Banking Competition, Monitoring Incentives and Financial Stability

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First version: August 2009
Current version: June 2013

This research has been carried out within the NCCR FINRISK project on “Systemic Risk and Dynamic Contract Theory”
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June 2013

Abstract

This paper addresses the desirability of competition in the banking industry. We develop a model where banks compete on both deposit and loan markets, and can use monitoring to control borrowers’ behavior. We first investigate how competition may affect banks’ monitoring incentives. We find that the impact of competition on banks’ monitoring incentives can be decomposed into two effects: an attractiveness effect and an efficiency effect. The first effect operates through the link between competition and loan margin. The second effect is due to the fact that the marginal impact of monitoring on borrowers’ management efforts depends on the loan rate. We characterize the sufficient condition under which greater competition will increase monitoring incentives as well as banks’ stability. We also analyse the role of capital requirement in correcting potential negative effects of competition vis à vis financial stability.

Keywords: Bank Competition, Bank Monitoring, Financial Stability

*I am very grateful to Jean-Charles Rochet and Rafael Repullo for helpful comments and suggestions. I also benefit from comments by participants at the 26th Annual Meeting of the Financial Management Association in New York and the Seminar at Norges Bank. All remaining errors are mine. The research leading to these results has received funding from the ERC (grant agreement 249415-RMAC) and from NCCR FinRisk (project Banking and Regulation).

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1 Introduction

"Competition among banks: good or bad?" has been a question raised for a long time. The general argument in favor of competition in any industry lies in its contributions to allocative, productive and dynamic efficiency (in the following, these effects of competition will be referred as welfare effects). However, for the banking industry, the answer is much less evident because of the delicate relationship between competition and stability.

From theoretical perspectives, competition may influence stability through both the liability and asset sides of banks' balance sheet. On the asset side, the classical thesis is that intense competition may worsen the excessive risk taking problem, a well-known moral hazard problem in banking. The intuition behind such argument is that greater competition erodes banks' franchise value, thus banks' failures are less costly. As a consequence, taking excessive risk becomes more attractive to banks. This result is shown within a framework, henceforth franchise-value framework, where, as a key assumption, the return distribution of banks' assets is exogenous and does not depend on the degree of competition in the banking sector. Such an assumption may be consistent if banks' activities are described as investments in different financial claims in the financial market. This, however, is not the case anymore, as pointed out by Boyd and DeNicolo (2005), if we look at banks' lending activities. In the same spirit of Stiglitz and Weiss (1981), Boyd and DeNicolo (2005) found that the quality of banks' loans is improved if the loan rate decreases. Their final conclusion is a monotonically increasing link between competition and banks' solvency.

Two important points may be drawn from the above considerations. First, the current literature portrays banks as passive lenders and ignores the role of banks in reducing information asymmetries. This approach is inconsistent with the intermediasation theory which always claims the ability to monitor and to process information
as the main specificity of bank lending. Moreover, existing analysis on the nexus between banking competition and stability are performed without any connection to the debate on the welfare effect of competition in the banking industry. We believe that such separation is not appropriate since an efficient bank should arguably be more resilient to negative shocks than an inefficient one. Hence, a more efficient banking industry is expected to be more stable.

This paper will address those two missing points by constructing a framework where the monitoring function of banks is taken into considerations. Specifically, we analyze a model where banks compete à la Cournot on both deposit and loan markets. On the deposit market, they compete to attract depositors. On the loan market, they compete to extend loans to firms. Both relationships, namely depositors - banks and banks - firms, are subject to moral hazard problems. The origin of moral hazard in the former is the system of deposit insurance with flat premium; whereas, in the latter, moral hazard is due to the fact that loan returns depend on the hidden effort of borrowers. Unlike depositors who are small households, banks, as sophisticated investors, can use costly monitoring to alleviate the information problem they face. In order to model monitoring, we adopt a continuous version of the formulation proposed by Holmström and Tirole (1997). We assume that banks can choose a monitoring intensity and that a higher monitoring intensity will induce a more appropriate behavior of borrowers because it reduces the marginal cost of their effort. Within such a setup, we investigate three questions: what are the effects of competition on banks’ monitoring incentives? Does competition hurt banks’ stability? Which devices could be used to correct potential negative effects of competition vis à vis financial stability?

For the first question, we find that the impact of competition on banks’ monitoring incentives can be decomposed into two effects. On the one hand, greater competition reduces loan margin and thus, makes monitoring less attractive to banks - monitoring-attractiveness effect. On the other hand, since how much monitoring may improve the loan return distribution depends on the loan rate, competition also impacts the efficiency of monitoring activities - monitoring-efficiency effect. While
the first effect clearly leads to the trade-off between competition and stability, the
direction of the second effect is uncertain. If more intense competition does not
involve any progression of the monitoring efficiency, the second effect reinforces the
first and the total effect will be negative. We, however, show that there are situations
where increasing competition does improve the efficiency of monitoring activities,
and such improvement overweights the negative impact stemming from the reduc-
tion of loan margin. Hence, our analysis shows that the common presumption that
market power increases banks’ incentives to exert monitoring effort is too simplis-
tic. Furthermore, the monitoring-efficiency effect arisen in our setup points out that
there exists a real connection between the welfare effect and the stability effect of
competition in the banking industry.

Regarding the second question, in our model, the quality of banks’ loan portfo-
lios is jointly determined by banks’ and borrowers’ behaviors. When competition
increases, the loan rate will decrease, which induces the borrowers to exert more
effort. However, this effect may be overweighted by the effect of competition on
banks’ monitoring incentives. Greater competition will reduce banks’ probability of
failure if it raises monitoring incentives of banks. It should be pointed out that our
setting encompasses the literature in the sense that we are able to produce some
basic results in the literature as special cases.

Concerning the third question, we focus on the role of capital requirement. We
extend our initial setup by assuming that banks have to hold some minimum capital
buffer to support deposits they collect. In our framework, the cost of capital is
assumed to be high enough so that the capital regulation is binding. We find that
apart from a positive direct effect on financial stability, the capital requirement
has also indirect effects which operate through its impact on interest rates. We
distinguish two kinds of corrective effects: weak correction vs. strong correction\(^1\),
and claim that with the capital requirement, we can attain a weak correction but
not strong correction.

The paper proceeds as follows. After reviewing the related literature in Section

\(^1\) See Section 5 for detailed definition.
2, we present the model in Section 3. Section 4 is devoted to the characterization of the symmetric equilibrium. In Section 5, we examine the role of capital requirement in correcting negative effects of competition vis-à-vis financial stability. In Section 6, we discuss some potential benefits of financial liberalization. Finally, Section 7 concludes with some remarks about future research directions.

2 Relation to the Literature

Our paper belongs to the theoretical literature analyzing the ties between competition and banks' risk-taking incentives. As we have mentioned in the introduction, there exist two strands within this literature.

The first and earliest strand was pioneered by Keeley (1990) and then successively followed by, among others, Allen and Gale (2000), Hellman et al. (2000), Matutes and Vives (2000), Cordella and Yeyati (2002), Repullo (2004). A common feature of these papers is that they use the franchise-value framework to address the effects of competition on risk-taking incentives of banks. This framework is characterized by the fact that banking competition is explicitly modeled only on the liability side. On the asset side, banks' asset allocation decisions are modeled as a "portfolio allocation problem" and then, banks' asset return does not depend on the degree of competition. Within this setup, greater competition implies an increase in the deposit rate and thus, reduces banks' charter values. Keeping in mind that charter values represent the cost of failure for banks, these papers conclude that more competition results in higher incentives for banks to take risks. Some of the above papers also investigate the efficiency of different regulatory tools in limiting perverse impacts of competition on risk-taking. For instance, Matutes and Vives (2000) consider the role of deposit regulation (rate regulation or deposit limits), and find that this instrument is sufficient to implement the welfare-optimal policy when the deposit insurance scheme is risk-sensitive. However, with a flat-premium deposit insurance, a deposit regulation may need to be combined with direct asset restrictions to improve welfare. Cordella and Yeyati (2002) focus on the effects of
information disclosure and deposit insurance scheme. They find that both are likely to mitigate adverse effects of competition.

The second strand includes two papers: Boyd and DeNicolo (2005); Martinez-Miera and Repullo (2008). These papers differentiate themselves from the first strand by the fact that they explicitly take into consideration the lenders - borrowers relationship on the asset side of banks’ balance sheet. This feature has two implications. First, banks’ asset returns depend on the competitiveness of the banking industry through the loan rate. Second, the riskiness of banks’ assets also depends on borrowers’ behaviors. Boyd and DeNicolo (2005) find that the risk level of banks’ assets is monotonically decreasing with the number of banks. The intuition of their result is as follows: when competition increases, the loan rate will decrease, which induces borrowers to choose safer investments. Martinez-Miera and Repullo (2008) deviate from Boyd and DeNicolo (2005) by assuming that loan returns are imperfectly correlated. In that case, a decrease of the loan rate reduces performances of non-defaulting loans which provide a buffer to cover loan losses. The authors show that when that effect of competition, called there margin effect, is taken into account, a U-shaped relationship between competition and the risk of bank failure generally obtains.

Our paper introduces the role of banks as monitors into the second strand. Hence, we get a more complete and appropriate description of bank-lending activities. To the best of our knowledge, only Caminal and Matutes (2002) have studied how market power affects banks’ solvency through its impacts on banks’ incentives to invest in reducing information problems. Their analysis is done within a setting where monitoring is perfect and where project choices are independent of market structure. In their analysis, banks only fail due to macroeconomic shocks, not because of project choices. They get the conclusion that market power enhances monitoring incentives.

Empirical literature about the relationship between competition and stability in banking has produced until now mixed findings. The main distinction among different empirical papers resides in the choice of measures for competitiveness and for
banks’ riskiness. Measures of market power used in the literature include measures of concentration (e.g. HHI index or n-firm concentration ratios), Lerner index or the Panzar and Rosse H-statistic. Proxy indicators for risk employed include Z-index, non-performing loan ratio. For example, measuring market structure by concentration indicators, Boyd et al. (2006) conclude that the probability of failure increases with more concentration in banking. Another work by Schaeck et al. (2006) uses Panzar and Rosse H-statistic as measure of competitiveness and finds that a more competitive banking system is more stable than a monopolistic system as a consequence of a lower likelihood of bank failure and a longer time to crisis. Contrasting with these results, in the context of Spanish banks, Jiménez et al. (2007) show that nonperforming loans decrease with the rise in the degree of market power which is measured by Lerner index.

3 The Model

We consider an economy with two dates \( t = 0, 1 \) and a banking industry composed of \( N \) commercial banks indexed by \( i = 1, 2, ..., N \). These banks compete à la Cournot to collect deposits from depositors and to extend loans to entrepreneurs.

A. Deposit Market

Banks have no capital\(^2\) and are funded by deposits at date 0. They face an upward sloping supply of deposits which is represented by an inverse supply curve \( r_D(.) \). Denote by \( D_i \) the amount of deposits collected by bank \( i \). We assume that deposits are fully insured, which implies that the deposit supply does not depend on risk. Hence, the deposit interest rate is only a function of total deposits \( \sum_{i=1}^{N} D_i \).

In our judgment, the assumption of deposit insurance best reflects the reality. In most countries of the world, there exists either explicitly or implicitly a system of deposit insurance. We assume that the deposit insurance premium is flat and, for expositional purposes, it is normalized to zero\(^3\).

\(^2\)We will relax this assumption later.
\(^3\)All our results are still valid if the flat premium is strictly positive.
Assumption 1 The inverse deposit supply function $r_D(.)$ satisfies

\[ r_D(0) > 0, r_D'(0) > 0, r_D''(.) \geq 0 \]

B. Loan Market

On the loan market, there is a population of risk-neutral and penniless entrepreneurs. Each entrepreneur has access to a project that requires one unit of investment at date 0 and yields at date 1 a stochastic cashflow $\tilde{R}$. We assume that $\tilde{R}$ can take two values

\[ \tilde{R} = \begin{cases} R & \text{with probability } p \\ 0 & \text{with probability } 1 - p \end{cases} \]

The distribution of the cashflow $\tilde{R}$ depends on the effort of the entrepreneur, i.e. how diligently the project is managed. We measure this effort by the probability of success $p \in [0, 1]$ of the project: by carefully running the project, the entrepreneur can improve the likelihood of getting a high return. The cost of being diligent corresponds to the sacrifice of some private benefits, which can be thought of as a quiet life, managerial perks or diversion of corporate revenues for private use.

To fund his project, the entrepreneur must borrow from banks\(^4\). This borrowing relationship is subject to a moral hazard problem because the bank cannot directly observe the entrepreneur’s effort. However, the bank can use monitoring activities to induce the appropriate behavior of their borrowers. In practice, bank’s monitoring amounts to verifying whether borrowers comply with restrictive covenants and to enforcing the covenants if they do not. Hence, as noted by Holmström and Tirole (1997), monitoring may reduce borrowers’ opportunity cost of being diligent\(^5\). In order to formalize this idea, we assume that the private benefits the entrepreneur

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\(^4\)In fact, in our model, each entrepreneur borrows from only one bank. Hence, we abstract from the use of multiple-bank lending as a way to improve monitoring incentives. For this question, see Carletti et al. (2007) and the references therein.

\(^5\)Imagine the situation where the entrepreneur’s private benefits come from the diversion of corporate revenues for private use. Without any supervision from the bank, he can realize it freely. However, if the bank keeps a close watch on the firm, the entrepreneur must use some costly manipulations to be able to disguise his action. Such manipulation costs are deductions from the private benefits he can reap.
may enjoy depend on how intensively the bank monitors the project’s running. Let $m_i \in [0, 1]$ denote the monitoring intensity chosen by bank $i$ for each unit of loan. Therefore, in our model, the entrepreneur’s private benefits are a function of two variables, namely $p$ and $m$. Denote it by $B(p, m)$. We make the following assumptions on the function $B(., .)$. From now on, for convenience of notation, we use subscripts to refer to partial derivatives.

**Assumption 2** The entrepreneur’s private benefit function $B(., .)$ satisfies

(i) $B_p(p, m) < 0; \ B_{pp}(p, m) < 0$

(ii) $B_{pm}(p, m) > 0$

(iii) $B_p(0, m) = 0; \ B_p(1, m) = -\infty$

The entrepreneur’s private benefits are then a decreasing and concave function of his effort (part (i)). Since in our model the cost of effort for the entrepreneur is modeled by some reduction in his private benefits, the negative of $B_p(p, m)$ can be interpreted as the marginal cost of effort. Thus, a positive sign of the cross-partial derivative $B_{pm}$ (part (ii)) means that a higher monitoring intensity makes effort less costly marginally. This property is crucial for the usefulness of monitoring in this paper. Part (iii) of the assumption serves to rule out corner solutions.

Monitoring is costly for banks, which introduces another incentive problem concerning banks. We represent the monitoring cost corresponding to the monitoring intensity $m$ by a twice differentiable function $C(m)$. We assume that the monitoring cost function is increasing, convex and, to insure interior solutions, satisfies two additional conditions:

**Assumption 3** The monitoring cost function $C(.)$ satisfies

(i) $C(0) = 0; \ C''(.) \geq 0$

(ii) $C'(0) = 0; \ C'(1) = +\infty$

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$^6$We here assume that all banks have access to the same monitoring technology. Therefore, we write both private benefit function and cost function without $i$ - label on the functional symbol.
Regarding the competition between banks to grant loans, similarly to the case of the deposit market, we adopt a Cournot formulation. Hence, given a loan supply $L_i$ of each bank $i$, the interest rate charged for each unit of loan will be determined by a downward sloping demand function $r_L(\sum_{i=1}^{N} L_i)^7$. Note that since deposits are the only source of funds for banks, the balance sheet identity implies that $D_i = L_i$ for all $i$.

**Assumption 4** The inverse loan demand function $r_L(.)$ satisfies

$$r_L(0) > 0, r'_L(0) < 0, r''_L(.) \leq 0$$

To insure that all parties get a positive surplus when the investment project succeeds, we impose an additional assumption:

**Assumption 5**

$$R > r_L(0) > r_D(0)$$

The timing of the model is as follows. At date 0, all banks simultaneously determine the amount of deposits collected and the volume of loans extended to entrepreneurs. Then, each bank $i$ chooses the monitoring intensity $m_i$ and each entrepreneur chooses the effort level $p$. At date 1, project returns are realized and payments are settled. Figure 1 summarizes this timing.

Before going to the characterization of the equilibrium, some further remarks are useful. First, in our model, by monitoring, banks can reduce the extent of the

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7In this paper, the loan competition is modeled in reduced-form by some decreasing and concave demand function. This demand function can be generated by a population of potential entrepreneurs whose reservation utility differs.
moral hazard problem but they cannot completely eliminate it. In other words, our monitoring technology is imperfect and its efficiency is determined, as we will see below, endogenously. Second, in our setting, the quality of loan portfolios, i.e. banks’ assets, depends on the behaviors of both parties in the borrowing relationship and neither banks nor entrepreneurs can have complete control over it. We believe that this feature best reflects the real, complex financial environment where incessant innovation not only provides participants with numerous means to better manage their investment, but also exposes them to more risk of control loss. From theoretical perspectives, this remark makes sense when we notice that two existing frameworks in the literature assume full control either of banks or of entrepreneurs over the riskiness of banks’ assets.

4 Symmetric Equilibrium

To solve for the equilibrium, we first determine the effort level the entrepreneur will choose when facing a loan rate $r_L$ and a monitoring intensity $m$. We then analyze the bank’s choice of monitoring intensity. The equilibrium’s characterization will be complete by finding the equilibrium deposit and loan rates.

4.1 Entrepreneurs’ effort level $p$

Given a loan rate $r_L$ and a monitoring intensity $m$, each entrepreneur will choose $p$ to maximize his expected profit, including the private benefits:

$$\max_{p \in [0,1]} \{ p(R - r_L) + B(p, m) \}$$  \hspace{1cm} (1)

Note that due to Assumption 2, the entrepreneur’s profit function is concave with respect to $p$ and no corner solutions exist. Hence, the solution is characterized by the following first-order condition (FOC):

$$R - r_L + B_p(p, m) = 0$$  \hspace{1cm} (2)
Denote the solution to equation (2) by \( p^* (r_L, m) \). Using implicit differentiation, we get
\[
\frac{\partial p^*}{\partial r_L} = \frac{1}{B_{pp} (p^*, m)} < 0
\]
and
\[
\frac{\partial p^*}{\partial m} = - \frac{B_{pm} (p^*, m)}{B_{pp} (p^*, m)} > 0
\]
Hence, (3) implies that a decrease in the interest rate on loans will help inducing the entrepreneur to exert a higher effort\(^8\). Moreover, from (4), we see that the bank can also incentivize the entrepreneur by monitoring more intensively. The intuition for this effort-enhancing effect of monitoring lies in the fact that a higher monitoring intensity reduces the marginal cost of effort. The marginal impact of monitoring on the effort level chosen by the entrepreneur \( p^*_m \) can be seen as an endogeneous measure of the efficiency of the bank’s monitoring activities.

### 4.2 Bank’s monitoring intensity \( m \)

We now turn to the monitoring incentives of banks. For given \( D_i \) and \( D_{-i} \), the expected profit of each bank \( i \) can be computed as\(^9\):
\[
\Pi^B_i = \{ p^* (r_L, m_i) [r_L - r_D] - C(m_i) \} D_i
\]
When writing the bank’s profit function, we make two assumptions:

First, we assume that loans’ returns are perfectly correlated. As noted by Allen and Gale (2000), perfect correlation of loans is equivalent to assuming that the risk associated with each loan can be decomposed into systemic and idiosyncratic components, and that with a large number of entrepreneurs, the idiosyncratic component can be perfectly diversified away. Moreover, although perfect correlation is an extreme case\(^10\), some degree of correlation is necessary to provide a role for

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\(^8\)Similarly with the effect identified in Boyd and DeNicolo (2005).

\(^9\)For notational simplicity, in situations where there is no risk of confusion, we will write loan and deposit rates simply as \( r_L \) and \( r_D \) suppressing the fact that they depend on respectively total loans and total deposits.

\(^10\)Martinez-Miera and Repullo (2008) study the case of imperfect correlation in a setting without
monitoring in our setup.

Second, the total monitoring costs are assumed to be proportional to the number of loans to be monitored\textsuperscript{11}. Put differently, we assume that the bank has resources to monitor an arbitrary large number of projects. This assumption implies that the size of the loan portfolio will not affect the choice of monitoring intensity by the bank. Whereby we abstract from the problem of the link between the bank’s size and the monitoring incentives\textsuperscript{12}.

The problem for bank $i$ is to determine the monitoring intensity that maximizes his profit:

$$\max_{m_i \in [0,1]} \Pi^B_i$$

Since $\Pi^B_i$ is a continuous function, it has a maximum on the feasible set $[0, 1]$. In addition, due to the part $(ii)$ of Assumption 3, corner solutions are excluded. Therefore, the solution of the above optimization problem satisfies:

$$p^*_m (r_L, m_i) [r_L - r_D] - C'(m_i) = 0 \quad (5)$$

and

$$p^*_m (r_L, m_i) [r_L - r_D] - C''(m_i) \leq 0 \quad (6)$$

Equation (5) clarifies the trade-off the bank faces when raising monitoring intensity. That is, the trade-off between a higher cost of monitoring and a higher probability that loans will pay off.

Let $m^*_i$ be the optimal monitoring intensity chosen by bank $i$. It is clear from equation (5) that the monitoring intensity depends on the interest rates of both deposit and loan markets $m^*_i (r_L, r_D)$. To analyze the effects of these interest rates on the bank’s monitoring incentives, we perform some comparative statics. First, by applying implicit differentiation to equation (5) and assuming that the inequality in

\textsuperscript{11}In this model, given a monitoring intensity $m$ for each unit of loan, the total costs of monitoring $D$ units of loans equal $C(m)D$.

\textsuperscript{12}See, for example, Cerasi and Daltung (2000) for the analysis of the optimal size of a bank.
(6) is strict, we obtain

\[ \frac{\partial m_i^*}{\partial r_D} = \frac{p_{r,m_i}^*(r_L, m_i^*)}{p_{r,m_i}^*(r_L, m_i^*) (r_L - r_D) - C''(m_i^*)} \]  

Because of (4) and the second order condition (6), we see that the partial derivative of \( m_i^* \) with respect to \( r_D \) is negative. Hence, an increase in the deposit rate reduces the bank’s monitoring incentives, which is exactly the standard effect of deposit competition found in the literature. Concerning the effects of the loan rate, we have

\[ \frac{\partial m_i^*}{\partial r_L} = - \frac{p_{r,m_i}^*(r_L, m_i^*) + p_{r,r_L}^*(r_L, m_i^*) (r_L - r_D)}{p_{r,m_i}^*(r_L, m_i^*) (r_L - r_D) - C''(m_i^*)} \]

Therefore apart from a similar effect as the deposit rate, the loan rate has another effect on the monitoring intensity, represented by the cross-partial derivative \( p_{r,r_L}^* \). This term can be negative or positive, depending on the properties of the private benefit function \( B(p,m) \). We will discuss this in more detail in the next section.

The main message here is that while increasing competition on the deposit market can only have a negative effect on monitoring incentives, increasing competition on the loan market may have a positive effect. This suggests that competition on the deposit market and on the loan market should be treated in different ways by policy makers.

### 4.3 Equilibrium interest rates

We are now in a position to determine the equilibrium deposit and loan rates. Given \( D_{-i} \) chosen by other banks, each bank \( i \) chooses \( D_i \) to maximize his profit:

\[ \max_{D_i \geq 0} \Pi_i^B \]

where

\[ \Pi_i^B = \{ p^* (r_L, m_i^*) (r_L (D_i + D_{-i}) - r_D (D_i + D_{-i})) - C(m_i^*) \} D_i \]
Let us denote total deposits by \( Z = \sum_{i=1}^{N} D_i \) and define a function \( f(Z) \) by

\[
f(Z) = p^* (r_L, m_i^*) [r_L(Z) - r_D(Z)] - C(m_i^*)
\]

\( f(Z) \) represents the expected return of an individual loan. The maximization program (9) becomes

\[
\max_{D_i \geq 0} \{ f(Z) D_i \}
\]

In what follows, we are going to assume that functional forms and parameter values are such that \( f'(0) < 0 \) and \( f''(.) \leq 0 \). Therefore, the symmetric equilibrium, where all banks choose the same amount of deposits \( D^* \) and so the total volume of deposits, \( Z^* = ND^* \), is characterized by the following equation:

\[
f'(Z^*)Z^* + N f(Z^*) = 0 \tag{10}
\]

**Lemma 1** In the symmetric equilibrium, the total volume of deposits (and also of loans) is increasing with the number of banks.

**Proof.** By totally differentiating (10), we have

\[
\frac{dZ^*}{dN} = - \frac{f(Z^*)}{f''(Z^*)Z^* + (N + 1)f'(Z^*)}
\]

which is positive since \( f'(.) < 0 \) and \( f''(.) < 0 \).

Lemma 1 states a standard result of increasing competition in a Cournot model. It implies that higher competition increases the deposit rate and decreases the loan rate.

We are now equipped to explore how the competitiveness of the banking industry affects banks’ monitoring incentives and banks’ failure probability. We measure the intensity of competition by the number of banks. In equilibrium, all banks choose
the same monitoring intensity equal to $m^* (r_L (Z^*), r_D (Z^*))$. We have

$$\frac{dm^*}{dN} = \frac{dm^* dZ^*}{dZ^* dN}$$

Since $Z^*$ is an increasing function of $N$, $\frac{dm^*}{dN}$ has the same sign as $\frac{dm^*}{dZ^*}$. Using (7) and (8), we obtain the following proposition:

**Proposition 1** The effect of competition on the monitoring intensity chosen by banks is given by the sign of

$$\frac{dm^*}{dZ^*} = \frac{\left( p_{mL} (r_L, m^*) r_L^' (Z^*) (r_L - r_D) + p_m^* (r_L, m^*) \left( r_L^' (Z^*) - r_D^' (Z^*) \right) \right)}{p_{mn} (r_L, m^*) (r_L - r_D) - C'' (m^*)}$$

(11)

Hence, competition impacts banks’ monitoring incentives through two channels:

First, more competition leads to a lower loan margin. Keeping in mind that, for banks, monitoring serves to decrease the probability of loans defaults, this first effect makes monitoring less attractive to banks, and thus unambiguously reduces their incentives - the *monitoring-attractiveness effect*. In (11), this effect corresponds to the second component of the numerator. Clearly, its sign is negative and, since the denominator is negative, this term will tend to induce a decreasing relationship between $N$ and $m^*$, which may reflect the common presumption that market power increases banks’ incentives for monitoring.

Competition, however, has another effect on the monitoring intensity chosen by banks, which is represented by the first term in the numerator of (11). Such effect comes from the link between the marginal impact of monitoring on entrepreneurs’ effort (i.e. $p_m^*$) and the loan rate - the *monitoring-efficiency effect*. What is the intuition for the dependence of monitoring efficiency on competition? As noted in Section 4.1, monitoring has an effort - enhancing value because a higher monitoring intensity reduces the marginal cost of effort. In addition, the choice of effort results from a trade - off between its benefits and costs. In consequence, how efficient
monitoring is depends on the effort benefit level that in turn depends on the intensity of competition through the loan rate.

The second effect is of ambiguous sign. Concretely, whether a higher competitiveness positively or negatively affects the monitoring efficiency depends on the shape of the private benefit function $B(p, m)$. Let us consider the case where $B(p, m)$ is multiplicatively separable in $p$ and $m$ as follows\(^{13}\)

$$B(p, m) = h(p)g(m)$$  \((12)\)

In such case, increasing competition will lead to an improvement in the efficiency of banks’ monitoring activities if the following condition holds

$$h''(p)h'(p) < \left[ h''(p) \right]^2$$ \((A)\)

This condition is equivalent to the function $\ln\left( |h'(p)| \right)$ being concave\(^{14}\) on the interval $[0, 1]$.

Therefore, when condition (A) does not hold, the monitoring-efficiency effect reinforces the monitoring-attractiveness effect, which implies that higher competition will hurt banks’ monitoring incentives. When condition (A) is satisfied, the two effects of competition on monitoring intensity go in opposite directions. The sufficient condition for a positive relationship between competition and monitoring incentives is the following\(^{15}\)

$$-\frac{\ln\left( |h'(p)| \right)}{\ln\left( |h'(p)| \right)} > h''(p)g(m)\frac{r_D' - r_L'}{r_L'(r_L - r_D')}$$ \((B)\)

\(^{13}\)Assumption 2 on the function $B(\ldots)$ is translated into the assumption that the function $h(\ldots)$ is decreasing and concave with $h'(0) = 0$ and $h'(1) = -\infty$, and that the function $g(\ldots)$ is decreasing.

\(^{14}\)|$h'(p)|$ is then said to be a logarithmically concave function on the interval $[0, 1]$.

\(^{15}\)Compared to condition (A), this condition means that the function $\ln\left( |h'(p)| \right)$ must be sufficiently concave.
Regarding banks’ failure, the equilibrium solvency probability for banks is \( p^* (r_L(Z^*), m^*(Z^*)) \):

\[
\frac{dp^*}{dN} = \left( \frac{\partial p^*}{\partial r_L} r_L(Z^*) + \frac{\partial p^*}{\partial m} m^*(Z^*) \right) \frac{dZ^*}{dN}
\]  

(13)

The first term in the parenthesis of (13) is positive, while the sign of the second term depends on the relationship between the equilibrium monitoring intensity and the banking competition. When banks’ monitoring incentives increase with competition, a more competitive banking industry is more stable. In other case, competition has an ambiguous effect on banks’ stability. Summing up, we have the following proposition

**Proposition 2** Assuming that the private benefit function has a separately multiplicative form as (12), then in a symmetric Nash equilibrium

(i) If condition (A) does not hold, the intensity of monitoring by banks decreases with the number of banks \( N \). In that case, increasing competition has an ambiguous effect on banks’ probability of failure.

(ii) If condition (B) holds, the intensity of monitoring by banks increases with the number of banks \( N \) and so, higher competition will make banks safer.

**Proof.** See appendix. ■

An interesting point is worth noting here. It relates to the connection between welfare effect and stability effect of competition in the banking industry. So far, these two effects are usually considered separately and, to the best of our knowledge, no studies point out their probable relationship. The new effect of competition on banks’ monitoring incentive found in this paper - *monitoring-efficiency effect* - sheds some light on this problem. In the banking industry, as in any other industry\(^{16}\), competitive pressure is believed to push firms to look for the most efficient way to organize their operations. This is the productive efficiency benefit, one of three welfare benefits frequently claimed to be associated with competition. In this sense,

\(^{16}\)For empirical evidence that individual firms’ productivity is higher in more competitive market in manufacturing industry, see, for example, Nickell (1996).
increasing competition is expected to be accompanied by a more efficient monitoring technology, which is beneficial to the stability. This argument illustrates the view that if banks are strengthened by the forces of competition, the banking system will be stronger and more resilient.

All in all, both effects on monitoring found in our paper are likely to be present in practice. When the banking sector is highly concentrated, the efficiency-improving effect of increasing competitive pressure is likely to be greater than the opposite effect of loan margin reduction. When in the banking market, there is already a great deal of competition, all options to improve efficiency are exhausted, increasing competition would result more in a reduction of loan margin than in an advance of efficiency. Therefore, part (ii) of Proposition (2) is more likely to occur when $N$ is small, whereas part (i) is more probable when $N$ is already high. This suggests that the relationship between competition and fragility may be in a U-shaped.

### 4.4 Special Cases

In this section, we highlight how some basic results in the literature can be obtained in our setup and, thus, shed some light on the role of alternative assumptions.

First of all, let us see what happens if we assume, as in the franchise-value framework, that the return on banks’ assets is independent of the degree of competition. Our setup can be then restated shortly as follows: $N$ banks compete to collect funds from depositors and invest the proceeds in loans. Each unit of loans pays some *exogenous* return $r_L$ in case of success and $0$ in case of failure. The loans’ probability of success depends on the monitoring intensity chosen privately by banks. With the independence of loans’ return, competition affects banks’ asset quality only through the deposit rate: in (11), by replacing $r_L(Z^*) = 0$, we get $\frac{dm^*}{dN} < 0$. Hence, greater competition unambiguously induces worse behaviors of banks. This in turn implies in (13) that the banks’ solvency probability is lower the higher competition is. That is exactly the famous trade-off between competition and stability.

Now, we turn to Boyd and DeNicolo’s setup where banks are treated as passive
lenders. They don’t have any instruments to mitigate the moral hazard problem present in their relationship with borrowers. One way to get rid of monitoring in our model is to assume that the cross-partial derivative $B_{pm}$ of the private benefit function is non positive. Such an assumption implies, as seen in (4), that monitoring does not have any disciplinary effect. In other words, monitoring technology becomes useless and thus, in equilibrium, banks choose a null monitoring intensity (see (5)). Without monitoring, the banks’ solvency probability is monotonically increasing with the number of banks, as (13) indicates. Therefore, with passive banks and a Cournot competition paradigm as Boyd and DeNicolo (2005), all effects of deposit competition on the banks’ asset quality are ignored.

To summarize, two existing frameworks in the literature, namely the franchise-value framework and the Boyd-DeNicolo (2005)’s setup, are two extreme cases of our setting. In each of these cases, there are always some effects found in our model that are missing.

5 Capital Requirement as Corrective Device

As the analysis in previous section has shown, the view that competition is unambiguously good or bad for the stability of banking system is too simplistic. The impact of competition on financial fragility can be very complex. Therefore, a more balanced policy approach with respect to banking competition, we believe, would be to find different methods to correct its negative effects and promote the positive ones. We distinguish two kinds of corrective effects: Weak correction refers to compensation for perverse consequences of competition. Strong correction corresponds to a change in the sign of the relationship between competition and stability.

Consistently with the growing role of capital requirement in prudential supervision, we examine in this section the effectiveness of this regulation to remedy perverse impacts of competition. In order to do that, we introduce capital regulation into the model of Section 3. We assume that banks must invest some of their own capital to support the deposits they mobilize. Let $k_i$ denote the capital invested
by bank $i$, expressed as a fraction of deposits mobilized. By regulation, $k_i$ must be greater or equal to some minimum capital requirement $k$. The opportunity cost of capital is $\rho$. We assume that $\rho$ is high enough so that banks will not hold any excess capital (i.e. $k_i = k$)\textsuperscript{17}. The view that the opportunity cost of banks’ capital is high is relevant because, otherwise, the moral hazard problem in banking could be solved easily. Regulators would simply require banks to hold sufficient capital and banks would willingly comply.

Since the entrepreneurs’ behavior when facing a loan rate $r_L$ and a monitoring intensity $m$ is the same as in our initial model, the solvency probability of each bank $i$ still equals $p^* (r_L, m_i)$. Its total loans $L_i$ equal $(1 + k)D_i$ and its profit can be written as follows\textsuperscript{18}:

$$\Pi_i^{CB} = [p^* (r_L, m_i) ((1 + k)r_L - r_D) - \rho k - C(m_i)(1 + k)] D_i$$

The optimal monitoring intensity chosen by bank $i$ is now the solution to the following condition\textsuperscript{19}:

$$p^*_{m_i}(r_L, m_i) [(1 + k)r_L - r_D] - C'(m_i)(1 + k) = 0 \quad (14)$$

Hence, besides the two interest rates, the optimal monitoring intensity, denoted now by $m_i^C$, is also directly influenced by the level of capital requirement. This direct effect of capital requirement on monitoring incentives can be determined as follows:

$$\frac{\partial m_i^C}{\partial k} = - \frac{p^*_{m_i}(r_L, m_i^C)r_L - C'(m_i^C)}{p^*_{m_i}(r_L, m_i^C) [(1 + k)r_L - r_D] - C''(m_i^C)(1 + k)}$$

\textsuperscript{17}This is equivalent to the assumption that $\rho$ is sufficiently higher than $r_L(0)$. The same assumption is made in Hellmann et al. (2000).
\textsuperscript{18}The superscript "CB" refers to capitalized banks.
\textsuperscript{19}The associated second order condition is $p_{m_i m_i}(r_L, m_i) [(1 + k)r_L - r_D] - C''(m_i)(1 + k) < 0$
From (14), we get
\[ \frac{\partial m_i^C}{\partial k} = - \left( \frac{1}{1+k} p_m^r r_D \right) \frac{1}{p_m^m, (r_L, m_i^C)} \left[ (1 + k) r_L - r_D \right] - C_m^r (m_i^C) (1 + k) > 0 \]
which means that a higher capital requirement has a positive direct effect on monitoring. The intuition for this positive effect is that the banks’ capital acts as a buffer against risk. When banks invest more of their own capital, they have to bear more downside risk, which incites them to behave more appropriately.

However, this is not the whole story yet. Variations of the capital requirement also bring about changes to the equilibrium interest rates. Overall effects of the capital requirement on monitoring then depend on the relationship between loan and deposit rates and monitoring incentives. Note that imposing a capital requirement can be seen as imposing an additional cost for deposits. Consequently, when banks’ capital is scarce, an increase in the capital requirement may reduce the available amount of deposits and loans in the banking sector, which leads the deposit rate to decrease and the loan rate to increase. If such a scenario happens, increasing the capital requirement may act as a countervailing force to an increase in competition, which lessens the decrease of loan margins caused by greater competition. Using the terminology proposed above, by increasing the capital requirement, we can obtain a weak correction effect.

Is a strong correction also accessible through an increase in the capital requirement? The answer is provided by the following proposition.

**Proposition 3** In the presence of the capital requirement, the effect of competition

\[ f_Z^C (Z^C, k) Z^C + N^C (Z^C, k) = 0 \]
where
\[ f^C (Z, k) = p^* (r_L, m_i^C) [(1 + k) r_L (1 + k) Z] - r_D (Z) - \rho k - C(m_i^C) (1 + k) \]
Therefore, \( Z^C \) is function of both \( N \) and \( k \), which implies that \( r_L \) and \( r_D \) also depend on \( k \).

\[ ^{20} \text{Indeed, with capital requirement, the total deposits } Z^C \text{ in the symmetric equilibrium are determined by} \]
\[ f_Z^C (Z^C, k) Z^C + N^C (Z^C, k) = 0 \]
\[ f^C (Z, k) = p^* (r_L, m_i^C) [(1 + k) r_L (1 + k) Z] - r_D (Z) - \rho k - C(m_i^C) (1 + k) \]
Therefore, \( Z^C \) is function of both \( N \) and \( k \), which implies that \( r_L \) and \( r_D \) also depend on \( k \).

\[ ^{21} \text{Without capital requirement, expected cost for one unit of deposit is } pr_D. \text{ With capital requirement } k, \text{ this expected cost becomes } pr_D + k (\rho - pr_L) \text{ which is greater than } pr_D \text{ when } \rho > r_L(0). \]
on the monitoring intensity chosen by banks is given by:

\[
\frac{\partial m_C}{\partial N} = \frac{((1 + k) r_L - r_D) (1 + k) p'_{mrr} (r_L, m_C) r'_L + p'_m (r_L, m_C) ((1 + k)^2 r'_L - r'_D)}{p''_{mm} (r_L, m_C)} \frac{\partial Z_C}{\partial N}
\]

(15)

**Proof.** Implicitly differentiating equation (14) with respect to \( N \), keeping in mind that \( r_L \) and \( r_D \) are function of \( Z_C \), immediately yields (15). □

In Proposition 2, we see that when condition (A) does not hold (i.e. \( p_{mrr} (., .) > 0 \)), there is a negative link between monitoring intensity and the degree of competition in the banking market. In that case, the sign of (15) is also negative regardless of the value of \( k \). Hence, increasing the capital requirement can not reverse the relationship between competition and monitoring.

**Corollary 1** Increasing the capital requirement can have a weak correction effect but not a strong correction effect

### 6 Benefits of Financial Liberalization

Since the last two decades, banking systems all over the world are experiencing a wave of financial liberalization. Its expression can be observed in different ways. Deposit-rate ceilings are lifted. Barriers to entry are reduced, entry of foreign banks is allowed. The wall between banking and non-banking activities is broken down. Restrictions on real estate lending are eliminated. In developing countries, publicly owned banks are privatized; directed credit declines and requirements for special credit allocations to priority sectors are removed. In the European Union, numerous measures are adopted to promote the integration of banking and financial markets.

An immediate consequence of financial liberalization is the erosion of banks’ profits. Based on this phenomenon, several papers (e.g. Hellmann et al. (2000)) claim that financial liberalization might aggravate moral hazard in banking. However this argument ignores two other realities also often associated with the process
First, financial liberalization may lead to significant gains in productivity and efficiency, especially in countries where the banking system is not very well developed yet. The magnitude of these efficiency gains is empirically established in numerous papers. For instance, Isik and Hassan (2003) examine productivity growth and efficiency change in Turkish commercial banks during the deregulation of the financial market in Turkey. They find that all types of Turkish banks have recorded significant productivity gains, driven mostly by efficiency increases. Efficiency increases, in turn, are mostly owing to the improvement of resource management practices. This last conclusion is very encouraging with respect to the efficiency effect found in our paper. The same upgrade of efficiency is reported in Shyu (1998) for the Taiwanese banking system as well as in Bhattacharya et al. (1997) for the liberalization process in India.

Second, a market enlargement typically accompanies financial liberalization. As Vives (2001) notes, this market extension comes either from the possibilities of access to international financial markets and market integration, or from an increase in internal demand for financial services once "financial repression" is eliminated. Vives (2001) focuses on larger diversification possibilities implied by market expansion. Here, we want to attract attention to its consequences for the elasticity of deposits supply and loans demand which appear in our condition (B) that we proved to be sufficient for a positive relationship between competition and stability.

7 Concluding Remarks

This paper offers an analysis of the desirability of competition in the banking industry. The main distinctive point of our study consists in bringing up the monitoring function of banks in the lending relationship with borrowers and then, investigating the impact of competition on the banks’ stability through its impact on monitoring incentives. We reveal two possible effects of competition on monitoring: attractiveness and efficiency effects. We also identify the sufficient condition
under which greater competition will increase monitoring incentives as well as the banks’ stability. When it comes to policy matters, we consider the role of capital requirement as a corrective device and show that with a capital requirement, one can obtain a weak correction but a not strong one.

To keep our analysis tractable, we have made some simplifying assumptions. We here wish to have some more detailed discussion about them. First, in our setup, we choose Cournot paradigm to model the competition between banks. The appropriateness of this paradigm in modeling the competitive behaviors of banks seems to be questioned by the literature examining banking competition under asymmetric information. The main objective of this literature is to study how informational asymmetries among banks affect competitive outcomes. More specifically, papers belonging to this literature are interested in characterizing the equilibria emerging in a loan market, where banks can use imperfect screening tests to assess the ability of potential borrowers to repay and they compete to fix the interest rate. Broecker (1990) shows that within such a setup, even in the limit, there is always some degree of oligopolistic competition, which contrasts with the findings of classical competition settings. Gehrig (1998) finds that market integration does not necessarily leads to more competitive outcomes in the loan market. More surprisingly, Marquez (2002) obtains that increasing the number of banks may push the loan rate up as it leads to less efficient screening by banks. Hauswald and Marquez (2006) show that this result would be reversed if information acquisition is endogenous. These considerations suggest that trying to construct a more adequate framework to model banking competition may be an interesting agenda for future research. However, we would also like to note that as long as more competition leads to lower loan rate and higher deposit rate - a likely outcome observed in practice, all our qualitative conclusions will hold.

Another remark concerns the fact that in this paper as well as in all other papers in the literature, the banks’ size did not play any role. However, it seems that the role of size in the banking industry is an important issue for at least two reasons. First, the moral hazard problem is more severe in big banks than in small banks
due to "too big to fail" effects. Second, it is much more challenging to supervise a large bank with very complex organization and where the risk of regulatory capture is more likely to be present. These two reasons can lead to criticizing the view that market power could promote financial stability. We leave this question to future research.

Acknowledgement 1 I thank Jean-Charles Rochet, Rafael Repullo, Javier Suarez, Donato Masciandaro, Fabiana Gómez for their comments and suggestions. I also thank participants and discussants at the Annual Meeting of the Association of Southern European Economic Theorists in Istanbul, the Norwegian Economist Meeting in Kristiansand, the Norges Bank’s seminar and the FMA Annual Meeting in New York. I thank Santiago Moreno for helping me to improve my English.

A Appendix

To prove Proposition 2, we have to establish two results:

(i) When condition (A) does not hold, the cross - partial derivative $p_{mL}^*$ has positive sign

(ii) When condition (B) is satisfied, the numerator of (11) is positive

Indeed, using (4) and the multiplicative form of the private benefit function $B(p, m)$, we get

$$p^*_m = -\frac{h'(p^*)g'(m)}{h''(p^*)g(m)}$$

(A.1)

Then,

$$p^*_{mL} = -\frac{[h''(p^*)h'''(p^*) - h''(p^*)h'''(p^*)] p^*_L g'(m) g(m)}{[h''(p^*)g(m)]^2}$$

Replacing $p^*_L = \frac{1}{h''(p^*)g(m)}$ (see (3)), we have

$$p^*_{mL} = \frac{[h'(p^*)h'''(p^*) - h''(p^*)h'''(p^*)] g'(m)}{h''(p^*)[h''(p^*)g(m)]^2}$$

(A.2)

Clearly, if $h'''(p)h'(p) > [h''(p)]^2$ for all $p$ (i.e. condition (A) does not hold), $p^*_{mL}$ will be positive.
Now we turn to (ii): the fact that the numerator of (11) is positive is equivalent to
\[ p_{m,r}^* (r_L, m^*) r'_L (r_L - r_D) > p_m^* (r_L, m^*) \left( r'_D - r'_L \right) \] (A.3)

Applying (A.1) and (A.2), we obtain the equivalence of condition (A.3) as follows
\[- \frac{h' (p^*) h''' (p^*) - h'' (p^*) h'' (p^*)}{h' (p^*) h'' (p^*)} > h'' (p^*) g(m^*) \frac{r'_D - r'_L}{r'_L (r_L - r_D)} \] (A.4)

The left-hand side of (A.4) is exactly \(- \frac{\ln\left(\frac{h'(p^*)}{h''(p^*)}\right)}{\ln\left(\frac{h'(p^*)}{h''(p^*)}\right)} \).

References


