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

Moshe Kim* Eirik Gaard Kristiansen† Bent Vale‡

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Abstract

This paper studies strategies pursued by banks in order to differentiate their services and soften competition. More specifically we analyze whether bank's ability to avoid losses, its capital ratio, or bank size 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. A likely interpretation is that borrowers use high-quality low-loss banks to signal their creditworthiness to other stakeholders. This supports the hypothesis that high-quality banks serve as certifiers for their borrowers. Furthermore, this suggests that not only lenders and supervisors but also borrowers may discipline banks to avoid losses.

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* University of Haifa, Department of Economics,

† Norwegian School of Economics and Business Administration and Norges Bank (The central bank of Norway).

‡ Norges Bank (The central bank of Norway), Corresponding author address: Norges Bank, C51, Box 1179, Sentrum, N-0107 Oslo Norway. Fax: +47 22 42 40 62, e-mail: bent.vale@norges-bank.no

1. Introduction

What do borrowers pay for? Are borrowers willing to pay higher rates to banks exhibiting higher reputation? If this is the case, some banks would invest in reputation for quality and differentiate their services from their rivals, thereby softening competition. In this paper we focus on such *endogenous* differentiation among banks. More precisely, which "quality" characteristics (equity ratios, loss avoidance, size etc.) do banks choose in order to differentiate themselves from competing banks.

There are two major reasons for borrowers to be concerned with bank quality. First, banks provide *certification* which can be used to alleviate consequences of asymmetric information and to contribute to borrowers' value. By borrowing from a bank known to have a high-quality loan portfolio (i.e. low loan-loss provisions) a firm can signal its creditworthiness to its other stakeholders. In this manner a high quality bank certifies its borrowers.[1] Thus, banks can segment the markets according to borrowers' willingness to pay for borrowing from banks with high-quality loan portfolios and extract higher rents from those valuing certification.

Second, borrowers may be concerned with *refinancing*. Refinancing is of crucial interest for locked-in customers. Some borrowers may face large lock-in effects due to the fact that their current bank has an informational advantage vis a vis 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, see Kim, Kliger, and Vale (2003)). This suggests that bank characteristics that are informative about a bank's ability to provide loans in the future, as reflected in bank solvency and diversification (size), is important

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[1]See e.g. Cook, Schellorn, and Spellman (2003), James (1987), Lummer and McConnell (1989), and Billett, Flannery, and Garfinkel (1995).

for borrowers.[2] 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)).[3]

The major interest of the empirical part of this study is to distinguish between the *certification* and *refinancing* motives.

If borrowers pay a premium for borrowing from banks providing certification (low loan-loss provisions) or from solvent banks with few problems in meeting future refinancing needs, banks face market discipline induced by borrowers. This asset side market discipline effect is different from the conventional one on the liability side (uninsured deposit and money market funding), which has been extensively studied in the banking literature.[4] A possible disciplinary effect from borrowers may reinforce the market disciplinary effect stemming from the liability side and make banks less financially fragile.

The issue of product differentiation in banking has been of interest for some time. Generally, banks can pursue two kinds of differentiation strategies. A bank can differ from other banks in a way that *all* customers consider as better than its competitors (e.g., better services). When customers agree about the quality ranking of different banks at equal prices, we call it *vertical product differentiation*. In contrast, horizontal product differentiation does not imply that all borrowers agree about such a ranking. For example, a bank may move a branch from one city to another, to the benefit of customers in the latter city. The empirical literature on product differentiation in banking has mainly been concerned with horizontal differentiation. See Matutes and Vives (1996), Berg and Kim (1998), Barros (1999), and Kim and Vale (2001). Degryse (1996) theoretically analyzes the interaction of horizontal and vertical differentiation. See also Anderson, De Palma, and Thisse

[2] See Detragiache, Garella, and Guiso (2000).

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

[4] 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. Martinez Peria and Schmukler (2001) and Gunther, Hooks, and Robinson (2000) provide empirical evidence of depositors disciplining banks' risk taking.

(1992).[5] The present paper, however, focuses on vertical product differentiation since we are interested in the effect of reputation for quality which is intrinsically a vertical differentiation phenomenon.[6]

In the present paper we restrict our attention to debt taken from the banking sector only. 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)).[7]

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 our stylized theoretical model which illustrates some of the main forces behind product differentiation; 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. A theoretical model

In this section we introduce a stylized two-stage model which illustrates the product differentiation effect discussed above.

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

[5] For literature about relationship lending and/or competition in credit markets see for instance Boot and Thakor (2000), Petersen and Rajan (1994), Petersen and Rajan (1995), or Winton (1997). These papers, however, are silent regarding vertical differentiation issues.

[6] In the empirical model we do however control for some horizontally differentiated elements like geographic location.

[7] These particular OECD statistics are not published for the years after 1995. Note, however, that 1995 is in the middle of our data sample extending from 1993 to 1998.

differentiate themselves.

For simplicity, we study the case with two banks, bank A and bank B. At stage 1, banks choose their quality variables, q_i, $i = A, B$ and, at stage 2, banks choose interest rates, r_i, $i = A, B$ (price 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 point out some potential quality variables in banking.

Certification (signalling): Bank loans may signal the financial quality of the borrowing firm to other creditors and shareholders. A loan from a bank known to have a low level of loan loss provisions provides a more favorable signal than a similar loan from a high-loss bank. Low loan loss provisions can result from high skills in screening and monitoring or from the bank being very risk averse. An outsider cannot directly observe from which of these two low losses originate. However, in both cases obtaining a loan from such a bank would serve as a certification of high credit worthiness. 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, buyers, and other stakeholders. In their theoretical model Chemmanur

and Fulghieri (1994) also show how loans from a more reputable bank provide more information than loans from a less reputable bank. Furthermore 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.

Refinancing (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. All else equal, a bank that is more diversified would be less likely to suffer losses that may reduce its lending capacity. As larger banks tend to be more diversified than smaller ones, borrowers concerned about refinancing would prefer borrowing from larger banks. Furthermore, borrowers may believe a larger bank is also more likely to be considered as "too big to fail" by the government.

Borrowers are assumed to have access to an investment project with present value, V (not including financing costs). There is a continuum of borrowers indexed by R on the unit interval $[0, 1]$ with unit density according to borrowers' increasing appreciation for banks' quality. By $\gamma \cdot R_j$ we denote borrower j's quality appreciation. The scale parameter, $\gamma \geq 0$, is introduced in order to study how more heterogeneity among borrowers (i.e. increase in γ) may affect competition and product differentiation. A borrower of type R_j gains $\gamma \cdot R_j \cdot q$ utility from borrowing from a bank with quality q.

As an example, a borrower who does not need refinancing in the future has a low R (possibly 0). In contrast, a borrower who is locked into a relationship with a particular bank (high switching cost) and needs refinancing in the future, would have a high R.[8] Banks cannot observe the Rs but they are well aware of the distribution

[8] See for example Sharpe (1990) and von Thadden (1998) for a discussion of switching costs due to information asymmetries between lenders.

of Rs in the economy.

Furthermore, we assume for simplicity that a bank's cost, $e(q)$, associated with choosing a quality level, q, different from the cost minimizing level, q_0, is quadratic,

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

where β is a positive parameter. Note that the cost minimizing quality level, q_o, can be interpreted as the quality level that a bank would have chosen if borrowers did not appreciate the quality level in question. Note also that if both banks choose the cost minimizing level of q (i.e. $q_0 = q_A = q_B$), banks would offer identical services and competition would be fierce. Hence, banks have incentives to deviate from q_0 and thereby soften competition.

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

2.1. Competition at stage 2

First, let us examine the demand for loans 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 j compares the net benefits from using bank A and bank B:[9]

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

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

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

$$\begin{aligned} V - r_A + q_A \gamma \widehat{R} &= V - r_B + q_B \gamma \widehat{R} \\ \widehat{R} &= \frac{r_A - r_B}{\gamma \left(q_A - q_B\right)} \quad . \end{aligned}$$

[9] 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: $p\left[V - r_i + q_i R_i\right]$. The choice between the two banks would, however, not have changed.

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

$$D_A(r_A, r_B) = \begin{cases} 0 & \text{if } \widehat{R} \geq 1 \\ 1 - \widehat{R} & \text{if } 0 \leq \widehat{R} \leq 1 \\ 1 & \text{if } \widehat{R} \leq 0 \end{cases}$$

$$D_B(r_A, r_B) = \begin{cases} 0 & \text{if } \widehat{R} \leq 0 \\ \widehat{R} & \text{if } 0 \leq \widehat{R} \leq 1 \\ 1 & \text{if } \widehat{R} \geq 1 \end{cases},$$

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:

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

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

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

Notice that there are two effects stemming from a change in a bank's quality variable on the equilibrium interest rate charged. First, there is a direct effect on the demand for its loans. If bank quality improves, borrowers are willing to pay higher interest rates. Second, there is an indirect competition effect on the equilibrium interest rate charged. If bank A (the high quality bank) improves its quality, the two competing banks will become more differentiated 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 that of the direct effect. In equilibrium, quality improvement of the low quality bank induces 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:

$$\begin{aligned} q_A^* &= q_o + \frac{2}{9}\frac{\gamma}{\beta} \\ q_B^* &= q_o - \frac{1}{18}\frac{\gamma}{\beta} \end{aligned} \tag{2.4}$$

Proposition 1 sums up our predictions from the theoretical model.[10]

Proposition 1.

i) If borrowers become more heterogenous, banks find it profitable to become more specialized:

$$\frac{d\,(q_A^* - q_B^*)}{d\gamma} > 0.$$

ii) If banks become more differentiated, their interest rates and profitability increase:

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

[10]Since we are not interested in the profit of banks as such but only banks' behavior, we do not specify the first-stage profit functions in Proposition 1.

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

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

Proof: i) Follows directly from (2.4) ii) The first part follows from (2.2), the second part and iii) from (2.3).

More heterogenous borrowers (i.e., higher γ) makes product differentiation a more efficient way to soften competition. As borrowers become more heterogenous both the high and low quality banks find it worthwhile to increase their investments in product differentiation (see (2.4)). Moreover, part iii) implies that both banks would prefer to be the high quality bank but ii) implies that both would loose if both become high quality banks (i.e., $q_A - q_B$ is small).[11]

3. Empirical model

In this section we present the empirical model that can facilitate a test of the refinancing hypothesis and the certification hypothesis. This is done by testing whether borrowers are willing to pay a premium for certain quality variables or characteristics of a bank according to the theoretical model presented in Section 2. The quality variables used in this test are the capital ratio of the bank, loan losses, and its size. Furthermore, according to the prediction of Proposition 1 ii) as banks are more dispersed in terms of a certain bank quality variable that borrowers may be willing to pay for, competition is softened. Although the focus of this model is vertical product differentiation, we also control for a major element of horizontal product differentiation, namely geographic location. This is done by dividing the country into separate regional markets.

The general structure of our empirical model is:

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

[11] 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.

where $s_{i,c,t}$ is the spread over the period t money market interest rate on loans from bank i in market c in period t, and $\mathbf{s}_{i,c,t-h}$ is a vector of its lagged values. $\mathrm{v}(\mathbf{q})_{i,c,t-h}$ 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 c in period $t-h$. $h \in [0,2]$ is the appropriate lag length for the various explanatory variables. $\mathrm{g}(\mathbf{q})_{c,t-h}$ is a vector containing for each bank quality variable a measure of the inequality in that variable across banks in market c 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 $s_{i,c,t}$. $\mathbf{f}_{c,t-h}$ is a vector of variables specific to market c in period $t-h$. ν_i is a bank specific dummy accounting for bank specific effects remaining constant over time and markets. ρ_c is a dummy variable for the markets, taking care of market specific effects which are constant over time and banks. τ_t is a dummy variable for periods representing macro economic effects which are constant across banks and markets. Finally $\epsilon_{i,c,t}$ is the mean zero error term.

The type of interest rates we consider here are the credit line interest rates banks charge firms. Hence $s_{i,c,t}$ 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 since they often are uncollateralized (see Berger and Udell (1995)).[12] 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. Moreover, a bank providing a credit line loan may also serve as a certifier, signalling the quality of the borrowers. Hence we test the hypothesis that credit line borrowers are willing to pay a premium for borrowing from a bank of high quality.

The theoretical model in section 2.1 predicts that the bank exhibiting higher value of a certain quality variable, will be able to charge a higher equilibrium interest rate. This is the motivation for specifying the variables $\mathrm{v}(\mathbf{q})_{i,c,t-h}$ in (3.1) 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

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

is referred to as vertical differentiation. However, when more than two banks are competing in the same market it is not only a bank's relative position vis à vis other banks, 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. This is the motivation for including $\mathrm{g}\left(\mathbf{q}\right)_{c,t-h}$ in (3.1) representing the cross-sectional inequality or dispersion of the quality variables in each market. As will be shown below, the Gini measure of inequality is used to represent the degree of dispersion.

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. During the crisis three of the four largest banks failed and were recapitalized by the government subject to trimming of the banks' balances and operating costs. Small 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. 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. In fact in most industrialized countries facing a banking crisis, the crises have been resolved in similar ways by capital injection or even government takeover of the failed banks, see (Lumpkin, 2002, p. 123).

The data are annual and include banks ranging from small local savings banks to large nationwide banks. This large variation in the data ensures a relatively large dispersion of the various banks' characteristics. The data consist both of balance sheet 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.[13] Norway is divided into 19 counties. Loans outstanding for each bank are also reported by county.

Markets are defined by geography. We define each county as one market. The capital Oslo, which itself is a county, and the county surrounding it, Akershus, are, however, 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.[14]

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 of the banks other than loans are not specified by county. However, the characteristics of a banking firm that we test for in this model (its ability to refinance a borrower or to act as a certifier for the borrower) would be constant across counties. Put differently, a bank's reputation regarding the characteristics considered in this paper is related to the whole bank's performance and not associated with a particular branch or market segment in which it operates. Hence for our purpose lack of these data by county can not be considered a severe limitation.

A summary of the variables used in the estimation and their definition are presented in table 3.1

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

[14] 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

The spread is calculated as the difference between a weighted average of interest rates on credit lines for all customers of a bank at yearend minus the three month money market interest rate at yearend. Spread is reported in pct. Assets, credit line loans and loans are measured in NOK billions, 1 NOK $\approx$ 0.125 EUR. Operating costs are measured in NOK millions. Capital ratio is measured according to the Basel 1988 Accord. Loss provisions are the stock of accumulated loss provisions relative to the stock of loans outstanding. Operating cost ratio is operating costs relative to loans outstanding. These variables are measured by bank and year. The Herfindahl index of market concentration is based on loans to businesses in each county and year.

3.2. Specification of the empirical model

We estimate the following version of (3.1):

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

where all variables are measured in ln and α_1, α_2, $\boldsymbol{\beta}$, $\boldsymbol{\eta}$, $\boldsymbol{\delta}$, and $\boldsymbol{\mu}$ are parameters to be estimated.[15]

To control for the element of $s_{i,t}$ that is due to each bank's borrower risk we use lagged values of $s_{i,t}$ and bank dummies. It is well known from other empirical work that the portfolio of a bank's borrowers changes slowly over time (see for instance Ongena and Smith (1998), Degryse and van Cayseele (2000) and Kim, Kliger, and Vale (2003)). Given this persistence in each bank's composition of borrowers, borrower idiosyncratic factors like risk can be partially controlled for by bank dummies

[15] A linear version of the same model did not pass the RESET test for functional form. By using ln both for the LHS and RHS variables, the estimated coefficients are interpreted as elasticities.

and partially by lagged LHS variables. Furthermore, the macroeconomic part of the loan portfolio risk is controlled for by the time dummies and the regional specific part by the regional dummies.[16]

In what follows we present the definition of the RHS variables used to estimate (3.2):

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

$v(\mathbf{q})_{i,c,t-1}$ 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 county c in period $t-1$. $g(\mathbf{q})_{c,t-1}$ is a vector containing for each bank quality variable a measure of the inequality in that variable across banks in county c 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' $\mathrm{v}(\mathbf{q})_{i,c,t}$ are vari-

[16] In a previous version of the model we used another way of controlling for borrower risk. See discussion in section 4.

ables 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 from its relevant market's median in the following way[17]:

$$\mathrm{v}(q)_{i,c,t} = \frac{q_{i,t}}{\underset{i \in c}{\text{median}}\,(q_{i,t})}.$$

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

As mentioned earlier, the dispersion of quality variables is of great importance since it softens competition. For dispersion we use the Gini measure of inequality calculated as follows:

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

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

where n_c is the number of banks operating in county c, 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 all else equal, the less likely it is that the bank will suffer huge losses and be forced to reduce its lending activity. Furthermore, borrowers may believe that a larger bank is also more likely to be considered as "too big to fail" by the government.

*cap*88 (capital ratio (Basel 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, if borrowers are willing to pay for this sign of quality. This may be so if they need future refinancing, and are locked in, as described earlier.

loss (ratio of accumulated loss provisions to loans outstanding) represents the results of the bank's ability to screen and monitor, as well as a bank's willingness to

[17] When taking the ln of $\mathrm{v}(q)_{i,c,t}$, then this variable will be the ln difference from the median.

take on risk in its loan portfolio. Thus borrowers who need to signal their quality to their other stakeholders can do so by borrowing from a bank that has suffered few loan losses (see the discussion of the certification role of banks in section 2). Low loss provisions will also increase the probability that the bank can maintain its solvency and hence its capacity to refinance borrowers in the future. To the extent borrowers are willing to pay for this quality variable, the expected impact of $\mathrm{v}(loss)_{i,c,t-1}$ on the spread is negative. The accumulated loss provisions is a good indicator of the credit quality of a bank's loan portfolio. According to the accounting standard for Norwegian banks in force during our sample period, banks are required to increase their loss provisions when and only when they get information indicating that the credit quality of their portfolio has deteriorated. This can be information on specific loans, for instance a borrower defaulting on his payments of interest and installments, or specific information regarding the overall loan portfolio. Thus, accumulated loss provisions in this data set are not general reserves that banks are allowed to set aside in good times independently of the level of risk in their loan portfolios.

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 assumption about heterogeneous borrowers 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, $costrat_{i,t}$ (ratio of materials and wage cost to loans outstanding) represents the banks' ability under imperfect competition to pass their operating costs on to their credit line borrowers.

The regional Herfindahl index $herfin_{c,t}$ (Herfindahl index of the bank to business credit market in county c in year 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.[18] The dummies control for bank, regional, and time specific effects.

Our model will support the refinancing hypothesis if the variables relating to banks' future lending capacity (the capital ratio, assets (size/diversification), and loan loss provisions) are found to be significant quality variables. However, if only low loan loss provisions are found to be a significant quality variable our model would support the certification hypothesis and not the refinancing hypothesis.

4. Results

The model presented 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.[19] 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.

[18] See for instance Bulow and Klemperer (2002) who construct a theory model of auctions where a reduction in the number of bidders actually raises the price when bidders are asymmetric.

[19] 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 $\mathrm{v}(\mathbf{q})_{i,c,t-1}$:		
$\ln \mathrm{v}(assets)_{i,c,t-1}$	0.0278 (1.31)	–
$\ln \mathrm{v}(cap88)_{i,c,t-1}$	−0.1389 (−3.19)	−0.1562 (−4.37)
$\ln \mathrm{v}(loss)_{i,c,t-1}$	−0.1458 (−5.68)	−0.1193 (−6.23)
Gini coefficients of quality $\mathrm{g}(\mathbf{q})_{c,t-1}$:		
$\ln \mathrm{g}(assets)_{c,t-1}$	−0.0266 (−0.09)	–
$\ln \mathrm{g}(cap88)_{c,t-1}$	−0.061 (−0.97)	–
$\ln \mathrm{g}(loss)_{c,t-1}$	0.1552 (3.16)	0.1528 (3.91)
Controls $(\mathbf{x}_{i,t}; \mathbf{f}_{c,t}; dummies)$:		
$\ln costrat_{i,t}$	0.8217 (3.52)	0.7880 (3.43)
$\ln herfin_{c,t}$	0.0396 (0.54)	–
υ_i	in	in
ρ_c	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. $v(\mathbf{q})_{i,c,t-1}$ 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 county c in period $t-1$. $g(\mathbf{q})_{c,t-1}$ is a vector containing for each bank quality variable a measure of the Gini coefficient of that variable across banks in county c in period $t-1$. Numbers in parentheses 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 Breusch-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 are reported.

We find the following variables insignificant; $\ln \mathrm{v}(assets)_{i,c,t-1}$, $\ln \mathrm{g}(assets)_{c,t-1}$, $\ln \mathrm{g}(cap88)_{c,t-1}$, $\ln herfin_{c,t}$, and the county dummies. Exclusion of these insignificant 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 residuals. Note that due to the log-linear specification all coefficients of the model can be interpreted as elasticities.

The refinancing hypothesis implies that borrowers care about bank characteristics which indicate to what extent a bank will be able to stay behind its borrowers and extend loans in the future. In line with the previous discussion this hypothesis will gain support if size, capital ratio, and loan losses turn out to be significant quality variables. In contrast, if borrowers only care about certification (signalling), only the quality of a bank's loan portfolio (loan losses) would be significant.

Our results lend support to the certification hypothesis since only loan loss provisions (quality of the loan portfolio) turns out to be a significant quality variable. Size and capital ratio turn out to be insignificant as quality variables. Consequently the refinancing hypothesis is not supported by our empirical results.

Banks can charge a premium to borrowers that want to signal their credit worthiness by borrowing from a low loss bank. Furthermore banks can segment the markets according to borrowers' willingness to pay for using low-loss banks.

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 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.[20] This suggests that there is 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 and significant sign for $\ln \mathrm{v}(cap88)_{i,c,t-1}$ may be explained by different degrees of risk aversion among banks: Banks with high degree of risk aversion

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

choose to operate with both 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. This may explain why well-capitalized banks charge low interest rates.[21] However, this result is not robust to shortening the length of the sample, as $\ln \mathrm{v}(cap88)_{i,c,t-1}$ becomes insignificant when the two first years are taken out (see the discussion of robustness below).

Among the control variables the coefficient of the $costrat_{i,t}$ is positive and significant. This may indicate that 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. However, neither this is a robust result, since its coefficient turns insignificant when the time length of the sample is shortened.

As the Herfindahl index does not obtain a significant coefficient we cannot say which is the more important theory; the traditional view of more concentrated credit markets leading to higher interest rates or the theories of 'winner's curse'.

Our results that borrowers facing high switching costs do not seem to care about the future lending capacity of their bank, may stem from the way the banking crisis in the early nineties was handled by the Norwegian government. All banks – with one minor exception – were recapitalized or merged into other larger banks, such that lending activities could continue.[22] This may explain why borrowers are not concerned with bank solvency. In fact in most industrialized countries facing a banking crisis, the crises have been resolved in similar ways by capital injection or even government takeover of the failed banks, see (Lumpkin, 2002, p. 123).

As some of the government induced mergers during the banking crisis were not fully implemented until 1994, borrowers may not have rationally anticipated the

[21] Similarly, a bank very close to or even below the minimum capital requirement may behave like a risk lover by lending to high-risk borrowers from which it charges a high interest rate.

[22] In fact Ongena, Smith, and Michalsen (2003) 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 (2002) finds evidence that small firms borrowing from problem banks were not negatively affected due to their bank relations.

outcome of this process as early as of 1993 or 1994. To account for this we reestimated our model, first taking out the year 1993 and then also leaving out 1994. The negative and significant coefficient for the capital ratio remained when just 1993 was taken out but it became insignificant when both 1993 and 1994 were taken out. The effect of operating costs, however, was insignificant in both subsamples. However, our main result of low loan loss provisions as a significant quality variable was not changed in any of these overlapping subsamples. This further strengthens the hypothesis of the certification role of banks when it comes to market discipline from borrowers. In a previous specification of the model, instead of using dummies to control for borrower risk, we used the loan loss ratio on credit line loans and the real money market interest rate. Our main qualitative results were similar to those of the model presented here. This indicates that our main results are relatively robust to different ways of controlling for borrower risk. The current specification, however, performs better in terms of misspecification tests than the previous one.[23]

This paper lends further support to the hypothesis of banks as certifiers already found in existing litterature. James (1987) finds a positive stock price response to the announcements of bank loans, whereas Lummer and McConnell (1989) find evidence that favourable loan renewals in particular give excess return to the stock issued by the borrowing firm. Billett, Flannery, and Garfinkel (1995) demonstrate that the equity response increases with the credit rating of the lender. In a recent paper Cook, Schellorn, and Spellman (2003) examine a sample of syndicated loans and show that lenders can extract a certification premium from borrowers, particularly so when collateral is missing. In the present paper we also find evidence of certification premiums for uncollateralized loans – lines of credit. This, however, relates to all loan sizes and not just to loans granted to publicly quoted firms, as in the litterature mentioned above. Furthermore we demonstrate how banks' ability to act as certifiers can be used strategically when banks compete in credit markets.

[23] To further check the robustness of our results we reestimated the model for the whole sample including other potential quality variables like the size of a bank's branch network and the liquidity of a bank. Neither of these two quality variables came out significant however, nor did their inclusion have any impact on the other estimated coefficients.

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 avoid 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 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. We do, however, find empirical support for the banks' ability to avoid losses, as a strategic variable, indicating that the quality of a bank's loan portfolio is used to certify the credit worthiness of borrowers. This implies that borrowers in the market for credit line loans can discipline banks to avoid future losses. Hence, banks may face market discipline not only from the liability side (extensively discussed in the litterature), but also from the asset side. This further strengthens the arguments for putting more emphasis on Pillar 3 of the Basel II which promotes transparency and market discipline.

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