Is there a tradeoff between bank competition and financial fragility?

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Abstract

We use a model of mean-shifting investment technologies to study the relationship between market structure, risk taking and social welfare in lending markets. Introduction of loan market competition is shown to reduce lending rates and to generate higher investments without increasing the equilibrium bankruptcy risk of borrowers. Hence, there need not be a tradeoff between lending market competition and financial fragility. Such a tradeoff may not emerge either when banks compete by conditioning interest rates on investment volumes irrespectively of whether credit rationing takes place or not. © 2000 Elsevier Science B.V. All rights reserved.

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1. Introduction

The banking industry is currently facing a global consolidation process. The emerging new landscape of the world banking industry is being shaped by a
huge wave of mergers and acquisitions (M&As), the amount of which was as high as US $553 billion during the period May 1997–May 1998. In Europe the single market programme dated back to 1992, the banking directives of the European Union from the early 1990s and, in particular, the monetary union initiated from the beginning of 1999 represent the regulatory changes which together with ongoing financial innovation will transform the banking industry. In the long run, a central goal of financial integration within the framework of the European Union is to encourage competition in banking. Conventional wisdom suggests that competition eliminates various restrictive practices and reduces margins between borrowing and lending rates, thereby improving the performance of the banking industry.

The banking industry, however, has several idiosyncratic features, making it hard to evaluate the consequences of increased banking competition as it is not possible to rely directly on general insights from the traditional literature in industrial economics. In particular, a number of factors, such as limited liability associated with debt contracts, the nature of asymmetric information between lenders and borrowers and the nature of the investment technology available to the projectholder, determines how the degree of competition will impact on the risk-taking incentives of banks. Thus, as it is concluded in the study of The European Central Bank, ECB (1999), increased competition can be expected to have a significant impact on the risks incurred by banks. For example, Gehrig (1996) offers evidence from the Swiss banking industry that provisions and loan losses have increased relative to interest margins and he suggests that this could be explained by increased competition in the Swiss banking industry. In reflection of a view according to which there would be a tradeoff between competition and financial stability in the financial sector, national authorities in many European countries have approved and, in some cases even encouraged, restructuring of the banking industry whereby the national measures of the banking market concentration have increased in most EU-countries (for evidence, see Tables 3.1–3.3 in ECB (1999)). Consequently, in Europe mergers among commercial banks have so far taken place predominantly within national markets rather than as cross-border consolidations (see Danthine et al., 1999 for extensive evidence that the degree of cross-border banking penetration in Europe has remained very modest, Tables 3.1 and 3.2).

Berger et al. (1999) offer an extensive survey, both in terms of updated facts and in terms of the literature, of the global consolidation process in the financial services industry with particular emphasis on the US market. They end up by stressing the importance of research in evaluating the consequences of financial consolidation by comparing the behavior of financial institutions before and after M&As. They also emphasize how the government may provide financial assistance or otherwise aid in the consolidation of troubled financial institutions during periods of financial crisis. For example, the FDIC provided financial assistance to allow healthy banks to purchase over 1000
insolvent US banks between 1984 and 1991. In other nations, governments have sometimes directly acquired troubled institutions. In light of this, one important way of evaluating the consequences of the ongoing consolidation process in the banking industry can be based on systematic studies of the relationship between market power and fragility of banking markets and this is the research approach adopted in the present study. Also, in light of the financial crises in Southeast Asia, the economic discussion has very much focused on the issue of competition and solvency in the banking industry. Some experts seem to blame the vulnerability of the banking industries in those countries on increased foreign competition as a central factor generating risky lending practices. Other experts subscribe to an opposite argument by pointing to the protectionist policies in the past as responsible for the financial fragility of the domestic banking industry at the time when it faces increasingly strong international competition (see the discussion in, for example, Furman and Stiglitz, 1998).

A number of recent research contributions has analyzed important aspects of the relationship between lending market structure and various aspects of performance. Broecker (1990), Nakamura (1993) and Riordan (1993) have studied the consequences of adverse selection resulting from the unobserved characteristics of borrowers. They argue that increased competition may make adverse selection problems more severe when borrowers that have been rejected at one bank can apply for loans at other banks so that the pool of funded projects will exhibit lower average quality as the number of banks increases.¹ Sha/C128er (1998) has extended the analysis of winner’s curse problems in lending in several directions. In particular, Shafer has investigated the impact of banks’ use of common information filters (like shared databases and uniform screening criteria) on the winner’s curse problems in lending and he has characterized the factors affecting the incentives of banks for using such common filters. Further, his analysis addressed not only how the number of lenders affect an individual bank’s loan loss rate, but his study also demonstrated reasons for why de novo banks (recent entrants) will be particularly susceptible to adverse selection leading to loan loss rates being higher for these de novo banks. In addition, Shafer’s study reported important empirical evidence regarding the nature and magnitude of his theoretical predictions as well as an outline of the broader macroeconomic implications of his findings.

In a different vein more market power has been shown to diminish the moral hazard problem banks face as lenders. Petersen and Rajan (1995) have

¹ Gehrig (1998) as well as Kanniainen and Stenbacka (1998) extend this approach within the framework of models, making it possible to explore the relationship between the incentives of banks for costly information acquisition based on ex ante monitoring efforts and the market structure of the banking industry.
argued that credit market competition imposes constraints on the ability of borrowers and lenders to intertemporally share the surplus from investment projects so that lenders in a competitive market may be forced to charge higher interest rates than lenders in a monopolistic market. Other contributions (for example, Besanko and Thakor, 1993; von Thadden, 1995) explain how banks with more market power might have stronger incentives to monitor the projects of borrowers and to establish long-term relationships. Caminal and Matutes (1997) study the welfare consequences of increased concentration in the lending industry when banks choose between credit rationing and monitoring in order to alleviate an underlying moral hazard problem. Increased market power will induce the bank to raise the lending rate but also strengthens the bank’s incentives for project-specific monitoring. From the point of view of social welfare these effects typically operate in opposite directions suggesting that there need not be a monotonic relationship between lending industry concentration and social welfare. With their attention restricted to the deposit side Matutes and Vives (2000) have demonstrated how the combination of deposit competition and deposit insurance can lead to excessive risk taking by banks.

Despite these contributions, having emphasized adverse selection as well as moral hazard aspects, the relationship between competition and risk taking in credit markets is still a largely unexplored topic. Banking markets are characterized by many industry-specific features, like those associated with asymmetric information, making it hard to evaluate the consequences of increased competition in general. The present study centers around the question: Will increased competition increase the fragility of banking markets? In particular, is there a tradeoff between credit market competition and financial fragility? Our study sheds light on these issues by constructing a model of mean-shifting investment technologies. This natural idea is technically captured by the concept of first-order stochastic dominance (as introduced into economics by Rothschild and Stiglitz, 1970). We show that under the assumptions of our model introduction of lending competition will reduce interest rates and generate higher investments without increasing the equilibrium bankruptcy risk of borrowers. Hence, there need not be a tradeoff between lending market competition and financial fragility. Our analysis also demonstrates that the absence of such a tradeoff is robust to whether credit rationing takes place or not. In fact, monopoly banks do not ration credit, while competitive banks do as long as the risk premium increases with the volume of investments.

We proceed as follows. The basic model exhibiting a mean-shifting investment technology is presented in Section 2. In Section 3 the projectholder’s choice of optimal debt-financed investment level is analyzed, whereas Section 4 considers the determination of lending rates with and without competition in the lending market. The consequences of competition for fragility of lending markets are characterized in Section 5 together with the social welfare conse-
quences of introducing competition. Section 6 extends the analysis to intermediate degrees of imperfect competition as well as to equilibria with credit rationing. Some concluding comments are presented in Section 7.

2. The basic model of mean-shifting investment technologies

We consider an individual entrepreneur in possession of a risky investment technology. The entrepreneur has no retained earnings and no access to equity capital, so that the project has to be fully financed by debt. There is no attempt without attempting to make the financial structure of firms an endogenous feature of our model. We regard this justified in light of the fact that our study is concerned with credit markets, and not necessarily with capital markets more generally. We return to discuss the implications of the seemingly restrictive assumption that the entrepreneur has no access to equity funding in Section 5.2 as well as in our concluding Section 7.

An investment $x$ generates a random return $\theta$ distributed continuously on the interval $[0, m]$ according to the conditional density function $f(\theta|x)$ so that the distribution function is given by $F(\theta|x) = \int_{0}^{\theta} f(\gamma|x)d\gamma$. Letting $F_x(\theta|x)$ denote the partial derivative of $F(\theta|x)$ with respect to investment, the mean-shifting investment technology is assumed to satisfy

**Assumption 1.** For every investment level $x$ and for each $0 < \gamma < m$ (A1) and (A2) below hold:

\[(A1) \quad F_x(\gamma|x) < 0,\]
\[(A2) \quad F_{xx}(\gamma|x) \geq 0.\]

Assumption (A1) depicts the ordinary first-order stochastic dominance condition capturing the idea that an increase in investment shifts the density to higher returns. Assumption (A2) means that the shift to higher returns takes place at a non-increasing rate. \(^2\) (A1) and (A2) are assumptions regarding the available investment technology at the project level. Assumption 1 implies that, at the project level, there are decreasing returns to investments. It suggests that there might be gains from diversifying a bank’s loan portfolio into a large

\(^2\) Formally (as introduced by Rothschild and Stiglitz (1970)) a probability distribution with a cumulative distribution $F(x)$ first-order stochastically dominates a probability distribution $G(x)$, if for every non-decreasing function $u : R \rightarrow R$ it holds that $\int u(x) dF(x) \geq \int u(x) dG(x)$, where $u(x)$ is the Bernoulli function.

\(^3\) Assumption (A2) is stronger than what we actually need for our conclusions later on. We explicitly formulate the second-order conditions for the project holder in Appendix A.
number of different projects in order to keep the projects at a scale where the marginal return from an additional unit of investment is high.  

Faced with an ordinary debt contract and acting under limited liability, the risk-neutral firm decides on an investment level in order to maximize its expected profits, \( V(x) \), defined by

\[
V(x) = \int_{\eta}^{\infty} (\gamma - Rx) f(\gamma|x) \, d\gamma,
\]

where \( R = 1 + r \) is the lending rate factor and \( \eta = Rx \) denotes the “break-even” state of nature, in which the projectholder is just able to remain solvent. The objective function (1) captures limited liability, which means that borrowers only care about the higher tail of the distribution of the project’s returns \( (\gamma \geq \eta) \), while ownership of the project shifts to the bank in case the borrower cannot fulfill the contractual obligations. The entrepreneur remains solvent for those states of nature which satisfy \( \gamma \geq \eta \), while there is bankruptcy when \( \gamma < \eta \). Consequently, based on the debt contract the firm’s return function is shifted into a convex function and the firm makes its investment decision in order to maximize project revenues net of financing costs with a perspective restricted to solvent states of nature. Conditional on an investment size \( x \), the probability of bankruptcy is given by \( F(\eta|x) \).

We assume that the bank commits itself to a lending rate factor \( R \) according to which it finances the investment of the projectholder. In its lending rate commitment the bank takes the projectholder’s optimal investment response \( x^*(R) \) into account. In line with most of the literature we assume that the bank is risk neutral so that it decides on a lending rate factor \( R \) in order to maximize its own expected profit, \( \Gamma(R) \), defined by

\[
\Gamma(R) = \int_{0}^{\eta^*} \gamma f(\gamma|x^*) \, d\gamma + x^*[\big(1 - F(\eta^*|x^*)\big)R - R_0],
\]

It should be emphasized that our model does not address the issue of diversification versus specialization with respect to the bank’s composition of its loan portfolio. Such an analysis can be found in Shy and Stenbacka (1999).

The existing literature has devoted much attention to the form of optimal financial contracts. For example, it is well known that the ordinary debt contract is the optimal incentive-compatible form of finance when lenders cannot observe a projectholder’s return without costly monitoring (see Gale and Hellwig, 1985). In this paper we mostly examine a model in which only interest rate contracts are feasible. This can be justified as reflecting an assumption that lenders are unable to observe the total amount borrowed by projectholders, in which case contracts with quantity-contingent interest rates are ruled out (see, e.g. King, 1986). Of course, our focus on ordinary debt contracts also seems justified as debt contracts empirically play a dominating role. Freixas and Rochet (1997, Chapter 4), contains a more detailed discussion of the issues involved.
where $R_0$ denotes the (constant) opportunity cost factor of granting loans, while $\eta^* = RX^*$ is the break-even state of nature associated with the optimal investment of the entrepreneur. The first term in the right-hand side of (2) covers the bank’s profit in those states of nature where the bank is the residual claimant as a consequence of the projectholder’s bankruptcy. The second term expresses the bank’s profits net of the opportunity cost of granting loans in those states of nature where the firm remains solvent. Via integration by parts, (2) can be simplified into

$$\Gamma(R) = x^* [(R - R_0) - G(\eta^* | x^*)],$$

(2a)

where

$$G(\eta^* | x^*) = \int_0^{\eta^*} F(\gamma | x^*) d\gamma / x^*.$$  

The first term in the right-hand side of (2a) captures the revenues to the bank from a lending rate $R$ if there were no risk that the project would default. Since there is a risk of project default, the bank’s objective function has to be modified by subtracting a term capturing a probability-adjusted measure of how much the project revenues fall short of $\eta^* = RX^*$, in which case the bank becomes the residual claimant. In this respect we can interpret $G(\eta^* | x^*)$ as an average risk premium relative to the solvency constraint of the project.

Banks too are subject to insolvency and limited liability and these properties may influence their lending decisions. Here we do not model these issues by explicitly characterizing the transformation mechanisms whereby borrowers’ project failures generate states of bank insolvency. Rather, we subscribe to the view expressed by Bhattacharya et al. (1998) insofar as “business activity measures, such as small business failure rates, are very useful in predicting bank runs” (p. 752).

The full analysis of the firm’s project choice is presented next, while Section 4 will focus on the optimal lending rate policy from the point of view of the bank under various market structures.

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6 In terms of the interpretations of our results it should be emphasized that for the purpose of the present analysis we have assumed equivalence between loan default and the borrower’s bankruptcy. This seems justified in light of the fact that in our model the borrower’s firm is formally equivalent to the funded project. Even so, the assumed equivalence between loan default and the borrower’s bankruptcy need not, however, necessarily be completely self-evident as the details of bankruptcy laws in some countries might make it possible that a default could occur without bankruptcy.

7 Generally, there is an extensive literature, surveyed in Bhattacharya et al. (1998) or Freixas and Rochet (1997, chapter 9) focusing on issues of bank solvency from a regulatory point of view.
3. Optimal debt-financed project choice

To investigate the projectholder’s optimal investment choice as a function of the lending rate, we apply integration by parts to find that the risk-neutral projectholder’s objective function (1) can be rewritten according to

\[ V(x) = m - Rx - \int_{\eta}^{m} F(\gamma|x) \, d\gamma. \]  

(1a)

From (1a) the necessary condition for an optimal investment choice \( x \) can be obtained by

\[ - \int_{\eta}^{m} F_x(\gamma|x) \, d\gamma = R(1 - F(\eta|x)). \]  

(3)

This is a standard condition whereby the optimal investment choice is determined by the requirement that the expected marginal return has to equal the expected marginal cost. The left-hand side of (3) expresses the marginal revenue increase from an additional unit of investment adjusted to states of nature where the firm remains solvent, while the right-hand side of (3) denotes the marginal cost increase in debt from an additional unit of investment adjusted to those states of nature where the firm can afford to pay back its debt obligation fully.

It is proved in Appendix A that by complementing the mean-shifting Assumptions (A1) and (A2) with the assumption

(A3) \( RF_x(\eta|x) + F_x(\eta|x) < 0, \)

we can guarantee that the firm’s investment problem is a concave program. To interpret property (A3) we introduce the ratio

\[ H(\eta|x) = - \frac{\int_{\eta}^{m} F_x(\gamma|x) \, d\gamma}{1 - F(\eta|x)}, \]

which describes the conditional marginal revenue from an additional unit of investment in those states of nature which keep the projectholder solvent. Making use of this, (3) can be rewritten as

\[ H(\eta|x) - R = 0. \]  

(4)

This offers an alternative interpretation of the optimal investment choice. According to (4), the project is expanded to the point at which the lending rate factor is equal to the conditional marginal revenue from an additional unit of investment in those states of nature which keep the projectholder solvent. It can be shown (see Appendix B) that Assumption (A3) is equivalent to the ratio \( H(\eta|x) \) being a decreasing function of \( \eta \). According to (A3), risk-increasing investments have decreasing marginal returns for the projectholder across non-default states of nature. This can be regarded as a property which is analogous
to the frequently made assumption of hazard ratios being decreasing functions. To summarize, we have

**Lemma 1.** Under Assumptions \((A1)\)–\((A3)\) the first-order condition \((3)\) (or \((4)\)) is sufficient for an optimal investment.

**Proof.** For a verification of the sufficient second-order conditions we refer to Appendix A. As Appendix B shows \((A3)\) holds if and only if \(H(\eta|x)\) is a decreasing function of \(\eta\).

What is the relationship between the lending rate and the projectholder’s optimal investment? By totally differentiating \((3)\) with respect to \(R\) we find

\[
\frac{\partial x^*}{\partial R} = \frac{(1 - F(\eta|x)) - x(RF_\eta(\eta|x) + F_\eta(\eta|x))}{V''(x)} < 0,
\]

where we have made use of \((A3)\) as well as the second-order condition \(V''(x) < 0\), which is written out explicitly in Appendix A. Hence, we can formulate

**Proposition 1.** An increase in the lending rate factor will cause the projectholder to decrease its optimal investment.

Under the mean-shifting investment technology an increase in the interest rate reduces the entrepreneur’s investments and thereby also the risk-taking incentives. As Assumption \((A1)\) implies that a lower level of investment leads to a higher probability of bankruptcy, we can conclude that Proposition 1 lies in conformity with the commonly held view in the literature that higher interest rates tend to be associated with choice of riskier projects.

4. Market structure in banking and lending rates

Having analyzed the projectholder’s investment decision, we now turn to consider the lending rate decisions by initially focusing on a bank operating in the absence of competition. In making its lending rate commitment such a bank has to take into account how the interest rate will affect the investment decision of the firm as characterized by \((3)\). Differentiating \((2)\) shows that the
optimal interest rate of a lending monopoly, \( R = R^M \), has to satisfy the first-order condition

\[
\frac{\partial x^M}{\partial R} \left[ (1 - F(\eta^M|x^M))R^M + \int_0^{\eta^M} F_x(\gamma|x^M) \, d\gamma - R_0 \right] = x^M[1 - F(\eta^M|x^M)].
\]

(6)

The right-hand side of (6) denotes the direct revenue-increasing effect of an increase in the lending rate on the bank’s profits. The left-hand side of (6) summarizes the indirect effects of a lending rate change generated through the investment volume of the projects financed.

Defining the interest rate elasticity as \( \varepsilon = \frac{(\partial x^M/x^M)}{\partial R^M/R^M} \) and making use of (4), the optimality condition (6) for the lending rate can be re-expressed as

\[
[1 - F(\eta^M|x^M)]R^M \left( 1 - \frac{1}{\varepsilon} \right) = R_0 + \int_0^{\eta^M} F_x(\gamma|x^M) \, d\gamma.
\]

(7)

According to (7), the optimal lending rate for the banking monopoly has to satisfy a risk-adjusted Lerner-index condition. At the optimum the expected returns exceed the expected costs by the mark-up factor \( (1 - \varepsilon^{-1}) \), which reflects the bank’s market power. The lending rate \( R^M \) increases with the opportunity cost of granting loans \( (R_0) \) and with the term \( \int_0^{\eta^M} F_x(\gamma|x^M) \, d\gamma \), which constitutes the difference between average revenues in solvent states when adjusted for elasticity and the opportunity cost of funds, and decreases with the interest rate elasticity of the project choice. We assume throughout the analysis the sufficient second-order conditions to hold.\(^{10}\)

Having characterized the lending rate determination for a bank monopolist, we now direct our attention to banking markets operating under competition. For this purpose we subscribe to the simplest possible characterization of Bertrand-type competition between lenders, which means that the lending rates are scaled down to generate zero expected profits. Alternatively, a perfectly competitive lending market would, of course, also fit into such a scenario. With reference to our model Bertrand competition means a lending rate satisfying \( \Gamma(R) = 0 \), where \( \Gamma \) is defined by (2) (or (2a)). Substitution into (2a) shows that such a competitive lending rate factor, \( R = R^C \), has to satisfy

\[
R^C - R_0 = G(\eta|x),
\]

(8)

\(^{10}\) We observe that the bank’s objective function can be written as \( \Gamma(R) = (R - R_0)x - G(\eta|x) \). Proceeding in the conventional way, we assume decreasing returns so that \( 2\partial x/\partial R + (R - R_0) \partial^2 x/\partial R^2 < 0 \) and that the risk premium \( G(\eta|x) \) is non-concave with respect to \( R \).
where $G(\eta|x)$ is the average risk premium needed to generate zero expected profit for a bank operating under competition.

Total differentiation of the risk premium with respect to $R$ shows that

$$\frac{dG(\eta|x)}{dR} = G_\eta(\eta|x) \frac{\partial \eta}{\partial R} + G_x(\eta|x) \frac{\partial x}{\partial R}. $$

Thus, since $G_\eta > 0$, $\frac{\partial \eta}{\partial R} = x(1 - \varepsilon) < 0$ and $\frac{\partial x}{\partial R} < 0$ we can infer that $G_x(\eta|x) \geq 0$ is a sufficient condition for $dG(\eta|x)/dR < 1$ to hold. According to (8), the latter condition is, in turn, a sufficient condition for the competitive interest rate, $R^C$, to be uniquely defined. For the rest of our analysis we will assume that

**Assumption 2.** The risk premium is a non-decreasing function of the investment meaning that

(A4) \hspace{1cm} G_x(\eta|x) \geq 0.

(A4) can be regarded as a natural assumption. It simply captures the notion that the per unit quality of loans deteriorates as the level of investment increases. Thus, it counterbalances the effects resulting from the decreasing returns to investments at the project level. In the next section we will investigate the impact of banking market competition on interest rate determination, project choice and on the projectholder’s bankruptcy risk in equilibrium.

5. Is there a tradeoff between bank competition and fragility?

In this section we study the impact of the lending market structure on interest rates, project selection and on the bankruptcy risk in equilibrium. Also, we explore the social welfare implications of introducing competition into the credit market.

5.1. Market structure and lending rates

We initially investigate the relationship between lending market structure and interest rates. For that purpose we evaluate the interest rate derivative of the bank’s objective function at $R = R^C$. From (8) we see that

$$\Gamma'(R^C) = x \left[ 1 - \frac{dG(\eta|x)}{dR} \right]. $$

As we have argued in the previous section, Assumption (A4) is a sufficient condition for us to conclude that $\Gamma'(R^C) > 0$. Consequently, we can formulate the following intuitively appealing conclusion.


**Proposition 2.** Introduction of competition into the lending market will generate lower interest rates.

It follows directly from combination of Propositions 1 and 2 that project-holders would expand their investment programs in response to introduction of competition into the credit market, as they would have access to credit at a lower interest rate.

5.2. Equilibrium probability of default

What will happen to the equilibrium probability of default if competition is introduced to the lending market? In other words, will a reduction in the interest rate increase financial fragility by increasing the equilibrium probability of default?

Initially, we observe that signing the effect of a lending rate change on the break-even state of nature is not equivalent to determining the impact on the probability of bankruptcy, \( F(\eta|x) \), which depends on both \( \eta \) and \( x \). In fact, total differentiation of \( F(\eta|x) \) with respect to \( R \) shows that

\[
\frac{dF(\eta|x)}{dR} = F_\eta(\eta|x) \frac{\partial \eta}{\partial R} + F_x(\eta|x) \frac{\partial x}{\partial R}.
\]  

(10)

According to (10) the effect of the lending rate factor on the projectholder’s bankruptcy risk can be decomposed into a limited liability effect and a mean-shifting effect (due to the nature of the investment technology). In (10), the first term on the right-hand side denotes the limited liability effect whereby an increase in the lending rate factor generates an increase in \( \eta \), and thereby the limited liability effect makes default more likely. If the distribution of project returns, captured by \( F(\cdot) \), were independent of the level of investment \( x \), this would be the only effect resulting from the nature of debt contracts. As changes in the investment level will shift the probability distribution of returns according to the Assumptions (A1)–(A3), we, however, need to take this mean-shifting effect into account. The second term on the right-hand side of (10) represents this mean-shifting effect. An increase in the lending rate will decrease the investment, but because the investment technology is mean-shifting such a change in the investment will also decrease the break even state of nature making bankruptcy less likely. In the light of Assumptions (A1)–(A4) we are able to formally compare the magnitudes of these two conflicting effects. Substituting the explicit expressions into the right-hand side of (10) we find that

\[
\frac{-F_\eta(\eta|x) \int_\gamma F_{\xi}(\gamma|x) \, d\gamma + [1 - F(\eta|x)](RF_\eta(\eta|x) + F_x(\eta|x)) - x[F_x(\eta|x)]^2}{V''(x)} > 0,
\]
where we have made extensive use of (A1)–(A4). Thus, we have proved the following central proposition to hold for the class of mean-shifting investment technologies satisfying the properties (A1)–(A4).

**Proposition 3.** A lower lending rate, even though it would generate higher investments, will unambiguously decrease the probability of default.

Combination of Propositions 2 and 3 directly demonstrates that introduction of competition into the credit market will reduce financial fragility by reducing the equilibrium probability of bankruptcy. Thus, we can conclude

**Corollary 1.** There is no tradeoff between competition and financial fragility.

Consequently, introduction of competition into lending markets will have benefits in addition to those directly linked to the associated reduction in the lending rate. Our analysis demonstrates how considerations of financial stability will, in fact, add to the gains from competition in lending markets. This feature is in sharp contrast to the rather commonly held view according to which competition tends to destabilize credit markets by increasing the equilibrium bankruptcy risk (see, for example, Broecker, 1990; Riordan, 1993; Matutes and Vives, 2000; Caminal and Matutes, 1997). Such a view seems to have had widespread support in many European countries, where the banking crisis of the early 1990s has triggered a wave of substantial bank mergers in the aftermath of financial deregulation. Such mergers have been considered as a way for governments to deal with troubled banks and the governments have actively tried to encourage mergers of sick banks into healthy ones (see, for example, The Economist, 1995).

Our analysis has been carried out under the assumption that the projects are fully debt-financed. Such an assumption means that the limited liability effect on the right-hand side of (10) will be at its strongest. The magnitude of the limited liability effect would be reduced to the extent that the project is equity-financed. Therefore, within the framework of our model the argument for the absence of any tradeoff between competition and financial fragility will undoubtedly survive all generalizations to arbitrary combinations of debt and equity as financial instruments.  

\[11\] Thus, our result demonstrating how considerations of financial stability will unambiguously add to the gains from

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11 Within the framework of a similar type of mean-shifting investment technologies Stenbacka and Tombak (1998) develops a theory for how the optimal combination of debt and equity financing will depend on the financial constraints facing the firms. Even though that study does not investigate the relationship between the lending market structure and financial fragility, it offers a formalized approach for how to extend our analysis to study the implications of the optimal financial structure of firms.
competition in lending markets is robust relative to generalizations incorporating access to equity funding.

Our model of mean-shifting investment technologies does not address aspects of adverse selection nor the incentives of banks for investments in information acquisition. In light of the evidence presented by Shaffer (1998) this omission is important, at least from an empirical point of view. In this respect our theoretical predictions should be seen to capture situations where a screening process eliminating “bad”-type projects has taken place at an earlier stage of the bank’s decision making process. Thus, our model might not necessarily be very well suited to address problems associated with debt-financed expansions of projects which are not associated with a sufficiently favorable return distribution so as to fit into the class of mean-shifting investment projects. Such a problem might, nevertheless, have been an essential ingredient of, for example, the extensive Saving & Loans-crisis in the US during the 1980s. In contrast to the adverse selection problem, our model has its focus on investment technologies where the mean-shifting property means that additional investments do improve the return distribution and we show that under such conditions there will not emerge any tradeoff between credit market competition and fragility. Lending market competition leads to lower interest rates, and even though this induces higher investments the bankruptcy risks nevertheless fall.

As the qualifying arguments above have made clear, we can characterize those circumstances under which our central conclusion, according to which there is no tradeoff between credit market competition and financial fragility, is particularly relevant from the point of view of real world banking. As the absence of a tradeoff between competition and financial fragility is threatened by the limited liability effect we can conclude that our result is more likely to hold the higher is the proportion by which projects are financed by equity. Similarly, the predictions of our model are more likely to survive the higher is the quality of the project-specific monitoring undertaken by the bank industry.

It is interesting to view our result predicting that introduction of competition into the credit market will reduce financial fragility in light of the empirical evidence reported by Boyd and Graham (1996). Their study found that there is no evidence, based on US experience, that large banks, endowed with more market power, are less likely to fail than are small ones. Proposition 3 is consistent with this empirical evidence, which, of course, does not mean that the average default rate, on which the present analysis has focused, would be

\[ \text{12 In this respect, our main result might be more robust in a system with greater reliance on markets, be they stock or debt markets, like the US model of financial intermediation than in European financial markets where the financial structure of firms is more heavily tilted towards bank loans (see Danthine et al., 1999, pp. 6–7).} \]
the only reasonable explanation. Boyd and Graham’s result could also reflect the fact that there are diseconomies of scale in banking once the size of a bank exceeds some particular threshold. 13 Again, the implications of our model for the fragility of the banking industry in the sense of Boyd and Graham are based on the implicit mechanisms (outside of our formal model) whereby borrowers’ project failures generate changes in the lending behavior of banks threatened by risks of insolvency.

5.3. Welfare implications

The lack of a tradeoff between competition and financial stability has strong implications for an evaluation of the social welfare consequences of introducing credit market competition. The first-best level of investment \( x \) that would be chosen by a projectholder not restricted to debt finance has to maximize

\[
W(x) = m - \int_0^m F(\gamma|x) \, d\gamma - R_0 x,
\]

where \( R_0 \) denotes the social opportunity cost factor of funds. This investment level, \( x^S \), satisfies

\[
- \int_0^m F_\gamma(\gamma|x) \, d\gamma = R_0.
\]

Assumption (A2) implies that \( W''(x) < 0 \). Accounting for the zero-profit condition and Proposition 2 it follows that \( R^M > R^C > R_0 \). In combination with Proposition 1, this feature implies that \( x^S > x^C > x^M \). The first-best investment, associated with the risk-free interest rate, exceeds the level resulting through the channel of funding investments with a competitive lending market. From a comparison of the optimality conditions (3) and (12) it can be concluded that the first-best investment cannot be implemented with any feasible debt contract. Even by lowering the interest rate to \( R_0 \), which would not be feasible as it would not meet the lender’s zero-profit condition, the lender would not be able to generate \( x^S \). Consequently, one can conclude from Propositions 1–3 that introduction of competition into the lending market will be welfare-improving irrespectively of the nature of potential social costs of bankruptcy. 14 Thus our analysis exhibits a monotonic relationship between lending market competition

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13 Also, as pointed out by a referee, with localized banking markets and multimarket banks, larger banks do not necessarily have more market power than smaller ones. This point is empirically relevant in the case of US in light of the fact that roughly 20% of the local banking markets are monopolies or duopolies with small local financial institutions.

14 Our analysis might also have some implications for the optimal structure of bankruptcy laws, a topic which is interesting for future research.
and social welfare irrespectively of the nature of the bankruptcy costs. These welfare results can be contrasted with those reported in Caminal and Matutes (1997). They demonstrated how an increase in lending market concentration increases lending rates as well as project monitoring. Whenever the second effect dominates it would be socially optimal, in their model, to have a banking industry where lenders have some degree of market power.

6. Some generalizations

This chapter offers two important extensions to our analysis so far. Firstly, we explore the implications of intermediate degrees of imperfect lending rate competition and establish that our main results, which were obtained by comparing the polar cases with monopoly and perfect competition, can be generalized in a continuous fashion to cover intermediate cases. Secondly, we investigate the robustness of our results to equilibria allowing for credit rationing.

6.1. Intermediate degrees of imperfect competition

It should be emphasized that our analysis has so far focused on a comparison between the polar extremes with monopoly and the market structure with perfect competition or Bertrand competition generating zero profits in a homogeneous market. Of course, it would be highly desirable to extend our analysis to cover the full range of intermediate degrees of imperfect competition. There seems to be two available approaches for such an extension. One option would be to reformulate our model within a framework of banks offering differentiated products (by making use of, for example, a location model of horizontal product differentiation). Alternatively, one could follow the approach adopted by Caminal and Matutes (1997), where the interaction between the lender and the borrower is formulated within the framework of a bargaining model such that the bargaining power of the borrower captures the degree of credit market competition.

In order to briefly explore the latter option we assume that the interest rate is determined as the outcome of bargaining between the bank and the projectholder. We also assume that the projectholder unilaterally decides on the level of investment. In such a situation the determination of the lending rate can be modeled as the outcome of the following Nash bargaining (NB) optimization:

\[
(NB) \quad \text{Max}_R \Omega = \Gamma^\beta V^{1-\beta},
\]

where \( \beta \) serves as a representation of the bank’s relative bargaining power and where we have assumed that zero expected profits are the threat points of the bank and the projectholder, respectively. The necessary condition associated with optimization of NB can be expressed as
\[ \beta \frac{\Gamma_R}{1} + (1 - \beta) \frac{V_R}{V} = 0, \]

where \( \Gamma_R \) and \( V_R \) are convenient notations for the partial lending rate derivatives of the bank’s and the projectholder’s objective functions, respectively. As the projectholder chooses the level of investment in an optimal way, we can apply the envelope theorem to see that \( V_R < 0 \). Hence, when we impose optimal behavior on behalf of the entrepreneur, the lending rate depends positively on the bank’s bargaining power, \( \beta \). In this respect, more intense lending market competition, i.e. a lower level of \( \beta \), will generate lower interest rates and thereby lower bankruptcy risks. Consequently, our results are not restricted to the polar cases of lending market structures with monopoly or perfect competition.

6.2. An extension to equilibria with credit rationing

So far we have restricted our analysis to the case where the interest rate does not change with the investment so that the investment choice is characterized by condition (3) and, consequently, there would be no credit rationing in equilibrium. We now turn to the case of interest rates being increasing functions of loan volumes and ask what such an extension implies for the relationship between competition and fragility. With the interest rate equilibrium as a function of the investment, \( R(x) \), the projectholders’ objective function now takes the form

\[ W(x) = m - R(x)x - \int_{\eta}^{m} F(\gamma|x) \, d\gamma, \tag{13} \]

where \( \eta = xR(x) \). We can see that

\[ W'(x) = V'(x) - x(1 - F(\eta|x))R'(x). \tag{14} \]

Thus, when \( R'(x) > 0 \) it follows that \( V'(x) > 0 \), which means that the competitive equilibrium is characterized by credit rationing. This configuration represents (see Fig. 1) a situation with a lower interest rate as well as less extensive investment programs compared to an equilibrium without credit rationing.

In Fig. 1, \( x^e \) denotes the projectholder’s demand for credit at a given lending rate \( R \), \( \Gamma(R) = 0 \) describes the bank’s zero expected profit curve while \( V^0 \)

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15 By totally differentiating the bank’s expected zero profit condition with respect to investments one can see that \( R'(x) > 0 \) is equivalent to the average risk premium being strictly increasing in project size.
represents the projectholder’s isoprofit curve. In Fig. 1, the credit rationing equilibrium is represented by $A$. As Fig. 1 illustrates, credit rationing will decrease bankruptcy risks and thereby stabilize lending markets.

As de Meza and Webb (1992) demonstrate in a related context, there would, under the assumptions made, be no credit rationing with a monopoly bank. Consequently, our conclusion according to which there is no tradeoff between competition and financial stability is robust relative to generalizations with the interest rate as an increasing function of the project size.

7. Concluding comments

In this paper we have used a model of mean-shifting investment technologies to analyze the relationship between the market structure in banking and risk taking (project choice) in credit markets. Also we have explored the welfare implications of introducing competition into lending markets.

We have shown that introduction of lending rate competition into the credit market will reduce lending rates and generate higher investments without in-
creasing bankruptcy risks in equilibrium. Hence, we have demonstrated that within the framework of the model presented there is no tradeoff between competition and financial fragility. Further, we have shown that such a tradeoff does not emerge either when banks compete by conditioning interest rates on investment volumes irrespectively of whether credit rationing takes place or not.

Our analysis has been carried out under the assumption that the entrepreneur has no access to equity funding. It is important to view this assumption against the interpretation of Proposition 3 in light of the mean-shifting effect dominating relative to the limited liability effect. Access to equity funding or requirements of collateral would typically reduce the limited liability effect. Therefore, in the presence of equity funding our argument for the absence of any tradeoff between competition and financial fragility would be even stronger. Thus, our result demonstrating how considerations of financial stability will unambiguously add to the gains from competition in lending markets is robust relative to generalizations incorporating access to equity funding.

The present analysis has abstracted from investigating how introduction of competition might affect the diversification incentives of banks. In light of the recent study by Shy and Stenbacka (1999) we have reasons to conjecture that our results are robust relative to generalizations making the diversification decisions of the banks an endogenous variable. Shy and Stenbacka demonstrate how, in the context of a differentiated banking industry, the banks’ incentives for diversification are invariant to a change in the banking market structure from duopoly to monopoly.

In the present analysis we have mostly restricted the strategy spaces of the banks to interest rates, which would be particularly well justified if the lenders were unable to observe the total amount borrowed from other sources. In line with the insights generated by the substantial literature on credit rationing we know in qualitative terms that banks would have an incentive to operate with credit supply functions, offering the entrepreneurs pairs of interest rates and volumes of credit in circumstances where the total amount borrowed from other sources could be observed. Bester and Hellwig (1989) present some progress along this line for the case of variable project size, but it would be a demanding analytical task to present a detailed analysis of optimal credit supply functions in the presence of strategic interaction between creditors. Also it is unclear whether such a detailed analysis would add much to the qualitative aspects of credit rationing already known.

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Appendix A. The sufficient second-order condition with respect to the investment decision

It can be verified by straightforward calculations that

\[ V''(x) = R(RF_y(\eta|x) + F_z(\eta|x)) + RF_z(\eta|x) - \int_{\eta}^{m} F_z(x|\eta) d\eta. \]

The first term is negative by (A3), the second term is negative by (A1) while the third term is negative by (A2). Consequently, combination of (A1)–(A3) implies that \( V''(x) < 0. \)

Appendix B. Proof that (A3) is equivalent to the ratio \( \eta|x \) being a decreasing function of \( \eta \)

Straightforward differentiation of the ratio \( H(\eta|x) \) with respect to \( \eta \) shows that

\[ H_{\eta}(\eta|x) = \frac{RF_y(\eta|x) + F_z(\eta|x)}{1 - F(\eta|x)}. \]

We can conclude that the sign of \( H_{\eta}(\eta|x) \) is determined by the numerator. The sign of the numerator is, however, negative if and only if Assumption (A3) holds.

References


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