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DOES COMPETITION MAKE LOAN MARKETS MORE FRAGILE?

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Abstract

We model the interaction between the concentration of the banking sector and the investment strategies of imperfectly competitive firms in the product market to address the question of whether competition makes loan markets more fragile. It is shown how a merger between two banks would typically decrease the interest rate and increase the investment volume of imperfectly competitive firms in the product market. Under quite plausible conditions this implies that a merger will increase the stability of loan markets in the sense of decreasing bankruptcy risks.

Keywords: Bank Competition, Bankruptcy Risk, Mergers, Credit Market Stability.

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I Introduction

The wave of financial deregulation has swept swiftly in the 1980s over many European countries, which until quite recently had highly regulated financial markets. The deregulation process has been reinforced by one of the main goals of the financial integration within the framework of the European Union, namely to encourage competition in banking. Historically domestic banks have been protected from competition by stringent regulatory requirements and the special place they have been afforded in the operation of the monetary system. However, according to the prevailing "home country doctrine" of the European Union, a bank which is registered in any European country is eligible to open branches and to offer financial services in any other member country (see, for example, Mayer and Vives (1993)). It is claimed that financial integration will increase competition by removing sources of restrictive practices. Intensified competition is expected in turn to reduce margins between borrowing and lending rates and thus to improve the performance of the banking industry.

While increased competition undoubtedly will reduce profit margins in the banking industry, there are strong reasons to warn against assertions that competition in banking would automatically be beneficial. The banking industry is very different from most other industries. Due to the presence of asymmetric information causing adverse selection and moral hazard problems (see e.g. Stiglitz and Weiss (1981) on the one hand and Milde and Riley (1988) on the other hand) the consequences of increased competition are more difficult to characterize. Broecker (1990) has studied the consequences of adverse selection due to the unobserved quality of borrowers. He has established how increased

competition might make the adverse selection problems more severe by showing how average credit-worthiness decreases as the number of banks increases via negative externatities caused by the rejection decisions of other banks. Riordan (1993) has applied auction theory to the bank loan market and demonstrated how fiercer competition can affect the screening decisions in the banking market in such a way that the proportion of bad loans is substantially increased. Also competition for depositors under deregulation and protection of depositors against bank failure can lead to instability problems like runs and excessive risk-taking (see e.g. Diamond and Dybvig (1983)). While these analyses have considered competition for either borrowers or depositors, Yanelle (1989) has studied aspects of "double competition", i.e. simultaneous competition for deposits as well as loan contracts. Yanelle argues that competition in intermediation does not automatically lead to efficient outcomes. Despite these contributions, it still seems to be a largely unexplored topic to delineate the relationship between competition and moral hazard problems in credit markets. The objective of this paper is to readdress the question of whether increased competition makes the banking sector more "fragile" by precisely characterizing the relationship between the banking structure, the interest rates facing investing firms in an imperfectly competitive product market, the volume of industry investments and bankruptcy risk.

At the same time as the financial integration within the framework of the European Union has encouraged competition in banking, the ongoing banking crisis in many countries in the aftermath of financial deregulation has triggered a wave of substantial bank mergers. Bank mergers have been considered as a way for governments to deal with troubled banks in such a way that the governments have actively tried to encourage mergers of sick banks into healthy ones (see, for example,

The Economist (1995)). The case of merging The Savings Bank of Finland (Suomen Säästöpankki) into its competitors in 1993 is a good example of such a policy. The present paper can be seen contributing to our knowledge regarding the consequences of policies where the regulators solve the problems of a troubled bank by actively supporting mergers with healthy banks. On the other hand, a substantial part of the existing empirical research on the consequences of bank mergers has focused on potential economies of scale and scope in banking as a motive for mergers (see e.g. Berger, Hanweck and Humphrey (1987)). Contrary to this approach our analysis centers around the consequences of mergers for lending rates, the volume of industry investments and bankruptcy risk.

Brander and Lewis (1986) have analyzed the linkages between imperfectly competitive product markets and debt-equity positions of firms. In a similar vein we present a model of the interaction between the concentration of the financial sector and the investment strategies of imperfectly competitive firms in the product market. We compare the situation where firms in a duopoly borrow from the same bank with the configuration where firms in a duopoly borrow from two different banks competing in a duopolistic banking market. Even though it might be rare to find banking markets which exhibit such high degrees of concentration it seems clear that such a comparison should be able to capture central qualitative implications of bank mergers. And indeed, there are recent examples which would fit our model almost quite literally. The recent merger between Union Bank of Finland (UBF) and Kansallis-Osake-Pankki (KOP) has created a bank giant commanding as much as 45 % of Finnish deposits and as much as approximatively 60 % of new loans to Finnish small and mid-size corporations. In our analysis we find that a merger between two bank duopolists would typically

decrease the interest rate and increase the investments of a downstream industry. We also characterize plausible conditions under which a bank merger would increase the stability of the loan market in the sense of decreasing its bankruptcy risk.

In presenting our study we first introduce the product market interaction between firms investing in risky projects in section II. In particular, we distinguish the impact of lending rate changes on the investments made in a banking duopoly from that prevailing in a banking monopoly. Section III starts by exploring the implications of a bank merger on lending rates as well as on total industry investment. In the latter part of section III the implications of a bank merger on the stability of the banking industry are developed by investigating how such a merger will affect the bankruptcy risk. The final section briefly sums up and discusses the findings of our analysis.

II Debt-Financed Investments in Risky Projects

II.1 Product Market Interaction

We consider two identical firms competing in the product market. The firms both have access to an investment project with uncertain return. If firm i (i = 1,2) invests x_i while its competitor j invests x_j the project yields $\pi^i(x_i, x_j, \theta)$ for firm i provided that the state of nature turns out to be θ. We assume a continuum of possible states of nature θ distributed

over the interval $[\theta_L, \theta_H]$ according to a cumulative distribution function $F(\theta)$. The corresponding density function is denoted by $f(\theta)$. The investment technology as well as the impact of the stochastic state of nature are characterized in the following assumption.[1]

Assumption A The revenues to firm i from the project satisfy

(A1) $\pi^i_i(x_i, x_j, \theta) > 0$, (A2) $\pi^i_j(x_i, x_j, \theta) < 0$,

(A3) $\pi^i_{ii}(x_i, x_j, \theta) < 0$, (A4) $\pi^i_{ij}(x_i, x_j, \theta) > 0$,

(A5) $\pi^i_\theta(x_i, x_j, \theta) > 0$, (A6) $\pi^i_{i\theta}(x_i, x_j, \theta) > 0$.

Assumption (A1) and (A3) state that the revenue of firm i's project is an increasing and concave function of its own investment. Assumption (A2) formalizes the idea that conflicting interests between the firms. Assumption (A4) characterizes the nature of strategic interaction between the firms and it means that the investment decisions are strategic complements.[2] From (A5) we see that higher values of the stochastic parameter θ represent better states of nature. Finally, (A6) implies that larger investments have higher marginal returns in good states of nature.

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[1] Partial derivatives are denoted according to

$$\pi^i_i(x_i, x_j, \theta) = \frac{\partial \pi^i(x_i, x_j, \theta)}{\partial x_i} \text{ and } \pi^i_{ij}(x_i, x_j, \theta) = \frac{\partial^2 \pi(x_i, x_j, \theta)}{\partial x_i \partial x_j} \text{ and so on.}$$

[2] The standard duopoly R&D race exhibited in Harris and Vickers (1987) is a good example of a model where the investment decisions are strategic complements. Other characterizations of situations where the investment decisions are strategic complements can be found in Bagwell and Staiger (1994).

The intention of the present paper is to analyze how competition between banks will impact on interest rates and investment decisions and thereby also on the risk exposure of a representative industry in the product market. For that reason we find it justified to assume that the firms have no capital of their own so that the investment projects have to be financed with debt from a bank. We will compare two separate configurations regarding the banking regime. In the first situation there are two competing banks and the two firms in the product market borrow from different banks. In the altenative scenario we focus on the case with a bank monopoly offering loans to both the duopolists in the product market.

II.2 Investments with a Banking Duopoly

We focus on two competing banks maximizing expected return in anticipation of the investment decisions of the firms in the product market. The banks commit themselves to lending rates at which they will satisfy the demand generated by the investment programs of the firms in the product market. Thus, the banks are engaged in two-stage competition. In choosing their lending rates, banks take into account how the lending rates will affect the investment decisions and thereby the value of the loan contract.

In this section we will restrict ourselves to an analysis of the investment decisions of the duopolists in the product market. Because the investment is financed with debt, there will be a surplus for the investing firm only when the state of nature is sufficiently good to cover

the debt.[3] In the standard debt contract the "breakeven" state of nature η_i, in which firm i is just able to remain solvent, is defined by

$$\pi^i(x_i, x_j, \eta_i) - (1+r_i)x_i = 0. \tag{1}$$

Clearly, $\eta_i = \eta_i(x_i, x_j, r_i)$ which states that the "breakeven" state of nature depends on the interest rate as well as on the investment level of both the firm itself and of its rival. The firm remains solvent for states of nature satisfying $\theta > \eta_i$, while there is bankruptcy when $\theta < \eta_i$. Consequently, the probability of bankruptcy is given by $F(\eta_i)$.

If bank i commits itself to a lending rate r_i to firm i, this firm will make its investment decision in order to maximize

$$V^i(x_i, x_j) = \int_{\eta_i}^{\theta_H} (\pi^i(x_i, x_j, \theta) - (1+r_i)x_i)\, dF(\theta). \tag{2}$$

Maximization of (2) yields the reaction functions

$$V^i_i(x_i, x_j) = \int_{\eta_i}^{\theta_H} (\pi^i_i(x_i, x_j, \theta) - (1+r_i))\, f(\theta)\, d\theta = 0. \tag{3}$$

Equation (3) can be rewritten according to

[3] Gale and Hellwig (1985) have shown that in a one-period setting like here the standard debt contract with state-independent interest is the optimal incentive-compatible form of finance when lenders cannot observe an entrepreneur's return realizations without costs.

$$\int_{\eta_i}^{\theta_{ii}} \pi_i^i(x_i, x_j, \theta)\, f(\theta)\, d\theta = (1 + r_i)[1 - F(\eta_i)].$$

From this formulation we can see that the left hand side denotes the marginal revenue increase from an additional unit of investment adjusted to the average among those states of nature where the firm is solvent. The right hand side in turn denotes the marginal cost increase in debt from an additional unit of investment for those states of nature where the firm can afford to pay back its debt in full.

Differentiation of (1) with respect to x_i shows that

$$\frac{\partial \eta_i}{\partial x_i} = \frac{1 + r_i - \pi_i^i(x_i, x_j, \eta_i)}{\pi_\theta^i(x_i, x_j, \eta_i)} > 0$$

for investment levels satisfying the first order condition (3). Thus, the "breakeven" state of nature is an increasing function of firm i's investment. Analogously, it can easily be established that

$$\frac{\partial \eta_i}{\partial r_i} > 0, \qquad \frac{\partial \eta_i}{\partial x_j} > 0.$$

so that firm i's "breakeven" state of nature increases with the interest rate charged as well as with its rival's investment. In what follows our analysis is restricted to situations which satisfy sufficient second order conditions as well as conditions for stability. These conditions are specified in

Assumption B The expected profit functions satisfy sufficient second order conditions and stability conditions according to (B1) and (B2) below:

$$V_{ii}^i(x_i, x_j) < 0, \quad (i = 1, 2), \tag{B1}$$

$$\Delta = V_{ii}^i V_{jj}^j - V_{ij}^i V_{ji}^j > 0. \tag{B2}$$

Provided that conditions (B1) and (B2) hold, the investment equilibrium (x_i^*, x_j^*) is characterized by the system of equations

$$V_i^i(x_i^*, x_j^*) = 0 \tag{4}$$

$$V_j^j(x_j^*, x_i^*) = 0. \tag{5}$$

By totally differentiating the system of equations defined by (4) and (5) with respect to r_i we find that

$$\frac{\partial x_i^*}{\partial r_i} = -\frac{V_{jj}^j V_{ir_i}^i}{\Delta} \tag{6}$$

and

$$\frac{\partial x_j^*}{\partial r_i} = -\frac{V_{ji}^j}{V_{jj}^j} \frac{\partial x_i^*}{\partial r_i}. \tag{7}$$

For the analysis of (6) and (7) we differentiate the first order condition (3) with respect to x_j to find that

$$V_{ij}^{i} = -\frac{\partial \eta_i}{\partial x_j}[\pi_i^i - (1+r_i)]f(\eta_i) + \int_{\eta_i}^{\theta_H} \pi_{ij}^{i}(x_i, x_j, \theta) f(\theta)\, d\theta > 0. \quad (8)$$

Hence, firm i's expected marginal revenue from investment is an increasing function of its rival's investment. This is because we have assumed the investments to be strategic complements (Assumption (A4)).[4] In order to make a complete analysis of (6) and (7) possible we further formulate

Assumption C An increase in the lending rate will decrease the expected marginal revenue of investment

$$V_{ir_i} < 0. \quad (C1)$$

In order to justify Assumption C we observe that

$$V_{ir_i}^{i} = -\frac{\partial \eta_i}{\partial r_i}[\pi_i^i - (1+r_i)] - [1 - F(\eta_i)].$$

Thus, Assumption (C1) holds naturally once we restrict ourselves to projects with a sufficiently high probability of default for feasible investment levels. We consider such a restriction to be justified given that the focus of our analysis lies on risky investments.

We are now able to evaluate (6) and (7). Based on (8), (C1) and the stability condition it must hold that

[4] One can see that the sign of V_{ij}^{i} is (can be) positive, even though investments are strategic independents (substitutes).

$$\frac{\partial x_i^*}{\partial r_i} < \frac{\partial x_j^*}{\partial r_i} < 0. \quad (9)$$

Consequently, an increase in the lending rate levied on firm i will reduce the investment of both firm i and its rival because of strategic complementarity between their investments. But, as is quite natural, such an increase in the lending rate towards firm i will reduce the investment of firm i to a larger extent than that of its rival due to the stability condition. The next subsection will focus on a bank monopoly granting loans to a symmetric duopoly with an intention of comparing the investment sensitivity to lending rate changes between the configurations of banking monopoly and duopoly.

II.3 Investments with a Banking Monopoly

In contrast to the previous section we here direct our attention to a monopoly in the banking market. The banking monopoly charges a common lending rate r relative to the identical duopolists in the product market. Keeping the notation otherwise unchanged, firm i will then decide on its investment level in order to maximize

$$W^i(x_i, x_j) = \int_{\eta_i}^{\theta_H} (\pi^i(x_i, x_j, \theta) - (1+r)x_i)\, dF(\theta). \quad (10)$$

Following an approach which is completely analogous to that of the previous section we can now characterize the impact of the lending rate on the equilibrium investment decisions $x_i^*(r) = x_j^*(r)$. Total

differentiation of the first order conditions for the investments reveals that

$$\frac{\partial x_i^*}{\partial r} = -\frac{W_{ir}^i(W_{ii}^i - W_{ji}^j)}{\Delta} < 0. \qquad (11)$$

Under the assumptions prevailing, comparison of (6), (7) and (10) makes it possible to formulate the relationship

$$\frac{\partial x_i^*}{\partial r} < \frac{\partial x_i^*}{\partial r_i} < \frac{\partial x_j^*}{\partial r_i} < 0. \qquad (12)$$

From (12) we see that an increase in the monopoly lending rate will reduce industry investment to a higher extent than a corresponding increase in the lending rate charged by the banks in a duopolistic industry. The lending rate charged by a monopoly bank affects investment behavior of the firms directly and in a symmetric way. When a bank in a duopolistic industry increases its lending rate it will also affect the investment behavior of its customer's rival in the product market. However, with duopoly banking an increase in the interest rate confronting firm i generates a smaller investment contraction for firm j than for firm i. Because the investment decisions are strategic complements the equilibrium investment with duopoly banking must therefore be reduced to a lower extent than the one with monopoly banking.

III Interest Rate Decisions

Having analyzed the investment decisions of firms with a banking duopoly as well as with a banking monopoly, we turn to consider the lending rate decisions of banks. We start by looking at a banking duopoly and then move on to the case with a bank monopoly in order to be able to explore the implications of a bank merger on lending rates as well as on total industry investment. Finally, we examine the implications of a bank merger on the stability of the banking industry by investigating how such a merger will affect the bankruptcy risk.

III.1 Interest Rate Decisions in a Banking Duopoly versus Monopoly

We now assume that the banks commit themselves to lending rate decisions at which they finance the investments of the firms. The banks make these lending rate commitments taking into account how the interest rates will affect the investments of the firms in the product market. In the previous section we have already delineated the investment equilibrium (x_i^*, x_j^*) resulting from the strategic interaction between the firms in the product market. Given this investment equilibrium, bank i commits itself to lend to firm i at an interest rate r_i which maximizes the expected value of the debt contract from bank i

$$\Gamma^i(r_i, r_j) = \int_{\theta_L}^{\eta_i} \pi^i(x_i^*, x_j^*, \theta)\, dF(\theta) + x_i^*[(1 - F(\eta_i))(1 + r_i) - (1 + r_0)], \qquad (13)$$

where r_0 denotes the opportunity cost of granting loans. The first term on the right hand side of (13) describes the bank's profit in those states of nature where firm i goes to bankruptcy. The second term expresses the bank's profits net of opportunity cost of granting loans in those states of nature where the firm remains solvent. Maximization of (13) yields the reaction functions

$$\begin{aligned}\Gamma_i^i(r_i, r_j) = {} & \frac{\partial \eta_i}{\partial r_i}\pi^i(x_i^*, x_j^*, \eta_i) f(\eta_i) + x_i^*[1 - F(\eta_i) - (1 + r_i) f(\eta_i)] \\ & + \frac{\partial x_i^*}{\partial r_i}[(1 - F(\eta_i))(1 + r_i) - (1 + r_0)] \qquad (14) \\ & + \int_{\theta_L}^{\eta_i} \left[\frac{\partial \pi^i(x_i^*, x_j^*, \theta)}{\partial x_i} \frac{\partial x_i^*}{\partial r_i} + \frac{\partial \pi^i(x_i^*, x_j^*, \theta)}{\partial x_j} \frac{\partial x_j^*}{\partial r_i} \right] dF(\theta) = 0.\end{aligned}$$

The first two terms in (14) describe the direct interest rate effects, while the third and fourth terms express the indirect effects induced by changes in investments. The intersection between the reaction functions defined by (14) will constitute the subgame perfect interest rate equilibrium in duopoly competition between the banks.

In order to find out how bank competition affects fragility of loan markets one has first to distinguish the interest rate equilibrium in duopoly competition from the optimal lending rate of a monopoly bank. A monopoly bank will choose an interest rate r in order to maximize

$$\psi(r) = \int_{\theta_L}^{\eta_i} \pi^i(x_i^*, x_j^*, \theta)\, dF(\theta) + x_i^*[(1 - F(\eta_i))(1 + r) - (1 + r_0)].$$

An increase in the interest rate of the monopoly bank will have a symmetric effect on the investments of the firms. For that reason the first-order condition can be written as

$$\begin{aligned}& \frac{\partial \eta_i}{\partial r}\pi^i(x_i^*, x_j^*, \eta_i) f(\eta_i) + x_i^*[1 - F(\eta_i) - (1 + r_i) f(\eta_i)] \\ & + \frac{\partial x_i^*}{\partial r}[(1 - F(\eta_i))(1 + r_i) - (1 + r_0)] \qquad (15) \\ & + \int_{\theta_L}^{\eta_i} \left[\frac{\partial \pi^i(x_i^*, x_j^*, \theta)}{\partial x_i} + \frac{\partial \pi^i(x_i^*, x_j^*, \theta)}{\partial x_j} \right] \frac{\partial x_i^*}{\partial r} = 0.\end{aligned}$$

Based on the first-order conditions (14) and (15) we are able to compare the optimal lending rate of a bank monopoly, r^m, with the interest rate equilibrium prevailing in a banking duopoly, r^d. Now one can establish

Proposition 1 A merger of of bank duopolists into a monopoly bank will generate a decrease in the interest rate.

Proof: Let us define the function $g^i(r_i, r_j)$ according to

$$g^i_i(r_i, r_j) = \frac{\partial \eta_i}{\partial r_i}\pi^i(x^*_i, x^*_j, \eta_i)f(\eta_i) + \frac{\partial x^*_i}{\partial r_i}[(1 - F(\eta_i))(1 + r_i) - (1 + r_0)]$$

$$+ x^*_i[1 - F(\eta_i) - (1 + r_i)f(\eta_i)].$$

Consider the system of equations

$$g^i_i(r_i, r_j) + \alpha \int_{\theta_L}^{\eta_i} \left[\frac{\partial \pi^i(x^*_i, x^*_j, \theta)}{\partial x_i} + \frac{\partial \pi^i(x^*_i, x^*_j, \theta)}{\partial x_j} \right] dF(\theta) = 0. \qquad (16)$$

From the relationships (12) we know that a bank merger corresponds to a decrease in α. In order to find out the impact of a bank merger on the interest rate we totally differentiate the system of equations (16) with respect to α. Leaving out the arguments from the function g^i, total differentiation yields

$$g^i_{ii}\frac{\partial r_i}{\partial \alpha} + g^i_{ij}\frac{\partial r_j}{\partial \alpha} + \int_{\theta_L}^{\eta_i} \left[\frac{\partial \pi^i(x^*_i, x^*_j, \theta)}{\partial x_i} + \frac{\partial \pi^i(x^*_i, x^*_j, \theta)}{\partial x_j} \right] dF(\theta) = 0$$

and similarly with respect to firm j

$$g^j_{jj}\frac{\partial r_j}{\partial \alpha} + g^j_{ji}\frac{\partial r_i}{\partial \alpha} + \int_{\theta_L}^{\eta_i} \left[\frac{\partial \pi^j(x^*_j, x^*_i, \theta)}{\partial x_j} + \frac{\partial \pi^j(x^*_j, x^*_i, \theta)}{\partial x_i} \right] dF(\theta) = 0.$$

Solution of this system of equations shows that

$$\frac{\partial r_i}{\partial \alpha} = -\frac{g^j_{jj} - g^i_{ij}}{g^i_{ii}g^j_{jj} - g^i_{ij}g^j_{ji}} \int_{\theta_H}^{\eta_i} \left[\frac{\partial \pi_i(x^*_i, x^*_j, \theta)}{\partial x_i} + \frac{\partial \pi^i(x^*_i, x^*_j, \theta)}{\partial x_j} \right] dF(\theta) > 0.$$

This conclusion is based on a combination of ordinary sufficient second order conditions and on the assumption that "own effects" dominate over "cross-effects" ($\pi^i_i > |\pi^i_j|$). Consequently, we have proved that $\partial r_i/\partial \alpha > 0$, from which the conclusion of the proposition follows.

QED

An intuitive explanation for why a merger leads to a lower lending rate is the following: With a banking duopoly a rise in the lending rate facing firm i affects also the investment behaviour of firms i's rival in the product market because of the strategic complementarity between their investments. This "cross-effect" is, however, smaller than the "own effect". Hence, when firms in the product market compete with investment strategies which are strategic complements the lending rate has to be raised more in a banking duopoly than in a banking monopoly.

Proposition 1 has an immediate corollary as one can see from the equation (12).

Corollary 1 A bank merger will imply an expansion of the investment programs for an imperfectly competitive product market.

A central conflict of interests between shareholders and bondholders is a typical feature of debt contracts. The shareholders place emphasis only on states of nature that are solvent, while in bankrupt states the

shareholders' losses are truncated at zero due to limited liability. Typically this would lead the product market firms to engage in investment programs which are too aggressive relative to investment programs which are first-best from the point of view of the credit market. Debtholders, on the other hand, place emphasis only on bankrupt states, which would distort them to favor investment strategies which are too conservative relative to the first-best level. These observations led Stiglitz (1985) to suggest debtholder representation in the boards of borrowing firms as a mechanism of implementing first-best investment levels. Later on Brander and Poitevin (1992) have presented a much more detailed model of the agency costs of debt. In particular, they showed how the terms of the compensation contract offered to outside management by shareholders can reduce these agency costs substantially. It is an immediate implication of our results that the agency costs of debt are dependent on the market structure in the banking industry. Thus, implementation of first-best investment programs would require bank representation in the boards of the product market firms which is different in a banking monopoly from the one in a banking duopoly. Alternatively, efficient (first-best) investment programs might also require compensation contracts offered to outside management which differ in a systematic way in response to changes in the market structure of the banking industry.[5]

[5] It should be emphasized that the structure of the financial market is assumed not to affect the nature of competition in the product market. Of cource, with bank representation in the boards of the firms the nature of competition in the product market could very well change.

III.2 Bank Competition and Bankruptcy Risk

In the case of the Scandinavian banking crisis of the early 90's it has often been pointed out that the crisis was preceeded by deregulation of the banking market. For that reason many observers have used the Scandinavian experience as an evidence of how increased competition in the bank loan market will generate higher instability in the financial sector. In this section we will investigate this issue within the framework of our model.

Let us consider the equation

$$\pi^i(x_i^*, x_j^*, \eta_i) - (1 + r_i)x_i^* = 0,$$

which has to hold according to the definition of η_i. By totally differentiating this equation with respect to r_i we find that

$$\begin{aligned} \frac{\partial \eta_i}{\partial r_i} &= \frac{1}{\pi_\theta^i}\left[x_i^* + \frac{\partial x_i^*}{\partial r_i}(1 + r_i - \pi_i^i)\right] - \frac{\partial x_j^*}{\partial r_i}\pi_j^i. \\ &= \frac{x_i^*}{\pi_\theta^i} + \frac{\partial x_i^*}{\partial r_i}\frac{\partial \eta_i}{\partial x_i} - \frac{\partial x_j^*}{\partial r_i}\pi_j^i. \end{aligned} \tag{17}$$

The first term in the right hand side of (17) is a direct effect of an increased lending rate on the "breakeven" state of nature. The other terms in the right hand side of (17) are indirect effects indicating that a change in the lending rate will impact on the probability of bankruptcy also via the induced effects on the firms' investment behavior. If we

identify the probability for firms of remaining solvent with the stability of loan markets, the following conclusion can be drawn from (17).

Proposition 2 A sufficient condition for competition to make the loan market more fragile is that the direct effect of a higher lending rate on the bankruptcy risk dominates its indirect effects generating smaller investments.

In the presence of bankruptcy risk the lending rate sensitivity of investments tends to be low because firms are interested only in those states of nature in which they remain solvent. Thus it is quite likely that a sufficient condition for competition to make the loan market more fragile holds. In our framework bank competition has a destabilizing effect on loan market because it results in higher lending rates and lower investments. In the likely case where the interest rate effect dominates the induced investment effect on the "breakeven" state of nature the bankruptcy risk increases with competition.

The fragility of financial markets and its relationship to competition has been analyzed to some extent in some earlier writings. Without exploring the implications of bank competition Mankiw (1987) has stressed the possibility of financial collapse in credit markets; a small increase in the riskiness of some of the potential borrowers can cause credit markets for all of them to collapse, even though there may be no change in the expected returns of the investment projects. Broecker (1990) has studied the consequences for competition among the banks of adverse selection due to unobserved quality of borrowers. He assumes that before a bank decides on granting a loan, it conducts a credit-worthiness test on the borrower. In the case of many banks borrowers

that have been rejected at one bank can apply for loans at other banks so that the pool of applications that any bank gets has on average lower quality than the population as a whole. As the "winner's curse" problem becomes more severe with more banks, banks become more conservative and charge a higher risk premium. In a similar vein Riordan (1993) has analyzed the bank loan market's screening decisions by applying auction theory to the bank loan market with two types of borrowers who are indistinguishable ex ante. Each lender observes a signal about the loan quality and a loan is supplied by the lender observing the best signal. If the signal – the estimated probability of repayment – is above (below) some threshold level, a loan is offered (rejected). Riordan also shows how an increase in the number of competitors causes each bank to become more conservative in the sense that the threshold signal required to provide a loan is an increasing function of the number of competitors. Neither Broecker (1990) nor Riordan (1993), however, characterize precisely the relationships between the banking market structure, the lending rates, the volume of loans and investments and the resulting bankruptcy risk.

IV Concluding Discussion

We have modelled the interaction between the concentration of the banking sector and the investment strategies of imperfectly competitive firms in the product market to address the question of whether competition makes loan markets more fragile. It has been shown how a merger between two banks would typically decrease the interest rate and increase the investment volume of imperfectly competitive firms in the

product market. Under quite plausible conditions this implies that a merger would increase the stability of loan markets in the sense of decreasing bankruptcy risks. Thus an imperfectly competitive product market industry would face a lower probability of bankruptcy under monopoly than under duopoly banking.

In general, it is reasonable to assume that there are industry-specific economies of scale in the processing of information as well as in the monitoring of loan applications. Such economies of scale might lead some banks to concentrate their lending activities to particular industries. On the other hand, arguments related to diversification should prevent banks from concentrating too large a proportion of their assets into one particular industry to the extent that risks borne by banks are not "macroeconomic" in nature and therefore diversifiable. In its selection of a banking strategy the bank engages in trading off the advantages of specialization against those of diversification. Our analysis has added one more important dimension to this tradeoff by delineating the link between the organization of the financial sector and the performance of an imperfectly competitive product market industry.

Throughout the analysis we have assumed that the banks commit themselves to lending rates at which they will satisfy the demand generated by the investment programs of the imperfectly competitive firms in the product market (horizontal supply function). In a world with risky investments the banks may not want, however, to commit themselves to such a simple type of strategy. Instead, as has been stressed in much of the banking discussions, the banks may choose as their strategy a "supply function" which specifies the volume of loans it provides as a function of the interest rate. Klemperer and Meyer (1989) have developed a richer model of competition under oligopoly along these lines. It is an important area of research to study the effect of

competition on the performance of the bank loan markets under this more general strategy where the banks commit themselves to the volume of loans as a function of the interest rates.

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