

Bank Competition and Collateral : Theory and Evidence

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Abstract

We investigate the impact of bank competition on the use of collateral in loan contracts. We develop a theoretical model incorporating information asymmetries in a spatial competition framework where banks choose between screening the borrower and asking collateral. We show that presence of collateral is more likely when bank competition is lower. We then test empirically this prediction on a sample of bank loans from 70 countries. We perform logit regressions of the presence of collateral on bank competition, measured by the Lerner index. Our empirical tests corroborate the theoretical predictions of a negative role of bank competition on the presence of collateral. These findings survive several robustness checks.

JEL Codes: G21, D43, D82

Keywords: Collateral, Bank Competition, Asymmetric information.

1. Introduction

Following the significant structural changes of the banking industry witnessed around the globe, much theoretical and empirical work has examined the economic role of bank competition in recent years.¹ The impact of bank competition on the access to bank finance has notably been investigated, as benefits from bank competition are intuitively expected from lower loan rates which should favor this access (e.g. Beck, Demirgüç-Kunt and Maksimovic, 2004).

Nevertheless, the role of bank competition on the access to bank finance is also dependent on its effects on collateral use, as collateral requirements are repeatedly mentioned as a major financing obstacle. For instance, by relying on the WBES survey for firms in 80 countries, Beck et al. (2006) notably report that collateral requirements are rated as the third most important financing obstacle among 12 financing obstacles, just after high interest rates and access to long-term loans. One can therefore wonder how bank competition influences the use of collateral.

However research on this topic is impressively poor. Three theoretical works have investigated this issue. Manove, Padilla and Pagano (2001) display a model in which banks choose between screening the borrower and asking the latter to pledge collateral. In their model, the bank gets a very precise signal about the firm's creditworthiness through screening. Therefore, posting collateral by borrowers induces banks to forego screening. Such behavior is exacerbated by bank competition, as the paper predicts that borrowers are more likely to post collateral in competitive markets than in monopolistic markets. Indeed enhanced competition would then favor bank laziness, meaning its reluctance to screen borrowers. Berlin and Butler (2002) develop a model based on the possibility of renegotiation between the bank and the borrower. This renegotiation can take place after the completion of the initial loan contract and depends on new information obtained by the bank. They support the view that bank competition leads to lower collateral requirements, which results from the incentives of the bank to proceed to renegotiation. Both former models consider the role of collateral in solving adverse selection problems, and offer opposing predictions. In contrast, Hainz (2003) proposes a model in which collateral helps solve moral hazard problems. She observes that competition reduces the use of collateral, as banks with monopoly power have incentives to use collateral to extract rents.

¹ See the special issue of the *Journal of Money, Credit and Banking* in 2004 (vol. 36, n°3) on this topic.

On the empirical side, two recent papers can be related to the impact of bank competition on the use of collateral, although they do not focus on this issue. Jimenez, Salas and Saurina (2006) investigate a wide range of determinants of the presence of collateral on a sample of 550 000 loans granted by Spanish banks. They notably analyze the impact of bank concentration, measured by the Herfindahl index, and find a negative impact of bank concentration on collateral use. Berger et al. (2007) test whether the adoption of a lending technology reducing ex ante information asymmetries, i.e. small business credit scoring, is associated with lower collateral use in loan contracts. Bank concentration measured by the Herfindahl index is included as a control variable. They find no significant sign for bank concentration to explain the incidence of collateral in their estimations.

We can thus point out that theoretical literature provides conflicting predictions which lack of empirical tests to their validation. The aim of this paper is to provide a broad and consistent analysis of the role of bank competition on the use of collateral, based on theoretical and empirical investigation.

We start by presenting an innovative theoretical explanation for the role of bank competition on the use of collateral. The model incorporates information asymmetries in an industrial organization framework. Our theoretical model is related to Manove, Padilla and Pagano (2001). Our starting point is also the choice for a bank between screening the borrower and asking collateral. However we differ from this model in two major aspects. The first difference concerns the fact that banks are not lazy in our model, in the sense that there is no additional information on the borrower that the bank can obtain. Therefore, our results are not driven by bank laziness. The second difference is the modeling of the market structure. Following recent theoretical works on bank competition (e.g. Dell'Arricia, 2001; Hauswald and Marquez, 2006), we consider a spatial competition framework based on a circular economy. Such representation is closer to the reality of banking markets, marked by differentiation, than monopoly or oligopoly. Furthermore, Degryse and Ongena (2005) have shown the role of geographical distance in shaping lending rates of banks.

We then test empirically our theoretical predictions with a cross-country analysis on a sample of 4931 bank loans from 70 countries. By performing a cross-country analysis, we do not rely to on a single country for our study which may lead to country-specific results. We perform logit regressions of the presence of collateral on bank competition. Bank competition is measured by the Lerner index, in line with

the recent empirical works on bank competition (Martin, Salas and Saurina, 2006; Maudos and Fernandez de Guevara, 2004, 2007). Unlike concentration indices, Lerner index does not infer the degree of competition from indirect proxies such as market shares. It infers bank' conduct directly and then informs on the actual behavior of the bank.

The rest of the paper is organized as follows. Section II presents the theoretical model. In section III, we develop the empirical results. We finally provide some concluding remarks in section IV.

II. Theoretical model

II.1 Set up of the model

Before analyzing the credit contracts offered, we describe the characteristics of the firms possibly applying for a loan and the banking sector. The total mass of firms is normalized to 1 . Firms are distributed uniformly around a circle of length 1 .² The share of good firms is μ and that of bad firms is $(1-\mu)$. The good firms have a project that is successful with probability p . In the case of success the project's payoff is X , in the case of failure it is 0 . The investment costs of the project are I . Thus, the expected payoff of a good firm is $pX-I > 0$, which we assume to be positive. Bad firms will fail with probability 1 . If they receive a loan, they take the money and run. Due to the lack of own liquid funds, the firms need to finance their investment through credit. The firm's owners are endowed with an asset A that can potentially be offered as collateral.

We consider a banking sector with N identical banks that are located equidistantly around the circle. Banks cannot observe the firm's type, i.e. whether a particular firm is good or bad. However, they know the distribution of good and bad firms. Moreover, banks can observe the firm's location. They compete in repayments. We assume that banks possess enough funds to finance all firms that apply for loans and that the firms' returns (and in the case of collateralization their assets) are high enough such that the market is covered.

Banks have two means to discriminate between good and bad firms: they either offer a collateralized credit contract which induces firms to signal their type, or they screen all firms applying for credit by evaluating their credit proposals. In the case of

² Thus, our model could be viewed as a Salop model where transportation costs are zero or without product differentiation and therefore have a model with perfect competition.

collateralization, the bank gets a payoff from the collateralized assets that are liquidated if the project fails. There are costs associated with liquidation. Therefore, the liquidation value of each unit of collateral, denoted by α , is lower than the continuation value of the firm, i.e., $\alpha < 1$.

If banks decide to screen, they receive a signal about a firm's creditworthiness. If the firm is good, the bank always gets the signal that the firm is good. However, if the firm is bad, the bank's signal is correct only with probability $s(d) > 0.5$.³ The quality of this signal depends on the distance d between bank and firm, i.e. the closer

a firm is located to a bank the better is the quality of the signal, $\frac{\partial s}{\partial d} < 0$.⁴ Thus, bad firms will be financed because banks make mistakes when conducting the creditworthiness test but these mistakes occur less frequently for firms that are located more closely to the bank. The idea is that banks get better information if a firm is located close-by because they can observe the firm's business or personally know the entrepreneur. Agarwal and Hauswald (2007) provide empirical evidence that distance matters for the informativeness of a signal. Alternatively, distance could be interpreted as a measure for the strength of the relationship between bank and firm. Note that offering a contract without either screening or collateralization does not pay off because we assume that $\mu p X - I < 0$.

The timing of the game is as follows: In the first stage, banks decide simultaneously which type of contract they offer. In the second stage, the banks determine simultaneously the terms of the credit contract they offer. Firms apply at the bank which offers the contract with the most favourable terms. If banks offer the same rate, firms apply at the closest bank (due to the application costs).

To render the analysis as clear as possible we make three simplifying assumptions. First, we assume that banks are not allowed to price-discriminate, i.e. they cannot make the terms of the loan contract dependent on the firm's location. This assumption allows deriving the same contract terms for all firms and therefore avoids that we have to give repayments for each individual firm.⁵ Second, the banks do not

³ Lehner and Schnitzer (2008) use the same setup in which the signal is imperfect for bad firms.

⁴ In Hauswald and Marquez (2006), the quality of the screening signal depends on the distance between banks and borrowers as well. Empirical evidence also shows that different banks rate obtain different results from screening a particular borrower (Jacobson, Lindé and Roszbach, 2006; Mitchell and van Roy, 2007). This is consistent with our setup.

⁵ It also implies that firms do not face a hold-up problem and therefore their payoffs are higher (except for the marginal firm). If the hold-up problem existed, firms would find the screening contract less

incur any costs per customer for performing the creditworthiness test. This cost would only add an additional term in each repayment function but would not change the insights obtained. The costs we want to emphasize are the losses the bank faces when it erroneously provides a loan to a bad firm. Third, we assume that firms apply at the closest bank if banks offer the same repayments. We would obtain the same qualitative result if firm's had to incur some cost of application.

We solve the game by backward induction. Thus, we first analyse the contract terms for a situation in which both banks offer either a collateralized or a screening contract. In a second step, we show that it is indeed optimal for the banks to offer the same type of contract.

II.2 Collateralized credit contract

We first suppose that all banks offer a collateralized credit contract. Collateralization implies that the firm repays an amount R^L in the case of success and that it loses collateral in the amount L in the case of failure. The credit contract has to be designed in a way that the bad firms have no incentive to demand credit. This is reached through collateralization. The incentive compatibility constraint for a bad firm can be written as:

$$\begin{aligned} I + (A - L) &\leq A && \text{or} \\ L &\geq I && (IC.F_L) \end{aligned}$$

If a bad firm receives a loan in the amount of I (and runs away with the money), it will lose assets in the amount of L as the project fails with certainty. Therefore, it is obvious that the amount of collateral that prevents bad firms from applying for credit is I . As a result, bad firms do not apply for loans. Moreover, given that from $(IC.F_L)$ $L=I$, the participation constraint of the good firm must hold:

$$\begin{aligned} p(A + X - R^L) + (1 - p)(A - I) &\geq A && \text{or} \\ p(X - R^L) - (1 - p)I &\geq 0 && (PC.F_L) \end{aligned}$$

If the project is successful, a good firm repays R^L from the payoff X it generates. In the case of failure, collateralized assets in the amount of I are seized by the bank. The expected payoff when the investment is credit-financed has to be at least as high as the payoff from not investing.

attractive relative to the collateralized contract. The insights from our model would not change, only the parameter ranges in which a particular contract is optimal.

The bank will participate if it makes at least zero expected profit with the contract offered. The bank's expected profit by each (good) firm is given by

$$pR^L + \alpha(1-p)I - I \geq 0 \quad (PC.B_L)$$

which implies that it needs a repayment of at least \underline{R}^L . The collateralized credit contract is described in the following lemma:

Lemma 1:

With a collateralized contract, all banks demand $\underline{R}^L = I \frac{(1-(1-p)\alpha)}{p}$ as a repayment and demand collateral $L=I$.

Proof: See the Appendix A.

Perfect competition between banks maximizes the marginal firm's expected payoff. As a result, banks make zero expected profits.

II.3 Screening contract

We next suppose that all banks offer a screening contract. With a screening contract, the banks will screen out the bad firms with probability $s(d)$. The bank demands a repayment R^S in the case of success and zero otherwise because the owner's personal assets are not pledged as collateral. The firm's participation constraint is the following:

$$\begin{aligned} A + p(X - R^S) &\geq A && \text{or} \\ R^S &\leq X && (PC.F_S) \end{aligned}$$

The firm must be better off by being able to realize the project and generate a return X and repay R^S than by not investing and getting the outside option of A .

The bank's participation constraint is given by

$$\mu(pR^S - I) - (1-\mu)(I - s^K)I \geq 0 \quad (PC.B_S)$$

Thus, the bank will offer loans only if the expected repayment it gets from good firms is high enough to compensate the losses it makes with financing the (marginal)

bad firm k . The marginal firm is the firm that the bank is financing and is furthest away from the bank. The repayment the bank needs to break even is denoted by \underline{R}^S .

Lemma 2:

With a screening contract, all banks demand $\underline{R}^S = I \frac{\mu + (1-\mu)(1-s^K)}{\mu p}$ as a repayment from all firms with a positive signal. The marginal firm k is the firm that is located half-way between two banks.

Proof: See the Appendix A.

Since all banks demand the same repayment in equilibrium, firms apply for loans at the closest bank. We assume that if both banks ask the same repayment, firms apply at the closest bank. Hence, all banks have the same market share and the marginal firm k is located half-way between two banks. Due to competition banks offer repayments that maximize the firm's expected payoff.

II.4 Comparison of contracts

A firm is indifferent between the two contracts (derived in Lemma 1 and 2) if its expected profits from both contracts are the same, i.e. if the firm obtains the same profit with a collateralized and a screening contract

$$p \left(X - I \frac{1-\alpha(1-p)}{p} \right) - (1-p)I = p \left(X + I \frac{\mu + (1-\mu)(1-s^K)}{\mu p} \right) \text{ or}$$

$$\alpha = 1 - \frac{(1-\mu)(1-s^K)}{(1-p)}$$

Having derived this threshold value, we can state the following proposition:

Proposition 1:

Both banks offer a collateralized contract if the liquidation value of collateral is high enough, i.e. $\alpha > 1 - \frac{(1-\mu)(1-s^K)}{(1-p)}$. Otherwise, they both offer a screening contract.

Proof: See the Appendix A.

Indeed, the banks have an incentive to offer the same types of contracts because deviating could reduce their profit (see the Appendix). Therefore, we do not have an equilibrium where both types of contracts are offered at the same time. Since there is competition between banks, they offer the contract that minimizes costs, which allows them to offer the most attractive contract terms. For high enough liquidation values, this is a contract with collateralization.

The result formulated in Proposition 1 has interesting comparative statics. Here, we have to take into account that the distance d between bank and firm depends on the number of banks N . This means the higher the number of banks, the smaller is the distance between firm and bank, i.e. $\frac{\partial d}{\partial N} < 0$ and therefore the quality of the signal increases, i.e. $\frac{\partial s}{\partial N} = \frac{\partial s}{\partial d} \frac{\partial d}{\partial N} > 0$. We summarize the comparative statics results in the next proposition.

Proposition 2:

It is more likely that a contract is collateralized if the less competition there is in the banking sector, i.e. N is lower.

Proof: See the Appendix A.

Collateralization becomes more likely if it gets cheaper relative to screening. Therefore, it is quite clear that collateralization is chosen more often if the liquidation value increases. Screening becomes more efficient if the quality of the screening

signal increases. Then, the banks make fewer mistakes in the evaluation of credit proposals and therefore have lower costs in form of non-repayments. The quality of the screening signal depends on two factors: the screening technology as such and the distance between bank and firm. The distance between bank and firm is determined by the degree of bank competition. If there are more banks in the market (and by assumption they are located equidistantly), the distance between banks is lower and so is the distance between bank and firm. Distance influences the degree of asymmetric information between firm and bank. The closer a firm is located to the bank, the more informed is the bank, and more precise is the screening signal. Thus, with more banks the distance between the marginal firm and the bank decreases. The quality of the screening signal is higher and thus the repayment the bank needs to break-even is lower.

III. Empirical evidence

The theoretical model shows that greater bank competition lowers collateral requirements. We now bring empirical evidence to bear on this issue. We first describe data and variables, before explaining how we measure bank competition. We then develop the empirical results.

III.1. Data and variables

The sample of bank loans is obtained from the *Dealscan* database, which is supplied by the Loan Pricing Corporation (LPC, Reuters). This database is commonly used in empirical studies on bank loans (e.g. Dahiya et al., 2003; Qian and Strahan, 2007).

We use loan data for the period January 2000 to December 2005 as it is the period with the best coverage for both loans and banks. Following Qian and Strahan (2007), we drop loans to firms from the financial industry (SIC 6) and from the public sector (SIC 9). Public ownership or the monopoly situation is likely to influence the risk of loans granted to these firms, which may bias the use of collateral in comparison to what would be observed in manufacturing and other services. These criteria produced a sample of 4,931 bank loans made to borrowers located in 70 countries. List of countries is displayed in table 1.

The focus of our research is the investigation of the relationship between the presence of collateral and the degree of bank competition. To this end, we proceed to

regressions of the presence of collateral on a set of variables including bank competition and a wide range of control variables including loan-level and country-level variables.

The explained variable is the presence of collateral, which is measured by a dummy variable (*Collateral*) equal to one if the loan is secured and to zero if it is not. The explanatory variable of primary concern is the Lerner index (*Lerner Index*), measuring bank competition. We use the mean Lerner index for each country. Its computation is described in the next subsection. Bank-level data are taken from the “Bankscope” database of BVD-IBCA.

We use 5 loan-level control variables to take loan characteristics into account. These include information on loan maturity (*Maturity*), and on the type of loan, which is controlled through a dummy variable equal to one if the loan is a term loan and otherwise to zero⁶ (*Loan Type*). As many loans are syndicated, we control for the number of lenders involved in the loan by measuring the logarithm of the number of lenders (*Number of Lenders*), following Qian and Strahan (2007). We also take into account information on loan size (*Loan Size*), which is defined as the amount of the tranche of the loan in thousand dollars. Indeed syndicated loans are granted by tranches, which can be charged with different loan rates. Finally, the presence of covenants in the loan contracts is controlled through a dummy variable equal to one if the loan contract includes covenants and otherwise to zero (*Covenants*).

We also use 5 country-level variables to take into account financial and economic development, and the legal environment. *Financial Development* is the ratio of the volume of credit to private enterprises to GDP. That ratio measures the extent to which credit is allocated to private firms, as opposed to government or state-owned firms. It is widely used in the empirical literature to proxy for the development of financial intermediaries (e.g. Beck and Levine, 2004). *Bank Costs* is defined as the mean ratio of overhead costs to total assets for all banks. Information comes from Beck, Demirgüç-Kunt and Levine (2000) for these both variables. *Economic Development* is defined as the logarithm of GDP per capita, with data coming from the World Bank’s World Development Indicators.

Following a large body of research on law and finance pioneered by La Porta et al. (1997), we also adopt two variables for the impact of legal environment. Protection

⁶ A term loan is defined in *Dealscan* as an instalment loan where amounts repaid may not be reborrowed.

of creditor rights (*Creditor Rights*) is measured with the index developed by La Porta et al. (1998) and updated by Djankov, McLiesh and Shleifer (2007). This index is scored on a scale from zero to four with a higher score indicating better protection. It considers four aspects of the protection of creditor rights. Law enforcement is measured with the ‘Rule of Law’ index provided by Kaufmann, Kraay and Mastruzzi (2007) on a yearly basis (*Rule of Law*). This indicator refers to “the extent to which agents have confidence in and abide by the rules of society”. It ranges from -2.5 to 2.5 with greater values associated with better law enforcement.

Dummy variables for each industry (for each 1-digit SIC code) and each year are also included in the estimations to control for industry effects and year effects. Descriptive statistics for all variables are reported in table 2.

III.2 The measurement of bank competition

Empirical research on the measurement of bank competition provides several tools, which can be divided into the traditional Industrial Organization (IO) and the new empirical IO approaches. The traditional IO approach proposes tests of market structure to assess bank competition based on the Structure Conduct Performance (SCP) model. The SCP hypothesis argues that greater concentration causes less competitive bank conduct and leads to greater profitability of the bank.⁷ According to this, competition can be measured by concentration indices such as the market share of the largest banks, or by the Herfindahl index. These tools were widely applied until the 1990s.

The new empirical IO approach provides non-structural tests to circumvent the problems of the measures of competition provided by the traditional IO approach. These latter measures suffer from the fact that they infer the degree of competition from indirect proxies such as market structure or market shares. In comparison, non-structural measures do not infer the competitive conduct of banks through the analysis of market structure, but rather measure banks’ conduct directly.

Following new empirical IO approach, we compute the Lerner index for each bank of our sample. The Lerner index has been computed in several recent studies on bank competition (e.g. Maudos and Fernandez de Guevara, 2004, 2007; Martin,

⁷ This can lower performance in terms of social welfare because higher interest rates worsen the firm’s incentives (Schnitzer, 1999).

Saurina and Salas, 2006). It is defined as the difference between the price and the marginal cost, divided by the price.

The price is computed by estimating the average price of bank production (proxied by total assets) as the ratio of total revenues to total assets, following Maudos and Fernandez de Guevara (2004). The marginal cost is estimated on the basis of a translog cost function with one output (total assets) and three input prices (price of labor, price of physical capital, and price of borrowed funds). One cost function is estimated for each year to allow technology to change over time. We impose the restriction of linear homogeneity in input prices by normalizing total costs and input prices by one input price. The cost function is specified as follows:

$$\begin{aligned} \ln\left(\frac{TC}{w_3}\right) &= \alpha_0 + \alpha_1 \ln y + \frac{1}{2} \alpha_2 (\ln y)^2 + \alpha_3 \ln\left(\frac{w_1}{w_3}\right) + \alpha_4 \ln\left(\frac{w_2}{w_3}\right) \\ &+ \alpha_5 \ln\left(\frac{w_1}{w_3}\right) \ln\left(\frac{w_2}{w_3}\right) + \frac{1}{2} \alpha_6 \left(\ln\left(\frac{w_1}{w_3}\right)\right)^2 + \frac{1}{2} \alpha_7 \left(\ln\left(\frac{w_2}{w_3}\right)\right)^2 \\ &+ \alpha_8 \ln y \ln\left(\frac{w_1}{w_3}\right) + \alpha_9 \ln y \ln\left(\frac{w_2}{w_3}\right) + \varepsilon \end{aligned}$$

where TC denotes total costs, y total assets, w_1 the price of labor (the ratio of personnel expenses to total assets)⁸, w_2 the price of physical capital (the ratio of other non-interest expenses to fixed assets), w_3 the price of borrowed funds (the ratio of paid interests to all funding). Total costs are the sum of personnel expenses, other non-interest expenses and paid interest. The indices for each bank have been dropped from the presentation for the sake of simplicity. The estimated coefficients of the cost function are then used to compute the marginal cost.

III.3 Results

We now display the empirical results. As the explained variable, the presence of collateral, is a binary variable, we perform logit regressions following Jimenez, Salas

⁸ As Bankscope database does not provide information on the number of employees, we use this proxy variable for the price of labor following Maudos and Fernandez de Guevara (2004, 2007).

and Saurina (2006) and Berger et al. (2007).⁹ We estimate four logit regressions of the use of collateral by testing different combinations of control variables. The first regression includes all loan-level and country-level control variables (column 1). The second one includes no country-level control variable (column 2). The third one skips the legal variables (*Creditor Rights* and *Rule of Law*) (column 3), while the fourth one skips the economic and financial variables (*Economic Development*, *Financial Development*, *Bank Costs*) (column 4).

The major finding is the positive coefficient of *Lerner Index*, which is significant at the 1% level in all regressions. We therefore observe that the presence of collateral is more likely when the degree of bank competition is lower. As a consequence, our estimations clearly support our theoretical prediction on the impact of bank competition on the use of collateral. This result is in sharp contrast with the negative link between bank concentration and collateral use observed by Jimenez, Salas and Saurina (2006) or the absence of link between both variables obtained by Berger et al. (2007). However, these studies focus on one single country and use concentration indices to measure bank competition, which limit their relevance for the investigation of the role of bank competition on the presence of collateral.

Regarding the loan-level control variables, the coefficient is significantly positive for *Maturity*, *Number of Lenders*, *Loan Type*, and *Covenants*, while it is significantly negative for *Loan Size*. Our results thus suggest that a loan is more likely to be secured when it has a longer maturity, a greater number of lenders, some covenants, or when it is a term loan. In the opposite, larger loans are less likely to be secured. These findings are in line with the empirical literature showing that riskier loans are more likely to be secured (e.g. Jimenez and Saurina, 2004).

Regarding the country-level variables, we find a positive and significant influence for *Bank Costs* and *Creditor Rights*, suggesting that banks with higher costs and benefiting from better protection of creditor rights ask more for collateral. The sign for *Financial Development* is not significant. *Economic Development* and *Rule of Law* are not significant in the estimation including all country-level variables, but they are significant when the other one is dropped from the estimation. The probable reason is the strong correlation between these both variables. These findings are

⁹ We adopt the logit model rather the probit model, because Akaike and Schwarz information criteria are lower in logit regressions. However, we have also performed the probit regressions, and found similar results.

consistent with Qian and Strahan (2007) who investigate how legal and institutional variables influence loan characteristics including the presence of collateral.

To further address the validity of the results, we use an alternative measure for bank competition in our estimations. Following the wide utilization of concentration indices in the literature, we take an indicator of bank concentration as a natural robustness check, even if we are fully aware of the limitations of such indices as mentioned above. Bank concentration is measured by the assets of the three largest banks as a share of all commercial banks (*Concentration*). Information comes again from the Beck, Demirgüç-Kunt and Levine (2000)'s database. Table 4 displays the estimations with bank concentration. We observe a positive and significant coefficient for *Concentration*, meaning that bank concentration favors the presence of collateral. Therefore, these results corroborate those obtained with the Lerner index.

Another source of skepticism might concern Dealscan database, which includes many syndicated loans. Consequently, the loan can be granted by a syndicate of banks from different countries, which might make hard to consider the degree of competition of one country as relevant to explain the use of collateral. However the investigation of the sample shows that a large number of banks involved in the syndicated loans are domestic banks. Without meaning that all lenders are domestic, it stresses the fact that bank competition at the domestic level clearly matters. From the perspective of syndicated loans practitioners (Fight, 2004), the strong implication of domestic banks in syndicated loans is in line with on the one hand the fact that the arrangers are usually relationship banks, which are generally local banks with respect to the borrower's country (Esty, 2001), on the other hand the fact that the presence of local lenders reduces problems related to information asymmetries (Sufi, 2007). Nevertheless we perform additional estimations to check whether our findings are dependent of the presence of syndicated loans. In this aim, we keep only single-lender loans, resulting in a strong reduction of the sample size. The loan sample then includes 1173 loans from 43 countries. The results of these estimations are reported in table 5. Once again, we find that bank competition exerts a positive and significant impact on the use of collateral. The only changes concern the significance of some country-level control variables. Therefore, in spite of the limitations of Dealscan database, these additional points support the relevance of our results.

Our findings have thus survived several robustness checks, leading to the strong support of our theoretical prediction that a loan is more likely to be secured if competition is lower in the banking industry.

IV. Concluding remarks

We investigate how bank competition influences the use of collateral. This question is of major interest to assess the implications of the structural changes of the banking industry on the access to bank finance, owing to the dependence of this access to collateral requirements.

We construct a theoretical model incorporating information asymmetries in a spatial competition framework. Banks can choose between screening the borrower or asking collateral in the loan contract. Quality of the screening signal depends on bank competition, as greater competition results in a better information for the bank on the borrower and therefore a more efficient screening signal. Therefore, increased competition in the banking industry makes less likely the use of collateral in loan contracts, by making more attractive the choice for screening. The model thus predicts that bank competition lowers the presence of collateral in loan contracts.

In order to check this theoretical prediction, we develop an empirical cross-country analysis based on the regression of the presence of collateral on bank competition measured by the Lerner index. As predicted by the model, our tests provide evidence on a negative impact of bank competition on the presence of collateral. Robustness checks confirm this finding with alternative specifications.

Thus our paper shows that presence of collateral is more likely when bank competition is lower. As a consequence, the effects of bank competition on loan rates and on collateral use are complementary for the access to bank finance, as the reduction of loan rates is accompanied by lower collateral requirements. This conclusion is in line with the finding of Beck, Demirgüç-Kunt and Maksimovic (2004) that greater bank concentration fosters financing obstacles. The normative implications of our findings are therefore the support of the efforts to favor bank competition.

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Table 1
List of countries

Algeria, Angola, Argentina, Australia, Austria, Belgium, Bangladesh, Bolivia, Brazil, Bulgaria, Cameroon, Chile, China, Colombia, Croatia, Czech Republic, Denmark, Ecuador, Egypt, Finland, France, Germany, Ghana, Greece, Guatemala, Hong Kong, Hungary, India, Indonesia, Ireland, Iran, Israel, Italy, Ivory Coast, Jamaica, Japan, Kazakhstan, Korea, Lithuania, Malaysia, Mexico, Morocco, Netherlands, Norway, New Zealand, Oman, Pakistan, Panama, Papua New Guinea, Peru, Philippines, Poland, Portugal, Romania, Russia, Saudi Arabia, Singapore, Slovenia, Slovakia, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Thailand, Tunisia, Turkey, United Kingdom, Venezuela, Viet Nam.

Table 2
Variables and Summary Statistics

Means and standard deviations for variables used in subsequent estimations. Sources: Dealscan for all loan characteristics; Beck, Demirgüç-Kunt and Levine (2000) for *Financial Development*, *Bank Costs* and *Bank Concentration*; World Development Indicators for *Economic Development*; Kaufmann, Kraay and Mastruzzi (2007) for *Rule of Law*; Djankov, McLiesh and Shleifer (2007) for *Creditor Rights*; own computations for *Lerner Index*.

Variable	Description	Mean	Std Dev.
Loan characteristics			
Collateral	Loan is secured (1=yes)	0.498	0.500
Maturity	Maturity of the loan in months	61.672	42.641
Loan Size	Logarithm of the loan size (\$000)	200.546	533.497
Number of Lenders	Logarithm of the number of lenders	1.317	1.022
Loan Type	Loan is a term loan (1=yes)	0.405	0.491
Covenants	Loan includes covenants (1=yes)	0.278	0.448
Country-level variables			
Lerner Index	Mean Lerner index	13.927	9.538
Economic Development	Logarithm of GDP per capita in PPP	9.758	0.779
Financial Development	Ratio of credit to private sector to GDP	1.016	0.369
Bank Costs	Mean ratio of overhead costs to assets	0.027	0.013
Creditor Rights	Index of creditors rights from 0 (weak) to 4 (strong)	2.440	1.061
Rule of Law	Measure of “the extent to which agents have confidence in and abide by the rules of society” from -2.5 (weak) to 2.5 (strong)	0.910	0.806
Bank Concentration	Share of 3 largest banks in total banking assets	0.556	0.155

Table 3
Main regressions

Logit regressions for *Collateral*. Definitions of variables appear in table 1. Table reports coefficients with Wald Chi-Squares in parentheses. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level. Dummy variables for industries and years are included in the regressions but are not reported.

Explanatory variables	Estimations			
	(1)	(2)	(3)	(4)
Intercept	4.441*** (21.80)	4.337*** (74.24)	4.436*** (41.07)	4.268*** (69.97)
Maturity	0.012*** (166.92)	0.012*** (172.55)	0.012*** (165.19)	0.012*** (167.80)
Loan Size	-0.294*** (104.08)	-0.278*** (96.92)	-0.289*** (100.99)	-0.266*** (87.85)
Number of Lenders	0.252*** (36.54)	0.273*** (46.35)	0.234*** (32.17)	0.300*** (54.02)
Loan Type	0.592*** (61.83)	0.661*** (82.05)	0.585*** (61.39)	0.619*** (70.28)
Covenants	0.608*** (52.50)	0.648*** (62.55)	0.627*** (56.90)	0.684*** (68.09)
Lerner Index	0.055*** (124.96)	0.045*** (130.24)	0.060*** (179.60)	0.039*** (78.10)
Economic Development	-0.109 (1.28)	-	-0.100* (2.98)	-
Financial Development	-0.147 (1.04)	-	0.038 (0.08)	-
Bank Costs	32.631*** (79.84)	-	31.812*** (83.67)	-
Creditor Rights	0.168*** (16.09)	-	-	0.101*** (6.66)
Rule of Law	-0.021 (0.04)	-	-	-0.297*** (34.84)
Likelihood ratio	1788.987***	1648.856***	1772.701***	1684.402***
Pseudo R ²	0.3043	0.2842	0.3020	0.2894
N	4931	4931	4931	4931

Table 4
Robustness tests: with bank concentration

Logit regressions for *Collateral*. Definitions of variables appear in table 1. Table reports coefficients with Wald Chi-Squares in parentheses. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level. Dummy variables for industries and years are included in the regressions but are not reported.

Explanatory variables	Estimations			
	(1)	(2)	(3)	(4)
Intercept	2.732*** (8.51)	4.897*** (93.75)	6.551*** (97.41)	4.090*** (63.04)
Maturity	0.012*** (165.07)	0.012*** (175.83)	0.011*** (148.72)	0.011*** (162.60)
Loan Size	-0.290*** (102.84)	-0.281*** (101.97)	-0.281*** (98.84)	-0.269*** (90.65)
Number of Lenders	0.251*** (36.48)	0.232*** (34.33)	0.214*** (27.71)	0.290*** (50.38)
Loan Type	0.547*** (54.02)	0.602*** (70.34)	0.571*** (60.45)	0.580*** (62.59)
Covenants	0.660*** (62.93)	0.676*** (69.72)	0.646*** (61.98)	0.688*** (69.47)
Bank Concentration	1.331*** (27.10)	0.531** (5.65)	1.166*** (23.48)	1.243*** (24.36)
Economic Development	0.082 (0.78)	-	-0.321*** (30.08)	-
Financial Development	0.229** (2.54)	-	0.514*** (15.48)	-
Bank Costs	22.907*** (43.45)	-	24.196*** (51.82)	-
Creditor Rights	0.276*** (46.13)	-	-	0.237*** (44.45)
Rule of Law	-0.543*** (33.06)	-	-	-0.504*** (91.13)
Likelihood ratio	1680.234***	1515.595***	1596.485***	1627.395***
Pseudo R ²	0.2888	0.2646	0.2766	0.2811
N	4931	4931	4931	4931

Table 5
Robustness tests: single-lender loans only

Logit regressions for *Collateral*. Definitions of variables appear in table 1. Table reports coefficients with Wald Chi-Squares in parentheses. *, **, *** denote an estimate significantly different from 0 at the 10%, 5% or 1% level. Dummy variables for industries and years are included in the regressions but are not reported.

Explanatory variables	Estimations			
	(1)	(2)	(3)	(4)
Intercept	4.659** (4.93)	5.295*** (20.90)	7.217*** (21.23)	5.421*** (21.08)
Maturity	0.006*** (10.22)	0.006*** (9.60)	0.006*** (8.81)	0.006*** (8.92)
Loan Size	-0.269*** (18.80)	-0.255*** (17.68)	-0.267*** (18.61)	-0.257*** (17.56)
Loan Type	0.893*** (20.87)	0.991*** (28.42)	0.909*** (21.92)	0.886*** (21.33)
Covenants	0.605*** (6.92)	0.684*** (9.50)	0.581** (6.48)	0.714*** (10.08)
Lerner Index	0.052*** (24.88)	0.055*** (43.01)	0.057*** (36.36)	0.053*** (30.25)
Economic Development	-0.008 (0.01)	-	-0.332*** (7.61)	-
Financial Development	0.681* (3.68)	-	0.646* (3.63)	-
Bank Costs	16.964* (3.48)	-	22.787*** (7.20)	-
Creditor Rights	-0.0186 (0.03)	-	-	0.025 (0.05)
Rule of Law	-0.4349* (3.26)	-	-	-0.367 (8.62)
Likelihood ratio	495.449***	478.089***	492.011***	489.204***
Pseudo R ²	0.3445	0.3347	0.3426	0.3410
N	1173	1173	1173	1173

Appendix

Proof of Lemma 1:

We have to argue that banks have an incentive to offer the repayment \underline{R}^L .

Suppose that bank I deviates and demands $\underline{R}^L - \varepsilon$. Then it attracts all (good) firms, but makes an expected loss.

Suppose that bank I deviates and demands $\underline{R}^L + \varepsilon$. Then it does not have any customers and makes zero expected profits.

Since both banks demand the same repayment and the firms must incur some marginal application costs, firms apply for loans at the closest bank. As a result, both banks have the same market share. Q.E.D.

Proof of Lemma 2:

We have to argue that banks have an incentive to offer the repayment \underline{R}^S .

Suppose that bank I deviates and demands $\underline{R}^S - \varepsilon$. Then it would make an expected loss with the marginal firm k . On top of that, it would attract all firms even those located further away. But for those firms the quality of the screening signal is lower. As a result, the expected loss would be even higher.

Suppose that bank I deviates and demands $\underline{R}^S + \varepsilon$. Then all firms have an incentive to apply at the competing bank and bank I makes zero expected profits. (Problem: bank 2 would make a loss)

Since both banks demand the same repayment and the firms must incur some marginal application costs, firms apply for loans at the closest bank. As a result, both banks have the same market share and the marginal firm k is located half-way between two banks. Q.E.D.

Proof of Proposition 1:

We have already derived the terms of the credit contracts provided that both banks offer the same type of contract. We still have to argue that it is an equilibrium that both banks offer the same contract.

Suppose bank I and bank 2 are located next to each other and both offer a collateralized contract because α is above the threshold value. Both banks make zero expected profit with the marginal borrower. What happens if bank I deviates and offers a screening contract? Since the screening contract is less attractive than the collateralized contract, all good firms would apply at bank 2. Only bad firms would find it attractive to apply at bank I . This could be bad firms from the area around bank I and bank 2. Thus, all applicants at bank I would be bad firms. As a result, bank 2 does not have an incentive to deviate and offer a screening contract.

Next, suppose that bank I and bank 2 offer a screening contract because α is below the threshold value. What happens if bank I deviates and offers a collateralized contract? Since the collateralized contract is less attractive than the screening contract, all good firms would apply at bank 2 for a screening contract and get the loan because

the signal is perfect. All bad firms would apply at bank 2 as well. Since bank 2 can observe the firm's location it could deny loans to firms that are located further away than the marginal firm k . Thus, given the contract terms bank 2 offered, it will still make zero expected profits. Bank 1 would lose all its customers. As a result, bank 1 does not have an incentive to deviate and offer a collateralized contract. Q.E.D.

Proof of Proposition 2:

$$\frac{\partial \alpha}{\partial N} < 0$$

$$\text{since } \frac{\partial \alpha}{\partial s^K} < 0 \text{ and } \frac{\partial s^K}{\partial N} = \frac{\partial s^K}{\partial d} \frac{\partial d}{\partial N} > 0$$