Management international
International Management
Gestiòn Internacional

Impact of Banking Competition on the Use of Soft Information
Impact de la concurrence bancaire sur l'utilisation de l'information soft
Impacto de la competencia bancaria sobre el uso de la información soft

Jérémie Bertrand et Jean-Christophe Statnik

Volume 23, numéro 2, 2019

URI : https://id.erudit.org/iderudit/1060036ar
DOI : https://doi.org/10.7202/1060036ar

Aller au sommaire du numéro

Éditeur(s)

HEC Montréal
Université Paris Dauphine

ISSN

1206-1697 (imprimé)
1918-9222 (numérique)

Découvrir la revue

Citer cet article

Bertrand, J. & Statnik, J.-C. (2019). Impact of Banking Competition on the Use of Soft Information. *Management international / International Management / Gestiòn Internacional*, *23*(2), 127–146. https://doi.org/10.7202/1060036ar

Résumé de l'article

Durant les 20 dernières années, la question de l'impact de la concurrence bancaire sur le choix entre le financement relationnel ou transactionnel a longuement été débattue sans aboutir à une réponse claire. Dans cet article, nous construisons une nouvelle mesure du financement relationnel basée sur le niveau d'information soft utilisée par la banque lors de la tarification du crédit. Cette nouvelle mesure permet de montrer que les banques préfèrent utiliser le financement relationnel lorsque la concurrence est faible. En outre, nous confirmons les conclusions théoriques antérieures : la relation entre la concurrence et le financement relationnel est concave.

Impact of Banking Competition on the Use of Soft Information

Impact de la concurrence bancaire sur l'utilisation de l'information soft

Impacto de la competencia bancaria sobre el uso de la información soft

JÉRÉMIE BERTRAND
ISA Lille – GRECAT
LSMRC Université de Lille

JEAN-CHRISTOPHE STATNIK
ISA Lille – GRECAT
LSMRC Université de Lille

ABSTRACT

Over the past 20 years, scholars have discussed the impact of banking competition on the choice between transactional and relationship lending technologies extensively, but no resolution has emerged. To address these questions, this article uses a new measure of relationship lending that accounts for the actual level of soft information that banks use in their loan pricing. With this new measure, the analysis reveals that banks prefer to implement relationship lending technology when competition is weak. In addition and in accordance with extant theoretical conclusions, the shape of the relationship between competition and relationship banking is nonlinear and concave.

Keywords: Banks, Lending Technologies, Banking Competition, SME

RÉSUMÉ

Durant les 20 dernières années, la question de l'impact de la concurrence bancaire sur le choix entre le financement relationnel ou transactionnel a longuement été débattue sans aboutir à une réponse claire. Dans cet article, nous construisons une nouvelle mesure du financement relationnel basée sur le niveau d'information soft utilisée par la banque lors de la tarification du crédit. Cette nouvelle mesure permet de montrer que les banques préfèrent utiliser le financement relationnel lorsque la concurrence est faible. En outre, nous confirmons les conclusions théoriques antérieures : la relation entre la concurrence et le financement relationnel est concave.

Mots-Clés : Banques, Technologies de financement, Concurrence bancaire, PME

RESUMEN

Durante estos 20 últimos anos, los investigadores discutieron acerca del impacto de la competencia bancaria en cuanto a la elección entre la relación bancaria y la relación tecnológica, pero ninguna se impuso. Este artículo se basa en una nueva medida de relación bancaria: el nivel real de informaciones soft en las que se basan muchos bancos para fijar los precios de sus préstamos. Con esta medida, nuestro análisis revela que los bancos apuestan por una relación bancaria cuando la competencia no es relevante. Además, la forma de la relación entre la competencia bancaria y la relación bancaria es cóncavo.

Palabras Clave: Bancos, relación bancaria, competencia bancaria, PyME

To price the credit sought by firms, banks must estimate the quality of each applicant's project accurately. They use different sources of information: accounting and financial data, credit history, firm characteristics, potential competitors, abilities of managers and so on. As Stein (2002) suggests, this information can be split into two parts. "Soft information" corresponds to qualitative details, such as the business skills or honesty of the firm manager. "Hard information" instead encompasses all quantitative data, such as accounting and financial data and credit scores. Using these two kinds of information, Berger and Udell (2006) distinguish two main categories of lending technology:

- *Transaction-based lending technology*, primarily based on borrowers' hard information.
- *Relationship lending technology,* primarily based on borrowers' soft information.

As Elsas (2005) notes, the choice between these two technologies depends on the characteristics of the borrowers, the bank and the market. Evidence clearly indicates that small and medium-sized enterprises (SME) and non-hierarchical banks benefit more from the relationship lending technology (Berger and Black, 2011; Berger *et al.*, 2005; Berger and Udell, 1995), but the impact of banking competition on the choice between transactional and relationship lending technologies remains uncertain. Mayer (1988) proposes an initial answer, by arguing that competition and relationship banking cannot coexist, because firms can easily switch banks, so banks have no interest in developing relationships. Petersen and Rajan (1995) adopt a similar view, then show theoretically and empirically that a bank in a competitive sector restrains its credit and uses only transactional lending. Ogura (2010, 2012) and Fischer (2000) confirm this discovery empirically.

In contrast, with their theoretical model, Boot and Thakor (2000) show that the greater the competition between banks, the more banks engage in relationship lending. Their result reflects an informational advantage, such that accurate and private information about borrowers provides good protection against banking competition. Dell'Ariccia and Marquez (2004) go a step further and demonstrate that when competition increases,

Pour citer cet article : Bertrand, J. & Statnik, J. C. (2018). Impact de la concurrence bancaire sur l'utilisation de l'information soft. *Management international*, 23(2), 127-146.

banks should extend their lending activities to include more "opaque" firms (i.e., the flight to captivity) (see also Hauswald and Marques, 2006). Schmeits (2005) also points out that competition is necessary to initiate relationship lending, because without competition, banks use the flexibility inherent in these contracts to demand high rates (i.e., holdup problem). Bonfim, Dai and Franco (2009), Montoriol-Garriga (2005), Black and Strahan (2002) and Memmel, Schmieder and Stein (2008) empirically validate these theoretical results.

How can we explain these discrepancies in empirical results? A first explanation is based on a non-monotonic approach to the relationship between banking competition and relationship lending. Even if relationship lending provides some protection against banking competition, this protection might weaken when competition increases: More lenders implies lower monopoly rents. The costs of achieving relationship lending are fixed though, so there is a threshold for competition, beyond which building a relationship is unprofitable and banks prefer to offer transactional lending. The relationship between competition and relationships then might not be monotonic but rather concave, prompting transactional lending when competition is low, relationship lending when it is medium and then transactional lending again when competition is high (Anand and Galetovic, 2006; Dinç, 2000; Yafeh and Yosha, 2001). Although Elsas (2005) and Degryse and Ongena (2007) empirically confirm this nonlinear relationship, they observe a convex, rather than concave, form. Finally, this nonlinear relation could be apparent rather than actual. As Presbitero and Zazzaro (2011) show, the nonlinear relationship between banking competition and the supply of relationship lending disappears when bank size is taken into account. Greater concentration causes banks to refocus on their core business, namely, relationship lending for small banks and transactional lending for large ones.

Another explanation relies instead on the measures of relationship lending that prior studies adopt. First, studies vary in how they measure relationship lending (Table A1 in the Appendix outlines the relationship proxies used in prior research). For example, Petersen and Rajan (1995) use firm age, whereas Bonfim *et al.* (2009) use the number of banks. These differences could affect the outcomes. The conflicting results obtained by Montoriol-Garriga (2005) and Petersen and Rajan (1995) illustrate this problem succinctly: Both use the same database (NSSBF 1988), but the former measures relationship lending according to the number of banks, whereas the latter relies on the age of the company. Second, measures of relationship lending may be problematic. For example, the size of a bank seems like an ambiguous proxy, and Uchida *et al.* (2012, p. 97) even show that though "loan officers at small banks produce more soft information than a large bank, large banks have the equivalent potential to underwrite relationship loan."

Finally, most empirical studies distinguish relationship and transactional lending using what may be an overly simplistic categorization, with the assumption that the two technologies are mutually exclusive (e.g., Petersen and Rajan, 1995; Berger and Black, 2011). However, Uchida *et al.* (2006) and Bartoli *et al.* (2013) show that banks frequently rely on multiple lending technologies banks to finance SMEs. Assessing lending technologies without considering the potential complementarity among them thus might bias some results and explain the conflicting conclusions reached thus far.

The main goal of this article is to address the impact of banking competition on lending technologies by using a new measure of the relationship lending technology that captures the amount of soft information that the bank uses to price the loans requested by firms. We do not attempt to include all dimensions of relationship lending but instead acknowledge that banks and firms implement this form of financing for two main reasons, beyond increasing the information held by the former about the latter. First, some firms seek a protection against troubled times. With a longstanding relationship, a bank can support its customer, even during bad periods (e.g., by charging lower interest rates), and in return, the customer compensates for the loss when its situation improves (Sharpe, 1990). Second, such relationships help banks cross-sell other products or services to borrowers (Santikian, 2014).

To measure relationship lending technology according to the amount of soft information used by the banks in the loan process, we start at the same point as Cerquiero *et al.* (2011), who seek to explain the dispersion of loan rates offered by banks to small enterprises. In a frictionless world, such dispersion should not exist, and similar firms obtain similar rates. In reality though, "frictions in the credit market enable banks to price in a discretionary manner" (Cerquiero *et al.*, 2011, p. 503). The greater these frictions, the less standardized is the lending technology used by a bank (loan officer). To go a step further, we seek to distinguish the use of soft information by the bank from other frictions in the credit market. Thereby we can build a measure of the use of soft information by banks, according to the level of standardization in the lending process. Moreover, our methodology disentangles transactional-based and relationship lending technologies without assuming that they are mutually exclusive. Rajan *et al.* (2015) propose a similar methodology in a different context, in that they study the behavioral changes exhibited by lenders in response to the boom in securitized subprime mortgages. With securitization, soft information becomes less valuable than hard information, so a lender's incentive to produce the former information is weak, and interest rates become worse predictors of default. However, Rajan *et al.* (2015) do not explicitly measure relationship lending as we do; instead, they regress loan interest rates (mortgages) on some indicators of hard information to deduce (using R-squares) the level of hard information that the lender uses to price the loan.

With our measure built, we next can turn to the issue of the impact of banking competition on lending technologies and, more precisely, on the use of soft information by the bank when it prices a loan. We show that banks prefer to implement relationship lending technologies when competition is weak. This result has important consequences in terms of regulation. Indeed, it is now well-known that the main benefits of bank–firm relationships result from improved credit availability (Petersen and Rajan, 1994; Berger and Udell, 1995; Berger *et al.* 2005). Consequently, it could be inappropriate fostering banking competition in countries where firms are heavily dependent on bank credit.

With regard to the shape of the relationship between competition and lending technology, we also find, in accordance with extant theoretical conclusions, that the relationship is nonlinear and concave.

In Section 2, we describe the method we implemented to build our proxy for relationship banking and the econometric model that we use to measure the impact of banking competition on relationship lending. After we describe the database and variables in Section 3, we present the model results and the impact of competition in Section 4. Section 5 contains the robustness tests, and Section 6 reports on a panel analysis based on two databases (NSSBF 98 and SSBF 03). Finally, Section 7 concludes.

Models

Measure of lending technologies

To build our measure of relationship lending technology, we start with the methodology proposed by Cerquiero *et al.* (2011), which we introduced previously, and then go a step further. In particular, we split the non-standardized technology into two parts. The first is a pure discretionary technology, such as when the loan officer's judgment might be affected by levels of bargaining power (for the bank or firm), experience, the gender of the applicant and so on. The second part is relationship lending, which accounts for the effects of this kind of financing on the rate charged by the bank. Our goal is to capture the amount of soft information the bank uses to price some loan, so we distinguish seeking better information from the other two central relationship lending objectives that we described in the introduction. Accordingly, our starting point is the following loan pricing equation:

$$Spread_i = a + b\times Hard_i + c\times Soft_i + d\times Disc_i + e\times OtherRel_i + f\times Control_i + \varepsilon_i. \quad (1)$$

In this equation, the interest rate (variable "Spread") charged by a bank depends on the level of hard and soft information used by bank to value the quality of the firm's project (variables "Hard" and "Soft"). But some discretion can add noise to the loan-pricing process (variable "Disc"). The establishment of relationship lending for reasons other than collecting soft information also affects the interest spread (variable "OtherRel"). Finally, the spread depends on contract characteristics, some macroeconomic variables and firm characteristics (variable "Control"). Because soft information by definition is non-quantifiable, it is not available in databases (e.g., SSBF 2003). We only have access to hard information, discretionary behavior and contract variables. Therefore, we use the following equation:

$$Spread_i = a + b\times Hard_i + c\times Disc_i + d\times OtherRel_i + e\times Control_i + \varepsilon'_i. \quad (2)$$

$$\text{where: } \varepsilon'_i = Soft_i + \varepsilon_i. \quad (3)$$

Equation 2 is the heart of our measure of relationship lending. Suppose a firm obtains a loan from a bank that resorts to mainly hard information in its risk assessment. In this case, the previous regression presents a weak error (small ε'_i). In contrast, if the bank uses a great deal of soft information, the error will be high. We apply this idea to our sample. First, we regress the spread on variables measuring hard information (vector "Hard$_i$"), discretionary behavior, contract variables and some other control variables. Second, we sort out all individual loans with high residuals. Because the residuals capture the quantity of soft information that banks take into account, we define our first measure of relationship lending technology as follows:

- SOFT1: Continuous variable corresponding to the square of the residuals.

To check the results we obtain with this continuous variable, we also build three binary measures:

- SOFT2: Dummy that takes a value of 1 when the absolute value of the residual of observation "i" is greater than 1 times the standard deviation of the regression's residuals.
- SOFT3: Dummy that takes a value of 1.1 when the absolute value of the residual of the observation "i" is greater than 1.1 times the standard deviation of the regression's residuals.
- SOFT4: Dummy that takes a value of 1.2 when the absolute value of the residual of the observation "i" is greater than 1.2 times the standard deviation of the regression's residuals.

Our methodology differs from that used by Cerquiero *et al.* (2011), in that we do not use a regression with multiplicative heteroskedasticity (Harvey, 1976). This methodology may seem appropriate, because it allows residual variance to vary across different observations. But even if the variance equation in the heteroskedastic regression can measure the impact of some variables on residual variance, it does not provide an explicit measure of relationship banking.

Relationship lending technology and competition banking

The second, main step addresses the impact of banking competition on lending technologies. We test the following equation:

$$Soft_i = a + b.Comp_i + c.Relation_i + \varepsilon_i. \quad (4)$$

The variable Soft$_i$ corresponds to our one of the four proxies of relational lending technologies (SOFT1, SOFT2, SOFT3, SOFT4) from the previous section. The vector Comp$_i$ measures banking competition. In line with previous research (e.g., Degryse and Ongena, 2007; Ogura, 2010; Petersen and Rajan, 1995), we use the Herfindahl-Hirschman index[1] (HHI) for the commercial bank deposits of the metropolitan statistical area (MSA) or county[2] where the firm's headquarters are located. Finally, Relation$_i$ is a vector of control variables related to relationship lending.

Data

The database

The 2003 Survey of Small Business Finances (SSBF), conducted by the Board of Governors of the Federal Reserve System, provides our data. The database contains information on 4240 SMEs, defined here as firms with fewer than 500 full-time-equivalent employees. For these firms, the detailed information includes balance sheets and income statements (e.g., liabilities, assets,

1. This index equals the sum of the squared market shares times 10,000.
2. In the United States, there are 3,144 counties and county equivalents and 381 MSAs.

income), firms' and owners' characteristics and relationships with financial service suppliers for a broad set of products and services (Mach and Wolken, 2006). This database often supports research on relationship banking (e.g., Berger and Black, 2011; Berger and Udell, 1995; Petersen and Rajan, 1994), though it contains sparse information about banks' characteristics. Beyond the advantage of being accessible for free, this database is interesting for two main reasons. First, it contains a great deal of information about SMEs, which suffer substantial information asymmetry and for which the benefits of relationship lending are thus the greatest. Second, the survey underlying the database is renewed regularly, so we can compare our model and results over time.

Because accounting data in SSBF 2003 are available only for 2003, we only retain firms that received credit during 2003 or 2004. In the sample of 1502 firms that negotiated credit in 2003 or 2004, we removed 76 finance, insurance and real estate firms (so-called FIRE firms), due to their specificities, as well as 185 firms that did not obtain loans from commercial banks. Of the remaining 1241 firms, only 688 provided all the needed variables (e.g., spread, credit score, maturity). Finally, we excluded 12 firms that had been in business for less than two years, because establishing a strong relationship takes time, and it is difficult for very young firms to implement such a relationship.

With the remaining 676 observations, we built a data set with five types of variables: firm characteristics, bank characteristics, loan characteristics, bank–firm relationships and market characteristics. Table A2 in the Appendix details the data set.

Variables used to measure relationship lending

Recall that we obtain a proxy of relationship lending from Equation 2:

$$Spread_i = a + b\times Hard_i + c\times Disc_i + d\times OtherRel_i + e\times Control_i + \varepsilon'_i. \quad (2)$$

The dependent variable is based on the spread, defined as the percentage over the index of the loan. Banking competition clearly influences the spread (Degryse and Ongena, 2005). We need to control for this influence without using banking concentration, a variable that is central to our regressions (Equations 4) for the impact of banking competition on lending technologies. To resolve this issue, we decided to subtract the spread of a firm by the mean spread of the zone of competitiveness in which the firm is located. Our dependent variable (SPREAD2) is the result. Yet we also recognize that this subtraction could affect our measure of relationship banking[3]. Indeed, if the mean spread of the zone of competition included a lot of soft information, then subtracting spreads by the mean spread would remove a significant portion of soft information. Thus, our measures of soft information constructed from residuals[4] would be biased[5]. To test this possibility, we regressed the mean spread of the zone of competitiveness on two variables (often used as proxies of soft information):

- PERSONAL: Dummy equal to 1 if the most frequent method of conducting business with the bank offering the credit is personal.
- DREL: Dummy that takes a value of 1 if the firm has only one bank and if the length of the relationship with this bank at the time of application is at least two years. This variable integrates two classic dimensions that characterize a strong relationship between banks and firms: duration and exclusivity.

Neither of these variables correlates with our variable of interest (Table A3).

Next, we split our vector of hard information into five variables: [6] the firm's rating on Dun & Bradstreet Rank Credit Score (D&B); the firm's leverage (LEVERAGE), as measure of its creditworthiness (D'Auria *et al.*, 1999); the owner's experience, which offers a proxy of the owner's rating (EXP); the previous firm's bankruptcy (BANKRUPTCY); and an interaction (dummy) that combines D&B ´ DSIZE to control for ratings according to firm size.

As we noted previously, the "Disc" vector corresponds to discretionary variables that are not formally linked to the relationship lending. It comprises four subgroups of variables. The first group contains variables that capture the reason the firm applied for credit (CAPT1, CAPT2, NOBANK, CHANGEBK); a second group of variables pertains to firm manager characteristics, including gender (FEMALE) and ethnicity (WHITE, BLACK, HISP, ASIAN); the third group captures the influence of the size and the structure of the firm (SIZE, OWNER AGE, CORPORATE, SUBS); and the fourth features bank characteristics (BHC).

Our strategy for separating the non-standardized technology into two parts (pure discretionary and relationship banking) becomes an issue for the variable that measures the physical distance between the firm and its main bank office (DISTANCE). On the one hand, the distance between a firm and its bank increases information asymmetry and thus implies more noise in loan pricing (Cerquiero *et al.*, 2011). On the other hand, this variable appears connected to relationship lending, such that a shorter physical distance might facilitate soft information gathering by the loan officer and help establish a lending relationship (Berger *et al.*, 2005). We decided to follow Cerquiero *et al.* (2011) and integrate DISTANCE into the "Disc" vector.

As explained previously, we also control for the other type of relationship lending, for which we include seven dummy variables that reflect why the firm applied for credit from this institution: PRIORRL, LGPOLICIES, PREVLOAN, PDTQ, PDTA1, PDTA2 and PDTA3.

Finally, we include several groups of control variables. Loan characteristics might explain some variability in the spread, such as loan maturity (MATURITY), its amount (AMOUNT), its type (CREDIT LINE, LEASING CAPITAL, MVE LOAN), potential partial credit rationing (RATIONING) and the amount of guarantee required (GARANTY). We also include the cost of the loan (COST) to the applicant, because sometimes banks

3. We thank Hans Degryse, who noted this potential problem during a 3L workshop.

4. See part "*Measure of lending technologies*"

5. To check if our main results are not dependent on this subtraction, we test without subtracting the mean spread, the results remain the same; they are available on request (we thank an anonymous referee for this suggestion).

6. We also test with the square of all hard variables; the results remain the same.

decide to offer a low spread but compensate for it with high fees. We control for the value of the original index[7] to which the credit is tied (INDEX1, INDEX2). A second set of control variables integrates industry specifications (five dummies), the year (one dummy) and the area, as represented by two sets of variables: eighteen dummies (one by geographical area) and URBAN (equal to 1 if the firm is located in a rural county). Finally, similar to Ogura (2010), we include the default premium (DEFAULT PREM) and term premium (TERM PREM) of the market when credit is applied. For a complete description of each variable, see Table A2.

Variables in the analysis of banking competition

To study the impact of banking competition on the choice of lending technology, we test:

$$Soft_i = a + b.Conc_i + c.Relation_i + \varepsilon_i. \quad (4)$$

The dependent variable is one of the four proxies of relationship lending (SOFT1, SOFT2, SOFT3, SOFT4). As noted previously, we measure banking competition using the Herfindahl-Hirschman index (HHI) of banks' market shares. Because the SSBF 2003 divides the concentration variable by 3, we created two dummies: HHI1, equal to 1 if HHI < 1000, and HHI2, equal to 1 if 1800 ≤ HHI. The vector Conc integrates these two dummies. The "Relation" control variables refer to relationship lending (DREL, PERSONAL) (Table A2).

Using the Herfindahl-Hirschman index (HHI) of banks' market shares as proxy of banking competition raises two issues[8]. Firstly, it is not a direct measure of banking competition. But it is currently well-established that the concentration measure could be a good approximation for bank market power (Fischer, 2000; Elsas, 2005; Boot and Thakor, 2000). Secondly, we use the concentration in the deposit market as the measure of the concentration in the market for SME. However, Petersen and Rajan (1995) explain that the concentration in the deposit market is a correct proxy of the concentration in the SME credit market, if the firms in the sample used borrow mainly from local markets. In our database (SSBF), we observe that half of our firms have their furthest bank maximum five miles away, and seventy-five percent below fifteen miles away. In addition, half of our firms have their main bank maximum three miles away and seventy-five percent below nine miles away. Consequently, we presume that the condition of Petersen and Rajan (1995) is respected and that our measure of concentration is a good proxy for the concentration in the SME credit market.

Results

Measure of relationship lending

Table A4-1 in the Appendix presents the results of the spread equation (Equation 2). In all regressions, we winsorize all our variables at 1%, to avoid potentially spurious outliers.[9] For the hard variable results, as expected, the coefficient of the D&B (rating) variable is negative and significant, in support of our intuition that a higher rating means a lower spread. In addition, LEVERAGE is negative and significant. Firms that choose their bank depending on their lending policies have a better spread than others.

Regarding the discretion variables, captive firms must pay a higher spread than others, and both HISP and WHITE are (highly) significant, such that the spread is higher if the manager is Hispanic or White, which suggests a surprising outcome. A firm in an urban area also has a higher spread than a firm in a rural zone. Regarding loan characteristics, we recognize a potential endogeneity problem between these variables and our dependent variable (SPREAD2), so we do not interpret these results. We do not rely on either measure or interpret the possible relation of causality between these variables though, so even if the problem is relevant, endogeneity does not affect our measures of the management of soft information (Introduction to Econometrics, 3/e Stock and Watson)[10].

Following the method we described in Section 2.1, we use residuals from Equation 3 to build our four indicators of relationship lending. Specifically, we determine our continuous variable (SOFT1) and the three binary proxies (SOFT2, SOFT3, SOFT4) when the absolute value of the residual of a given observation is greater than (respectively) 1, 1.1 or 1.2 times the standard deviation of the regression's residuals. Table A4-2 displays the results of each sort. For example, in the case of SOFT2, there are 151 observations (22% of our sample) for which the bank mainly used soft information to price the loan.

Concentration and relationship lending

Table A5 in the Appendix reports the results of our analysis (Equation 4), related to the impact of concentration on relationship lending. The first column corresponds to our continuous proxy (SOFT1), and the three others reflect our binary proxies of relationship lending (SOFT2, SOFT3, SOFT4). From the continuous proxy SOFT1, we determine that HHI1 is negative and significant, such that low concentration in the banking sector diminishes the probability that banks use soft information. Therefore, our results validate Petersen and Rajan's (1995) conclusions, rather than those proposed by Boot and Thakor (2000), regarding the impact of banking competition on the lending technologies that banks implement. For the dummy variables, we find that HHI1 is significant and negative for SOFT3 and SOFT4 but not for SOFT2. Perhaps banking concentration affects the important use of soft information by the bank (SOFT 3 and 4) rather than its mean use (SOFT2).

If HHI1 is almost always negative and significant, HHI2 is never significant. This result indicates that the link between the use of soft information and banking market concentration is nonlinear. To confirm this result, we test Equation 4 after replacing our $Conc_i$ vector variables with the HHI and its square

7. In SSBF, interest rates can be tied to the prime rate, LIBOR or some other index.

8. We thank an anonymous referee for pointing out these two issues.

9. We also conduct the tests without any winsorization, and the results remain the same. These results are available on request.

10. Stock and Watson (2011) explain that the endogeneity problem affects the value and the standard-errors of the coefficients in the regression but not the value of the residuals. As our measure of soft information is based on the residuals of the regression (equation 2), the endogeneity problem doesn't affect this measure.

(see Table A6). Coefficients of HHI and HHI² are, respectively, positively and negatively significant. Such results validate the anticipated nonlinear link and support theoretical findings by Dinç (2000), Anand and Galetovic (2006) and Yafeh and Yosha (2001): when banking concentration is weak this latter positively influences the use of relationship lending but this link is reversed when the competition is high.

By extrapolating results obtained for HHI and HHI² (Table A6, model 3) in the event that the bank concentration index fluctuates continuously between 1 and 3, we are able to determine the maximum reached by the variable Soft and find the probability that the bank will use relationship lending technology to price the loan increases to a maximum of almost 20% (19%) for a theoretical concentration of 2.68[11]. We interpret this result in the following way. In geographical areas characterized by a weak or medium banking concentration (HHI index equals 1 or 2), an increase of the banking concentration facilitates the establishment of relationship lending technology; this effect is reversed when concentration is strong (HHI index equals 3). Table A7 displays the distribution of our observations according to their location in one of the nine geographical divisions[12] and the average banking concentration in the division where the firm is based. We observe that 44% of our observations belong to a division[13] whose banking sector is very concentrated.

Finally, regarding the variables that characterize bank–firm relationships, we note that the personal contact between the firm and the bank does not seem to affect the use of soft information. The variable measuring the strength and duration of this relationship (DREL) reveals a positive and significant result though, in support of the accuracy of our approach.

Panel analysis

Panel sample

In this section, we construct a new sample by merging the 1998 NSSBF (224 observations of credit provided from 1996 to 1998) and the 2003 SSBF (676 observations of credit provided from 2003 to 2004). We thus obtain a new sample of 900 observations of credit provisions from 1996 to 2004 but use the same variables, with the exception of the dummy BHC, which is absent from the 1998 NSSBF. Table A2 contains the statistical description of the 1998 NSSBF.

Methodology

We follow the same methodology and first run our spread equation,[14.]

$$Spread_i = a + b{\times}Hard_i + c{\times}Disc_i + d{\times}Control_i + \varepsilon'_i.$$

Then we use the residuals to construct our continuous variable (SOFT1) and the three dummy variables (SOFT2, SOFT3, SOFT4) for use in the second equation:

$$Soft_i = a + b.Conc_i + c.Relation_i + \varepsilon_i.$$

Results

Table A8-1 in the Appendix displays the results for our first equation. As before, we do not interpret the loan characteristic variables, due to the endogeneity with our dependent variable. Table A8-2 details the number of soft variables further, according to this analysis.

Using these variables in our second equation, we obtain results for the linear impact of competition on the use of soft information (Table A9 in the Appendix). As these results show, HHI1 always exerts a negative, highly significant impact. Moreover, HHI2 is positive and significant, in support of our previous results. A high level of concentration leads to a preference for the use of soft information. Moreover, the results seem to indicate that concentration exerts a linear impact on the use of soft information, as supported by the evidence in Table A10. With a dummy variable that equals 1 if the credit was granted in 2003 rather than 1998 (Y2003), we estimate the same regression, splitting the impact of HHI1 and HHI2 according to this dummy. Whether in 1998 or 2003, the impact of concentration on the use of soft information by the bank remains the same: Low (high) concentration leads to a decrease (increase) in the use of soft information (Table A11). However, the nonlinearity is only significant in 2003 (Table A12). Finally and interestingly, we note that the variable DREL is always positive and significant, which confirms the appropriateness of our measure.

Conclusion

Questions about the impact of banking competition on the choice between transaction-based and relationship-based technology have persisted for decades (both empirically and theoretically), without any clear resolution. With this study, we seek to address these questions by using a new measure of relationship lending technology. Starting from the methodology developed by Cerquiero *et al.* (2011), we build an accurate measure of lending relationship technology that reflects the actual level of soft information a bank uses at the time of loan pricing, as precisely as possible. This new approach permits us to conclude that banks prefer to implement relationship lending technology when competition is weak, in support of Petersen and Rajan's (1995) findings. We also can specify the shape of the relationship between competition and relationship banking; in accordance with theoretical predictions from Dinç (2000), Anand and Galetovic (2006) and Yafeh and Yosha (2001), we find that the relationship between competition and relationship banking

11. This result is obtained in assuming the following relation $Soft = \Phi(-4.231 + 2.504hhi - 0.467hhi^2)$, where Φ is the cumulative normal distribution and *hhi* characterizes a continuous evolution of banking competition between 1 and 3 (as all other variables are non-significant, we do not take them into account.). We thank an anonymous referee for this suggestion.

12. The United States Census Bureau defines four statistical regions, with nine divisions: Middle Atlantic, South Atlantic, East North Central, West North Central, East South Central, West South Central, Mountain, Pacific and New England.

13. In SSBF 2003, HHI index is given by division.

14. Our dependent variable is still the spread of a firm minus the mean spread of the zone of competitiveness where the firm is located. We confirm and ensure that the mean spread of the zone of competitiveness is not correlated with any soft variable.

is nonlinear and concave: when the banking concentration is weak or medium, an increase in it facilitates the establishment of relationship lending technology, but this effect is reversed when the concentration is strong.

A first managerial implication of our results concerns firms issuing a lot of "soft information" as SMEs. As these firms are heavily dependent on relationship lending, they should favour banks located in areas with weak competition in order to maximize their access to credit.

The second implication concerns the organizational structure of banks. In following the theoretical work of Stein (2002), Berger *et al.* (2005) show that relationship and transactional banks do not have the same organizational form: the former is bigger and more centralized than the latter. Agarwal and Hauswald (2010b) go further by observing that "delegating real authority" to loan officers "provides strong incentives for collection, transmission, and strategic use of soft information"[15]. Hence, banks located in areas where the banking competition is weak should promote the development of relationship lending by a strong delegating authority and less turnover for loan officers, so that they can build strong relationships with firms.

Our conclusion also highlights a "dark side" of banking competition. Indeed, fierce competition could drive banks to focus mainly on hard information penalizing small and medium sized firms. This "dark side" appears all the more important as we observe an increase of banking competition all over the world (Mirzaei and Moore; 2014[16]). In that perspective, developing countries, whose economies are mostly characterized by small firms, should think twice before fostering banking competition.

Finally, at the European level, the non-linearity between bank competition and relationship lending should induce the regulator to take into account the heterogeneity of banking competition in each country. Table A13 displays banking concentration in the European Union in 2016 measured by the Herfindahl index of banks' market shares. We can observe a significant disparity in the banking structure: some countries have a highly competitive banking industry (Germany, Luxembourg, Austria), while others are characterised by a low level of competition in this sector (The Netherlands, Greece, Estonia). Consequently, a European policy seeking to improve business credit conditions (availability and cost) using competition in the banking sector as a lever could have opposite effects depending on the level of banking competition in each country. For instance, an increasing of the increase in banking competition would ease the use of relationship lending technology in The Netherlands and Greece but at the same time would be a brake on this kind of financing in Germany and Luxembourg.

References

Agarwal, S., Hauswald, R. (2010a). "Distance and Private Information in Lending". *The Review of Financial Studies* 23 (7), 2757-2788.

Agarwal, S., Hauswald, R. (2010b). "Authority and Information". *Working Paper*.

Anand, B.N., Galetovic, A., (2006). "Relationships, competition and the structure of investment banking markets". *Journal of Industrial Economics* 54, 2, 151-199.

Bartoli, F., Ferri, G., Murro, P., Rotondi, Z. (2013). "SME financing and the choice of lending technology in Italy: Complementarity or substitutability?" *Journal of Banking and Finance*, 37, 5476-5485.

Berger, A., Black, L., (2011). "Bank size, lending technologies, and small business finance." *Journal of Banking and Finance* 35, 3, 724-735.

Berger, A.N., Miller, N.H., Petersen, M.A., Rajan, R.G., Stein, J.C., (2005). "Does function follow organizational form? Evidence from lending practices of large and small banks." *Journal of Financial Economics* 76, 237-269.

Berger, A., Udell, G., (1995). "Relationship lending and lines of credit in small firm finance." *Journal of Business* 68, 3, 351-381.

Berger, A., Udell, G., (2006). "A more complete conceptual framework for SME financing." *Journal of Banking and Finance*, 30, 2945-2966.

Black, S.E., Strahan, P.E., (2002). "Entrepreneurship and bank credit availability". *Journal of Finance* 57, 6, 2807-2833.

Bonfim, D., Dai, Q., Franco, F., (2009). "The number of bank relationships, borrowing costs and bank competition". Working paper.

Boot, A.W., Thakor, A.V., (2000). "Can relationship banking survive competition?" *Journal of Finance* 55, 2, 679-713.

Cerquiero, G., Degryse, H. Ongena, S., (2011). "Rules versus discretion in loan rate setting." *Journal of Financial Intermediation* 20, 503-529.

D'auria, C., Foglia, A., Marullo Reedtz, P., (1999). "Bank interest rates and credit relationships in Italy." *Journal of Banking and Finance* 23, 1067-1093.

Degryse, H., Ongena, S., (2005). "Distance, lending relationships, and competition." *Journal of Finance* 60, 1, 231-266.

Degryse, H., Ongena, S., (2007). "The impact of competition on bank orientation." *Journal of Financial Intermediation* 16, 3, 399-424.

Dell'aricia G., Marquez, R., (2004). "Information and bank credit allocation". *Journal of Financial Economics* 72, 185-214.

Dinç, I.S., (2000). "Bank reputation, bank commitment, and the effects of competition in credit markets." *Review of Financial Studies* 13, 5, 781-812.

Elsas, R., (2005). "Empirical determinants of relationship lending." *Journal of Financial Intermediation* 14, 32-57.

Fischer, K.H., (2000). "Acquisition of information in loan markets and bank market power: An empirical investigation." *Working paper*, Johann Wolfgang Goethe University Frankfurt.

Harvey, A.C., (1976). "Estimating regression models with multiplicative heteroscedasticity." *Econometrica* 44, 3, 461-465.

Hauswald, R., Marquez, R., (2006). "Competition and strategic information acquisition in credit markets." *Review of Financial Studies* 19, 3, 967-1000.

15. Agarwal and Hauswald (2010), page 3.

16. This study is done across 146 countries.

Mach, T., Wolken, J., (2006). "Financial services used by small businesses: Evidence from the 2003 Survey of Small Business Finance." *Federal Reserve Bulletin*, October.

MAYER, C., (1988). "New issues in corporate finance." *European Economic Review* 32, 1167-1189.

Memmel, C., Schmieder, C., Stein, I., (2008). "Relationship lending: Empirical evidence for Germany." *Economic and Financial Reports 2008/1*, European Investment Bank, Economics Department.

Mirzaei, A., Moore, T. (2014). "What are the driving forces of bank competition across different income groups of countries?" *Journal of International Financial Markets, Institutions & Money* 32, 38-71.

Montoriol-Garriga, J., (2005). "Relationship lending: Does the number of banks matter? Evidence from the US." *Working paper.*

Ogura, Y., (2010). "Interbank competition and information production: Evidence from the interest rate difference." *Journal of Financial Intermediation* 19, 2, 279-304.

Ogura, Y., (2012). "Lending competition and credit availability for new firms: Empirical study with the price cost margin in regional loan markets." *Journal of Banking and Finance* 36, 1822-1838.

Rajan, U., Seru, A., Vig, V., (2015). "The failures of models that predict failure: Distance, incentives and defaults." *Journal of Financial Economics*, 115 237-260.

Petersen, M., Rajan, R., (1994). "The benefits of lending relationships: Evidence from small business data." *Journal of Finance* 49, 3-37.

Petersen, M., Rajan, R., (1995). "The effect of credit card competition on lending relationships." *Quarterly Journal of Economics* 110, 406-443.

Presbitero, A., Zazzaro, A., 2011. "Competition and relationship lending: Friends or foes?" *Journal of Financial Intermediation* 20, 387-413.

Santikian, L. (2014). "The Ties That Bind: Bank Relationships and Small Business Lending." *Journal of Financial Intermediation* 23, 177-213.

Schmeits, A., (2005). "Discretionary contracts, competition and bank–firm relationships." *Working paper,* Washington University in St. Louis, MO.

Sharpe, S. (1990). "Asymmetric Information, Bank Lending, and Implicit Contracts: A Stylized Model of Customer Relationships." *The Journal of Finance*, 45, 1069-1087.

Stein, J., (2002). "Information production and capital allocation: Decentralized versus hierarchical firms." *The Journal of Finance* 57, 1891-1921.

Stock, J., Watson, M. (2011). "Introduction to Econometrics, 3rd Edition. Pearson, 840 p.

Uchida, H., Udell, G., YAMORI, N. (2006). "SME financing and the choice of lending technology." *RIETI Discussion Paper Series*.

Uchida, H., Udell, G., Yamori, N. (2012). "Loan officers and relationship lending to SMEs." *Journal of Financial Intermediation*, 21, 97-112.

Yafeh, Y., Yosha, O., (2001). "Industrial organization of financial systems and strategic use of relationship banking." *European Finance Review* 5, 1-2, 63-78.

TABLE A1
Measures of relationship banking in prior literature

Theoretical studies	Empirical studies	Measure of relationship banking
Petersen and Rajan (1995)	Petersen and Rajan (1995)	Firm age
	Fischer (2000)	Quantity and type of information issued by firms
	Ogura (2010)	Inside bank (length of relationship and amount deposited in checking account)
	Ogura (2012)	Bank size
Boot and Thakor (2000)	Bonfim *et al*. (2009)	Number of banks
	Montoriol-Garriga (2005)	Number of banks
	Black and Strahan (2002)	Creation of new business
	Memmel, Schmieder and Stein (2007)	Length and strength of relation
Nonlinear relation	Elsas (2005)	Status of bank: main bank or not
	Presbitero and Zazzaro (2011)	Main bank's share of credit supply greater than one-third
	Degryse and Ongena (2007)	Length of relationship and status of bank (main or not)

TABLE A2
Descriptive statistics

Variables	Description	Mean		Std. Dev.	
		2003	1998	2003	1998
Firm characteristics					
SIZE	Natural logarithm of total assets	14.11	13.21	2.07	2.38
D&B (Rating)	Dun & Bradstreet Rank Credit Score: 1 = most risky; 6 = least risky	4.03	2.99	1.45	1.16
LEVERAGE	Log(Total debts / Total assets)	1.14	2.37	5.39	20.04
EXP (owner experience)	Weighted average experience of owners (year)	23.90	19.85	10.56	10.26
SIC1 (Construction)	1 if Construction industry	13.28%	12.05%	33.97%	32.63%
SIC2 (Manufacturing)	1 if Manufacturing industry	21.04%	17.86%	40.79%	38.38%
SIC3 (Wholesale)	1 if Wholesale industry	11.94%	12.95%	32.45%	33.65%
SIC4 (Retail)	1 if Retail Trade industry	17.01%	19.64%	37.60%	39.82%
SIC5 (Services)	1 if Services industry	32.09%	30.80%	46.72%	46.27%
SUBS (S-Corporation)	1 if the firm is a S-corporation	46.71%	39.29%	49.93%	48.95%
CORP (C-Corporation)	1 if the firm is a C-corporation	36.42%	35.27%	48.16%	47.89%
BANKRUPTCY	1 if the main owner has declared bankruptcy within the past 7 years	0.29%	0%	5.46%	0%
FIRM DEFAULT	1 if firm has been 60 or more days delinquent on business obligations within past 3 years	18.06%	81.69%	38.49%	38.76%
JUDGEMENTS	1 if at least a judgment has been rendered against the firm within the past 3 years	2.99%	3.12%	17.03%	17.44%
FEMALE	1 if the manager is a female	12.09%	18.75%	32.62%	39.11%
WHITE	1 if the manager is white	82.69%	82.14%	37.87%	38.38%
BLACK	1 if the manager is black	0.45%	5.36%	6.68%	22.57%
HISP	1 if the manager is Hispanic	2.54%	4.02%	15.74%	19.68%
ASIAN	1 if the manager is Asian	3.58%	8.48%	18.59%	27.92%
AGE	Age of firm in years	3.99	3.90	0.18	0.21
Bank characteristics					
BHC	1 if the bank is affiliated with a holding	87.61%	NC	32.97%	NC
Loan characteristics					
SPREAD	Percentage over index of the loan	1.305	2.18	1.456	2.37
SPREAD2	Percentage over index of the loan – mean spread of the zone of competitiveness of the firm	0	0	1.44	2.349
MATURITY	Maturity of the loan (months)	31.01	48.53	45.68	67.39
AMOUNT	Natural logarithm of the amount of the loan/credit granted/1000	5.93	5.10	1.81	1.82
INDEX1	1 if credit is tied to it, 0 otherwise	87.01%	100%	33.63%	100%
INDEX2	1 if credit is tied to it, 0 otherwise	7.91%	0%	27.01%	0%
RATIONING	Amount of credit granted/amount of credit applied	1.07	0.98	0.84	0.21
GARANTY (account_garanty)	1 if inventory or accounts receivable were required as collateral	37.16%	29.46%	48.36%	45.69%
COST (cost_loan)	(Total dollar amount of fees associated with obtaining the credit/Total amount of the credit granted) × 100 (in%)	41.01%	2.20%	102.03%	16.26%
YEAR_2003	1 if the loan is made in 2003, 0 otherwise	29.85%	-	45.80%	-

TABLE A2
Descriptive statistics

Variables	Description	Mean		Std. Dev.	
		2003	1998	2003	1998
YEAR_1997	1 if the loan is made in 1997, 0 otherwise	-	14.73%	-	35.52%
YEAR_1998	1 if the loan is made in 1998, 0 otherwise	-	31.25%	-	46.46%
MVE LOAN	1 if the loan is a mortgage, a vehicle loan or an equipment loan, 0 otherwise	7.61%	1.78%	26.54%	13.28%
CREDIT LINE	1 if the loan is a new line of credit or a line of credit renewal, 0 otherwise	54.17%	10.27%	49.86%	30.42%
LEASING CAPITAL	1 if the loan is a capital lease, 0 otherwise	0.15%	0%	3.86%	0%
PRIORRL	1 if, among all the reasons quoted by the firm in the question "why apply for credit from this institution?" the firm answers: Long-term relationship/ongoing relationship/prior relationship, 0 otherwise	39.64%	25%	48.95%	43.40%
LGPOLICIES	1 if the firm answers: Lending policies or terms, 0 otherwise	4.44%	2.68%	20.61%	16.18%
PREVLOAN	1 if the firm answers: Previous loan, loan when starting business, 0 otherwise	4.29%	0.89%	20.28%	9.43%
PDTQ	1 if the firm answers: Quality of service or of services, 0 otherwise	1.48%	3.57%	9.38%	18.60%
PDTA1	1 if the firm answers: Convenience/ease of use, 0 otherwise	5.32%	5.80%	22.47%	23.43%
PDTA2	1 if the firm answers: One-stop shopping, able to obtain multiple services at same institution, 0 otherwise	1.33%	0%	11.47%	0%
PDTA3	1 if the firm answers: Service availability (including credit card processing availability), 0 otherwise	2.07%	1.33%	14.25%	11.52%
CAPT1	1 if the firm answers: Seller referral (e.g. car dealer suggested loan company), 0 otherwise	0.15%	0%	3.84%	0%
CAPT2	1 if the firm answers: Captive finance (e.g. used financial institution owned by seller), 0 otherwise	0.30%	0%	5.43%	0%
NOBANK	1 if the firm answers: Credit needed, no other response given, 0 otherwise	4.29%	0%	20.29%	0%
CHANGEBK	1 if the firm answers: Dissatisfaction with previous institution, 0 otherwise	0.89%	2.68%	9.38%	16.18%
Bank-firm relation					
DISTANCE	Distance of the firm to its bank (in miles)	25.68	112.40	126.25	318.68
DREL (Relationship dummy)	1 if the firm has only one bank and if the length of relationship with this bank at time of application is at minimum 2 years (in%)	7.16%	26.79%	25.81%	44.38%
PERSONAL	1 if the most frequent method of conducting business with the bank which made the credit was in person	63.73%	42.86%	48.11%	49.60%
Market characteristics					
DEFAULT PREMIUM	The market yield on US Treasury securities of the closest term of the most recent loan minus the market yield on US Treasury securities at 3-month constant Treasury	0.91	0.46	0.88	0.39
TERM PREMIUM	Moody's yield on BAA seasoned corporate bond minus the market yield on US Treasury securities at 10-year constant maturity (in%).	2.28	2.05	0.296	0.35
HHI	Banking Market Concentration 2003 – 100% bank deposits. Variable equal to 1 if 0 < Herfindahl < 1000; 2 if 1000 ⩽ Herfindahl < 1800; 3 if 1800 ⩽ Herfindahl	2.378	2.51	0.603	0.59
HHI1	1 if commercial bank deposit Herfindahl index of MSA/county where firm's headquarters is located is HHI < 1000 (low concentrated) (in%)	6.42%	4.91%	24.53%	21.66%
HHI2	1 if commercial bank deposit Herfindahl index of MSA/county where firm's headquarters is located is HHI > 1800 (high concentrated) (in%)	44.18%	55.80%	49.70%	49.77%
URBAN	1 if the firm located in rural county (cf. MSA)	17.61%	0%	38.12%	0%
Number of observations		**676**	**224**		

This table contains the means and standard deviations of each variable for a sample of loans in the 2003 SSBF and 1998 NSSBF.

TABLE A3
Determinants of mean spread in SSBF 2003

Dependent variable	Meanspread
DREL	-0.035
	[0.306]
PERSONAL	0.008
	[0.644]
Constant	1.301***
	[0.000]
Observations	676
R-squared	0.006
Adjusted R-squared	0.003

This regression shows the impact of soft variables on the dependent variable of the mean spread of the zone of competitiveness (MEANSPREAD). The regression is robust to heteroskedasticity. We do not winsorize the variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ (in brackets).

TABLE A4-1
Determinants of spread in SSBF 2003, Equation 2 (winsorized at 1%)

Dependent variable	Spread2
Hard variables	
D&B	-0.123**
	[0.031]
LEVERAGE	-0.103**
	[0.038]
EXP	-0.013
	[0.253]
FIRM DEFAULT	-0.047
	[0.815]
JUDGMENTS	0.444
	[0.209]
BANKRUPTCY	-0.063
	[0.875]
D&B * SIZE	0.050
	[0.462]
Other Relationship variables	
PRIORRL	-0.201
	[0.311]
LGPOLICIES	-0.921**
	[0.010]
PREVLOAN	0.009
	[0.979]
PDTQ	0.193
	[0.594]
PDTA1	0.449
	[0.197]
PDTA2	0.035
	[0.922]
PDTA3	0.038
	[0.893]
Discretion variables	
CAPT1	5.426***
	[0.000]
CAPT2	0.312
	[0.662]

Dependent variable	Spread2
NOBANK	0.319
	[0.310]
CHANGEBK	-0.568
	[0.329]
SIZE	0.005
	[0.959]
OWNER AGE	1.024
	[0.124]
FEMALE	-0.043
	[0.854]
WHITE	0.276*
	[0.057]
BLACK	-0.182
	[0.766]
ASIAN	-0.109
	[0.803]
HISP	1.083***
	[0.003]
SUBS	0.217
	[0.382]
CORP	-0.031
	[0.899]
BHC	-0.114
	[0.589]
DISTANCE	-0.000
	[0.748]
Loan characteristics	
MATURITY	0.004
	[0.328]
AMOUNT	-0.288***
	[0.001]
CREDIT LINE	-1.059*
	[0.055]
LEASING CAPITAL	0.707
	[0.503]

Dependent variable	Spread2
MVE LOAN	-0.900
	[0.186]
RATIONING	0.025
	[0.856]
GARANTY	0.353**
	[0.030]
COST	0.136
	[0.180]
INDEX1	-0.435
	[0.236]
INDEX2	0.153
	[0.764]
Market characteristics	
DEFAULT PREM.	-0.284
	[0.173]
TERM PREM.	-0.194
	[0.695]
URBAN	1.875***
	[0.004]
Industry dummies	Yes
Year dummy	Yes
Area dummies	Yes
Constant	-0.714
	[0.808]
Observations	676
R^2	0.299
Adjusted R^2	0.226

This regression shows the impact of the rating on the spread of the last approved credit. Our dependent variable is SPREAD2, which is the spread minus the mean spread of the zone of competitiveness. We also add control variables for the firm's characteristics, contract variables and market characteristics. The regression is robust to heteroskedasticity. We winsorize the variables at 1%. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ (in brackets).

TABLE A4-2
Three binary proxies of relationship lending

Dummy variable	Number of observations	Percentage in the sample
SOFT2 (>σ)	151	22%
SOFT3 (>1.1σ)	128	19%
SOFT4 (>1.2σ)	111	16%

TABLE A5
Determinants of relationship lending in SSBF 2003, Equation 4 (winsorized at 1%)

	(1)	(2)	(3)	(4)
Dependent variable	**SOFT1**	**SOFT2**	**SOFT3**	**SOFT4**
	ε^2	1σ	1.1σ	1.2σ
Market characteristics				
HHI[1]	-0.792**	-0.312	-1.104***	-1.013***
	[0.012]	[0.444]	[0.000]	[0.000]
HHI[2]	0.191	0.233	0.171	0.153
	[0.629]	[0.201]	[0.357]	[0.424]
Bank-firm relation				
PERSONAL	0.029	0.023	-0.009	-0.067
	[0.943]	[0.912]	[0.966]	[0.762]
DREL	0.169	0.517*	0.207	0.255
	[0.649]	[0.052]	[0.437]	[0.350]
Constant	1.247***	-1.108***	-1.090***	-1.152***
	[0.000]	[0.000]	[0.000]	[0.000]
R^2	0.006			
Adjusted R^2	0.000			
Pseudo R^2		0.025	0.023	0.021
Observations	676	676	676	676

These regressions show the impact of the concentration on relationship lending. In an ordinary least squares regression (column 1), the dependent variable is the square of the residuals. The probit differences among columns (2), (3) and (4) come from the threshold chosen to define our Soft dummy. The three thresholds equal to 1σ, 1.1σ and 1.2 σ, respectively. We control for bank–firm relationship and firm characteristic variables. The regression is robust to heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ (in brackets).

TABLE A6
Determinants of relationship lending in SSBF 2003, Equation 5 (winsorized at 1%)

	(1)	(2)	(3)	(4)
Dependent variable	**SOFT1**	**SOFT2**	**SOFT3**	**SOFT4**
	ε^2	1σ	1.1σ	1.2σ
Market characteristics				
HHI	1.692	0.431	2.504***	2.304***
	[0.182]	[0.700]	[0.002]	[0.006]
HHI²	-0.300	-0.040	-0.467**	-0.430**
	[0.357]	[0.870]	[0.013]	[0.026]
Bank-firm relation				
PERSONAL	0.029	0.023	-0.009	-0.067
	[0.943]	[0.912]	[0.966]	[0.762]
DREL	0.169	0.517*	0.207	0.255
	[0.649]	[0.052]	[0.437]	[0.350]
Constant	-0.936	-1.812	-4.231***	-4.039***
	[0.416]	[0.141]	[0.000]	[0.000]
R^2	0.006			
Adjusted R^2	0.000			
Pseudo R^2		0.025	0.023	0.021
Observations	676	676	676	676

These regressions show the impact of the concentration on relationship lending. In an ordinary least squares regression (column 1), the dependent variable is the square of the residuals. The probit differences among columns (2), (3) and (4) come from the threshold chosen to define our Soft dummy. The three thresholds equal to 1σ, 1.1σ and 1.2 σ, respectively. We control for bank–firm relationship and firm characteristic variables. The regression is robust to heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ (in brackets).

TABLE A7
Distribution of observations according to their location (geographical divisions[17]) and the average banking concentration by division where the firm is based

	HHI < 1000 (HHI = 1)	1000 ⩽ HHI < 1800 (HHI = 2)	1800 ⩽ HHI (HHI = 3)	Total
New England	0	0	31	31
Middle Atlantic	0	41	38	79
East North Central	25	53	32	110
West North Central	4	31	35	70
South Atlantic	4	66	40	110
East South Central	4	25	13	42
West South Central	6	27	32	65
Mountain	0	21	30	51
Pacific	0	71	47	118
Total	**43**	**335**	**298**	**676**
%	6.36%	49.56%	44.08%	100%

17. The United States Census Bureau defines four statistical regions, with nine divisions: Middle Atlantic, South Atlantic, East North Central, West North Central, East South Central, West South Central, Mountain, Pacific and New England.

TABLE A8-1
Determinants of spread in SSBF 2003-1998, Equation 2 (winsorized at 1%)

Dependent variable	Spread2	Dependent variable	Spread2	Dependent variable	Spread2
Hard variables		CAPT2	1.410**	LEASING CAPITAL	2.158**
D&B	-0.070		[0.039]		[0.014]
	[0.289]	NOBANK	0.356	MVE LOAN	0.819*
LEVERAGE	-0.012		[0.315]		[0.094]
	[0.871]	CHANGEBK	-0.172	RATIONING	0.083
EXP	-0.004		[0.790]		[0.712]
	[0.725]	SIZE	0.050	GARANTY	-0.105
FIRM DEFAULT	-0.060		[0.590]		[0.545]
	[0.801]	OWNER AGE	0.158	COST	0.187**
JUDGMENTS	-0.499		[0.825]		[0.039]
	[0.277]	FEMALE	0.178	INDEX1	-0.508
BANKRUPTCY	0.151		[0.473]		[0.195]
	[0.668]	WHITE	0.236	INDEX2	-0.013
D&B * SIZE	0.000		[0.269]		[0.979]
	[0.998]	BLACK	-0.908	**Market characteristics**	
Reason variables			[0.143]	DEFAULT PREM.	-0.198
PRIORRL	-0.127	ASIAN	0.586		[0.260]
	[0.461]		[0.197]	TERM PREM.	-0.378
LGPOLICIES	-0.747*	HISP	0.968**		[0.441]
	[0.059]		[0.024]	URBAN	0.311
PREVLOAN	-0.119	SUBS	-0.030		[0.491]
	[0.675]		[0.898]		
PDTQ	0.396	CORP	-0.284	Industry dummies	Yes
	[0.441]		[0.241]	Year dummy	Yes
PDTA1	0.298	DISTANCE	0.001	Area dummies	Yes
	[0.464]		[0.217]		
PDTA2	0.004	**Loan characteristics**		Constant	0.084
	[0.992]	MATURITY	-0.001		[0.979]
PDTA3	0.014		[0.863]		
	[0.964]	AMOUNT	-0.241***	Observations	900
Discretion variables			[0.007]	R^2	0.188
CAPT1	4.531***	CREDIT LINE	0.441	Adjusted R^2	0.126
	[0.000]		[0.135]		

This regression shows the impact of the rating on the spread of the last approved credit. Our dependent variable is SPREAD2, which is the spread minus the mean spread of the zone of competitiveness. We also add control variables for the firm's characteristics, contract variables and market characteristics. The regression is robust to heteroskedasticity. We winsorize the variables at 1%. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ (in brackets).

TABLE A8-2
Three binary proxies of relationship lending in the panel analysis

Dummy variable	Number of observations	Percentage in the sample
SOFT2 (>σ)	188	21%
SOFT3 (>1.1σ)	156	17%
SOFT4 (>1.2σ)	134	15%

TABLE A9
Determinants of relationship lending in SSBF 2003-1998, Equation 4 (winsorized at 1%)

	(1)	(2)	(3)	(4)
Dependent variable	**SOFT1**	**SOFT2**	**SOFT3**	**SOFT4**
	ε^2	1σ	1.1σ	1.2σ
Market characteristics				
HHI	-1.357***	-0.938**	-0.884**	-0.860**
	[0.001]	[0.013]	[0.029]	[0.049]
HHI^2	0.878*	0.314**	0.245	0.251
	[0.098]	[0.034]	[0.113]	[0.115]
Bank-firm relation				
PERSONAL	-0.226	-0.127	-0.072	-0.025
	[0.664]	[0.397]	[0.647]	[0.879]
DREL	2.460**	0.662***	0.522***	0.477**
	[0.015]	[0.000]	[0.006]	[0.015]
Constant	1.763***	-0.942***	-1.061***	-1.159***
	[0.000]	[0.000]	[0.000]	[0.000]
R^2	0.040			
Adjusted R^2	0.036			
Pseudo R^2		0.062	0.042	0.038
Observations	900	900	900	900

These regressions show the impact of the concentration on relationship lending. In an ordinary least squares regression (column 1), the dependent variable is the square of the residuals. The probit differences among columns (2), (3) and (4) come from the threshold chosen to define our Soft dummy. The three thresholds equal to 1σ, 1.1σ and 1.2 σ, respectively. We control for bank–firm relationship and firm characteristic variables. The regression is robust to heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ (in brackets).

TABLE A10
Determinants of relationship lending in SSBF 2003-1998, Equation 5 (winsorized at 1%)

	(1)	(2)	(3)	(4)
Dependent variable	**SOFT1**	**SOFT2**	**SOFT3**	**SOFT4**
	ε^2	1σ	1.1σ	1.2σ
Market characteristics				
HHI	2.076	1.874*	1.843*	1.774
	[0.201]	[0.065]	[0.090]	[0.128]
HHI^2	-0.240	-0.312	-0.320	-0.304
	[0.567]	[0.151]	[0.167]	[0.218]
Bank-firm relation				
PERSONAL	-0.226	-0.127	-0.072	-0.025
	[0.664]	[0.397]	[0.647]	[0.879]
DREL	2.460**	0.662***	0.522***	0.477**
	[0.015]	[0.000]	[0.006]	[0.015]
Constant	-1.431	-3.442***	-3.468***	-3.489***
	[0.308]	[0.003]	[0.005]	[0.008]
R^2	0.040			
Adjusted R^2	0.036			
Pseudo R^2		0.062	0.042	0.038
Observations	900	900	900	900

These regressions show the impact of the concentration on relationship lending. In an ordinary least squares regression (column 1), the dependent variable is the square of the residuals. The probit differences among columns (2), (3) and (4) come from the threshold chosen to define our Soft dummy. The three thresholds equal to 1σ, 1.1σ and $1.2\,\sigma$, respectively. We control for bank–firm relationship and firm characteristic variables. The regression is robust to heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ (in brackets).

TABLE A11
Determinants of relationship lending in SSBF 2003-1998, Equation 4 (winsorized at 1%)

	(1)	(2)	(3)	(4)
Dependent variable	**SOFT1**	**SOFT2**	**SOFT3**	**SOFT4**
	ε^2	1σ	1.1σ	1.2σ
Market characteristics				
HHI	-0.656	-0.080	-0.082	0.002
	[0.265]	[0.883]	[0.891]	[0.997]
HHI[1] * Y2003	-1.543***	-1.685***	-1.548***	-1.878***
	[0.000]	[0.000]	[0.000]	[0.000]
HHI[2]	2.446**	0.723***	0.495**	0.492**
	[0.010]	[0.000]	[0.015]	[0.020]
HHI[2] * Y2003	-0.064	0.011	0.064	0.077
	[0.900]	[0.948]	[0.724]	[0.679]
Bank-firm relation				
PERSONAL	0.231	0.017	0.020	0.067
	[0.687]	[0.916]	[0.906]	[0.701]
DREL	2.197**	0.611***	0.491**	0.450**
	[0.029]	[0.002]	[0.013]	[0.028]
Constant	1.527***	-1.019***	-1.111***	-1.210***
	[0.000]	[0.000]	[0.000]	[0.000]
Year dummy	Yes	Yes	Yes	Yes
R^2	0.061			
Adjusted R^2	0.055			
Pseudo R^2		0.093	0.056	0.052
Observations	900	900	900	900

These regressions show the impact of the concentration on relationship lending. In an ordinary least squares regression (column 1), the dependent variable is the square of the residuals. The probit differences among columns (2), (3) and (4) come from the threshold chosen to define our Soft dummy. The three thresholds equal to 1σ, 1.1σ and 1.2 σ, respectively. We control for bank–firm relationship and firm characteristic variables. The regression is robust to heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ (in brackets).

TABLE A12
Determinants of relationship lending in SSBF 2003-1998, Equation 5 (winsorized at 1%)

	(1)	(2)	(3)	(4)
Dependent variable	**SOFT1**	**SOFT2**	**SOFT3**	**SOFT4**
	ε^2	1σ	1.1σ	1.2σ
Market characteristics				
HHI	5.095	0.569	0.895	0.993
	[0.270]	[0.709]	[0.588]	[0.545]
HHI * Y2003	1.576	3.568***	3.139***	3.777***
	[0.213]	[0.000]	[0.001]	[0.000]
HHI^2	-0.882	-0.040	-0.149	-0.184
	[0.458]	[0.904]	[0.674]	[0.603]
HHI^2 * Y2003	-0.214	-0.682***	-0.585***	-0.702***
	[0.517]	[0.002]	[0.007]	[0.003]
Bank-firm relation				
PERSONAL	0.580	0.095	0.093	0.157
	[0.325]	[0.576]	[0.597]	[0.401]
DREL	1.854**	0.538***	0.415**	0.356*
	[0.048]	[0.005]	[0.033]	[0.075]
Constant	-3.415	-1.653	-1.961	-2.045
	[0.342]	[0.324]	[0.283]	[0.259]
Year dummy	Yes	Yes	Yes	Yes
R^2	0.079			
Adjusted R^2	0.071			
Pseudo R^2		0.104	0.068	0.071
Observations	900	900	900	900

These regressions show the impact of the concentration on relationship lending. In an ordinary least squares regression (column 1), the dependent variable is the square of the residuals. The probit differences among columns (2), (3) and (4) come from the threshold chosen to define our Soft dummy. The three thresholds equal to 1σ, 1.1σ and $1.2\ \sigma$, respectively. We control for bank–firm relationship and firm characteristic variables. The regression is robust to heteroskedasticity. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$ (in brackets).

TABLE A13
Herfindahl index (HHi) for credit institutions in the EU in 2016

	HHI<1000	1000<HII<1800	HHI>1800
Austria	358		
Belgium		1017	
Bulgaria	939		
Croatia		1405	
Cyprus		1372	
Czech Republic		1009	
Denmark		1224	
Estonia			2406
Finland		1790	
France	572		
Germany	277		
Greece			2332
Hungary	879		
Ireland	644		
Italy	452		
Latvia		1080	
Lithuania			1938
Luxembourg	260		
Malta			1599
Netherlands			2097
Poland	659		
Portugal		1182	
Romania	894		
Slovakia		1264	
Slovenia		1147	
Spain	937		
Sweden	845		
United Kingdom	422		

The Herfindahl index (HHI) refers to the concentration of banking business. It is obtained by summing the squares of the market shares of all credit institutions in the banking sector (source: Statistical Data Warehouse 2016, European Central Bank).