Nevertheless, in some cases a structure that achieves these results can be obtained by manipulating public investors' response to the bank's actions. Suppose the bank loan is long-term, has face value D_2^B , and is *junior* to the public claim, which is short-term and has face value D_1^P . At time $\frac{1}{2}$, the bank can demand that its claim be collateralized with prespecified assets whose time 1 value is $K \cdot L_1$ and time 2 value is $K \cdot L_2$, where $K \in [0, 1]$.¹² The action of demanding collateral is publicly observable because the bank has to perfect its claim in court. At time 1, the public claim matures. Based on both the public signal and the bank's action, the public forms beliefs about the firm's chance of success. Since the public debt is diffusely held, the manager cannot renegotiate it. Instead, one of two things happens: if the public investors believe that the firm can offer a new face value D_2^P such that the expected value of this new debt equals the old face value D_1^P , the public debt can be refinanced; otherwise, the firm is unable to refinance its public debt, resulting in liquidation.¹³

Now consider the following equilibrium. The bank monitors, and finds out the firm's true state of affairs θ at time $\frac{1}{2}$. If the state is θ_1 , it collateralizes its claim; if the state is θ_2 , it does nothing. If the bank takes collateral, at time 1 the public conjectures the true state is θ_1 , the firm is unable to roll over the public debt, and liquidation follows. If the bank does not take collateral, the public conjectures the true state is θ_2 , and the firm rolls over its public debt at a new face value of $(D_1^P - L_2)/\theta_2 + L_2$. Unlike short-term debt, this equilibrium gives the bank incentive to monitor; unlike long-term debt with covenants, the bank is able to force liquidation whenever the bad state (θ_1) occurs by signaling its information to the market.

PROPOSITION 3. *Suppose that the bank receives junior long-term debt with face value D_2^B and the right to claim collateral equal to K times L_1 , and the public receives senior short-term debt with face value D_1^P . Then a fully revealing equilibrium of the type just described exists when the following*

¹² Our assumption that the bank collateral's share of asset value is constant over time is made for notational simplicity alone; all that is really required is that the collateral's value in distress must decline over time. We assume that the bank acts before the public signal is realized both to simplify analysis and to reflect the fact that the legal system tends to disallow attempts to perfect additional collateral immediately before bankruptcy filings.

¹³ Here, refinancing means that the firm issues new debt with face value D_2^P , using the proceeds to pay off any public debtholders who are not willing to roll their claims over. Implicitly, we are assuming that the firm cannot renegotiate its public debt, even when renegotiation might be optimal ex post. This follows from hold-out problems (see for example Gertner and Scharfstein (1991) and Green and Juster (1993)).

conditions hold.¹⁴

$$D_2^B + \frac{D_1^P - L_2}{\theta_2} \leq X \leq \frac{D_1^P - (1 - K) \cdot L_2}{\theta_1} \quad (10)$$

$$\max\{KL_1, L_1 - D_1^P\} \geq \theta_1 \cdot \left[X - \frac{D_1^P - L_2}{\theta_2} \right] \quad (11)$$

$$\frac{1}{2}\theta_1 D_2^B + c \leq \frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} \leq \frac{1}{2}\theta_2 D_2^B - c \quad (12)$$

$$\frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} + \frac{1}{2}\theta_2 D_2^B - c \geq I^B \quad (13)$$

$$\frac{1}{2} \cdot \min\{D_1^P, (1 - K)L_1\} + \frac{1}{2}D_1^P \geq I - I^B \quad (14)$$

The first inequality in condition (10) guarantees that, if the bank does not take collateral and the public conjectures that the state is θ_2 , the public debt can be rolled over and the bank can collect its promised amount when the firm is successful. The second inequality guarantees that, if the bank takes collateral and the public conjectures that the state is θ_1 , the public debt cannot be rolled over. Condition (11) ensures that the bank cannot be bribed to forego taking collateral in the bad state. The inequalities in condition (12) come from incentive compatibility conditions guaranteeing that the bank prefers monitoring and selectively taking collateral to not monitoring and either never taking collateral or always taking it, respectively. Finally, conditions (13) and (14) are individual rationality conditions for the bank and for the public, respectively. We assume that the entrepreneur redefines I^B and I^P so that constraint (13) is binding; that is, the entrepreneur captures all surplus.

The intuition behind this equilibrium is that, although the bank has an unrestricted right to take collateral, its desire to do so is tempered by its fear of triggering actions by public investors that diminish the value of future cash flows in which the bank has a substantial stake. Therefore, the bank only takes collateral in the bad state, signalling its information to the public. Notice also that, in equilibrium, the bank's incentive to monitor does not depend on the public signal or any ability to write detailed covenants. This is because the bank gets the power to liquidate the firm only through the actions of the public investor. Public investors use the bank's actions as a signal of the true state, ignoring the public signal; thus, first-best liquidation is achieved.

Although we have presented this equilibrium under a specific financial structure, the intuition holds more generally. For example, we assume that a bank's insistence upon more collateral causes immediate liquidation. All we need, however, is that this action causes other creditors to demand higher

¹⁴ To simplify notation, we assume that D_1^P exceeds second period salvage value L_2 and is weakly less than L_1 .

interest rates and shorter maturities. This will increase the probability of liquidation and reduce the expected value of the bank's future rents if the firm is not liquidated. Similarly, our assumption that the bank's claim, if unsecured, is junior to other creditors is not crucial. All that is needed is that the collateral enhances the bank's position in the bad state. This is true if the bank is *pari-passu* with the public debt, or if bankruptcy courts uphold the rights of secured creditors better than they uphold the rights of senior unsecured creditors. Finally, although we have assumed the bank's claim is long term in order that it have the incentive to monitor, even with short-term debt, the bank would only wish to liquidate if it had secured itself, which could still act as a signal to public creditors.

Even if this equilibrium exists, it may not be unique. There are three possible alternative equilibria: (i) the bank monitors, but takes collateral only in the good state (θ_2); (ii) the bank does not monitor and never takes collateral; (iii) the bank does not monitor and always takes collateral. (Notice that if the bank monitors, it must act differently for θ_1 than for θ_2 ; otherwise, its information has no effect on the public action, and the bank gets no value from the information.) The next proposition gives conditions under which the first of these alternative equilibria can be ruled out.

PROPOSITION 4. *Suppose the conditions in Proposition 3 are met, so that an equilibrium exists in which the bank's taking collateral signals the bad state. Then if either of the following conditions hold, there is no equilibrium in which the bank monitors, takes collateral when the true state is θ_2 , and does not take collateral when the true state is θ_1 :*

$$\frac{D_1^P - L_2}{\theta_1} \leq X \quad (15)$$

$$KL_1 - (L_1 - D_1^P) > (1 - \theta_2) \cdot KL_2 \quad (16)$$

Intuitively, the only possible equilibrium in which the bank taking collateral signals the good state is one in which public investors respond to "no collateral" (the bad state) by liquidating the firm and respond to "collateral" (the good state) by rolling over their debt: if rather than liquidating they roll over their debt when collateral is not taken, the bank would want to take collateral (it bolsters its position and sends a good signal). When condition (15) holds, public investors actually prefer to roll over their debt in the bad state, breaking the equilibrium. Condition (16) implies that the bank has more to gain from taking collateral in the event of liquidation than it gains from taking collateral as a protection against the firm's future failure, a reasonable enough condition if taking collateral is to signal bad current prospects. This condition will hold if the firm's collateral is sufficiently risky (so that L_2 is sufficiently less than L_1),

or if public debt is sufficiently high relative to the firm's immediate liquidation value L_1 .¹⁵

The next proposition rules out the equilibrium in which the bank never takes collateral.

PROPOSITION 5: *Suppose the conditions in Proposition 3 are met, so that an equilibrium exists in which the bank's taking collateral signals the bad state. Then an equilibrium in which the bank never takes collateral cannot exist if either (i) $\pi_2 < (D_1^P - L_2)/X$, (ii) $\pi_1 > (D_1^P - L_2)/X$, or (iii) $L_1 - D_1^P < \pi_1 \cdot D_2^B$.*

The intuition behind part (i) of this proposition is straightforward: in the conjectured equilibrium, the bank's actions reveal nothing, so liquidation is based on the public signal. When the condition on π_2 holds, the firm would always be liquidated, so no one would lend in the first place. Parts (ii) and (iii) derive from the requirements of the base equilibrium in Proposition 3: once the entrepreneur offers terms consistent with that equilibrium, the bank must monitor and seize collateral in the bad state in order to meet its individual rationality constraint. When either condition is met, the bank cannot earn enough in the alternative nonrevealing equilibrium to meet its required return, so this equilibrium cannot exist.¹⁶ Finally, note that all it takes to rule out the equilibria in propositions 4 and 5 is that the level of public debt D_1^P be high enough relative to the liquidation value L_1 .

The last possible alternative equilibrium is one in which the bank doesn't monitor and always takes collateral. This equilibrium can coexist with the signalling equilibrium from Proposition 3; however, as the next proposition shows, it breaks down under certain circumstances.

PROPOSITION 6. *Suppose the conditions of Proposition 3 hold. (i) If $\pi_2 < [D_1^P - (1 - K)L_2]/X$, then there is no equilibrium in which the bank always takes collateral.*

(ii) Suppose $[D_1^P - (1 - K)L_2]/X \in (\pi_1, \pi_2]$. If

$$\frac{1}{2}\pi_2 \cdot B + \frac{1}{2}(1 - \pi_2)KL_2 < \frac{1}{2}\theta_2 \cdot D_2^B - c \quad (17)$$

$$\text{where } B = \text{Min} \left\{ D_2^B, X + KL_2 - \frac{D_1^P - (1 - K) \cdot L_2}{\pi_2} \right\}$$

¹⁵ Strictly speaking, condition (16) rules out this alternative equilibrium only when the bank's individual rationality constraint in the equilibrium of Proposition 3 is binding. This will always be true if the entrepreneur can give the bank a take-it-or-leave-it offer which specifies not only the contract terms but the amount the bank invests. If the entrepreneur can only dictate contract terms, this alternative equilibrium might be feasible if the bank invests less and the public invests more. Nevertheless, if $L_1 - D_1^P$ is small relative to KL_2 , this equilibrium is not incentive compatible; the bank prefers always to take collateral and forego monitoring.

¹⁶ As with condition (16), this result assumes that the entrepreneur's offer dictates the amount the bank invests. Nevertheless, even if the entrepreneur cannot dictate investment amounts, the alternative equilibrium will not pass the Universal Divinity criterion of Banks and Sobel (1987) so long as D_1^P is not much less than L_1 .

then there is no equilibrium in which the bank always takes collateral.

(iii) If $[D_1^P - (1 - K)L_2]/X \leq \pi_1$, and

$$\begin{aligned} & \frac{1}{2}\pi_1 \cdot A + \frac{1}{2}\pi_2 \cdot B + (1 - p)KL_2 \\ & < \frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} + \frac{1}{2}\theta_2 \cdot D_2^B - c \quad (18) \end{aligned}$$

$$\text{where } A = \text{Min}\left\{D_2^B, X + KL_2 - \frac{D_1^P - (1 - K) \cdot L_2}{\pi_1}\right\}$$

then there is no equilibrium in which the bank always takes collateral.

Once more, these results derive from the individual rationality constraints of the various investors. If the condition in (i) holds, then a nonrevealing equilibrium in which the bank always takes collateral would always lead to liquidation, and investors would not be willing to invest in the first place. In cases (ii) and (iii), such a nonrevealing equilibrium could be feasible; however, the bank's own individual rationality condition is violated if conditions (17) or (18) hold, respectively.¹⁷ Here, A and B represent the maximum amount the bank can receive if the firm is successful, given that public investors are senior and may demand a rollover value that is so high that the bank does not receive D_2^B in full.

When will conditions (17) or (18) hold? Since $A \leq B \leq D_2^B$, it is easy to show the following:

COROLLARY 1. *Suppose the conditions of Proposition 3 hold. (i) If KL_2 is sufficiently close to zero, and π_2 is sufficiently below θ_2 (i.e., β is sufficiently close to $\frac{1}{2}$), then there can be no equilibrium in which the bank always takes collateral. (ii) If π_2 is sufficiently close to θ_2 (β is sufficiently close to 1), then the equilibrium in which the bank always takes collateral exists.*

When collateral protects the bank's position more in the present than in the future, taking collateral is a strong indication that the bank wants the firm liquidated now. By contrast, if collateral values are stable over time, taking collateral bolsters the bank's position both now and in the future and is not necessarily revealing. Since the collateral's value when the firm succeeds is irrelevant (the bank only benefits from the collateral if the firm fails), a low value of KL_2 is consistent with collateral that is risky as well as collateral whose value depreciates rapidly. Of course, if the public signal is sufficiently precise, the bank may be content to take collateral all the time and let the decision to liquidate the firm be based on public information alone, thereby avoiding the cost of monitoring.

In order to put the discussion in this section on a more concrete footing, we return to the example from the previous section. Once more, with these

¹⁷ Again, this assumes that the entrepreneur can dictate the amount the bank invests. If this is not the case, Universal Divinity rules out this equilibrium under conditions that are qualitatively similar to conditions (17) and (18).

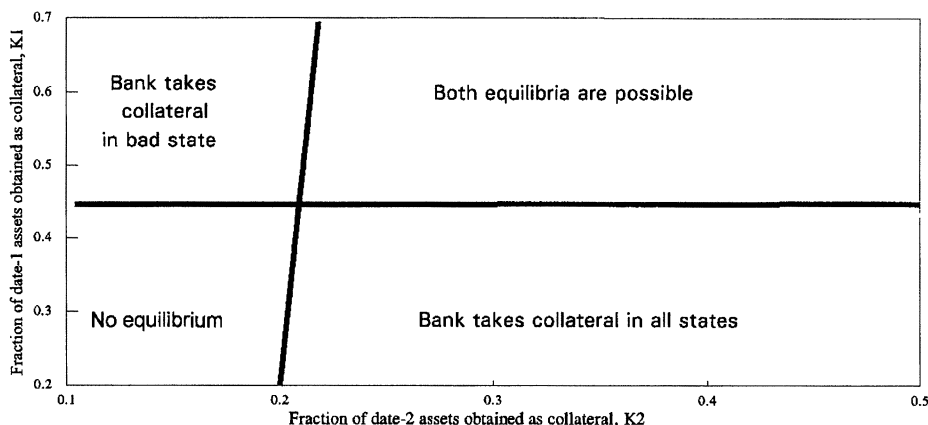


Figure 2. Two possible equilibria. This figure shows which of two equilibria exist, as the value of the additional collateral the bank can take varies. The two possible equilibria are one in which the bank only takes additional collateral when the firm is in the bad state at time 1, and one in which the bank takes additional collateral regardless of the firm's state at time 1. K_1 is the value of the additional collateral at time 1, and K_2 is the value of this collateral at time 2. Other parameter values are as in Example 1 in the text.

parameter values short-term bank debt doesn't support monitoring, and long-term bank debt with covenants supports monitoring but doesn't achieve first-best liquidation. Suppose the entrepreneur sets $D_1^P = 0.8$, $D_2^B = 1.2$, $I^B = 0.6$, and $K = 0.45$. It is easy to check that all of the conditions in Proposition 3 are satisfied, so the signalling equilibrium where taking collateral is bad news does exist. Condition (16) in Proposition 4 and conditions (ii) and (iii) of Proposition 5 hold, ruling out equilibria where collateral is good news or where collateral is never taken. Nevertheless, the nonrevealing equilibrium where the bank always takes collateral *does* exist.

In Figure 2, we allow the bank's share of the collateral to be K_1 at date 1 and K_2 at date 2. We then plot the different equilibria based on the other parameter values in our example. When K_1 is high relative to K_2 (the upper left corner), the unique equilibrium is one where the bank's taking collateral signals the bad state. Thus, even if the firm's assets do not necessarily depreciate, so long as the bank is collateralized with the portion of the firm's assets that depreciates ($K_1 \gg K_2$), the signalling equilibrium is unique. Note also that the first best is achieved, even though short-term debt does not provide enough incentive to monitor, and long-term debt with covenants does not provide enough ability to liquidate. It is in this sense that setting up games between claimholders can improve contractibility.

V. Legal and Empirical Evidence

A. Covenants

In our introduction we argued that many of the explanations for the use of covenants in long-term debt contracts could just as easily be dealt with by

making debt short-term or payable on demand. One argument for covenants that circumvents this criticism is that short-term loans may give lenders too much power, leading to excessive liquidation.¹⁸ The notion that short-term loans simply give lenders too much incentive to liquidate suggests that covenants are written to ensure that lenders can only act against borrowers in the “right” situations. The difficulty with this argument is that covenants are not always written in the fine detail such objectives would suggest: many covenants are standard boiler-plate, fleshed out as much by lawyers as by loan officers or treasurers (Simpson (1973)). Nevertheless, enforcing a covenant requires some processing of information. Effective use of covenants forces the lender to do some monitoring; having started the task, it may be possible to get more insight into the borrower’s condition at little additional cost. Thus, even relatively crude covenants may be consistent with our model, as shown in Figure 1.¹⁹

Our model also suggests that covenants on private debt are more detailed and restrictive than those on public debt. There is much evidence that is consistent with this. For example, in a study of 128 accounting-based covenant violations, Chen and Wei (1993) find only four of the violations were for debt issues held by the public (also see Smith and Warner (1979), Kahan and Tuckman (1994), and Carey *et al.* (1993)).

Nevertheless, our model assumes that covenants are not perfect contractual mechanisms for ensuring monitoring and control. Chen and Wei (1993) find that 44 percent of the private debt covenant defaults in their sample were waived, suggesting that lenders decide whether to take action against the borrower based on additional information that cannot easily be incorporated into the debt agreement. Kahan and Tuckman (1994) document the use of “indefinite covenants” in private placements; these covenants require *ex post* clarification, and thus necessitate monitoring by the lender if they are to be of any use. Beneish and Press (1994) provide some evidence that firms may default on debt without violating covenants beforehand, suggesting that covenants may not cover all contingencies (they do not find that the covenants were “too slack”).

¹⁸ In Diamond (1991a, 1993), managers extract nontransferable control rents from future cash flows, and at an interim date a noisy public signal of the firm’s future chance of success becomes available. Because they do not take the control rent into account, short-term creditors tend to liquidate too often, and so firms prefer a mix of long-term and short-term debt. In our model, similar results would obtain if the nontransferable benefits pledged to stakeholders were more heavily weighted towards the future than were those available to lenders.

¹⁹ One might argue that long-term fixed-rate debt protects the borrower against changes in interest rates. Nevertheless, even disregarding the relatively recent innovation of interest rate swaps (which give the same protection with lower credit risk for the bank), a large percentage of long-term bank loans have floating rates. Another possibility is that the transactions costs of rolling over debt might make long-term debt preferable to short-term debt; however, making loans payable on demand would overcome this problem without reducing the bank’s rights of control. Thus, these explanations for the use of long-term debt are not particularly compelling.

Our view that covenants are used to encourage monitoring is also consistent with a number of legal institutions.²⁰ For instance, courts penalize lenders both for taking actions when covenants have not in fact been violated and for exercising powers beyond those allowed by the covenants; the lender is found to be “in control” of the borrower, and may be either liable for the borrower’s losses or “equitably subordinated” to other lenders. Another example is the Doctrine of Waiver, under which a court does not allow a lender to enforce a covenant if previous inaction implicitly signalled the borrower that the covenant had been waived. Specifically, courts hold that “when a lender has the ability to learn of a breach of a financial covenant and fails to do so, it waives the covenant.” This clearly reduces a lender’s powers if it has neglected to monitor.

B. Collateral

Our model suggests that collateralized debt should be observed more in firms that need monitoring, and that changes in collateral should be positively correlated with the onset of financial distress. In a sample of distressed firms, James (1993) finds that 40 percent of the bank debt is unsecured one year prior to distress; as distress approaches, the degree to which bank claims are secured increases. Aggregate volumes of secured debt display a similar inverse relationship with the business cycle, particularly for small- and medium-sized firms.²¹

The use of security has many explanations. If the value of the collateral is unaffected by any actions the borrower undertakes once he or she has been funded, then the provision of security completely obviates the need for investigating the borrower. The classic example of this is pawnbroking.²² Another virtue of a secured claim is that it limits the extent to which other creditors can share in assets promised to a particular creditor, enabling the borrower to commit assets to a specific lender. As a result, the ability to finance new projects with secured debt can mitigate the extent to which prior creditors share in new projects, reducing the Myers underinvestment problem (see Stulz and Johnson (1985)). Finally, some authors suggest that collateral can be used as a signal of borrower quality (Besanko and Thakor (1987), Boot, Thakor, and Udell (1991)).

None of these explanations directly addresses the empirical evidence just cited, which suggests that firms “use up” their collateral when they are in

²⁰ This paragraph draws extensively on Lloyd (1991).

²¹ An analysis of COMPUSTAT finds that the median fraction of secured debt to total debt for small manufacturing firms varies from a high of 0.4 during the 1982 recession to a low of 0.26 in 1989, increasing again during the 1990–1991 recession. For large firms, the medians fluctuate less, between 0.05 in 1982 and 0.02 in 1989.

²² Of course, the pawnbroker also avoids any costs of seizing assets. More generally, some institutions that make asset-backed loans may be relatively efficient sellers of the assets used as collateral. For example, car dealerships would have a cost advantage in selling repossessed cars.

trouble rather than when they have good investment opportunities.²³ As with covenants, our model suggests that the existing literature on collateral does not pay sufficient attention to the lender's incentives. Obviously, a fully collateralized lender is immunized from borrower performance and has no incentive to monitor. An unsecured lender suffers from poor borrower performance but has little incentive to take actions that lead to a run on the firm; with little incentive to take action, such a lender may have little incentive to monitor. We have shown that, in some situations, introducing another class of creditors who take the bank's actions as a signal of its information may cause the bank to condition its taking of collateral on its knowledge of the firm's state of affairs, increasing its incentive to monitor.²⁴

As with covenants, there are legal institutions that are consistent with the monitoring function of collateral which we have described. Section 60 of the Bankruptcy Act defines a "voidable preference" as "a transfer . . . of any of the property of a debtor . . . on account of an antecedent debt, made or suffered by such debtor while insolvent and within four months before the filing . . . of the petition [for bankruptcy] the effect of which will be to enable such a creditor to obtain a greater percentage of his debt than some other creditor of the same class." In essence, the voidable preference makes it impossible for the lender to wait until the last moment to secure its claim, forcing it to monitor for early signs of distress. This alerts free-riding stakeholders to the possibility of trouble, at a time when management can still be forced to alter its actions. Of course, this restriction is two-edged: if the lender does not find out the true state of affairs until the firm is on the verge of bankruptcy, the lender now has less incentive to act.

One might argue that the empirical relationship between the securing of assets and the onset of distress has an alternative explanation. Firms may not offer collateral at the time of contracting simply because offering assets as security has some cost or reduces the firm's operational flexibility. If expected cash flows later decline, there is greater risk that the firm may misappropriate liquid assets or pledge them to other lenders; this greater risk makes lenders demand collateral when the firm is close to distress (see Myers and Rajan (1994)). While our explanation is not inconsistent with this, it differs in that it is based on information asymmetries. In Myers and Rajan's framework, when the firm is close to distress, outside equity is better off when any lender becomes secured because security reduces the possibility of managerial moral hazard. Our model modifies this by arguing that an informed lender becoming

²³ Beneish and Press (1993) find that, after additional collateral, the most common new covenants in renegotiated loans are restrictions on investments and on additional debt issuance.

²⁴ Although we do not model this, one could in fact link the bank's ability to ask for additional collateral to the violation of certain covenants. This is not essential to our model, which suggests that credible signalling can take place endogenously. It is essential to our story that the bank not be able fully to protect itself; otherwise, it would always become secured, removing any incentives to monitor. However, even if the bank's current loan is fully secured after it takes collateral, some of its future rents may be unsecured; thus, our model does not necessarily require that bank loans must be undercollateralized *ex post*.

secured conveys adverse information about the state of the firm. This should reduce the value of equity. Of course, in a world of symmetric information, no agency problems, no difficulty in renegotiation, and strict absolute priority rules, debt becoming secured should have no effect on the value of equity.

Brown, James, and Mooradian (1993) find evidence consistent with this. In a sample of public and private debt restructurings between 1980 and 1990, they find that when bondholders are offered more senior or secured claims, the average two day prediction error for the stock is 7.48 percent, while it is -1.80 percent when a bank takes a senior or secured position. The difference is significant at the 1 percent level. In a cross-sectional regression relating the prediction errors to the characteristics of the restructuring, they find that an indicator for a bank's getting higher priority, or securing its claim, is negative and significant at the 1 percent level. They provide further evidence suggesting the effect is informational and not due to bondholder expropriation or changes in leverage.²⁵

In conclusion, our results suggest that the need to give lenders incentives to monitor and the ability to control borrowers may partly explain important features of loan contracts. A number of broad empirical facts regarding the use of covenants and collateral are consistent with our predictions, though, of course, more detailed empirical work is needed. The scope for future work is clear.

Appendix

Proof of Lemma 1: (i) If $\theta^* \leq \theta_1$, then $\theta_1 \gamma X + \gamma L_2 \geq \gamma L_1$. Because $\theta_1 < \pi_1 < \pi_2 < \theta_2$, the firm is never liquidated. Since $(\theta_1 + \theta_2)/2 = (\pi_1 + \pi_2)/2 = p$, $\Delta_{FB} = \gamma[pX + L_2] - \gamma[pX + L_1] = 0$. If $\theta^* \geq \theta_2$, $\theta_2 \gamma X + \gamma L_2 \leq \gamma L_1$, so the firm is always liquidated. Thus the firm will never be funded, and $\Delta_{FB} = 0$.

(ii) $\theta^* \in (\theta_1, \theta_2)$, so $\gamma \cdot E_{\theta} \max[\theta X + L_2, L_1] = \gamma[L_1 + L_2 + \theta_2 X]/2$. When $\theta^* \in (\theta_1, \pi_1)$, $\gamma \cdot E_{\pi} \max[\pi X + L_2, L_1] = \gamma[2L_2 + (\pi_1 + \pi_2)X]/2 = \gamma[2L_2 + (\theta_1 + \theta_2)X]/2$. Thus $\Delta_{FB} = \gamma[L_1 - L_2 - \theta_1 X]/2 = (\theta^* - \theta_1)\gamma X/2$. The other cases follow in similar fashion. Q.E.D.

Proof of Lemma 2: (i) If p is unchanged while $\theta_2 - \theta_1$ increases, then θ_2 increases and θ_1 decreases. When $\theta^* \in (\theta_1, \theta_2)$, this immediately implies that Δ_{FB} increases. In addition, the intervals of θ^* on which Δ_{FB} equals zero ($[0, \theta_1]$ and $[\theta_2, 1]$) are diminished, so if θ^* starts at θ_1 or θ_2 , Δ_{FB} goes from zero to a positive value.

(ii) Once more, π_2 must increase while π_1 must decrease. Using the results of Lemma 1, Δ_{FB} is unchanged when $\theta^* < \pi_1$ or $\theta^* > \pi_2$, and Δ_{FB} decreases when $\theta^* \in [\pi_1, \pi_2]$.

(iii) Since $\theta^* = (L_1 - L_2)/X$, it equals zero when $L_1 = L_2$, is increasing in L_1 , and decreasing in L_2 . From Lemma 1, Δ_{FB} is constant (at zero) in θ^* for $\theta^* \in [0, \theta_1]$, increasing for $\theta^* \in (\theta_1, \pi_1)$, constant for $\theta^* \in (\pi_1, \pi_2)$, decreasing for θ^*

²⁵ An explanation not inconsistent with our model is that once the bank takes a senior, secured position it also has less of an incentive to monitor management, which hurts outside equity.

$\in (\pi_2, \theta_2)$, and constant at zero thereafter. Combining this with the relationships between θ^* and L_1 and L_2 gives the desired results.

(iv) Since θ^* is decreasing in X , this follows the same logic as (iv). Q.E.D.

Proof of Lemma 3: (i) If $\theta^{\text{ST}} \leq \theta_1$, $\theta_1(D_1 - L_2) + L_2 \geq L_1$, so regardless of its information, the bank always prefers to roll over its debt at the face value D_1 rather than liquidate or renegotiate, either of which yields an expected value of L_1 . Since $(\theta_1 + \theta_2)/2 = (\pi_1 + \pi_2)/2 = p$, $\Delta_{\text{ST}} = [p(D_1 - L_2) + L_2] - [p(D_1 - L_2) + L_2] = 0$.

(ii) If $\theta^{\text{ST}} \geq \theta_2$, $\theta_2(D_1 - L_2) + L_2 \leq L_1$, so regardless of its information, the most the bank can hope for is an expected payment of L_1 . Thus lending at face value D_1 is always unprofitable, and improved information has no value.

(iii) $\theta^{\text{ST}} \in (\theta_1, \theta_2)$, so $E_{\theta} \max[\theta(D_1 - L_2) + L_2, L_1] = [L_1 + L_2 + \theta_2(D_1 - L_2)]/2$. When $\theta^{\text{ST}} \in (\theta_1, \pi_1)$, $E_{\pi} \max[\pi(D_1 - L_2) + L_2, L_1] = [2L_2 + (\pi_1 + \pi_2) \cdot (D_1 - L_2)]/2 = [2L_2 + (\theta_1 + \theta_2)(D_1 - L_2)]/2$. Thus $\Delta_{\text{ST}} = [L_1 - L_2 - \theta_1(D_1 - L_2)]/2 = (\theta^{\text{ST}} - \theta_1)(D_1 - L_2)/2$. The other cases follow in similar fashion.

(iv) We know from (iii) that if $\theta^{\text{ST}} > \theta_2$, the bank would never lend. Thus, we can restrict analysis to $(L_1 - L_2)/(D_1 - L_2) = \theta^{\text{ST}} \leq \theta_2$, which means $D_1 \geq (L_1 - L_2)/\theta_2 + L_2$. Note that θ^{ST} decreases monotonically in D_1 , so we can analyze the impact of changing D_1 across various regions for θ^{ST} .

For $\theta^{\text{ST}} \in (\pi_2, \theta_2)$, $\Delta_{\text{ST}} = (\theta_2 - \theta^{\text{ST}})(D_1 - L_2)/2 = [\theta_2(D_1 - L_2) - (L_1 - L_2)]/2$, which is increasing in D_1 .

For $\theta^{\text{ST}} \in [\pi_1, \pi_2]$, $\Delta_{\text{ST}} = (\theta_2 - \pi_2)(D_1 - L_2)/2$, which is also increasing in D_1 .

For $\theta^{\text{ST}} \in (\theta_1, \pi_1)$, $\Delta_{\text{ST}} = (\theta^{\text{ST}} - \theta_2)(D_1 - L_2)/2 = [L_1 - L_2 - \theta_1(D_1 - L_2)]/2$, which decreases in D_1 .

Finally, for $\theta^{\text{ST}} < \theta_1$, Δ_{ST} is constant at zero.

Since Δ_{ST} decreases in D_1 for $\theta^{\text{ST}} < \pi_1$ (i.e., $D_1 > (L_1 - L_2)/\pi_1 + L_2$), and Δ_{ST} strictly increases in D_1 for $\theta^{\text{ST}} \geq \pi_1$, it follows that Δ_{ST} is maximized at $D_1 = (L_1 - L_2)/\pi_1 + L_2$. This immediately implies $\theta^{\text{ST}} = \pi_1$ at the optimum. Substituting into Δ_{ST} , we obtain $\Delta_{\text{ST}} = (\theta_2 - \pi_2)(D_1 - L_2)/2 = (\theta_2 - \pi_2)(L_1 - L_2)/2\pi_1$. (Note that $\theta_2 - \pi_2 = \pi_1 - \theta_1$.) Q.E.D.

Proof of Proposition 1: (i) When condition (1) in the text holds, the bank will find it incentive compatible to monitor if it has made a short-term loan with face value D_1 . When condition (2) holds, D_1 is feasible. Finally, if the bank makes the loan and monitors, its net profit is

$$\frac{1}{2}\{L_1 + \theta_2(D_1 - L_2) + L_2\} - c - I. \quad (\text{A1})$$

For the bank's actions to be rational, this must exceed zero; rearranging yields condition (3) in the text.

(ii) By Lemma 3, the bank's incentive to monitor, Δ_{ST} , is less than or equal to $(\pi_1 - \theta_1)(L_1 - L_2)/2\pi_1$. Thus, when condition (4) holds, it is never incentive compatible for the bank to monitor.

From condition (3) in part (i) of this proposition, the face value of the bank's debt must be at least $[2(I + C) - L_1 - L_2]/\theta_2 + L_2$ if the bank is to break even

on lending short-term and monitoring. When condition (5) holds, this break-even face value exceeds $X + L_2$, so it is infeasible. Q.E.D.

Proof of Lemma 4: (i) Suppose $\theta^{CV} \leq \theta_1$ and the covenant is violated. $(L_1 - L_2)/(D_2 - L_2) = \theta^{CV} \leq \theta_1$, so $\theta_1(D_2 - L_2) + L_2 \geq L_1$. Thus, even if the firm's prospect of success is θ_1 , the bank won't liquidate or renegotiate the loan. Thus the bank never enforces covenant violations, and its incentive to monitor is zero as in Lemma 3 (i).

(ii) Suppose $\theta^{CV} \geq \theta_2$. Then $\theta_2(D_2 - L_2) + L_2 \leq L_1$, so, regardless of the firm's chance of success, the bank always liquidates or renegotiates the loan. Since $L_1 < I$, this means the bank cannot break even on its investment, so it won't make the loan in the first place, and its incentive to monitor is zero.

(iii) Now $\theta^{CV} \in (\theta_1, \theta_2)$. Δ_{CV} equals the difference between expression (4) in the text and $p(D_2 - L_2) + L_2$. Using the definition of θ^{CV} , expression (6) becomes

$$\frac{1}{2}\{\alpha L_1 + (1 - \alpha)[\theta_2(D_2 - L_2) + L_2]\} + \frac{1}{2}\{\phi_2(D_2 - L_2) + L_2\} \quad (A2)$$

Also, $\phi_2 = (1 - \alpha)\theta_1 + \alpha\theta_2$, and $p(D_2 - L_2) + L_2 = \frac{1}{2}(\theta_1 + \theta_2)(D_2 - L_2) + L_2$. Thus Δ_{CV} equals

$$\begin{aligned} & \frac{1}{2}\{\alpha L_1 + (1 - \alpha)[\theta_2(D_2 - L_2) + L_2]\} \\ & + \frac{1}{2}\{[(1 - \alpha)\theta_1 + \alpha\theta_2](D_2 - L_2) + L_2\} - \frac{1}{2}(\theta_1 + \theta_2)(D_2 - L_2) - L_2 \\ & = \frac{1}{2}\{\alpha L_1 + (1 - \alpha)L_2 - L_2 \\ & \quad + [(1 - \alpha)(\theta_1 + \theta_2) + \alpha\theta_2 - (\theta_1 + \theta_2)](D_2 - L_2)\} \quad (A3) \end{aligned}$$

Consolidating terms yields $\Delta_{CV} = \frac{1}{2}\alpha \cdot [L_1 - L_2 - \theta_1(D_2 - L_2)]$.

(iv) Since Δ_{CV} is decreasing in D_2 for $\theta^{CV} \in [\theta_1, \theta_2]$, it will be maximized by making D_2 as small as possible, subject to the constraint that the bank finds it rational to lend and monitor (reducing D_2 increases θ^{CV} , and from (ii) the bank certainly won't lend once θ^{CV} reaches θ_2). If the bank does lend and monitor, it receives a net expected value of (A2) less $I + c$, which equals

$$\frac{1}{2}\{\alpha L_1 + (1 - \alpha)L_2 + L_2 + [(1 - \alpha)\theta_1 + \theta_2](D_2 - L_2)\} - I - c \quad (A4)$$

Equation (A4) must exceed zero if the bank is to lend and monitor, and (A4) is increasing in D_2 . Thus making D_2 as small as possible involves setting (A4) equal to zero. Solving for the value of D_2^{CV*} that satisfies this yields expression (7) in the text. Q.E.D.

Proof of Proposition 2: Condition (9) in the text implies that it is feasible for the bank to make a long-term loan with face value D_2^{CV*} , which means the bank will break even if it lends and monitors. Condition (8) means that the bank's value of information is greater than the cost of monitoring, so it is incentive compatible for the bank to actually monitor once it has made the loan. When

condition (8) is violated, the bank's maximum value of information isn't enough to make monitoring worthwhile. When condition (9) is violated, the maximum feasible face value of the debt ($D_2 = X + L_2$) doesn't allow the bank to break even on lending long-term and monitoring. Q.E.D.

Proof of Proposition 3. The bank relies on the public lender to liquidate. Therefore, we must check that the public lender has the incentive to do so when the bank takes collateral and signals state θ_1 . Furthermore, it should not be possible for the management to bribe the public lender. A sufficient condition for this is

$$\theta_1 X + (1 - K)L_2 < D_1^P,$$

which simplifies to

$$\theta_1 \leq \frac{D_1^P - (1 - K) \cdot L_2}{X}. \quad (\text{A5})$$

Also, the public lender should want to continue if the bank does not take collateral. This requires that

$$\theta_2 X + L_2 > D_1^P. \quad (\text{A6})$$

The promised payment to the public and private lender should be feasible in state θ_2 .

$$(D_1^P - L_2)/\theta_2 + L_2 + D_2^B \leq X + L_2.$$

which implies that

$$D_2^B + \frac{D_1^P - L_2}{\theta_2} \leq X. \quad (\text{A7})$$

Notice that this condition also implies $\theta_2 X + L_2 > D_1^P$, so equation (A6) is redundant.

Next, in state θ_1 , it should be in the bank's incentive to demand collateral, even though the public lender will liquidate,

$$\max\{KL_1, L_1 - D_1^P\} \geq \theta_1 \cdot D_2^B, \quad (\text{A8})$$

and the firm should not be able to bribe the bank to forego collateral and allow the firm to continue:

$$\max\{KL_1, L_1 - D_1^P\} \geq \theta_1 \cdot [X - (D_1^P - L_2)/\theta_2]. \quad (\text{A9})$$

Notice that, together with equation (A7), (A9) implies (A8).

In state θ_2 the bank should prefer to continue without collateral rather than demand collateral and risk liquidation:

$$\max\{KL_1, L_1 - D_1^P\} \leq \theta_2 D_2^B. \quad (\text{A10})$$

The bank should prefer to monitor and selectively take collateral rather than always take collateral:

$$\max\{KL_1, L_1 - D_1^P\} \leq \frac{1}{2}\theta_2 D_2^B + \frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} - c,$$

which simplifies to

$$\frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} \leq \frac{1}{2}\theta_2 D_2^B - c. \quad (\text{A11})$$

The bank should prefer to monitor and selectively take collateral rather than never take collateral:

$$\frac{1}{2}[\theta_1 D_2^B + \theta_2 D_2^B] \leq \frac{1}{2}\theta_2 D_2^B + \frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} - c,$$

which simplifies to

$$\frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} - c \geq \frac{1}{2}\theta_1 D_2^B. \quad (\text{A12})$$

Notice that equation (A11) implies (A10).

The bank should expect to break even:

$$\frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} + \frac{1}{2}\theta_2 D_2^B - c \geq I^B. \quad (\text{A13})$$

The public investor should break even:

$$\frac{1}{2} \cdot \min\{D_1^P, (1 - K)L_1\} + \frac{1}{2}D_1^P \geq I - I^B. \quad (\text{A14})$$

Thus, sufficient conditions for the existence of the equilibrium are equations (A5), (A7), (A9), (A11), (A12), (A13), and (A14), which become conditions (10) to (14) in the text. Q.E.D.

Proof of Proposition 4: First we show that, if the conditions in Proposition 3 hold, an equilibrium in which the bank takes collateral in θ_2 but not in θ_1 must have the public roll over its debt when collateral is taken and not when collateral isn't taken. There are three alternative cases to consider: (i) the public rolls over its debt in both states; (ii) the public doesn't roll over its debt in the good state; (ii) the public never rolls over its debt.

(i) If the public always rolls over its debt, it sets a face value of $D_2^P(\theta_1) = [D_1^P - L_2]/\theta_1 + L_2$ when the bank doesn't take collateral (state θ_1), and $D_2^P(\theta_2) = [D_1^P - (1 - K)L_2]/\theta_2 + (1 - K)L_2$ when the bank takes collateral (state θ_2). In each case, the firm continues, and the bank receives $\min\{D_2^B, X + L_2 - D_2^P(\cdot)\}$ if the firm is successful at time 2, 0 if the firm fails at time 2 and

the bank didn't take collateral, and KL_2 if the firm doesn't fail at time 2 and the bank did take collateral.

Incentive compatibility requires that the bank not deviate. Thus, if $\theta = \theta_1$, the bank must prefer to forego collateral rather than take it and signal θ_2 :

$$\begin{aligned} \theta_1 \cdot \min\{D_2^B, X + L_2 - D_2^P(\theta_1)\} \\ \geq \theta_1 \cdot \min\{D_2^B, X + L_2 - D_2^P(\theta_2)\} + (1 - \theta_1) \cdot KL_2. \end{aligned} \quad (A15)$$

Similarly, if $\theta = \theta_2$, the bank must prefer to take collateral:

$$\begin{aligned} \theta_2 \cdot \min\{D_2^B, X + L_2 - D_2^P(\theta_1)\} \\ \leq \theta_2 \cdot \min\{D_2^B, X + L_2 - D_2^P(\theta_2)\} + (1 - \theta_2) \cdot KL_2. \end{aligned} \quad (A16)$$

Divide equations (A15) by θ_1 and (A16) by θ_2 ; since $\theta_2 > \theta_1$, $\theta_1^{-1} - 1 > \theta_2^{-1} - 1 > 0$, and so we have a contradiction.

(ii) If the public rolls over its debt when the bank doesn't take collateral, but doesn't roll it over when the bank does take collateral, we have $D_2^P(\theta_1) \leq X + L_2$ and $D_2^P(\theta_2) > X + L_2$. In state θ_1 , incentive compatibility for the bank requires that $\theta_1 \cdot \min\{D_2^B, X + L_2 - D_2^P(\theta_1)\} \geq KL_1$. Since $\theta_2 > \theta_1$, it follows that $\theta_2 \cdot \min\{D_2^B, X + L_2 - D_2^P(\theta_1)\} > KL_1$; but this means that the bank prefers to forego collateral in θ_2 rather than take collateral and cause liquidation. This destroys the incentive compatibility of the equilibrium.

(iii) If the public never rolls over its debt, the firm is always liquidated. Since investors get a total of L_1 for sure, and $L_1 < I$, investors would never lend money to the firm in the first place.

Thus, the only possible outcome is for the public to roll over its debt when collateral is taken and to liquidate the firm when collateral isn't taken. Thus $D_2^P(\theta_1) = [D_1^P - L_2]/\theta_1 + L_2$ must be infeasible (i.e., $> X + L_2$). Rearranging this leads to $\theta_1 < (D_1^P - L_2)/X$, which is violated whenever condition (15) in the text holds. (Similarly, $D_2^P(\theta_2) = [D_1^P - (1 - K)L_2]/\theta_2 + (1 - K)L_2$ must be no more than $X + (1 - K)L_2$, but this is the same as $\theta_2 \geq (D_1^P - (1 - K)L_2)/X$, which can be shown to follow from conditions (10) and (12).)

Finally, the bank must earn enough to break even on its investment:

$$\frac{1}{2}(L_1 - D_1^P) + \frac{1}{2}[\theta_2 \cdot \min\{D_2^B, X + L_2 - D_2^P(\theta_2)\} + (1 - \theta_2)KL_2] - c \geq I^B \quad (A17)$$

Since the conditions of Proposition 3 hold, and we assume the bank earns a breakeven return on its investment, condition (13) in the text holds with equality:

$$\frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} + \frac{1}{2}\theta_2 D_2^B - c = I^B. \quad (A18)$$

Subtracting (A17) from (A18) yields

$$\begin{aligned} & \frac{1}{2} \cdot \max\{KL_1 - (L_1 - D_1^P), 0\} \\ & + \frac{1}{2}[\theta_2 \cdot \max\{0, D_2^B - (X + L_2 - D_2^P(\theta_2))\}] - \frac{1}{2}(1 - \theta_2)KL_2 \leq 0 \quad (\text{A19}) \end{aligned}$$

It follows that if condition (16) in the text holds, equation (A19) cannot hold. (The condition mentioned in the footnote comes from the incentive compatibility condition that gets the bank to monitor rather than always take collateral:

$$\begin{aligned} & \frac{1}{2}(L_1 - D_1^P) + \frac{1}{2}[\theta_2 \cdot \min\{D_2^B, X + L_2 - D_2^P(\theta_2)\} + (1 - \theta_2)KL_2] - c \\ & \geq \frac{1}{2}(p \cdot \min\{\cdot\} + (1 - p) \cdot KL_2). \end{aligned}$$

Rearranging leads to

$$\frac{1}{2}(L_1 - D_1^P) - c \geq \frac{1}{2}\theta_1 \cdot \min\{D_2^B, X + L_2 - D_2^P(\theta_2)\} + \frac{1}{2}(1 - \theta_1)KL_2,$$

which is clearly violated when $L_1 - D_1^P$ is close to or below zero.)

Proof of Proposition 5: (i) In equilibrium, the public learns nothing from the bank's actions. Clearly, if this is to be an equilibrium, the firm must be refinanced when the public signal is π_2 (otherwise, the firm would always be liquidated, so investors wouldn't lend money in the first place). Thus $\pi_2 X + L_2 \geq D_1^P$. When the public signal is π_1 , the public refinances if $\pi_1 X + L_2 \geq D_1^P$, and doesn't if $\pi_1 X + L_2 < D_1^P$.

(ii) $\pi_1 X + L_2 \geq D_1^P$. Let $D_2^P(\pi_1) = (D_1^P - L_2)/\pi_1 + L_2$ be the face value of rolled over public debt, depending on the public signal π_i . Let $A' = \min\{D_2^B, X + L_2 - D_2^P(\pi_1)\}$ and $B' = \min\{D_2^B, X + L_2 - D_2^P(\pi_2)\}$ be the maximum amount the bank can hope to receive if the public signal is π_1 or π_2 , respectively.

In equilibrium, the bank's expected return is $\frac{1}{2}\pi_1 A' + \frac{1}{2}\pi_2 B' \leq \frac{1}{2}(\pi_1 + \pi_2)D_2^B = \frac{1}{2}(\theta_1 + \theta_2)D_2^B$. From the base equilibrium of Proposition 3, we know that condition (13) in the text holds exactly (this is equation (A18) above: $\frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} + \frac{1}{2}\theta_2 D_2^B - c = I^B$).

But condition (12) in the text also holds, so $\frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} \geq \frac{1}{2}\theta_1 D_2^B + c$. Combining this with (A18) yields $I^B \geq \frac{1}{2}(\theta_1 + \theta_2)D_2^B \geq \frac{1}{2}\pi_1 A' + \frac{1}{2}\pi_2 B'$, with strict inequality unless the first inequality in condition (12) holds with equality and $A' = B' = D_2^B$. Thus, when the conditions of Proposition 3 hold, the bank's individual rationality condition in the alternative equilibrium is violated except on a set of measure zero.

(iii) $\pi_1 X + L_2 < D_1^P$. Now the public investor liquidates if the public signal is π_1 . The bank's individual rationality condition holds if $\frac{1}{2} \cdot (L_1 - D_1^P) + \frac{1}{2}\pi_2 B' \geq I^B$. Once again, the base equilibrium implies $\frac{1}{2} \cdot \max\{KL_1, L_1 -$

$D_1^P\} + \frac{1}{2}\theta_2 D_2^B - c = I^B$. Since $\frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} - c \geq \frac{1}{2}\theta_1 D_2^B$, we have $I^B \geq \frac{1}{2}(\theta_1 + \theta_2)D_2^B = \frac{1}{2}(\pi_1 + \pi_2)D_2^B \geq \frac{1}{2}\pi_1 D_2^B + \frac{1}{2}\pi_2 B'$. Thus, if the bank's individual rationality condition is to hold, it is necessary that $L_1 - D_1^P \geq \pi_1 P \geq \pi_1 D_2^B$. Q.E.D.

Proof of Proposition 6: (i) Again, the public investor should have an incentive to refinance the firm conditional on public signal π_2 , or else the firm will always be liquidated, and the equilibrium cannot be individually rational. Therefore, we must have $\pi_2 X + (1 - K)L_2 \geq D_1^P$.

(ii) $\pi_1 < [D_1^P - (1 - K)L_2]/X \leq \pi_2$. In the alternative equilibrium, public investors don't roll over their debt when the public signal is π_1 and do roll over their debt when the public signal is π_2 . In this case, the bank's individual rationality constraint is $\frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} + \frac{1}{2}[\pi_2 B + (1 - \pi_2)KL_2] \geq I^B$. Once again, the base equilibrium from Proposition 3 implies $\frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} + \frac{1}{2}\theta_2 D_2^B - c = I^B$. Substituting the second condition into the first, we have $\frac{1}{2}[\pi_2 B + (1 - \pi_2)KL_2] \geq \frac{1}{2}\theta_2 D_2^B - c$. Thus, when condition (17) in the text holds, this alternative equilibrium cannot exist.

(iii) $[D_1^P - (1 - K)L_2]/X \leq \pi_1$. Now, public investors roll over their debt regardless of the public signal. The bank's individual rationality constraint is $\frac{1}{2}\pi_1 A + \frac{1}{2}\pi_2 B + (1 - p)KL_2 \geq I^B$, where A and B are as given in the text. Once more, Proposition 3 implies $I^B = \frac{1}{2}KL_1 + \frac{1}{2}D_2^B - c$. Thus, when condition (18) holds, the bank's individual rationality constraint is violated and the alternative equilibrium where the bank always takes collateral cannot exist. Q.E.D.

Proof of Corollary 1: (i) Suppose that $KL_2 = 0$ and $\beta = \frac{1}{2}$, so that $\pi_1 = \pi_2 = p$. From Proposition 6(i), if $p < [D_1^P - (1 - K)L_2]/X$, there is no equilibrium in which the bank always takes collateral.

If $p \geq [D_1^P - (1 - K)L_2]/X$, then Proposition 6(iii) implies that there is no equilibrium if condition (18) in the text holds. Given our assumptions, $A = B \leq D_2^B$ and $KL_2 = 0$, so condition (18) holds if

$$\frac{1}{2}(\pi_1 + \pi_2)D_2^B = p \cdot D_2^B < \frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} + \frac{1}{2}\theta_2 \cdot D_2^B - c \quad (\text{A20})$$

Since $p = \frac{1}{2}(\theta_1 + \theta_2)$, equation (A20) is equivalent to $\frac{1}{2}\theta_1 \cdot D_2^B < \frac{1}{2} \cdot \max\{KL_1, L_1 - D_1^P\} - c$. Since this is the first inequality in condition (12) in Proposition 3 with a strict inequality, this holds whenever Proposition 3 holds except on a set of measure zero.

(ii) From conditions (10) and (12) in the text, $\theta_2 \geq [D_1^P - (1 - K)L_2]/X$, and $\theta_1 < [D_1^P - (1 - K)L_2]/X$. Thus, when π_2 is close to θ_2 , π_1 is close to θ_1 , and so we are in case (ii) of Proposition 6. But then condition (17) in the text can be shown to be the same as

$$\frac{1}{2} \cdot \min\{\pi_2 \cdot D_2^B + (1 - \pi_2)KL_2, \pi_2 X + L_2 - D_1^P\} < \frac{1}{2}\theta_2 \cdot D_2^B - c \quad (\text{A21})$$

From condition (10) in the text, $\theta_2 \cdot D_2^B \leq \theta_2 X + L_2 - D_1^P$. Thus, when π_2 is close to θ_2 , both terms in the brackets on the left-hand side of (A21) exceed $\theta_2 \cdot D_2^B - 2c$, and so equation (A21) will not hold. Q.E.D.

REFERENCES

- Banks, Jeffrey, and Joel Sobel, 1987, Equilibrium selection in signalling games, *Econometrica* 55, 647–661.
- Barclay, Michael, and Clifford Smith, 1995, The maturity structure of corporate debt, forthcoming, *Journal of Finance*.
- Beneish, Messod, and Eric Press, 1993, Costs of technical violation of accounting based covenants, *Accounting Review* 68, 233–257.
- Beneish, Messod, and Eric Press, 1994, Interrelation among events of default, Working paper, Temple University.
- Berglöf, Eric, and Ernst-Ludwig von Thadden, 1994, Short term vs long term interest: Capital structure with multiple investors, *Quarterly Journal of Economics* 109, 1055–1084.
- Berkovitch, Elazar, and Ronen Israel, 1993, The design of internal control and capital structure, Working paper, University of Michigan.
- Berlin, Mitchell, and Loretta Mester, 1992, Debt covenants and renegotiation, *Journal of Financial Intermediation* 2, 95–133.
- Besanko, David, and George Kanatas, 1993, Credit market equilibrium with bank monitoring and moral hazard, *Review of Financial Studies* 6, 213–232.
- Besanko, David, and Anjan Thakor, 1987, Collateral and rationing: Sorting equilibria in monopolistic and competitive credit markets, *International Economic Review* 28, 671–689.
- Bolton, Patrick, and David Scharfstein, 1992, The structure of debt contracts, Working paper, M.I.T.
- Boot, Arnoud, Anjan Thakor, and Gregory Udell, 1991, Secured lending and default risk: Equilibrium analysis, policy implications, and empirical results, *Economic Journal* 101, 458–472.
- Brown, David, Christopher James, and Robert Mooradian, 1993, The information content of distressed restructurings involving public and private debt claims, *Journal of Financial Economics* 33, 93–118.
- Calomiris, Charles, Charles Himmelberg, and P. Wachtel, 1994, Commercial paper and corporate finance: A microeconomic perspective, Working paper, University of Illinois, Urbana-Champaign.
- Campbell, Timothy, and William Kracaw, 1980, Information production, market signalling and the theory of financial intermediation, *Journal of Finance* 35, 863–882.
- Carey, Mark, Stephen Prowse, John Rea, and Gregory Udell, 1993, The economics of the private placement market, Staff study, Board of Governors of the Federal Reserve System.
- Chen, Kevin, and John Wei, 1993, Creditors' decisions to waive violations of accounting-based debt covenants, *Accounting Review* 68, 218–232.
- Cole, Robert, 1984, *Consumer and Commercial Credit Management*, 7th ed. (Richard D. Irwin, Inc., Homewood, Illinois).
- Dewatripont, Mathias, and Jean Tirole, 1992, A theory of debt and equity—Diversity of securities and management-shareholder congruence, *Quarterly Journal of Economics* 109, 1027–1054.
- Diamond, Douglas, 1984, Financial Intermediation and delegated monitoring, *Review of Economic Studies* 51, 393–414.
- Diamond, Douglas, 1991a, Debt maturity structure and liquidity risk, *Quarterly Journal of Economics* 56, 709–738.
- Diamond, Douglas, 1991b, Monitoring and reputation: The choice between bank loans and directly placed debt, *Journal of Political Economy* 99, 688–721.
- Diamond, Douglas, 1993, Seniority and maturity of debt contracts, *Journal of Financial Economics* 33, 341–368.
- Fama, Eugene, 1985, What's different about banks?, *Journal of Monetary Economics*, 15, 29–39.

- Gertner, Robert, and David Scharfstein, 1991, A theory of workouts and the effects of reorganization law, *Journal of Finance* 46, 1189–1222.
- Green, Richard, and Arnold Juster, 1993, Financial structure, distress, and restructuring, Working paper, Carnegie Mellon University.
- Harris, Milton, and Artur Raviv, 1995, The role of games in security design, *Review of Financial Studies* 8, 327–367.
- James, Christopher, 1987, Some evidence on the uniqueness of bank loans, *Journal of Financial Economics* 19, 217–235.
- James, Christopher, 1993, When banks take equity: An analysis of the agency costs of debt in financial distress, Working paper, University of Florida.
- Kahan, Marcel, and Bruce Tuckman, 1993, Private vs. public lending: Evidence from covenants, Working paper, New York University.
- Leland, Hayne E., and David H. Pyle, 1977, Informational Asymmetries, financial structure, and financial intermediation, *Journal of Finance* 32, 371–387.
- Lloyd, R., 1991, Financial covenants in commercial loan documentation: Uses and limitations, *University of Tennessee Law Review* 58.
- Longhofer, Stanley, 1993, Bankruptcy rules and debt contracting: On the relative efficiency of absolute priority, proportionate priority, and first-come, first-served rules, Working paper, University of Illinois, Urbana-Champaign.
- Lummer, Scott, and John McConnell, 1989, Further evidence on the bank lending process and the capital-market response to bank loan agreements, *Journal of Financial Economics* 25, 99–122.
- Magee, Robert, and Sri Sridhar, 1994, Financial contracting, debt covenants, and earnings management, Working paper, Northwestern University.
- Myers, Stewart, and Raghuram Rajan, 1994, The paradox of liquidity, Working paper, University of Chicago.
- Park, Cheol, 1994, Monitoring and debt seniority structure, Working paper, University of Chicago.
- Persons, John, 1995, Liars never prosper? How management misrepresentation reduces monitoring costs, Working paper, Ohio State University.
- Petersen, Mitchell, and Raghuram Rajan, 1994, The benefits of lending relationships: Evidence from small business data, *Journal of Finance* 49, 3–37.
- Picker, Randall, 1992, Security interests, misbehavior, and common pools, *University of Chicago Law Review* 59.
- Simpson, D., 1973, The drafting of loan agreements: A borrower's viewpoint, *Business Lawyer* 29, 1161–1196.
- Smith, Clifford, and Jerold Warner, 1979, On financial contracting: An analysis of bond covenants, *Journal of Financial Economics* 7, 117–162.
- Stulz, René, and Herbert Johnson, 1985, An analysis of secured debt, *Journal of Financial Economics* 14, 501–521.
- Winton, Andrew, 1995, Costly state verification and multiple investors: The role of seniority, *Review of Financial Studies* 8, 91–123.