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by

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Strategic Bank Monitoring and Firms' Debt Structure*

Eirik Gaard Kristiansen†

October 12, 2005

Abstract

Firms choose debt structure and competing banks choose monitoring intensity. Monitoring improves credit allocation, but creates informational lock-in effects in bank-borrower relationships. In a competitive credit market, banks dissipate anticipated profit from serving locked-in borrowers subsequently revealed to the bank as *good* to attract new borrowers with *unknown* credit quality. Consequently, banks' lending strategies result in cross-subsidies from good to bad borrowers. We investigate how firms' choice of debt structure interacts with the cross-subsidies inherent in banks' lending strategies. The analysis sheds light on how dynamic bank competition determines monitoring intensity, seniority, and maturity structure in bank dependent industries.

Keywords: corporate debt structure, bank lending, lock-in effects.

JEL Classification: D82, G32, G21, L14.

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1 Introduction

Empirical studies have shown that banks fund loans that are not profitable for the bank from a short-term perspective but may be profitable if the relationship with the borrower last long enough (see e.g. Petersen and Rajan (1995) and Cetorelli and Gambera (2001)). Relationship lending makes such subsidies feasible because the proprietary information acquired during the relationship produces rents for the bank later in the relationship that offset earlier losses. If good borrowers, representing low credit risk, produce most of the bank rent in later periods but *all* types of borrowers obtain the initial subsidy, banks' lending strategies generate cross-subsidies between good and bad borrowers. In this paper we derive debt-structure implications from the intertemporal cross-subsidy inherent in banks' dynamic lending strategies. The link to debt structure arises because the level of the cross-subsidy depends on banks' monitoring intentsity which again depends on firm' debt structure. We examine particularly firms' choice of maturity and seniority structure of debt.

Our starting point is that borrowers indirectly through their choice of debt structure choose monitoring intensity and the dynamic pricing of loans. We show that increased monitoring intensity alleviates borrowers' moral hazard problems and reduces the first-period financing costs, but results in increased cross-subsidies from good to bad borrowers. Hence, borrowers choose a debt structure which balances the costs and benefits from increased monitoring intensity. In equilibrium, the borrowers' debt structure reflects both the cost (cross-subsidies) and benefits (reduced moral hazard problems) associated with increased monitoring intensity. Good borrowers do not necessarily favor that banks acquire precise information about their type since the associated monitoring intensity also implies a high level of cross-subsidies from good to bad borrowers.

Banks' role as monitors suggests that banks should be junior claimants (see Fama (1985)), however banks are typically senior, secured claimants and not particularly exposed to firms' moral hazard problems. Our approach suggests an explanation for why banks have senior claims with low exposure to borrowers' moral hazard prob-

lems. Low sensitivity to borrowers' moral hazard problems induce banks to invest less in monitoring which again reduces the lock-in effects and cross-subsidy effects associated with banks' lending strategies. Banks' long-term view on borrowers creates incentives to monitor although current claims are senior.[1] Furthermore, our model predicts that firms having large growth opportunities have bank claims that are less exposed to moral hazard problems than firms with fewer growth opportunities. This negative correlation between firms' growth opportunities and exposure of bank claims is in our model due to the inherent cross-subsidy effect in the bank-loan market. The cross-subsidy effect is particularly strong for firms with large growth opportunities. Consequently, growth firms have particularly strong incentives to reduce the equilibrium level of the cross-subsidy effect by structuring their loans (e.g. seniority of bank claims) such that the monitoring intensity and lock-in effects are reduced.

These results are consistent with empirical studies of Barclay and Smith (1995, 1996) who found that the debt issued by growth firms was significantly more concentrated among high-priority classes. Firms with high market-to-book ratios had higher proportions of secured and ordinary senior debt and little subordinated debt. They suggest that this debt structure is constructed to avoid conflicts among creditors and, thereby, reduce the potential for underinvestment in upcoming investment projects (Myers (1977)). We complement this view by showing that growth firms prefer high-priority debt because this debt structure reduces the cross-subsidy effect inherent in banks' strategic pricing of loans. Unlike other papers, our argument does not involve the assumption that banks are more willing to make debt concessions when firms have financial distress than other lenders, an assumption with mixed empirical support.[2]

[1] In a related paper Gorton and Kahn (2000) show that the seniority of bank claims can be explained in a model where initial loan terms are set to efficiently balance the bargaining power of a borrower and a bank in later renegotiation of loan-terms. See also Repullo and Suarez (1998) and Longhofer and Santos (2000).

[2] Gilson et al. (1990) finds that firm's reliance on bank debt increases the likelihood of successful debt restructuring while Asquith et al. (1994), James (1996), James (1995), and Franks and Torous (1994) find that banks typically make fewer concessions than other debt holders.

We consider a two-period model with the following main features. In the beginning of each period a firm starts a project. After investing in the first project, the firm privately observes the state of the world. Depending on the state of the world, continuing the project (as opposed to liquidating it) may have positive or negative net present value (NPV). As the owner of the firm has a residual claim, and all financing is through external debt, he always wants to continue the project. The quality of the second project (success probability) is privately known by the firm at date zero. Monitoring by a bank reveals information about the first *and* the second project. The model setup captures two consequences of bank monitoring. First, monitoring improves firms' continuation/liquidation decisions in the first period (i.e., monitoring alleviates firms' moral hazard problems). Secondly, monitoring creates lock-in effects in bank relationships (i.e., the outside banks fear winner's curse when they compete for borrowers). Since the lock-in effect drives the cross-subsidy effect, firms take this into account choosing debt structure at date 0.

Firms that have two sequential projects may obtain funding sequentially or they may obtain all required funding when the first project starts. We consider the first option as short-term financing and the second option as long-term financing. If firms choose long-term financing, the loan terms for the second project does not depend on monitoring information acquired during the first project. Since banks or other investors have not acquired additional monitoring information about the borrower when they offer a long-term loan, loan terms will reflect average project quality. Borrowers compare these loan terms with short-term financing costs reflecting cross-subsidies inherent in banks' dynamic pricing of loans. Firms choose debt structure in order to minimize financing costs and cross-subsidies. We show that firms' choice between long-term and short term funding depends on the pool of borrowers. If the pool of borrowers is of low quality, firms choose (if they are able to obtain) long-term funding of the second project. In this case our model predicts high monitoring intensity and that banks' claims on firms are highly exposed to firms' moral hazard problems. If the pool of borrowers is of higher quality, firms choose short-term debt (or a mix of short and long-term debt) to finance the second project. In this case we

predict that monitoring intensity is reduced and that banks' claims on firms are less exposed to firms' moral hazard problems. Consequently, we establish a link between a firm's choice between long-term and short-term debt and how exposed bank claims are to the firm's moral hazard problems. This suggests that empirical studies of debt maturity should take into account that priority structures and maturity structures of debt are chosen simultaneously. Our paper predicts that if a firm has both short- and long-term debt, the firm's short-term bank loan is more exposed to the firm's moral hazard problems and have lower priority than would be the case if the firm was exclusively financed by short term debt.

Standard debt contracts make it difficult for firms to disentangle the benefits and costs of increased monitoring intensity. We show how properly designed loan commitment contracts can be used to disentangle the benefits and costs associated with increased monitoring. We examine a loan commitment contract that is consistent with empirical observations of such contracts and show that supply of loan commitments may have an important effect on monitoring intensity and firms' choice between monitoring and non-monitoring external financing sources.

An important motivation for this paper stems from empirical studies finding that lock-in effects make banks able to practice intertemporal smoothing of loan-contract terms (see Petersen and Rajan (1994), Berger and Udell (1995) and Kim et al. (2005)). The idea is that if borrowers face moral hazard problems (e.g. risk-shifting problems as in Petersen and Rajan (1995)), intertemporal smoothing of contract terms can be value enhancing. Empirical and theoretical literature have focused on the threat to long-term banking relationships from bank competition or from financial markets (see Petersen and Rajan (1995), Boot and Thakor (2000), and Hauswald and Marquez (2005)). In contrast, we ask whether *borrowers' choice* of debt structure enhances long-term bank relationships and monitoring. If fierce bank competition weakens bank relationships, borrowers may choose a debt structure which strengthens bank relationships (i.e., monitoring intensity). The basic insight from our model is that if good borrowers pay for all borrowers' benefits from tight bank relationships, the equilibrium debt structure implies weak bank-borrower

relationships.

This paper builds on papers analyzing banks' strategic investments in monitoring. In this branch of the literature, banks choose monitoring intensities not only to improve their loan-allocation decisions, but they also take into account how monitoring improves their competitive position in the banking market (see Dell'Ariccia et al. (1999)). Ruckes (2004) and Thakor (1996) show that macroeconomic conditions can determine the extent banks engage in costly screening activities. In contrast to these papers, we allow borrowers to choose debt structure taking into account that banks choose monitoring intensity strategically.

It is well-known from Sharpe (1990) and Rajan (1992) that monitoring can generate informational lock-in effects.[3] In contrast to the current paper, these papers assume that there *initially* is symmetric information between borrowers and banks. Consequently, borrowers are not concerned with bank generated cross-subsidies between good and bad types which the current paper investigates.

The banking literature on lock-in effects is related to the industrial organization literature on switching costs (see Klemperer and Farrell (forthcoming) for a review). The switching cost literature does not focus on situations where customers control the degree of lock-in effects and the level of cross-subsidies between different types of customers. Hence, we think our paper contributes to the switching cost literature by examining a market where buyers control the degree of switching costs (informational lock-in) and the associated cross-subsidy between buyer types.

There is a related literature analyzing the relationship between asymmetric information problems in credit markets and loan structure. A branch of this literature takes banks' monitoring intensity as *exogenously* given and study interesting questions like number and types of creditors (Bolton and Scharfstien (1996), and Detragiache et al. (2000)), debt maturity (Rajan (1992), Diamond (1991), Diamond (1993), and, Flannery (1986)). In contrast we endogenize a bank's monitoring intensity and let it depend on strategic competition in the banking sector. Another branch of this literature focuses on how the design of debt contracts influences

[3]See also von Thadden (2004).

banks' monitoring efforts (Park (2000), Rajan and Winton (1995), Besanko and Kantas (1993) and, Carletti (2000)). In these papers borrowers are assumed to be ex ante *homogenous* and, consequently, borrowers choose *efficient* debt structure and they are not concerned with cross-subsidies implied by banks' lending policy. In contrast, we consider heterogeneous borrowers that choose debt contracts taking into account endogenous cross-subsidies generated by banks' lending policy. In our setting, borrowers are inclined to choose a debt structure inducing *inefficient* monitoring intensity in order to reduce the equilibrium level of cross-subsidies.

The model is outlined in Section 2. Section 3 examines the equilibrium when firms use short-term financing of their projects. In Section 4 we analyze a firm's choice of debt maturity and how debt maturity is related to the priority structure of claims and monitoring intensity. In Section 5 we examine how loan commitments influence firms' debt structure (seniority of claims) and indirectly the choice of monitoring intensity. Section 6 discusses some remaining issues. Section 7 concludes.

2 Model and Assumptions

We consider firms with two sequential projects and no own funds. At date zero a firm contacts investors to finance its first project. After financing is done and the project has started, an investor, for instance a bank, monitors the borrower. Monitoring reveals a signal about the quality of the first project. Depending on this signal, the project may continue or be liquidated.[4] The borrower has a second project which starts after the first project. In Section 3, we assume that the financing of the two sequential projects is done sequentially. This assumption is plausible in markets where investors find the second project vague and fear that it not will be implemented and that their committed funds may be wasted.[5] In Section 4 we relax

[4]In this respect, our model is similar to those of Rajan (1992), Repullo and Suarez (1998), Park (2000) which also consider how bank monitoring can ensure efficient liquidation/continuation decisions.

[5]We could have assumed that entrepreneurs with a positive probability do not discover a second project at date 2 and potential loans obtained at date 0 are wasted. If this probability is sufficiently high, it would be impossible to obtain funding for a potential second project at date 0. To keep the model as simple as possible, we do not adopt this assumption.

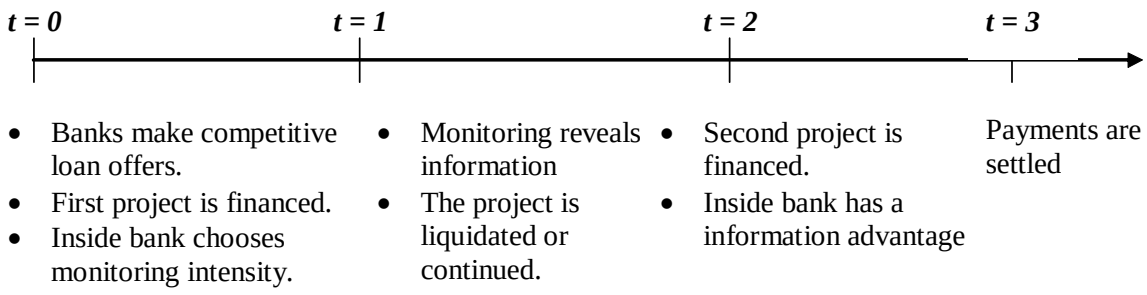

Figure 1: Timeline.

this assumption and consider long-term financing of the second project. All agents are risk neutral and the risk free interest rate is zero.

2.1 First project

The first project requires an investment of I_1 dollars. The project can either be good (G) and return cash flow $C > I_1$ if it is continued after date 1 or bad (B) and return 0 if it is continued after date 1. Both types of project can be liquidated at date 1 for value $L < I_1$. At date zero, the borrower and the investors agree that the probability of having a good first project is s. We assume that $s > \frac{1}{2}$.[6] At date 1, investors would like to liquidate projects which monitoring indicates are bad and continue good projects. The borrower, on the other hand, wants to continue independently of project type due to private benefits. Hence there is a moral hazard problem associated with the first project. Monitoring by investors prevents borrowers from continuing projects that should have been liquidated and alleviates thereby the moral hazard problem. More efficient liquidation decisions reduce costs of funds and, consequently, borrowers prefer some monitoring in equilibrium. We assume that borrowers need some monitoring in order to obtain financing; $sC < I_1$. The monitoring technology is described below.

[6] This assumption simplified the analysis by making it feasible for a firm to use priority structure of debt to implement preferred monitoring intensity.

2.2 Second project

The second project starts at date 2. It is stochastically independent of project 1 and requires an investment of I_2 dollars. If the project succeeds it returns cash flow R and if it fails it is worthless. A good project succeeds with probability $\bar{\theta}$ while a bad project succeeds with probability $\underline{\theta} < \bar{\theta}$. Both types of second-period projects have positive net present value (NPV). To simplify the analysis, we assume that the potential profit from the first project is consumed before the second project starts and I_2 has to be externally financed.[7] At date zero, the borrower knows the quality of the second project but investors only know the distribution of good and bad borrowers. Hence there is an adverse selection problem associated with the second project. The share of good borrowers is t.

This setup can be interpreted in the following way; a borrower knows that he will find a good project at date 2 while banks only know the distribution of borrower talent.

2.3 Monitoring technology

Banks may engage in costly monitoring. Monitoring reveals both long-term and short-term information. By examining the current project, the monitoring bank obtains information about the borrower's success probabilities in the future.

By investing $c(\alpha) = \frac{\gamma}{2}\alpha^2$, where $\alpha \in \left[\frac{1}{2}, 1\right]$, in monitoring, the banks obtain with probability α a correct signal about the first *and* the second project:

$$\text{First project:} \qquad \Pr(signal = G \mid G) = \Pr(signal = B \mid B) = \alpha$$

$$\text{Second project:} \qquad \Pr(signal = \bar{\theta} \mid \bar{\theta}) = \Pr(signal = \underline{\theta} \mid \underline{\theta}) = \alpha$$

For instance consider a borrower with a good first project (G) and a bad second project ($\underline{\theta}$) Monitoring will with probability α provide a favorable signal about the first project and with probability α provide an unfavorable signal about the

[7] Otherwise, we would have to assume that the potential profit from the first project is sufficiently low to prevent use of equity to signal entrepreneur type when the second project is financed (as in Leland and Pyle (1977)).

second project. If $\alpha = 1$, monitoring signals are perfect and the monitor has perfect information about the first and second project, but we assume that this is too costly to be an equilibrium outcome (the γ parameter in $c(\alpha)$ is chosen such that the the equlibrium level of α is not a corner solution, i.e., $\alpha \in \left\langle \frac{1}{2}, 1 \right\rangle$).

Only banks that monitor receive non-public information about the quality of the projects.

2.4 Loan Contracts

There are many competing banks and other investors all of which will accept any contract that has a non-negative expected return. At date 0 and at date 2 banks compete by making sequential bids for a borrower. The competition among banks is considered as an "English auction" where banks gradually decrease their offered interest rate (improve their bids) until only one bank is active. This bank captures the borrower. Banks may drop out at any time, and if they do they are not allowed to reenter the competition (auction) for the borrower. This type of competition yields a large informational advantage to the inside bank. Note, however, that our results are robust to changes in the way banks bid for borrowers as long as banks at date 2 earn more from lending to good borrowers than from lending to bad borrowers.

Loan contracts can have different seniority and borrowers may choose seniority in order to induce their preferred monitoring intensity. In Section 4 we consider both seniority and maturity structure of debt. In Section 5 we examine firms' use of loan commitments.

3 Equilibrium

Suppose that firms cannot secure funding for their second projects at date 0. This could be because future projects are difficult to describe at date 0 and investors do not find it profitable to fund projects that are very vague.

We examine the subgame-perfect equilibrium by first analyzing the equilibrium in the game starting at date 2. The equilibrium level of monitoring intensity, α^*, is

compared with the efficient level of monitoring intensity, α^{**}. The efficient level of monitoring intensity maximizes total surplus.

3.1 Second Project

The lender that monitored the first project obtains some information about the borrower and his second project. An outside bank has no information about the borrowers that can be used to separate the $\overline{\theta}$-borrower from the $\underline{\theta}$-borrower and must offer the same loan contract to both borrower types. Since competing outside banks fear the informational advantage of the insider they bid conservatively. In our setup where investors bid sequentially, outsiders know that the insider will improve his bid on financing the borrower until he expects zero profit from lending. Consequently, outsiders anticipate that they capture borrowers with unfavorable monitoring information if they are successful in capturing a borrower. Consequently, an outside investor will require that the borrower pays back $D_2(\alpha) = \frac{I_2}{E[\theta|signal=\underline{\theta}]}$ where

$$E[\theta \mid signal = \underline{\theta}] = \underline{\theta} + \frac{t(1-\alpha)}{t(1-\alpha)+(1-t)\alpha}\left(\overline{\theta}-\underline{\theta}\right)$$

is the expected success probability for the second project given that monitoring has revealed a negative signal ($signal = \underline{\theta}$) to the inside bank.[8] Since the outside banks make competitive offers on the negative-signal borrowers, the inside bank does not earn positive profit on serving negative-signal borrowers. However, the inside bank's profit from lending to a positive-signal borrower in period 2, $\phi_2(\alpha)$, is

$$\begin{aligned} \phi_2(\alpha) &= E\left[\theta \mid signal = \overline{\theta}\right] D_2(\alpha) - I_2 \\ &= \left[\frac{E\left[\theta \mid signal = \overline{\theta}\right]}{E[\theta \mid signal = \underline{\theta}]} - 1\right] I_2 \end{aligned} \tag{1}$$

where

$$E\left[\theta \mid signal = \overline{\theta}\right] = \underline{\theta} + \frac{t\alpha}{t\alpha+(1-t)(1-\alpha)}\left(\overline{\theta}-\underline{\theta}\right)$$

is the expected success probability given that monitoring has revealed a positive signal ($signal = \overline{\theta}$). Notice that bank profit, $\phi_2(\alpha)$, is increasing in the information

[8] This required pay back yields zero expected profit to the outside investor.

advantage of the inside bank (i.e., α). Figure 2 illustrates how the equilibrium face value of debt and face value of debt yielding zero bank profit depend on the inside bank's monitoring intensity.

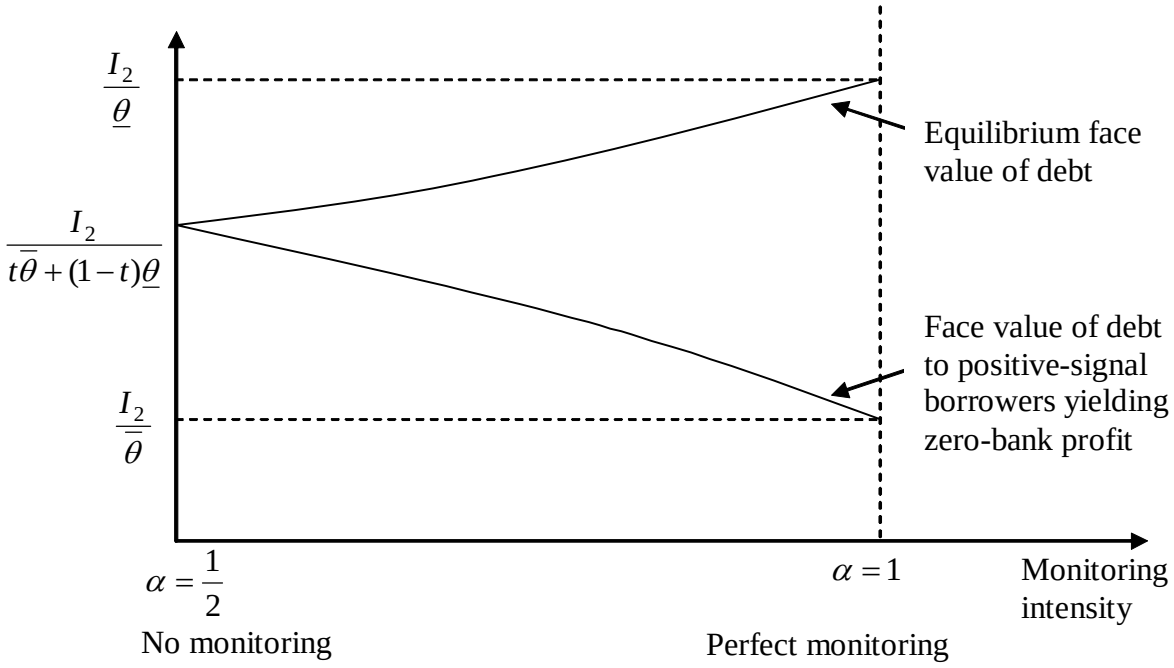

Figure 2: Inside bank's profit on serving positive-signal borrowers.

Notice that the increasing difference between the two graphs implies that the inside bank's profit from serving positive-signal borrowers is increasing in monitoring intensity.

A good borrower's expected profit from the second project (not taking into account that banks use expected profit to make competitive loan offers when they finance the first project) is

$$\pi_2(\alpha) = \bar{\theta}\left[R - D_2(\alpha)\right].$$

3.2 First period

We will first examine a good borrower's preferred bank-monitoring intensity and thereafter derive which debt-seniority structure that will induce the lender to choose

the preferred monitoring intensity. Notice that we focus on a good firm's debt choice because a bad firm always will mimic a good firm in order to conceal his type to potential lenders. This "mimicking-equilibrium" is supported by a belief structure where investors regard firms that deviate from the suggested debt structure as being of the low-quality type (i.e., the $\underline{\theta}$-type).[9]

First we examine the first project *in isolation* from the second project. A firm's expected profit from his first project is

$$\pi_1(\alpha) = \alpha s\left(C - D_1(\alpha)\right) \tag{2}$$

where $D_1(\alpha)$ is the required debt payment if the project is continued and lenders' expected profit is zero (recall that we assume that the bank-loan market is competitive). Note that αs is the probability of having a good project (probability s) and providing a positive monitoring signal (probability α). If the project is liquidated, the lenders get the liquidation value and the borrower gets nothing. $D_1(\alpha)$ is given by

$$D_1(\alpha) = \left\{D_1 \,|I_1 + c(\alpha) = (1-s)\alpha L + s\left(1-\alpha\right)L + s\alpha D_1\right\} \tag{3}$$

which implies that the bank's expected profit from lending is zero.

The firm maximizes (2) with respect to α and subject to (3). Given that monitoring costs are sufficiently large (γ is sufficiently large), there exists an interior solution where the borrower balances the gains from more efficient liquidation decisions and more costly monitoring;

$$\alpha^* = \frac{1}{\gamma}\left[(1-s)L + s\left(C - L\right)\right]. \tag{4}$$

Since lenders earn zero profit, borrowers take into account all potential losses from inefficient monitoring and choose the efficient monitoring intensity. Hence, α^* represents the *efficient* monitoring intensity for the first project.

Recall that we have assumed that all second-period projects yield positive NPV. It follows that monitoring does not improve total surplus from these projects and that α^* represents the efficient monitoring intensity taking into account both the first

[9] As in Diamond (1993) the debt structure preferred by the good type is chosen by all borrowers.

and the second project. Note, however, that the monitoring intensity determines the distribution of the surplus from the second projects.

So far we have assumed that borrowers determine monitoring intensity directly (i.e., specified in the loan contract). We will now examine how debt structure can be used to induce the preferred monitoring intensity. Consider two classes of debt; debt owned by banks that do monitoring and debt owned by outside investors without a monitoring technology available. A monitoring bank is able to stop projects that monitoring indicates should be liquidated. Let l ($\leq L$) and d ($\leq C$) denote the amount a bank gets if the project is liquidated and if it succeeds, respectively. The borrower chooses a combination of l and d which satisfies the lender's break-even constraint. A bank's exposure to a borrower's liquidation/continuation decision (moral hazard problem) is determined by the difference between d and l. We denote claims that carry low exposure senior claims. The bank maximizes its expected profit,

$$\phi_1(\alpha) = ((1-s)\alpha + s(1-\alpha))l + s\alpha d - \frac{\gamma}{2}\alpha^2$$

with respect to monitoring intensity, α. From the bank's first order condition we have

$$\alpha(l,d) = \frac{1}{\gamma}((1-s)l + s(d-l)). \tag{5}$$

It follows that $\alpha(l,d) = \alpha^*$ (see equation (4)) if

$$(1-s)l^* + s(d^* - l^*) = (1-s)L + s(C-L) \tag{6}$$

or put differently

$$l^* = L - \frac{s}{2s-1}(C - d^*). \tag{7}$$

A bank lends the borrower M to finance the first project and the bank earns zero expected profit;

$$M = ((1-s)\alpha^* + s(1-\alpha^*))l^* + s\alpha^* d^* - \frac{\gamma}{2}\alpha^{*2}. \tag{8}$$

The remaining part of the required investment (I_1) is borrowed from non-monitoring investors that earn zero-profit and correctly anticipate monitoring intensity α^*. This

induces the good borrower's preferred monitoring intensity and let him capture the whole surplus from the first project.

In a competitive credit market, the borrower has to carry all costs associated with inefficient liquidation of bad projects (the moral-hazard problem). Consequently, he chooses a debt structure which induces efficient monitoring (α^{**}) and liquidation decisions. Proposition 1 summarize our results so far.[10]

Proposition 1 *In the absence of lock-in effects, the equilibrium debt structure induces efficient monitoring intensity, $\alpha^* = \alpha^{**}$. A firm borrows M from a bank and $I_1 - M$ from non-monitoring external investors. Equation (7) describes the bank's claim on the firm in case of liquidation (l^*) and continuation (d^*) and equation (8) describes the amount borrowed from a bank (M).*

We will now examine how the second project influences the borrower's optimal monitoring intensity.

A bank that monitors the borrower anticipates that monitoring yields an informational advantage when the borrower needs additional funding. In a competitive credit market, banks use this anticipated profit to capture the borrower when he applies for his first loan. Consequently, a good borrower's total expected profit from the two projects is

$$\begin{aligned}
\Pi &= \pi_1(\alpha) + \overline{\pi}_2(\alpha) \\
&= \pi_1(\alpha) + \pi_2(\alpha) + (t\alpha + (1-t)(1-\alpha))\,\phi_2(\alpha) \\
&= \alpha s(C - D_1(\alpha)) + \bar{\theta}[R - D_2(\alpha)] + (t\alpha + (1-t)(1-\alpha))\,\phi_2(\alpha)
\end{aligned}$$

where $\overline{\pi}_2(\alpha) = \pi_2(\alpha) + (t\alpha + (1-t)(1-\alpha))\,\phi_2(\alpha)$ is total profit the good borrower captures from his second project including the subsidy on the first loan. Notice that all borrowers, and not only the good types, get a subsidized loan when they apply for their first loan. The expected profit of the bank capturing the borrower is equal to the probability of obtaining a positive signal from monitoring (i.e.,

[10]Note that there are many different combinations of (M, d, l) that satisfy equation (7) and equation (8). Consequently, a firm can induce the same monitoring intensity by having different combinations of (M, d, l).

$(t\alpha + (1-t)(1-\alpha))$ times the profit given a positive signal, $\phi_2(\alpha)$. This pricing of loans implies a cross-subsidy from good to bad borrowers because banks earn more profit on good than bad borrowers at date 2.

By using $D_2(\alpha) = \frac{I_2}{E[\theta|signal=\underline{\theta}]}$ and equation (1) we can rewrite the good borrower's profit from his second project as

$$\overline{\pi}_2(\alpha) = \underbrace{\bar{\theta}R}_{\text{Expected gain}} - \underbrace{\left[\frac{\bar{\theta} - (t\alpha + (1-t)(1-\alpha))\left(E\left[\theta \mid signal = \overline{\theta}\right] - E\left[\theta \mid signal = \underline{\theta}\right]\right)}{E\left[\theta \mid signal = \underline{\theta}\right]}\right] I_2}_{\text{Expected financing costs including cross-subsidies}}$$

This expression will be useful when we later examine borrower's preferred monitoring intensity and the associated choice of debt structure.

Figure 3 illustrates underpricing and overpricing of bank loans to good borrowers due to lock-in effects (recall that all borrowers get the subsidized loan at date 0).

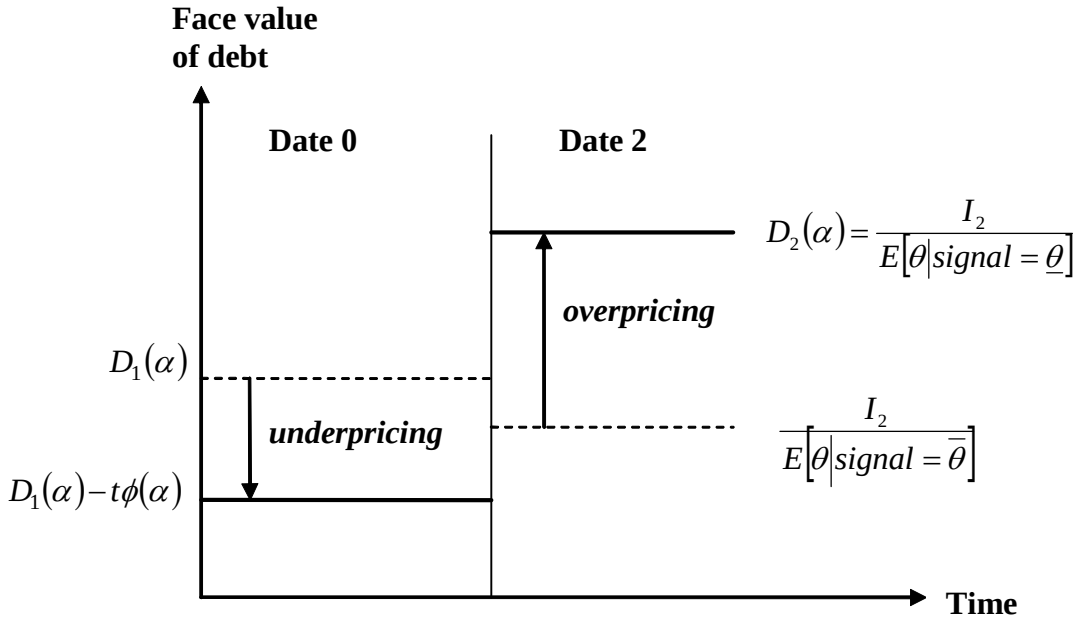

Figure 3: Pricing of loans to the first and second project.

Our next step is to examine what monitoring intensity a borrower prefers taking into account that monitoring intensity determines under- and over-pricing of loans (as illustrated in Figure 3). Thereafter we derive the priority structure of debt that implements the preferred monitoring intensity.

Proposition 2 *In order to reduce the implicit cross-subsidies inherent in a bank's lending strategy, a firm chooses a debt structure which induces inefficiently low monitoring intensity, i.e.,* $\alpha^* < \alpha^{**}$.

Proof: Note that $\alpha^* < \alpha^{**}$ if $\frac{\partial \overline{\pi}_2(\alpha)}{\partial \alpha} < 0$ for $\alpha \in \left[\frac{1}{2}, 1\right]$. Since

$$\frac{\partial \overline{\pi}_2(\alpha)}{\partial \alpha} = -\frac{\left(\overline{\theta} - \underline{\theta}\right)^2 (1-t)^2 t}{\left(-\overline{\theta} t (1-\alpha) - \underline{\theta}\alpha (1-t)\right)^2} I_2 < 0 \tag{9}$$

Proposition 2 follows. QED.

Corollary 1 *i) If* $\left(\bar{\theta} - \underline{\theta}\right) \to 0$ *it follows that* $\alpha^* \to \alpha^{**}$. *Monitoring intensity becomes efficient when the potential for asymmetric information in the second period disappears. ii) If* I_2 *increases, it follows that* $\alpha^{**} - \alpha^*$ *increases.*

Proof: Follows directly from equation (9). QED.

By reducing the monitoring intensity from α^{**} to α^*, the moral hazard problem associated with the first project increases and, consequently, the non-subsidized face value of the first loan increases from $D_1(\alpha^{**})$ to $D_2(\alpha^*)$. However, this negative effect is compensated by a weaker lock-in effect and a reduced cross-subsidy effect. By reducing the bank profit associated with monitoring, i.e., $\phi(\alpha)$, the borrower makes the pricing of the first-period loan less aggressive which reduces the cross-subsidy effect. In equilibrium, the good borrower balances the benefits from reduced moral hazard problems (reduced $D_1(\alpha)$) and the loss from cross-subsidies (overpricing of loans at date 2). Figure 4 illustrates this trade-off. The thin arrows represent the level of over- and under-pricing given efficient monitoring intensity, α^{**}, and the thick arrows represent the level of over and under-pricing given that the monitoring intensity is reduced to α^*.

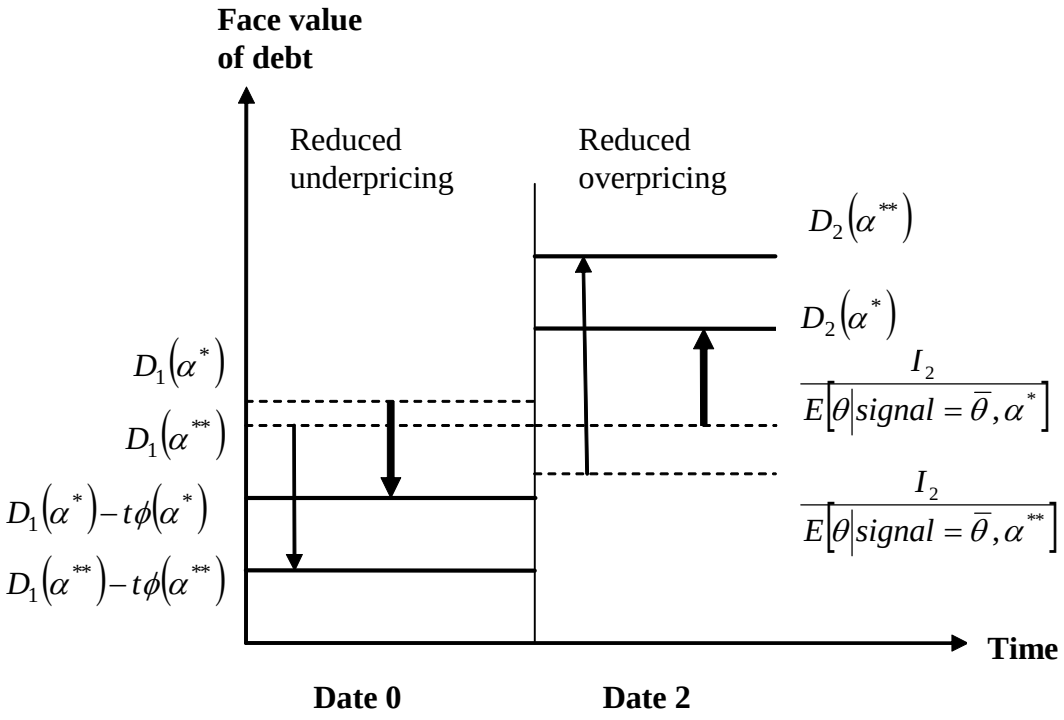

Figure 4: Reduced monitoring intensity implies less over- and under-pricing (thick arrows instead of thin arrows).

The firm can implement its preferred monitoring intensity by modifying its priority structure from the one inducing efficient monitoring intensity, or by borrowing less from a monitoring bank and more from non-monitoring outside investors.

Proposition 3 *A firm implements its preferred monitoring intensity, $\alpha^{*} < \alpha^{**}$ by either modifying the priority structure of debt or the amount borrowed from a bank compared with the efficient debt structure described in Proposition 1:*
i) Suppose the amount borrowed from a bank is constant. The firm reduces monitoring intensity from α^{**} to α^{*} by making the debt repayment less sensitive to liquidation/continuation decisions (i.e., the firm increases l and reduces d correspondingly in order to make the expected bank profit equal to zero).
ii) Alternatively, the firm can reduce the amount borrowed from a bank (i.e., reduce M by reducing l and d correspondingly so expected bank profit is kept equal to zero).

Proof: Follows directly from equation (5) and equation (8). QED.

Proposition 3 i) is consistent with the generally accepted fact that bank debt is typically senior to that of other creditors (i.e. a bank gets a large share of the firm in case the firm is liquidated). In a setting with sequential investment projects, monitoring incentives provided by strategic competition among banks substitute incentives provided by the design of loan contracts. Consequently, loan contracts provide weak monitoring incentives when strategic bank competition provides strong incentives.

We have shown that firms' seniority structure reflects banks' strategic investments in monitoring and associated implicit cross-subsidies between borrowers. Our next step is to investigate how the distribution of borrower types influences the level of cross-subsidies and firms' choice of debt structure. A change in the distribution of borrower types (i.e., t) has two different effects on good borrowers' profit from their second projects;

1. Keeping the bank profit in the second period constant, an increase in the share of good borrowers decreases the cross-subsidy effect. As t increases the good borrowers capture a larger share of bank profit generated in the second period. Since the cross-subsidy effect implied by banks' lending strategies decreases, a good firm's incentives to deviate from the efficient monitoring intensity are reduced. In isolation this effect implies that borrowers choose debt structures which induce more efficient monitoring intensities as firms' average quality improves.

2. Private information about borrower type becomes more valuable when the uncertainty about borrower type increases. The ex ante uncertainty about firm type is most severe if $t = \frac{1}{2}$ (equal probability for being good and bad). Consequently, the inside bank's informational advantage is particularly large when t is close to $\frac{1}{2}$ (keeping α constant).[11] This implies that the inside bank's

[11] Note that $E\left[\theta \mid signal = \overline{\theta}\right]$ and $E\left[\theta \mid signal = \underline{\theta}\right]$ are most sensitive to improved precision in monitoring signals when if t is close to $\frac{1}{2}$.

profit is increasing when t approaches $\frac{1}{2}$ and consequently, all else equal, there is more underpricing and a larger cross-subsidy effect when the uncertainty about the firm type is large. This positive effect on bank profit from increased uncertainty about borrower type (i.e., t approaches $\frac{1}{2}$), implies, all else equal, that the equilibrium level of cross-subsidy increases. This effect implies that the good borrowers get stronger incentives to deviate from the efficient debt structure, and it reduces the monitoring intensity when the average borrower-quality improves, i.e., t approaches $\frac{1}{2}$.

Figure 5 illustrates how the marginal effect on second-project profit from increased monitoring intensity (i.e., $\frac{d\overline{\pi}_2(\alpha)}{d\alpha}$) depends on the average quality of the borrower (i.e., t). The figure is constructed by substituting $\overline{\theta} = .8$, $\underline{\theta} = .5$, $\alpha^{**} = .8$ and $I_2 = 1$ into equation (9) in the proof of Proposition 2.

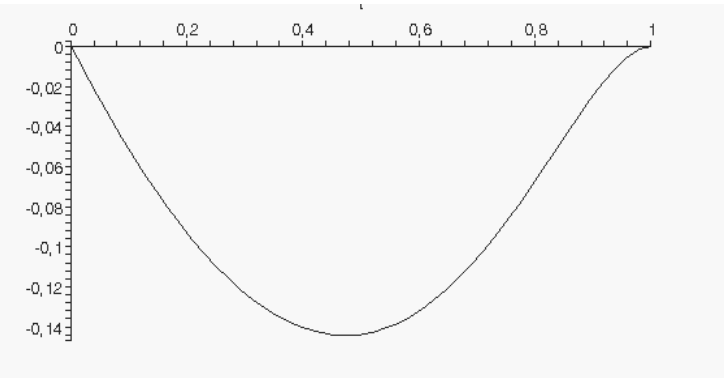

Figure 5: A good borrowers' incentives to induce low monitoring intensity, $\frac{d\overline{\pi}_2(\alpha)}{d\alpha}$, depends on the quality of borrowers in the population, t.

Consequently, the equilibrium level of monitoring intensity deviates more from the efficient level when the uncertainty about borrower type is large than when it is low. By using Proposition 4 we can conclude that a firm borrows less from a bank or have bank debt which is less sensitive to continuation/liquidation decisions when there is severe uncertainty about firm type.

The above analysis suggests that the strength of bank relationships measured as monitoring intensity reflects how important a borrower's moral hazard problem is relative to the cross-subsidy effects inherent in banks' lending strategies.

4 Debt maturity

We will in this section examine the case where firms' second projects are sufficiently well-specified to make it profitable for banks to extend credit to the second project at date 0. Firms choose priority structure *and* maturity structure of debt in order to minimize expected financing costs. As before the bad borrower type mimics the good type in order to conceal his type.

Let $T \leq I_2$ be a borrower's long-term loan obtained at date 0 in order to cover investments at date 2. Since lenders do not have any private monitoring information about the borrower when the loan is extended, they expect that the borrower is of average quality and, consequently, has success probability $E[\theta] = t\overline{\theta} + (1-t)\underline{\theta}$. In a competitive credit market, the face value of a loan of 1 dollar is

$$\frac{1}{E[\theta]}$$

and the lender expects to earn zero profit. Borrowers compare the expected financing costs by using long-term and short-term debt.[12]

Suppose monitoring intensity, α, is given and not influenced by the debt maturity choice. A good borrower chooses long-term financing if the following condition is satisfied.

$$G(\alpha,t) = \underbrace{\frac{\bar{\theta} - (t\alpha + (1-t)(1-\alpha))\left(E\left[\theta \mid signal = \overline{\theta}\right] - E\left[\theta \mid signal = \underline{\theta}\right]\right)}{E\left[\theta \mid signal = \underline{\theta}\right]}}_{\text{Expected repayment on a short-term loan } \textit{including} \text{ cross-subsidies}} - \underbrace{\frac{\overline{\theta}}{E[\theta]}}_{\text{Expected repayment on a long-term loan}}$$

$$> 0$$

[12] Recall that in our setting short-term debt is debt obtained at date 2 in order to cover investments made at date 2.

The condition compares the expected repayment from borrowing 1 dollar at date 2 instead of at date 0 given that the borrower is good ($\overline{\theta}$). If $G(\alpha, t) > 0$, a short-term loan is more expensive than a long-term loan and, consequently, firms choose a long-term loan (borrow at date 0 to cover investments at date 2). In Proposition 4 we take into account that maturity structure influences the equilibrium level of monitoring intensity, $\hat{\alpha}$:

Proposition 4 *Debt maturity and monitoring intensity.*
There are critical shares of good borrowers $\widehat{t}$ *and* $\widehat{\widehat{t}}$ *such that:*
i) If $t < \widehat{t}$*, a firm finances the second project with long-term debt. The priority structure of short-term debt is chosen to induce efficient monitoring intensity,* $\hat{\alpha} = \alpha^{**}$.
ii) If $\widehat{t} < t < \widehat{\widehat{t}}$*, a firm finances the second project with a mix of long- and short-term debt. Monitoring intensity is below the efficient level but above the monitoring intensity implied if the firm had only short term debt,* $\alpha^* < \widehat{\alpha} < \alpha^{**}$.
iii) If $\widehat{\widehat{t}} < t$*, a firm finances the second project with short-term debt. Monitoring intensity is inefficiently low,* $\hat{\alpha} = \alpha^*$.
Definition of $\widehat{t}$ *and* $\widehat{\widehat{t}}$*:*
If $t : t = \frac{\underline{\theta}\alpha^{**}}{\left(\underline{\theta}\alpha^{**} + \overline{\theta}\alpha^{**} - \overline{\theta}\right)}$ *is on* $[0,1]$ *this defines* $\widehat{t}$*, otherwise* $\widehat{t} = 0$.
If $t : t = \frac{\underline{\theta}\alpha^{*}}{\left(\underline{\theta}\alpha^{*} + \overline{\theta}\alpha^{*} - \overline{\theta}\right)}$ *is on* $[0,1]$ *this defines* $\widehat{\widehat{t}}$*, otherwise* $\widehat{\widehat{t}} = 0$. $\widehat{t} \leq \widehat{\widehat{t}}$.

Proof: See the Appendix.

The priority structure of bank claims follows directly from the maturity structure and monitoring intensity described in Proposition 4.

Figure 6 illustrates Proposition 4. The figure also describes the consequences on the structure of bank claims. If a borrower wants to induce low monitoring intensity, the bank's equilibrium claim on the borrower has low exposure to the firm's moral hazard problem.

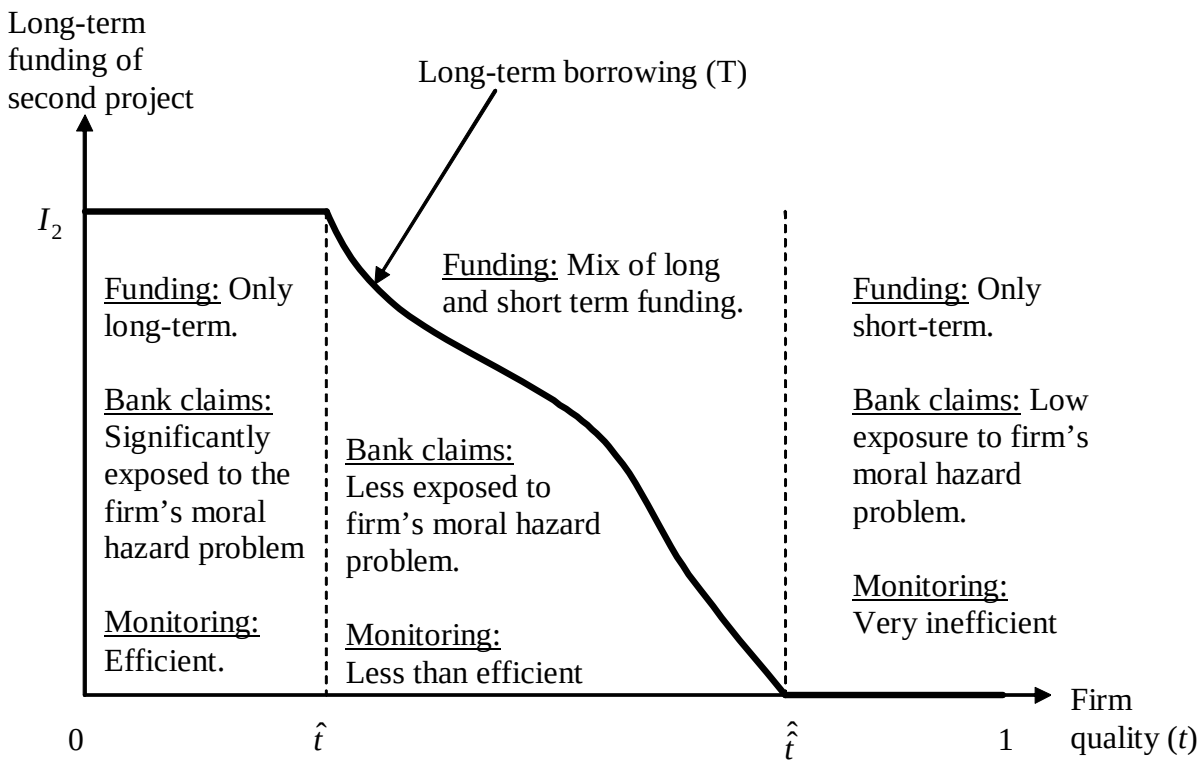

Figure 6: Long-term debt, monitoring and bank claims explained by the average quality of borrowers.

5 Loan commitment

A loan commitment is a promise by a bank to lend to a firm up to a specified amount during a specified future time period at specified terms. According to Duca and Vanhoose (1990) roughly 80% of all commercial lending in the U.S. is done under loan commitments.

The terms specify the covenants the borrower must satisfy during the commitment period to ensure the commitment is honored. The terms usually involve "escape clauses" which give the bank the discretion to not honor promises under "extenuating" circumstances ("material deterioration", as judged by the bank, in the

borrower's financial condition).[13] See Thakor (1995) for a discussion of banks' discretion in honoring loan commitments. In the sample of loan commitments studied by Shockley and Thakor (1997) virtually all commitments contain an escape clause that allowed the bank to deny credit if the borrower's financial condition deteriorated. We define a loan commitment in the following way: *A loan commitment is an agreement between a bank and an borrower at date 0 specifying the amount the borrower can borrow at date 2 and the required pay back (i.e., interest rate). The bank can either fulfill the loan commitment or cancel it if non-verifiable monitoring information is disadvantageous for the borrower.*

Note that the loan commitment puts some restrictions on what a bank can do at date 2. The bank is not allowed to renegotiate the contract. If the bank could freely renegotiate, it would have had the same market power as it would have had in the absence of a loan commitment, i.e., the loan commitment would have been worthless for the borrower.

Consider the following loan commitment contract; the bank is committed to lend the borrower I_2 at date 2 and requires pay back

$$d_2^0(\alpha) = \frac{I_2}{E\left[\theta \mid signal = \overline{\theta}\right]}$$

unless monitoring has revealed unfavorable information about the borrower.[14] Note that since the bank earns zero expected profit on the loan commitment contract, all cross-subsidies due to lock-in effects are removed. However, Proposition 5 shows that the borrower can do better than this.

Proposition 5 *Suppose that banks offer loan commitment contracts as specified above,* $(I_2, d_2^0(\alpha^c))$*. In equilibrium, firms and banks enter into loan contracts which induce inefficiently high monitoring intensity, i.e.,* $\alpha^c > \alpha^{**}$*.*

[13] The widespread use of "escape clauses" is also discussed in Boot et al. (1993). They argue that banks may want to build up reputation for honoring loan commitments even in cases where the formal contract give them the latitude not to.

[14] Note that the expected type given a positive monitoring signal, $E\left[\theta \mid signal = \overline{\theta}\right]$, depends on monitoring intensity α. An increase in α increases $E\left[\theta \mid signal = \overline{\theta}\right]$.

Proof: Note that repayment $d_2^0(\alpha)$ implies that the bank earns zero profit from lending to the second project. Consequently, a good borrower's profit from the second project is

$$\Psi(\alpha) = \bar{\theta}\left[R - I_2\left(\alpha\frac{1}{E\left[\theta \mid signal = \overline{\theta}\right]} + (1-\alpha)\frac{1}{E\left[\theta \mid signal = \underline{\theta}\right]}\right)\right]$$

not including monitoring costs. At $\alpha = \alpha^{**}$, there is no first order effect from increased monitoring intensity on the profit from the *first* project, but a positive first order effect on the profit from the second project, i.e., $\Psi'(\alpha^{**}) > 0$. Consequently, the borrower demands a loan-commitment contract which induces inefficiently high monitoring intensity, i.e., $\alpha^c > \alpha^{**}$.QED.

Proposition 5 stands in contrast to Proposition 2. Proposition 2 shows that due to cross-subsidies associated with strategic bank monitoring and pricing of loans, firms prefer a debt structure yielding inefficiently *low* monitoring intensity while Proposition 5 shows that loan-commitment contracts induce borrowers to choose a debt structure resulting in inefficiently *high* monitoring intensity. The intuition for this result is as follows. Loan commitment contracts prevent inside banks from charging a positive markup on loans to positive-signal borrowers. Consequently, increased monitoring intensity broadens the difference between good and bad borrowers' financing costs. Since good borrowers focus on their own financing costs and do not take into account how increased monitoring intensity increases the bad borrowers financing costs, good borrowers are inclined to induce overinvestment in monitoring.

From Proposition 3 we know how a borrower can structure his debt in order to induce his preferred monitoring intensity. The borrower can either borrow more from a bank or he can make the bank's claim more exposed to moral hazard problems in the firm (the continuation/liquidation decision). Both alternatives will strengthen the bank's monitoring incentives.

6 Discussion

Above we have examined firms' choice of debt structure in a financial market where monitoring is needed to alleviate firms' moral hazard problems, but creates informational lock-in effects. Although efficient monitoring intensity can be achieved through properly designed debt contracts, the market outcome entails inefficient monitoring intensity. In this section we will address some issues that we so far have not discussed.

Symmetric information: A first-time borrower may not know how talented he is (i.e., his success probability). In some cases, the best assumption might be to assume that the bank and the borrower have the same information about a project's success probabilities. If a risk-neutral borrower does not know his type, he will not be concerned about cross-subsidies between different types as long as the expected cross-subsidy is zero. Consequently, if a bank and a borrower have symmetric information when a project is financed, the borrower chooses a debt structure which induces the *efficient* monitoring intensity.

Overconfident borrowers: It is often claimed that borrowers are overconfident and that they have excessive beliefs in their own abilities. Overconfident borrowers might choose a different debt structure than unbiased borrowers. A way to illustrate how overconfidence might change debt structure in our model would be to assume that none of the borrowers have private information about their abilities but they all *believe* that they are high types. Hence in this setting borrowers should have chosen a debt structure inducing efficient monitoring (there is symmetric information about abilities). However, the borrowers will behave as they were of the high type and choose the debt structure described in this paper. Although the borrower is of average quality, she will choose a debt structure that is supposed to counteract feared cross-subsidies between high and low types. Surprisingly, we see that overconfidence induces inefficiently low monitoring intensity in our setting.

Multiple bank relationships: By borrowing from more than one inside bank, a borrower becomes less dependent on a single inside bank and the inside bank's mar-

ket power is curtailed by competing inside banks. In our approach banks' anticipated market power motivates a bank to spend resources on monitoring. Consequently, there is a close relationship between monitoring intensity and inside banks' market power.

We have emphasized that firms through financial contracts directly can determine monitoring intensity. Our analysis complements, for instance, Carletti (2000) who analyzes how the use of multiple bank relationships change banks' market power and monitoring intensity. It is in many cases more difficult to induce the preferred monitoring intensity by adjusting the number of bank relationships than by adjusting financial contracts; a single bank relationship might yield too much information lock-in and too high monitoring intensity, while, on the other hand, having two inside banks might yield too low monitoring intensity.[15]

However, if the preferred monitoring intensity cannot be achieved by using properly designed debt structure then the borrower might instead be able to reduce his financing costs by using several banks. Multiple bank relationships may imply inefficient duplication of monitoring efforts. In a competitive equilibrium these duplication costs must be borne by the borrowers through higher interest rates. But if other means to reduce market power of banks in the first period are unavailable (e.g. a borrower cannot use the priority structure of debt to induce the preferred monitoring intensity), borrowers might choose to have more than one bank relationship. This is because the costs associated with duplication of monitoring might be smaller than the "cross-subsidy costs".

Competition intensity in the banking sector: So far we have assumed that banks compete fiercely at date 0 and that all potential profit at date 2 is used to attract borrowers at date 0. It might be interesting to consider what would change if bank competition became less fierce at date 0. If bank competition at date 0 became less fierce, banks would not spend all date-2 profit on making date-0 loans attractive.

[15] In a related paper of Elsas et al. (2004) shows how the benefits of relationship lending can be reaped when firms have several bank lenders by making one of the lending banks special. One of the bank lenders has an informational advantage. They show how this may explain the extensive use of multiple bank lenders (Ongena and Smith (2001)).

Consequently, the good borrowers would get a smaller share of the anticipated future bank profit. Less bank competition strengthens borrowers' incentives to choose a "low-monitoring-intensity" debt structure which counteracts banks' market power due to informational lock-in effects.[16] Banks become lazy monitors, not due to banks' market power per se, but because borrowers choose debt structures which reduce banks' monitoring incentives.

7 Conclusion

This paper examines how strategic bank competition can explain firms' choice of debt structure. We consider a dynamic bank-loan market where loan terms in sequential periods are interlinked and borrowers minimize total financing costs.

In a competitive bank-loan market where banks know that they on average will earn profit on borrowers in later periods, banks make aggressive loan offers in the first period. Since banks earn more profit on borrowers revealed to the bank as good than on bad borrowers, the good borrowers pay for the aggressive pricing of all loans in the first period. Consequently, dynamic pricing of bank loans results in cross-subsidies from good to bad borrowers. We show how borrowers can use maturity structure, seniority structure, and loan commitments to counteract the cross-subsidy effect associated with banks' dynamic pricing of loans.

[16] This argument implies that banks' market power induce borrowers to weaken their bank relationships (i.e., lower monitoring intensity).

Appendix

Proof of Proposition 4. $G(\alpha)$ can be rewritten by using the expressions for $E\left[\theta \mid signal = \underline{\theta}\right]$, $E\left[\theta \mid signal = \overline{\theta}\right]$, and $E\left[\theta\right]$. After some tedious but straight forward manipulations of this expression we have

$$G(\alpha, t) = \frac{t(1-t)^2\left(\overline{\theta} - \underline{\theta}\right)^2(2\alpha - 1)}{-\left(t\overline{\theta} + (1-t)\underline{\theta}\right)\left(\left(\underline{\theta}\alpha + \overline{\theta}\alpha - \overline{\theta}\right)t - \underline{\theta}\alpha\right)}.$$

Observe that $sign\left[G(\alpha)\right] = -sign\left[\left(\underline{\theta}\alpha + \overline{\theta}\alpha - \overline{\theta}\right)t - \underline{\theta}\alpha\right]$.

Part i): If $t < \widehat{t}$ we have that $G(\alpha^{**}, t) > 0$ and a firm chooses long-term debt to finance the second project. Priority structure of the short-term debt spent on the first project is chosen such that bank monitoring is efficient (there are no cross-subsidies due to lock-in effects in this case). $\widehat{t}$ is given by $\left(\underline{\theta}\alpha^{**} + \overline{\theta}\alpha^{**} - \overline{\theta}\right)t - \underline{\theta}\alpha^{**} = 0$ or $t = \frac{\underline{\theta}\alpha^{**}}{\left(\underline{\theta}\alpha^{**} + \overline{\theta}\alpha^{**} - \overline{\theta}\right)}$ if this implies that $\widehat{t}$ is on $[0, 1]$ and $\widehat{t} = 0$ otherwise.

Part ii): If $t > \widehat{t}$, it follows from the above calculations that $G(\alpha^{**}, t) < 0$ and a firm chooses to include at least some short-term debt. Furthermore, note that if $G(\alpha^{*}, t) > 0$, firms will not choose exclusively short-term debt.

From Corollary 1 ii) we have that α^* is decreasing in the short-term loan obtained at date 2. Furthermore, note that $\frac{\underline{\theta}\alpha}{\left(\underline{\theta}\alpha + \overline{\theta}\alpha - \overline{\theta}\right)}$ is decreasing in α (i.e., $\left(\frac{\underline{\theta}\alpha}{\left(\underline{\theta}\alpha + \overline{\theta}\alpha - \overline{\theta}\right)}\right)' = -\frac{\underline{\theta}\overline{\theta}}{\left(\overline{\theta}\alpha - \overline{\theta} + \underline{\theta}\alpha\right)^2} < 0$). Consequently, the firm increases short-term funding of the second project until $G(\alpha, t)$ change sign from negative to positive.

For $t > \frac{\underline{\theta}\alpha^*}{\left(\underline{\theta}\alpha^* + \overline{\theta}\alpha^* - \overline{\theta}\right)}$, the firm find it profitable to have only short-term debt and, consequently, $\widehat{\widehat{t}} = \frac{\underline{\theta}\alpha^*}{\left(\underline{\theta}\alpha^* + \overline{\theta}\alpha^* - \overline{\theta}\right)}$ represents an upper limit on the interval where firms mix between long term and short term debt to finance the second project.

Part iii): If $t > \widehat{\widehat{t}}$ we have that $G(\alpha^{*}, t) < 0$ and a firm chooses short-term funding of the second project. QED.

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