working paper

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Relationship Loans and Information Exploitability in a Competitive Market: Loan Commitments vs. Spot Loans

by Ozgur Emre Ergungor

FEDERAL RESERVE BANK OF CLEVELAND

Working Paper 00-13

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Abstract

Despite the numerous benefits of loan commitments, only 79% of the commercial and industrial loans are made under commitment. I show that two factors limit the use of loan commitments. First, because banks commit themselves to lend, they carry costly liquidity reserves to meet their obligations. Due to liquidity costs, the interest rate on commitment loans is high relative to spot loans. Second, high interest rates trigger moral hazard. If the bank expects a profitable relationship in the future, it can absorb a portion of the liquidity costs to reduce the interest rate and attenuate moral hazard. If not, the borrower cannot get a loan commitment.

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A loan commitment gives the commitment buyer the right to sell its debt to the bank at a prespecified price over some preestablished time interval. The contract stipulates the various fees which must be paid over the life of the commitment[1], a formula for calculating the loan interest rate, and the conditions under which the bank can revoke the commitment. In particular, every loan commitment contains a Material Adverse Change (MAC) clause which gives the bank the right to refuse to make the loan if the borrower's financial condition or future business prospects deteriorate over time after the contract is signed.

Loan commitments are widely used in the economy. A recent Federal Reserve statistical release (E2 - June 2000) shows that 79% of all commercial and industrial lending is made under commitment contracts (approximately $787 billion). Moreover, as of March 31, 2000, outstanding (unused) loan commitments of U.S. corporations have grown to $1 trillion 564 billion[2] up from $743 billion in 1990.

Due to their widespread use, loan commitments have received considerable attention in the literature. Two important questions have been addressed: *Why do loan commitments exist*? (Kanatas (1987), Boot, Thakor, and Udell (1987), Thakor and Udell (1987), Thakor (1989), Maksimovic (1990), Berkovitch and Greenbaum (1990), Greenbaum, Kanatas, and Venezia (1991), Boot, Greenbaum, and Thakor (1993), Houston and Venkataraman (1994), Shockley (1995) and Kashyap, Rajan, and Stein (1999)). *How should they be priced*? (Thakor, Hong and Greenbaum (1981), Thakor (1982), Greenbaum and Venezia (1985) and Melnik and Plaut (1986)). On the first question, the essence of what we know is that loan commitments are a contractual mechanism for optimal risk sharing when borrowers are risk averse and future interest rates are random; even under universal risk neutrality, loan commitments may still be used to attenuate moral hazard or resolve pre-contract informational asymmetry. On the valuation question, the principal insight is that loan commitments can be priced as put options where the borrower's debt is the underlying deliverable.

While the current literature improved our understanding of loan commitments considerably, there are still some stylized facts that remain unexplained.

First, despite the numerous benefits of loan commitments described in the literature, a significant fraction of commercial and industrial (C&I) lending (20%) is made with spot loans (loans made without prior commitment). The theory suggests that loan commitments prevent market failure when spot loans are ineffective in resolving information problems. In other words, commitment loans are used when spot loans are infeasible. However, there is no theory that explains the split between commitment loans and spot loans when both types of loans are available to borrowers.

Second, although a large percentage of C&I lending is done under loan commitments, this percentage is smaller for floating rate loans and short-maturity loans (except in the first quarter of 2000; see Figure 1). There is no theory that relates loan maturity to whether or not the loan is made under commitment.

[Figure 1 goes about here]

Third, according to the Federal Reserve's Senior Loan Officer Opinion Survey on Bank Lending (1988), borrowers view the guarantee provided by a loan commitment against being rationed as the most important reason for buying loan commitments. The literature on the existence of loan commitments assumes that these contracts carry a fixed interest rate and rationalizes them as a protection against interest rate uncertainty and as a tool to attenuate moral hazard at high interest rates. However, more than 80% of loan commitments are marked to market rates and do not provide any protection against the rate fluctuations[3]. Moreover, the evidence indicates that loan commitment buyers are more concerned about the unavailability of loans than the level of interest rates. In support of this argument, Figure 2 shows that the percentage of C&I loans made under commitment is highly correlated (correlation coef. is 0.67) with the level of banks' lending standards. In other words, a tightening in the spot market leads to a greater takedown from loan commitments.

[Figure 2 goes about here]

Based on these facts, I address the following four questions in this paper.

- How do we explain why risk neutral banks do not sell loan commitments to all borrowers despite all the benefits of loan commitments described in the literature?
- Among those borrowers that purchase loan commitments, what determines the choice between borrowing in the spot market and taking down a loan under commitment?
- How do we explain the demand for loan commitments in terms of protection against credit (quantity) rationing?
- What is the relationship between the loan's maturity and the choice between spot vs. commitment borrowing?

I address these questions in a setting where borrowers do not have collateralizeable assets and high interest rates create asset substitution moral hazard in the sense that borrowers prefer risky negative-NPV projects to safe positive-NPV projects when their loan interest rate is sufficiently high. The basic idea behind how my analysis addresses the first question is as follows. When banks sell loan commitments, they are legally obliged to make credit available even in states in which they have insufficient funds[4]. This implies that they have to keep idle reserves to make sure that they can meet their obligations. Idle reserves are costly for various reasons. First, depending on the size of the bank, 5 to 8% of a bank's assets are kept as cash. Hence, there is the opportunity cost of foregone interest. Second, even when the bank purchases treasury securities, the shareholders are still unhappy because of the double taxation of the interest income. Third, the availability of liquid reserves to the bank's managers aggravates the agency problems within the bank [Myers and Rajan (1998)]. I refer to these costs as "liquidity costs".

The bank cannot recoup these costs immediately by charging a high interest rate because this would make the borrower prefer the socially-dominated risky project. However, if the bank obtains proprietary firm-specific information about the borrower during this initial phase of their relationship and this information is exploitable in the future, the bank can expect to extract rents from the borrower by using its informational advantage relative to other lenders. The incumbent bank and the borrower can share these informational rents. If these expected rents are sufficiently large, the bank can absorb the costs of carrying liquidity reserves to the point where it makes zero expected profit ex ante. The borrower's commitment loan interest rate is grossed up to reflect the *rest* of the liquidity carrying-costs as long as this rate is still low enough to induce the borrower to prefer the desired safe project. When information exploitability is low and these rents are not enough to cover the bank's liquidity-carrying costs, a relatively larger fraction of these costs needs to be reflected in the price of the commitment loan which then precipitates moral hazard as the borrower prefers the risky project at this relatively high interest rate. When the bank knows that the borrower will choose the risky project, it refuses to lend with a loan commitment because the project has negative NPV.

On the second question, note that if the borrower does not have sufficient wealth to compensate the bank for the liquidity costs before it takes down the loan, the interest rate on a commitment loan has to compensate the bank for liquidity carrying costs. A spot loan, in contrast, is free from these costs because a bank makes a spot loan only if it has sufficient liquidity. Therefore, a spot loan is always cheaper than a commitment loan. The advantage of a commitment loan is that it provides a funding guarantee while the availability of a spot loan is uncertain ex ante. For that reason, borrowers prefer spot loans over commitment loans when credit is available in the spot market.

To address the third question and explain the insurance aspect of loan commitments, I assume that if the incumbent bank is in a liquidity crunch, it is possible for the borrower to get a loan from a competitor bank. However, there is always a positive probability that the borrower will not be able to find a loan *immediately*, even at a cost. The reasoning is that all banks in the spot market are subject to liquidity shocks and it may take a while for the borrower to find a bank with sufficient liquidity. In a competitive product market, a delay in investment is costly for the borrower because a competitor may take the project and steal the borrower's first mover advantage. Therefore, a loan commitment is valuable to the borrower because the funding guarantee prevents investment delays and allows the borrower to capture the full potential of its investment.

Now, consider the fourth question. To establish the relationship between loan maturity and whether the loan is made under commitment, I claim that the longer the maturity of a loan, the more time the bank has to investigate the borrower and acquire exploitable information. In other words, when the bank lends with a short-maturity loan, it is less likely to obtain exploitable information about the borrower during that short time interval. The crucial assumption behind this argument is that either the bank does not have a prior relationship with this borrower or the bank's prior experience with this borrower does not provide any hints about the borrower's current project. The low information exploitability means that the informational rents generated during the bank-borrower relationship will be insufficient to overcome the bank's liquidity-carrying cost to the extent necessary to keep the borrowing rate low enough to make the borrower prefer the safe project; thus the bank will refuse to lend with a loan commitment and we will observe a broader use of spot loans.

A. Literature Review

In my model, credit rationing arises from two sources. First, the bank has a cost of carrying liquidity. Second, there is asset substitution moral hazard. Asset substitution moral hazard creates a need for bank loans and liquidity costs determine the choice between spot loans and commitment loans. Credit rationing due to moral hazard has been addressed by Stiglitz and Weiss (1981) in their analysis of a credit market with adverse selection and moral hazard. In the case with moral hazard, the main idea is that a borrower with multiple investment opportunities switches from safe projects to risky projects at high interest rates because interest rates affect the borrower's return from safe versus risky projects differently. The increase in the borrower's riskiness can reduce the bank's expected return as the interest rate increases and the expected return can be maximized at an interest rate level below the market-clearing rate[5]. Boot, Thakor and Udell (1987, 1991) and Boot and Thakor (1991) show that loan commitments can prevent rationing by mitigating those problems. The bank can offer the borrower a sufficiently low interest rate to deter moral hazard. However, the bank suffers a loss when it lends at a rate below the market interest rate. To compensate the bank, the borrower pays a commitment fee when the contract is signed. Because this fee becomes a sunk cost when it is paid, it does not affect the project choice. However, these papers do not explain how loan commitments provide *insurance* against rationing. Insurance is the protection provided to the policy holder against an adverse event. Deductibles and other contract terms may reduce the likelihood of the event by forcing the policy holder to take precautions; but in the end, there is always a positive probability that the adverse event will occur. With loan commitments, the adverse event (rationing) is completely eliminated and there is nothing left to insure against. Therefore, the insurance-against-rationing aspect of loan commitments is not obvious in these models.

I differ from this literature in two respects. First, I show that a loan commitment has no advantage over spot loans in attenuating moral hazard and dealing with the resulting credit rationing when the bank-borrower relationship is sufficiently long rather than a one-time-only transaction. Similar to my results, Petersen and Rajan (1995) showed that spot loans in long-term relationships can attenuate asset-substitution moral hazard by subsidizing the borrower at the beginning and recovering the subsidy later in the future by extracting a share from the project's surplus by exploiting the informational advantage acquired during the initial phase of the relationship relative to other lenders. With these findings, it is not clear why borrowers would prefer loan commitments as insurance against rationing when the alternative is a long-relationship spot loan. This is clarified by my analysis. The advantage of loan commitments is that they provide a guaranteed source of funds that the spot credit market is unable to provide at a cost.

Second, in the relationship banking and loan commitment literature [e.g., Sharpe (1990), Rajan (1992), Petersen and Rajan (1995), Yafeh and Yosha (1995)], the incumbent bank always has an informational advantage over competitors. By introducing varying degrees of exploitability of the information the bank has about the borrower, I allow competing banks to sometimes be in a situation in which the incumbent bank's information exploitability advantage is insufficient to keep the borrower.

In addition, I explain why short-maturity loans are less likely to be made under commitments. This issue has not been addressed in the literature.

The rest of the paper is organized as follows: Section 2 presents the model; Section 3 explains how information exploitability affects the contract choice; Section 4 presents the empirical implications of the model; Section 5 discusses the important assumptions of the model and Section 6 concludes.

I. The Model

A. Projects and Payoff Characteristics

I assume a three-period *risk-neutral* world with four points in time: {-1, 0, 1, 2}. The events at date –1 will be described in the next subsection. At date 0, there are two types of borrowers: *good* or *bad*. Good borrowers can choose either a safe or risky project. (See figure 3 below). Both projects cost I_0 dollars. A safe project pays out S_1 at date 1 and the risky project pays out R_1 with probability p and 0 with probability $(1-p)$. Furthermore, when the safe project concludes at date 1, the good borrower can invest I_S in another safe project that returns S_2 at date 2. On the other hand, when the risky project concludes and *if* it is successful, the borrower can invest I_R in a safe project that pays out R_2 at date 2. Projects of *bad* borrowers return nothing. I assume that the commonlyknown prior probability that the borrower is good is $\theta \varepsilon (0,1)$ [6].

[Figure 3 goes about here]

I also make the following assumptions:

Assumption 1:

(i) $S_2 + S_1 - I_S - I_0 > 0$; the safe project has positive NPV

(ii) $p(R_2 + R_1 - I_R) - I_0 < 0$; the risky project has negative NPV. The bank does not want to finance the risky project.

(iii) $pR_2 = S_2 > pI_R = I_S$; the future projects have positive NPV and have the same expected return and investment no matter which project is chosen at date 0 [7].

(iv) $I_S > R_1 > S_1$; the borrower will need additional funding at date 1.

B. Information Structure

Borrowers with no initial wealth and no collateralizeable assets[8] look for financing at time –1. Neither borrowers nor banks know any borrower's type at that time. It is, however, common knowledge that a borrower is good with probability θ. Borrowers learn their types at time 0. I also assume that cash flows and the project choice are unobservable to and unverifiable by outsiders. That is, the good borrower cannot write contingent contracts to signal its type.

Bank loans are the only source of financing. All banks are identical. Although borrowers learn their types at time 0, banks continue to be uninformed; at date 0, a bank only knows that a borrower is good with probability θ. If a bank lends to a borrower at t=0 and starts a relationship, it can learn that borrower's type at date 1. This assumption is in accord with the literature on relationship banking that a bank learns significantly about the borrower during its relationship. (See, for example, Diamond (1991), Rajan (1992), Berlin and Mester (1992), Shockley (1995), Blackwell and Winters (1997), Longhofer and Santos (1999)).

I also assume that the information about the borrower that the bank will acquire during the relationship will be exploitable in the future with probability ϕ. Information is considered exploitable if it provides the bank an informational advantage in the final period relative to other lenders. So, if competitors learn the borrower's type at time 1, the incumbent bank's information does not provide any competitive advantage although it is still valid information about the borrower. How the competitors learn the borrower's type is exogenous to the model. Other banks that the borrower has relationship with, financial analysts, bond-rating agencies are plausible information producers.

Finally, note that when the bank lends to the borrower in the second period, this is a clear signal to other lenders that the borrowers is good. I assume that the borrower cannot prepay its loan and switch to another lender due to prepayment penalties.

Figure 4 summarizes the information structure.

[Figure 4 goes about here]

C. Lending Process and Contract Availability

I assume that the borrower takes down a short-term loan each period[9]. The loan at time 0 can take two forms: a loan taken down from a commitment made at time –1 or a no-commitment spot loan. The third-period loan at time 1 is a spot loan. I will explain later that there is no need for a loan commitment in the final period.

If the borrower decides to use a spot loan at time 0, it borrows I_0 from the bank and promises to repay $D_{1,S}$ at date 1. If the borrower decides to use a loan commitment at time –1 to fund the project at time 0, it borrows the same amount but the commitment stipulates the borrower's repayment obligation at time 1 as $D_{1,LC}$. The price charged on the loan commitment is different from the price charged on the spot loan due to the costs associated with the use of loan commitments. These costs will be introduced momentarily. Note that at time 0, a borrower who owns a loan commitment can either use a spot loan or the commitment to get I_0. Finally, I assume that $S_1 > \max[D_{1,S}, D_{1,LC}]$[10]. That is, the good borrower always has enough cash at time 1 to pay off the initial debt. After the debt repayment, I assume that the borrower keeps a fraction γ of the remaining cash flow of the first project as dividend, reinvests the rest in the third-period project and borrows $(I_S - (1-\gamma)(S_1 - D_1))$ to bring the total investment to I_S. I will endogenize the dividend payout ratio, γ, later.

Finally, the third-period spot loan is priced as follows. If the bank loses its informational advantage at time 1, it has to price the third-period loan competitively. In a risk-neutral world where the risk-free rate is zero, perfect competition corresponds to an expected return on loans of $M=1$. If the bank retains its private information, it can charge a monopoly rate such that its expected return on loans is $M>1$. As in Petersen and Rajan (1995), I will call M the market power of the bank.

The bank's liquidity availability at time 0 is random. That is, the bank will have enough reserves to lend to the borrower with probability q_b or it will be in a liquidity crunch and ration credit with probability $(1 - q_b)$[11]. Note that I am ruling out the possibility that the bank could obtain liquidity from the Federal Reserve's Discount

Window. This is a sensible assumption because the Federal Reserve strongly discourages repeated visits to the Discount Window. A bank with frequent liquidity problems may be scolded or perhaps subjected to rigorous examination or told to stay away from the window until its affairs are in order. Therefore, if the bank is not legally required to provide liquidity to the customer, it will choose to not lend in a liquidity crunch state. Yet, the incumbent bank has the option to carry liquidity from time –1 to time 0 by incurring a cost of \$$C$. This is the cost of keeping idle liquidity reserves. A bank that carries liquidity is always able to lend at time 0. However, as I will show in the next section, banks do not carry liquidity unless they are required to do so by a legally enforceable loan commitment. If the borrower does not purchase a loan commitment and is rationed by the incumbent bank in the spot market, it can immediately find another bank with probability q_m. I assume that $q_b \geq q_m$[12]. Given these probabilities, the funds needed for the first project will not be immediately available to the borrower with probability $(1-q_b)$ $(1-q_m)$ if it decides to wait to borrow from the spot market. However, if the borrower looks for financing long enough, it can always find a bank with sufficient liquidity. The intuition is that spot market rationing in reality is likely to only affect the timing of the project rather than whether it is undertaken or not. In a competitive product market, however, timing is a critical variable. If the borrower does not take the project, a competitor may come in and the borrower may lose the first-mover advantage. To capture this idea, I will assume that if the project is delayed, the borrower can get only a fraction $(1-\alpha)$ of the original value. The cost α is dissipative and increasing in the product market competition.

Then, the advantage of loan commitments is that they provide a guaranteed source of funds and prevent investment delays[13]. Their disadvantage is that they are more expensive than spot loans because of the liquidity-carrying costs. So, the borrower's contract choice is based on the trade-off between the funding guarantee of loan commitments and the better interest rate deal of spot loans.

The bank faces the following problem in pricing a loan. When the bank picks an interest rate for the first period loan, it must take into account the possible losses from lending to bad borrowers. A high interest rate, on the other hand, can distort the borrower's incentives and make it choose the risky negative-NPV project.

The next section shows how spot loans and loan commitments deal with this problem.

II. Contract Choice

In this section, I investigate how the information exploitability parameter, ϕ, affects the effectiveness of spot loans and commitment loans in attenuating moral hazard. I initially analyze the spot loans and then the loan commitments. In both cases, I start the analysis by examining the events at date 2 and move backward in time.

A. Spot Loans

Let's initially assume that the borrower has chosen the safe project in the second period and now it is in the third period. I'll come back to the moral hazard problem and the project choice at time 0 when I discuss the second period.

At time 2, the end of the third period, the bank earns \$$M$ from each dollar lent at time 1 if the information is exploitable and \$1 if the information is not exploitable and the loan is priced competitively. Given the exploitability probability ϕ, the bank's expected revenue per dollar at time 1 from the third-period lending is $(\phi M+(1-\phi))$. Its profit is obtained by subtracting the cost of the loan (\$1) from the revenue. That is, the bank makes an expected profit of $\phi(M-1)$ from each dollar lent in the third period. Because the total lending in this period is \$$(I_S-(1-\gamma)(S_1-D_1))$, the bank's expected profit is

$$\Pi_3^{bank}=\phi(M-1)(I_S-(1-\gamma)(S_1-D_1)) \tag{1}$$

Note that the bank's revenue is the borrower's cost. Therefore, at time 2, the borrower's profit is

$$\Pi_3^{borrower}=S_2-(\phi M+(1-\phi))(I_S-(1-\gamma)(S_1-D_1)) \tag{2}$$

Now, let's go back to the second period. The initial second-period loan is priced in such a way that the bank makes zero expected profit at time 0.

$$\theta\left[D_{1,S}+\phi(M-1)\left(I_S-(1-\gamma)(S_1-D_{1,S})\right)\right]=I_0 \tag{3}$$

The left-hand side of (3) is the bank's expected income from the relationship at time 0, if the borrower is good with probability θ. The right-hand side is the cost of the first loan. Rearranging (3), I obtain the repayment obligation of the initial loan repaid at time 1.

$$D_{1,S}=\frac{I_0}{\theta(1+(M-1)(1-\gamma)\phi)}-\frac{\phi(M-1)(I_S-S_1(1-\gamma))}{(1+(M-1)(1-\gamma)\phi} \tag{3'}$$

Based on the assumption that a fraction γ of the first project's remaining cash flows is paid as dividend, the borrower's total expected profit from the use of a spot loan at time -1 is

$$\Pi_{-1,S}^{borrower} = \theta\left(1-\alpha(1-q_m)(1-q_b)\right)\left(\gamma(S_1 - D_{1,S}) + \Pi_3^{borrower}\right)$$

$$= \theta\left(1-\alpha(1-q_m)(1-q_b)\right)\left(S_1 + S_2 - \frac{I_0}{\theta} - I_S\right) \qquad (4)$$

where $\left(1-\alpha(1-q_m)(1-q_b)\right)$ is the expected share of the profits that can be retained by the borrower given the positive probability that spot credit may not be available immediately and the project may be delayed. The θ term is outside the parenthesis because the borrower does not know its type until it invests in the project. Also note that (4) does not depend on the information exploitability probability, ϕ, and the payout ratio, γ. The intuition for the first observation is that in a risk-neutral world where the bank always makes zero expected profit, any wealth transfer to the bank due to increasing exploitability is reflected in the first-loan's face value as a lower price. Hence, the borrower is indifferent to changes in the exploitability probability. Similarly, a high payout ratio increases the third-period borrowing and the bank's expected profit in that period. Due to the bank's zero expected profit condition, this increase is exactly offset by a reduction in the price of the second-period loan. Therefore, the borrower is indifferent to the payout ratio.

The discussion so far assumed that the borrower chooses the safe project. However, this is true only if the bank correctly sets the interest rate at date 0. The borrower will choose the safe project over the risky one if the repayment obligation of the first period loan, D_1, is such that:

$$S_2 + S_1 - D_1 - (\phi M + (1-\phi))I_S \geq p\left[R_2 + R_1 - D_1 - (\phi M + (1-\phi))I_R\right] \tag{5}$$

The left hand side of the (5) is the borrower's profit with the safe project. The bank loses its informational advantage with probability $1-\phi$, and when this happens the borrower pays the competitive rate M=1 on the third-period borrowing $(I_S - (1-\gamma)(S_1 - D_1))$; otherwise, it pays M>1. Similarly, the right-hand side is the borrower's profit with the risky project. Also note that, both types of projects are subject to liquidity crunch risk. Therefore, the probability of credit availability q does not appear in the equation.

By using Assumption 1 (iii) and (iv) and rearranging (5),

$$D_1 \leq D_{1,B} = \frac{S_1 - pR_1}{1-p} \tag{5'}$$

(5') shows that the repayment obligation of the initial loan has to be less than $D_{1,B}$ to induce the borrower to take the safe project. Note that my previous argument on the borrower's indifference to the payout ratio is valid as long as the borrower can be induced to take the safe project in the second period. As I explained earlier, a high payout ratio reduces the initial loan's repayment obligation and therefore attenuates the asset-substitution moral hazard. From this point on, I will set γ equal to 1. This assumption may seem counterintuitive at first because lenders usually impose debt covenants that limit cash disbursements to shareholders. However, in a relationship-lending setting, a large dividend implies a larger borrowing and therefore more profit for the bank. I also assume that the borrower precommits itself to this dividend policy. That is, after promising the bank a 100% dividend payout at time 1 (which implies high third-period borrowing and high expected profit for the bank in that period) and obtaining a low price for the initial loan, the borrower cannot invest the cash flows from the initial project in the equity of the second project and reduce the third-period borrowing. I rewrite (3') as

$$D_{1,S} = \frac{I_0}{\theta} - \phi(M-1)I_S \qquad (3'')$$

The next result explains how a spot loan deals with the asset substitution moral hazard.

Proposition 1: *(i) The borrower always takes the safe project and the bank is willing to lend with a spot loan if the exploitability probability ϕ is greater than*

$$\phi_c^S = \frac{\frac{I_0}{\theta} - \frac{S_1 - pR_1}{1-p}}{(M-1)I_S} \qquad (6)$$

(ii) ϕ_c^S is decreasing in the market power (M) and the fraction of good borrowers (θ).

Proof: The price of the loan, D_1, must be sufficiently low to induce the borrower to invest in the safe project and sufficiently high to compensate the bank; i.e. $D_{1,S} \leq D_1 \leq D_{1,B}$. Solving this inequality for ϕ, we obtain

$$\phi \geq \frac{\frac{I_0}{\theta} - \frac{S_1 - pR_1}{1-p}}{(M-1)I_S} = \phi_c^S$$

By using Assumption 1,

$$\frac{d\phi_c^S}{dM} = -\frac{\frac{I_0}{\theta} - \frac{S_1 - pR_1}{1-p}}{(M-1)^2 I_S} < 0$$

$$\frac{d\phi_c^S}{d\theta} = -\frac{I_0}{\theta^2 (M-1) I_S} < 0 \quad \square$$

The first part of this result simply states that the spot loan market exists if the loan price is feasible. Note that the price is feasible for any D_I such that $D_{1,S} \leq D_I \leq . D_{1,B}$ Infeasibility implies $D_{1,B} \leq D_{1,S}$. If the exploitability probability is too low, the price at which the bank can recover the cost of the initial loan induces the borrower to take the risky project. The bank anticipates this action and refuses to lend because the risky project has negative NPV. So, although the borrower is indifferent to the information exploitability (as shown in (4)), exploitability determines the fraction of the costs that can be transferred into the future where they do not affect the borrower's project choice. Therefore, the borrower is indifferent to exploitability as long as it can be induced to take the safe project. Otherwise, the bank refuses to lend and the borrower makes zero profit. The intuition of the second part is that when the bank's market power is high, it can recapture the loss due to competitive pricing by extracting a larger share of the future surplus. By the same token, when θ is large, less money is wasted because of the bad borrower and current rents are sufficient to cover the subsidy at low ϕ values.

Before concluding this section, I'd like to point out that in the absence of information-producing bank-borrower relationships (ϕ=0, the bank learns nothing useful about the borrower), the loan market always fails. Relationships alleviate this market failure by reducing competitive pressures. Nevertheless, note that ϕ_c^S is always positive.

That is, although relationships reduce rationing, the market may still fail with positive probability when information exploitability is low.

B. Loan Commitments

A loan commitment is an option. This implies that after the borrower purchases the loan commitment, it is under no obligation to use it. Therefore, it is free to borrow from the spot market if it can get credit.

After purchasing a loan commitment at time –1, a spot loan from another bank at date 0 costs the borrower $D_{1,S}$, the same repayment obligation as in (3'').

The incumbent bank prices the loan under commitment by taking into account the possibility that the borrower may get a spot loan from a competitor with probability q_m. If the borrower receives an offer from a competitor at time 0, the bank gives the borrower a spot loan that carries the same terms as a loan that can be obtained from another bank in the spot market. The bank's zero expected profit condition becomes

$$\theta\left[q_m D_{1,S} + (1-q_m)D_{1,LC} + \phi(M-1)I_S\right] = I_0 + C \tag{7}$$

Rearranging (7), I obtain the repayment obligation of the loan made under commitment.

$$D_{1,LC} = \frac{I_0 + C}{\theta} - \phi(M-1)I_S = D_{1,S} + \frac{C}{\theta} \tag{7'}$$

(7') shows that the loan made under commitment is always more expensive than a spot loan due to the liquidity-carrying costs. The next proposition explains how this affects the contract choice at time 0.

Proposition 2: *At time 0, borrowers always prefer the spot loan over the loan made under commitment when credit is available.*

Proof: At time 0, after the borrower observes that credit is available in the spot market, its profit from the spot loan is

$$\Pi_{0,S}^{borrower} = \theta\ (S_1 + S_2 - \frac{I_0}{\theta} - I_S) \tag{8}$$

Similarly, the profit from the commitment loan is

$$\Pi_{0,LC}^{borrower} = \theta\ (S_1 + S_2 - \frac{I_0 + C}{\theta} - I_S) \tag{9}$$

Clearly, (8)>(9). When the funding guarantee advantage of the loan commitment becomes obsolete, the spot loan is preferred because it is cheaper. □

The intuition is that when credit is costlessly available in the spot market, the uncertainty about credit availability is resolved and the funding guarantee of the loan commitment has no advantage to the borrower. Moreover, borrowing under commitment entails the payment of the bank's liquidity costs. Therefore, the borrower always uses the spot loan irrespective of its contract choice at time –1. Note that the bank can charge a usage fee to the borrower for not using the loan commitment and prevent it from switching to a spot loan. However, the bank cannot benefit from this action because in a competitive market, it has to compensate the borrower for the usage fee by reducing the loan interest rate. Since the bank is indifferent ex ante, I assume that it does not charge the usage fee.

The liquidity costs also affect the extent to which loan commitments can prevent asset-substitution moral hazard. The next proposition explains this argument.

Proposition 3: *The borrower always takes the safe project and the bank is willing to lend with a commitment loan if the exploitability probability ϕ is greater than*

$$\phi_c^{LC} = \frac{\frac{I_0 + C}{\theta} - \frac{S_1 - pR_1}{1-p}}{(M-1)I_S} = \phi_c^S + \frac{C}{\theta(M-1)I_S} \tag{10}$$

Proof: The proof is similar to that of Proposition 1. D_1 must satisfy $D_{1,LC} \leq D_1 \leq D_{1,B}$. Solving this inequality for ϕ, we obtain

$$\phi \geq \frac{\frac{I_0 + C}{\theta} - \frac{S_1 - pR_1}{1-p}}{(M-1)I_S} = \phi_c^{LC} \quad \square$$

Proposition 3 shows that the liquidity-carrying costs reduce the usefulness of loan commitments relative to spot loans in attenuating moral hazard at low information exploitability probabilities because the bank's future rents are not enough to carry these costs into the future where they do not affect project choice.

With a loan commitment the borrower's expected profit at time –1 becomes

$$\Pi_{-1,LC}^{borrower} = \theta\ (S_1 - q_m D_{1,S} - (1-q_m) D_{1,LC} + \Pi_3^{borrower})$$

$$= \theta\ (S_1 + S_2 - \frac{I_0 + C}{\theta} - I_S) \tag{11}$$

The next proposition compares (11) to the borrower's expected profit with a spot loan, (4), and reveals the conditions under which loan commitments dominate spot loans at time –1.

Proposition 4: *If information exploitability is sufficiently large so that loan commitments are feasible, loan commitments dominate spot loans at time –1, when*

(i) the cost of delayed investment, α*, is sufficiently large. In other words,*

$$\alpha > \frac{C}{(1-q_b)(1-q_m)\theta(S_1 + S_2 - \frac{I_0}{\theta} - I_S)} \tag{12}$$

(ii) the liquidity in the spot market is sufficiently low. In other words,

$$\lambda < 1 - \frac{C}{\alpha\theta(S_1 + S_2 - \frac{I_0}{\theta} - I_S)} \tag{13}$$

where $\lambda = \left(1-(1-q_m)(1-q_b)\right)$ *is the probability that liquidity will be immediately available at time 0.*

Proof: (i) Loan commitments are preferred over spot loans at time –1, if

$$\Pi_{-1,LC}^{borrower} > \Pi_{-1,S}^{borrower} \tag{14}$$

Rearranging terms and solving for α, I obtain

$$\alpha > \frac{C}{(1-q_b)(1-q_m)\theta(S_1 + S_2 - \frac{I_0}{\theta} - I_S)}$$

(ii) Similar to part (i), I solve (14) for the probability of immediately obtaining liquidity in the spot market which I label as $\lambda = \left(1-(1-q_m)(1-q_b)\right)$ and obtain

$$\lambda < 1 - \frac{C}{\alpha\theta(S_1 + S_2 - \frac{I_0}{\theta} - I_S)}. \qquad \square$$

Proposition 4(i) explains that as the credit market competition increases, borrowers prefer loan commitments despite their higher cost because rationing becomes more damaging. To see the intuition behind part (ii), note that an increase in the share of rents lost to competitors, α, increases the right-hand side of (13). That is, in an increasingly competitive product market, although an increase in liquidity reduces the importance of the funding guarantee, the simultaneous increase in the losses to competitors ensures that the loan commitment is still the preferred contract.

To clarify the discussion so far, let me recapitulate the difference between the results in propositions 2 and 4. Proposition 4 deals with the choice *at time –1* between purchasing a loan commitment and waiting for the future spot market while proposition 2 dealt with the choice *at time 0* between borrowing from the spot market and using the loan commitment purchased earlier. The choice at time 0 depended only on fund availability in the spot market because commitment loans are always more expensive than spot loans. At time –1, the expected loss to competitors must be sufficiently high to validate the high cost of loan commitments and the bank must be willing to lend with a loan commitment given the threat of moral hazard.

My results so far are based on the implicit assumption that the bank that sells a loan commitment always carries liquidity to honor its claim. The next proposition clarifies and formalizes this assumption.

Proposition 5: *In the absence of a legally enforceable commitment to lend, the bank does not carry liquidity from date –1 to date 0 even if it is compensated for the cost of carry.*

Proof: If the bank can credibly commit itself to lend, the borrower is willing to take the initial loan at a repayment obligation of $D_{1,LC} = D_{1,S} + \frac{C}{\theta}$. Otherwise, the borrower demands the lower repayment obligation of a spot loan $D_{1,S}$.

If the bank can walk away from its commitment with legal impunity, it can promise to lend, convince the borrower to accept $D_{1,LC}$ and not carry liquidity. In that case, the bank makes an expected profit of \$$C$ (It expects to earn \$$C/\theta$ from each borrower with probability θ). Therefore, the bank must be legally bound or its commitments will be worthless. □

This result reflects a classic moral hazard problem. The bank takes an action after its compensation is guaranteed. If the bank is compensated for the cost of carrying liquidity, the compensation is adjusted in such a way that the bank makes zero expected profit net of the liquidity-carrying cost. In that case, the bank prefers to take the compensation and not carry liquidity because this guarantees a positive profit. Even if the compensation is tied to the condition that the bank actually lends at time 0, the bank will still make zero expected profit at time –1. Assuming that carrying liquidity is unverifiable if the bank is not in a crunch, the bank will not carry liquidity and collect the compensation if it has sufficient liquidity reserves to lend at time 0, leading to a positive expected profit. Therefore, an explicit legally enforceable commitment to lend is necessary to induce the bank to keep idle liquidity reserves[14].

In the next section, I extract the empirical implications of the analysis.

III. Empirical Implications

Empirical Implication A: The first implication is a direct application of proposition 3. When information exploitability is high, the model predicts a greater use of loan commitments as long as the benefits of the funding guarantee are larger than the liquidity-carrying costs. Information exploitability will be high when there are few information producers for that borrower that would compete with the incumbent bank.

This leads to the following prediction.

Prediction #1: *The use of loan commitments will be relatively low for firms that have multiple banking relationships and for firms followed by a large number of analysts.*

Empirical Implication B: This implication follows from proposition 4. If the competition in the borrower's product market is sufficiently high, we observe borrowers who purchase loan commitments to protect themselves from rationing even in markets where liquidity is increasing but prefer not to use them when credit is available in the spot market. This leads to the following prediction.

Prediction 2: *If the competition in the product market is increasing over time, borrowers will insure a larger share of their future funding needs with loan commitments.*

Prediction 3: *Borrowers who purchased loan commitments to protect themselves from rationing will switch to spot loans when credit is available. Hence, the takedown fraction will decline with increasing liquidity (and vice versa).*

Figures 5 and 6 provide evidence in support of these predictions.

[Figures 5 and 6 go about here]

Figure 5 shows that in the 90s, the rate of growth in loan commitment purchases exceeded the rate of growth in total loan demand. I explain this by the borrowers' desire to insure a larger fraction of their funding needs in the increasingly competitive product markets of the 90s.

As predicted by my model, Figure 6 shows that borrowers use a smaller fraction of their credit limits (i.e. the takedown fraction declines) when banks relax their lending requirements and make spot loans more accessible. When they tighten, loan commitment usage goes up. The correlation is 75 percent.

IV. Model Robustness and Discussion

An important assumption in this paper is that borrowers do not have an initial endowment that they can invest in equity. Clearly, an equity investment would reduce moral hazard by putting the borrower's own money at risk. Note that as long as the initial endowment is less than the initial cost of the project, the presence of the bank loan will create moral hazard. The main difference between my results and the results with equity investment is that the latter will allow the bank to lend money at relatively lower exploitability probabilities. Hence, more positive-NPV projects will receive funding.

Also, similar to Boot, Thakor and Udell (1987), the borrower's initial endowment can be used to pay the bank a commitment fee when the contract is signed. The fee can be used to pay the bank's liquidity-carrying costs without affecting the borrower's project choice. The intuition is that the borrower chooses its project *after* purchasing the loan commitment and paying the fee. At that point in time, the fee is a sunk cost and does not affect the borrower's incentives. Note that because of the bank's zero expected profit condition, the fee payment will reduce the price of the initial loan so that the bank is indifferent to the fee payment ex ante. The resulting lower interest rate allows borrowers with low information exploitability probabilities to benefit from the funding guarantee of the loan commitment. Hence, the existence of an initial endowment and the payment of a commitment fee makes the loan commitment available to a greater spectrum of borrowers. The results of this paper are still valid as long as the initial endowment is not enough to fully cover the bank's liquidity carrying costs. In that case, the loan commitment will always be more expensive than a spot loan and borrowers with sufficiently low information exploitability probabilities will switch to risky projects when they finance their investment with a loan commitment.

Another important assumption of this paper is that bank loans are the only source of funding. The reason why borrowers choose bank loans over other forms of financing is described in various papers. (Diamond (1991), Rajan (1992), Berlin and Mester (1992)). One of the key advantages of a bank loan is that banks can attenuate asset-substitution moral hazard by subsidizing the borrower at the beginning and recovering the subsidy later in the future by sharing the project's surplus. This is efficient because back-loaded state contingent interest payments are less distortionary than front-loaded fixed interest payments. It is for this reason that outside equity, for example, is dominated by a the bank loan in this setting. Equity does not allow the lender to extract cash from the firm because dividend payments are voluntary. Public debt is also dominated by the bank loan because of the impossibility of spreading interest costs over time. Moreover, if the borrower does not have a well-established reputation, equity or public debt issues may be prohibitively costly.

In the third period, however, the borrower is free to choose its funding source if the bank's information is not exploitable. I implicitly assume that investors in capital markets cannot obtain the bank's information and therefore cannot compete with the bank in the last period. However, as documented by Best and Zhang (1993) there are various information producers in the market other than the prospective lender, such as financial analysts and investment banks that have relationships with the firm or other commercial banks that the firm has deposits with. The private information that the prospective lender will obtain from the borrower may also be revealed to these information producers. In my analysis, I assumed that when the bank does not have an informational advantage, it can always match the competitors' offers because it is competing only with banks and all banks are identical. When we allow for public debt, for example, bank loans may be too expensive for a borrower whose quality is well-established in the market. Then, the bank may be unable to offer a sufficiently low price and lose the customer. It can be shown that the risk of losing business to non-bank competitors reduces the bank's incentive to offer relationship loans (commitment or spot). However, the intuition that governs the choice between spot loans and loan commitments is unaffected.

The last assumption that I will discuss in this section is that borrowers cannot pledge any collateral. It has been shown in the literature that collateral plays two important roles: First, it can be used to alleviate credit rationing due to pre-contractual informational asymmetries because it can be used to sort the privately-informed borrowers in a separating equilibrium. (See, for example, Bester (1985), Besanko and Thakor (1987)). In my model, there is no pre-contractual informational asymmetry, so adverse selection is not an issue. Second, collateral can also be used to attenuate moral hazard even though monitoring and repossessing the asset are costly because the borrower loses the collateralized asset only if it defaults and default probability depends on the borrower's actions. (See Bester (1987), Chan and Thakor (1987), Boot, Thakor and Udell (1991)). In my model, having a collateralizeable asset would lessen moral hazard and reduce rationing (reduce ϕ_c^S and ϕ_c^{LC}). This would, in turn, reduce the importance of bank loans and make capital markets a non-negligible competitor. As I previously explained in this section, the same results would go through.

V. Concluding Remarks

This paper illuminates two stylized facts about bank loan commitments.

According to the Federal Reserve's Senior Loan Officer Opinion Survey on Bank Lending (1988), guarantee against being rationed is the most important reason for buying loan commitments. My analysis rationalizes loan commitments as a guarantee against future rationing.

Data show that as the loan maturity shrinks so does loan commitment use. My model explains this by showing that loan commitment demand is increasing in the exploitability of the information about the borrower. A short-maturity loan (or a short-term relationship) does not give the bank sufficient time to investigate the borrower and obtain exploitable information. Low exploitability implies broader use of spot loans.

The empirical predictions of the model are as follows:

- The use of loan commitments will be low for firms that have multiple banking relationships.

- The use of loan commitments will be low for firms followed by a large number of analysts.
- Borrowers who purchased loan commitments to protect themselves from rationing will switch to spot loans when credit is available and the takedown fraction will decline with increasing liquidity.

The current research still leaves some interesting questions unanswered. For example, Federal Reserve Release E.2. shows that loan commitments are more likely to be subject to prepayment penalties and are less likely to be secured with collateral. The relationship between the fact that the loan is made under commitment and other contract parameters remains to be understood.

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Footnotes

[1] The fee structure can include a commitment fee which is an upfront fee paid when the commitment is made, an annual (service) fee which is paid on the borrowed amount and a usage fee which is levied on the available unused credit.

[2] FDIC bank data

[3] Neither do they provide protection against the changes in the borrower's default risk. The bank may renege on its commitment by invoking the MAC clause if the borrower's financial condition deteriorates.

[4] The Material Adverse Change clause allows banks to escape their legal liability, but this has to do with a decline in the borrower's financial condition not the bank's liquidity.

[5] The case of adverse selection is very similar. Banks cannot distinguish between privately informed credit applicants with different risk attributes, an increase in interest rates drives safer borrowers out of the credit market and makes the applicant pool riskier.

[6] A similar structure is in Petersen and Rajan (1995)

[7] This assumption is not critical. It allows us to concentrate our attention on the first period.

[8] See section 5 for a discussion of this and other critical assumptions.

[9] Clearly, the firm could spread repayments of the initial loan between date 1 and date 2. Since the discount rate is zero, the short-term lending assumption has no effect on the results.

[10] When I refer to the repayment obligation of the second-period loan in general without referring to the contract type, I will drop the {S, LC} subscripts and use D_1.

[11] It is possible to make a similar assumption on the bank's fund availability at date 1 for the third-period loan. However, this assumption does not have a significant contribution to the results and is omitted to simplify the model. So, I assume that the bank will have enough funds at time 1 independent from the fund availability at time 0.

[12] Otherwise, the borrower is more likely to find credit from a different bank and therefore will not contract with the incumbent bank in the first place. This is not a critical assumption.

[13] Because credit is available in the spot market at time 1, there is no need for loan commitments in the final period.

[14] Banks have a regulatory obligation to keep capital reserves against their loan commitment obligations. However, these reserves are not sufficient to cover a bank's entire commitment portfolio. Therefore, a commitment is needed to induce the bank to keep reserves beyond the legal requirements.

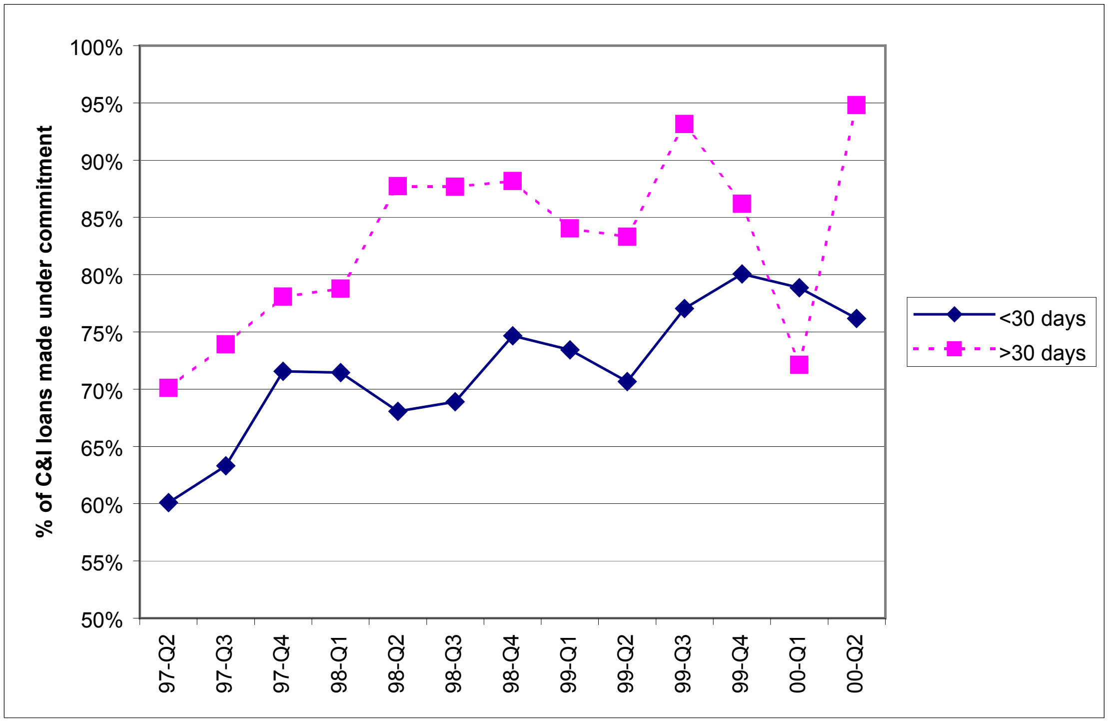

Figure 1. Historical data on loan maturity and loan commitment use. Floating-rate loans are assumed to have 0-maturity. *Source:* Federal Reserve Statistical Release E.2.

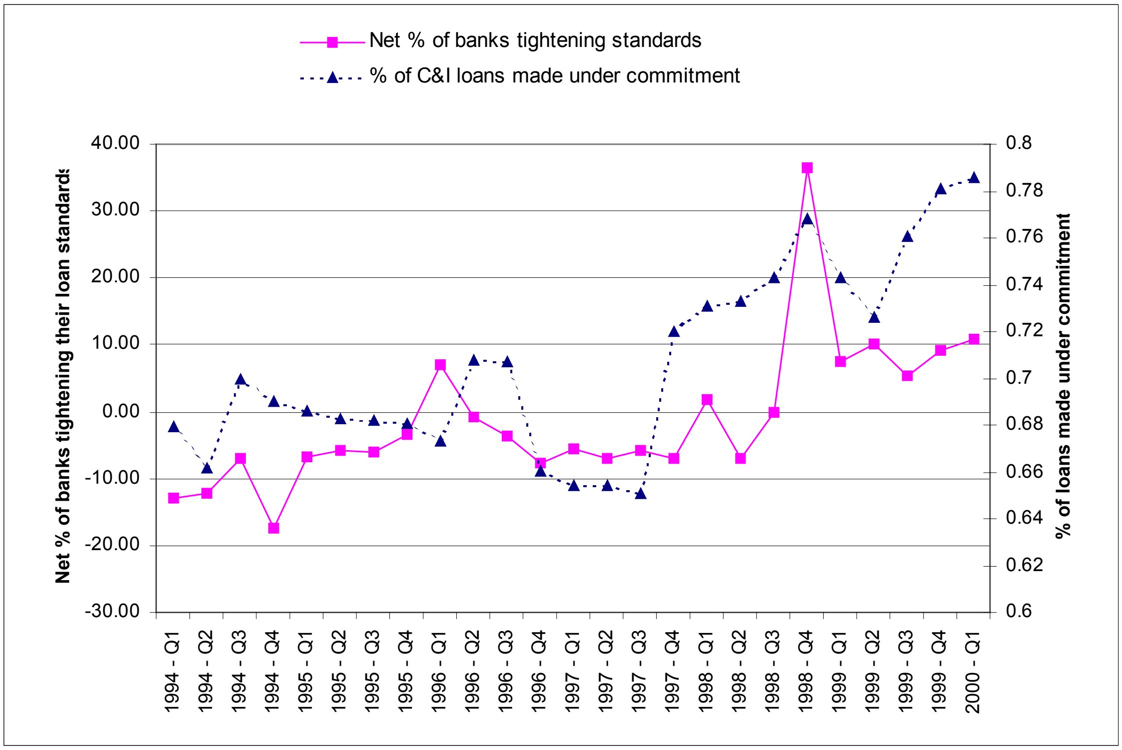

Figure 2. A comparison of banks lending standards with loan commitment takedown. A negative percentage implies that the lending standards were relaxed. ***Source:*** **FDIC and FED surveys and statistical releases.**

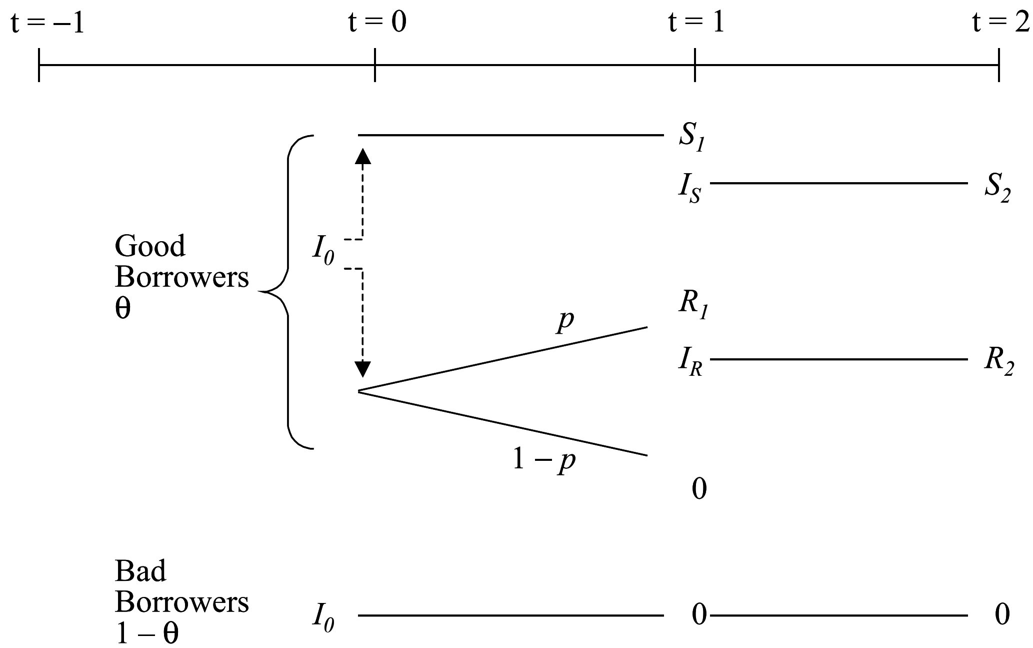

Figure 3. Borrower types and project availability

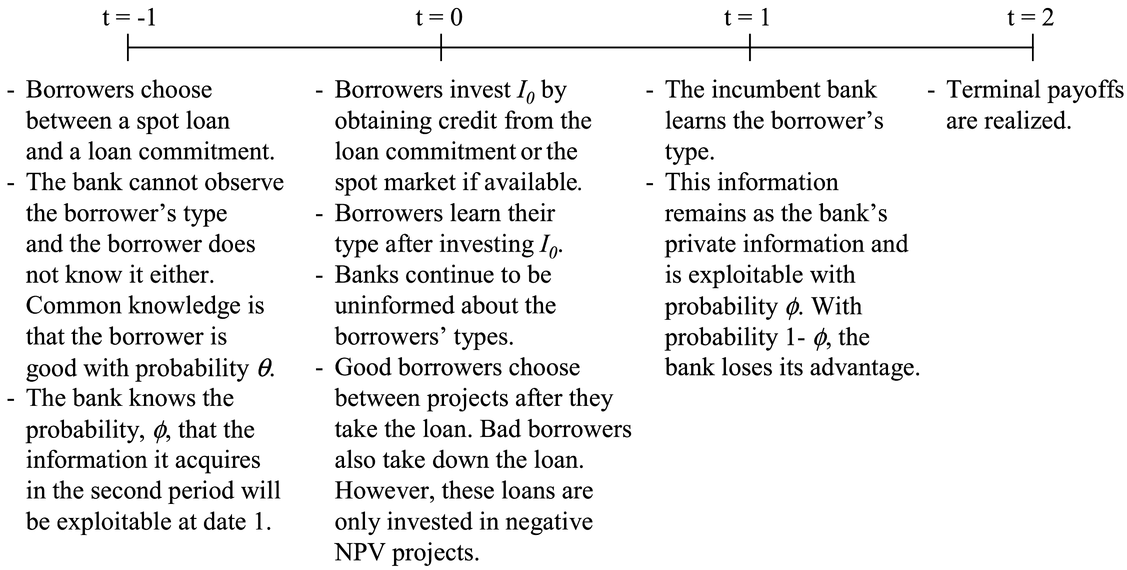

Figure 4. The sequence of events and the information structure

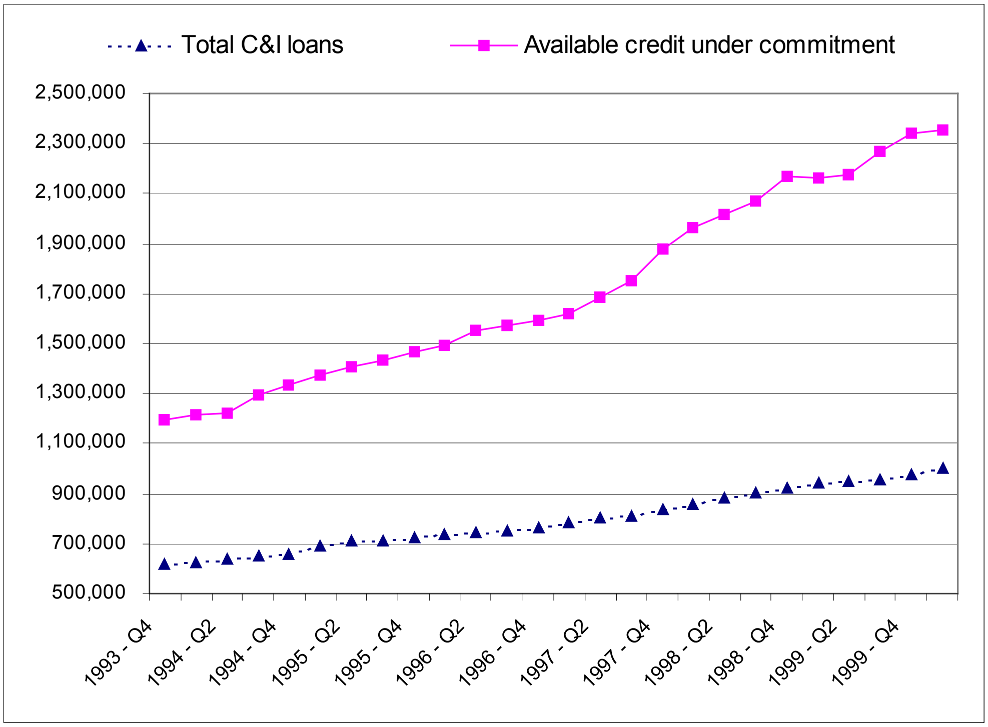

Figure 5. A comparison of the available loan commitment credit to the total amount of C&I loans.

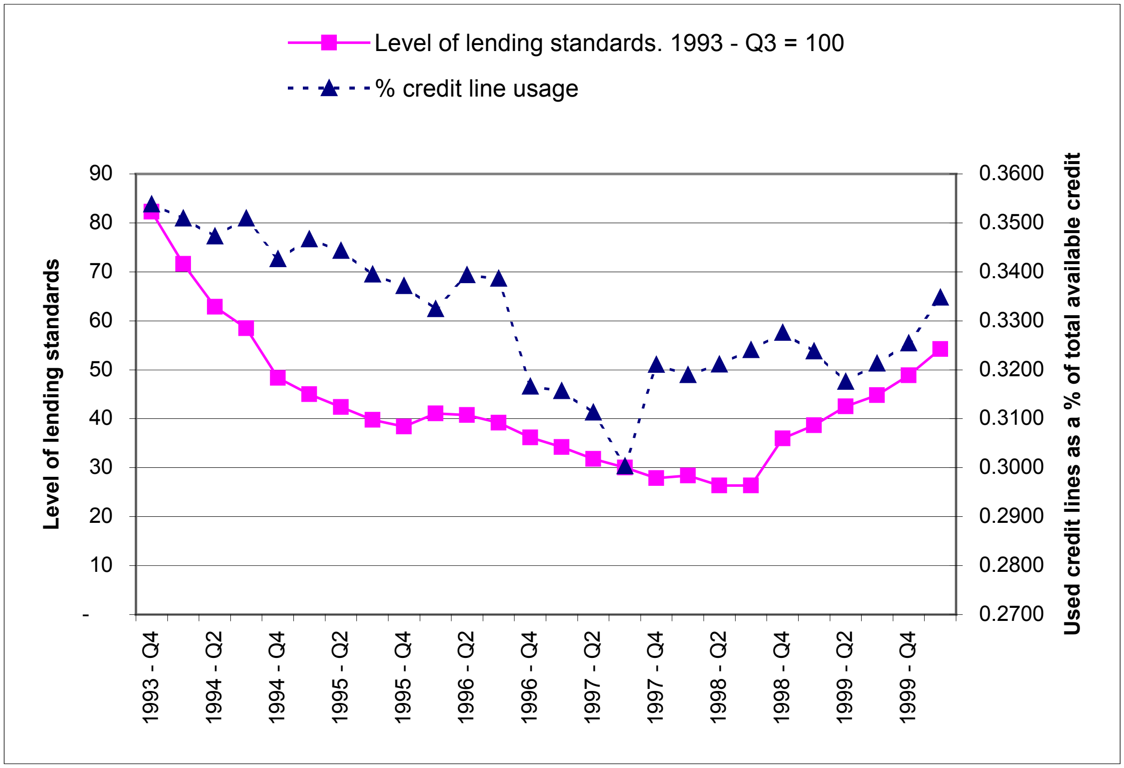

Figure 6. A comparison of the level of banks' credit standards to the usage rate of loan commitments.