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Do Loan Commitments Cause Overlending?

I begin with a model that generates quantity credit rationing by banks in the spot credit market when the real interest rate is high and there is an economic downturn. Then I rationalize a bank loan commitment as partial insurance against such future rationing. Incorporating uncertainty about both the creditworthiness of borrowers and the abilities of banks to screen borrowers, I extend the bank contracting literature wherein I examine banks' decisions of whether to lend under the commitments sold earlier. I show that this discretion of whether to honor borrowing requests under commitments generates reputational concerns on the part of banks and can lead to an equilibrium in which loan commitments serve their role in increasing credit supply relative to the spot credit market, but produce the inefficiency of excessive credit supply when the real interest rate is low and the economy is doing well. Despite this, welfare is higher with loan commitments than with spot credit. Numerous empirical predictions and policy implications are drawn out.

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TWO ISSUES HAVE recently preoccupied policymakers in financial markets. The first is the role of banks in the business cycle. As banks expand and contract the availability of credit to firms, they affect corporate investments and economic activity. The central bank attempts to influence the supply of corporate credit by manipulating monetary policy variables such as the money supply, the discount rate and so on (the money channel). But as Stiglitz and Weiss (1981) have observed, the central bank's ability to influence bank lending can be

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frustrated by quantity credit rationing by banks, i.e., what happens in the credit channel. It has been *suggested* that loan commitments—whereby banks sell promises to extend *future* credit at partially-predetermined terms—are widely used because they can help to reduce credit rationing (e.g., Duca and Vanhooose, 1990, Morgan, 1994, Woodford, 1996).

The second issue in recent policy debates is whether bank regulation should be “state contingent” and change with the state of the economy. For example, the Bank for International Settlements (BIS) is concerned about the appropriate link between capital standards and the state of the economy. The Basel II capital guidelines, with their three “pillars”, are likely to lead to banks being required to hold more capital during economic downturns (see, for example, Ayuso, Pérez, and Saurina 2004).

I propose in this paper that these two issues are connected and raise the following important question: if borrowers purchase bank loan commitments to (partially) insure themselves against future credit rationing, what implications does this have for bank lending behavior during economic upturns and downturns and hence possibly for how bank regulation might vary across the business cycle?

To address this question, I develop a model that extends the bank contracting literature wherein I model the bank’s decision to lend under the commitment, given the Material Adverse Change (MAC) clause that is ubiquitous in loan commitment contracts. This clause permits the bank to decline to lend under the commitment if the borrower’s financial condition has declined significantly since the commitment was sold. I begin by showing that there is an endogenous rationale for a loan commitment because rationing leads to too little credit being extended in the spot credit market during economic downturns.¹ I then show that loan commitments (with MAC clauses) result in excessive credit being extended during economic booms because of the reputational concerns of banks extending loan commitments.² That is, banks invoke the MAC clause for borrowers who are not creditworthy during economic downturns but choose to lend to such borrowers during economic booms even though they could have chosen to invoke the MAC clause instead.

From a loan contracting perspective, the analysis produces the novel empirical prediction that banks will invoke the MAC clause more during economic downturns

1. Many papers present theories in which loan commitments ameliorate informational frictions (e.g. Boot, Greenbaum, and Thakor, 1993, Shockley, 1995), and others link a bank’s deposit-gathering and commitment-lending functions (see Kashyap, Rajan, and Stein 2002). None of these papers formally examines the credit rationing issue, however. Morgan (1994) uses a costly-state-verification (CSV) framework to show that when there is a deadweight monitoring cost associated with bankruptcy, the lender will refuse to lend more than a certain amount with a debt contract. This kind of rationing can be reduced via a loan commitment in which the borrower purchases a larger loan limit than with spot debt and pays a fee for the unused portion of the line as in Boot, Thakor, and Udell (1987). A key difference is that the borrower purchases a commitment in my model solely to insure against rationing, whereas in Morgan (1994) a loan commitment is simply a more efficient contract, with or without rationing, because the usage fee levied on the unused portion of the commitment reduces expected bankruptcy costs.

2. These announcement effects are merely empirical predictions of the model; the model does not say whether borrowers’ managers actually care about these announcement effects. In fact, borrowers demand loan commitments—insurance against quantity rationing with spot credit—as opposed to any signaling considerations. Nonetheless, announcement effects do arise, and if managers care about them, their demand for loan commitments would strengthen.

than during economic booms, even after adjusting for possibly systematic borrower credit-quality differences across downturns and booms. Moreover, the incidence of defaults by bank borrowers will be higher in periods following economic booms. In addition to these predictions, when the analysis is extended to examine its stock price implications, numerous predictions about announcement effects are generated. I discuss these in detail later.

The macro regulatory policy implication of my analysis is that regulatory supervision of bank asset portfolios ought to be more stringent during booms, or that capital regulation should be countercyclical. To the best of my knowledge, such a *state-contingent* link between regulatory supervision of a bank and the percentage of its lending done under loan commitments has never previously been proposed. Moreover, because banks tend to take on more credit risk during economic booms, the contingent liability of the federal deposit insurer (FDIC) is also affected by the level of the stock market. The analysis suggests that more stringent information disclosure rules in the stock market will diminish the bank's ability to influence perceptions of its credit analysis skills, and thus bank regulators may wish to consider more stringent information disclosure requirements in financial markets.

The key contribution of this paper is to show that the credit rationing insurance provided by loan commitments has a possible downside, namely the possibility of overlending during economic booms. Moreover, in deriving this result, numerous empirical predictions and policy implications are extracted.

My results depend critically on two features that make banks different from other firms. One is that they operate largely in forward credit markets by selling commitments. Kashyap, Rajan, and Stein (2002) point out that selling loan commitments is an economically-natural function of banks since they gather deposits. Their point is that commitment lending and deposit-taking are two manifestations of one primitive function, namely the provision of liquidity on demand. As long as deposit withdrawals and commitment takedowns are imperfectly correlated, there will be synergies between these two functions that banks will wish to exploit by engaging in both activities. The other feature of banks that drives my results is that loan commitments are discretionary contracts that enable banks to void them at their discretion, providing banks with a tool to manage their reputational capital (Boot, Greenbaum, and Thakor 1993).

Apart from the loan-commitments literature, my paper is related to the literature on credit rationing and on the fluctuations in bank credit policies. The rationing that arises in my model with spot credit is similar to that in Stiglitz and Weiss (1981) in that it is engendered by asset-substitution moral hazard. It is different from the credit-rationing in Thakor (1996) where the borrower applies to too many banks and none feels that its probability of earning a profit on the borrower is high enough to justify performing the credit analysis necessary to extend credit. On the issue of why bank credit policies fluctuate, an interesting alternative theory is provided by Rajan (1994). He considers a model in which bank managers have career concerns and observe each other's earnings reports; these reports are affected by whether banks cut off credit to bad borrowers or continue to lend to them. This

leads to herding behavior wherein banks cluster together in overextending credit when the state of the economy is favorable.

There are numerous differences between Rajan's (1994) analysis and mine. First, unlike Rajan, I find that banks provide just the right amount of spot credit, as opposed to too much, when the economy is favorable, and too little credit when the state of the economy is unfavorable. Second, Rajan assumes that the economy state is *unobservable* to everyone but banks, which produces credit herding by banks, but *not* any correlation between credit extension and *observable* state variable like the state of the economy as in my model. Third, I focus on the difference between loan commitments and spot credit, whereas Rajan focuses exclusively on the extension of previously-granted spot credit. Finally, my analysis generates many new empirical predictions, which are discussed in Section 3.

The rest of the paper is organized as follows. Section 1 analyzes the spot credit market model. Section 2 analyzes the equilibrium with loan commitments. Section 3 discusses the empirical implications of the analysis. Section 4 concludes. The appendix contains the proofs of Propositions 1–4.

1. THE MODEL AND ANALYSIS WITH SPOT CREDIT

In this section I describe the model, focusing first on the spot credit market. This is followed by introduction of the loan commitment.

1.1 *The Players and Preferences*

The key players are borrowers who need funds to invest in projects and banks. Everybody is risk neutral. While borrowers care only about their expected payoffs at the maturity date of their bank loans, banks are assumed to also have concerns about the present value of their rents beyond the loan maturity date and thus weigh the reputational consequences of their actions in a manner that will be made precise shortly.

1.2 *Time Line and Market Structure*

There are three points in time for the first “business cycle” for banks. At date $t = 0$, each borrower discovers whether it has a project it needs funding for. Each project requires a \$1 investment at $t = 1$ and will yield a single payoff at $t = 2$. At $t = 1$, every borrower that needs funding approaches a bank in the spot market for a loan. I assume that each borrower has equity E , so that if it decides to use it, the loan amount it would need is $1 - E$. Banks are initially all observationally identical and perfectly competitive and compete to offer loans that just break even in an expected value sense, given the information set at that time. However, banks care about a sequence of business cycles beyond $t = 2$. I shall deal with the present value of the bank's rents from this sequence.

1.3 Project Types and Payoffs

There are two types of projects: good (g) and bad (b). Good projects pay off $\$X > 1$ with probability one at $t = 2$. Bad projects pay off $\$X$ with probability $\delta \in (0,1)$ and 0 with probability $1 - \delta$, where $\delta X < 1$. Each project provides the borrower with a private, non-contractible control rent at $t = 2$; this rent is $R > 0$ for the good project and NR , with $N > 1$, for the bad project.³ From the lender's standpoint then, good projects are worth funding if the cost of financing is not too high, whereas bad projects are never worth funding.

1.4 Borrower Types

At $t = 0$, there are three types of borrowers: good (G), bad (B), and those whose types are not yet determined (BG). The G borrower has a choice between a "g" and a "b" project, whereas the B borrower is locked into the b project. No one, including the borrower itself, knows which category the borrower falls into. Everybody has a common prior belief that a randomly-selected borrower has a probability p of being G, q of being B, and $1 - p - q$ of being BG at $t = 0$. At $t = 1$, it will be determined which category the BG borrowers will belong to: B or G. This determination will be driven by the realization of a state of nature θ that represents a "macroeconomic" state or state of the economy. We assume $\theta \in \{H,L\}$, where H represents a "high" state in which interest rates are low and the economy is "doing well," and L represents a "low" state in which interest rates are high and the economy is "doing poorly."

If $\theta = H$ at $t = 1$, every BG borrower becomes a G borrower. If $\theta = L$ at $t = 1$, every BG borrower becomes a B borrower; this introduces a correlation between the average quality of the borrower pool and the state of the economy. If a borrower applies for a loan to a bank *and* the bank performs credit analysis, the bank and the borrower *privately* discover the borrower's true type (B or G) at $t = 1$. This information is not available to anyone else.

This specification of the macro shock implies that a good realization ($\theta = H$) involves both a low interest rate and better investment opportunities. This describes a situation in which low interest rates help to stimulate consumer demand and improve the profitability of projects for firms. For example, when interest rates fall, typically demand for cars, homes, and major home appliances goes up, improving the profitability of projects for automobile manufactures, real estate companies, and makers of home appliances.⁴ Similarly, high interest rates will depress consumer demand and worsen project profitability for borrowers.

3. The assumption that the control rent is higher for the bad project is not essential for the analysis, but it expands the set of exogenous parameter values for which the borrower would prefer the bad project, thereby exacerbating asset-substitution moral hazard. Intuitively, I want to capture a situation in which we have a project that is really very bad from an NPV standpoint, but the borrower may still like it because it permits a lot of non-contractible rent expropriation, much more so than the good project.

4. Alternative specifications of the macro shock are clearly possible in which there is a finer partitioning of the state space. With this finer partition, low interest rates may be accompanied sometimes by good investment opportunities (high asset prices) and sometimes by poor investment opportunities (low to medium asset prices). What I want to describe is a situation in which there is simultaneously a plentiful supply of credit (low rates) and high asset prices (a bull stock market). So, consideration of a finer partitioning of the state space would complicate the analysis without affecting the conclusions. Later, I will discuss whether the results would be affected if good investment opportunities go together with high interest rates.

This specification is meant to be a reduced-form representation of a more general model in which the supply of and demand for credit influence the determination of interest rates. When borrowers have more positive-NPV projects, bank–borrower agency problems are less severe, and banks may be more willing to supply credit.⁵ Moreover, such good times may also involve higher borrower projects and larger amounts of internal financing for projects available to borrowers, lessening their dependence on bank credit. Consequently, a relatively low interest rate would arise. Conversely, during an economic downturn, borrowers would have worse projects, agency problems would be exacerbated, and the supply of bank credit may diminish. Borrowers, strapped with lower cash flows, may exhibit a greater dependence on bank credit to finance projects that could help them recover. Consequently, a relatively high interest rate may arise.⁶

1.5 Bank Types

At $t = 0$, there is uncertainty about the bank's type. Nobody, including the bank, knows its type. The prior probability is $\alpha \in (0,1)$ that the bank is "talented" (T) and it is $1 - \alpha$ that it is "not talented" (N). This type of uncertainty is relevant only if the bank is screening borrowers at $t = 0$,⁷ because in that case the identification of the borrower's type is based on a noisy credit-analysis signal ϕ , and the precision of the T bank's signal is higher than that of the N bank's signal. This will play a role in the case with the loan commitments because the bank has to decide whom to sell commitments to at $t = 0$, but not with spot credit where all decisions are made at $t = 1$ when the bank's credit analysis reveals the borrower's type noiselessly, regardless of the bank's type. The idea is that over time, *all* banks that conduct credit analysis are able to learn what they need to about their borrowers, but the more talented banks are able to gather more precise information *earlier* in the process. I will describe the signals the T and N banks receive when I examine loan commitments.

1.6 Who Knows What and When

At $t = 0$ the borrower finds out whether it needs credit but is unaware of its type. Nothing else happens at this time in the spot credit market. At $t = 1$, the state of the economy, θ , is realized, and everybody discovers whether it is H or L . Now each borrower that needs credit approaches a bank in the spot credit market. The bank approached by the borrower performs credit analysis, after which the borrower

5. This would follow, for example, from a model like Bernanke and Gertler's (1989), in which the availability of more positive-NPV projects would augment borrower net worth, reduce agency costs, and increase bank credit supply.

6. This is precisely the kind of reasoning put forth by Mill (1965, p. 65): "The willingness to lend is greater than usual at the commencement of a period of speculation, and much less than usual during the revulsion which follows ... During the revulsion, ... interest rates always rise inordinately, because, while there is a most pressing need on the part of many persons to borrow, there is a general disinclination to lend."

7. The role of banks as information processors has been formalized in many papers. See, for example, Allen (1990), Dell'Ariccia, Friedman, and Marquez (1999), and Ramakrishnan and Thakor (1984).

and the bank become privately informed about the borrower's type; all that is common knowledge is that it is more likely that the borrower is G if $\theta = H$ than if $\theta = L$. It is not known whether the bank manager is T or N, but there are common priors over the bank's type. If credit is extended at $t = 1$, the payoff on the borrower's project is realized at $t = 2$ and the bank is paid if possible.

The bank's cost of funds is the riskless rate. The single-period rate covering the first period is zero at $t = 0$, and it is random at $t = 1$. If $\theta = H$ at $t = 1$, this rate is $C_H - 1 > 0$, whereas if $\theta = L$ at $t = 1$, this rate is $C_L - 1 > C_H - 1$. Thus, the relevant interest factors (one plus the interest rate) in the second period are C_H and C_L . I assume $X > C_L$, and that the single-period interest factor for all periods beyond $t = 2$ is the interest factor realized at $t = 1$. Moreover, the borrower's equity is small enough that $C_H[1 - E] > 1$.

1.7 Objective Function of Bank

A key to the model is that each bank cares not only about the payoff on the loan it makes at $t = 1$, but also about the present value of its payoffs beyond $t = 2$. That is, the bank may care about the perceived value of its credit-analysis ability at $t = 2$. The reason for this is that new borrowers at $t = 2$ may be concerned about whether it is an N or a T bank they are dealing with because the bank's type affects the borrower's welfare (this will be verified later; see Proposition 6 in Section 2). I assume that there is an unlimited number of *de novo* banks at $t = 2$ that borrowers could approach for credit in business cycles beyond the one I focus on. Each *de novo* bank has a reputation of α , i.e., $\Pr(T) = \alpha$. However, a bank that has made loans prior to $t = 2$ may develop a reputation that differs from α . If the bank's reputation exceeds α , I assume it can earn a rent on its lending at $t = 2$ and beyond that is proportional to the difference between its reputation and α .⁸ If the bank's reputation is less than α , it cannot acquire any more business at $t = 2$. Thus, the bank's objective function is to maximize

$$V = ay + b(C_i)\max\{[P_2(T|\Omega) - \alpha], 0\} \tag{1}$$

where $a > 0$ is an exogenous constant, $b(C_i) > 0 \forall C_i$, y is the bank's net payoff at $t = 2$ from lending (or not lending) to the borrower at $t = 1$, and $P_2(T|\Omega)$ is the posterior probability that the bank is T, conditional on the market's information set, Ω , at $t = 2$.⁹ Note that $b(C_i)$ is a function of the interest factor C_i to reflect the fact that the present value of the bank's rents beyond $t = 2$, assessed at $t = 2$, will depend on the prevailing interest rate. That is, $b'(\cdot) < 0$, so that $b(C_H) > b(C_L)$.

A few comments on Equation (1) are in order. First, by construction, the bank cares about its payoff from the loan at $t = 2$ and its reputational rents beyond $t = 2$. This is a natural specification in a model with unobservable heterogeneity in bank ability. Second, the bank benefits from a higher reputation, and these reputational benefits accrue to *both* the bank and the borrower. This raises the issue of

8. This is similar to the setup about reputational rents in Boot, Greenbaum, and Thakor (1993).

9. Clearly, $y \in \Omega$.

how the rents generated by better bank reputation are shared. I am assuming that if a bank develops a higher reputation, it is not the only one with that reputation. There are a few other banks that have better reputations than *de novo* banks. Borrowers may be able to get these reputable banks to compete, so that the banks do not extract *all* the borrower surplus generated by their superior reputation. However, the competition among banks with superior reputations is imperfect, so that the more reputable banks do not compete away all the reputational rents.

1.8 The Myopic Credit Market Equilibrium

By a “myopic” equilibrium, I mean one in which the bank cares only about its first-business-cycle payoff at $t = 2$, and not its reputation-dependent payoff beyond $t = 2$. For this analysis, I want to focus on parameter values such that banks are willing to lend to only G borrowers when $\theta = H$, and are unwilling to extend credit to any borrowers when $\theta = L$. The reason for focusing on this case is that it provides the basis for the loan commitment to create value as a guarantee against the (quantity) rationing of credit that would occur in the spot market (in state L). Let r_L^G be the loan interest factor (one plus the interest rate) the bank would charge a G borrower when $\theta = L$, if the bank believed the borrower would choose project g. Similarly, let r_L^B be the loan interest factor the bank would charge a B borrower or a G borrower it believes will choose project b when $\theta = L$. It is obvious that each of these rates must be the rate at which the (competitive) bank just breaks even. The reason is that there are only two types of credit risks—g and b. If the credit risk is b, the bank should simply deny credit, so its willingness to extend credit must mean that the credit risk is g, in which case any attempt to charge a higher rate should invite a (Bertrand) competitor to undercut the bank’s price.

Now if $\theta = H$, it is apparent that $r_H^G = C_H$. When $\theta = L$, the rate the bank would like to charge to break even when $\theta = L$ is C_L (with a repayment obligation of $C_L[1 - E]$ if the borrower puts up E in equity) if the borrower is G and can be assumed to choose the g project, and it is C_L/δ (with a repayment obligation of $C_L[1 - E]/\delta$) if this borrower chooses the b project. However, since $C_L[1 - E]/\delta > X$, there is no rate at which the bank can break even on a loan to a borrower investing in a b project. I assume that the following parametric restriction holds:

$$X - C_H + R > \delta[X - C_H] + NR$$

i.e., the G borrower prefers the g project to the b project when the repayment obligation is C_H , and even if there is no equity participation. I further assume that

$$X - C_L[1 - E] + R < \delta[X - C_L[1 - E]] + NR$$

i.e., the G borrower prefers the b project to the g project even with equity participation of E if the loan is priced at C_L (the source of the asset-substitution moral hazard). This means that banks will not extend credit to any borrowers when $\theta = L$. Combining the above inequalities yields a single parametric restriction (PR)

$$[X - C_H][1 - \delta] > R[N - 1] > [X - C_L][1 - E][1 - \delta] \quad (\text{PR-1})$$

Let r^* be the critical loan interest factor (one plus the interest rate) such that the borrower is indifferent between the good and bad projects:

$$X - r^* + R = \delta[X - r^*] + NR.$$

$$\text{That is, } r^* = X - \frac{R[N - 1]}{1 - \delta}. \quad (2)$$

It is clear from (PR-1) that $r^* \in (C_H, C_L)$. Note that if the borrower puts up E in equity, the critical loan interest factor becomes $r^* = r^*[1 - E]^{-1} > r^*$. Figure 1 shows the equilibrium that is stated in Proposition 1.

PROPOSITION 1: *The myopic equilibrium in the spot credit market at $t = 1$ entails the following. If the state of the economy is $\theta = H$, all borrowers that need funds approach banks. If the bank's credit analysis reveals the borrower is type G, the borrower receives a $\$1 - E$ loan with a repayment obligation of $r_H^G[1 - E]$, where $r_H^G = C_H$. The borrower is denied credit if the credit analysis reveals the borrower is type B. If the state of the economy is $\theta = L$, no borrowers approach banks because they know they will be denied credit regardless of the bank's credit analysis signal.*

The intuition behind Proposition 1 is straightforward. When $\theta = L$, the riskless rate is so high that even a G borrower's repayment obligation with a g project is too high to induce it to invest in the g project and give up the non-contractible private control rent, NR , available with the b project. This asset-substitution moral hazard induces the bank to ration credit, as in Stiglitz and Weiss (1981), when $\theta = L$.¹⁰ In the $\theta = H$ state, the riskless rate is low enough that the bank can price its loan to both break even and coax the G borrower to choose g. So, credit is extended to G borrowers. The borrower thus enjoys its highest firm value when $\theta = H$ and it receives credit. In all other states, it cannot invest in the project and hence is worthless.

This result should be interpreted as characterizing a situation in which a correlation between a macroeconomic state variable (which implies a high funding cost for banks) and individual borrowers' credit risks leads banks to ration credit. Although for simplicity I have chosen to consider the case in which *all* borrowers are rationed in a particular state, in a more general version of this model a subset of borrowers would be rationed.

Because the borrower does have $\$E$ in equity, using it to partly finance the project increases the critical loan interest rate above which asset-substitution moral hazard is triggered. However, the parametric assumptions are such that this equity is not enough to deter moral hazard. The consequence of this is described in the result below.

10. The difference is that, while I have zero lending when $\theta = L$, Stiglitz and Weiss (1981) have positive lending but at a rate below the market-clearing interest rate, so that there is excess credit demand in equilibrium.

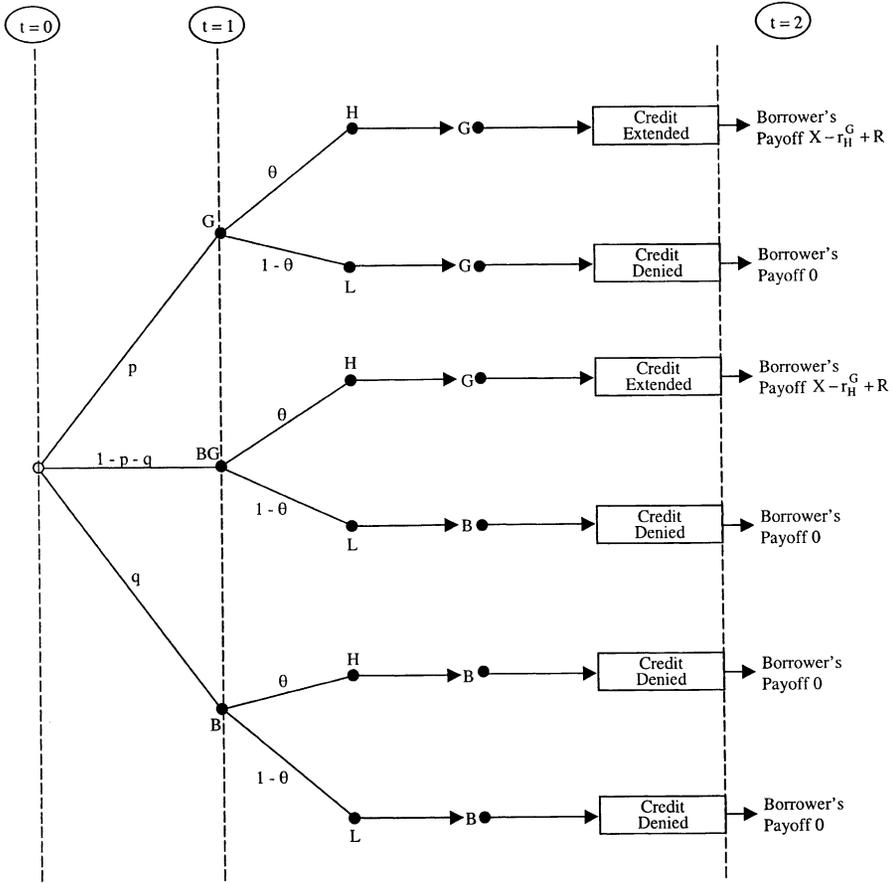


FIG. 1 Sequence of Events in the Spot Credit Market Equilibrium

LEMMA 1: *The borrower's welfare is unaffected by whether it uses its equity to reduce the loan amount to $\$1 - E$ or borrows $\$1$.*¹¹

The intuition is that the borrower is risk neutral, loans are competitively priced, and the opportunity cost of equity for the borrower is the same as the opportunity cost of funds for the bank. The only way equity can make a difference in this setting is if it alters the borrower's project choice and makes the bank willing to lend in a state in which it would not lend without the equity. Since that does not happen here, the borrower's welfare is unaffected by E . Given this, I will assume, for notational parsimony, that the borrower avoids equity participation and borrows $\$1$ in the spot market. Equity will have a bigger role to play with loan commitments.

11. The fact that equity is insufficient to deter asset-substitution moral hazard is a consequence of the parametric restrictions I have chosen to impose on the model. This allows me to sidestep the issue of how borrower net worth can affect the terms of bank credit, as in Bernanke and Gertler (1989). In a model such as that, borrower welfare would be positively affected by E .

So far I have considered what would happen if banks were only maximizing their payoff between $t = 1$ and $t = 2$. I now consider the behavior of banks that maximize Equation (1).

1.9 The Spot Credit Market Equilibrium with Reputational Concerns

In this case the bank is also concerned about its reputation at $t = 2$ and the present value of its future business at that time.

The reputational equilibrium is defined below.

Definition of Equilibrium: A reputational sequential equilibrium (Kreps and Wilson 1982) in the spot credit market is a Nash equilibrium in which the reputation-conscious bank of each type (T and N) observes the state of the economy (θ) and the borrower's type and makes a decision to grant or deny credit so as to maximize Equation (1). On making this decision, the bank: (1) assumes that borrowers will make project choices so as to maximize their own payoffs, given the bank's credit granting decision, (2) prices each loan competitively so as to earn zero expected profit, and (3) makes correct conjectures about the market's beliefs about its type conditional on its actions. Based on the bank's credit granting decision, the market updates its prior belief about the bank's type using Bayes rule if the bank's decision had positive probability in the equilibrium strategies of banks. If a bank makes a decision that had zero probability in the equilibrium strategies of banks (an out-of-equilibrium move), the market assigns some probability distribution over the bank's type and determines the bank's reputation at $t = 2$ based on this distribution. This probability distribution, representing the market's out-of-equilibrium beliefs, is such that no bank wishes to deviate from its equilibrium strategy. This sequential equilibrium survives the universal divinity refinement (Banks and Sobel 1987) if, conditional on an out-of-equilibrium move by the bank, the market assigns its out-of-equilibrium beliefs (probability distribution over the type of the deviating bank) in the following manner. The market believes that the deviating bank is type i if the set of reputations $S(P_2^i(T|\Omega))$ assigned to such a bank satisfies

$$\bar{S}(P_2^j(T|\Omega)) \cup S(P_2^j(T|\Omega)) \subset S(P_2^i(T|\Omega))$$

where, conditional on the observed out-of-equilibrium move, $\bar{S}(P_2^j(T|\Omega))$ is the set of reputations for the type j bank that leave the bank indifferent between deviating with that out-of-equilibrium move and not deviating, $S(P_2^j(T|\Omega))$ is the set of reputations for the type j bank that make it strictly prefer to deviate from its equilibrium strategy, and $S(P_2^i(T|\Omega))$ is the set of reputations for the type i bank that make it strictly prefer to deviate from its equilibrium strategy. That is, the market believes with probability one that the bank observed to have chosen the out-of-equilibrium move is the bank that is "more likely" to have deviated from the equilibrium.

PROPOSITION 2: *When the state of the economy is $\theta = H$, the reputation-conscious bank continues to implement the myopic spot credit policy in the reputational Nash equilibrium, extending credit to G borrowers and denying credit to B borrowers when $\theta = H$, and denying credit to all borrowers when $\theta = L$. This equilibrium*

is also sequential and is universally divine with the posterior belief that any bank that lends to a borrower when $\theta = L$ or lends to a borrower when $\theta = H$ but then faces borrower default at $t = 2$ is type N with probability one.

To see the intuition, consider first $\theta = H$. Since *both* the T and N banks observe the *same* information about a borrower's type, they should both make the same credit-granting decision. Hence, the borrower's repayment outcome at $t = 2$ reveals nothing about the bank's type. In equilibrium, the borrower does not default and hence nothing is revealed about the bank anyway. If the bank makes an out-of-equilibrium choice and lends to a B borrower, it loses money on the first-period loan in an expected value sense. If the borrower repays the loan, the market does not discover an out-of-equilibrium move was made and there is no reputational gain (i.e., the belief about the bank's type remains the same as the priors). There is also no reputational gain if the borrower defaults and the market does realize that an out-of-equilibrium move was made. The reason is that the bank did not know its own type when it made the move, so no information is revealed by the default. A similar argument shows that there is no reputational gain in lending to any borrower when $\theta = L$. Hence, the myopic equilibrium is obtained even when the bank cares about reputational rents.

The inefficiency of this equilibrium is that too little credit is extended when $\theta = L$ since even the good (G) borrowers are unable to obtain loans. I will show in the next section that this can open the door to a loan commitment as a way to increase credit availability. As before, the borrower's highest firm value is when $\theta = H$ and it receives credit.

2. THE MODEL AND ANALYSIS WITH A LOAN COMMITMENT

A loan commitment is defined as a contract that gives the borrower the option to borrow in the future at (partially) predetermined terms. The option belongs to the borrower, so the bank cannot refuse to lend even if by doing so it stands to incur an expected loss. The borrower, by contrast, can walk away if it locates cheaper credit in the spot market. The only exception to the bank's obligation to lend is if it discovers that the borrower's financial condition has deteriorated sufficiently significantly from the time it sold the loan commitment to the time it must decide to extend the loan. In this case, the bank can invoke the Material Adverse Change (MAC) clause in the loan commitment contract and refuse to honor its commitment. As Boot, Greenbaum, and Thakor (1993) have shown, invoking the MAC clause has two effects. On the one hand, it preserves some of the financial capital the bank would have lost by lending to a borrower that was not creditworthy. On the other hand, it depreciates some of the bank's reputational capital built up over time by honoring its commitments.¹²

12. Loan commitments may be thought of as "relationship lending" whereas spot lending may be thought of as "transaction lending" (see Boot and Thakor 2000, Dinc 2000, Boot's 2000 review). See also Sharpe (1990) and Rajan (1992) for models that illuminate the relationship nature of bank lending. There is an older literature on bank-customer relationships and how they affect lending decisions (see Kane and Malkiel 1965).

2.1 Sequence of Events and Who Knows What and When

At $t = 0$, the borrower finds out whether it has a project, but not what kind of project. If it has a project, it approaches a bank to purchase a loan commitment that gives it the option to borrow \$1 at $t = 1$ at a predetermined interest rate. It pays a fee, F , at $t = 0$ for this commitment, by using its equity E ; the fee can be thought of as the price of the commitment put option. For simplicity, I assume that F is approximately equal to E , so that once F is paid, the borrower has virtually no equity left, and must borrow \$1 under the commitment. At $t = 0$, nobody is aware of the bank's type, but there is a commonly-shared prior belief $\alpha \in (0,1)$ that the bank is T. Moreover, nobody is aware of the borrower's type either, but there is a commonly-shared prior belief that the probability is p that the borrower is G, $1 - p - q$ that it is BG, and q that it is B. However, the bank conducts credit analysis prior to deciding whether to sell the borrower a loan commitment. This generates a signal ϕ about the borrower's type at $t = 0$ that is *privately* observed only by the bank. The probability distribution of ϕ is as follows:

$$\Pr(\phi = i \mid \text{borrower's true type } j, \text{ bank manager's type } k) = \begin{cases} 1 & \text{if } i = j, \quad j \in \{G,B\}, \quad k = T \\ 0 & \text{if } i \neq j, \quad j \in \{G,B\}, \quad k = T \\ \beta \in (0,1) & \text{if } i = G, \quad j = BG, \quad k \in \{N,T\} \\ \beta & \text{if } i = G, \quad j \in \{B,G\}, \quad k = N \\ 1 - \beta & \text{if } i = B, \quad j = BG, \quad k \in \{N,T\} \\ 1 - \beta & \text{if } i = B, \quad j \in \{B,G\}, \quad k = N \end{cases} \quad (3)$$

Thus, the T-type bank receives a perfect signal about the borrower's type and the N-type bank receives a completely uninformative signal as long as the borrower's type is either B or G. If the borrower's type is BG, both the T and N bank are equally ineffective in screening, since each receives an uninformative signal $\phi = G$ with probability β . Thus, the effect of the bank's talent diminishes as the proportion of BG types, $1 - p - q$, increases.

The assumption that the bank has a possibly noisier assessment of the borrower's credit risk when extending a loan commitment than when making a spot loan is quite natural. When a loan commitment is purchased, the actual investment in the project is an event that is still some time out in the future, and the longer this time horizon, the greater the uncertainty. With a spot loan, the funds are invested right away and thus, given the usual temporal resolution of uncertainty, the bank knows more about the project.

I will confine my attention to parameter values such that, in the first-best case, a bank of any type¹³ will sell the loan commitment to a borrower on whom $\phi = G$ is observed and decline selling it if $\phi = B$ is observed.

Now consider a borrower that purchased a loan commitment at $t = 0$ that commits the bank to lend \$1 at $t = 1$ at an interest factor \bar{r} that is determined at $t = -0$.

13. Contrast this with the signal ϕ at $t = 0$ that is observed only by the bank.

Thus, the loan commitment sold at $t = 0$ is a contract $\{F, \bar{r}\}$. At $t = 1$, the state θ is first realized. This realization becomes common knowledge. If $\theta = H$, all the BG borrowers become G borrowers, and if $\theta = L$, all the BG borrowers become B borrowers. Next, each borrower and the bank it purchased the loan commitment from noiselessly learn the borrower's type. After this, the bank decides whether to lend to the borrower at $t = 1$. Note that, as in the spot credit case, the information about the borrower's type that is generated at $t = 1$ is *privately* observed by the bank and the borrower;¹³ the market remains uninformed about the borrower's type at $t = 1$.

The bank can invoke the MAC clause and refuse to lend to the borrower if it discovers that the borrower is B.¹⁴ I assume that a borrower who is denied credit under a loan commitment can sue the bank for contractual non-performance. If the borrower is B, it would lose in such legal action. But if the borrower is G, it is sure to win. The only role played by this assumption about the legal system is to ensure that the bank would not refuse to lend under its commitment to a G borrower, but it *may* choose to do so when the borrower's type is B.

Figure 2 shows the sequence of events in the loan commitment case. Unlike Figure 1, this merely describes the payoffs assuming the borrower is able to invest in the project at $t = 1$. Thus, it ignores the possibility that a B borrower would not be able to borrow at $t = 1$. Throughout, I assume that all of the bank's decisions (sell or not sell the loan commitment, the commitment fee, the borrowing rate under the commitment, and whether to lend or refuse to lend under the commitment) are publicly observable. Only the realizations of ϕ at $t = 0$ is privately observed by the bank, and the borrower's type at $t = 1$ is privately observed by the bank and the borrower.

A borrower denied credit under a loan commitment at $t = 1$ by a bank invoking the MAC clause will not be able to obtain credit from another bank. The reason is that the loan commitment seller's credit denial indicates it is a B borrower. Even if this were not the case, the borrower would have to approach another bank and be screened by it. This screening would reveal the borrower to be B and credit would be denied. However, a G borrower that decides not to borrow under a previously-purchased commitment can always access the spot credit market and have itself screened by another bank in order to obtain spot credit.

2.2 The Loan Commitment Equilibrium

Once again, the myopic equilibrium is the outcome when the bank maximizes its payoff between $t = 0$ and $t = 2$ and ignores payoffs beyond $t = 2$. This equilibrium is described below.

14. The MAC clause is intended for situations in which the bank receives new information after it sells the commitment. This is clearly true here for the BG borrowers whose types are determined at $t = 1$. It is also true for the B and G borrowers since, even though their types were determined at $t = 0$, the bank acquires *new* information about them *after* selling the commitment at $t = 0$.

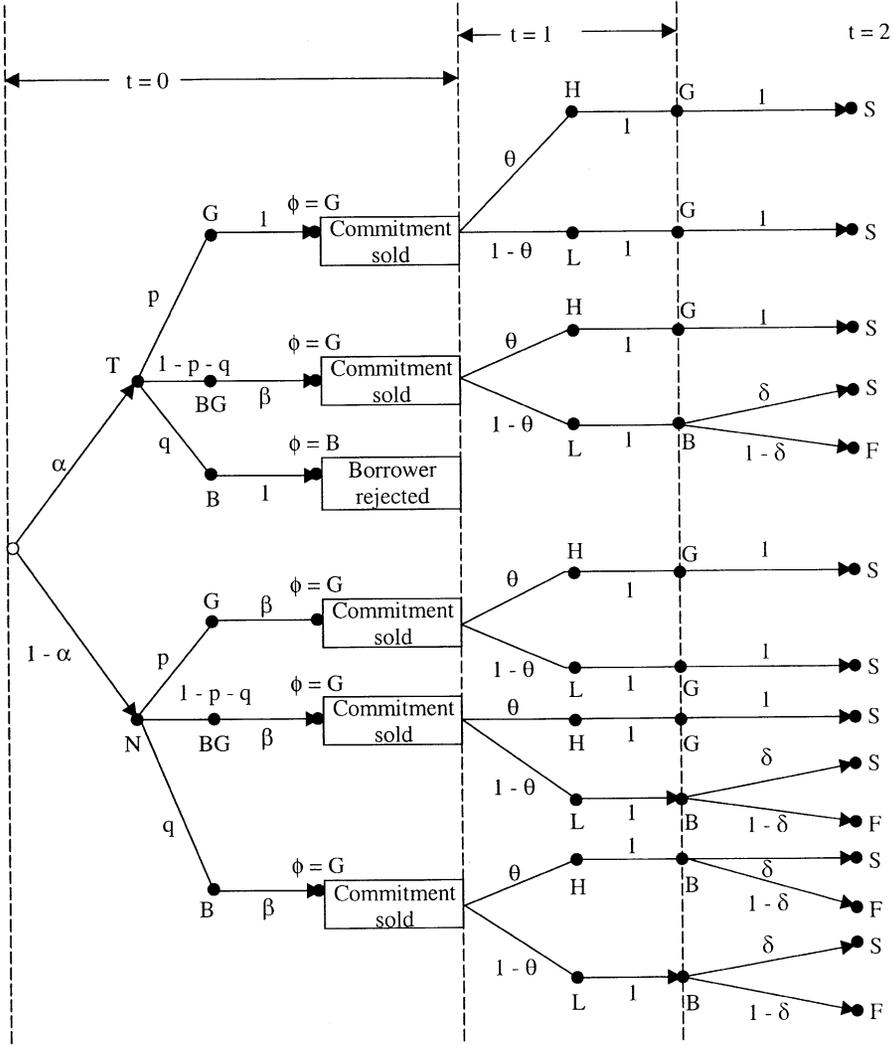


FIG. 2 Sequence of Events with a Loan Commitment

PROPOSITION 3: *In the unique myopic loan commitment equilibrium, the bank sells loan commitments to all applicants at $t = 0$, regardless of ϕ . The only commitment contract sold in equilibrium is of the form $\{F_G, \bar{r}\}$ where $\bar{r} = r^*$, and F_G is set so that the expected profit on the loan commitment is zero if the bank has observed $\phi = G$ and positive if it has observed $\phi = B$. At $t = 1$, the bank learns each borrower's type and honors its commitment if the borrower is G, invoking the MAC clause if the borrower is B. The G borrower takes down the commitment if $\theta = L$*

and borrows in the spot credit market rather than under the commitment if $\theta = H$.

The intuition is as follows. Working backwards at $t = 1$, we know that because the bank knows the borrower's type at $t = 1$, it will follow the strategy indicated in the proposition. What will happen at $t = 0$? If there was a sufficiently large cost to not honoring a commitment, the bank would sell commitments to borrowers on which it observes $\phi = G$ and deny credit to the $\phi = B$ borrowers. But I have assumed no such direct cost. There may be reputational costs associated with not honoring a commitment at $t = 1$, but these costs would concern the bank only if it cared about its payoffs beyond $t = 2$. So the bank will sell commitments to all applicants at $t = 0$, counting on learning the borrower's type with certainty at $t = 1$ and thus invoking the MAC clause to deny credit to the B borrowers then. In principle, the bank would like to offer two contracts, $\{F_G^*, \bar{r}\}$ to the borrowers on which $\phi = G$ is observed, and $\{F_B^*, \bar{r}\}$ to the borrowers on which $\phi = B$ is observed. However, since F_G^* and F_B^* are simply the present values of the interest rate subsidies to be received by the respective borrowers in the future, it is clear that $F_G^* > F_B^*$ because the $\phi = G$ borrower is more likely to receive credit at $t = 1$ and take advantage of the interest rate subsidy. Hence, the bank which *privately* observes ϕ will always offer the contract $\{F_G^*, \bar{r}\}$ regardless of the observed ϕ . This means it earns zero expected profit when $\phi = G$ because competition will force F_G^* to be set exactly equal to the present value of the interest rate subsidy to a $\phi = G$ borrower. But it will earn *positive* expected profit when $\phi = B$.

The borrower will wish to minimize the bank's positive profit. The way to do this is to minimize the interest rate subsidy by setting $\bar{r} = r^*$. This is why $\bar{r} = r^*$ is chosen even though any \bar{r} in $[0, r^*]$ will induce the G borrower to choose the g project. Since $r^* > C_H$, the G borrower will find it cheaper to borrow in the spot credit market at C_H by having another bank perform credit analysis and discover it is G.

2.3 The Reputational Equilibrium with a Loan Commitment

I now examine what happens when the bank cares about its payoffs beyond $t = 2$ and hence its reputation at $t = 1$.

It is possible that a bank with reputational concerns may wish to behave differently from what has been characterized in Proposition 3, because of the potential reputational damage from invoking the MAC clause at $t = 1$. I now state the final two parametric restrictions on the model:

$$\beta < \frac{p}{p + q} \tag{PR-2}$$

This restriction ensures that signal $\phi = G$ at $t = 0$ conveys more favorable information about the bank's talent than a signal $\phi = B$. Further,

$$\frac{\alpha}{1 - \alpha} > \beta \text{ and } \alpha < \frac{1}{4} \tag{PR-3}$$

This restriction is sufficient for the bank to make a negative expected profit on

selling a loan commitment to a $\phi = B$ borrower and collecting a commitment fee appropriate for a $\phi = G$ borrower, ignoring reputational payoffs.

PROPOSITION 4: *In a loan commitment equilibrium with reputational concerns on the part of the bank that uses a loan commitment contract with an MAC clause, the following constitutes a universally divine sequential equilibrium under the appropriate constellation of exogenous parameter values.¹⁵*

- (i) *At $t = 0$, the bank sells a loan commitment to a borrower on which $\phi = G$ is observed and denies a loan commitment to a borrower on which $\phi = B$ is observed.*
- (ii) *At $t = 1$, if $\theta = H$ is realized, the bank lends under the commitment regardless of the borrower's observed type at $t = 1$. When $\theta = L$ is realized, it lends only if the borrower is G and invokes the MAC clause whenever the borrower is B .*
- (iii) *A borrower purchasing a loan commitment enhances its value at $t = 0$.*
- (iv) *At $t = 0$, the bank's reputation is higher if it sells a commitment to a borrower than if it rejects the borrower. The bank's reputation improves further if it decides to extend credit under the commitment at $t = 1$.*
- (v) *The market revises its beliefs using Bayes rule whenever it observes an equilibrium move. If the bank invokes the MAC clause and denies credit when $\theta = H$, the market's posterior belief is that the bank is N with probability one.*

This proposition makes six key points. First, the bank's decision to sell a loan commitment when $\phi = G$ and not when $\phi = B$ is solely due to reputational concerns. The key here is that a $\phi = B$ signal elevates the likelihood of encountering a B borrower at $t = 1$. Because the reputational damage in invoking the MAC clause then, the bank knows it will lend even to a B borrower in the $\theta = H$ state. To avoid this future financial loss, the bank prefers to not sell a commitment to a $\phi = B$ borrower.

Second, the basic rationale for purchasing a loan commitment as partial insurance against quantity credit rationing during an economic downturn holds. When $\theta = L$, and the economy is in a downturn, more credit is available with a loan commitment than in the spot credit market.

Third, the loan-commitment equilibrium involves an inefficiency in that credit is provided to a B borrower in the $\theta = H$ state. That is, there is an oversupply of credit under loan commitments during economic booms. This happens solely due to the reputational concerns of the bank. Since such an inefficiency is not encountered with the myopic equilibrium, it would be tempting to think of a bank precommitting to ignore its credit-analysis signal ϕ and extending credit to all borrowers who purchased the loan commitment. However, as long as the commitment has an MAC clause,¹⁶ such a precommitment is not credible (see proof of Proposition 4).

15. See Kreps and Wilson (1982) and Banks and Sobel (1987). I do not formally define the loan commitment reputational equilibrium here. The definition is similar to that given for the spot market equilibrium earlier.

16. I do not address the question of why the loan commitment has an MAC clause, since I take the contract as given. Boot, Greenbaum, and Thakor (1993) endogenize the MAC clause in loan commitments. In their model, the MAC clause permits the bank to more efficiently manage the tradeoff between reputational and financial capital. In my model, the MAC clause allows the bank to avoid lending to the B borrower at $t = 1$. Despite the distortion of overlending in the H state in the loan commitment equilibrium involving commitments with the MAC clause, the amount of lending to B borrowers would be even greater without the MAC clause. This would lead to even greater lending inefficiencies.

Fourth, banks will invoke the MAC clause and decline to lend under commitments during economic downturns rather than booms. This is a testable prediction about the behavior of banks that lend under commitments. In fact, this result may help shed light on a somewhat surprising empirical finding in Berger and Udell (1992). They find that, even though commitments are apparently purchased to insure against rationing, *lending* under commitments does not seem to increase significantly when credit markets are tight (i.e., high interest rates).

Fifth, the borrower has a higher firm value with a loan commitment than without. There are two forces at work here. One is that purchasing a loan commitment allows the borrower to invest in a positive-NPV project, which increases value. The other is that the bank's decision to sell a loan commitment to the borrower is a certification of borrower quality and causes uninformed agents to perceive the firm as more valuable.

Sixth, like the borrower, the bank experiences an increase in its reputation when it sells a loan commitment at $t = 0$ and then another increase when it lends under the commitment at $t = 1$.

The main point of this proposition is that in the H state, there is an oversupply of credit in the sense that the bank is extending loans on which it makes an expected loss. The intuition is as follows. A bank that observes a B borrower in the $\theta = H$ state knows that it is type N, since in this state of the economy a type-T bank would never have encountered a B borrower (see Figure 2). So if it invokes the MAC clause and denies credit to the borrower, it unambiguously identifies itself as an N bank. By lending, it has a probability δ of avoiding this fate.

Why is there an oversupply of credit in the H state and not the L state? The reason is that the reputational loss to the bank from invoking the MAC clause differs across the H and L states. For one thing, in the L state, even a talented (T) bank may encounter a bad (B) borrower, so the reputational damage from telling the market that the borrower is B is relatively low. By contrast, in the H state it is impossible for a T bank to encounter a B borrower, so acknowledging such a borrower is reputationally relatively more costly. Additionally, the interest (discount) rate is lower in the H state, leading to $b(C_H) > b(C_L)$, and hence the *present value* of the bank's future reputational rents is higher when $\theta = H$ than when $\theta = L$. That is, the marginal value of developing a reputation is higher for the bank in the H state.

Is this result robust with respect to my assumption that the riskless rate is lower when the economy is doing better? Clearly, it is possible for this relationship to be reversed, so that booms are accompanied by higher interest rates—due to higher investment demand—and downturns are accompanied by lower interest rates. Would Proposition 4 still hold in such an environment? The answer is yes. As the proof of the proposition indicates, my main result holds even if $C_H > C_L$, so that $b(C_H) < b(C_L)$, as long as $b(CH)/b(CL)$ is not too small. That is, the assumption that $C_H < C_L$ is merely sufficient for the main result, not necessary.

Thus, we have an interesting contrast between the spot credit and loan commitment cases. In the spot credit case, there is too little credit extended. In the loan commitment case, too much credit is extended.

3. WELFARE COMPARISONS, EMPIRICAL PREDICTIONS, AND IMPLICATIONS FOR BANK REGULATORS

In this section I have three goals. First, I will compare the reputational equilibria in the spot-credit and loan-commitment cases from the standpoint of overall welfare. Second, I will discuss the implications of the analysis for bank regulators. And finally, I will explore the connotations of the analysis for stock market information disclosure rules and deposit insurance.

3.1 *The First Best and a Welfare Comparison*

I first present the first-best outcome and then present the welfare analysis. In the first best, there are no informational constraints of any sort—borrower project choices are observable to all and bank and borrower types are also observable to all. The following result then obtains.

LEMMA 2: *The first-best outcome is one in which both the type-T and type-N banks extend credit only to G borrowers at $t = 1$, the G borrowers choose g projects in both the H and L states, and banks earn zero expected profits on all loans.*

The intuition is simple. With perfect project choice monitoring, banks can be assured that G borrowers choose g projects in the L state, which eliminates the distortion of too little credit in the L state with spot credit. Given this, a loan commitment becomes unnecessary, eliminating the key distinction between type-T and type-N banks, so both banks lend to G borrowers. B borrowers, who are locked into b projects, do not receive any credit from any bank. Given this, I can compare the (second-best) reputational equilibria with spot and commitment lending in terms of welfare.

The following result provides a welfare comparison.

PROPOSITION 5: *Assuming that $(X - C_L + R)/C_L$ is large enough, welfare is higher in the reputational loan-commitment equilibrium than in the reputational spot credit equilibrium.*

The intuition for the condition under which a loan commitment Pareto dominates is as follows. The source of value enhancement with a loan commitment is the expanded availability of credit for the G borrower when $\theta = L$ since it is the unavailability of credit in this state that distorts the second-best spot-credit equilibrium away from the first best. The value to the borrower of this expanded availability of credit is proportional to the surplus it loses when it is denied spot credit, which is $(X - C_L + R)/C_L$. The distortion away from the first best with a loan commitment is that the B borrower is provided credit when $\theta = H$. The loss in surplus here is that a negative-NPV project is funded, one with a net payoff of $\delta X - C_H < 0$. Thus, a loan commitment produces higher welfare if $(X - C_L + R)/C_L$ is large enough.

We have assumed throughout that a bank with a better reputation at $t = 2$ will enjoy higher profits beyond $t = 2$. We now show that this is because more reputable banks produce higher expected utilities for borrowers even when they charge higher loan commitment prices commensurate with their reputations.

PROPOSITION 6: *The borrower's welfare is increasing in the bank's reputation.*

The intuition is as follows. An increase in the bank's reputation makes it more likely that a borrower that has purchased a commitment at $t = 0$ will actually receive credit at $t = 1$ in states in which it should get a loan and less likely that it will be given credit at $t = 1$ when $\theta = H$ and the borrower is B. Since the borrower has to pay *ex ante* a higher commitment fee for receiving credit in a state in which it should not, it prefers a transaction in which there is a stronger precommitment by the bank to not do so.

Since borrowers prefer to deal with more reputable banks, these banks will be able to charge higher prices at $t = 2$ and earn reputational rents relative to *de novo* banks with reputations of α . This justifies the form of the objective function (Equation 1). Moreover, the result in this proposition is consistent with the empirical finding in Billett, Flannery, and Garfinkel (1995) that the abnormal returns in response to borrowers announcing bank loans are greater when these loans are extended by banks with better credit ratings.

3.2 Stock Price Implications and Other Empirical Predictions

Although the stock market does not have a role to play in my analysis in terms of the funding of borrower projects, if banks and borrowers are publicly traded, the analysis yields interesting implications about stock price reactions to various bank and borrower decisions linked to loan commitments. I first discuss the implications for spot credit and then for loan commitments.

Spot credit. From Proposition 2 we know that in the reputational Nash equilibrium only G borrowers receive credit and that too only when $\theta = H$. Thus, the bank's credit-granting decision will reveal to the market that the borrower is of type G and has found funding for a positive-NPV project. Since the borrower's value is normalized to be zero when the bank denies credit but is positive when credit is granted, the analysis immediately yields the first empirical prediction, namely that the bank's credit-granting decision will elicit a positive stock price reaction for the borrower. Empirical support for this was first provided by James (1987). Moreover, the less there is known *a priori* about the borrower, the greater is the runup if its stock price expected to be since the runup in my model is directly proportional to the incremental information conveyed by the bank's signal. Empirical support is provided by Best and Zhang (1993) who find significant price reactions to bank loans only for less-well-known borrowers.

Loan commitments. From Proposition 4 we know that the bank sells a loan commitment only to borrowers on which the informative signal generated by its credit analysis at $t = 0$ reveals $\phi = G$, i.e., that the borrower is of type G. Borrowers associated with $\phi = B$ are denied loan commitments. This generates the second prediction: the bank's decision to sell the borrower a loan commitment will convey good news to the stock market and the borrower's stock price will experience a positive announcement effect. This prediction has found empirical support in Shockley and Thakor (1997). Moreover, Proposition 6 implies that the announcement effect for the borrower will be larger the better the bank's reputation.

Proposition 4 further asserts that borrowers who purchase loan commitments at $t = 0$ will receive credit at $t = 1$ only if $\theta = H$ or if $\theta = L$ and the borrower is type G. That is, the borrower is assured of receiving credit at $t = 1$ if $\theta = H$ and has some (type-dependent) probability of being denied credit if $\theta = L$. This immediately implies that after the realization of θ is known at $t = 1$ but before the bank's credit-granting decision under the loan commitment is known, a borrower that purchased a commitment at $t = 0$ will experience a higher stock price at $t = 1$ if $\theta = H$ than if $\theta = L$. Thus, the third prediction is that the positive stock price reactions experienced by borrowers upon receiving loans under previously-purchased commitments will be greater under economic downturns than in booms. Moreover, if $\theta = H$ is actually realized, the bank's credit-granting decision at $t = 1$ under the commitment will be uninformative to the stock market since it is known that the bank grants credit to all its loan-commitment borrowers when $\theta = H$. Thus, the borrower should experience no stock price reaction upon receiving credit under a commitment at $t = 1$ when $\theta = H$. By contrast, receiving credit under the commitment at $t = 1$ when $\theta = L$ should elicit a positive reaction in the borrower's stock price since it is known that in this state the borrower receives credit only if it is type G. Thus, the fourth prediction of the model is that receiving spot credit during an economic downturn will elicit a higher price reaction for a borrower than receiving a loan during an economic boom under a previously-purchased commitment.

Proposition 4 also tells us something about the bank's stock price. The bank's reputation at $t = 0$ is higher if it sells a loan commitment than if it does not, and a higher reputation means a higher expected future payoff. Similarly, the bank enjoys a better reputation at $t = 1$ if it chooses to lend under the commitment than if it invokes the MAC clause. Thus, the fifth empirical prediction is that the bank's stock price will increase both when it sells a commitment and when it honors it, and decline when it invokes the MAC clause.

In addition to these stock price predictions, the analysis implies that because there is excessive lending during economic booms, bank asset portfolios are predicted to decline in credit quality during periods of economic booms and low interest rates. Consequently, the sixth prediction is that the incidence of borrower defaults will be higher in periods following an economic boom. Empirical testing of this would have to be careful to control for mechanical business cycle effects such as bear markets or recessions following economic booms; such a downturn could lead to more borrower defaults following economic booms even in the absence of the reputational effects I analyze. Thus, overall market movements would need to be controlled for. For instance, to test my theory, one would like to know if loan defaults at banks in post-economic-boom-periods are cross-sectionally *positively* correlated with the fraction of bank lending under commitments.

Finally, there will be a greater incidence of banks invoking the MAC clause to decline to lend under commitments during economic downturns than during economic booms, even adjusting for possibly systematic differences in borrower credit-quality and spot-market credit availability during downturns and booms.

3.3 Regulatory Policy Implication

My analysis has an implication for a central bank like the U.S. Federal Reserve Bank. When real interest rates are low and there is an economic boom, the Fed should anticipate that bank loan portfolios will worsen in credit quality and the effects of this will be observed in subsequent periods. In particular, the banking sector will suffer a decline in stability following an economic boom. This creates a reason for the Fed to be “concerned” about the level of the market and the oversupply of credit during booms. The policy prescription from this is that regulatory auditing of bank loan portfolios should intensify during economic booms. This could involve more frequent examinations of banks, closer scrutiny of loan portfolios, and the like, with possible implications for bank ratings and capital requirements. If this is successful in reducing overlending under loan commitments during economic booms, it will reduce the welfare loss in the loan commitment equilibrium (see Proposition 5).

One of the important issues for the Federal Reserve System is whether it makes sense to make bank regulation “state contingent”, i.e., whether its stringency should vary with the state of the economy. Similarly, the BIS is concerned with whether capital standards should be procyclical. Under the Basel II capital guidelines, it appears that capital requirements for banks will go up during economic downturns; see, for example, Ayuso, Pérez, and Saurina (2004) for this observation and DeCamps, Rochet, and Roger (2004) for an examination of the interaction between the three pillars of Basel II. What my analysis shows is that there is a theoretical justification for doing the exact opposite and making the supervision aspect of bank regulation more stringent (and perhaps raising capital standards) during economic booms, particularly for banks with larger relative (to spot lending) loan commitment exposures.

3.4 Stock Market Information Disclosure Rules and Deposit Insurance

How would information disclosure requirements faced by firms in the stock market affect the equilibrium in this model? Assuming that those firms that purchase loan commitments from banks are traded in the stock market, more stringent information disclosure rules will lead to more being known about these firms. This means that it will be more difficult for a bank to lend to a B borrower in the $\theta = H$ state in order to protect the value of its reputational capital; in a more general model, there might be a fewer number of states in which the inefficiency remains. The inefficiency stemming from the oversupply of credit during economic booms (and low real interest rates) should therefore diminish as firms are required to disclose more information.

This has implications for federal deposit insurance. Apart from the Fed, the FDIC should also be concerned about the deterioration in bank loan portfolios during economic booms; this increases the contingent liability of the FDIC. More stringent stock market information disclosure requirements actually benefit the FDIC because they help arrest, to some extent, the credit quality decline engendered by the reputational concerns of banks.

Banks, of course, have at least three good reasons to resist more stringent disclosure requirements. First, these requirements would apply to traded banks as well, leading to possibly greater volatility in bank stock prices as the market reacts to new information. Second, greater information disclosure would reduce the informational advantage banks have over others, eroding their business. And finally, banks would lose some of their ability to manage their own reputational capital.

Traditionally, bank regulators, like the Fed, have supported banks in their resistance to greater market disclosure (e.g., mark-to-market accounting). What our analysis reveals is that bank regulators may want to reconsider this view.

4. CONCLUSION

I have developed a credit market model in which banks can lend either in the spot market or by selling loan commitments that create state-contingent obligations to lend in the future. In both cases, the focus of the analysis has been on the reputational equilibrium in which banks make decisions taking into account the impact of these decisions on future outcomes.

The main contribution of this paper is to extend the loan contracting literature by starting with insurance against quantity rationing in the spot credit market during economic downturns as the endogenous rationale for borrowers to demand loan commitments and then showing that the reputational concerns of banks lead to overlending by banks under loan commitments during economic booms. Despite the possibility of overlending and the resulting welfare loss, commitment lending by reputation-conscious banks generates higher welfare than spot lending.

This analysis generates results that square with several stylized facts about commitment lending. Borrowers often cite insurance against credit rationing as an important reason for demanding commitments, just as the analysis suggests. Moreover, firms' stock prices increase when they receive bank loan commitments (consistent with the evidence in Shockley in Thakor 1997) and when they receive bank loans (consistent with the evidence in James 1987) under commitments. Beyond known empirical regularities, the analysis also generates new predictions that could be confronted with the data to reject the model.

I also draw policy implications from the analysis. If empirical tests do not reject the predictions of the model, the analysis makes a strong case for "state-contingent" bank regulation. Bank supervisors should monitor bank asset quality more vigilantly during economic booms, and one should consider calibrating capital standards based on the state of the economy as well.

APPENDIX

PROOF OF PROPOSITION 1: The lowest rate that the bank can charge when $\theta = L$ is C_L . But from PR-1 it is known that in this case the G borrower chooses

the *b* project, in which case there is no interest rate at which the bank can break even. So credit is rationed when $\theta = L$. Knowing this, no borrower bothers applying for credit. When $\theta = H$, the bank can break even if it charges C_H and the borrower chooses the *g* project; PR-1 ensures that it does. So, credit is extended when $\theta = H$. The reason why it is extended at C_H is that banks are competitive and credit is extended in equilibrium to only *G* borrowers. Hence, given that the bank's credit-granting decision reveals that the borrower is *G*, any attempt to charge more than C_H will invite Bertrand undercutting by a competing bank.

PROOF OF LEMMA 1: If the borrower takes a \$1 loan, its expected utility with a spot loan is:

$$EU_S = [1 - q]\theta \left\{ \frac{X - C_H + R}{R} \right\} + E.$$

If the borrower uses equity participation of E and takes a loan of $\$1 - E$, its expected utility is:

$$E\hat{U}_S = [1 - q]\theta \left\{ \frac{X - C_H[1 - E] + R}{R} \right\} + [1 - [1 - q]\theta]E.$$

It is easy to verify that $EU_S = E\hat{U}_S$.

PROOF OF PROPOSITION 2: Proposition 1 has established that, from the standpoint of *ay*, the first part of the bank's objective function, when $\theta = H$ the bank wants to lend to *G* borrowers and deny credit to *B* borrowers, and when $\theta = L$ it wants to deny credit to all borrowers. I show now that this decision rule is unaffected by the bank's reputational concern; i.e., $b \max\{\Pr(T|\Omega) - \alpha, 0\}$, the second part of its objective function. To see this, suppose $\theta = H$. Note that the conjectured equilibrium strategy for each bank is such that no borrower default should be observed at $t = 2$. So if no default is observed, the posterior beliefs of the market about the bank's type remain the same as the priors. Suppose a default is observed for some bank. Then there are two possibilities. One is that the bank made an out-of-equilibrium move and loaned to a *B* borrower. The other is that the bank loaned to a *G* borrower who chose the out-of-equilibrium move of selecting project *b*. However, there can be no reputational benefit to the borrower from doing this (recall the borrower has a single-period horizon), and PR-1 guarantees that the borrower is better off choosing *g* when $\theta = H$ and the loan is priced at C_H . Thus, the only possibility is that the bank loaned to a *B* borrower. In this case, let the market adopt the following posterior belief:

$$\Pr(\text{bank is type N} \mid \text{borrower defaulted at } t = 2) = 1. \quad (\text{A1})$$

If the bank, confronted with a *B* borrower, does not lend, then

$$\Pr(\text{bank is type N} \mid \text{no loan given}) = 1 - \alpha,$$

which is the prior belief. Thus, by lending to a *B* borrower, the bank's reputational payoff is

$$b(C_H)\max\{\{\delta[\alpha - \alpha] + [1 - \delta][0 - \alpha]\},0\} \\ = b(C_H)\max\{- [1 - \delta]\alpha,0\} = 0 .$$

If the bank does not lend to the B borrower, its reputational payoff is:

$$b(C_H)[\alpha - \alpha] = 0 .$$

Hence, the bank chooses not to lend to a B borrower when $\theta = H$, and this is part of a sequential equilibrium. Moreover, it is obviously a part of a sequential equilibrium for the bank to lend to a G borrower at C_H when $\theta = H$ because the market's posterior beliefs about the bank's type in both cases will be the same as the prior beliefs, so the bank is reputationally indifferent between lending and not lending.

Now consider $\theta = L$. The equilibrium strategy is for no lending to occur. So if lending does take place, suppose the market assigns the out-of-equilibrium belief

$$\Pr(\text{bank's type N} \mid \text{lending when } \theta = L) = 1 . \tag{A2}$$

Then clearly no bank will wish to lend, and this too is part of a sequential equilibrium.

To see that the out-of-equilibrium beliefs in Equations (A1) and (A2) survive the universal divinity refinement, note that *both* types of banks are *equally* skilled at distinguishing between G and B borrowers at $t = 1$. So, the set of beliefs by the market in response to an out-of-equilibrium move that would cause type T to defect from the equilibrium with that move is identical to the corresponding set of beliefs for the N-type bank. Hence, neither type's set is nested within the other type's set, and neither type can be eliminated as a potential defector according to the universal divinity criterion. This means the sequential equilibrium is universally divine.

PROOF OF PROPOSITION 3: I begin by observing that the bank must set the commitment borrowing rate at $\bar{r} \leq r^*$, because only then can it ensure that the G borrower will choose the g project. There are two feasible intervals for the values r can take: $\bar{r} = C_H$ and $\bar{r} \in [C_H, r^*]$. The reason is as follows. If $\bar{r} = C_H$, then the borrower will have no incentive to seek credit outside the loan commitment contract in any state of the world, as long as it is creditworthy (i.e., the bank's signal reveals the borrower is G at $t = 1$) because no spot lender can give it cheaper credit. Any $\bar{r} < C_H$ continues to preserve this property and is thus at best a "wash" for the borrower because the interest rate subsidy will be reflected in F_G and F_B , the *ex ante* prices of the commitment. This would leave the borrower indifferent across values of \bar{r} in the interval $[0, C_H]$. Of course, values of $\bar{r} > C_H$ can be chosen, but in this case the borrower will eschew borrowing under the commitment if $\theta = H$ because it will be able to get cheaper spot credit by having itself screened by another bank. This too will be reflected in the commitment fee paid up front.

Consider now a borrower on which $\phi = G$ is observed at $t = 0$. The bank's expected profit from giving the borrower a commitment at $\bar{r} = C_H$ is:

$$\Pr(G \mid \phi = G) \left\{ \theta \left[\frac{C_H}{C_H} \right] + [1 - \theta] \left[\frac{C_H}{C_L} \right] - 1 \right\} + \Pr(B \mid \phi = G) \{0\} + F_G \tag{A3}$$

if at $t = 1$ it lends to a G borrower and denies credit to a B borrower, which is

optimal when the bank has no reputational concerns. Note that $\Pr(i | \phi = G)$ is the probability (assessed at $t = 0$) that the bank will discover at $t = 1$ that the borrower is type i when the signal ϕ at $t = 0$ indicated G . The smallest value of F_G is the one that yields the bank a zero expected profit on the commitment. That is, defining $\lambda \equiv C_H/C_L < 1$, we have:

$$F_G \geq \Pr(G | \phi = G)[1 - \theta][1 - \lambda] \quad (\text{A4})$$

I similarly show that, for a borrower on which $\phi = B$ is observed at $t = 0$, the smallest commitment fee with $\bar{r} = C_H$ would be:

$$F_B \geq \Pr(G | \phi = B)[1 - \theta][1 - \lambda] \quad (\text{A5})$$

Since $\Pr(G | \phi = G) > \Pr(G | \phi = B)$, it is clear that $\min F_G > \min F_B$. In a perfectly competitive loan commitment market, the bank will thus post two contracts, $\{F_G^*, \bar{r}\}$ and $\{F_B^*, \bar{r}\}$, where F_G^* and F_B^* are the values of F_G and F_B in Equations (A4) and (A5), respectively when these hold as equalities. However, the bank will always claim that $\phi = G$ was observed because it earns a higher profit by doing so. When $\phi = G$ is actually observed, the bank's expected profit is zero, but when a contract $\{F_G^*, \bar{r}\}$ is sold to a borrower on which $\phi = B$ is observed, the bank's expected profit is positive.

Consider now $\bar{r} \in (C_H, r^*)$. Since the commitment will not be drawn down when $\theta = H$, the bank's expected profits for $\phi = G$ can be written as:

$$\Pr(G | \phi = G) \left\{ [1 - \theta] \left[\frac{\bar{r}}{C_L} - 1 \right] \right\} + F_G.$$

If the bank earns zero expected profit on such a borrower,

$$F_G^* = \Pr(G | \phi = G)[1 - \theta] \left[\frac{C_L - \bar{r}}{C_L} \right] \quad (\text{A6})$$

Similarly, for a borrower on which $\phi = B$ is observed,

$$F_B^* = \Pr(G | \phi = B)[1 - \theta] \left[\frac{C_L - \bar{r}}{C_L} \right] \quad (\text{A7})$$

Since $F_G^* > F_B^*$, again the bank will claim $\phi = G$ regardless of the observed ϕ . Recognizing this, the borrower will have an incentive to minimize the amount of positive profit earned by the bank. The bank's positive profit is $F_G^* - F_B^*$ when $\phi = B$ and the contract $\{F_G^*, \bar{r}\}$ is sold. Thus,

$$F_G^* - F_B^* = [\Pr(G | \phi = G) - \Pr(G | \phi = B)][1 - \theta] \left[\frac{C_L - \bar{r}}{C_L} \right].$$

Clearly, this expression is minimized by increasing \bar{r} to its maximum feasible value, r^* . This means that in a competitive loan commitment market, the *unique* commitment rate that will emerge in equilibrium is r^* since that will be strictly preferred by borrowers to all other rates. F_G^* and F_B^* will satisfy Equations (A6) and (A7)

with $\bar{r} = r^*$. The bank will earn a zero expected when $\phi = G$ and a positive expected profit when $\phi = B$.

PROOF OF PROPOSITION 4: I will work backwards following a dynamic programming approach. Consider first what happens at $t = 1$ in the $\theta = L$ state. If the borrower is G, there is no question about invoking the MAC clause because the bank cannot possibly win in a dispute with the borrower. So lending occurs to such a borrower. If the borrower is B, then the bank's reputation if it rejects the borrower, using the market's equilibrium belief that a rejected borrower must be B, is:

$$\Pr(T | L, \text{borrower rejected at } t = 1) = \frac{\alpha[1 - p - q]}{\alpha[1 - p - q] + [1 - \alpha][1 - p]} \tag{A8}$$

If this borrower is given a loan, then either state S or state F will be observed at $t = 2$. If state S is observed, the bank's reputation will be:

$$\Pr(T | L, S) = \frac{\alpha p + \alpha[1 - p - q]\beta\delta}{\{\alpha p + [1 - p - q]\beta\delta + [1 - \alpha]p\beta + [1 - \alpha]q\beta\delta\}} \tag{A9}$$

If state F is observed, the bank's reputation will be:

$$\Pr(T | L, F) = \frac{\alpha[1 - p - q]}{\alpha[1 - p - q] + [1 - \alpha][1 - p]} < \alpha \tag{A10}$$

which is the same as $\Pr(T | L, \text{borrower rejected at } t = 1)$. Thus, rejecting the borrower leads to a sure reputation of $\Pr(T | L, F)$, with a reputation-related payoff of 0 because $\Pr(T | L, F) < \alpha$, and lending leads to an expected reputation of $\delta\Pr(T | L, S) + [1 - \delta]\Pr(T | L, F)$, with a reputation-related payoff of $b(C_L)\delta[\Pr(T | L, S) - \alpha]$. Hence, the expected loss from lending to a B borrower in the L state is:

$$b(C_L)\delta[\Pr(T | L, S) - \alpha] > 0. \tag{A11}$$

Now consider the $\theta = H$ state. Again, a G borrower is given credit. If the bank rejects a B borrower, then its reputation at $t = 1$ becomes $\Pr(T | H, \text{borrower rejected at } t = 1)$, which is 0 since a T bank would never encounter a B borrower in the $\theta = H$ state; we will check later this belief on the part of the market in response to the bank's out-of-equilibrium move is justified under universal divinity. Thus, the expected loss in the bank's reputation-related payoff from denying credit to a B borrower in $\theta = H$ state is

$$\delta b(C_H)[\Pr(T | H, S) - \alpha] > 0, \tag{A12}$$

where

$$\Pr(T | H, S) = \frac{\alpha p + \alpha[1 - p - q]\beta}{\{\alpha p + [1 - p - q]\beta + [1 - \alpha]p\beta + [1 - \alpha]q\beta\delta\}} \tag{A13}$$

It is straightforward to verify that $\Pr(T | H, S) > \Pr(T | L, S)$.

If the bank cared solely about its reputation-related payoff, the analysis above reveals that it would never reject a borrower at $t = 1$ by invoking the MAC clause. However, in its objective function in Equation (1) it cares about both its payoff at $t = 2$ and its own reputation-related payoff. Thus, if $a/b(C_L)$ is large enough, the bank will reject a B borrower in the $\theta = L$ state. However, the equilibrium also requires the bank manager to extend credit to a B borrower in the $\theta = H$ state. For the manager to reject the B borrower in the $\theta = L$ state and lend to it in the $\theta = H$ state, it should be parametrically possible to accommodate a greater reputation-related payoff loss to the bank from denying credit when $\theta = L$ than when $\theta = H$. That is, it should be true that

$$\delta b(C_H)[\Pr(T|H,S) - \alpha] > \delta b(C_L)[\Pr(T|L,S) - \alpha] \quad (\text{A14})$$

$\Pr(T|H,S) > \Pr(T|L,S)$ and $b(C_H) > b(C_L)$, this inequality holds. In fact, it will hold as long as $b(C_H) < b(C_L)$ and $b(C_L)/b(C_H)$ is not too large.

Given that it is in the best interest of the bank to deny credit to a borrower with $\phi = B$, it will *not* be subgame perfect for the bank to precommit *ex ante* to always extend credit *ex post* regardless of the signal, as long as the loan commitment includes the MAC clause. That is, any such precommitment will lack credibility.

Now consider $t = 0$. If the bank observes $\phi = G$ and extends a loan commitment, its expected reputation at $t = 2$ is $E_{\bar{x}}(\Pr(T|\phi_m = G, \phi = G, \bar{x}))$, where ϕ_m is the signal the market believes the bank saw, ϕ is the actual signal seen by the bank, and $\bar{x} \in \{S, F\}$ is the outcome at $t = 2$. Since the bank's action is an equilibrium action, beliefs form a martingale and it follows that

$$\begin{aligned} E_{\bar{x}}(\Pr(T|\phi_m = G, \phi = G, \bar{x})) &= \Pr(T|\phi = G) \\ &= \frac{\{p + [1 - p - q]\beta\}\alpha}{\alpha\{p + [1 - p - q]\beta\} + [1 - \alpha]\beta}. \end{aligned} \quad (\text{A15})$$

Similarly, if the bank observes a $\phi = B$ signal and rejects the borrower, its expected reputation at $t = 2$ can be written as:

$$\begin{aligned} E_{\bar{x}}(\Pr(T|\phi_m = B, \phi = B, \bar{x})) &= \Pr(T|\phi = B) \\ &= \frac{\{[1 - p - q][1 - \beta] + q\}\alpha}{\alpha\{[1 - p - q][1 - \beta] + q\} + [1 - \beta][1 - \alpha]} \end{aligned} \quad (\text{A16})$$

Comparing Equations (A15) and (A16), we see that PR-2 guarantees that $\Pr(T|\phi = G) > \alpha > \Pr(T|\phi = B)$. This means the bank will never refuse to sell a commitment to a borrower on which $\phi = G$ has been observed since selling a commitment leads to an expected reputation of $\Pr(T|\phi = G)$ and not selling it leads to an expected reputation of $\Pr(T|\phi = B)$.

Now suppose the bank decides to sell a commitment to a borrower on which it has observed $\phi = B$. Its expected reputation at $t = 2$ from doing so at $t = 0$, taking the $t = 1$ equilibrium behavior as given, is:

$$\begin{aligned}
E_{\bar{x}}(\Pr(T|\phi = B \text{ and sell loan commitment at } t = 0, \bar{x})) & \\
&= \alpha[1 - p - q][1 - \beta]D^{-1}[\theta\Pr(T|H,S) \\
&+ [1 - \theta]\Pr(T|L,F)] + \alpha q D^{-1}[\theta\delta\Pr(T|H,S) \\
&+ [1 - \theta]\Pr(T|L,F)] \\
&+ [1 - \alpha]p[1 - \beta]D^{-1}[\theta\Pr(T|H,S) \\
&+ [1 - \theta]\Pr(T|L,S)] \\
&+ [1 - \alpha][1 - p - q][1 - \beta]D^{-1}[\theta\Pr(T|H,S) \\
&+ [1 - \theta]\Pr(T|L,F)] \\
&+ [1 - \alpha]q[1 - \beta]D^{-1}[\theta\delta\Pr(T|H,S) \\
&+ [1 - \theta]\Pr(T|L,F)] \tag{A17}
\end{aligned}$$

where $D \equiv \alpha[1 - p - q][1 - \beta] + \alpha q + [1 - \alpha][1 - \beta]$, and $\Pr(T|H,S)$, $\Pr(T|L,F)$, and $\Pr(T|L,S)$ are the same as before. It is easy to verify that there is a non-empty set of exogenous parameter values for which $\Pr(T|\phi = B) > E_{\bar{x}}(\Pr(T|\phi = B \text{ and sell loan commitment at } t = 0, \bar{x}))$. For example, the following parameter values suffice: $\alpha = 0.249$, $\beta = 0.33$, $p = 0.4$, $q = 0.5$, $\theta = 0.3$, $\delta = 0.001$ (note $\beta < p/(p + q)$).

What has been established then is that, *purely out of reputational concerns*, the bank will deny a loan commitment when $\phi = B$ and extend it when $\phi = G$. Moreover, since $\Pr(T|\phi = G) > \Pr(T|\phi = B)$, the bank will experience a positive stock price reaction when it sells a commitment at $t = 0$. Further, since $\Pr(T|G,\theta) > \Pr(T|B,\theta)$, the bank will experience a further positive price reaction when it honors the commitment at $t = 1$, proving part (iv) of the proposition.

So will the bank not extend a loan commitment to a $\phi = B$ borrower if we take into account its entire objective function in Equation (1)? Since $\alpha > \Pr(T|\phi = B) > E_{\bar{x}}(\Pr(T|\phi = B \text{ and sell loan commitment at } t = 0, \bar{x}))$, the reputational payoff for the bank is zero regardless of whether it extends a commitment to a $\phi = B$ borrower or does not. The expected loss to the bank at $t = 0$ from extending a commitment to a $\phi = B$ borrower, *given* the bank's equilibrium behavior at $t = 1$, is:

$$\begin{aligned}
E(\text{Loss}|\phi = B) &= \frac{[1 - \delta]C_H\theta}{C_H}[\alpha q + [1 - p][1 - \beta]] \\
&+ \left[\frac{C_L - C_H}{C_L}\right][1 - \theta]p[1 - \beta][1 - \alpha] \tag{A18}
\end{aligned}$$

The expected loss to the bank at $t = 0$ from extending a commitment to a $\phi = G$ borrower, *given* the bank's equilibrium behavior at $t = 1$, is:

$$E(\text{Loss} \mid \phi = G) = \left[\frac{C_L - C_H}{C_L} \right] [\alpha p [1 - \theta]] + [1 - \alpha][1 - \theta]\beta p + \frac{[1 - \delta]C_H[1 - \alpha]q\beta\theta}{C_H} \quad (\text{A19})$$

In equilibrium, the loan commitment fee, F , will be set equal to $E(\text{Loss} \mid \phi = G)$ to allow the bank to exactly break even. Given PR-3, however, it is easy to verify that

$$E(\text{Loss} \mid \phi = B) > E(\text{Loss} \mid \phi = G).$$

So the commitment fee will not be enough to compensate the bank if it sells a commitment to a $\phi = B$ borrower. Thus, the bank will refuse to sell commitments to $\phi = B$ borrower.

With $a = 1, b(C_H) = 7000, b(C_L) = 700, \bar{r} = C_H = 1.22, C_L = 1.3$, and the other exogenous parameters as chosen above, it is clear that the bank chooses to sell a loan commitment when $\phi = G$, deny it when $\phi = B$, and then deny credit at $t = 1$ if $\theta = L$ and the borrower is B but extend credit if $\theta = H$ and the borrower is B. That is, Equation (A14) satisfied along with

$$a \left[\frac{\delta \bar{r} - C_H}{C_H} \right] + b(C_H)\delta[\text{Pr}(T \mid H, S) - \alpha] > 0 \quad (\text{A20})$$

and

$$a \left[\frac{\delta \bar{r} - C_L}{C_L} \right] + b(C_L)\delta[\text{Pr}(T \mid L, S) - \alpha] < 0 \quad (\text{A21})$$

All that remains is to consider out-of-equilibrium moves. The only out-of-equilibrium move is that the bank denies credit at $t = 1$ when $\theta = H$. If such a move is observed, we can use the Banks and Sobel (1987) universal divinity criterion to ask: What kind of bank is such a move more likely to come from? It is obvious that a T bank would never observe a B borrower when $\theta = H$. Thus, the market must assign a posterior probability $\text{Pr}(\text{bank is N} \mid \theta = H, \text{borrower denied credit at } t = 1) = 1$. Knowing this, no bank will deny credit.

PROOF OF PROPOSITION 5: Under the spot market equilibrium, the borrowers' *ex ante* ($t = 0$) expected utility is:

$$EU_S = [1 - q]\theta \left\{ \frac{X - C_H + R}{C_H} \right\} \quad (\text{A22})$$

Under the loan commitment equilibrium, the borrower's *ex ante* ($t = 0$) expected utility is:

$$\begin{aligned} EU_L = & -F + \{\alpha p\theta + \alpha[1 - p - q]\beta\theta \\ & + [1 - \alpha]p\beta\theta + [1 - \alpha][1 - p - q]\beta\theta\} \\ & \times \left\{ \frac{X - \bar{r} + R}{C_H} \right\} + \{\alpha p[1 - \theta] \end{aligned}$$

$$\begin{aligned}
& + [1 - \alpha]p[1 - \theta]\beta\left\{\frac{X - \bar{r} + R}{C_L}\right\} \\
& + [1 - \alpha]q\beta\theta\left\{\frac{\delta\{X - \bar{r}\} + NR}{C_H}\right\}
\end{aligned} \tag{A23}$$

where F must be set to allow the bank to break even. That is,

$$\begin{aligned}
F & = \{\alpha p[1 - \theta] + [1 - \alpha][1 - \theta]\beta p\}\left\{\frac{C_L - C_H}{C_L}\right\} \\
& + \frac{[1 - \delta]C_H[1 - \alpha]q\beta\theta}{C_H}
\end{aligned} \tag{A24}$$

Substituting Equation (A16) in Equation (A15) and recognizing that $\bar{r} = C_H$ yields the borrower's expected utility as:

$$\begin{aligned}
EU_L & = \{\alpha p\theta + [1 - p - q]\beta\theta + [1 - \alpha]p\beta\theta\}\left\{\frac{X - C_H + R}{C_H}\right\} \\
& + \{\alpha p[1 - \theta] + [1 - \alpha]p[1 - \theta]\beta\}\left\{\frac{X - C_L + R}{C_L}\right\} \\
& + [1 - \alpha]q\beta\theta\left\{\frac{\delta X - C_H + NR}{C_H}\right\}
\end{aligned} \tag{A25}$$

Comparing Equations (A22) and (A25), we see that the borrower's expected utility with a loan commitment is strictly higher than with spot credit if $(X - C_L + R)/R$ is large enough.

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