The impact of the recent financial crisis on bank loan interest rates and guarantees.

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Abstract. The paper analyzes the role of guarantees on loan interest rates before and during the recent financial crisis in Italian firm financing. The paper improves on existing literature by distinguishing between real and personal guarantees. Further, the paper investigates the potential different role of guarantees in the bank-borrower relationship during the recent financial crisis.

This paper draws from individual Italian bank and firm data taken from the Banks' Supervisory Reports to the Bank of Italy and the Central Credit Register over the period 2006-2009.

Our analysis demonstrates that collateral affects the cost of credit of Italian firms by systematically reducing the interest rate of secured loans, while personal guarantees increase it. These effects are amplified during the crisis. Furthermore, guarantees are a more powerful instrument for ex-ante riskier borrowers than for safer borrowers. Indeed, riskier borrowers obtain significantly lower interest rates on secured loans than interest rate they would be charged on unsecured loans.

Keywords: financial crisis, guarantees, lending relationship.

JEL classification: E43, G21, D82

* The opinions presented are solely those of the authors and do not necessarily reflect the positions and views of the Bank of Italy.

1. Introduction

The importance of guarantees in bank lending activity is widely acknowledged, and their role is even recognized in the Basel Capital Accords that foresee a specific regulation for secured loans. Moreover, there is extensive literature that deals with the role of guarantees in determining the cost and the availability of credit, and borrower characteristics that have a greater effect on collateral requirements. In the presence of informational opacity, collateral and guarantees are powerful tools useful for mitigating adverse selection problems that may arise at the loan origination, and moral hazard risk that arises after credit has been granted (Berger and Udell, 1990). Indeed, the provision of real and personal guarantees has always been facilitating bank credit access, especially during economic crises (Cowling, 2010).

This paper aims at analyzing the role played by collateral and personal guarantees on bank-loan interest rates granted to Italian firms by means of a large dataset drawn from the Central Credit Register for the period 2006-2009. The Central Credit Register is an information system regarding the debt of the customers of the banks and financial companies supervised by the Bank of Italy. By means of the Central Credit Register the Bank of Italy provides intermediaries with a service intended to improve the quality of the lending of the credit system and ultimately to enhance its stability. The purpose of this paper is twofold. Firstly, to model and estimate a bank-loan supply function in order to understand the role and the relative weights of the two types of guarantees in the setting of bank interest rates. Secondly, to understand if and how Italian bank behaviour has changed during the recent economic and financial crisis.[1]

Pozzolo (2004) studied the effects of secured and unsecured loans on interest rates in the loan market of Italian firms. In his work he controlled for the presence of guarantees by means of two dummy variables (one for collateral and one for personal guarantees). The novelty of the paper is: a) the use of a larger database than Pozzolo's, spanned from 2006 to 2009; b) the use of the guarantee-loan ratios as explanatory variables. Indeed, we expect that interest rates depend upon the relative value of guarantees with respect to the size of the granted loan, and not only upon the presence of guarantees; c) we deal with a single-nested panel data model in which firms may be grouped by banks, and estimate a "mixed effects" model in which fixed-effects are analogous to standard regression coefficients and are estimated directly. The random effects are not directly estimated but are summarized according to their estimated variances and covariances. We assume random effects vary across banks and may take the form of either random intercepts or random coefficients. Whereas random intercepts represent heterogeneity between banks in the overall response, random coefficients represent heterogeneity in the relationship between the response and explanatory variables, i.e. the impact of personal guarantees and collateral on the loan interest rate varies across banks.

The distinction between real guarantees (collateral) and personal guarantees, and their potential different role in bank-borrower relationships, plays an important role in models of bank interest rates. In an asymmetric information context, guarantees play a

[1] Panetta and Signoretti (2010) show that, during recent economic and financial turmoil, the deceleration of Italian bank loans has been affected both by demand and supply factors. As for firms, they show that loan demand declined following the investment contraction, while lower levels of bank loan supply were the joint result of the increase in borrowers' risk and in the degree of bank risk aversion.

role in solving different problems that may arise at loan origination (hidden information-adverse selection problems) or after the loan has been granted (hidden action-moral hazard problems).

Furthermore, a principal role is played by the distinction between inside collateral and outside collateral. The former is physical assets owned by the borrower, and is mainly used to order creditors priority in case of borrower's default. The latter is assets posted by external grantors: in case of default, outside collateral enhances the claim of a single creditor by recurring against additional assets external to the debtor. Therefore, outside collateral should be more powerful than inside collateral in solving asymmetric information problems.

Personal guarantees are on the other hand contractual obligations of a third party, and they act as external collateral. However, they do not give the lender a specific claim on particular assets, and restrict the actions (s)he could take in case of borrowers' bankruptcy (Berger and Udell, 2000).

The Central Credit Register database does not provide information on inside and outside collateral. Therefore, this paper will only discuss empirical results concerning the role of collateral and guarantees on bank loan interest rates charged to Italian small-sized firms.

This paper uses unbalanced sample data on 214 individual Italian banks and 560,339 firms data over the period 2006-2009.

The empirical strategy is as follows.

Firstly, the paper estimates a bivariate probit model to understand how the crisis, together with the borrower observed riskiness and other variables, influenced the probability of observing secured loans. This analysis seems to confirm that guarantees are associated with riskier borrowers.

Secondly, the paper estimates a multilevel model in which the dependent variable, i.e. the spread between the bank loan and overnight interest rates, is regressed on loan-contract, individual-firm and -bank characteristics, and on time dummies. Our analysis demonstrates that collateral affects the cost of credit of Italian firms by systematically reducing the interest rate of secured loans, while personal guarantees increase it. These effects are amplified during the crisis. Furthermore, guarantees are a more powerful instrument for ex-ante riskier borrowers than for safer borrowers. Indeed, riskier borrowers obtain significantly lower interest rates on secured loans than interest rate they would be charged on unsecured loans.

The paper is organized as follows. Section 2 reviews the theoretical and empirical literature, while Section 3 describes the data used and provides some descriptive statistics; Section 4 describes the empirical model, the estimation strategy and discusses the findings. Section 5 concludes.

2. Review of the literature

The role of collateral and guarantees on bank lending activity has been widely discussed. In this section we focus on the main contributions that analyze the theoretical and empirical relationship between guarantees and loan interest rates.

Theoretically, under perfect information, the bank can distinguish between different types of borrowers, and has perfect knowledge about the riskiness of their investment projects. In this setting guarantees are used to reduce the potential loss that the bank

would incur in the case of borrowers' default. According to the "sort by observed risk paradigm" observably risky borrowers are asked to pledge collateral while observably safe borrowers are not (Berger and Udell, 1990).

Under asymmetric information guarantees play a role in solving different problems that may arise at loan origination (hidden information) or after the loan is granted (hidden action).

A hidden information-adverse selection problem arises in situations in which banks cannot discern the *ex-ante* riskiness of the entrepreneur. Without guarantees, the average loan rate would be higher than the optimal rate for safe borrowers, and only riskier borrowers would apply for banks loans. In these situations, guarantees act as a signaling device to distinguish the *ex-ante* riskiness of the entrepreneur: the low risk borrower will choose a contract with guarantees in order to take advantage of a lower interest rate (Bester, 1985 and 1987; Besanko and Thakor, 1987).

A hidden action-moral hazard problem arises when banks cannot observe the borrower behavior after the loan has been granted. In these situations, guarantees are used as an incentive device, and reduce the debtor incentive to strategically default. As Boot et al. (1991) have shown, if there is substitutability between the borrower quality and action, the riskier borrower pledges more guarantees, while the safe borrower gets an unsecured loan. Guarantees are used as an incentive device: secured loans are made to riskier borrowers to reduce the debtor incentive to strategically default.

Therefore, three alternatives define the correlation between loan interest rate and guarantees.

First, the risk premium and guarantees are negative correlated if guarantees are used as a signaling device to solve the adverse selection problem.

Second, the correlation between guarantees and risk premium is still negative if guarantees are used as an incentive device to reduce moral hazard, and guarantees more than compensate the borrower risk.

Finally, the correlation between guarantees and risk premium is positive if guarantees are used as an incentive device to reduce moral hazard, and guarantees do not compensate the borrower risk.

Empirical results on the impact of collateral and personal guarantees on the loan rate are mixed.

There are studies that find a positive impact of guarantees on interest rates.

Berger and Udell (1990, 1995), by using a large dataset on American commercial loans, have found that interest rates on secured loans are on average higher than those on unsecured loans. Guarantees are most often associated with riskier borrowers, riskier loans, and riskier banks. This result supports the idea that observably riskier borrowers are asked to pledge more guarantees to mitigate the moral hazard problem.

Casolaro et al. (2008), using information on syndicated credit facilities granted to borrowers of over 80 countries between 1990 and 2001, have also found that secured loans have larger interest rate spreads than unsecured loans.

Ono and Uesugi (2009), who have investigated the determinants of collateral and personal guarantees in the small business loan market in Japan, have reached similar results. The authors have found that both collateral and personal guarantees increase interest rates charged on loans and the finding is robust to potential guarantees endogeneity. The authors conclude that guarantees are useful in mitigating the moral hazard as they are more likely to be pledged by riskier borrowers.

Ogawa et al. (2010) use a matched sample of Japanese small firms and main banks, and investigate bank-firm relationships in the early 2000s. The authors have concluded that personal guarantees positively affect the interest rates charged on small firms lending.

Other studies find a negative impact of guarantees on interest rates.

Harhoff and Korting (1998) present a study of the lending relationship between banks and SMEs in Germany. The authors have concluded that interest rates on SME secured loans are lower than those on SME unsecured loans.

Jimènez, Salas-Fumàs and Saurina (2006) have uncovered direct evidence of a negative association between collateral and the borrower's risk.

In a principal-agent setting, John et al. (2003) have concluded that guarantees decrease the riskiness of a given loan, and that collateralized debt has a higher yield than general debt, after controlling for credit rationing.

Pozzolo (2004), Bonaccorsi di Patti (2006) and Calcagnini et al. (2011) provide evidence for Italy.

Pozzolo (2004) has found that real guarantees are not statistically related to the borrower risk. He interprets this finding as potentially consistent with the hypothesis that inside collateral is used as a signaling device to solve the adverse selection problem. On the other hand, he finds that personal guarantees are more likely to be asked for when the borrower is *ex-ante* riskier. However, once the borrower's riskiness is controlled for, both real and personal guarantees reduce the interest rate charged on loans.

Bonaccorsi di Patti (2006) presents a detailed analysis of the widespread use of both real and personal guarantees in the loan market for Italian firms. The article finds that guarantees are more likely to be pledged by riskier firms, and that personal and real guarantees are positively correlated. Moreover, the article finds that internal and external collateral are substitutes.

Calcagnini et al. (2011) analyze the role of collateral and guarantees on Italian micro firm (producer households). The authors have ascertained that collateral and personal guarantees affect the cost of credit of small business by systematically reducing the spread of secured loans, after controlling for borrower and loan riskiness, and that this effect is amplified during the crisis.

3. Data and Summary Statistics

The empirical analysis uses information on lines of credit to a large sample of Italian nonfinancial firms. Data has been taken from two sources: the Banks' Supervisory Reports to the Bank of Italy (Segnalazioni di Vigilanza) and the Central Credit Register (Centrale dei Rischi). The first source is used for data on banks' balance sheets. The second contains information on single bank loans, the interest rates charged and the value of the assets posted as guarantees (distinguished between real and personal).[2] [3]

[2] The Central Credit Register is regulated by the resolution adopted by the Credit Committee on 29 March 1994 pursuant to Articles 53, 67 and 107 of the Banking Law. The following participate in this centralized service:

– banks entered in the register referred to in Article 13 of the Banking Law;

– financial intermediaries entered in the register of banking groups and/or the special register referred to in, respectively, Articles 64 and 107 of the Banking Law that engage exclusively or primarily in financing

We use data on firm financing for the period 2006-2009 for a total of 560,339 firms and 214 banks.

Table 1 shows the distribution (% values) of firms' loans by type of guarantees for the period 1999-2009. The share of loans granted by collateral (mainly mortgages) constantly increased. The faster rate of growth observed in the first type of loans has been compensated by the share of loans granted by personal guarantees, that are potentially riskier than collateral as they represent a generic claim on the wealth of the grantor, who has therefore a large degree of freedom and could possibly default on it. Finally, all other types of unsecured loans (labelled as 'Unsecured' in Table 1) have been relatively constant, especially during the most recent years.

As expected, the financial crisis has negatively affected the number of firms' loans, especially of unsecured loans that decreased by 28% from 2008 to 2009. Loans granted by personal guarantees and collateral decreased by 18% and 22%, respectively (Table 2). This dynamic can be mainly explained by negative demand effects (fewer investments, fewer mortgages and fewer collateralized loans), but also by banks tightening their credit, and higher bank risk aversion.[4]

The average size of loans granted by collateral is typically larger than the average size of the other types of loans (Table 3). Furthermore, descriptive statistics show that the average size of unsecured loans or loans granted by personal guarantees decreased more than the average size of collateralized loans (-16%, -21%, and -0.01% from 2008 to 2009, respectively).

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activity. Financial intermediaries more than 50 per cent of whose financing activity consists of consumer credit are exempted. Consequently, the group of financial intermediaries reporting to the Central Credit Register is not identical to the group that transmits supervisory returns.
Participating intermediaries also report the exposures of foreign branches to borrowers resident in Italy. All the statistical distributions take such loans into account.
Once a month intermediaries are required to report each customer's debtor position, comprising both individual and joint liabilities (joint accounts and partnerships).
The whole position relative to a given customer must be reported where even one of the following conditions applies:
the sum of credit granted or used for all loans and guarantees granted to the customer is at least 30,000 euros;
the total value of personal guarantees provided by the customer is at least 30,000 euros;
the customer's position is classified among bad debts or is written off during the reference month, regardless of the amount;
the face value of factoring claims the intermediary has acquired from the customer is at least 30,000 euros;
the value of the transactions carried out by the intermediary on behalf of third parties is at least 30,000 euros.
Where a report is made because one of the above conditions applies, it must cover all the outstanding positions of the customer in question (Bank of Italy, 2010, p.117).

[3] Before 2009 the threshold was 75,000 euros. Once we account for this change, the findings shown in Tables 2, 3, and 4 are actually reinforced.

[4] The large decrease in the number of contracts in the database could be partially due to statistical changes which occurred in personal or firm data, and industry reclassifications which occurred in 2009. However, variables' trend in our database are consistent with those observed in the data referred to the whole population of banks and households businesses. Indeed, from 2008 to 2009, the total number of lending contracts in Italy decreased by 20.47%. See http://bip.bancaditalia.it/4972unix/homebipita.htm

Loan interest rate decreased between 2008 and 2009, especially for collateralized loans (see Table 4). Indeed, in Italy, during the crisis, following the negative trend of official interest rates, the cost of credit decreased significantly and in 2009 interest rates were 3.9 and 3.1 percent points lower than 2008 levels for variable interest rate contracts and fixed interest rate contracts, respectively (Panetta and Signoretti, 2010).

However, interest rate spreads has been increasing since 2006, and they have been higher for unsecured loans than for loans secured by guarantees, especially for collateralized loans. Between 2008 and 2009 the spread on firm collateralized loans decreased (-0.13) (see Table 5).

Summing up, descriptive statistics show a correlation between loan interest rates and real and personal guarantees, as secured loans demonstrate both lower interest rates and lower increases in the spreads during the observed period.

To disentangle the direct effect of real and personal guarantees (and their interaction with the crisis and with the type of customer) on the cost of credit, we estimate multilevel model relating interest rate spreads to loan contracts, firm, and bank characteristics.

4. Model specification and estimation strategy

4.1 Determinants of personal and real guarantees: Bivariate Probit Model

The empirical strategy consists of a two-step analysis. In the first step, we aim at estimating the determinants of collateral and personal guarantees. In particular, we want to verify if previous findings about the role of collateral and personal guarantees in solving adverse selection and moral hazard problems are confirmed, i.e. high quality debtors may use collateral as a signal device, while riskier borrowers are requested to post personal guarantees as an incentive device to solve moral hazard problems.

We assume that the conditional probability of the firm to post guarantees, Pr(*GUAR=1|X*), given a cumulative distribution function Φ (.), depends on loan, firm and bank characteristics. Moreover, we add time dummies to capture the impact of the financial crisis.

Collateral and personal guarantees are jointly determined and depend on the same set of variables. Therefore, the error correlation between the two types of guarantees may be different from zero, and we estimate the following bivariate probit model:

$$p_{ij} = \Pr(GUAR_{ij,t} = 1 \mid X) = \Phi(X'\beta)$$

with

$$X'\beta = \beta_1 RISK_{ijt} + \beta_2 LOAN\_S_{ijt} + \beta_3 FIRM\_S_{ijt} + \beta_4 PRIV_{ijt} + \beta_5 LEND\_REL_{ijt} +$$
$$+\beta_6 NUM\_REL_{ijt} + \beta_7 BANK\_S_j + \beta_8 CENTRAL_j + \beta_9 SOUTH_j + \beta' TIME\_D_t + \varepsilon_{ijt} \quad (1)$$

Variables used in model (1) are described in details in the data Appendix.

Table 6 reports data summary statistics.

Columns (1) and (2) of Table 7 report the marginal effects of the bivariate probit model (1), in which the likelihood ratio test rejects the null of zero correlation between the errors of the two probit models (see Table 7 *rho* labeled LR test).

Results support the hypothesis that guarantees are associated to riskier borrowers. We capture customer risk by using a measure of observed risk (RISK) given by the "substandard" loan of the firm in temporary difficulties.[5]

The estimated coefficient of RISK is positive and statistically significant in both columns: riskier borrowers have a higher probability of posting real or personal guarantees.

While the impact of loan size (LOAN_S) on personal guarantees is negative but small in absolute values (column (1)), LOAN_S increases the probability of loans to be secured by collateral (column (2)): the result is likely to be driven by the presence of mortgages which, by the Italian code, have to be collateralized.[6]

Large firms (FIRM_S, proxied by the loan size) have a lower probability of posting personal guarantees than firms of smaller size. The finding reflects the stronger bargaining power of large firms than other firms. As for the positive estimated coefficient of FIRM_S in column (2), the result is likely driven by the presence of mortgages: FIRM_S is a binary dummy variable which takes a value of 1 when the loan value is equal or greater €1,000,000 and 0 when the loan value is less than €1,000,000.[7]

Private companies are asked to post personal guarantees: the estimated coefficient of PRIV is positive in column (1) of Table (7). The finding is consistent with the fact that personal guarantees are only external to the firm and they are typically posted by the proprietorship. On the other hand, private companies have stronger bargaining power than public companies, and reach better contract conditions. Therefore, private companies have a lower probability of posting collateral and the estimated coefficient of PRIV is negative in column (2) of Table (7).

Long-term lending relationships (LEND_REL) between banks and customers negatively affect the probability of posting both personal guarantees and collateral. On the one hand, a long-term banking relationship may benefit the borrowers by helping to build trust between borrowers and lenders, and consequently to reduce moral hazard. If guarantees are asked to solve moral hazard problems, the probability of posting guarantees decreases the longer the lending relationship (Boot and Thakor, 1994). On the other hand, longer lending relationships could be associated with a higher use of collateral if long-term relationships generate more severe hold-up problems (Ogawa et al. 2010). The findings suggest that the negative effects of the hold-up problem dominate the benefits of the relationship lending.

Furthermore, an increasing multiple lending relationships (NUM_REL) negatively affects the probability of posting both collateral and personal guarantees. The result is consistent both with the hypothesis that "banks are unwilling to require a guarantee on their loans if this has the side effect of making implicitly available to competing lenders the result of their screening activity" (Pozzolo, 2004 p.14) and with the fact that firms take actions against the monopoly power of a main bank, and eventually get better contract conditions, in the presence of multiple-bank relationships (Ogawa et al, 2010).

The probability for firms to post personal guarantees is slightly higher if banks are large (BANK_S=1). However, the probability to post collateral if banks are large is

[5] In empirical literature the interest rate charged on the loan is often used as the measure of customer riskiness. The use of an observed measure of customer riskiness such as RISK allows controlling for the endogeneity issue concerning guarantees.

[6] In our data we do not have enough information to distinguish between different types of loans.

[7] This threshold is used in the statistics of European Central Bank and in several Bank of Italy papers.

lower. The latter finding is consistent with the theoretical and empirical literature according to which larger banks have a higher ability to evaluate customer risk and, therefore, screen riskier investment projects. Particularly, secured loans may be considered by the lender as an alternative to screen and evaluate borrower or loan riskiness. Smaller banks generally have a lower level of expertise and scarce resources to evaluate the economic loan risks. Therefore, they have more incentives to use collateral instead of undertaking a project evaluation (Manove and Padilla (1999); Manove, Padilla and Pagano (2001); Jiménez, Salas and Saurina (2006)).

Bank regional location plays a significant role on the likelihood of posting both personal guarantees and collateral. Compared to banks located in the North of Italy, loans provided by banks in Central Italy (CENTRAL) or in the South (SOUTH) show a higher probability of requiring guarantees or collateral.

The economic and financial crisis increases the probability of loans to be secured, especially during the year 2009.

To capture the impact of both large- and medium-sized firms on interest spreads, columns (3) and (4) of Table 7 show the estimated coefficients of model (1) in which we use an alternative measure of firm size with respect to FIRM_S. LARGE is again a dummy variable that takes value equal to one if the loan granted is greater or equal to 250,000 euro. In the sample, the 44.75% of loans is greater or equal to this threshold while only the 13.51% is greater or equal to 1,000,000 euro. The estimates confirm previous findings that larger loans have a higher probability to post real guarantees.

4.2 Interest rate model

The previous Section analyzed the determinants of real and personal guarantees, and results show that riskier borrowers have a higher probability of posting both real and personal guarantees as an incentive device to solve moral hazard problems.

This Section focuses on the impact of guarantees on loan interest rates.

The following simple interest rate model may well describe the bank loan market:

$$r_{ij} = r(L) + markup_{ij} + riskpremium_{ij} \quad (2)$$

where r_{ij} is the interest rate charged to customer i by bank j. We assume that r_{ij} is a function of the market interest rate ($r(L)$), plus a mark-up and a risk premium.

We assume that $r(L)$ is a positive function of the market loan demand, given a fixed savings supply in the short term. Here, $r(L)$ is the overnight interest rate which is the same for all banks.

The mark-up term captures banks' market power. We assume that the mark-up varies across customers inversely with the customer size (FIRM_S) and directly with the bank size (BANK_S). Moreover, the number of bank relationships (NUM_REL) and the time length (number of years) of the lending relationship (LEND_REL) may also affect the mark-up. While we expect a negative impact for the first variable, the impact of the length of the lending relationship is not known *a priori*. On one side, a longer lending relationship should increase loan interest rates by generating an information monopoly that enables banks to extract rents from borrowers. On the other, a long-term banking relationship may benefit the borrowers: borrowers pay higher interest rates and pledge

guarantees early in the relationship, but, once their first project is successful, they are awarded with unsecured loans and lower loan rates (Boot and Thakor, 1994).

The risk premium is the interest rate component that positively depends on customer and loan riskiness. We capture customer risk by means of a measure of observed risk, RISK, as described in Section 3.1. The customer risk depends on other firm characteristics, such as if the firm is private or not (PRIV).

Loan riskiness depends positively on loan size (LOAN_S). It is possible that LOAN_S may capture firm size. If this were the case the estimated coefficient of this variable may have sign opposite to what it is expected.

Moreover, we make use of additional information on the presence of guarantees to control for customers' risk. Specifically, we use the relative (to the loan size) amount of collateral (COLL) and personal guarantees (PERS) posted, and a dummy (DOUBLEG) to capture the contemporaneous presence of both types of guarantees. However, as described in Section 2, the impact of guarantees on interest rate is not defined *a priori*. Indeed, guarantees may be used as a signal of high quality debtor, and therefore we should expect a negative impact on interest rate; or riskier borrowers may post guarantees, and therefore we should expect a positive impact of guarantees on interest rate.

Finally, we control for banks' geographical location by means of three dummy variables (NORTH, CENTRAL and SOUTH).[8]

Since $r(L)$ and r_{ij} are highly correlated, we opted for a slightly different version of model (2) where the dependent variable is the spread between the two interest rates ($SPD_{i,j}$, = r_{ij} - $r(L)$).

As explanatory variables we have three main groups of variates:

- a vector $X_{i,j,t}$ containing the characteristics of each loan contract: COLL, PERS, DOUBLEG and LOAN_S;
- a vector $F_{i,t}$ containing firm characteristics: RISK, NUM_REL, LEND_REL, FIRM_S, PRIV;
- a vector $B_{j,t}$ containing bank characteristics: BANK_S, CENTRAL and SOUTH.

Furthermore, our model includes time-dummy variables to identify the impact of the economic crisis and two interaction variables that are expected to capture the impact of the financial crisis on real and personal guarantee requirements CRISIS*COLL and CRISIS*PERS, respectively.

The empirical equation takes the following form:

$$\begin{aligned} \mathrm{SPD}_{i,j,t} &= \beta_0 + \beta_1' X_{i,j,t} + \beta_2' F_{i,t} + \beta_3' B_{j,t} + \beta_4' TIME\_D_t + \\ &+ \beta_5 CRISIS^* COLL_{i,j,t} + \beta_6 CRISIS^* PERS_{i,j,t} + u_{i,j,t} \end{aligned} \qquad (3)$$

[8] To determine if our interest rate model can be correctly identified as a supply function, we should assume that the variance of the stochastic term in the loan offer function is smaller than the corresponding variance in the loan asking function. This assumption seems acceptable given that, for instance, a given bank forces its lending officers to follow certain common techniques of credit analysis that may result in more precision in processing lending application (i.e. in a lower stochastic variance). Diversely, borrowers are subjected to industry specific seasonal and cyclical shocks; moreover, firm treasures are not compelled to behave similarly when they apply for loans. Both reasons imply a larger stochastic variance for the loan asking function (see Hester (1967), p.132).

The subscript i refers to firms, j to banks, t to time periods. $u_{i,j,t}$ is a disturbance with a multiway error-components structure:

$u_{i,j,t} = \alpha_i + \lambda_{i,j} + \varepsilon_{i,j,t}$

where α_i, $\lambda_{i,j}$ and $\varepsilon_{i,j,t}$ are assumed to be i.i.d., and are mutually independent.

Antweiler (2001) derived the maximum likelihood estimator for panel data with unbalanced hierarchies. We deal with a single-nested panel in which firms may be grouped by banks, and estimate a "mixed effects" model in which a fixed-effects approach is used to estimate regression coefficients and a random-effects approach is used for the low-level group, i.e. banks.

The multilevel analysis assumes that the latent variables, or random effects, can be interpreted as unobserved heterogeneity at the different levels inducing dependence among all lower-level units in the same higher-level unit. Whereas random intercepts represent heterogeneity between clusters in the overall response, random coefficients represent heterogeneity in the relationship between the response and explanatory variables (Rabe-Hesketh et al., 2004). Figure (1) represents the data structure. We have information on bank loans granted to firms. Each bank grants loans to many firms. The paper estimates model (3) both under the assumption that the intercept is random and the overall response varies across banks; and under the assumption that the slope is also random, i.e. the impact of guarantees and collateral on the loan interest rate varies across banks. Moreover, we allow for correlation among random effects by assuming an unstructured variance-covariance matrix.

In the dataset some firms may have multiple bank relationships in each year (Firm 3 in Figure 1).[9]

Figure 1. Nested panel data model

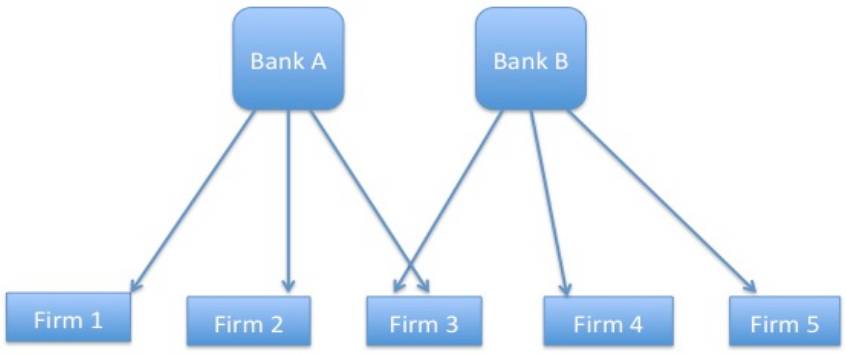

Table 8 shows the estimated coefficients of the multilevel models. The likelihood ratio test rejects the null of no random effects for all specifications (see Table 8 *re* labeled LR test, p-value reported).

Different model specifications are shown in Table 8. First, we estimated model (3) both under the assumption that the intercept is random, and under the assumption that

[9] The panel data is not a pure nested model, as we have some firms that have loans from different banks in each period. Therefore, for robustness checks purposes, we estimate model (3) considering only firms that do not have multiple bank relationships (NUM_REL=1) in each year. Estimates confirm the findings of Tables (9) and (10).

the slope is also random, i.e. the impact of guarantees and collateral on the loan interest rate varies across banks. Testing the two specifications by means of the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC), according to which "small is better", the latter specification is preferred to the former. Therefore, column (1) of Table 8 shows the estimated coefficients of the multilevel model (3) with random intercept and random slope, but without the interaction variables CRISIS*PERS and CRISIS*COLL.

As expected, riskier firms are charged higher interest rates: the estimated coefficient of RISK is positive and statistically significant.

Results show that collateral (COLL) and personal guarantees (PERS) affect loan interest rates differently. While the presence of collateral (COLL) decreases the interest rate, the presence of personal guarantees (PERS) increases it. These findings are consistent with the idea that once banks control for the borrower risk, collateral decreases interest rates, while the positive estimated coefficient of PERS shows that personal guarantees are potentially riskier than collateral as they represent a generic claim on the wealth of the grantor, who has therefore a large degree of freedom and could possibly default on it. Furthermore, it confirms previous studies according to which personal guarantees are associated to a higher observed borrower risk that might not be fully captured by the RISK variable (Pozzolo, 2004). The contemporaneous presence of both types of guarantees (DOUBLEG) does not affect the interest rate on loan.

Loan size (LOAN_S) and firm size (FIRM_S) show an inverse relationship with interest rate, as larger loans and larger firms pay a lower interest rate. In these cases the scale effect of the loan size more than counterbalances the potentially higher risk associated to loans of larger size. Larger loans are likely associated to larger firms that have a stronger bargaining power and contract a lower interest rate.

A stronger bargaining power is also likely associated to private companies as opposite to state owned companies as the estimated coefficient of PRIV is negative and statistically significant at one percent level.

As for other firm characteristics, the lending relationship (LEND_REL) does not affect the interest rate, while the number of lending relationships (NUM_REL), which may be also interpreted as a measure of borrower riskiness, decreases interest rates. Indeed, multiple bank relationships may solve the hold up problem that arises for a firm with one close bank: firms take actions against the monopoly power of a main bank and eventually pay a lower interest rate (Ogawa et al, 2010).

While bank size does not affect loan interest rates, banks located in the Centre and the South of Italy charge a higher interest rate than banks in the North. Finally, time dummies account for the effects of the financial crisis on interest rates. Their coefficients are highly statistically significant and positive reflecting the increase in interest rates between 2006-2009.

To account for the potential interaction of the crisis with the presence of collateral and guarantees, column (2) of Table 8 shows the estimated coefficients of model (3).

Overall, estimates shown in column (2) confirm the findings of column (1).

Specifically, the estimates show that during the crisis loans secured by collateral systematically pay lower interest rates, as the coefficient of CRISIS*COLL is negative and statistically significant. The result, together with the negative estimated coefficients

of COLL, underlines that collateral contributes not only to grant credit (as shown by descriptive statistics in Table2 2 and 3) but also to reduce loan interest rate.

As for personal guarantees, the estimates suggest that loans secured by personal guarantees are riskier or associated to riskier borrowers as both the estimated coefficient of CRISIS*PERS is negative but the marginal effect of personal guarantees on interest rate is still positive.

Finally, the longer the lending relationship (LEND_REL) is, the higher the interest rate. The finding is not new to empirical literature (see Harhoff et al., 1998; Petersen and Rajan, 1994 for a survey of the empirical literature). Chakravarty and Yilmazer (2009) assert that the overall granting process is a sequential process given by three stages: application, decision and rate setting. The authors find that the lending relationship matters only in the first and second stages, i.e.: conditional on being approved, relationships are not important in determining the loan rate. Similarly, Petersen and Rajan (1994) do not find statistical evidence that the strength of the lender-borrower relationship is correlated with cheaper credit. Moreover, our dataset composition contains different types of loans for which reputation and relationship effects may be less important (Berger and Udell, 1995). Therefore, in our sample, the length of the lending relationship may capture not only the strength of the bank-borrower relationship, but also a monopoly power of a main bank that asks for higher interest rates.

All model specifications find that riskier firms pay higher interest rates. Column (3) shows the estimated coefficients of model (3) in which we further control for the impact of the interaction of firm risk with guarantees on loan interest rates by adding two interaction variables RISK*COLL and RISK*PERS. Estimates show that the negative impact of guarantees on loan interest rates is higher the riskier the firm: *ceteris paribus*, guarantees are a more powerful instrument for *ex-ante* riskier borrowers than for safer borrowers. Indeed, riskier borrowers obtain significantly lower interest rates on secured loans than the interest rate they would be charged on unsecured loans.

To capture the impact of both large- and medium-sized firms on the interest spreads, column (4) shows the estimated coefficients of model (3) in which the variable LARGE is used instead of the variable FIRM_S to measure firm size. The estimated coefficient shows that medium- and large-sized firms pay lower interest rates than smaller firms. Overall, the estimates confirm findings in columns (1)-(3) of Table 8.

To check the robustness of our results column (5) in Table 8 shows the estimated coefficients of the baseline model specification of column (1) when treating real and personal guarantees as endogenous variables. Guarantees might be endogenous due to unmeasured and unmeasurable influences acting at firm or bank levels such as the fact that interest rates and guarantees are simultaneously set at the time of a loan approval. [10] In multilevel analysis, the unmeasured influences of omitted variables or measurement error in the fixed part gets incorporated in the random part of the model, thereby violating the assumption of the independence of regressors and model disturbances (Ebbes et al., 2004). If this is the case, the OLS estimated coefficients are biased, and instrumental variables (IV) estimation techniques can be used to reduce the bias (Spencer and Fielding, 2000).

[10] All bank level variables in model (3) are exogenous. Therefore, we rule out bank-level endogeneity and only take into account firm level endogeneity.

First of all, to obtain IV estimates of model (3), we used Lewbel's approach to construct 'internal instruments' (Lewbel, 1997) and then estimated separate multilevel models for COLL and PERS as function of the instruments and all the other exogenous variables included in the model.

Secondly, we used the predictions of the endogenous variables, IVCOLL and IVPERS, as variables in model (3) to obtain consistent estimates of the fixed-effects parameters. Then, we corrected the coefficients' variance-covariance matrix by means of the 'real' mean square error (Baltagi, 2002).[11]

IV estimates confirm the previous finding about collateral, while personal guarantees have no statistically significant effect on interest rates. Even if personal guarantees are external (and therefore should be more powerful in solving adverse selection or moral hazard problems), they are potentially riskier than collateral as they represent a generic claim on the wealth of the grantor, who has therefore a large degree of freedom and could possibly default on it. However, the estimated coefficient of DOUBLEG is positive and statistically significant: it is likely that riskier borrowers are requested to post both types of guarantees.

Table 8 shows the fixed-effects estimates of model (3). As for guarantees, fixed effects refer to the overall expected effect of the presence of real or personal guarantees on interest rates. However, according to our model specification, random effects also depend on guarantees. Random effects measure whether the impact of guarantees on interest rates differs among banks / from bank to bank.

Table 9 shows the estimated random-effects parameters of model specification shown in column (1) of Table 8. The variance component of the random intercept (Standard dev (CONSTANT)) is statistically significant, meaning that interest rates significantly differ across banks. Furthermore, the slopes of collateral and personal guarantees also show statically significant variance components, (Standard dev(COLL)) and (Standard dev(PERS)), respectively. Therefore, real guarantees and personal guarantees affect loan interest rates through random effects that differ across banks.

All variance components can be used to partition the variance across levels and compute the intra-class correlation coefficient (ICC) of interest rates within a cluster (bank).

Specifically, the intra-class correlation coefficient is the proportion of the interest rate total variance that is attributed to the bank level, and it is equal to:

$$ICC = \frac{0.49^2 + 0.16^2 + 0.49^2}{0.49^2 + 0.16^2 + 0.49^2 + 1.70^2} = 0.15,$$

meaning that the 15% of the interest rate total variance is attributable to bank-level differences (Albright and Marinova, 2010).

Finally, the correlations between bank intercepts and slopes (Covariance (COLL, CONSTANT)) and (Covariance (PERS, CONSTANT)) are positive and statistically significant across banks. Therefore, given the negative estimated coefficient of collateral (see Table 8), the decrease in interest rates for a one percent increase in guarantees is larger for banks charging higher average interest rates.

[11] The latter is constructed by taking into account the best linear unbiased prediction of the random part of the baseline model.

5. Conclusions

This paper analyzed the role of guarantees on loan interest rates charged on Italian firms' loans. In addition, it tried to understand bank behavior before and during the recent financial crisis.

The bivariate probit analysis showed that the probability of loans to be secured increased during the recent financial crises. Moreover, the probability of loans to be secured by real or personal guarantees increases with firm riskiness.

Estimates from our interest rate model showed that loan interest rates respond differently to collateral and personal guarantees. Collateral helps reduce loan interest rates charged to firms, once we control for borrower and loan riskiness, before and during the financial crisis. As for personal guarantees, once we control for variables' endogeneity, our findings show that personal guarantees have no impact on loan interest rates. Indeed, personal guarantees do not give the lender a specific claim on particular assets, and restrict the actions (s)he could take in case of borrowers' bankruptcy. Therefore, they have no effect on loan interest rates. However, during troublesome periods, such as the current financial crisis, providing personal guarantees together with collateral is a signal of borrowers' quality that has positive effects on interest rates.

Finally, results showed that - *ceteris paribus* - guarantees are a more powerful instrument for *ex-ante* riskier borrowers than for safer borrowers. Indeed, riskier borrowers obtain significantly lower interest rates on secured loans than interest rate they would be charged on unsecured loans.

Data Appendix

The empirical analysis uses information on lines of credit to a large sample of Italian nonfinancial firms. Data are taken from two sources: the Banks' Supervisory Reports to the Bank of Italy (Segnalazioni di Vigilanza) and the Central Credit Register (Centrale dei Rischi).

Specifically, we draw a 40 percent random sample of firms from the Central Credit Register.

We control for outliers by dropping from the sample the observations for which:

a. the SPD variable is less than 1;
b. the PERS variable is greater than 2;
c. the LOAN_S variable is smaller than the p1 percentile;
d. the LOAN_S variable is greater than the p99 percentile;
e. the interest rate applied is smaller than the p1 percentile;
f. the interest rate applied is greater than the p99 percentile.

Our final sample has a total of 560339 firms. The panel is unbalanced.

The variables used are defined as follows.

SPD is the spread between the interest rate applied on loan by each bank and the interest rate on overnight interbank deposits. Both interest rates are averages of each year's fourth quarter values.

COLL is the share of each loan guaranteed by real guarantees. Loans are mainly mortgages granted by banks to the borrower. This variable is a proxy for inside collateral.

PERS is the share of each loan guaranteed by personal guarantees. Personal guarantees are granted by third parties in favour of borrowers. This variable acts as outside collateral.

DOUBLEG is a binary dummy variable that takes a value of 1 when both personal and real guarantees are posted and 0 otherwise.

LOAN_S is the ratio between the amount of loan granted to the firm by each bank in the database and the average size of loan granted to firms of the same sector. It represents a proxy for loan size.

FIRM_S is a binary dummy variable which takes a value of 1 when the amount of loan is equal or greater €1,000,000 and 0 when the value of loan is less than €1,000,000. Alternatively, we use the dummy variable LARGE. The latter is a binary dummy variable which takes a value of 1 when the amount of loan is equal or greater € 250,000 and 0 when the value of loan is less than € 250,000.

RISK is a dummy variable that takes value equal to one if the firm has substandard loans, i.e. the firm is in temporary difficulty. This variable is a measure of ex ante (observed) credit risk of the firm.

PRIV is a binary dummy variable, which takes a value of 1 when the borrower is a private firm, and 0 when the borrower is a public firm.

LEND_REL is equal to the number of years in the sample that the firm-bank relationship lasts.

NUM_REL is the number of lending relationship for each firm in each year.

NORTH is a binary geographical dummy variable that has a value of 1 for customers with headquarter in Northern Italy and 0 otherwise.

CENTRAL is a binary geographical dummy variable that has a value of 1 for customers with headquarter in Central Italy and 0 otherwise.

SOUTH is a binary geographical dummy variable that has a value of 1 for customers with headquarter in Southern Italy and 0 otherwise.

BANK_S is a binary dummy variable that has a value of 1 for banks which are classified as “major” or “large” according to the classification of Bank of Italy by size; 0 otherwise (Bank of Italy, 2008).

CRISIS*COLL represents the interaction between real guarantees (COLL) and a dummy that is equal to1 in every year of the financial crisis period (2008 and 2009); it is 0 in the pre-crisis years (2006 and 2007).

CRISIS*PERS represents the interaction between personal guarantees (PERS) and a dummy that is equal to1 in every year of the financial crisis period (2008 and 2009); it is 0 in the pre-crisis years (2006 and 2007).

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Table 1 *Firms' loans by type of guarantees (% distribution).*

	1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
Collateral	24.0	24.9	24.6	26.6	29.7	32.0	33.8	31.3	33.2	33.8	34.9
Personal Guarantees	27.1	27.4	25.2	25.6	24.1	24.3	23.6	26.6	23.6	23.1	22.0
Unsecured	48.8	47.7	50.2	47.8	46.2	43.7	44.5	42.1	43.2	43.0	43.2

Source: Supervision reports - Bank of Italy.

Table 2 *Number of loans and yearly change (%) by type of guarantee.*

YEAR	Unsecured Loans		Personal and Real Guarantees		Personal Guarantees		Real Guarantees		Total	
	Number	Δ (%)	Number	Δ (%)	Number	Δ (%)	Number	Δ (%)	Number	Δ (%)
2006	102888		46369		119623		36511		305391	
2007	110043	6.95	54848	18.29	128620	7.52	44239	21.17	337750	10.60%
2008	106805	-2.94	54236	-1.12	125451	-2.46	42154	-4.71	328646	-2.70%
2009	77001	-27.91	45076	-16.89	102456	-18.33	30618	-27.37	255151	-22.36%

Source: Our calculations on Bank of Italy data.

Table 3 *Average loan size and yearly change (%) by type of guarantee.*

Year	Unsecured Loans		Personal and Real Guarantees		Personal Guarantees		Real Guarantees		Total	
	Average Loan Size	Δ (%)	Average Loan Size	Δ (%)	Average Loan Size	Δ (%)	Average Loan Size	Δ (%)	Average Loan Size	Δ (%)
2006	408822.99		661836.53		278489.59		757203.28		437837.68	
2007	446167.77	9.13	671755.77	1.50	289583.69	3.98	732749.05	-3.23	460708.93	5.22
2008	511297.74	14.60	889440.31	32.41	374165.48	29.21	909482.15	24.12	572429.25	24.25
2009	427295.38	-16.43	755298.35	-15.08	294759.28	-21.22	904557.2	-0.54	489292.96	-14.52

Source: Our calculations on Bank of Italy data.

Table 4 *Interest rate and yearly change by type of guarantee.*

Year	Unsecured Loans		Personal and Real Guarantees		Personal Guarantees		Real Guarantees		Total	
	Average interest rate	Δ	Average interest rate	Δ	Average interest rate	Δ	Average interest rate	Δ	Average interest rate	Δ
2006	5.88		6.03		6.62		5.86		6.19	
2007	6.57	0.69	6.59	0.56	7.23	0.60	6.37	0.51	6.80	0.61
2008	6.73	0.16	6.87	0.28	7.42	0.19	6.64	0.27	7.00	0.21
2009	4.71	-2.02	4.09	-2.78	5.36	-2.06	3.78	-2.86	4.75	-2.26

Source: Our calculations on Bank of Italy data.

Table 5 *Interest rate spread and yearly change by type of guarantee.*

Year	Unsecured Loans		Personal and Real Guarantees		Personal Guarantees		Real Guarantees		Total	
	Average interest rate	Δ	Average interest rate	Δ	Average interest rate	Δ	Average interest rate	Δ	Average interest rate	Δ
2006	2.52		2.67		3.26		2.50		2.83	
2007	2.62	0.10	2.64	-0.03	3.28	0.01	2.42	-0.08	2.85	0.02
2008	3.67	1.05	3.81	1.17	4.36	1.08	3.58	1.16	3.94	1.10
2009	4.38	0.71	3.76	-0.05	5.03	0.67	3.45	-0.13	4.42	0.47

Source: Our calculations on Bank of Italy data.

Table 6 *Summary statistics of regression variables.*

Variable	Observations	Mean	Median	SD	Min	Max
SPD	1226938	3.46	3.06	1.98	0.00	13.00
COLL	1226938	0.22	0	0.38	0	1
PERS	1226938	0.55	0.41	0.58	0	2
LOAN_S	1226938	0.72	0.30	1.23	0.00	10.88
LEND_REL	1226938	1.25	1	0.51	1	10
RISK	1226938	0.05	0	0.21	0	1
FIRM_S	1226938	0.11	0	0.32	0	1
LARGE	1226938	0.40	0	0.49	0	1
NUM_REL	1226938	1.77	1	1.23	1	22

Source: Our calculations on Bank of Italy data.

Table 7. *Bivariate Probit Models: Marginal Effects.*

VARIABLES	(1) Personal	(2) Collateral	(3) Personal	(4) Collateral
L.RISK	0.094***	0.126***	0.094***	0.127***
	(0.002)	(0.002)	(0.005)	(0.002)
LOAN S	-0.003***	0.057***	-0.015***	0.044***
	(0.001)	(0.001)	(0.000)	(0.000)
FIRM S	-0.068***	0.187***		
	(0.002)	(0.002)		
PRIV	0.149***	-0.103***	0.149***	-0.141***
	(0.001)	(0.001)	(0.001)	(0.001)
LEND REL	-0.005***	-0.034***	-0.004***	-0.052***
	(0.001)	(0.001)	(0.001)	(0.001)
NUM REL	-0.051***	-0.093***	-0.051***	-0.102***
	(0.001)	(0.000)	(0.000)	(0.000)
BANK S	0.004***	-0.040***	0.004***	-0.043***
	(0.001)	(0.001)	(0.001)	(0.001)
CENTRAL	0.060***	0.035***	0.061***	0.035***
	(0.001)	(0.001)	(0.001)	(0.001)
SOUTH	0.130***	0.073***	0.130***	0.072***
	(0.001)	(0.001)	(0.001)	(0.001)
2007	-0.011***	0.006***	-0.010***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)
2008	-0.008**	-0.003***	-0.010***	-0.021***
	(0.001)	(0.001)	(0.001)	(0.001)
2009	0.041***	0.023***	0.041***	0.011***
	(0.001)	(0.005)	(0.001)	(0.005)
LARGE			-0.004***	0.256***
			(0.001)	(0.001)
Observations	1,226,938	1,226,938	1,226,938	1,226,938
LR test: rho=0 (p-value)	0.00		0.00	
AIC	2970161		2916730	
BIC	2970461		2917031	

*Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1*

Table 8. *The determinants of bank loan interest rates: multilevel models.*

	(1)	(2)	(3)	(4)	(5)
VARIABLES	SPD	SPD	SPD	SPD	SPD
RISK	1.482***	1.484***	2.321***	1.476***	1.502***
	(0.007)	(0.007)	(0.012)	(0.007)	(0.008)
COLL	-0.606***	-0.452***	-0.378***	-0.350***	-0.831***
	(0.036)	(0.036)	(0.037)	(0.035)	(0.045)
PERS	0.300***	0.308***	0.328***	0.286***	0.003
	(0.013)	(0.013)	(0.013)	(0.013)	(0.023)
DOUBLEG	-0.002	0.000	0.018***	0.060***	0.147***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)
LOAN_S	-0.188***	-0.190***	-0.191***	-0.113***	-0.189***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)
LEND_REL	0.005	0.006*	0.012***	0.026***	-0.003)
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
FIRM_S	-0.130***	-0.123***	-0.125***		-0.122***
	(0.007)	(0.007)	(0.007)		(0.008)
PRIV	-0.475***	-0.477***	-0.478***	-0.403***	-0.440***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
NUM_REL	-0.071***	-0.070***	-0.071***	-0.046***	-0.095***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
BANK_S	0.113	0.101	0.091	0.097	0.083
	(0.075)	(0.075)	(0.073)	(0.074)	(0.08)
CENTRAL	0.226***	0.226***	0.220***	0.222***	0.252***
	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)
SOUTH	0.343***	0.341***	0.331***	0.332***	0.390***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
2007	0.026***	0.023***	0.023***	0.029***	0.030***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
2008	1.096***	1.172***	1.156***	1.203***	1.099***
	(0.004)	(0.006)	(0.006)	(0.006)	(0.005)
2009	1.528***	1.605***	1.583***	1.613***	1.544***
	(0.005)	(0.006)	(0.006)	(0.006)	(0.005)
*CRISIS*COLL*		-0.315***	-0.272***		
		(0.008)	(0.008)		
*CRISIS*PERS*		-0.016***	-0.004		
		(0.005)	(0.005)		
*RISK*COLL*			-1.586***		
			(0.017)		
*RISK*PERS*			-0.516***		
			(0.012)		
LARGE				-0.581***	
				(0.004)	
Constant	2.980***	2.945***	2.919***	2.962***	3.170***
	(0.036)	(0.036)	(0.036)	(0.035)	(0.043)
Observations	1,226,938	1,226,938	1,226,938	1,226,938	1,226,938
Number of banks	214	214	214	214	214
LR test *re*=0	0.00 (Conserv)	0.00 (Conserv)	0.00 (Conserv)	0.00 (Conserv)	0.00 (Conserv)
AIC	4779265	4777795	4767747	4755467	4782450
BIC	4779541	4778096	4768071	4755767	4782727

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Table 9 *Random-effects parameters.*

SPD	Coef.	Std. Err.	z	P>z	[95% Conf. Interval]	
Standard dev (COLL)	0.49	0.03	17.76	0.00	0.44	0.54
Standard dev (PERS)	0.16	0.01	15.64	0.00	0.14	0.18
Standard dev (CONSTANT)	0.49	0.03	18.44	0.00	0.44	0.54
Covariance (COLL, PERS)	0.67	0.06	11.34	0.00	0.55	0.78
Covariance (COLL, CONSTANT)	0.33	0.03	12.35	0.00	0.28	0.38
Covariance (PERS, CONSTANT)	1.39	0.13	10.70	0.00	1.13	1.64
Standard dev (RESIDUAL)	1.70	0.00	1566.09	0.00	1.69	1.70