ENDOGENOUS PRODUCT DIFFERENTIATION IN CREDIT MARKETS: WHAT DO BORROWERS PAY FOR?*

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Abstract

This paper studies strategies pursued by banks in order to differentiate their services from those of their rivals. In that way competition among banks is softened. More specifically we analyze if the bank size, the bank's ability to avoid losses, and its capital ratio can be used as strategic variables to make banks different and increase the interest rates banks can charge their borrowers in equilibrium. Using a panel of data covering Norwegian banks between 1993 and 1998 we find empirical support that the ability to avoid losses, measured by the ratio of loss provisions, may act as such a strategic variable. Our main finding is that borrowers in the market for credit line loans may discipline banks to avoid losses. We also find evidence that banks pass on parts of increases in their operating costs to credit line borrowers. However, we do not find evidence for the use of high capital ratio as a strategic variable that borrowers are willing to pay for.

1. Introduction

There exists a vast literature investigating the nature of competition in markets with differentiated products. In this paper we focus on *endogenous* differentiation among banks. More precisely, how banks strategically choose different "quality" characteristics (equity ratios, loss avoidance, size etc.) in order to differentiate themselves from competing banks, and thereby soften competition. This focus enables the analysis of why banks become different and not why different borrowers choose different contracts, which is extensively analyzed in the literature.

The fact that borrowers are different opens up an opportunity for banks to differentiate their quality characteristics (provide different services and levels of quality) in order to soften competition.

For instance, some borrowers face large lock-in effects due to the fact that their current bank has an informational advantage compared to competing banks (see Sharpe (1990)). These borrowers are inclined to choose banks that they anticipate are able to extend credit lines or provide new loans in future periods (switching to another bank is costly). This suggests that bank characteristics that are informative about a bank's ability to provide loans in the future is important for the borrowers. We explore two such variables; bank solvency and diversification, the latter represented by bank size. Well diversified and well capitalized banks will less likely face large losses and are more able to withstand potential losses. Locked-in borrowers may prefer such banks (see Chemmanur and Fulghieri (1994)).[1]

Signalling is an important characteristic which can be used to alleviate asymmetric information and to contribute to a borrower's value (see for instance Billett, Flannery, and Garfinkel (1995)). By borrowing from a high quality bank a borrowing firm can signal its creditworthiness to its other stake holders. Thus, banks can segment the markets according to borrowers' willingness to pay for borrowing from banks known to have a high quality loan portfolio (i.e. low loan-loss provisions), and extract higher rents from those valuing such a characteristic.

If borrowers are willing to pay extra for borrowing from banks with low loan-loss provisions or high capital ratio, banks face a market discipline effect different from

[1] Peek and Rosengren (1997) provide empirical evidence for a negative relation between loan losses at banks and their concurrent supply of loans.

the ones in the deposit and money markets, which have been previously studied in the banking literature.[2] A possible disciplinary effect in the credit market may reinforce the market disciplinary effect in the deposit and money markets and make banks less financially fragile.

The aforementioned examples of quality characteristics illustrate that theory alone cannot provide a definite answer as to what characteristics borrowers are willing pay for; this is an empirical issue, which we explore in this paper.

The majority of the literature dealing with debt structure analyzes the decision made by firms of whether to utilize arm's length (publicly traded) versus bank debt. A comprehensive review of the issue is given in Boot (2000). An interesting recent paper by Cantillo and Wright (2000) investigates the characteristics determining which companies finance themselves through intermediaries and which borrow directly from arm's length investors. In the present paper however, we focus on and restrict our attention to debt taken from the banking sector only, and analyze why and how banks choose different characteristics to differentiate themselves in order to soften competition. This is because most European countries have relatively thin markets for arm's length debt (bonds and certificates). OECD statistics show that bond and certificates as of 1995 comprised only around 4.0%-6.0% of total funding for the private non-financial firms in Europe (see OECD (1996)).

Before conducting the empirical analysis, we provide a stylized, two-stage, theoretical model which can shed some light on ways banks can utilize borrower-heterogeneity in order to differentiate themselves. In the empirical part, we use data from the Norwegian banking industry to illustrate along which dimensions banks may find it most profitable to differentiate and soften competition.

The paper is organized in the following way: section 2 presents the theoretical model; section 3 describes the data used, variables calculations, and the empirical model. Empirical results and discussion are presented in section 4. Section 5 concludes the paper.

[2]See for instance Calomiris and Kahn (1991) for a theoretical model explaining how depositors can discipline bank managers. Rochet and Tirole (1996) provide a theory of peer monitoring among banks in the interbank market. Both in Martinez Peria and Schmukler (2001) and in Gunther, Hooks, and J.Robinson (2000) there is emprical evidence of depositors disciplining banks' risk taking.

2. A theoretical model

A two-stage model is introduced to illustrate how banks can differentiate their services in order to attract borrowers with different financial needs. In general, banks can pursue two kinds of differentiation strategies. A bank can differ from the other banks in a way that *all* borrowers consider as better than its competitors (e.g. better services). In the literature this kind of differentiation is denoted *vertical product differentiation*, and this is the kind of product differentiation we consider here. In contrast, horizontal product differentiation does not imply that all borrowers agree about whether or not a bank offers better services than its competitors. For example, a bank may move a branch from city A to city B, to the benefit of customers in the latter city.

In the theoretical model we are deliberately vague about exactly which strategic variable banks use in their vertical product differentiation strategy. In the empirical part we analyze different potential "quality" variables that banks can use to differentiate.

For simplicity, we study the case with two banks, bank A and bank B. At stage 1, the banks choose their quality variables, q_i, $i = A, B$ and, at stage 2, the banks choose interest rates, r_i, $i = A, B$ (Bertrand competition). This two-stage structure captures the notion that some characteristics are used as strategic variables, i.e. variables more costly or difficult to alter than interest rates. Figure 1 presents a schematic diagram of the two-stage game:

Stage 1

Banks choose quality variables, q_A and q_B, simultaneously.

Stage 2

Banks choose interest rates, r_A and r_B, simultaneously.

Borrowers accept an offer from one of the banks.

Figure 1: Competition in a two-stage game

There are numerous potential ways a bank can distinguish itself from its competitors. If bank relationships are important, borrowers may be concerned about the

capabilities or characteristics of their main bank. Let us here briefly point out some potential quality variables in banking. Which quality variables that are important is an empirical question examined in the following empirical part of the paper.

- *Monitoring/screening*: Some banks may be well-known for having high-quality staff that is experienced evaluators of investment projects. A low level of losses on loans may indicate high monitoring/screening capabilities. A borrower that faces switching costs may favor such a bank since it increases the probability of correct evaluation of future loan applications (profitable projects obtain loans). This idea has been explored in Chemmanur and Fulghieri (1994).

- *Signalling*: Bank loans may signal the quality of the borrowing firm to stock owners, buyers, suppliers and other creditors.[3] A loan commitment from a high-quality bank may provide a more favorable signal than a similar loan commitment from low-quality banks. This is so because high-quality banks provide a more thorough screening and monitoring of its borrowers. Furthermore, some banks have a reputation for being more risk averse than others. Consequently, a loan commitment from a bank with a reputation for being highly risk averse can signal that its borrowers have a low-probability of going bankrupt. In this way, a bank loan can be used to alleviate the asymmetric information problems a firm may face in negotiations with, for example, suppliers and buyers. Signalling quality of a bank can for instance be negatively associated with the extent to which the bank has suffered losses on its loan portfolio.

- *Bank solvency* : Empirical literature has shown that borrowers may suffer if their main bank is forced to restrict its lending capacity (see Slovin, Sushka, and Polonchek (1993)). Consequently, a borrower may be concerned about their main bank's solvency or, more precisely, how likely it is that their bank may face difficulties in providing loans in the future. Both a high capital ratio and low loss provisions are variables that contribute to a bank's solvency.

[3]The empirical study of Billett, Flannery, and Garfinkel (1995) shows that loans from high-quality lenders are associated with larger positive stock price reactions than loans from low-quality lenders.

- *Size*: Large banks tend to have a more extensive hierarchical structure than small banks. Generally, Qian (1994) shows that this may weaken incentives for workers in the lowest hierarchical tiers. Consequently, in large organization workers are frequently guided by rules rather than a more flexible incentives system. Along these lines, Cerasi and Daltung (1996) focus on how diversification benefits in banking may be countervailed by losses due to weaker incentives and more rule-based decision making in the lowest tiers in large banks. Hence, some borrowers may prefer to use small and more flexible banks whereas others may prefer large diversified banks.

Our very simple model structure is able to capture all these potentially important bank characteristics.

In the first period borrowers are assumed to have access to an investment project with present value, V (not including financing costs).

In the following analysis we take into account that there are many different qualities of a bank that borrowers may consider when they choose their main bank. For simplicity, we denote borrower f's value of a bank relationship with a bank of quality q (higher q means higher quality) as,

$$qR_f$$

where R_f represents borrower f's appreciation of the bank's quality. As an example; a borrower which does not need additional funding in the future has a low R_f (possibly 0). In contrast, a borrower that is locked into a relationship with a particular bank (high switching cost) and needs high quality service today as well as in the future, would have a high R_f.[4] Note that R_f cannot be observed by the bank and hence a bank must charge the same interest rate to all of its borrowers. On the other hand, banks may also differ in many ways. A well capitalized bank will very unlikely be forced to introduce credit restrictions. Furthermore, borrowers may expect that banks that have suffered low losses in the past due to high-quality monitoring and screening of loan applicants will be able to do skillful evaluation of new projects also in the future. A loan from such a bank can also serve as a positive signal to other

[4]See for example Sharpe (1990) for a discussion of switching costs due to information asymmetries between lenders.

stakeholders in the borrowing firm about the firm's income prospects and its creditworthiness. In the theory model, we do not allow the banks to differentiate along many dimensions at the same time. However, our simple framework suffices to show that heterogenous borrowers enable the banks to pursue differentiation strategies and thereby reduce the level of competition.

We make three simplifying assumptions:

Assumption 1. *R_f is uniformly distributed on $[0,1]$.*

Assumption 2. *Total market demand is normalized to 1.*

Assumption 3. *Costs related to deviations from a banks' cost minimizing quality level, q_o, are quadratic.*

$$e(q_i) = \beta (q_i - q_o)^2 \qquad i = A, B$$

Note that the cost minimizing quality level, q_o, can be interpreted as the quality level that would have been chosen in the absence of strategic interactions among the banks. Banks deviate from this level in order to soften the level of competition in interest rates in period 2 (with identical banks, $q_o = q_A = q_B$ competition would be fierce and there would be no profit).

To find the sub-game perfect Nash equilibrium in the two-stage game we start with stage 2.

2.1. Competition at stage 2

First, let us examine the demand for loan given q_A, q_B, r_A, and r_B. Without loss of generality assume $q_A \geq q_B$, which implies that $r_A \geq r_B$ (otherwise bank B's offer dominates bank A's offer). Borrower f compares the net benefits from using bank A and bank B:[5]

$$\text{Bank A:} \qquad V - r_A + q_A R_f$$

[5]For simplicity we have assumed that the project has a certain outcome. However, we could have assumed that there is a probability $p < 1$ for success. In case of failure the project is worthless. Then, the expected value of the project would have been: $p[V - r_i + q_i R_i]$. The choice between the two banks would, however, not have changed.

$$\text{Bank B:} \qquad V - r_B + q_B R_f$$

A borrower of type $\widehat{R}$, is indifferent between using bank A and bank B.

$$\begin{aligned} V - r_A + q_A \widehat{R} &= V - r_B + q_B \widehat{R} \\ \widehat{R} &= \frac{r_A - r_B}{q_A - q_B} \end{aligned}$$

Consequently, bank A and bank B face demand $D_A(r_A, r_B)$ and $D_B(r_A, r_B)$, respectively

$$\begin{aligned} D_A(r_A, r_B) &= 1 - \widehat{R} \\ D_B(r_A, r_B) &= \widehat{R} \quad , \end{aligned}$$

and the banks' stage-2 profit levels are

$$\begin{aligned} \pi_A(r_A, r_B) &= (r_A - r_0)\, D_A(r_A, r_B) \\ \pi_B(r_A, r_B) &= (r_B - r_0)\, D_B(r_A, r_B) \quad , \end{aligned} \tag{2.1}$$

where r_0 is the banks' cost of funding. From the two banks' profit maximizing choice of interest rates, we get the Nash equilibrium at stage 2:

$$\begin{aligned} r_A &= (q_A - q_B)\frac{2}{3} + r_0 \\ r_B &= (q_A - q_B)\frac{1}{3} + r_0 \quad . \end{aligned} \tag{2.2}$$

From, equation (2.1) and (2.2) we have

$$\begin{aligned} \pi_A(q_A, q_B) &= \frac{4}{9}(q_A - q_B) \\ \pi_B(q_A, q_B) &= \frac{1}{9}(q_A - q_B) \quad . \end{aligned} \tag{2.3}$$

Notice that there are two effects from a change in a bank's quality variable onto the equilibrium interest rate charged. First, there is a direct effect onto the demand for loans. If bank quality improves, borrowers are willing to pay higher interest rates. Second, there is an indirect competition effect onto the equilibrium interest rate

charged. If Bank A (the high quality bank) improves its quality, the two competing banks will become more different and competition is softened. Hence, both banks are able to charge higher interest rates (see equation (2.2)). On the other hand, if Bank B (the low quality bank) improves its quality, the banks become less differentiated and competition becomes more vigorous. In the simple model introduced above the indirect competition effect exceeds the strength of the direct effect. In equilibrium, quality improvement of the low quality bank induce both banks to charge lower interest rates (see equation (2.2)). More identical banks compete more fiercely.

2.2. Competition at stage 1

At stage 1 the banks decide on their strategic variables (q_A and q_B) taking as given the profit maximization behavior at stage 2.

Seen from stage 1 the banks' profit maximization problems are:

$$\text{Bank A:} \quad \underset{q_A}{Max} \{\pi_A(q_A, q_B) - e(q_A)\}$$

$$\text{Bank B:} \quad \underset{q_B}{Max} \{\pi_B(q_A, q_B) - e(q_B)\}$$

From the first order conditions we get

$$\begin{aligned} q_A^* &= q_o + \frac{2}{9}\frac{1}{\beta} \\ q_B^* &= q_o - \frac{1}{18}\frac{1}{\beta} \end{aligned}$$

Proposition 1 sums up our predictions from the theoretical model

Proposition 1.

i) If the banks become more differentiated, their interest rates and profitability increase,

$$\frac{dr_i}{d\,(q_A^* - q_B^*)} > 0, \qquad i = A, B,$$

$$\frac{d\pi_i}{d\,(q_A^* - q_B^*)} > 0, \qquad i = A, B, .$$

ii) The bank with the higher level of the strategic quality variable has the higher stage-2 profit.

Proof: i) The first part follows from (2.2), the second part and ii) from (2.3).

Proposition 1 ii) implies that both banks would prefer to be the high quality bank but i) implies that both would loose if both become high quality banks (i.e. $q_A - q_B$ is small).[6]

3. Empirical model

In this section we present the empirical model that can facilitate a test of the prediction of Proposition 1 i); as banks are more dispersed in terms of a certain bank quality variable that borrowers appreciate and hence may be willing to pay for, competition is softened and banks are able to charge borrowers higher interest rates. More specifically, we want to analyze empirically what characteristics of a bank borrowers are willing to pay for, and hence along what characteristics banks can distinguish themselves from each other in order to soften competition.

The general structure of our empirical model is:

$$s_{i,r,t} = f(\mathbf{s}_{i,r,t-h}, \mathrm{v}\left(\mathbf{q}\right)_{i,r,t-h}, \mathrm{g}\left(\mathbf{q}\right)_{r,t-h}, \mathbf{x}_{i,t-h}, \mathbf{f}_{r,t-h}, \nu_i, \rho_r, \tau_t, \epsilon_{i,r,t}) \quad , \tag{3.1}$$

where $s_{i,r,t}$ is the spread over the period t money market interest rate on loans from bank i in market r in period t, and $\mathbf{s}_{i,r,t-h}$ a vector of its lagged values. $\mathrm{v}\left(\mathbf{q}\right)_{i,r,t-h}$ is a vector representing the difference between the value of bank i's quality variables and the cross-sectional median of the corresponding bank quality variables in market r in period $t-h$. $h \in [0, T]$ is the appropriate lag length for the various explanatory variables. $\mathrm{g}\left(\mathbf{q}\right)_{r,t-h}$ is a vector containing for each bank quality variable a measure of the inequality in that variable across banks in market r in period $t-h$. $\mathbf{x}_{i,t-h}$ is a vector of other bank and period specific variables that may influence the interest rate spread $s_{i,r,t}$. $\mathbf{f}_{r,t-h}$ is a vector of variables specific to market r in period t. ν_i is a bank specific dummy taking care of bank specific effects staying constant over periods and markets. ρ_r is a dummy variable for the markets, taking care of market specific effects staying constant over time and bank. τ_t is a dummy variable for periods taking care of macro economic effects staying constant across banks and markets. Finally $\epsilon_{i,r,t}$ is the error term.

[6] In this model as in all other models with ex ante symmetric agents and ex post asymmetric profit levels, there is a potential coordination problem.

The type of interest rates we consider are the interest rates banks charge on credit lines to firms. Hence $s_{i,r,t}$ is the spread of interest rates on credit lines over the money market rate. Credit lines are usually considered as the most information intensive type of loans, see Berger and Udell (1995).[7] Thus, problems of lock-in and high switching costs are likely to be more pronounced in markets for credit lines than in other loan markets. Therefore the quality of a bank should be more important for credit line customers than for other loan customers. We therefore apply and test the hypothesis that credit line borrowers are willing to pay extra for borrowing from a bank of high quality.

The theoretical model in section 2.1 predicts that the better a bank is compared to its competitors in terms of a certain quality variable, the higher equilibrium interest rate it charges. That is the motivation for specifying the variables depicted in $\mathrm{v}\left(\mathbf{q}\right)_{i,r,t-h}$ as differences from the cross-sectional median of the corresponding bank quality variables in the market in which bank i operates. Thus, these variables represent, what is referred to as vertical differentiation. However, when more than two banks are competing in the same market it is not just how much better or worse bank i is, that matters for its competitive position, i.e. how much it is able to charge its borrowers. The overall differentiation of all competitors in terms of the quality variable will also matter. A larger dispersion will soften the overall competition in the market and enable all banks to charge their borrowers a higher margin. That is the motivation for including $\mathrm{g}\left(\mathbf{q}\right)_{r,t-h}$ that represents the cross-sectional inequality or dispersion of the quality variables in each market. As will be shown below, we measure these inequalities by Gini coefficients.

Markets are defined by geography, and the country is divided into 18 regions, as is explained in more details in subsection 3.1.

3.1. Data

We use a panel of Norwegian bank data covering the years 1993 to 1998. This is the period immediately following the banking crisis in Norway. In the crisis three of the four largest banks failed and were recapitalized by the government subject to

[7] Mester (1992) estimates a cost function based on information-theoretic considerations, realizing the different costs entailed in the provision of different information-intensive outputs.

trimming of the banks' balances and operating costs. Smaller banks that failed were acquired by sounder banks with the help of guarantees from the deposit insurance funds. Only one small bank was forced to close. Thus, all other problem banks were allowed to continue their operations but, as mentioned, on certain conditions. It can therefore be assumed that in the years covered by our data both banks and their borrowers had learnt about possible consequences of a bank running into solvency problems.

The data are annual and include banks ranging from small local savings banks to large nationwide banks. This large variety in the data ensures a relatively large dispersion of various characteristics of the banks. The data consist both of balance items, items from the banks' result accounting, and average interest rates by the end of the year on some specific loan aggregates. The number of banks in the sample used varies between a maximum of 121 in 1998 and a minimum of 108 in 1994.[8] Norway is divided into 19 counties. Loans outstanding for each bank are also reported by county.

Markets are defined by geography, and the country is divided into 19 counties. We define each county as one market. The capital Oslo, which itself is a county, and the county surrounding it, Akershus, are defined as one market, leaving us with a total of 18 markets. The majority of Norwegian banks only operate in one or two counties. Only the three largest banks are represented in all of the 18 loan markets defined here in the whole period covered. The fourth largest bank is represented in all 18 markets in three of six years.[9]

As the data on interest rates charged by the banks are not specified by county we have to maintain the hypothesis that there is no systematic variation in the interest rates on credit lines across counties, thus any variation is random and is captured by the error term of the model. However, we have data on total loans by all banks by county, that allows us to define which banks operate in what county. Characteristics

[8] Only banks reporting the necessary data are included in the sample.

[9] In cases where a bank has less than 0.1 pct. of the loan market in a county, it is considered not represented in that county, and that particular combination of bank and county is not included in the data set. If this was not done, small banks, having a few borrowers that physically have moved to another county and maintained their loans in the original bank, would have been considered as actively competing for loans in that county. This also implies that a few very small banks are not included in the sample nor as competing banks to those in the sample.

Table 3.1: Summary statistics

	Mean	Std. dev.	Min	Max
Spread	4.74	1.32	0.19	10.14
Assets	30.415	45.480	0.120	161.485
Credit line loans	2.848	4.632	0.005	19.361
Loans	25.618	37.402	0.102	123.834
Capital ratio pct.	15.96	6.04	6.99	46.33
Loss provisions pct.	3.70	2.78	0.07	14.19
Operating cost ratio	2.78	0.54	1.28	5.96
Operating costs	724.3	1062.8	3.5	3599.7
Herfindahl index	1963	615	1138	3987

Spread is the difference between interest rates on credit line loans and the 3 months money market interest rate, in pct. Assets, credit line loans and loans are measured in NOK billions, 1 NOK $\approx$ 0.125 EUR. Operating costs is measured in NOK millions. Capital ratio is measured according to the Basel 1988 Accord. Loss proviosions are the stock of accumulated loss provisions relative the stock of loans outstanding. Operating cost ratio is operating costs relative to loans outstanding. The Herfindahl index is measured by each county and year, wheres all other variables in the table are measured by bank and year.

of the banks other than loans are not specified by county. However, most of the characteristics of a banking firm that matter to the borrowers (its solvency, capital ratio, overall size, its overall ability to screen and monitor etc.) would be constant across counties. Hence for our purpose this can not be considered a severe limitation of the data.

A summary of the data used in the estimation is presented in table 3.1

3.2. Specification of the empirical model

We estimate the following log-linear version of 3.1:[10]

$$s_{i,t} = \alpha_1 s_{i,t-1} + \alpha_2 s_{i,t-2} + \mathrm{v}\left(\mathbf{q}\right)_{i,r,t-h}\boldsymbol{\beta} + \mathrm{g}\left(\mathbf{q}\right)_{r,t-h}\boldsymbol{\gamma} + \mathbf{x}_{i,r,t-h}\boldsymbol{\delta} + \mathbf{f}_{r,t-h}\boldsymbol{\mu} + \nu_i + \rho_r + \tau_t + \epsilon_{i,r,t} \tag{3.2}$$

where $h \in [0, 1]$.

[10] A linear version of the same model did not pass the RESET test for functional form.

Since we do not know the identity of the borrowers at each bank, we are not able to directly control for the element of $s_{i,t}$ that is due to borrower specific risk. However, it is well known from other empirical work that the composition of a bank's borrowers only changes slowly over time (see for instance Ongena and Smith (1998), Degryse and van Cayseele (2000) and Kim, Kliger, and Vale (1999)). Hence in the absence of borrower specific information, borrower specific risk can partially be controlled for by the bank dummies and partially by the lagged values of $s_{i,t}$. Furthermore, the macroeconomic part of borrower risk is controlled for by the time dummies and the regional specific part by the regional dummies.

We specify a log-linear version of 3.2 with the following RHS variables:

Variable	Description
$s_{i,t-1}$, $s_{i,t-2}$	Lags of the spread of interest rate on credit lines
Bank quality $\mathrm{v}(\mathbf{q})_{i,r,t-h}$:	
$\mathrm{v}(assets)_{i,r,t-1}$	Total assets of bank i end of year $t-1$
$\mathrm{v}(cap88)_{i,r,t-1}$	Capital ratio(Basel 88) of bank i end of year $t-1$
$\mathrm{v}(loss)_{i,r,t-1}$	Ratio of accumulated loss provisions to loans outstanding for bank i end of year $t-1$
Gini coefficients of quality $\mathrm{g}(\mathbf{q})_{r,t-h}$:	
$\mathrm{g}(assets)_{r,t-1}$	
$\mathrm{g}(cap88)_{r,t-1}$	
$\mathrm{g}(loss)_{r,t-1}$	
Controls ($\mathbf{x}_{i,t}$;	$\mathbf{f}_{r,t}$; dummies):
$costrat_{i,t}$	Ratio of materials- and wage cost to loans outstanding for bank i in year t
$herfin_{r,t}$	Herfindahl index of the bank to business credit market in county r in year t
ν_i, ρ_r, τ_t	Bank, county and year dummies

$v(q)_{i,r,t-1}$ is a vector representing the difference between the value of bank i's quality variables and the cross-sectional median of the corresponding bank quality variables in market r in period $t-1$. $g(q)_{r,t-1}$ is a vector containing for each bank quality variable a measure of the inequality in that variable across banks in market r in period $t-1$.
All lagged stock variables are aggregated backwards, i.e. the bank structure of year t is forced upon the variable in year $t-1$.

The variables listed under the heading 'bank quality variables' are variables that borrowers are likely to take into account as signals by banks when choosing a bank.

The operator v represents the cross-sectional difference of a quality variable q in the following way:

$$\mathrm{v}(q)_{i,r,t} = q_{i,t} - \underset{i \in r}{\mathrm{median}}\,(q_{i,t}) \quad .$$

$i \in r$ states that median is calculated only over banks operating in county r. Note that even if $q_{i,t}$ only varies across banks and years, $\mathrm{v}(q)_{i,r,t}$ will also vary across counties.

The Gini coefficients are calculated as:

$$\mathrm{g}(q)_{r,t} = 1 + \frac{1}{n_r} - \frac{2}{n_r^2 \overline{q}_{r,t}} \sum_{i \in r} j \cdot q_{i,t}$$

$$\text{where } \overline{q}_{r,t} = \frac{1}{n_r} \sum_{i \in r} q_{i,t} \quad , \; j = 1, 2, 3, \cdots, n_r \quad ,$$

n_r is the number of banks operating in county r, and j is a rank number assigned to each $q_{i,t}$ in decreasing order of size.

assets represents the size of a bank. The larger the bank the more diversified its portfolio is likely to be, and cet. par. the less likely it is that the bank will suffer huge losses and be forced to reduce its lending activity. Furthermore, a larger bank is also more likely to be considered as "too big to fail" by the government. On the other hand large banks may face more severe principal/agent problems in their organization than small banks do, and thus perform monitoring and screening of less quality than smaller banks. One way to reduce these agency costs is for a large bank to adhere to rules rather than discretion, which for the borrowers may result in more rigid loan conditions. Borrowers who value tight monitoring and screening highly and for whom more flexible loan conditions are important, may hence be willing to pay more for services offered by a smaller bank. For borrowers willing to accept lower quality of monitoring and screening functions or more rigid loan conditions, the opposite may hold. Hence the expected impact of $\mathrm{v}(assets)_{i,r,t-1}$ on the banks' spread is ambiguous. C.f. discussion in section 2.

*cap*88 represents the solvency of a bank in terms of its ability to withstand large loan losses without being forced to cut its lending in order to satisfy the capital requirements. This variable can have a positive impact on the spread, as borrowers may be willing to pay for this sign of quality. A positive sign can also indicate that banks under imperfect competition are able to pass on to borrowers the higher

total costs of finance incurred by a higher capital ratio. However, different degrees of risk aversion among banks can be reflected in a negative sign of $\mathrm{v}(cap88)_{i,r,t-1}$ in this reduced form model. Banks with high degree of risk aversion are expected to operate both with a high capital ratio – to minimize the possibility of moving below the minimum requirement – and at the same time lend to safe borrowers, borrowers from which they only can charge a low interest rate spread. The other extreme of this story would be a bank very close to or even below the minimum capital requirement that behaves like a risk lover or 'gambles for resurrection' by lending to high risk borrowers from which it can charge a high interest rate spread. Thus, the expected sign of the coefficient $\mathrm{v}(cap88)_{i,r,t-1}$ is indeterminate.

loss as a quality variable represents the results of the bank's ability to screen and monitor, as well as borrowers' need to signal their low riskiness to other creditors and to their customers, by borrowing from a bank that has suffered few loan losses (c.f. the discussion in the two first bullet points of section 2). Low loss provisions will also increase the probability that the bank can maintain its solvency and hence its lending capacity in the future. To the extent borrowers are willing to pay for this quality variable, the expected impact of $\mathrm{v}(loss)_{i,r,t-1}$ on the spread is negative.

The expected sign of the estimated parameters for all the Gini coefficients are positive. More dispersion among banks in terms of variables borrowers care about, serves to soften competition and hence increase the interest rate banks can charge their borrowers. Recall that a key assumption – and a fairly realistic one – in this paper is the heterogeneity of borrower preferences. If one of the Gini coefficients of an underlying variable turns out to be insignificantly different from zero, this indicates that more dispersion among competing banks along this variable does not soften competition. Under our heterogeneity assumption this also implies that the underlying variable is not a quality variable as defined in section 2.

We use a lag of one year for all the quality variables. Borrowers have to base their evaluation of the bank on the values published in the bank's annual report and financial statements for the last year. These are usually more comprehensive and more scrupulously audited statements than the quarterly statements made during the year.

Among the control variables, $costrat_{i,t}$ represents the banks' ability under im-

perfect competition to pass their operating costs on to their credit line borrowers.

The regional Herfindahl index $herfin_{r,t}$ controls for the competitive environment, as measured by market concentration, in which a bank operates. The more concentrated the market is the higher is the value of the Herfindahl index. A more concentrated market is usually considered a less competitive market, and banks should be able to charge a higher interest rate. Hence the expected sign of this variable should be positive. However, it could also have a negative sign due to the 'winner's curse' problem discussed in auction theory.[11]

The dummies control for bank, regional, and time specific effects.[12]

4. Empirical results

The model in 3.2 is estimated using two-stage least square. $costrat_{i,t}$ is endogenous, it may be partially determined by the LHS variable $s_{i,t}$. It is therefore instrumented using its own one year lag, not aggregated backwards.[13] The correlation between $\ln costrat_{i,t}$ and its lag is 0.90.

We start by estimating the general model including all the RHS variables listed in section 3.2, The results are presented in Table 4.1 column (a), and indicate a model that satisfies certain misspecification tests regarding lack of serial correlation in the residuals and no functional form misspecification.

We find no evidence of size as a quality variable as both $\ln \mathrm{v}(assets)_{i,r,t-1}$ and the corresponding Gini coefficient are insignificant. The insignificance of the Gini coefficient of the capital ratio indicates that the capital ratio is not a strategic variable as defined in section 2. The Herfindahl index is insignificant as well. Furthermore, all county dummies are insignificant. Exclusion of all these variables is statistically valid, as is shown by the reported F-test. Thus, we get the parsimonious model (b) which also passes the tests for functional form and for no serial correlation in the

[11] See for instance Bulow and Klemperer (1999) who construct a theory model of auctions where a reduction in the number of bidders actually raises the price when bidders are asymmetric.

[12] In a previous version of the model, instead of using dummies we controlled for borrower risk using the loan loss ratio on credit line loans and a macro variable, the real interest rate. Our main qualitative results were equivalent to those of the model presented in this paper. This model, however, performs better in terms misspecification tests than the previous version.

[13] Backward aggregation of a variable means that the bank structure of year t is forced upon the variable in year $t-1$.

Table 4.1: Empirical results

LHS variable $\ln s_{i,t}$
(credit line interest rate spread over money market interest rate)

Variable	(a)	(b)
$\ln s_{i,t-1}$	0.0296 (0.89)	0.0252 (0.76)
$\ln s_{i,t-2}$	0.0230 (1.11)	0.0174 (0.85)
Bank quality $\mathrm{v}(\mathbf{q})_{i,r,t-1}$:		
$\ln \mathrm{v}(assets)_{i,r,t-1}$	0.0278 (1.31)	–
$\ln \mathrm{v}(cap88)_{i,r,t-1}$	−0.1389 (−3.19)	−0.1562 (−4.37)
$\ln \mathrm{v}(loss)_{i,r,t-1}$	−0.1458 (−5.68)	−0.1193 (−6.23)
Gini coefficients of quality $\mathrm{g}(\mathbf{q})_{r,t-1}$:		
$\ln \mathrm{g}(assets)_{r,t-1}$	−0.0266 (−0.09)	–
$\ln \mathrm{g}(cap88)_{r,t-1}$	−0.061 (−0.97)	–
$\ln \mathrm{g}(loss)_{r,t-1}$	0.1552 (3.16)	0.1528 (3.91)
Controls $(\mathbf{x}_{i,t}; \mathbf{f}_{r,t}; dummies)$:		
$\ln costrat_{i,t}$	0.8217 (3.52)	0.7880 (3.43)
$\ln herfin_{r,t}$	0.0396 (0.54)	–
υ_i	in	in
ρ_r	in	–
τ_t	in	in
F-test, (a) – (b)	–	0.81
AR(1,2)	0.19	0.62
RESET	0.91	0.94
R^2 adj.	0.4804	0.4869

Number of observations is 1241. $v(\mathbf{q})_{i,r,t-1}$ is a vector representing the difference between the value of bank i's quality variables and the cross-sectional median of the corresponding bank quality variables in market r in period $t-1$. $g(\mathbf{q})_{r,t-1}$ is a vector containing for each bank quality variable a measure of the Gini coefficient of that variable across banks in market r in period $t-1$. Numbers in parantheses are White heteroscedasticity consistent t-values. The F-test is a test of the joint significance of the variables excluded from model (a), the p-value is reported. AR(1,2) is a joint Preusch-Pagan test for first and second order serial correlation in the residuals. P-values for the F-test are reported (see Greene (1993) p. 428). RESET is the test for functional form using the square of the predicted value as RHS. P-values of the t-test is reported.

residuals. Note that due to the log-linear specification all coefficients of the model can be interpreted as elasticities.

The negative and significant coefficient of $\ln \mathrm{v}(loss)_{i,r,t-1}$ and the positive and significant coefficient of the corresponding $\ln \mathrm{g}(loss)_{r,t-1}$ supports the hypothesis that banks can segment the markets according to borrowers' willingness to pay for borrowing from banks with low losses (c.f. the two first bullet points in section 2).

Borrowers' appreciation of banks with low loss provisions serves as an important disciplinary device, inducing banks to avoid losses. To illustrate the strength of this disciplinary effect, consider a bank at sample mean with an interest rate spread on its credit line loans of 4.74 pct. It will according to our results be 'punished' by a reduction of the interest rate spread in the range of 0.38 to 0.74 pct. points, if its loss provisions relative to its competitors double.[14] Thus, there may be a market discipline effect at work not only in the money market, but also in the market for credit line loans. Both banks' lenders and borrowers punish banks with high loan losses.

The negative sign for $\ln \mathrm{v}(cap88)_{i,r,t-1}$ supports the claim that banks with high risk aversion tend to both have high capital ratio and lend to safe borrowers implying a low interest rate spread.

Among the control variables note that the elasticity of the $costrat_{i,t}$ is positive and significant. Thus, banks operating under imperfect competition in the market for credit line loans are able to pass some of their operating costs over to these borrowers. The estimated elasticity implies that a bank at sample mean, with NOK mill. 724 in operating costs and credit line loans of NOK mill. 2848, facing a ten pct. increase in its operating costs would be able to pass approximately NOK mill. 11 of the cost increase of NOK mill. 72 onto its credit line borrowers.

As the Herfindahl index does not obtain a significant coefficient we can neither give support to the traditional view of more concentrated credit markets leading to higher interest rates nor to the theories of 'winner's curse'.

Our results seem to indicate that borrowers care more about the signalling effect from bank loans than they care about the solvency of the bank at which they borrow. A loan from a low-loss bank provides a positive signal to the other stakeholders of

[14] This range is calculated as a 95 pct. confidence interval.

the borrowing firm. One alternative interpretation of borrowers' appreciation of low loan losses is that borrowers care about the solvency of the banks and hence the future of their bank relationship. Had the solvency of banks been of major concern to borrowers, we would expect to see positive and significant signs both of $\ln \mathrm{v}(cap88)_{i,r,t-1}$ and its Gini coefficient. Since this is not the case, we are left with the signalling interpretation of the significance of the loan loss provisions.

The empirical results that borrowers facing high switching costs do not seem to care about the future lending capacity of their bank, may be associated with the way the banking crisis in the early nineties was handled by the Norwegian government. All banks – with one minor exception – were recapitalized such that lending activities could continue.[15] This may explain why borrowers are not concerned with bank solvency.

5. Concluding remarks

In this paper we have studied strategies pursued by banks to differentiate their services from those of their rivals and thereby soften competition. More specifically we have analyzed if the bank size, a bank's ability to avoiding losses, and its capital ratio can be used as such strategic variables. We also study to what extent borrowers are willing to pay for high quality along these dimensions. Using a panel of data covering Norwegian banks between 1993 and 1998 we found empirical support for the banks' ability to avoid losses, measured by the ratio of loss provisions, as such a strategic variable. This implies that borrowers in the market for credit line loans may discipline banks to avoid future losses. Borrowers' appreciation of low-loss banks is interpreted as evidence that loans from such banks provide a positive signal. We also found evidence that banks pass on parts of increases in their operating costs to credit line borrowers. However, we did not find evidence for the use of high capital-ratio as a strategic variable that borrowers are willing to pay for. This finding may be explained by the way the banking crisis in the early nineties was handled.

[15] In fact Ongena, Smith, and Michalsen (2000) find that firms listed on Oslo Stock Exchange that maintained a banking relationship with any of the problem banks during the announcements of the banks' distress events, on average only had small and temporary negative excess returns around the distress announcement dates. Furthermore, Vale (2001) finds evidence that small firms borrowing from problem banks were not affected negatively due to their bank relations.

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