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Credit market competition, collateral and young firms' finance [*♥]

Gabriel Jiménez
(Banco de España)

Vicente Salas Fumás
(Universidad de Zaragoza and Banco de España)

Jesús Saurina
(Banco de España)

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Abstract

This paper extends previous work on the relationship between credit market competition and the availability of bank credit for young firms of different credit quality, to situations where firms can pledge collateral to secure the loans. Bank loans data from the Spanish Credit Register show that the average credit quality of borrowers that get loans decreases with market concentration and with the availability of collateral in the market, although the effect of more collateral is lower in higher levels of concentration. Second, young firms of lower credit quality are less likely to pledge collateral, and pay higher interest for their loans than young firms of higher average credit quality; as firms get older lower quality firms are more likely to pledge collateral than high quality ones. Third, higher credit market concentration lowers the use of collateral for young firms. The evidence indicates that market power and collateral are substitutes to increase credit availability.

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Key words: collateral; asymmetric information; relationship banking; competition

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[♥] Address for correspondence: Jesús Saurina; C/Alcalá 48, 28014 Madrid, Spain. Tlf: + 34 91 338 5080; e-mail: jsaurina@bde.es.

1. Introduction

Are collateral and credit market competition complements or substitutes when it comes to facilitate access to banks' credit to young firms of different quality? The level of competition in credit markets has been shown to play a significant role in the availability and cost of bank finance for young firms (Petersen and Rajan, 1995). But much less is known about how credit market competition and the use of collateral interact in determining the availability and cost of credit, even though to pledge collateral is a common practice in loan contracts (Berger and Udell, 1990, 1995; Boot et al., 1991; Harhof and Körting, 1998; Jiménez and Saurina, 2004; John et al., 2003; Stultz and Johnson, 1985). This paper extends some of the basic predictions of Petersen and Rajan (1995) to the case where borrowers can pledge collateral to overcome situations of credit rationing, and tests the predictions with data on Spanish loans.

The use of collateral in loans has been explained as the consequence of information asymmetry in credit markets. When the quality of the borrowers is private information the rational credit rationing decision of lenders, Stiglitz and Weiss (1981), induces good borrowers to use collateral to signal high quality and get finance at lower interest rates (Bester, 1985; Besanko and Thakor, 1987a,b; Chan and Kanatas, 1985). To pledge collateral competes with forms of investing in information by banks about the quality of the borrowers, such as relationship lending and experience (Boot and Thakor, 1994, 2000; Manove and Padilla, 2001; Rajan and Winton, 1995), to manage credit risk. For young firms that do not have experience and relationships with banks the use of collateral may be the only way to provide valuable information about its credit quality. Petersen and Rajan (1995) explain how competition in the credit market may affect the availability and cost of debt for young firms in a world of adverse selection and moral hazard, but their analysis ignores the role of collateral in solving these problems.

Although theories of collateral predict that the use of collateral should be associated with lower credit risk, since those borrowers that pledge collateral are of high credit quality, empirical research has systematically found a positive association between collateral and risk (Berger and Udell, 1990, 1995; Jiménez and Saurina, 2004). To solve the puzzle a distinction is made between observed and private risk (Berger and Udell, 1990; Boot et al., 1991). When lenders can observe the credit quality of the

borrowers the rational decision is to ask collateral in loans made to bad quality borrowers and not to ask for collateral in loans to high quality ones. Moreover, in situations of moral hazard but no adverse selection to ask for collateral is more efficient than to ask for higher interest rates to compensate lenders for the risk they face (Boot et al., 1991). So the empirical evidence on the positive association between collateral and risk has been interpreted as evidence that observed risk and moral hazard dominate lending relations.

This paper compares the determinants of the terms of loans (i.e. collateral and cost) to young firms of different credit quality under different information asymmetries and market conditions. To do so, it takes advantage of the unique data set of the Credit Register of the Banco de España (CIR) that includes all new loans made to Spanish non-financial firms every year from 1993 to 2002. For each firm that gets a new loan we can observe its credit record in different moments of time and group them accordingly. The group of borrowers of observed low quality includes borrowers that, according to the CIR, have a loan in default at the time they get a new one. The group of unobserved (or imperfectly observed) low credit quality includes those borrowers that do not have a loan in default at the time they get a new one but default a year after. Borrowers that do not default immediately before or after they receive a loan are those of higher average credit quality. Among borrowers of observed low credit quality there are no opportunities to take advantage of the benefits of reputation and information acquisition under relational lending (Petersen and Rajan, 1994, 1995; Berger and Udell, 1995; Boot, 2000). However their credit availability can still be affected by credit market competitive conditions (Petersen and Rajan, 1995).

On the other hand, the use of collateral to signal credit quality is only feasible in the group of borrowers where credit quality is private information. If young firms use collateral to signal their quality, then loans made in period t to firms in the lower quality group (that default in t+1) are less likely to use collateral than loans made to firms that belong to the higher quality group (that do not default in t+1). Research on determinants of collateral (Berger and Udell, 1990, 1995; Harhoff and Körting, 1998; Degryse and van Cayseele, 2000) compares the likelihood of collateral in firms of different age but it ignores the possibility that, earlier in their life, firms use collateral to sort themselves as of high quality. We find evidence that use of collateral and credit risk are negatively

associated among young firms. So, high quality firms pledge collateral earlier in their life and get loans at lower interest rates than low quality ones. This evidence is consistent with theories that predict the use of collateral as a signaling device[1].

The second issue of interest in the paper is the effect of credit market competition in the availability and terms of credit to business firms. The empirical evidence provided in the paper indicates that in more concentrated credit markets and in markets with more collateral, the average credit quality of borrowers is lower than in less concentrated credit markets and in markets with less collateral. We also observe that concentration moderates the effect of more collateral in the availability of bank credit to low quality borrowers, in the sense that collateral lowers the credit quality of borrowers that get finance in higher proportion in more competitive credit markets than in less competitive, more concentrated, ones. The positive effect of market power in the availability of credit to borrowers of lower quality is shown in Petersen and Rajan (1995), but the interaction between credit market competition and use of collateral as joint determinants of the availability of credit for low quality borrowers are new in the literature.

Market power also affects the terms of individual loans to young firms. Young firms get loans in more favorable terms (lower use of collateral) in more concentrated credit markets than in less concentrated markets. As firms get older the differences in the likelihood of collateral as a function of market concentration disappear. Petersen and Rajan (1995) present evidence on the relationship between interest of loans and age of the firms in markets of different level of concentration, but the results on the relationship between credit market concentration and use of collateral are new in the literature. As well this is the first analysis of the determinants of the terms of loans distinguishing firms with observed low credit quality and the other ones where credit risk is private information.

Our panel data contrasts with the survey cross-section data used in previous related work (Petersen and Rajan, 1994, 1995; Berger and Undell, 1995; Harhoff and

[1] The result on use of collateral in young firms of low credit risk is also reported in Jiménez, Salas and Saurina (2004). We present it here for completeness.

Körting, 1998). Given that we have a time dimension, we can test the main hypothesis controlling for lenders individual effects and time varying effects. In ten years time (1993-2002), we cover an entire business cycle. The use of panel data to study the determinants of the terms of bank loans, as we do in this paper, is new in the literature. Moreover, our sample size is quite large in comparison to previous papers, covering a wide range of firm sizes[2]. In addition, we control directly for the quality of the borrowers thanks to the CIR data. Finally, the paper presents complementary evidence on the relative information content of accounting performance variables and of CIR based variables about the credit quality of the borrowers, and on the influence of relationship lending variables in the terms of loans.

The remaining of the paper is divided as follows. Section 2 contains the model while the hypotheses to be tested appear in section 3 and the results of the estimation in section 4. Finally, section 5 contains a discussion and the main conclusions.

2. A model of moral hazard in lending with collateral

The model is an extension of Petersen and Rajan (1995) on credit markets under problems of adverse selection and moral hazard. Our main contribution is to introduce the possibility that borrowers pledge collateral in the loan they receive. The use of collateral implies that lenders can charge higher interest rates in the early time periods without creating moral hazard problems in the decision about the project choice (safe or risky project), and that collateral lowers the quality of the marginal borrower that gets finance.

The model assumes a market with borrowers of two types, high and low quality. Borrowers can invest the funds of the loan in safe or risky projects. Variables I, S and R represent, respectively, the investment in the project and therefore the size of the loan, the value of the safe project at the end of the period and the value of the risky project also at the end of the period. Three moments of time are considered, the current period 0, the start of period 1 and the start of period 2[3]. Lenders want to finance entrepreneurs

[2] We do have information of more than 150.000 firms of all sizes, while Petersen and Rajan (1995), Berger and Udell (1995) and Harhoff and Körting (1998) focus on surveys of around 1.500 to 1.000 small firms.
[3] We assume that the reader is familiar with Petersen and Rajan's model.

that are sufficiently good to make non-negative expected profits and that choose safe projects. In period 0, when the information asymmetries exist, the lender has some discretion in how much interest to charge for the loan. But in period 1, under full information, it will charge the rate $M \geq 1$, where M=1 indicates that the credit market is competitive and interest rate is 0 (by assumption). Therefore, higher values of M indicate more market power by the lenders in the market. It is also assumed that the quality of entrepreneurs in the market, θ, is uniformly distributed between 0 and 1 in such a way that the probability that a borrower from this market is at least as good as θ_0 is equal to $1-\theta_0$.

Define by D_1 the amount the borrower repays in t=1, so that for the safe investments the new amount of funds to borrow in t=1 will be $I_{1s} - (S_1 - D_1)$. If the good entrepreneur chooses the safe project the profits will be,

$$\text{Max}\{S_2 - M[I_{1s} - (S_1 - D_1)], 0\}. \quad (1)$$

Similarly, if the entrepreneur can now pledge collateral C which will be lost if the project fails, the pay off from the risky project will be,

$$\text{Max}\{p(R_2 - M[I_{1r} - (R_1 - D_1)]) - (1-p)C, 0\}. \quad (2)$$

Taking into account the assumptions of the model the good entrepreneur will choose the good project if the expected profits of this choice are at least as high as the profits from the risky one, or if,

$$[S_1 - p\,R_1]/(1-p) + C/M \geq D_1. \quad (3)$$

A second condition for financing the investment is that the lender expects to recover the finance provided in t=0, I_0. Taking into account the interest it can charge at date t=1 and that the probability that the quality of the borrower is θ, this implies that D_1 must be at least,

$$D_1 \geq I_0/(M\theta) - [(M-1)/M]\,(I_{1s} - S_1). \quad (4)$$

Combining (3) and (4) the minimum value of θ that can get finance is given by θ_m such that,

$$\theta_m (M,C) = I_0(1-p)/[M(S_1 - pR_1) + (M-1)(I_{1s}-S_1)(1-p) + C(1-p)]. \quad (5)$$

Result 1:

a) As market power M of the lender increases, the threshold value of credit quality, θ_m, that gets finance decreases. Therefore, firms of lower credit quality will get finance (Petersen and Rajan, 1995).

b) The use of collateral C decreases the threshold value of θ_m, for a given market power. Thus, with collateral more firms of lower quality will get finance than without it.

c) The rate at which θ_m decreases with the use of collateral is lower in markets with more market power M, than in markets with less market power. This means that market power and use of collateral are substitutes when it comes to facilitate access to credit to borrowers of lower quality[4].

The explanation of these results is as follows. Higher market power means that the lender can charge higher interest rates in the future and therefore it can extract more rents from the borrower. In exchange, it can charge lower initial interest rate D_1, that in turn implies that the lender has more incentives to choose the safe project, for a given value of θ. Finally, the bank can accept a lower value of the probability of being a good borrower.

With collateral, the lender can charge a higher initial interest rate without violating the moral hazard constraint (3) than when there is no collateral, which again implies that the non negative profit condition of the lender can be satisfied with borrowers of lower quality. Result c) comes from equation (5) where market power and the use of collateral enter in a non-additive way and the presence of one of them moderates the contribution of the other to increase credit availability to borrowers of lower quality.

[4] That is, the cross derivative of θ_m in (5) with respect to collateral and market power M, is positive.

Petersen and Rajan (1995) extend the model to predict the interest rate charged to firms as a function of their quality, and how such interest rate should vary with the age of the firm. The two relevant boundaries for the interest rate charged in period 0, D_1, are equation (3), upper bound, and (4), lower bound. From (3), collateral increases the upper bound of the initial interest rate contracted. Taking into account that collateral reduces the quality of the last borrower that gets finance the lower bound (4) will also be different for the case with collateral than for the case without it. Therefore we can write:

Result 2:

a) The initial interest rate charged to the lowest quality borrower financed will decrease with lenders' market power (Petersen and Rajan, 1995).

b) For a given market power, the initial interest rate charged to the lowest quality firm financed in a market will be higher with collateral than without collateral, as θ_m is lower with collateral than without it (equation (5)).

c) The differences in the initial interest rate charged to the lowest quality firms in two markets with different market power will be higher with collateral than without collateral.

The Petersen and Rajan (1995) model predicts that in markets where lenders have market power, they charge lower than competitive interest rates when borrowers are young and the adverse selection and moral hazard problems are more severe. The reason is that lenders compensate these lower rates later, charging above competitive interest rates. As the borrower gets older some of these problems should be less severe, because of reputation, monitoring and survival of the fittest effects, and the cost of credit should go down (Diamond, 1991; Berger and Udell, 1995; Boot and Thakor, 1994). Since the model predicts that initial interest rates start higher in more competitive credit markets than in less competitive ones, then the pace of the decline should be higher in the former than in the later. From Result 2b above we also expect that the rate of decline will be higher with collateral than without it.

Result 3:

a) The relative decline in loan repayments as the borrower gets older is lower when the lender has more market power (Petersen and Rajan, 1995).

b) The relative decline in loan repayments as the borrower gets older is higher with collateral than without it.

2.1. Collateral and information

The exposition above extends the results of Petersen and Rajan (1995) to take into account the possibility that low quality borrowers pledge collateral in order to have access to credit. In fact, if we assume that the quality of the borrower θ is observable by the lender then, from equation (5), collateral can be written as a function of credit quality and the rest of the variables of the model,

$$C(M,\theta) = I_0/\theta - M(S_1 - pR_1)/(1-p) - (M-1)(I_{1s} - S_1) \qquad (6)$$

From this result we can make predictions about the determinants of collateral when quality of the borrower is public information:

Result 4:

a) When the quality of the borrower can be observed by the lender, collateral will be more likely among low quality borrowers (lower θ) and, for a given quality, less likely in markets where lenders have more market power (higher M). This result comes directly from the fact that C(M,θ) decreases with credit quality and with market power.

b) From (4) loan repayments are higher for borrowers of lower quality. Therefore those low quality borrowers that pledge collateral and get a loan will be charged higher initial interest rates than high quality ones.

Result 4b implies that the use of collateral and the interest rate of loans will be positively associated since both variables respond in the same direction to changes in the credit quality of the borrowers. The empirical evidence on the positive correlation between interest rates and the use of collateral in loans, Berger and Udell (1990, 1995), would be consistent with the situation where loans are made under conditions of observed risk.

There are situations when credit risk cannot be observed because it is private information of the borrower. This is especially likely among young firms for which relationship lending and other forms of producing information and reputation are ineffective to close the information gap. The literature on credit markets has shown that collateral can be used to signal borrowers' credit quality (Bester, 1985; Besanko and Thakor, 1987a,b; Chan and Kanakas, 1987). In equilibrium, high quality borrowers will be more likely to pledge collateral than low quality borrowers in exchange for low initial interest rates. The theoretical results are now formulated as follows.

Result 5:

a) When quality of the borrower is private information, collateral will be more likely among high quality borrowers, who will use collateral to signal their high quality.

b) High quality borrowers sorted this way will pay lower interests in their loans than low quality ones.

3. Data, empirical models and predictions

Our two main sources of information to test the theoretical results are the Credit Register (CIR) of Banco de España and accounting data (financial statements) that firms submit, at least annually, to the Commercial Register (Registro Mercantil). The CIR provides data on all *new loans* granted to firms by Spanish banks and other intermediaries during a given year. For each loan, information is available about type of instrument, currency, collateral, amount, maturity, identification of the borrower, industry, region, identity of the lender and if the loan is in default at the end of the year or not[5]. No information is available, however, about the interest rate charged to the loan, or about the purpose of the loan. We shall focus on new long-term financial loans to business firms every year from 1993 to 2002, that is loans with three or more years of maturity. Province level variables such as credit market concentration, availability of collateral and average credit quality of borrowers that get bank finance are all constructed taking advantage of the CIR database.

[5] Banks have access to the total exposure of the borrower in the Spanish banking system at the time the loan is granted, but they do not have previous information from the CIR. So, for instance, they know if the firm defaulted in t-1 although data on previous defaults is not available from the CIR for banks.

The financial statements (balance sheet and income statement), age and industry for each firm are obtained from the Spanish subsidiary of Bureau van Dyck, Informa, based mainly in the accounting statements firms report to the Commercial Register. The actual test of the theory will be adapted to the data availability and the purpose of this section is to present the empirical predictions and the models which we test.

3.1. Empirical model I. Credit availability to low quality borrowers

The first empirical analysis will concentrate in the predictions from Result 1 about the quality of borrowers that will get bank finance in credit market with more or less availability of collateral and with different banks' market power. Equation (3) and Result 1 are translated into the following empirical predictions:

i) a) *The average quality of borrowers obtaining finance should be lower in more concentrated credit markets (higher market power) and lower in markets where borrowers pledge more collateral.*
b) The difference in the average quality of borrowers in the market with less collateral, with respect to the quality in the market with more collateral, is higher in less concentrated credit markets.

We consider each one of the fifty Spanish provinces a different credit market. The quality of borrowers that get bank finance in each province is measured, in an inverse way, by the amount of loans in default (i.e. 90 days past due) over total outstanding loans to firms in the province I at the end of year t, $PRBADLO_{it}$. A higher value of the proportion of loans overdue will indicate that the quality of borrowers that get loans in the province is lower than in other provinces where the ratio is lower. The availability of collateral in each province is measured by the ratio amount of collateral over total amount of business loans in the province at the end of period t, $COLL_{it}$. Market power of banks will be assumed to be proportional to the concentration of the credit market in the province. Concentration in turn will be measured by the $HERFINDAHL_{it}$ index, where the index is computed as the sum of the squared market shares of all banks that grant loans in the province i in period t. This measure of concentration, and proxy for market power, is standard in the literature (Petersen and Rajan, 1995). To compute these variables we use *all* the loans made to business firms by Spanish banks and not only loans to firms that are in the sample studied in the two following empirical models.

Result 1 is a general one. So, there is no need to constrain the estimates to new loans or a sample of firms.

The empirical model is then formulated as follows:

$$PRBADLO_{it} = \alpha PRBADLO_{it-1} + \beta + \beta_1 HERFINDAHL_{it} + \beta_2 COLL_{it} + \beta_3 HERFINDAHL_{it} xCOLL_{it} + \eta_i + d_t + \varepsilon_{it}, \quad (E1)$$

where η_i is a dummy variable that takes the value of 1 for province i and 0 otherwise, d_t is a time dummy variable and ε_{it} is the error term. The time and province dummy variable control for unobserved effects.

Taking into account that the dependent variable is an inverse measure of credit quality of the borrowers in each market, the theory predicts (Result 1) that the estimated coefficients will satisfy $\beta_1>0$, $\beta_2>0$ and $\beta_3< 0$.

3.2. Empirical model II. Use of collateral in individual loans

The theory on determinants of the use of collateral in loans predicts that the likelihood of collateral will depend, among others, on the competitive conditions of the credit market and on the information asymmetry between borrowers and lenders. Market concentration, the Herfindahl index of concentration of the province, will control for differences in competitive conditions across markets, in an inverse way. The variable AGE, number of years since the firm was set up, used to sort borrowers of different age, is obtained from the Informa database. To determine the information asymmetry conditions, under which the loans are made, we take advantage of the credit record of borrowers in the Credit Register. The analysis will be limited to new long-term loans (over three years of maturity) since they concentrate most of the loans with collateral[6].

The information in the CIR allows us to group borrowers in three categories. Those that have a loan in default at the time they get a new loan, those that do not have a loan in default at the time they get a new one but default the year after, and the rest of

borrowers. Borrowers in the first group are considered of observed lower credit quality and are identified by the dummy variable $DEFAULT_{t-1}$ that takes the value of 1 if the borrower that gets the loan has a loan in default and 0 otherwise. Borrowers that default a loan in t+1 not having defaults in t-1, are identified by the dummy variable $DEFAULT_{t+1}$ that takes the value of 1 if the firm defaults in t+1 but did not have a default in t-1, and 0 otherwise. These borrowers reveal themselves ex post as of low credit quality but we do not know if their quality was observed or not by the lender at the time the loan was made. Their records in the CIR indicates that they are paying their loans' obligations but maybe lenders have other sources of information besides the Credit Register to know their quality.

In this paper we assume that the hypothesis that loans are made under private information about the credit quality of the lender holds among young borrowers with no record of past defaults. In this group there will be opportunities to use collateral to signal quality. However as firms get older the opportunities to observe the true credit quality of the borrower increases as more information outside the Credit Register accumulates over time. Therefore within borrowers in $DEFAULT_{t+1}=1$ the situation of observed credit risk in t is expected to increase with the age of the firm.

Taking into account the data availability the actual empirical predictions are formulated as follows:

ii) a) The likelihood of collateral is higher in the group of borrowers of observed lower credit quality, $DEFAULT_{t-1}=1$, than in the rest of borrowers.

b) The likelihood of using collateral in loans to young firms will be lower in more concentrated credit markets than in less concentrated ones.

c) The likelihood of collateral in loans to young firms is higher in the group of borrowers of (unobserved) higher average credit quality, $DEFAULT_{t+1}=0$, than in the group of borrowers of lower credit quality, $DEFAULT_{t+1}=1$.

d) As firms get older, the likelihood of collateral is higher in firms of lower credit quality, $DEFAULT_{t+1}=1$, than in firms of higher average credit quality, $DEFAULT_{t+1}=0$.

[6] In the population of loans, among long term loans 50% have collateral while among short-term loans the proportion of them that have collateral is only 8%.

Predictions ii)a) and ii)b) come directly from the model presented above (equation (6), Result 4a), assuming that market concentration is positively associated with market power. Prediction ii)c) comes from the literature on determinants of collateral as a signal of credit quality, Result 5a. This signaling makes sense in young firms when credit quality of the borrower is not observable. As firms get older, the assumption of observed risk is more realistic, and in this case Prediction ii)d) just indicates that conditions of observed risk at the time the loan is made are more likely as borrowers get older. From 5a, under observed risk the likelihood of collateral is higher in low credit quality borrowers than in good ones.

The model to be estimated is formulated as follows:

$$\Pr(COLLATERAL_{jkt} = 1) = F(\beta + \beta_1 DEFAULT_{kt-1} + \beta_2 DEFAULT_{kt+1} + \beta_3 AGE_{kt-1} + \beta_4 HERFINDAHL_{kt} + \beta_5 AGE_{kt-1} x HERFINDAHL_{kt} + DEFAULT_{kt+1} x(\beta_6 HERFINDAHL_{kt} + \beta_7 AGE_{kt-1} + \beta_8 AGE_{kt-1} x HERFINDAHL_{kt}) + ACCOUNTING\ \ VARIABLES_{kt-1} + RELATIONSHIP\ \ LENDING_{kt-1} + CONTROL\ \ VARIABLES_{kt}), \qquad (E2)$$

where $F(x) = 1/(1+\exp(-x))$ is the Logistic distribution function. Index *j* indicates loan, *k* indicates firm and *t* indicates time period. The dependent variable $COLLATERAL_{jkt}$ is a dummy variable that takes the value of 1 if loan j made to firm k in period t is made with collateral, and 0 otherwise. Besides the variables directly related with the predictions the model includes other explanatory variables that can be used to learn about the credit quality of the borrower (accounting variables and variables of relationship lending)[7], that have been associated with decisions about the use of collateral, and other control variables.

Prediction ii)a) implies $\beta_1>0$, while ii)b) implies $\beta_4<0$ and $\beta_5>0$ (if market concentration affects loans terms mainly among young firms). From prediction ii)c) $\beta_2<0$, while ii)d) implies $\beta_7>0$.

[7] In this model and in the next one all accounting and relationship lending variables are introduced into the model lagged one year to avoid possible endogeneity problems.

Lenders can infer the credit quality of borrowers using other information besides the record in the Credit Register, for example that contained in the financial statements of the firm. We take this into account by using accounting measures of size, profitability and solvency as additional explanatory variables of the use of collateral, ACCOUNTING VARIABLES. TOTAL ASSETS measure the size of the firm. Profitability is measured by ROA = Ebit / Assets. The solvency and liquidity variables are: equity to total assets ratio, EQUITY/TOTAL ASSETS, coverage of the interest expenses by the profits before interests, INTEREST INCOME/EBIT, debt maturity, SHORT TERM DEBT/TOTAL DEBT, the inverse of the current ratio, SHORT TERM DEBT/CURRENT ASSETS, and the liquidity ratio, CASH/TOTAL ASSETS. Size, equity finance, return on investment and liquidity should be positively correlated with credit quality, and lower the likelihood of collateral, while for the other variables the expected correlation will be negative.

The relationship lending variables used in the model are the number of years the borrower that gets the loan has been with the bank that grants it, DURATION, and the number of lenders the borrowers has relations with at the time of the loan, NUMBER OF LENDERS. Longer duration is expected to lower the likelihood of collateral if it means better sorting of borrowers, Berger and Udell (1995) or more trust in the borrower-lender relationship, Boot and Thakor (1994). But to increase it under hold up, Sharpe (1990), Rajan (1992). To have loans with more lenders may indicate that the borrower is of lower quality and banks want to share the risk with others in order to provide funds, in which case the association of this variable with collateral is expected to be positive. On the contrary, it may indicate higher competition among lenders and then, a negative sign would be expected.

The list of control variables includes: SIZE of the loan, the amount of money lent in thousands of euro; PROVINCE, a dummy variable that takes the value of 1 for the province where the firm that gets the loan is located and 0 otherwise; the dummy variable INDUSTRY that takes the value of 1 for the industry of the borrower; the dummy variable TIME that takes the value of 1 for year t in the period 1993-2002 and 0 otherwise; the dummy variable BANK that controls for differences in credit policies across banks in the sample.

3.3. Empirical model III. Cost of credit

The dependent variable is now the cost of credit. Since no information is available for the interest rate charged in each individual loan the cost of credit will have to be estimated at the level of the firm and for all the debt, bank and non bank. The unit of analysis is now the firm, not the individual loan as in the case of collateral.

The predictions from the theory are formulated as follows.

iii) a) The cost of credit will be higher in lenders of observed lower credit quality, $DEFAULT_{t-1}=1$.

b) The cost of credit will be lower for young firms in more concentrated credit markets than in less concentrated markets (Petersen and Rajan, 1995).

c) Young firms in the group of higher average credit quality, $DEFAULT_{t+1}=0$, will pay lower initial interests for their loans than firms of similar age in the group of firms of lower credit quality, $DEFAULT_{t+1}=1$.

Prediction iii)a) comes directly from Result 4b, while prediction iii)b) comes directly from Petersen and Rajan (1995). Prediction iii)c) comes from the result that young firms of higher credit quality are likely to use collateral to signal their quality and get lower interest rate, Result 5b.

The dependent variable is defined as the ratio between interest expenses as reported by the firm in the income statement and total debt in the balance sheet, COD = INTEREST EXPENSES/DEBT. The explanatory variables are the same as in the case of collateral but now we also introduce as additional control variables, lagged values of the dependent variable to account for the persistence of average cost of debt over time.

$$COD_{kt} = \beta + \beta_1 DEFAULT_{kt-1} + \beta_2 DEFAULT_{kt+1} + \beta_3 AGE_{kt-1} + \beta_4 HERFINDAHL_{kt} + \beta_5 AGE_{kt-1} x HERFINDAHL_{kt} + DEFAULT_{kt+1}(\beta_6 HERFINDAHL_{kt} + \beta_7 AGE_{kt-1}) + ACCOUNTING\ \ VARIABLES_{kt-1} + RELATIONSHIP\ \ VARIABLES_{kt-1} + CONTROL\ \ VARIABLES_{kt} + \varepsilon_{kt}. \qquad (E3)$$

Prediction iii)a) implies $\beta_1>0$; Prediction iii)b) implies $\beta_4<0$ and $\beta_5>0$; and Prediction iii)c) means $\beta_2> 0$, $\beta_7< 0$.

4. Results

4.1. Descriptive statistics of the variables

The descriptive statistics of the variables used in the analysis are presented in Table 1, including province level variables, variables referred to individual loans and variables referred to borrowers (firms)[8]. Loans in default represent, in average for all provinces and years, 5.41% of the total loans. The dispersion is fairly high as it goes from 0.37% to 28.34% with a standard deviation of 4.32%. The period under study includes the deep recession of the early nineties that affected more severely the most industrialized provinces of Spain. The average Herfindahl index across provinces and years is 7.57%, which implies an equivalent to around 14 banks of equal size in the province. Again, differences in concentration are rather high, and the numbers have to be interpreted under the intense merger activity that has taken place during these years, in both commercial and savings banks, and the expansion of savings banks outside their traditional territories. Finally, the collateral pledged in loans represents, on average, 25.5% of the face value of total loans, although in some province and time period collateral represented up to 58.7% of the total loans granted.

The sample of individual loans indicates that 49% of the long-term loans granted to business firms have collateral, a number in line with data from other countries, Berger and Udell (1990), Harhof and Körting (1998)[9]. The firms in the sample pay an average interest rate of 5.12% for their debt, but again we observe large differences among them and over time. Notice that some firms are subsidiaries that can get finance from the parent company at lower than market interest rates. Also note that during the

[8] The accounting and relationship lending variables have been winsorised setting the observations above (below) the 95th (5th) percentile at the value of the 95th (5th) percentile to eliminate extreme values of the variables that can distort the results.

[9] Note that in the data at the province level we have both short and long term loans while in the individual loans data we only consider long term loans, loans with maturity of 3 years or more. The proportion of loans with collateral among short term loans is only 8%, in average, so this explains the differences in the measures of collateral, 25.5% and 49%, in the two samples.

period of study the interbank or the money market interest rate in Spain has gone from around 15% in the early years of the period to less than 3% in the last part of the period.

In around 2% of the loans granted, borrowers that get the loan had a loan in default at the time they get a new one, while around 1% of those loans made to borrowers that did not have a loan in default defaulted one year after. Taking into account the sample size of 277,207 loans, this means that the sample sizes of loans to borrowers of observed low credit quality, $DEFAULT_{t-1}=1$, and loans to borrowers of unobserved credit quality but that reveal themselves as of low quality one year after, $DEFAULT_{t+1}=1$, are rather large to perform comparative analysis (5,540 and 2,772 observations, respectively).

The average age of firms in the sample is around 14 years and the average size in terms of total assets is 4.75 millions of euros. The range of age and size is wide so small and young firms are well represented in the sample[10]. The summary statistics of the accounting variables indicates that the economic and financial situation of the firms in the sample is quite diverse. The average length of the relationship between the borrower and the lender in the sample is 4.57 years and, on average, firms keep lending relationships with more than 5 banks. The average size of the loan represents around 8.5% of the average assets of the firms in the sample, a reasonable value taking into account that we have only long term loans.

4.2. Access to credit in province markets

The results of estimating equation (E1) are shown in Table 2. The estimation is made using the Arellano and Bond (1991) procedure that corrects for the possible endogeneity of the explanatory variables, proportion of loans with collateral, $COLL_{it}$, and concentration index, $HERFINDAHL_{it}$. The dependent variable is transformed using a logistic transformation so the domain of the new variable goes from minus to plus infinite. We present two estimations: Model 1 with no interaction between the two explanatory variables, and Model 2 with cross-partial effects. Both models include the

[10] These numbers are in line with those used in other studies such as Harhoff and Körting (1998) for Germany and Petersen and Rajan (1995) and Berger and Udell (1995) for the US, although the average size of the firm in our sample is larger. The analysis here is not limited to small firms, although among Spanish firms of any size, bank debt is the most important source of external finance.

lagged dependent variable to account for persistent effects of bad loans over time. Our basic model is Model 2, with non-linear effects between market concentration and availability of collateral, but we present Model 1 where the explanatory variables enter in an additive form for comparative purposes.

In Model 1 both explanatory variables have positive coefficients as predicted from the theory, and therefore we would conclude that more collateral and higher credit market concentration both imply lower average quality of borrowers that get loans in province markets, Prediction i)a). In Model 2 the coefficients of the two variables continue to be positive and their values are twice those in Model 1, while the cross effects among the variables are negative and significant as expected from the theoretical analysis. This evidence is consistent with the theoretical prediction that the use of collateral contributes more to facilitate low quality borrowers to get bank credit in more competitive credit markets than in less competitive ones. In other word, for a given Herfindahl index, the log-term difference in the proportion of bad loans in two markets i and j with levels of collateral $COLL_{it}$ and $COLL_{jt}$, is given by $0.336(PBD_{it}–PBD_{jt})= (0.054–0.003xHERFINDAHL_t)(COLL_{it}–COLL_{jt})$, which decreases with market concentration. This confirms Prediction i)b).

4.3. The use of collateral in loans

The results of the estimation of model (E2) on the determinants of collateral are shown in Table 3[11]. All the estimations are made assuming a logit function of the probability of collateral. The explanatory variables that are likely to have decreasing marginal effects in the likelihood of collateral are introduced in the model in log form: ASSETS, AGE, DURATION, NUMBER OF LENDERS and SIZE OF THE LOAN. Models 1, 2, and 3 are for the pool of loans to all borrowers. They will be the benchmark to compare with the results obtained form the model that separates borrowers with observed low quality and borrowers with private risk, and young and old firms, Model 4. Model 3 is also the closest to other models estimated in previous research so its results can be compared with related literature.

4.3.1. Pool of loans and borrowers

Model 1 presents the estimation of E(2) using only as explanatory variables the control variables (dummies and size of the loan), concentration in the credit market, and the quality of the borrower in terms of having or not loans in default. The next estimation, Model 2, introduces two additional explanatory variables, the age and the size of the firm/borrower, while Model 3 corresponds to the basic model for the pool of borrowers (i.e., including also accounting performance variables and relationship lending variables but without a distinction between borrowers of different credit quality). Taken together the results of the estimation indicate that the control variables, jointly with DEFAULT and HERFIDAHL contain a substantial part of the information about the determinants of the use of collateral that is provided by the basic model (the pseudo R^2 is 0.18 for Model 1 and 0.22 for Model 3).

In the pool of loans and borrowers, the probability that a new loan uses collateral is higher if the loan is made to borrowers of observed low credit quality, the sign of the coefficient of $DEFAULT_{t-1}$ is positive and highly significant in all models. The marginal analysis reveals that to be in the group of borrowers with a loan in default at the time of getting a new one increases the likelihood of collateral in the new loan by 26.7%, compared with the likelihood among borrowers that do not default. This result confirms prediction ii)a).

For the average firm in the sample to be in the group of those borrowers that default in t+1 not having defaulted before, also increases the likelihood of collateral in a significant way, coefficient of $DEFAULT_{t+1}$=1 positive and statistically significant. The economic significance of this result is that these borrowers have a 16% higher probability to pledge collateral in the loan than borrowers with no defaults. The evidence suggests that, for the average borrower, lenders are able to observe its credit risk and consequently, high risk ones are asked to pledge collateral as a condition to get the loan. Overall, the evidence indicates that for the average borrower in the sample, lending is made predominantly under conditions of observed risk, Berger and Udell (1991). But the fact that the estimated coefficient of $DEFAULT_{t+1}$ is half the coefficient of $DEFAULT_{t-1}$ suggests that among those borrowers that do not have a loan in default

[11] Jiménez et al., 2004 discuss thoroughly the determinants of collateral in loans to non-financial firms.

at the time they get a new, lending conditions can be different from that in the group of borrowers of known low credit quality.

The likelihood of collateral in loans is lower in more concentrated credit markets, as the negative estimated coefficient of the variable HERFINDAHL indicates. This result for the pool of borrowers and loans is consistent with the evidence obtained at the province market level that, for a given average credit quality that gets loans, the use of collateral is more likely in more competitive, less concentrated credit markets.

Model 2 indicates that the likelihood of collateral decreases with age and size of borrowers, coefficients of Log AGE and Log Assets both negative and statistically significant. The introduction of these variables in the logit model almost doubles the positive value of the estimated coefficient for the variable Log SIZE of the loan. The absolute value of this coefficient is higher than the coefficient of the variable Log ASSETS that measures the size of the firm, which indicates that the likelihood of collateral increases with the size of the loan after taking into account that larger firms are likely to ask for larger average loans.

When relationship banking and accounting performance variables are included, Model 3, the coefficient of the variable Log AGE becomes negative and statistically significant while Log DURATION and Log NUMBER OF LENDERS both have negative and statistically significant coefficients. Since “duration” of the borrower-lender relationship affects the investment in borrower’s specific information by the lender and “age” of the firm is associated with the availability of borrowers’ public information, the change in sign in the coefficient of the age variable and the negative coefficient of duration indicates that the terms of the loan, use of collateral in our case, improve as a result of longer borrower-lender relationships that allow to accumulate private information about the borrower. In other words, the information generated through the intermediation process is private information revealed only to lenders directly involved in the relation, while no relevant information is leaked to the market as a whole.

This result contrast with Berger and Udell (1995) who find a negative association between age and use of collateral even after controlling for duration, and to

the result of Harhoff and Körting (1998) for Germany who find no statistical significance for the variable age. To calibrate its economic significance note that 8.5 years of relationship with the bank that grants the last loan, one standard deviation above the mean of 4,5 years, has a 20.1% lower probability to pledge collateral than a firm with 4 years of relationship. This value is in line with the finding of Berger and Udell (1995) for US firms: borrowers with ten years of relationship with the bank that grants the line of credit reduce the likelihood of collateral by over 30% with respect to borrowers that have only been one year with the bank.

Firms with higher leverage, both in terms of stocks, less Equity over total Assts, and in terms of flows, higher Interest expenses over Profits before interest charges, have higher likelihood to pledge collateral in new loans than firms with less leverage. Controlling for the rest of variables, firms with higher financial risk at the time they get a loan are more likely to be asked to pledge collateral. The debt structure and the cash of the firm also affect the likelihood of collateral. A joint one standard deviation change over the mean of the performance accounting variables, in the direction of lower performance and more risk, increases the likelihood to pledge collateral in a loan by 21.2%%.

Finally, note that the introduction of the accounting performance variables in the explanation of the likelihood of collateral leaves unchanged the values of the estimated coefficients of the rest of explanatory variables, mainly the variables about observed defaults. This indicates that variables as DEFAULT in t-1 and t+1 capture other information about the credit quality of borrowers different form that that can be obtained form the accounting statements.

4.3.2. Determinants of collateral in loans to young firms

One of the main interests of the paper is to study the terms of loans to young firms for whom the possibilities to observe their credit quality are lower and, thus, there are opportunities to signal quality with pledging collateral. Moreover, the balance of the costs and benefits of investing in borrower specific information and build long term relations is made at the beginning of a bank-firm relationship. This means that variables such as market power, that according to the Petersen and Rajan (1995) model are

critical in such decisions, are expected to play a more relevant role in the group of young firms than in the average firm of the sample. The introduction in the model of explanatory variables that capture the cross effect of $DEFAULT_{t+1}$ and HERFINDAHL with Log of AGE will allow us to compare the results for firms of different age.

From Model 4, for those borrowers with no default, $DEFAULT_{t+1}=0$, the relationship between likelihood of collateral and age of the borrower is given by –0.199+ 0.035HERFINDAHL. For the mean value of the Herfindahl index, 7% from Table 1, that value is 0.045, positive but lower than 0.065 for the whole population of borrowers obtained from Model 3. In any case, the positive sign of the HERFINDAHL in the expression above indicates that the effect of age of the borrower in the likelihood of collateral is decreasing with market concentration, or alternatively increasing with competition.

Among borrowers with $DEFAULT_{t+1}=1$, the likelihood of collateral as a function of AGE is given by[12] –0.332 + (0.03+ 0.025xHERFINDAHL)xlogAGE. In the group of borrowers with no loans in default at the time they get a new one, the likelihood of collateral increases with the age of the borrower for any value of the concentration index. For the sample mean value of HERFINDAHL, 7%, the coefficient of the Log AGE in this group of firms is 0.205 (0.03+0.025x7), substantially higher than the value of the coefficient 0.045 obtained above for borrowers that do not default. The coefficient of age is also higher in more concentrated credit markets.

The negative coefficient of the variable $DEFAULT_{t+1}$, -0.332 (only significant at the 20% level) indicates that in the group of borrowers identified ex post as of low credit quality, young firms (i.e. those of Log AGE=0) have a lower likelihood of collateral in their loans than firms that do not default in t+1. In other words, the likelihood of collateral is lower in firms of low credit quality than in firms of higher credit quality. The evidence is consistent with the prediction from theories that explain

[12] The coefficients in this expression are obtained from Table 3 taking into account that for the interactive variables the coefficients of the variables multiplied by $DEFAULT_{t+1}$ are equal to the coefficients of the variables when $DEFAULT_{t+1}=0$ plus the coefficients when $DEFAULT_{t+1} = 0$. We assume that the constant of the Logit model is equal to zero since it is not statistically significant, then 0.03 = 0.231-0.199 and 0.025 = 0.035 – 0.010.

the use of collateral as a solution to adverse selection problems, so the likelihood of collateral is inversely related to credit risk. The evidence confirms prediction ii)c).

As firms get older there are more opportunities to learn about their credit quality and even if they do not have a loan in default at the time they get a new one, lenders have other means to find out their quality. This explains the positive sign of Log AGE in the group of borrowers that reveal ex post as of low credit quality and the fact that for the average firm in the sample, age 14 years, the likelihood of collateral is higher in the group of $DEFAULT_{t+1}$=1 than in the group of no default (Model 3). This confirms prediction ii)d).

Figure 1 shows the results of the model that is consistent with both predictions ii)c) and ii)d). Among young firms collateral is less likely in firms that reveal ex post as of low credit quality. However beyond certain age, around 5 years in our sample, firms that reveal as of low quality are more likely to pledge collateral than the rest of firms that do not default. In our conceptual framework this is explained in terms of changes in the information conditions from private risk when firms are young to observed risk when they get older.

The second variable of our interest is market concentration. Among borrowers with no defaults at the time they get a new loan and no defaults a year after, $DEFAULT_{t+1}$=0, the relationship between likelihood of collateral and market concentration, according to Model 4, is given by (-0.097 + 0.035LogAGE)xHERFINDAHL. For the mean value of the age variable, 14 years, the coefficient is close to zero, so higher market concentration lowers the likelihood of collateral in a significant way mainly among young firms. In the group of borrowers with $DEFAULT_{t+1}$=1 the conclusion is similar since the coefficient of market concentration is now[13], (-0.055 + 0.025Log AGE)xHERFINDAHL. For low values of AGE the term in parenthesis will be negative. The two results imply that young firms are more likely to get loans without collateral in more concentrated credit markets than in less concentrated, more competitive ones, a result consistent with prediction ii)b).

[13] The coefficients are calculated in the same way as is explained in footnote 11.

Figure 2 illustrates these results for two different values of the HERFIDAHL variable, 5% (20 banks of equal size) and 10% (10 banks of equal size). Higher market concentration only lowers the likelihood of collateral in a significant way in the group of young firms. As firms age the differences disappear. For most of the relevant ages of firms in the sample, up to 14 years, the likelihood of collateral is higher in the less concentrated credit market, but the differences in likelihood are higher among young firms and decrease as firms get older. The fact that in more concentrated credit markets the likelihood of collateral increases with the age of the borrower suggests that banks hold up firms that get funds early in their life. In more competitive credit markets the terms of the contract improve with the age of the borrower, a result consistent with the idea that the average credit quality of the borrowers that get funds increases over time and in more competitive credit markets experienced borrowers have more alternatives to get finance.

Model 5, last column of Table 3, shows the results when "duration" of the borrower – lender relationship substitutes "age" of the firm as the variable that measures the opportunities to learn about the credit quality of the borrower over time. In other words, the assumption is now that only the private information generated in the relationship is of value to decide about the terms of the loans. From an operational point of view this means that Log DURATION substitutes Log AGE in the evaluation of the cross effects of the variables. For borrowers with no default, the likelihood of collateral decreases with duration according to (–0.248+0.017xHERFINDAHL)xLog DURATION. The coefficient is –0.13 for the concentration index evaluated in the sample mean of 7%, which implies that among those borrowers of higher credit quality the likelihood of collateral decreases with duration, a result similar to that found in Models 3 and 4. But note that the coefficient of Log DURATION decreases with market concentration. Lenders start their relationship with a particular borrower with a higher demand of collateral in less concentrated credit markets.

Higher market power lowers the requirements of collateral early in the relationship with the borrower, as the theoretical model predicts for young firms, compared with the requirement of collateral if the relationship was established in a more competitive credit market. The result is similar to that found by Petersen and Rajan (1995) about the relationship between age of the firm and cost of credit in markets of

different concentration, but here the terms of the loan refer to the use of collateral and age of the firm is substituted by years of bank-firm relationship.

In the group of low quality firms, $DEFAULT_{t+1}=1$, the relationship between likelihood of collateral and duration is given by (0.08–0.008xHERFINDAHL)xLog DURATION[14]. The coefficient is positive in the mean value of the concentration variable but close to zero in the range of relevant values of this variable. Therefore, if any, duration of the borrower-lender relationship increases the likelihood of collateral in loans for those borrowers that are sorted as low quality as the relationship evolves.

To sum up, duration of the relationship with the lender increases the information available on credit quality and this information has mainly private value (recall that Log AGE has a positive coefficient). The information collected helps lenders to sort out borrowers in terms of credit quality and only borrowers of higher credit quality get better terms on their loans over time. The benefits of the relationship are higher in less concentrated credit markets than in more concentrated ones, that is, lenders start a relationship with a borrower with a higher likelihood of collateral in situations of lower market power than in situations of higher market power.

4.4. Cost of credit

Only data on average cost of debt for the firms in the sample is available. Therefore, the results on the tests of predictions iii) will have to be taken with caution since, ideally, the proper data for those tests is the interest rate charged in each individual loan. Additionally, variables such as DURATION and SIZE of the loan are now measured as averages over the duration of all lenders and over volume of loans granted to the firm, respectively. As before, results are presented for the pool of firms and for firms of different age.

4.4.1. Pool of borrowers

Model 1 in Table 4 presents the results of estimating the model on the determinants of the cost of debt, E3, excluding the lags of the dependent variable as

explanatory variables. The tests of autocorrelation, shown at the bottom of the first column, indicate that the null hypothesis of first and second-order serial correlation in the residuals cannot be rejected, as expected since the average cost of debt is time persistent[15]. In Model 2 the dependent variable is included among the explanatory variables with sufficient number of lags to eliminate all-orders serial correlation[16]. Three lags are needed to achieve this purpose which reduces the number of observations to one third. The coefficient of the variable $DEFAULT_{t-1}$ is positive although non significant, but $DEFAULT_{t+1}$ has a positive and significant coefficient, which indicates that risky borrowers pay higher cost for their loans. This evidence is consistent with Prediction iii)a).

For the pool of firms the cost of debt decreases with age and increases with size of the firm, although it decreases with the Size of the loan, a variable that has to be correlated with total Assets. In fact if Log ASSETS is not included in the model then Log SIZE of the loan has a positive and significant coefficient. Accounting performance variables have coefficients with the expected sign since firms more leveraged, less profitable and with less cash have higher average cost of debt than otherwise. In Model 2 DURATION is not significant while NUMBER OF LENDERS is positive and significant. Average cost of debt increases with market concentration but the estimated coefficient of HERFINDAHL is not significant.

The analysis of the economic significance of the results from Model 2, indicates that, in the long term, a firm of low quality (i.e. $DEFAULT_{t+1}=1$), has an average cost of debt 0.6 percentage points (pp) higher than firms that do not have a loan in default. A one standard deviation variation in the values of *all* the accounting performance variables in the direction of higher borrower's risk increases the cost of debt in 1.3 pp with respect to the cost of debt for the average firm in the sample. A 25 year-old firm, one standard deviation above the average age of the firms in the sample, pays 0.4 pp less than a firm 3 year-old, one standard deviation below the sample mean. A firm in a

[14] The coefficients are calculated as follows: 0.08=-0.248+0.326 and 0.008=0.017-0.024.

[15] In fact, the estimated serial correlation matrix of the residuals show a very persistent pattern with a first-order correlation coefficient of 0.897 and a quick decline, both facts consistent with the presence of high autocorrelation in the residuals. The existence of serial correlation potentially biases the results because some of the variables introduced into the model are considered predetermined.

[16] In Model 2 the first and second-order serial correlation test are shown and the existence of autocorrelation is rejected. Although not shown, further order correlations are rejected too.

credit market with a level of concentration equivalent to 20 banks of equal size (HERFINDAHL=5%) will pay 0.2 pp less for its debt than a firm in a market with 10 banks of equal size. Finally, a firm who has loans with 8 different banks, one standard deviation above the sample mean of the variable, will pay 1.3 pp more than a firm that borrows from a single bank.

The results of Model 2 can be compared with others obtained in previous papers. The finding that DURATION is not significant is similar to the result obtained by Harhof and Körting (1998) for German firms, and to the result of Petersen and Rajan (1995) for US firms[17]. Petersen and Rajan (1994) also find that firms that have loans with a higher number of banks pay higher interest in their loans, while in Harhof and Körting (1998) the variable NUMBER OF LENDERS is not statistically significant. All previous papers, including Berger and Udell (1995), find that older firms finance themselves at a lower cost than younger ones. All these papers estimate the model of the determinants of the cost of bank debt only with cross section data. None of these papers controls for ex post credit quality of the borrower. The comparison between Model 2 and 1 points out that the use of an inappropriate econometric specification could lead to rather different conclusions about the role played by the concentration in the credit market or the existence of hold up problems in bank-firm relationships.

4.4.2. Cost of debt for borrowers of different quality

Model 3 in Table 4 presents the results on determinants of the cost of debt allowing for differences in coefficients of selected variables for those borrowers that are known to be of low quality, $DEFAULT_{t+1}=1$, and for credit markets with different concentration.

The coefficient of the variable $DEFAULT_{t+1}$ is again positive and significant but its estimated value is 50% higher than that of Model 2 (0.669 compared with 0.438). On the other hand, the estimated coefficient of the Log AGE variable is statistically significant for firms that reveal as of low credit quality in t+1, with a negative coefficient equal to –0.237. For firms that do not default the coefficient of Log AGE is

[17] Berger and Udell (1995) find that Duration lowers the cost of credit lines using the same data set than Petersen and Rajan (1995).

marginally decreasing with the concentration index, (0.018 –0.01HERFINDAHL)x Log DURATION, but for the average value of the index it is very close to zero. Thus, among good quality borrowers the average cost of debt is independent of the age of the firm. Figure 3 compares the relationship between average cost of debt and age for firms of low and high credit quality. Interest rates start higher in firms of low quality and decrease at a higher rate than those in the group of good quality so that, at the sample mean age, the differences between the two functions disappear.

The HERFINDAHL variable is neither significant by itself nor interacting with other variables (i.e. age of the firm and default in t+1). Besides, the sign of the coefficients imply that firms start paying higher interest rates in more concentrated credit markets than in less concentrated ones. Therefore, in this sample no evidence is found in support of prediction iii)b). Consequently, the prediction on interest rates being higher for young firms in more competitive markets than in less competitive, more concentrated ones, Petersen and Rajan (1995) is not supported by our data.

5. Discussion and conclusion

Competition in credit markets can go against the workings of informal institutions such as reputation and relationship lending that contributes to increase the credit available for small business firms. This important insight of Petersen and Rajan (1994 and 1995) ignores collateral, a widely used formal institution that also contributes to eliminate credit rationing to small and new firms. This paper introduces the collateral decision in models of credit markets that link banks' credit availability (use of collateral) and cost, with market power of lenders and with reputation and monitoring effects associated with age and length of the relationships. Our results confirm that collateral is in fact a relevant institution to explain the functioning of credit markets, and that interacts with other informal institutions in complex ways.

First of all, collateral and market power are substitutes when it comes to lower the quality of the last borrower that gets finance in a market, since the contribution of one of them to increase the proportion of borrowers that get finance, is lower for higher values of the other. In this sense, we find that in markets with more collateral, average credit quality of borrowers that gets bank loans is lower than in markets with less

collateral, but the difference in average credit quality between markets with different amount of collateral is lower in more concentrated credit markets. The implication of this result is that as borrowers increase their wealth and have more assets to use as collateral, increases in credit market competition will not lower the access to credit since lenders can substitute market power by the use of collateral.

Second, young firms use collateral to signal high quality as some theoretical models on the use of collateral predict. Therefore, the benefits of reputation and relationship lending, which evolve with age of the firms and with the length of the relationships with lenders, are moderated by the fact that the firms are classified as high credit risk or as low credit risk early in their life. The empirical evidence confirms that young low risk firms under private information are more likely to pledge collateral when they are young than firms of lower quality of the same age. Doing so they have initially lower interest rates. For firms of lower credit quality the likelihood to pledge collateral increases with age, although in exchange of securing the loan with collateral they reduce the cost of their loans towards the market interest rate. As firms get older their true credit quality is public knowledge and low quality borrowers are more likely to pledge collateral since lending is made under observed risk. These findings are important since they provide evidence that use of collateral can be associated with borrowers of lower credit risk. This happens among young firms, those where signaling may really be useful to convey information since these firms do not have experience in the market and no other information exists on them about their credit quality.

Third, young firms are less likely to pledge collateral in more concentrated credit markets than in less concentrated ones. The reason is that higher concentration implies more market power and as indicated above, collateral and market power are substitutes to protect the interests of lenders under asymmetric information. As firms get older the differences in likelihood attributed to more or less concentration disappear since age implies more public information available about borrowers. This result is symmetric to the finding of Petersen and Rajan (1995) about the relationship between market concentration and cost of credit to young firms, in the sense that young firms start at higher interest rates in less concentrated markets. But here it is formulated in terms of collateral and less collateral is interpreted as evidence of better terms of the loan. However, the paper does not fin evidence of the finding of Petersen and Rajan (1995)

since average cost of debt appears statistically independent of the concentration in the market. The conclusion has to be taken with some caution because the proper data to test the hypothesis on interest rates is the cost of the loan not the average cost of total outstanding debt as used in this paper.

However, the collateral requirements in loans do not decline with the age of borrowers in either of the samples of firms (although the likelihood of collateral increases with age at a higher rate in borrowers of high risk). Borrowers with no loans in default benefit of longer duration in the relationship with their creditors since longer duration implies lower likelihood to have to pledge collateral. The decline in the likelihood of collateral with longer duration of the bank-firm relationship, but not with the age of the borrower, is consistent with reputation effects (Boot and Thakor, 1994) and with monitoring activities that produce creditor's private information that is of no value for the market as a whole (Diamond, 1991; Rajan and Winton, 1995). We also find that for borrowers of higher credit quality the likelihood of collateral decreases faster with duration in markets where lenders have less market power than in markets with more market power. The results parallels that obtained by Petersen and Rajan (1995) for the interest of loans, which means that cost of debt and collateral are terms of loans that respond in a similar patterns to market power and problems of moral hazard, keeping in mind that, in addition, collateral plays a role as a signaling device in response to adverse selection problems.

For the pool of firms of different credit quality, the length of the relationship between borrowers and lenders lowers the likelihood of using collateral in a particular loan but it does not have any effect in the cost of debt, a result similar to that found in previous papers (Petersen and Rajan, 1995). Therefore it appears that in our sample, relationship lending also translates more easily into benefits in terms of more facilities to get a loan than in terms of lower interest.

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Table 1

Mean, standard deviation (S.D.), minimum and maximum values of the variables in the period 1984 to 2002. $PRBADLO_{it}$ is the non-performing loan ratio in province i at time t. $Herfindahl_t$ is the index of credit market concentration equal to the sum of banks squared market shares in loans made in each one of the fifty Spanish provinces in year t. $COLL_{it}$ is the proportion of the amount of collateral over the total amount of business loans in province i at the end of period t. $Default_{t-1}$ is a dummy variable with value 1 if the borrower that gets the loan has a loan in default and 0 otherwise. $Default_{t+1}$ is a dummy variable that takes the value 1 if the borrower does not have a loan in default at the time the loan is granted but defaults a year after. *Age of the firm*$_{t-1}$ is the number of years since the firm was set up, lagged one year. *Short term debt* has a maturity less than one year. *Liquidity ratio*$_{t-1}$ is the ratio between cash and total assets. $Duration_{t-1}$ is the number of years of lender - borrower relationships prior to when the loan is made. *Number of lenders*$_{t-1}$ is the number of banks the borrower has loans with prior to when the loan is made. *Cost of Debt*$_t$ is the ratio between interest expenses as reported by the firm in the income statement and total debt in the balance sheet. *Collateral* is a dummy variable that takes the value of 1 if the loan has collateral and 0 otherwise. *Size of the loan* and T*otal assets* in millions of euro and in constant prices of 2002.

Variables	Mean	S.D.	Minimum	Maximum
CREDIT MARKETS (PROVINCES) (Equation E1)				
Dependent variable				
PRBADLO$_{it}$ (%)	5.41	4.32	0.37	28.34
Explanatory variables				
HERFINDAHL $_{it}$ (%)	7.57	3.47	2.52	42.48
COLL $_{it}$ (%)	25.50	8.07	6.29	58.67
No. Observations	800			
LOANS & FIRMS (Equations E2 and E3)				
Dependent variables				
Collateral (1/0)	0.49	0.50	0.00	1.00
Cost of Debt $_t$ (%)	5.12	3.72	0.36	25.00
Borrower's Risk				
Default $_{i,t-1}$ (1/0)	0.02	0.14	0.00	1.00
Default $_{i,t+1}$ (1/0)	0.01	0.11	0.00	1.00
Age of the Firm $_{i,t-1}$	13.91	11.10	0.00	98.00
Total Assets $_{i,t-1}$	4,749.12	6,630.39	159.17	23,365.13
Equity/Total Assets $_{i,t-1}$	27.51	17.77	2.99	66.53
Interest Expenses/(Profits+Interest Income) $_{i,t-1}$	50.58	47.90	-56.60	159.43
ROA $_{i,t-1}$	7.79	6.07	-2.51	22.84
Short Term Debt/Short Term Assets $_{i,t-1}$	100.06	60.43	27.61	296.08
Short Term Debt/Total Debt $_{i,t-1}$	69.38	23.42	19.44	100.00
Liquity Ratio $_{i,t-1}$	5.04	6.09	0.00	24.20
Relationship lending				
Duration $_{i,t-1}$	4.57	3.96	0.00	17.00
Number of lenders $_{i,t-1}$	5.43	2.96	2.00	12.00
Competition				
Herfindahl $_t$ (%)	7.02	2.39	3.60	20.01
Control Variables				
Size of the loan $_t$	403.62	563.49	13.68	2,054.94
No. Observations				
Equation 1 (Collateral)	277,207			
Equation 2 (Cost of Debt)	102,753			
No. Firms				
Equation 1 (Collateral)	117,884			
Equation 2 (Cost of Debt)	35,232			

Table 2

Results of the estimation of model E1 on the determinants of average credit quality of borrowers that get bank loans in the different geographic markets (Spanish provinces). Time period 1985-2002. Estimation of equation (E1) in first differences using Arellano and Bond (1991) estimator. Dependant variable PBD_{it}, the logistic transformation of the non-performing loan ratio in province i at time t ($PRBADLO_{it}$) to obtain a non bounded dependant variable: $PBD_{it} = Log(PRBADLO_{it}/(1-PRBADLO_{it}))$. $HERFINDAHL_{it}$ is the index of credit market concentration equal to the sum of banks squared market shares in loans made in each one of the fifty Spanish provinces in year t. $COLL_{it}$ is the proportion of the amount of collateral over the total amount of business loans at the end of period t. PBD_{it-1}, $HERFINDAHL_{it}$x$COLL_{it}$ and $COLL_{it}$x$HERFINDAHL_{it}$ are treated as endogenous, using 2 lags as instruments. The lagged dependent variable is introduced as an explanatory variable to account for persistence effects over time. Sargan test as well as test for first-order (m1) and second-order (m2) serial correlation of the residuals (in differences) are shown. Standard error (SE) consistent to any pattern of heteroskedasticity within panels. 15 time dummies included. ***, **, *, statistically significant at 1%, 5% and 10%.

Variable	**Model 1**		**Model 2**	
Dependent Variable	PBD_{it}		PBD_{it}	
Estimation	Arellano-Bond		Arellano-Bond	
	Coefficient	*Robust SE*	*Coefficient*	*Robust SE*
$PBD_{i,t-1}$	0.664	0.046 ***	0.619	0.044 ***
$COLL_{it}$	0.028	0.006 ***	0.054	0.010 ***
$HERFINDAHL_{it}$	0.037	0.009 ***	0.067	0.013 ***
$COLL_{it}$ * $HERFINDAHL_{it}$	--	--	-0.003	0.001 ***
No. Observations	800		800	
Sargan test / p-value	36.5	1.00	37.6	1.00
Test for AR(1), m1 / p-value	-4.33	0.00	-4.80	0.00
Test for AR(2), m2 / p-value	-1.10	0.27	-1.01	0.31

Table 3

Estimation of the determinants of the use of collateral in loans. Logistic model estimated for the pool of data. Time period 1993-2002. For the definition of the variables see Table 1. 9 time dummies, 49 regional dummies, 10 industry dummies and 190 bank dummies included. Standard error (SE) consistent to any pattern of heteroskedasticity within panels. ***, **, *, statistically significant at 1%, 5% and 10%.

Variable	**Model 1**		**Model 2**		**Model 3**		**Model 4**		**Model 5**	
Dependent Variable	Collateral (1/0)		Collateral (1/0)		Collateral (1/0)		Collateral (1/0)		Collateral (1/0)	
Estimation	Logit		Logit		Logit		Logit		Logit	
	Coefficient	*Robust SE*	*Coefficient*	*Robust SE*	*Coefficient*	*Robust SE*	*Coefficient*	*Robust SE*	*Coefficient*	*Robust SE*
Constant	-1.937	0.998 *	-0.106	1.262	0.077	1.194	0.574	1.332	0.253	1.200
Borrower's Risk										
Default $_{t-1}$ (1/0)	0.523	0.051 ***	0.716	0.055 ***	0.674	0.052 ***	0.678	0.053 ***	0.677	0.053 ***
Default $_{t+1}$ (1/0)	0.313	0.031 ***	0.315	0.032 ***	0.315	0.033 ***	-0.332	0.257	-0.172	0.155
log(Age of the Firm $_{t-1}$)	--	--	-0.103	0.013 ***	0.065	0.013 ***	-0.199	0.038 ***	0.030	0.014 **
log(Total Assets $_{t-1}$)	--	--	-0.432	0.007 ***	-0.312	0.009 ***	-0.310	0.009 ***	-0.307	0.010 ***
Equity/Total Assets $_{t-1}$	--	--	--	--	-0.010	0.000 ***	-0.010	0.000 ***	-0.010	0.000 ***
Interest Expenses/(Profits+Interest Income) $_{t-1}$	--	--	--	--	7.E-04	0.000 ***	0.001	0.000 ***	0.001	0.000 ***
ROA $_{t-1}$	--	--	--	--	0.001	0.001	0.001	0.001	0.001	0.001
Short Term Debt/Short Term Assets $_{t-1}$	--	--	--	--	-0.001	0.000 ***	-0.001	0.000 ***	-0.001	0.000 ***
Short Term Debt/Total Debt $_{t-1}$	--	--	--	--	-0.005	0.000 ***	-0.005	0.000 ***	-0.005	0.000 ***
Liquity Ratio $_{t-1}$	--	--	--	--	-0.004	0.001 ***	-0.004	0.001 ***	-0.004	0.001 ***
Relationship lending										
log(Duration $_{t-1}$)	--	--	--	--	-0.129	0.008 ***	-0.125	0.008 ***	-0.248	0.022 ***
log(Number of lenders $_{t-1}$)	--	--	--	--	-0.429	0.024 ***	-0.418	0.023 ***	-0.423	0.024 ***
Competition	--	--	--	--						
Herfindahl $_{t}$	-0.017	0.005 ***	-0.021	0.005 ***	-0.023	0.005 ***	-0.097	0.011 ***	-0.044	0.006 ***
Cross Effects										
Herfindahl $_{t}$ * log(Age of the Firm $_{t-1}$)	--	--	--	--	--	--	0.035	0.005 ***	--	--
Herfindahl $_{t}$ * Default $_{t+1}$	--	--	--	--	--	--	0.042	0.032	0.042	0.020 **
log(Age of the Firm $_{t-1}$) * Default $_{t+1}$	--	--	--	--	--	--	0.231	0.124 *	--	--
log(Age of the Firm $_{t-1}$) * Default $_{t+1}$ * Herfindahl $_{t}$	--	--	--	--	--	--	-0.010	0.016	--	--
Herfindahl $_{t}$ * log(Duration $_{t-1}$)	--	--	--	--	--	--	--	--	0.017	0.003 ***
log(Duration $_{t-1}$) * Default $_{t+1}$	--	--	--	--	--	--	--	--	0.326	0.109 ***
log(Duration $_{t-1}$) * Default $_{t+1}$ * Herfindahl $_{t}$	--	--	--	--	--	--	--	--	-0.024	0.015 *
Control Variables										
log(Size of the loan)	0.375	0.009 ***	0.624	0.009 ***	0.600	0.009 ***	0.601	0.009 ***	0.599	0.009 ***
No. Observations	275,317		275,317		275,317		275,317		275,317	
Pseudo R^2	0.18		0.21		0.22		0.22		0.22	
Log L	-156,742		-150,712		-148,658		-148,548		-148,641	
χ^2 covariates / p-value	18,939	0.00	22,885	0.00	26,721	0.00	26,813	0.00	26,689	0.00

Table 4

Determinats of the cost of debt for firms. OLS estimation for the pool of data. Time period 1993-2002. *Cost of Credit*$_t$ is the ratio between interest expenses as reported by the firm in the income statement and total debt in the balance sheet. *Default*$_{t-1}$ is a dummy variable with value 1 if the borrower that gets the loan has a loan in default and 0 otherwise. *Default*$_{t+1}$ is a dummy variable that takes the value 1 if the borrower does not have a loan in default at the time the loan is granted but defaults a year after. Log(*Age of the firm*$_{t-1}$) is the number of years since the firm was set up, in logs and lagged one year. *Short term debt* has a maturity less than one year. *Liquidity ratio*$_{t-1}$ is the ratio between cash and total assets. *Log* (*Duration*$_{t-1}$) is the number of years of lender - borrower relationships prior to when the loan is made, in logs. *Log* (*Number of lenders*$_{t-1}$) is the number of banks the borrower has loans with prior to when the loan is made, in logs. *Herfindahl*$_t$ is the index of credit market concentration equal to the sum of banks squared market shares in loans made in each one of the fifty Spanish provinces in year t. *Log (Size of the loans)* is the sum of all the new loans made by the firm in t, in logs. 8 time dummies, 49 regional dummies and 10 industry dummies included. Test for first-order (m1) and second-order (m2) serial correlation of the residuals (in levels) are shown. Standard error (SE) consistent to any pattern of heteroskedasticity and autocorrelation within panels. ***, **, *, statistically significant at 1%, 5% and 10%.

Variable	**Model 1**		**Model 2**		**Moldel 3**	
Dependent Variable	Cost of Credit $_{k,t}$		Cost of Credit $_{k,t}$		Cost of Credit $_{k,t}$	
Estimation	OLS		OLS		OLS	
	Coefficient	*Robust SE*	*Coefficient*	*Robust SE*	*Coefficient*	*Robust SE*
Constant	11.351	0.352 ***	2.918	0.408 ***	2.714	0.409 ***
Cost of Credit $_{k,t-1}$	--	--	0.479	0.012 ***	0.479	0.012 ***
Cost of Credit $_{k,t-2}$	--	--	0.118	0.008 ***	0.118	0.008 ***
Cost of Credit $_{k,t-3}$	--	--	0.068	0.006 ***	0.068	0.006 ***
Borrower's Risk						
Default $_{k,t-1}$ (1/0)	0.826	0.090 ***	0.087	0.118	0.220	0.152
Default $_{k,t+1}$ (1/0)	1.151	0.110 ***	0.438	0.141 ***	0.699	0.240 ***
log(Age of the Firm $_{k,t-1}$)	0.079	0.026 ***	-0.062	0.027 **	0.018	0.054
log(Total Assets $_{k,t-1}$)	-0.627	0.016 ***	0.051	0.018 ***	0.051	0.018 ***
Equity/Total Assets $_{k,t-1}$	0.011	0.001 ***	-0.005	0.001 ***	-0.005	0.001 ***
Interest Expenses/(Profits+Interest Income) $_{k,t-1}$	0.013	0.000 ***	0.001	0.000 ***	0.001	0.000 ***
ROA $_{k,t-1}$	0.104	0.003 ***	-0.007	0.003 **	-0.007	0.003 **
Short Term Debt/Short Term Assets $_{k,t-1}$	0.001	0.000 ***	0.000	0.000	0.000	0.000
Short Term Debt/Total Debt $_{k,t-1}$	-0.021	0.001 ***	-0.009	0.001 ***	-0.009	0.001 ***
Liquity Ratio $_{k,t-1}$	-0.039	0.002 ***	-0.007	0.003 ***	-0.007	0.003 ***
Relationship lending						
log(Duration $_{k,t-1}$)	0.126	0.014 ***	0.026	0.016	0.025	0.016
log(Number of lenders $_{k,t-1}$)	1.639	0.032 ***	0.201	0.034 ***	0.200	0.034 ***
Competition						
Herfindahl $_t$	0.030	0.010 ***	0.012	0.013	0.035	0.023
Cross Effects						
Herfindahl $_t$ * log(Age of the Firm$_{k,t-1}$)	--	--	--	--	-0.010	0.007
Herfindahl $_t$ * Default $_{k,t+1}$	--	--	--	--	0.051	0.053
log(Age of the Firm$_{k,t-1}$) * Default $_{k,t+1}$	--	--	--	--	-0.237	0.126 *
Control Variables						
log(Size of the loans$_{kt}$)	-0.156	0.011 ***	-0.147	0.013 ***	-0.148	0.013 ***
No. Observations	102,753		33,304		33,304	
R^2	0.33		0.54		0.54	
Test for AR(1), m1 / p-value	35.50	0.00	1.30	0.19	1.32	0.19
Test for AR(2), m2 / p-value	30.66	0.00	1.03	0.30	1.05	0.29
F test / p-value	326.69	0.00	242.38	0.00	234.14	0.00

Figure 1

Predicted probability of the use of collateral in loans as a function of the age of the firm for low average quality of borrowers and for the rest of borrowers. $Default_{t-1}$ is a dummy variable with value 1 if the borrower that gets the loan has a loan in default and 0 otherwise. $Default_{t+1}$ is a dummy variable that takes the value 1 if the borrower does not have a loan in default at the time the loan is granted but defaults a year after. Predicted probabilities estimates from Table 3. All variables except *Age of the firm* and $Default_{t+1}$ were set to the sample means.

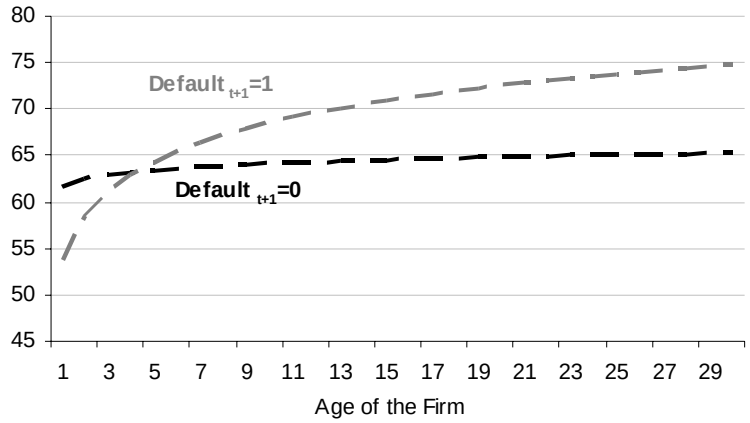

Figure 2

Predicted probability of the use of collateral in loans as a function of the age of the firm and for credit markets of different concentration. $Default_{t-1}$ is a dummy variable with value 1 if the borrower that gets the loan has a loan in default and 0 otherwise. $Default_{t+1}$ is a dummy variable that takes the value 1 if the borrower does not have a loan in default at the time the loan is granted but defaults a year after. Predicted probabilities estimates from Table 3. All variables except *Age of the firm* and *Herfindahl* were set to the sample means.

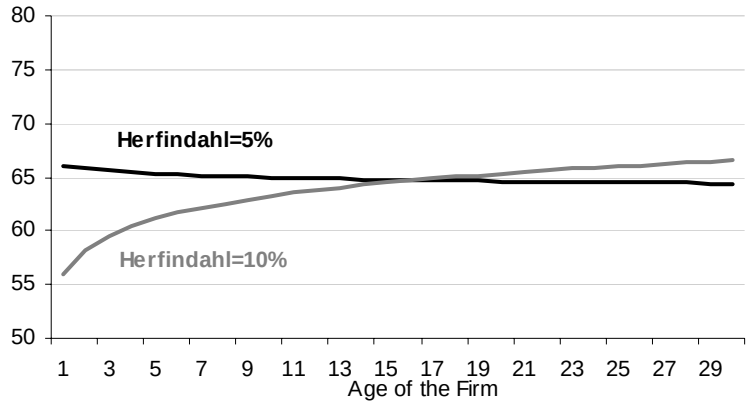

Figure 3

Average cost of debt for the firms as a function of their age for borrowers of average lower credit quality and for the rest of borrowers. $Default_{t-1}$ is a dummy variable with value 1 if the borrower that gets the loan has a loan in default and 0 otherwise. $Default_{t+1}$ is a dummy variable that takes the value 1 if the borrower does not have a loan in default at the time the loan is granted but defaults a year after. *Cost of credit* estimates from Table 4. All variables except *Age of the firm* and $Default_{t+1}$ were set to the sample means.