Can Competition in the Credit Market Be Excessive?*

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Abstract

We study how market power affects investment and welfare when banks choose between restricting loan sizes and monitoring, in order to alleviate an underlying moral hazard problem. The impact of market power on aggregate welfare is the result of two countervailing effects. An increase in banks' market power results in: (i) higher lending rates, which worsens the borrower's incentive problem and reduces investment by unmonitored firms; (ii) higher monitoring effort,which reduces the proportion of credit-constrained firms. Whenever the second effect dominates, it is optimal to provide banks with some degree of market power.

key words: market power, monitoring, loan size rationing, moral hazard.

1 Introduction

The relationship between market power and efficiency in the banking industry is often the subject of heated debate. The most common argument used to justify the process of deregulation and liberalization experienced

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in many countries over the last two decades is precisely that by promoting competition among banks the efficiency of the industry will improve. In contrast, many commentators point out that too much competition can undermine bank solvency and hence some market power may help preventing financial crises.

In this paper we argue that the relationship between banks' market power and efficiency depends on the net balance of two countervailing effects and it may turn out that granting banks some market power may be socially beneficial. The argument, however, is completely orthogonal to legitimate concerns about risk-taking behavior and financial fragility, and it has to do with the role of banks in reducing asymmetric information in the credit market.

In general, banks invest in information at various stages of the credit process. Ex-ante, they may acquire information about borrowers in order to reduce the scope of potential adverse selection problems (screening), at the interim stage they may monitor borrowers' choices addressing moral hazard problems (interim monitoring), and ex-post they may need to verify the final outcome (ex-post verification). In this paper, we focus on interim monitoring. Specifically, our goal is to study how market power affects banks' incentives to monitor borrowers and its welfare implications.

In our model, lending is subject to a particular moral hazard problem: because of limited liability entrepreneurs may find it optimal to embark on projects which are inefficient. Banks have two alternative ways of altering entrepreneurs' incentives. First, they can ration the loan size so as to induce entrepreneurs to take efficient decisions. Second, they can monitor the transaction and thus reduce the information asymmetry and facilitate higher levels of investment. We interpret the former as transaction-based credit and the latter as a form of information-based credit. With transaction-based credit, the decision to grant a loan only depends on public information, whilst granting information-based credit requires the bank to make a firm-specific investment that improves the information of the bank and possibly increases the project value of the firm. Our modelling approach is thus consistent with the empirical literature, thus indicating that close ties with banks are associated with credit availability (Hoshi, Kashyap and Scharfstein (1990a and b), and Berger and Udell (1995) Petersen and Rajan (1994)).

The degree of monopoly power has an impact on the equilibrium mix of transaction-based and information-based credit, and thus acts through various channels. On the one hand, for a given information structure, we obtain the classical result: an increase in banks' market power results in higher interest rates, which worsens borrowers' incentive problems and tightens credit constraints and thus translates into lower lending levels and lower total surplus. On the other hand, banks' monitoring incentives increase with their share of the extra surplus created by eliminating asymmetric information. Bank monitoring typically generates soft information (contracting possibilities are not expanded) that allow parties to implement more efficient outcomes, provided they reach an agreement on how to share the extra surplus. For any distribution of ex-post bargaining power, a bank with a higher market power ex-ante will be able to capture a larger return and hence will be willing to exert higher monitoring effort.[1] Therefore, the proportion of information-based credit increases with banks' market power. Through this novel channel, aggregate welfare increases with banks' market power. Therefore the net effect of market power on aggregate investment and welfare is in general ambiguous.

Our framework emphasizes that loan size rationing is not the only possible response to severe moral hazard problems. Instead, banks can react by adjusting along multiple dimensions. In particular, enhanced incentive problems are likely to lead to a certain combination of tighter credit and increased monitoring to maintain lending for borrowers with whom the bank has established a long-term relationship. Such a trade-off has important implications for evaluating the effects of financial liberalization.[2] Indeed, whenever the negative effect on banks' monitoring incentives is strong enough, a reduction of monopoly power resulting, for instance, from deregulation reduces average investment and welfare, and we can thus talk about "excessive competition". The intuition is that fiercer competition leads to lower interest rates and larger loans to unmonitored firms, but this can be more than compensated for by an increase in the proportion of unmonitored and hence credit constrained firms.

Our paper is close to the literature on relationship banking. In particular it is closer in spirit to Besanko and Thakor (1993) and Petersen

[1]In our static model, ex-post bargaining power is assumed to be exogenous. In a more sophisticated (dynamic) model ex-post bargaining power is likely to be positively related to ex-ante market power, which would reinforce our results.

[2]In the current paper banks do not face aggregate portfolio risk. The implications of such a trade-off on banking failures are analyzed in a companion paper, Caminal and Matutes (2002).

and Rajan (1995) who worry about the possibility that competition might hinder relationship banking. However, the mechanisms at work are rather different. Furthermore, following along the lines of Chan et al. (1986) and Sharpe (1990), the literature on relationship banking models information acquisition simply as a by-product of lending activity. In contrast, our modelling approach is more closely related to Diamond (1991). In these models, monitoring increases the value of the project, and the decision of the bank as to how much to invest in monitoring its loan applicants is explicitly accounted for. Unlike these papers, we focus on the consequences of a double moral hazard problem, namely the firm's moral hazard outlined above, plus the bank's moral hazard, the fact that it cannot commit itself to an efficient level of monitoring. Closer to us in this sense are Besanko and Kanatas (1993) in which the bank can choose the manager's effort level by monitoring. However, in their model it is the firm who chooses the proportion of information-based and transaction-based credit (i.e., they model the choice of firms' capital structure), in a framework with fixed loan sizes and perfect competition in the banking sector.[3]

The remainder of the paper is structured as follows. Section 2 presents the model. Sections 3 and 4 characterize the properties of the optimal contracts and the monitoring incentives respectively. Section 5 derives implications for lending rates, investment and welfare as a function of market power, and explores their cyclical behavior. Concluding remarks close the paper.

2 The model

Consider a credit market with two types of agents, banks and entrepreneurs; both types are risk neutral. Banks face a perfectly elastic supply of funds at the gross interest rate I, and lend these funds to entrepreneurs, who have investment opportunities but no internal funds. There is a continuum of entrepreneurs (unit mass) and n banks. Financial contracts are restricted by asymmetric information, entrepreneur's limited liability, and banks' monitoring possibilities.

[3]There is also a literature that studies the impact of banks' market power on screening policies in an adverse selection framework. See, for instance, Riordan (1993), Kanniainen and Stenbacka (1997) and Villas-Boas and Schmidt-Mohr (1999).

2.1 Investment technology

Entrepreneurs have access to a continuum of investment projects, indexed by α, which can be operated at different scales. If an entrepreneur invests k and selects project α, she obtains a random return: with probability α the project succeeds and yields $\mu(\alpha) f(k)$, and with probability $1-\alpha$ the project fails and yields 0.

For simplicity we restrict to the following functional form:

$$f(k) = Ak^{\lambda}$$

with $0 < \lambda < 1$, $A > 0$. Notice that the elasticity of return with respect to investment is constant, i.e., $\frac{f'(k)k}{f(k)} = \lambda$.

In principle, the project choice α, is the entrepreneur's private information. The bank can observe α only after investing some resources, as specified below. Also, for simplicity let us assume that[4]:

$$\mu(\alpha) = \frac{1 + (1-z)\ln\alpha}{\alpha}$$

where z is a constant, $z < 1$, and the variable α is restricted to lie in the closed interval $[\underline{\alpha}, 1]$, with $\underline{\alpha} = \exp\left\{-\frac{z}{1-z}\right\} < 1$. Notice that $\mu(1) = 1$, and $\mu'(\alpha) < 0$ in the relevant range. Also, $\alpha\mu(\alpha)$ increases with α. Thus, a higher value of α implies both a higher probability of success and a higher expected return, but also a lower return conditional on success. Hence, the socially efficient choice is $\alpha^e = 1$, since expected output is maximized and, moreover, risk is minimized. Consequently, the efficient level of investment, k^e, equalizes marginal benefits and marginal costs: $f'(k^e) = I$.

As we will see below, z parametrizes the extent of the firm's moral hazard problem, as a higher value of z decreases the incentives to choose the efficient project. Indeed, for any $\alpha < 1$ the return of the project which is conditional on success increases with z. We assume throughout the paper that $1 - z < \lambda$. This condition makes sure that the entrepreneur's incentive constraint is always binding.

The variable α can be interpreted as the choice of technology, but also as any other decision taken by the entrepreneur, which is observable by outsiders at a cost, and which influences the distribution of returns. [5]

[4] See also Bacchetta and Caminal (2000) for a similar moral hazard problem. The role of the specific funcional form is discussed in Section 8.

[5] For instance, the entrepreneur can choose to operate in a well known mature market

2.2 Bank monitoring

Banks have access to a costly and random monitoring technology that allows them to observe the choice of α, with a certain probability. In particular, if the bank incurs a cost $\Psi(\beta)$ then with probability β monitoring effort is successful and the bank is able to observe the firm's choice of project, and with probability $1-\beta$ monitoring effort fails and the bank can observe nothing. Neither monitoring effort nor its effectiveness are verifiable by third parties. When the bank can observe α it is unable to collect hard information. In other words, with probability β the choice of α is observable but not verifiable. As a result, contracts can not be written conditional on α. Nevertheless, if the bank can observe α then the borrower and the lender are in a bargaining situation. As discussed below, both parties can gain by reaching an agreement on α, k, and a sharing rule.

The specification that monitoring effort either completely succeeds or completely fails makes the model tractable, while preserving the idea that banks' ability to observe firms' decisions increases with the amount of resources invested in monitoring.[6] The main effects can be illustrated with a quadratic cost function: $\Psi(\beta) = \frac{1}{4\delta}\beta^2$. We assume that the parameter δ is positive but sufficiently small, so that in equilibrium $\beta \leq 1$.

2.3 Observability of project returns

Following Bester and Hellwig (1987) we assume that the bank is able to observe whether the project has failed or not, but it is unable to observe the return in case of success. As a result, the financial contract must be a

and get a fixed return, or try luck and explore new markets which may turn out to be a flop or a great success. Alternatively, the firm may design an advertising campaign that caters for its traditional customer base and is thus safe, or else may choose to completely renew its image in which case, with some luck, it captures many new consumers, but with some probability it looses its old base without managing to attract a new segment. The firm may also pursue alternative R&D strategies with different success rates and associated prizes. Finally, the firm may continue to use the same suppliers which have been producing reliable inputs, or else explore new input suppliers which deliver at lower prices, but manufacture less reliable products. Under the assumptions of our model, the most conservative strategies are always efficient, but nevertheless firms may have incentives to act differently.

[6] Similarly, we could have assumed that if the bank pays a cost c then it can observe the choice of α with probability one. If different entrepreneurs have different monitoring costs, c, the formulation would be analogous.

standard debt contract and specify a fixed interest rate, r, which is paid in case of success.[7]

2.4 Timing

We consider the following timing:

STAGE 1: Competition

1.1) Banks simultaneously announce financial contracts.

1.2) Entrepreneurs choose a bank and sign the contract.

STAGE 2: Relationship banking

2.1) Banks choose their monitoring effort, β.

2.2) After both parties observe the outcome of the monitoring effort, then the bank provides a loan of size k, and the entrepreneur selects α.

2.3) Output realizes and payments are made.

In stage 2.2 parties can implement the contract; or, alternatively, they can reach an agreement to implement a decision that is not pre-specified in the contract. Therefore, we can restrict our analysis to contracts that are renegotiation-proof. Similarly, we assume that the terms of the contract must be individually rational in stage 2.2. That is, parties can not commit to arrangements that involve negative profits in some states of nature.[8]

We could have set up a model of stage financing and assumed that some funds are committed when banks choose their monitoring effort. As long as the amount of funds precommitted is not too large, qualitative results would be the same.

2.5 Optimal contracts and outcome of the bargaining process

Contracts can not be conditional on α (which is not verifiable) or on project returns (which are not even observable). At most they can specify a menu of pairs of interest rates and investment levels (r, k) and an allocation of residual rights (who gets to choose among the possible alternatives). If

[7] We thank an anonymous referee for suggesting this approach. If project returns are verifiable then contracts can make payments to the bank conditional on project returns and overcome the firm's moral hazard problem. Obviously, if they are not verifiable then the entrepreneur has incentives to lie and always report a low realization. As it is well known, if verification is (finetely) costly then the optimal contract may not be renegotiation-proof.

[8] See discussion in Section 8.

monitoring effort fails then the contract can pre-specify a pair (r_0, k_0), which is constrained efficient. If monitoring effort is successful then parties are in a bargaining situation. The bank can threaten the entrepreneur with cutting funds unless the right project choice is made. Similarly, the entrepreneur can threaten the bank with choosing an inefficient project unless the terms of the credit are considered adequate. Thus, parties can reach an agreement on a triple (k_1, r_1, α_1), which by construction can not be pre-specified in the contract. At most the contract can dictate the pair (r', k') that would be implemented in case of disagreement. Since the outcome of monitoring effort and whether an agreement is reached are non-verifiable, the disagreement point must be the same as in the case monitoring effort failed $(k_0 = k', r_0 = r')$.

Summarizing, an optimal contract specifies a pair (k_0, r_0). In case monitoring effort fails then such a contract is implemented. In case monitoring effort succeeds then parties bargain over all feasible outcomes, taking (k_0, r_0) as the outcome in case of disagreement. We do not model explicitly the bargaining process and take as a reduced form the symmetric Nash bargaining solution; i.e., we assume that parties reach an agreement (k_1, r_1, α_1), that maximizes the expected return of the project and which splits the extra gains equally.[9]

3 Equilibrium contracts

3.1 Optimal contracting under asymmetric information

Let us consider the optimal contract in case α is not observable. It must be anticipated that, given the terms of the debt contract, the entrepreneur selects the privately optimal project type. In other words, given (k, r) the entrepreneur chooses α in order to maximize

$$\pi = \alpha \left[\mu(\alpha) f(k) - rk\right]$$

i.e., the interior solution, denoted by α^*, is given by:

$$\alpha^* = \frac{(1-z) f(k)}{rk}$$

[9]See the discussion in Section 8.

The privately optimal value of α is equal to $\min\{\alpha^*, 1\}$. Suppose that the solution to the above optimization problem is interior, i.e., $\alpha^* \leq 1$. In this case, for any pair (k, r) the payoffs of the bank and the entrepreneur are given respectively by:

$$\pi = [\alpha^* \mu(\alpha^*) - (1 - z)] f(k)$$

$$b = (\alpha^* r - I) k = (1 - z) f(k) - Ik$$

That is, in the case of an interior solution, the expected payment to the bank per unit of capital, $\alpha^* r$, only depends on k. On the other hand, the entrepreneur's expected profit depends on k but also on α^*.

Let us consider contracts that are constrained efficient, i.e., (k, r) must be the solution to maximize b subject to $\pi \geq \overline{\pi}$, where $\overline{\pi}$ is an arbitrary level of the entrepreneur's expected profits. Notice that b is independent of the interest rate, and π is an increasing function of α^*, which decreases with r. This means that it is never efficient to set an interest rate that induces the entrepreneur to choose an inefficient project. Thus, the maximum interest rate, $\widehat{r}$, is such that $\alpha^* = 1$, which can be written as:

$$\widehat{r}(k) = (1 - z) \frac{f(k)}{k} = \frac{1 - z}{\lambda} f'(k)$$

In other words, if the bank offers a contract (r, k) that induces $\alpha < 1$, then a reduction in r (holding k constant) does not affect the bank's payoff, but indirectly increases the firm's payoff, by inducing a more efficient project choice. The intuition is the following. Since the firm appropriates the additional benefits of the good realizations and does not incur the full cost in the case of bad realizations, it has a tendency to choose excessively risky projects, whenever debt service is relatively high. Furthermore, the bank cannot compensate for a positive probability of default with a higher interest rate, since a higher rate would induce the firm to choose an even riskier (and lower expected return) project. The optimal strategy is to induce the efficient project choice by increasing the firm's return per unit of investment, which implies reducing the loan size. In other words, suppose that for a given level of investment, k, the bank increases the interest rate above $\widehat{r}(k)$. This reduces the entrepreneur's share of the project return and worsens incentives (reduces the probability of success). Given the assumption on $\mu(\alpha)$ the proportional reduction in the probability of success is equal to the proportional increase in the interest rate, and hence the expected payment to the bank remains unchanged. However, total expected return decreases, which is reflected in a lower payoff for the entrepreneur.[10]

Finally, we show that in equilibrium the entrepreneur's incentive constraint is always binding. Suppose not, i.e., in equilibrium (k, r) are such that $\alpha^* > 1$. Then, the efficient contract involves the first best level of investment, k^e. Notice that since $1 - z < \lambda$, $\widehat{r}(k^e) < I$, which implies that the incentive constraint is binding for any contract that involves non-negative profits for the bank.

Notice that $\frac{d\widehat{r}(k)}{dk} < 0$. That is, a higher level of capital is compatible with entrepreneur's incentives only if the interest rate is reduced; or, viceversa, the bank can only charge a higher interest rates if it further reduces the loan size.

Since in equilibrium $\alpha^* = 1$, then the payoffs of the bank and the entrepreneur can be written as (superscript A stands for 'asymmetric' information)

$$\pi^A = zf(k)$$

$$b^A = (1 - z) f(k) - Ik$$

Hence, π increases with k and b is a concave function of k. The loan size that maximizes bank profits under asymmetric information, $\underline{k}$, is given by the first order condition:

$$f'(\underline{k}) = \frac{I}{1 - z}$$

The associated interest rate is given by:

$$\widehat{r}(\underline{k}) = \frac{I}{\lambda}$$

Thus, bank profits decrease with k if $k > \underline{k}$, and increase with k if $k < \underline{k}$. This implies that it is never efficient to set a level of investment below $\underline{k}$ (it is never efficient to set an interest rate above the monopoly rate).

On the other extreme, banks never accept to lend at a rate below their cost of funds. Hence the maximum loan size, $\overline{k}$, is such that $\widehat{r}\left(\overline{k}\right) = I$, i.e., it is given by:

[10] In Section 8 we discuss the role of the functional form used for $\mu(\alpha)$.

$$f'\left(\overline{k}\right)=\frac{\lambda}{1-z}I$$

Thus, if α is not observable, in a constrained efficient contract $k\in\left[\underline{k},\overline{k}\right]$. Since $\overline{k}<k^{e}$, asymmetric information causes underinvestment (loan size rationing).

All this information is summarized in the following proposition:

Proposition 1 *If α is not observable, constrained efficient contracts consist of a pair (k,r) that induces the entrepreneur to choose $\alpha=1$. However, the level of investment is inefficiently low. In particular, $k\in\left[\underline{k},\overline{k}\right]$, with $0<\underline{k}<\overline{k}<k^{e}$. The interest rate is given by $\widehat{r}(k)=\frac{1-z}{\lambda}f'(k)$, which implies that $r\in\left[I,\frac{I}{\lambda}\right]$, and it decreases with the level of investment.*

3.2 Optimal contracting under symmetric information

Suppose that monitoring effort has succeeded. In this case parties are placed in a bargaining position and seek to reach an agreement on the project choice, the level of investment and the interest rate (α_1,k_1,r_1). If they disagree then the default contract is $\{k_0,\widehat{r}(k_0)\}$. However, they can implement more efficient outcomes. Let us first look at the Pareto frontier, i.e., the set of (α,k,r) that solve the following optimization problem:

$$Max\left\{(\alpha r-I)\,k\right\}$$

$$subject\ to\left\{\alpha\left[\mu(\alpha)\,f(k)-rk\right]\geq\overline{\pi}\right\}$$

Along the Pareto frontier $k=k^{e}$ and $\alpha=1$. The interest rate depends exclusively on how the project return is divided. It is useful to define total surplus as a function of the investment level, provided $\alpha=1$:

$$S(k)\equiv f(k)-Ik$$

Notice that $S'(k)>0$ for any $k<k^{e}$. Finally, let us define the maximum surplus, S^{e}, $S^{e}=S(k^{e})$. Using this notation, then it becomes clear

that parties must split the extra surplus that can be materialized thanks to the bank's monitoring effort and conditional on reaching an agreement: $S^e - S(k_0)$. If parties equally split this extra surplus then bank's and entrepreneur's payoffs, net of monitoring costs, are respectively (superscript S stands for 'symmetric' information):

$$b^S = (1-z) f(k_0) - Ik_0 + \frac{1}{2}[S^e - S(k_0)]$$

$$\pi^S = zf(k_0) + \frac{1}{2}[S^e - S(k_0)]$$

Proposition 2 *If monitoring is successful then parties reach an agreement and choose $\alpha = 1$ and $k = k^e$.*

Thus, the terms of the default contract (k_0) do not affect neither k_1 nor α_1, and is only reflected on the interest rate.

4 Monitoring incentives

In stage 2.1, the bank anticipates the outcome of the bargaining process if monitoring succeeds. Thus, the bank chooses β in order to maximize expected profits:

$$B \equiv (1-\beta) b^A + \beta b^S - \Psi(\beta)$$

i.e.,

$$B = (1-z) f(k_0) - Ik_0 + \beta\frac{1}{2}[S^e - S(k_0)] - \frac{1}{4\delta}\beta^2$$

Hence, the optimal value of β equalizes marginal benefits and marginal costs:

$$\beta = \delta[S^e - S(k_0)]$$

Notice that monitoring effort is an increasing function of the gap between the bank's expected profits under successful and unsuccessful monitoring. In particular, monitoring effort decreases with k_0; that is, it increases with the interest rate specified in the default contract.

Proposition 3 *Monitoring effort is a decreasing function of the level of investment (increasing function of the interest rate) specified in the default contract.*

5 Ex-ante payoffs:

Taking into account the ex-post privately optimal monitoring policy, banks' ex-ante profits can be written as a function of the loan size specified in the default contract:

$$B(k_0) = (1 - z) f(k_0) - I k_0 + \frac{\delta}{4} [S^e - S(k_0)]^2$$

Notice that bank profits decrease with the loan size in the default contract (increase with the interest rate specified in the default contract):

$$\frac{dB}{dk_0} = \{(1 - z) f'(k_0) - I\} - \frac{\delta}{2} [S^e - S(k_0)] S'(k_0) < 0$$

The first term is non-positive as long as $k_0 \leq \overline{k}$, and the second term is negative since $S'(k_0) < 0$. The intuition is the following. A higher interest rate in the default contract increases bank profits in case monitoring effort fails, as well as in case monitoring effort succeeds but parties fail to reach an agreement. Moreover, the extra surplus created by monitoring increases, which in turn improve monitoring incentives and hence the probability of realizing such extra surplus.

Similarly, the entrepreneur's ex-ante expected payoff is given by:

$$\Pi = (1 - \beta) \pi^A + \beta \pi^S$$

i.e.,

$$\Pi(k_0) = z f(k_0) + \frac{\delta}{2} [S^e - S(k_0)]^2$$

Now the effect of the loan size of the default contract on entrepreneur's ex-ante profits is less obvious and results from the net balance of two countervailing forces:

$$\frac{d\Pi}{dk_0} = z f'(k_0) - \delta [S^e - S(k_0)] S'(k_0)$$

The first term is positive: a lower interest in the default contract raises firm profits in case monitoring effort fails (as well as in case monitoring effort succeeds but parties do not reach an agreement). However, the probability of enjoying larger rents is reduced because of the lower monitoring incentives. It turns out that the assumption of a quadratic monitoring cost function resolves the potential ambiguity (see section 8). In particular, provided $k_0 \in \left[\underline{k}, \overline{k}\right]$:

$$\frac{d\Pi}{dk_0} = zf'(k_0) - \beta\left[f'(k_0) - I\right] > 0$$

The reason is that $\beta < 1$ and since $k_0 \geq \underline{k}$, $(1-z)\, f'(k_0) \leq I$.

6 Competition

In this section we consider simple and standard market structures. In fact, most of the insights of the paper can be obtained from comparing the two extreme scenarios: monopoly and Bertrand competition. At the end of this section we also discuss intermediate market structures.

6.1 Bertrand competition

Suppose that in stage 1 n banks, $n > 1$, compete to attract entrepreneurs, who perceive different banks as perfect substitutes.

In equilibrium banks offer a contract $\{k_0, \widehat{r}(k_0)\}$ which maximizes $\Pi(k_0)$ subject to $k_0 \in \left[\underline{k}, \overline{k}\right]$ and $B(k_0) \geq 0$. Given that for any $k_0 \in \left[\underline{k}, \overline{k}\right]$, $B(k_0) > 0$, the second constraint is not binding. In principle, banks would be willing to commit ex-ante to a loan rate below I, (that is, to a $k_0 > \overline{k}$) in case monitoring effort fails. However, banks would not be willing to keep their promise ex-post and would prefer to quit the relationship in case of asymmetric information.[11] Since $\Pi(k_0)$ monotonically increases with k_0, the equilibrium of the Bertrand game involves $k_0 = \overline{k}$ (the reader should remember that $\widehat{r}\left(\overline{k}\right) = I$).

6.2 Monopoly

The monopoly problem consists of choosing $\{k_0, \widehat{r}(k_0)\}$ which maximizes $B(k_0)$ subject to $k_0 \in \left[\underline{k}, \overline{k}\right]$ and $\Pi(k_0) \geq 0$. Again, for any $k_0 \in \left[\underline{k}, \overline{k}\right]$, $\Pi(k_0) > 0$, and hence the second constraint is not binding. In principle, a monopoly bank would like to commit ex-ante to set an interest rate in

[11] See Section 8.

case of asymmetric information above the monopoly rate $(k_0 < \underline{k})$. The intuition is the following. A small reduction in k_0 from $\underline{k}$ (the level of investment that maximize bank profits in case of asymmetric information) causes only a second order loss in bank profits in case monitoring effort fails, but it improves monitoring incentives, which has a positive first order effect on bank profits. However, if monitoring effort fails (or disagreement occurs) parties have incentives to renegotiate such a contract. Therefore, the monopoly solution is $k_0 = \underline{k}$.

Comparing the monopoly solution to Bertrand competition, since β is a decreasing function of k_0 we can conclude that:

Proposition 4 *With respect to the case of Bertrand competition, under monopoly: (i) banks exert higher monitoring effort, and thus the probability of implementing the efficient level of investment is higher, (ii) in case monitoring effort fails, loan size rationing is exacerbated.*

6.3 Intermediate market structures

Consider the Salop model. Entrepreneurs are uniformly distributed in a unit circumference, and the n banks are symmetrically located. that is, the distance between two consecutive banks is $x = \frac{1}{n}$. An entrepreneur located at a distance y from a particular bank must pay a cost ty if it chooses to borrow from that bank. The interpretation of such a 'transportation' costs is the standard one. It could literally reflect geographic differentiation, but also any other dimension of horizontal differentiation (different banks can provide different services which are linked to the credit relationship, or are specialized in different types of borrowers). Suppose banks simultaneously announce their offers $\{k_0, \widehat{r}(k_0)\}$. An entrepreneur located between two consecutive banks, j and $j+1$, with distances y and $x-y$, respectively, prefers the bank j's offer if and only if:

$$\Pi\left(k_0^j\right) - ty \geq \Pi\left(k_0^{j+1}\right) - t(x-y)$$

If we define as $\overline{y}$ the entrepreneur indifferent between the offers of the two banks, $\overline{y}$ is given by:

$$\overline{y}\left(k_0^j, k_0^{j+1}\right) = \frac{x}{2} + \frac{1}{2t}\left[\Pi\left(k_0^j\right) - \Pi\left(k_0^{j+1}\right)\right]$$

If other banks set k_0^{-j} then the optimal level of k_0^j is the solution to maximize:

$$B\left(k_0^j\right)\overline{y}\left(k_0^j, k_0^{j+1}\right)$$

subject to $k_0 \in \left[\underline{k}, \overline{k}\right]$. The first order condition, evaluated at $k_0^j = k_0^{-j} \equiv k_0$, is given by:

$$xtB'\left(k_0\right) + B\left(k_0\right)\Pi'\left(k_0\right) = 0$$

If xt is arbitrarily small (the number of banks is arbitrarily large), the left hand side of the equation is positive (since $\Pi'(.) > 0$) for any $k_0 \in \left[\underline{k}, \overline{k}\right]$, and hence in this case the symmetric Nash equilibrium involves $k_0^N = \overline{k}$. In the other extreme, if xt is arbitrarily large the left hand side of this equation is negative (since $B'(.) < 0$) for any $k_0 \in \left[\underline{k}, \overline{k}\right]$, and hence in this case the symmetric Nash equilibrium involves $k_0^N = \underline{k}$.

For intermediate values of xt, provided the above first order condition has a unique solution and the second order condition is satisfied, a higher value of xt implies a lower k_0^N.[12] In this case, since there is an inverse relationship between the number of banks and the parameter xt, the level of investment in the default contract, k_0^N, increases with the number of banks. The corollary is that monitoring effort decreases with the number of banks.

7 Welfare

Expected aggregate welfare (total surplus) can be written as:

$$W = \beta S^e + (1-\beta) S\left(k_0\right) - \Psi\left(\beta\right)$$

And taking into account banks' monitoring incentives:

[12]The firm's objective function is not necessarily concave. Using numerical methods, for all the parameter values considered we have found that, for any $xt > 0$, there is a unique symmetric Nash equilibrium that defines a decreasing function $k_0^N(xt)$. However, for parameter values that imply that $\beta(\underline{k})$ is close to 1 (δ large, z large), $k_0^N(xt)$ is discontinuous. That is, it may be the case that some values of $k_0 \in \left[\underline{k}, \overline{k}\right]$ can not be implemented as a Nash equilibrium for any xt. All these technical difficulties are avoided if banks can discriminate among entrepreneurs at different locations. In this case, the average k_0^N continuously decreases with xt.

$$W = S(k_0) + \frac{3\delta}{4}\left[S^e - S(k_0)\right]^2$$

Thus,

$$\frac{dW}{dk_0} = S'(k_0)\left[1 - \frac{3}{2}\beta(k_0)\right]$$

The sign of $\frac{dW}{dk_0}$ is ambiguous.[13] The reason is that aggregate welfare varies according to the net balance of two coutervailing effects. On the one hand, a higher value of k_0 implies that the level of investment when monitoring fails increases and approaches the efficient level. On the other hand, a higher value of k_0 reduces monitoring incentives, and hence reduces the probability of implement the efficient investment level. In particular, the sign of $\frac{dW}{dk_0}$ depends on whether β is higher or lower than $\frac{2}{3}$.

Consider one extreme case. Suppose that $\beta(\underline{k}) = \delta\left[S^e - S(\underline{k})\right] < \frac{2}{3}$. This will occur if the parameter z is sufficiently low (if loan size rationing is not too important) and monitoring effort is sufficiently costly (low δ). In this case, for any market structure $\beta < \frac{2}{3}$ and hence $\frac{dW}{dk_0} > 0$. This implies that the optimal market structure is one that implements $k_0 = \overline{k}$ (Bertrand competition, or a sufficiently large number of banks in Salop's model). The reason is that monitoring incentives are too weak and as a result the classical effect dominates (more competition implies lower interest rate and larger loan sizes).

Let us consider the other extreme. Suppose in this case $\beta\left(\overline{k}\right) > \frac{2}{3}$ (low monitoring costs or strong loan size rationing), then for all market structures $\beta > \frac{2}{3}$, $\frac{dW}{dk_0} < 0$, and hence the market structure that maximizes aggregate welfare is monopoly.

In all other intermediate cases, the market structure that maximizes aggregate welfare is the one that achieves $\beta = \frac{2}{3}$.[14]

[13] Of course, this welfare analysis disregards the impact of market power on the deposit side in which the possibility of excessive competition also exists. See, for instance, Matutes and Vives (1996 and 200).

[14] As discussed in footnote 12, for some parameter values it might not be possible to implement the value of k_0 that induces $\beta = \frac{2}{3}$. In this case, we would need to look for the second best solution, after taking into account the implementability constraint.

8 Discussion

The model discussed in this paper is highly stylized and quite special, in the sense that we have used specific functional forms. Nevertheless, we have been able to illustrate that the relationship between total welfare and market structure is in general ambiguous and depends on the net balance between two countervailing effects. In this section we discuss how different channels are affected by relaxing various special assumptions.

8.1 The firm's moral hazard problem

For an arbitrary $\mu(\alpha)$, equilibrium agency costs can take the form of either inefficient project choices ($\alpha < 1$), or loan size rationing ($f'(k) > I$), or both. Our choice for $\mu(\alpha)$ leads to equilibria with efficient project choices, but inefficiently low investment levels. Thus, aggregate welfare depends exclusively on the average loan size, which significantly simplifies the presentation. In a more general framework, unmonitored firms would also have access to smaller loans but also they would choose inefficiently risky projects. Such a generalization is not likely to provide significant additional insights.

8.2 The shape of monitoring costs

Under quadratic monitoring costs the elasticity of monitoring effort (as measured by β) with respect to the potential extra surplus from monitoring, $S^e - S(k_0)$, is 1. As a result, entrepreneurs' profits are increasing in k_0, which implies that entrepreneurs always prefer the lowest possible interest rate. The same result would hold if such an elasticity is lower than 1. However, if over some range the elasticity of monitoring effort with respect to the potential extra surplus from monitoring is sufficiently high then entrepreneurs might prefer contracts with relatively high interest rates. Thus, even under Bertrand competition, banks' rents would be larger. However, as long as banks can not appropriate all the gains from monitoring, higher market power will result in higher monitoring effort and the same trade-off will arise.

8.3 The shape of the production function

We have assumed that the elasticity of the return with respect to investment is constant. This assumption simplifies the presentation considerably without affecting any of the properties of the model. First, the assumption that garantees that the firm's incentive constraint is always binding can be expressed as a restriction on a single parameter. Second, it allows a simple characterization of the possible values that the loan size and the lending rate can take in equilibrium.

8.4 Ex-post bargaining power

In our model there is no hint on how ex-post bargaining power is determined. We take equal weights for illustration purposes. In a more elaborate (dynamic) model, ex-post bargaining power could be related to market structure. In particular, firms' bargaining power is likely to increase as banks compete more fiercely for customers. If this is the case our results would be reinforced.

8.5 Commitment power

We have assumed that parties can not commit to arrangements that involve negative profits in some states of nature. Such an assumption bites only in case competition among banks is sufficiently intense. For instance, under Bertrand competition, banks would like to commit ex-ante to a default contract that involves a lending rate below the market rate. Thus, in case monitoring effort fails banks would make negative profits that can be compensated by the positive rents obtained when monitoring succeeds.

The qualitative results of the paper do not depend on banks making positive profits under Bertrand competition. In fact, if we relax the assumption that banks can not commit to a default contract with negative profits, the properties of the model remain unchanged. However, in this case it would be difficult to provide explicit conditions on parameter values that make firms' incentive constraints binding under Bertrand competition.[15]

[15] Banks will not be willing to offer default contracts with negative profits if, for instance, a significant fraction of entrepreneurs are 'opaque', i.e., banks have a much harder time trying to observe their project choices.

9 Concluding remarks

We have analyzed a stylized model of the credit market where lending is constrained by asymmetric access to information. Banks optimally choose between restricting the loan size or monitoring firms' decisions. We have shown that an increase in the bank's market power: (a) reduces the level of investment by unmonitored firms, and (b) increases monitoring effort and thus reduces the proportion of credit-constrained firms. As a result, the effect of market power on investment and welfare have ambiguous signs, and hence it is possible that some degree of market power enhances welfare. That is, our model provides a new rationale for excess competition in the credit market, complementary to the arguments provided by the literature on relationship banking.[16]

The literature assesses the welfare effects of banking deregulation by analyzing how increased competition affects interest rates, banks' X-efficiency, and banks' portfolio risk .[17] However, it may be misleading to draw any conclusion from the net effect of these factors. Indeed, our paper suggests that market power may also have important implications for the availability of credit, since the benefits from relationship banking are more likely to be realized in a framework of limited competition.

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[16]For example, Besanjo and Thakor (1993) and Petersen and Rajan (1995).

[17]See, for instance, Berger and Humphrey (1994), Berger and Hannan (1993), and Keeley (1990).

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