Does Collateral Help Mitigate Adverse Selection ? A Cross-Country Analysis

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Abstract

We investigate whether collateral helps to solve adverse selection problems. Theory predicts a negative relationship between presence of collateral and risk premium, as collateral constitutes a signalling instrument for the borrower to be charged with a lower risk premium. However, bankers' view and most empirical evidence contradict this prediction in accordance with the observed-risk hypothesis. We provide new evidence with loan-level data and country-level data for a sample of 5843 bank loans from 43 countries. We test whether the degree information asymmetries affects the link between the presence of collateral and risk premium. We include five proxies for the degree of information asymmetries, measuring opacity of financial information, trust, and development. We find that a greater degree of information asymmetries reduces the positive relationship between the presence of collateral and the risk premium. This finding provides support for the adverse selection and observed-risk hypotheses, as both hypotheses may be empirically validated depending of the degree of information asymmetries in the country.

JEL Codes: G20, O5

Keywords*:* Collateral, Bank, Asymmetric information, Institutions.

1. Introduction

There is widespread evidence regarding the massive use of collateral by banks for firm loans. Berger and Udell (1995) observe that 53% of firm loans are secured in the USA, whereas Davydenko and Franks (2005) observe that 75.7% of firm loans are secured in France and 88.5% in Germany.

It is therefore of utmost interest to know why banks use collateral. A first intuitive reason is that collateral provides a reduction in the risk of loan loss for the bank in the event of default. It can also be argued however that collateral helps solve problems resulting from information asymmetries, and notably the problem of moral hazard after the loan is granted. By giving collateral, the interests of the borrower are forcibly aligned with those of the bank. Furthermore, collateral, which in turn helps minimize adverse selection, constitutes a signalling instrument by providing the bank with valuable information at the time of lending. Indeed, collateral helps the bank obtain private information owned by the borrower, as high-quality borrowers are more likely to provide collateral in compensation for a low loan rate than low-quality borrowers.

Extensive publications provide theoretical support for this latter argument (Bester, 1985; Chan and Kanatas, 1985; Besanko and Thakor, 1987), which is quite easily testable. Indeed, the signalling role of collateral and its ability to mitigate adverse selection problems should lead to lower rates for secured loans.

However, two surprising observations emerge from the empirical literature. The first one is the small number of studies on this topic, which are all single-country studies, and all investigate this issue in developed countries (Berger and Udell, 1990, 1995, Degryse and Van Cayseele, 2000, Jimenez and Saurina, 2004).

The second and most striking observation is the consensual lack of empirical support for the adverse selection hypothesis in the use of collateral. Indeed most papers conclude to a positive relationship between collateral and risk premium, with such finding in accordance with the commonly accepted view among bankers that riskier loans would be associated with more collateral, as mentioned by Berger and Udell (1990) and Jimenez and Saurina (2004). The rationale is that banks would be able to sort the borrowers from information they have on their quality. As a result, they would charge

riskier borrowers with higher loan rates and require higher collateral from these borrowers. This argument is commonly called the observed-risk hypothesis.

The aim of this paper is therefore to provide a broad and ambitious investigation of the role of collateral to mitigate adverse selection problems. Our starting point is the consideration that the conflicting debate between the adverse selection hypothesis and the observed-risk hypothesis is flawed. Indeed, both hypotheses may be empirically validated depending of the degree of information asymmetries. Namely, they differ regarding the importance of the information asymmetries between the borrower and the bank. In presence of strong information asymmetries, the incentives for the borrower would be stronger to signal his quality to the bank, while in case of low information asymmetries the bank is more likely to know the quality of the borrower and therefore to charge the borrower with a greater loan rate and a higher probability to require collateral from him. Therefore, both hypotheses may be validated depending on the degree of information asymmetries in a country.

To this end, we perform a cross-country investigation of the relationship between collateral and risk premium to allow the consideration of different national frameworks. We do so by using the dataset *Dealscan* which provides detailed information on loan characteristics for a large set of countries. It enables a major contribution to the role of collateral to mitigate adverse selection problems by investigating the possible impact of country-specific variables influencing information asymmetries on this role. We use five proxies to capture the degree of information asymmetries between the borrower and the bank before the loan is granted. They control for opacity of financial information, trust, economic and financial development.

Namely, the adverse selection hypothesis would be rejected whether a positive link between collateral and risk premium is observed. However it also receives some support in parallel with the observed-risk hypothesis if we conclude that factors reducing information asymmetries contribute to strengthen the positive link between collateral and risk premium. Such finding would indeed mean that the relationship between collateral and risk premium is dependent of the degree of information asymmetries between the borrower and the bank, in accordance with both hypotheses.

The rest of the paper is organized as follows. Section II presents the framework of the role of collateral to solve adverse selection problems. We first develop the background on this role, before describing the country-level variables adopted to control for this relationship in our investigation. Section III describes the data and loan-level variables. In section IV, we report the results. We finally provide some concluding remarks in section V, and the Appendix contains explanations of all variables we use in the paper.

II. Collateral and adverse selection: a conceptual framework

II.1 Theoretical and empirical background

This section presents the literature on the adverse selection argument for the use of collateral. Before presenting the empirical tests, it is necessary to develop the theory underlying the argument.

Collateral may solve the problem of adverse selection thanks to the better information owned by the borrower in comparison to the bank before the lending decision. This private information may lead to credit rationing because of the inability of the bank to price the loan according to the borrower's quality (Stiglitz and Weiss, 1981). Therefore, high-quality borrowers have incentives to show their quality, using a credible signal, one that can not be provided by low-quality borrowers. Collateral is such a signal, as it is more costly for low-quality borrowers since they have a higher chance of defaulting and hence of losing the collateral (Bester, 1985; Chan and Kanatas, 1985; Besanko and Thakor, 1987). Consequently, as collateral acts as a signalling device, it conveys valuable information about the borrower to the bank, which can then screen borrowers by offering the choice between a secured loan with a low interest rate and an unsecured loan with a high interest rate. A high-quality borrower will be inclined to choose the secured loan since his low risk of default diminishes the probability of losing collateral and increases the probability of repaying interest.

This argument supports a negative link between collateral and credit risk, as a secured loan would be associated with a higher quality of borrowers. However, the fact that collateral is associated with greater credit risk has gone mainstream among bankers as mentioned by Berger and Udell (1990) and Jimenez and Saurina (2004). The rationale

underlying the observed-risk hypothesis is that, with information on the quality of potential borrowers, banks are able to charge riskier borrowers with higher rates, simultaneously requiring more collateral from these borrowers to reduce loan loss in the event of default. Since collateral reduces potential loss, the bank would be more inclined ceteris paribus to demand collateral from high-risk clients.

The coexistence of this hypothesis and the adverse selection argument makes the link between collateral and risk premium of utmost interest. Therefore, we tackle the question of knowing whether the selection adverse argument is empirically validated for the use of collateral.

Empirical literature remains however relatively scarce on this issue. Berger and Udell (1990) investigate the relationship between collateral and credit risk on a sample of one million loans from US banks. They test the hypothesis that adverse selection matters for the use of collateral by regressing the risk premium on a set of loan characteristics including a dummy variable considering whether the loan is secured or not. The conclusion does not corroborate the adverse selection argument, as a positive and significant relationship is observed between collateral and risk premium. This finding may be explained by the fact that banks require more collateral from riskier borrowers who are also charged with higher loan rates, in accordance with the observed-risk hypothesis.

However, in a work focusing on the associations between collateral, banking relationship and risk premium, Degryse and Van Cayseele (2000) find a negative link between the presence of collateral and interest rate for a sample of 18 000 Belgian loans. It is important to note, however, that this result, in accordance with the adverse selection hypothesis, may be influenced by the specificities of the dataset. This study is the only one on this topic, using loans from only one bank, as all loans come from a major Belgian bank. Therefore the behavior of the bank in loan collateralization affects the results and limits their generalization.

Jimenez and Saurina (2004) focus on the determinants of the probability of default of bank loans analyzing 3 million loans provided by Spanish banks. Probability of default is considered as an ex post credit risk measure. As a consequence, they do not only test whether collateral mitigates adverse selection problems, but also whether collateral

solves moral hazard problems. The probability of default is explained by a set of loan characteristics including information on collateral. Depending on the collateralized share of the loan, the model takes into account three dummy variables. The authors find a greater probability of default for secured loans, which is in accordance with the view of a positive link between the presence of collateral and credit risk.

Finally, the most recent study from Jimenez, Salas and Saurina (2006) takes a broader perspective by analyzing a wide range of determinants of the presence of collateral. This study does not however analyze the link between the presence of collateral and risk premium. Tested determinants include the characteristics of the borrower with credit quality, but also the characteristics of the bank, the competition on the loan market and the macroeconomic conditions. Credit quality, related to the theories on a bank's use of collateral, is proxied by a dummy variable which takes into account the fact that the borrower had recently a loan in default. The authors then observe that the credit quality of the borrower positively affects the presence of collateral, which is in accordance with the observed-risk hypothesis.

This presentation of the literature devoted to the adverse selection argument for the use of collateral leads to two main conclusions. First, empirical evidence tends to support the observed-risk hypothesis, according to which riskier borrowers are more often required to provide collateral. This hypothesis is commonly accepted by bankers. At first glance, this element tends to invalidate the theoretical argument of the use of collateral to resolve adverse selection problems. Second, the few studies that exist remain limited to few developed countries. Therefore, no study testing this role of collateral has ever been performed in developing countries. Consequently, their results may be influenced by hidden variables such as institutions and development. Our empirical work aims to address these deficiencies.

II.2 Country-level explanatory variables

Our work investigates the role that collateral plays in mitigating adverse selection. To this end, we test the relationship between collateral and risk premium with a set of 43 countries. Next to the general relationship observed between these both variables, one may wonder whether some country-specific variables exert an impact on this link.

Indeed, the theoretical argument supporting the role of collateral to mitigate ex ante information asymmetries is based on its signalling role. The opposite hypothesis, the observed-risk hypothesis, considers that, before the loan is granted, information asymmetries are overestimated and that banks can sort the borrowers from information they have on their credit quality.

As a consequence, we can consider that country-specific factors exert an impact on information asymmetries, affecting the relationship between collateral and risk premium. Namely, all factors increasing ex ante information asymmetries should favor the adverse selection hypothesis and therefore support a negative relationship. Meanwhile, all elements reducing ex ante information asymmetries should strengthen the observed-risk hypothesis and consequently support a positive relationship. Three categories of variables can notably affect the magnitude of ex ante information asymmetries between the borrower and the bank.

First, the opacity of a borrower's financial information before the loan is granted exerts an obvious impact on the information asymmetries. Greater quality and availability of financial information for the bank reduces information asymmetries. In our study, we adopt an indicator for the quality of financial information, *Accounting Standards*. Following La Porta et al. (1998) and Bushman, Piotroski and Smith (2004), this variable proxies quality of financial information about firms. It measures the number of items listed on firms' financial statements, an indicator ranging from zero to 90 and compiled by Center for International Financial Analysis and Research (CIFAR).

A second variable is the presence of information sharing mechanisms. Indeed, following Japelli and Pagano (2002), two types of information sharing institutions can be implemented in a country: private bureaus and public registries. Private bureaus are based on principles of voluntary membership and mutuality of data flows. They are commercial organizations in most cases. Public registries are generally founded by the central bank or a banking supervisory authority and gather information for credits over a certain threshold. Information from public registries may be free of charge for banks. Japelli and Pagano (1993) have shown that information sharing institutions reduce information asymmetries in the relationship between the borrower and the bank by allowing a reduction of the loan rates and of the probability of repayment failure.

It is taken into account through a dummy variable equal to unity if an information sharing institution operates in the country (*Information Sharing*). This variable is also replaced by its two components in some estimations: *Public Registry* and *Private Bureau*, which are dummy variables respectively equal to one if a public registry or a private bureau operates in the country, and otherwise zero. This process investigates which information sharing institution contributes the most to the link between collateral and risk premium.

Second, the behavior of the borrower and the resulting expectations of the bank may affect information asymmetries. A borrower's honesty contributes to reduce information asymmetries by decreasing hidden information. Additionally, a bank's trust of its borrower reduces the efforts of banks to mitigate problems resulting from information asymmetries.

Following Knack and Keefer (1997), Zak and Knack (2001) and La Porta et al. (1997b), we adopt a measure of trust from World Values Survey (*Trust*). It is defined as the weighted average normalized to scale 0 to 100 of survey responses to the question: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?", where a response of 1 indicates that most people can be trusted and 0 indicates that you can't be too careful. A greater value of this measure is therefore expected to be associated with lower information asymmetries. Consequently, a greater degree of trust should enhance the link between collateral and risk premium.

Third, bank behavior can exert an impact on information asymmetries. Better skills of bank employees in risk analysis of loans are likely to reduce the information asymmetries before the loan granting. We can then consider that such skills are favored by financial and economic development, owing to better knowledge and learning of bank employees. *Economic Development* is defined as the logarithm of GDP per capita averaged between 1994 and 2003, with data coming from Penn World Tables 6.2. Several measures of financial development can be applied as done by Levine, Loayza and Beck (2000). However, as our focus is on the skills of bank employees in risk analysis of loans, the adopted measure of financial development for our study needs to proxy the importance of bank credit in a country. Therefore, we define *Financial Development* as the ratio of the volume of credit to private enterprises to GDP averaged over the 1995 to

1997 period. 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). We expect a positive impact of these variables on the relationship between presence of collateral and risk premium, as they are both associated with lower information asymmetries.

We also include some control variables in our analysis. These variables are chosen according to their expected explanatory power of the risk premium, the explained variable in the regressions. Following a large body of research on law and finance pioneered by La Porta et al. (1997a), we adopt two variables for the impact of legal environment. Protection of creditor rights is measured with the index developed by La Porta et al. (1998) (*Creditor Rights*). 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 Zoido-Lobaton (1999a, b) (*Rule of Law*). This indicator assesses the respect of a country's citizens for their country's legal framework. It refers to "the extent to which agents have confidence in and abide by the rules of society," taking into consideration that a chief component of this cluster is the enforceability of contracts. We prefer to use this indicator rather than La Porta et al. (1998)'s "Rule of Law" index, owing to its availability.

A third control variable takes bank costs into account. Indeed risk premium is expected to cover operating costs of banks. Therefore, bank costs should be positively associated with risk premium. *Bank Costs* is defined as the ratio of overhead costs to total banking assets for 1999, following Barth, Caprio and Levine (2004). This information is derived from the same article.

III. Data and variables

The sample of bank loans is obtained from the *Dealscan* database, which is supplied by the Loan Pricing Corporation (LPC, Reuters), which provides detailed information on loans to large companies. As the focus of our research is the investigation of country-level factors on the use of collateral to solve adverse selection problems, we only keep loans from countries for which we have country-level information for most of the required factors. We use loan data for the period January 1991 to August 2006. Indeed the dataset goes back to the late 1980s but the coverage of bank loans is poor during this decade.

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 5,843 bank loans made to borrowers located in 43 countries (excluding the US).

The focus of our research is the investigation of the relationship between risk premium and the presence of collateral. To this end, we proceed to regressions of risk premium on a set of variables including the presence of collateral and some loan-level control variables. Risk premium is the difference between the loan rate and the prime rate used by the bank for the loan pricing. Information on risk premium is directly provided in the database.

We estimate the following equation using OLS regression:

$$\text{Risk Premium} = f(\text{Intercept}, \text{Collateral}, \text{Collateral} \times \text{Key Variable}, X, \varepsilon) \qquad (1)$$

The explanatory variable of primary concern is the presence of collateral, which, in accordance with most works on the use of collateral, is measured by a dummy variable (*Collateral*) equal to one if the loan is secured and to zero if it is not. We also investigate how the degree of information asymmetries influences the relationship between risk premium and the presence of collateral. To account for these variables, we add

Collateral×*Key Variable*, which is an interaction term between each country-level variable measuring this degree and the presence of collateral in the regressions.

X is a vector of control variables. These include information on loan maturity (*Maturity*), 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 zero[1] (*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, following notably Qian and Strahan (2007) (*Number of Lenders*). We also take into account information on loan size (*LoanAmount*), 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*). 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. ε is the residual which is supposed to be normally distributed.

Table 1 reports mean values for the loan-level variables by country. Risk premium varies considerably, from 71.67 basic points in Ghana to 320 in South Africa, with a mean value of 166.06 basic points for the full sample. These differences partly reflect the differences in economic development which contribute to reduce the risk premium, even if significant exceptions exist. The proportion of secured loans strongly varies across countries from 10.99% in Japan to 100% in five countries (Ghana, Guatemala, Morocco, Peru, and Uruguay). On the full sample, 55.72% of loans are secured.

Regarding the maturity of loans, the cross-country discrepancies are rather limited with mean maturities ranging from 12 months in Morocco to 137 months in Portugal. As many loans are syndicated, the number of lenders ranges from 1 in Uruguay to 20 in Ghana, with a mean of 7.98 lenders for the full sample.

The share of term loans, which is provided by the value of *Loan Type*, varies from 0% in Morocco to 100% in Ghana and Guatemala. As the 1st and the 9th deciles are respectively 31% and 82%, we can however conclude that a significant proportion of most countries' loans are term loans and other loans. Here again, the extreme values are

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

linked, at least in part, to the small size of national samples. The mean size of loans varies considerably across countries, even if all loans have a substantial amount in accordance with the coverage of *Dealscan*. The range goes from 9,065.6 thousand dollars in Uruguay to 547,022.2 thousand dollars in Denmark.

IV. Results

This section displays the results of our study on the role of collateral to solve adverse selection problems. In our regression models, we begin by testing the link between risk premium and the presence of collateral in cross-country estimations. These estimations provide some benchmark regressions for the rest of the study. We then investigate how the degree of information asymmetries influences the relationship between risk premium and the presence of collateral. To this end, we add an interaction term between each country-level variable measuring this degree and the presence of collateral in the regressions.

Next we perform two kinds of robustness check tests. First, we test whether our findings are sensitive to the inclusion of other country-level variables, and second, we investigate the issue of the endogeneity of collateral in our estimations.

IV.1 The benchmark estimations

We first present the results of the regression of risk premium for the different sets of variables. These estimations are benchmarks for the ones including the interaction terms, as they provide valuable information on the coefficient of *Collateral* and on the coefficients of the control variables, which are likely to be affected by the inclusion of the interaction terms. The results are displayed in table 2.

We perform five estimations by testing different combinations of country-level variables. The first estimation does not include any country-level variable (column 1). The second estimation includes dummy variables for countries to control for all country-specific variables (column 2). The third one adds the control variables (*Creditor Rights, Rule of Law, Bank Costs*) as explanatory variables in the estimation (column 3).

The fourth and fifth estimations (columns 4 and 5) add the country-level variables which affect the degree of information asymmetries (*Trust, Information Sharing,*

Accounting Standards, Economic Development, Financial Development). As *Accounting Standards* is only available for 35 countries among the 43 in our sample, we perform the estimations with and without this variable.

The major finding is the positive coefficient of *Collateral*, which is significant at the 1% level in all regressions. This result is robust to all five estimations. We therefore observe that risk premium increases when the loan is secured. This broad evidence does not support the theoretical argument according to which collateral helps solve the problem of adverse selection. It corroborates in contrast the observed-risk hypothesis according to which banks would ask for more collateral from riskier companies, which are already charged with higher loan rates. We then support most empirical evidence on this issue, which concludes a positive link between the presence of collateral and risk premium.

Turning to the loan-level control variables, we can stress the robustness of their signs across the five estimations. *Maturity* is positive in all estimations and significant in four of them, suggesting that longer loans are charged with greater risk premium in accordance with literature. *Number of Lenders* has a significant and negative coefficient in all estimations, in accordance with the view of a lower risk premium for loans with a greater number of lenders. This is an expected result as syndicated loans benefit from lower risk premium than other loans (Allen, 1990).

Loan Type is positive in all estimations, suggesting that term loans are charged with greater risk premium. This finding can be explained by the lower risk of term loans than of other loans, once maturity is controlled. The coefficient of *Loan Size* is negative in all estimations, even if it is significant only once. This finding supports the view that bigger loans are charged with lower risk premium, as shown in the literature. Finally the presence of covenants is positively associated with risk premium.

This subsection has shown that collateral is positively associated with risk premium in our cross-country sample. Supporting the observed-risk hypothesis, this is a major result, as it is the first study that uses a cross-country sample. The heterogeneity of our country sample presents a major advantage which must be exploited for a thorough investigation of the role of collateral to solve adverse selection. Indeed, the positive link between collateral and risk premium may be dependent on the degree of information

asymmetries between the borrower and the bank before the loan is granted. Therefore, the adverse selection hypothesis can also receive some support if we observe that greater information asymmetries reduce the positive link between collateral and risk premium. In this aim, we perform estimations controlling for the influence of the degree of information asymmetries.

IV.2 The estimations with an interaction term

We now turn to estimations including an interaction term between *Collateral* and one country-specific variable which might influence the degree of ex ante information asymmetries between the borrower and the bank. To examine the sensitivity of the results, we perform the regressions with two different condition information sets of country-level variables. The first set of regressors includes the control variables and the variable interacting with *Collateral*, while the second set includes all country-level variables. We then aim to reduce the chances that the cross-country regressions include a selected group of regressors which yields a favored result.

The first estimations are devoted to the opacity of financial information. We test the role of two variables: *Accounting Standards*, and *Information Sharing*. In addition, as *Information Sharing* can be decomposed into its two components, we also investigate the role of *Public Registry* and *Private Bureau*. The estimations with *Accounting Standards* are displayed in table 3, while those for *Information Sharing* and its components are presented in table 4. We observe that the coefficient of the interaction term is significantly positive for the estimations with *Accounting Standards* and *Information Sharing*. These findings therefore support the view that a lower degree of information asymmetries increases the positive relationship between collateral and risk premium, and consequently enhances the likelihood of the observed-risk hypothesis. They may also be in accordance with the adverse selection hypothesis, as a low degree of one of these variables could be small enough to favor a negative relationship between collateral and risk premium.

Therefore, we check whether the relationship might be negative in some countries. To this end, we compute the overall coefficient of Collateral for all estimations, which is the sum of the coefficients of *Collateral* and of the interaction term multiplied by the

value of the key variable. Indeed the overall coefficient of *Collateral* may be negative for low values of the key value. The thresholds are computed in all cases and compared to the values of countries.[2] The threshold is 40.966 with *Accounting Standards*. We have three countries with values for this variable below the threshold (Egypt, Peru, Uruguay). With *Information Sharing*, the threshold is 0.271. As this is a dummy variable, countries with a zero value are below the threshold. In this case is only India. Therefore, the link between collateral and risk premium can be negative in some countries owing to their strong degree of information asymmetries.

A final remark concerns the results for both variables taking the presence of information-sharing institutions into account. We can observe that the positive and significant sign of *Information Sharing* is explained by the component *Private Bureau*, as the interaction term is significant in the estimation with *Private Bureau* and is not in the one with *Public Registry*. This result supports the view that, contrary to the existence of public registries, the existence of private bureaus contributes to improve the information owned by banks.

The second estimations concern *Trust*, and are displayed in Table 3. Our results show again a positive and significant coefficient for the interaction term. As *Trust* proxies honesty of the borrower and trust of the bank towards the borrower, this finding is again in favor of the view that a lower degree of information asymmetries contributes to strengthen the positive relationship between collateral and risk premium. With *Trust*, the overall coefficient of *Collateral* is always positive as both coefficients for *Collateral* and for the interaction term are positive. Therefore, the degree of *Trust* can not lead to some countries in which collateral would affect negatively risk premium.

Finally, the third set of estimations is devoted to the role of economic and financial development and is presented in table 5. As mentioned above, the argument is that bank employees would benefit from better skills in analysis of risk default for loans in a country with a greater level of economic and financial development. Therefore, they would face a lower degree of ex ante information asymmetries. Once again, we observe positive and significant coefficients for the interaction term in the regressions. As greater

[2] We only compute here the thresholds for estimations with the full conditioning information set (odd-numbered estimations), but results are totally similar when the thresholds are computed for estimations with the simple conditioning information set (even-numbered estimations).

economic and financial development is associated with lower information asymmetries, these findings support the views that lower information asymmetries increase the positive link between collateral and risk premium.

We can again wonder whether there exist some countries characterized by information asymmetries strong enough to lead to a negative link between presence of collateral and risk premium. With *Economic Development*, the threshold is 7.149. However the minimum value for this variable is 7.149. As a result, no country has an overall coefficient of Collateral which is negative. With *Financial Development*, the threshold is 0.295. Thirteen countries have a value below this threshold (Argentina, Ghana, Guatemala, Honduras, Mexico, Pakistan, Peru, Poland, Slovenia, Turkey, Uruguay, Venezuela), which mean that the overall coefficient of collateral is negative for these countries.

In summary, the findings clearly support the hypothesis that the degree of information asymmetries exerts an influence on the relationship between collateral and risk premium. We therefore provide some support for the observed-risk hypothesis and the adverse selection hypothesis, as both hypotheses may be empirically validated depending on the degree of information asymmetries in the country. In accordance with this remark, we observe that the relationship between presence of collateral and risk premium, which was positive in benchmark regressions, can be negative in countries with strong information asymmetries. Such finding is only observed for developing countries, which may explain why this result contradicts former evidence on this topic. It also constitutes a major motivation ex post for this seminal investigation on a sample of countries, including some developing countries.

IV.3 Robustness tests

Our robustness checks include two sets of tests. The first one investigates the inclusion of alternative country-level variables. The second one analyzes the issue of

endogeneity of collateral in our estimations. In all robustness tests, we display results from model specifications with the full conditioning information set.

We first test the inclusion of alternative country-level variables. We start by adding "fundamental variables" in the estimations. Namely, such variables affect institutional variables which were adopted in our estimations. We test the presence of two sets of fundamental characteristics. We add variables for legal origin, as this dimension has been shown to influence financial development (La Porta et al., 1997a). We add dummy variables if legal origin is Common law, French origin, German origin, or Socialist origin. The dummy variable for Scandinavian origin is dropped. As legal origin exerts an impact on creditor rights and rule of law, we exclude these latter variables from the regressions that take legal origin into account. Furthermore, we control for culture, which can be defined as "those customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation." (Guiso, Sapienza and Zingales, 2006). Following Stulz and Williamson (2003), we proxy culture by religion and define primary religion as the one practiced by the largest fraction of the country. We add dummy variables if the primary religion is Catholic, Protestant, Muslim, or Buddhist. The dummy variable if another religion is the most practiced is dropped.[3]

Additionally, we test the presence of alternative variables for legal environment to check the sensitivity of our findings to the choice of legal environment variables. We add legal formalism, which measures costs of enforcing contracts through courts, based on surveys of lawyers and judges, and which is provided by Djankov et al. (2003). This variable is strongly correlated with *Rule of Law*. Therefore, this latter variable is excluded from the estimation including *Legal Formalism.*

We also account for corruption. Indeed corruption may influence the behavior of the banks, as more corruption may increase banks' safeguards against loan loss, owing to unpredictable court decisions or loans granted by bribed employees. Corruption is measured with the World Bank's index "Corruption" (*Corruption*) (Kaufmann, Kraay and Zoido-Lobaton, 1999a,b). This composite index aggregates indicators of corruption

[3] Religion could have been interacted with collateral to check whether religion exerts an influence on the link between collateral and risk premium. However such investigation is useless owing to the difficulties of the interpretation in terms of information asymmetries. There are indeed no straightforward expectations to which the different religions should be associated to the degree of information asymmetries.

obtained from experts' surveys and indices of corruption resting on residents' surveys. It ranges from -2.5 to 2.5 with greater values for less corrupted countries. For clarity, we rescaled the index from 0 for the lowest corruption to 10 for the highest corruption.

The estimations with all these alternative sets of variables are presented in table 6, in which we display coefficients for *Collateral* and for the interaction term between *Collateral* and the country-level variables proxying the degree of information asymmetries. Most of our findings are robust to the specification of the set of country-level variables. This specification for all variables does not affect the sign and the significance of the interaction term, with certain exceptions for the significance of the interaction term with *Trust*. For this latter variable, the interaction term is significant in estimations with *Corruption* and *Legal Formalism*, as it was in standard estimations. However the introduction of "fundamental" country-level variables cancels the significance of the interaction term. Such results can be explained by the influence of "fundamental" variables on trust, notably by the potential impact of religion on trust.

This first set of tests leads to the conclusion that our findings are robust to the choice of country-level variables, as alternative specifications do not alter our results.

We now turn to the issues of endogeneity in our estimations. Following previous studies (Berger and Udell, 1990; Harhoff and Körting, 1998), we have assumed that collateral and risk premium are determined in a sequential procedure, with the collateral decision preceding the determination of risk premium. This assumption of sequentiality is widely accepted in empirical works (Dennis, Nandy and Sharpe, 2000; Dennis and Sharpe, 2005; Bharath et al., 2006). However, such an approach ignores the potential endogeneity issue of collateral with risk premium, as well as the potential simultaneity between these both loan characteristics.

In order to tackle these issues, we re-estimate the model specifications using a simultaneous equations framework[4]. Under the hypothesis of sequentiality in the collateral and risk premium decision, we assume a unidirectional relationship between

[4] Let's also note that we cannot clearly reject the hypothesis of endogeneity of the *Collateral* variable in the *Risk Premium* equation (4) at the 1% level using Durban-Wu-Hausman test.

Risk Premium and *Collateral*, following Dennis, Nandy and Sharpe (2000) and Bharath et al.(2006). The two equations structural model can be described as follows[5]

$$\begin{cases} \text{Risk Premium} = f(\text{Intercept}, \text{Collateral}^*, \text{Collateral}^* \times \text{Key Variable}, X, \varepsilon) \\ \text{Collateral} = g(\text{Intercept}, Z, \upsilon) \end{cases} \quad (2)$$

Collateral^* is the fitted value of *Collateral* estimated in a first stage and $\text{Collateral}^* \times \text{Key Variable}$ is the crossed variable using the fitted value of *Collateral* and the investigated *Key Variable*. X is a vector of the explanatory variables used in the individual regressions already described. Z is a vector of the following explanatory variables : *Loan Type, Loan Amount, Number of Lenders, Distribution Method, Seniority*, and dummy variables for industries and years. ε and υ are the residuals which are supposed to be normally distributed. *Distribution Method* is a dummy variable equal to 1 if the loan is syndicated (82.94% of our sample) and *Seniority* is a dummy variable equal to 1 if the loan is senior (45.30% of our sample).

We use the three stages least squares (3SLS) method to estimate the two equations model in order to exploit the correlation of the disturbances across the equations[6]. The estimation of the system is complicated by the presence of both continuous (*Risk Premium*) and discrete choice (*Collateral*) variables. We follow Angrist (2001) and estimate the equation explaining *Collateral* with a probit regression in a first stage. The instruments for the 3SLS estimates are obtained from the benchmark and with interaction terms regressions and the specification for *Collateral*. The explanatory variables for the former have been selected following statistical analysis: we have retained the variables which are the most correlated with *Collateral* and the least correlated with *Risk Premium*. The results of stepwise discriminant analysis and probit regression confirm this selection.

Results from the probit regression of *Collateral* are displayed in table 7. The statistics of the regression are satisfactory, with a significant likelihood ratio and a

[5] We present the general specification, although we first estimate the equations system for the benchmark regressions and then for the interaction terms.
[6] Two stage least squares (2SLS) method gives similar regressions results.

satisfactory percentage of concordance (above 75%). All of the coefficients have expected significant signs.

We display the results from model specifications with the full conditioning information set in tables 8 and 9. Table 8 gives the results of the re-estimation of the specification for the two benchmark regressions in columns 4 and 5 from table 2. The main finding is the switch of sign for the coefficient of *Collateral*, which becomes significantly negative. This is in sharp contrast with former studies on the link between collateral and risk premium (e.g. Berger and Udell, 1990). However all former studies did not control for endogeneity of collateral.

On a theoretical basis, this result is consistent with the adverse selection hypothesis, according to which collateral serves as a signalling instrument (Bester, 1985; Chan and Kanatas, 1985; Besanko and Thakor, 1987).

In addition, this view is supported by Bharath et al. (2006). These authors investigate the benefits of relationship banking for companies. To this end, they analyze the determinants of loan price on a sample of US loans, including the presence of collateral. They therefore obtain similar findings to ours. On the one hand, the OLS regressions show a positive and significant sign for the presence of collateral as an explaining variable of the loan price. On the other hand, the estimations performed with a simultaneous equations model controlling for endogeneity change this result to a negative and significant coefficient for the presence of collateral.

This is a major finding, as it suggests that, when endogeneity is controlled, a negative link emerges between collateral and risk premium. However, our key issue is not the sign of this relationship for the full sample, but whether the degree of ex ante information asymmetries influences this link. This is a more relevant issue to understand the use of collateral by banks, since it tends to demonstrate that adverse selection and observed-risk hypotheses may not be antagonistic, and can both be empirically validated depending of the degree of the country.

To this end, we perform estimations with interaction terms between Collateral and the country-specific variables proxying the degree of ex ante information asymmetries for the regressions from tables 3, 4, 5, 6. We are able to test whether the observed signs of

the interaction terms remain unchanged when endogeneity is controlled. These estimations are reported in table 9.

All coefficients of the interaction terms remain positive, but some are not significant. More specifically, the estimations with *Trust*, *Economic Development* and *Financial Development* show positive and significant coefficients for the interaction term, while the coefficients for the interaction term with *Accounting Standards* and *Information Sharing* are not significant, even if their sign does not switch.

Consequently, we conclude that the tests controlling for endogeneity do not hamper our key finding regarding the role of information asymmetries on the relationship between collateral and risk premium. Indeed, we still observe that lower information asymmetries increase the overall coefficient of Collateral to explain Risk Premium. Therefore, these robustness tests strengthen our main conclusion that both observed-risk and adverse selection hypotheses may be empirically validated depending of the degree of information asymmetries in the country.

V. Concluding remarks

In this paper, we analyze the role of collateral to mitigate adverse selection problems on a large set of loans from 43 countries. According to the adverse selection hypothesis, we should observe a negative relationship between the presence of collateral and risk premium, as collateral constitutes a signalling instrument for high-quality borrowers. The observed-risk hypothesis is however in favor of a positive link between these both variables, owing to the ability of the bank to sort borrowers according to their quality.

At first glance, these hypotheses are contradictory, even though they are both based on the degree of information asymmetries before the loan granting. Indeed, the adverse selection hypothesis assumes the existence of strong information asymmetries resulting in the need for the borrower to use quality signals, while observed-risk hypothesis considers low information asymmetries leading to the ability of the bank to observe borrower risk. As a consequence, both hypotheses may be empirically validated depending on the degree of information asymmetries.

We find that a lower degree of information asymmetries, proxied through five country-level variables, enhances the positive relationship between the presence of collateral and risk premium. We therefore provide some support for the adverse selection and observed-risk hypotheses, as both hypotheses may be empirically validated depending on the degree of information asymmetries in the country. In addition, this result is robust to tests controlling for the potential endogeneity of collateral.

Our findings strongly qualify the view that the role of collateral to mitigate adverse selection problems should be rejected, in sharp contrast to the existing empirical literature. They are in line with the theoretical arguments provided notably by Bester (1985), Chan and Kanatas (1985) and Besanko and Thakor (1987).

The normative implications of our findings are the support of the efforts to reduce information asymmetries before the loan granting. Indeed, collateral requirements have been widely mentioned to constitute major obstacles to the access to credit. Therefore, as lower information asymmetries reduce such requirements, they favor access to credit and consequently promote investment. Authorities can contribute to reduce information asymmetries through better quality of financial information and the implementation of information-sharing institutions.

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Table 1
Summary statistics on key variables by country

This table provides means for Risk Premium (in basic points), Maturity (in months), Number of Lenders, Loan Size (in thousand dollars), and frequencies for Collateral, Loan Type, Covenants. N is the number of loans.

Country	N	Risk Premium	Collateral	Maturity	Number of Lenders	Loan Type	Loan Size	Covenants
Argentina	47	250.03	0.6808	60.79	9.66	0.7660	97,953.2	0.2979
Australia	772	114.88	0.4003	84.78	7.35	0.3873	111,551.8	0.2176
Austria	8	230.00	0.8750	77.88	8.88	0.6250	80,197.3	0.1250
Belgium	16	156.56	0.9375	64.88	13.19	0.5000	193,347.6	0.1250
Brazil	50	263.93	0.8200	48.72	7.92	0.8000	118,449.8	0.1600
Chile	31	204.03	0.6774	55.19	9.39	0.7742	112,673.0	0.4194
China	405	135.89	0.4765	70.36	6.79	0.6988	34,622.0	0.1358
Colombia	11	273.86	0.6364	56.73	6.00	0.8182	62,457.7	0.5455
Denmark	16	191.09	0.8125	74.25	12.19	0.4375	547,022.2	0.1250
Egypt	10	169.25	0.9000	84.40	10.40	0.7000	207,366.8	0.4000
Finland	16	164.69	0.6875	76.00	12.31	0.5625	171,483.9	0.3750
France	285	228.77	0.8877	78.23	8.19	0.5333	71,128.6	0.1860
Ghana	6	71.67	1.0000	15.17	20.00	1.0000	359,419.2	0.1667
Greece	37	221.88	0.8919	86.65	5.05	0.4324	88,631.7	0.2162
Guatemala	2	200.00	1.0000	72.00	9.50	1.0000	54,843.8	0.0000
Hungary	13	140.38	0.7692	74.46	8.46	0.4615	100,936.3	0.0769
India	202	158.30	0.4554	69.69	5.77	0.7723	35,321.4	0.0891
Indonesia	665	254.39	0.6782	55.43	8.77	0.5699	32,605.8	0.0361
Ireland	42	214.70	0.7143	91.00	10.24	0.5000	191,423.7	0.5476
Israel	8	99.06	0.7500	56.25	4.00	0.5000	60,008.7	0.3750
Italy	94	190.80	0.9043	75.78	9.44	0.5745	141,810.2	0.1702
Japan	273	92.65	0.1099	41.91	7.75	0.4103	95,058.2	0.1795
Korea	921	117.19	0.3605	64.51	6.65	0.5548	39,036.2	0.0988
Mexico	91	229.75	0.6264	54.14	9.77	0.7473	102,975.3	0.3736
Morocco	1	110.00	1.0000	12.00	16.00	0.0000	335,120.3	0.0000
Netherlands	154	189.33	0.7857	71.74	8.90	0.4481	118,449.8	0.3312
New Zeal.	122	115.54	0.2131	64.51	4.93	0.2704	74,775.4	0.2295
Norway	45	202.67	0.8222	71.44	5.58	0.3556	101,950.7	0.3556
Pakistan	43	277.94	0.3953	40.51	5.84	0.8372	35,321.4	0.0233
Peru	9	198.61	1.0000	85.33	13.67	0.4444	119,640.3	0.2222
Philippines	232	247.68	0.5216	73.03	6.74	0.5991	36,035.0	0.1207
Poland	23	124.88	0.8261	70.04	9.48	0.3043	95,058.2	0.3479
Portugal	12	120.21	0.9167	137.00	13.17	0.4167	243,347.3	0.1667
Singapore	256	145.76	0.5742	59.14	6.05	0.4219	48,158.1	0.2656
Slovenia	4	95.63	0.7500	93.00	12.00	0.5000	44,902.3	0.0000
South Africa	9	320.00	0.8889	57.33	8.00	0.1111	76,286.0	0.6667
Spain	269	136.04	0.7658	90.03	11.64	0.6468	66,986.4	0.1115
Sweden	42	84.30	0.5238	61.95	8.57	0.3095	243,347.3	0.3571
Switzerland	40	228.19	0.7500	60.70	10.63	0.3500	127,038.4	0.4750
Turkey	18	191.11	0.8333	75.83	11.39	0.5000	129,604.8	0.2222
UK	528	185.90	0.7670	71.40	10.45	0.4564	146,128.9	0.3693
Uruguay	3	91.67	1.0000	42.00	1.00	0.6667	9,065.6	0.0000
Venezuela	12	146.46	0.8333	68.58	10.25	0.8333	68,339.6	0.0000
Full sample	5843	166.06	0.5572	68.71	7.98	0.5300	65,006.6	0.1836

Table 2
Benchmark regressions

Definitions of variables appear in the Appendix. The dependent variable is Risk Premium. Table reports coefficients with t-statistics 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.

	Estimations				
Explanatory variables	(1)	(2)	(3)	(4)	(5)
Intercept	278.584***	328.178***	235.246***	202.162***	671.700***
	(8.77)	(8.40)	(7.57)	(2.81)	(6.93)
Collateral	62.625***	32.896***	43.291***	43.542***	47.794***
	(13.48)	(6.92)	(9.40)	(9.43)	(9.95)
Maturity	0.061	0.178***	0.141***	0.142***	0.087**
	(1.48)	(4.48)	(3.54)	(3.57)	(2.24)
Number of lenders	-22.108***	-22.431***	-24.567***	-24.828***	-20.985***
	(9.39)	(9.77)	(10.76)	(10.85)	(8.79)
Loan Type	13.090***	6.834	2.537	2.877	15.167***
	(3.06)	(1.63)	(0.61)	(0.69)	(3.55)
Loan Size	-4.345**	-1.436	-0.751	-0.124	-1.810
	(2.52)	(0.82)	(0.44)	(0.07)	(1.03)
Covenants	13.650**	8.088	19.359***	20.295***	23.361***
	(2.23)	(1.33)	(3.25)	(3.38)	(4.07)
Economic Development	-	-	-	1.116	-71.508***
				(0.13)	(6.58)
Financial Development	-	-	-	2.135	10.344
				(0.27)	(1.30)
Information Sharing	-	-	-	31.027**	74.556***
				(2.10)	(4.37)
Trust	-	-	-	-0.394**	-0.290
				(2.18)	(1.25)
Accounting Standards	-	-	-	-	1.953***
					(3.81)
Creditor Rights	-	-	1.853	4.532*	-4.569*
			(0.77)	(1.76)	(1.65)
Rule of Law	-	-	-43.250***	-49.570***	14.007
			(12.97)	(5.85)	(1.16)
Banking Costs	-	-	1045.883	865.286***	1059.293
			***	(4.09)	***
			(5.65)		(5.08)
Country dummy variables	No	Yes	No	No	No
Adjusted R^2	0.0910	0.1793	0.1520	0.1530	0.1741
N	5843	5843	5843	5843	4724

Table 3
Regressions with interaction variables for trust and accounting standards

Definitions of variables appear in the Appendix. The dependent variable is Risk Premium. Table reports coefficients with t-statistics 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.

	Key variable			
Explanatory variables	**Trust**		**Accounting Standards**	
	(1)	(2)	(3)	(4)
Intercept	257.672***	217.578***	200.414***	750.576***
	(7.95)	(3.00)	(3.85)	(7.30)
Collateral	21.046	21.232*	-58.475	-61.326
	(1.63)	(1.65)	(1.27)	(1.28)
Collateral × KeyVariable	0.585*	0.578*	1.452**	1.497**
	(1.87)	(1.85)	(2.31)	(2.29)
Maturity	0.140***	0.143***	0.079**	0.087**
	(3.52)	(3.59)	(2.05)	(2.25)
Number of Lenders	-24.478***	-24.782***	-21.816***	-20.939***
	(10.72)	(10.83)	(9.12)	(8.77)
Loan Type	2.060	2.811	14.268***	14.129***
	(0.49)	(0.67)	(3.30)	(3.29)
Loan Size	-0.389	-0.182	-2.266	-1.622
	(0.22)	(0.10)	(1.30)	(0.93)
Covenants	20.190***	20.394***	26.453***	23.642***
	(3.38)	(3.40)	(4.61)	(4.12)
Economic Development	-	1.103	-	-71.889***
		(0.13)		(6.62)
Financial Development	-	2.313	-	5.040
		(0.29)		(0.61)
Information Sharing	-	30.737**	-	80.213***
		(2.08)		(4.65)
Trust	-0.637**	-0.739***	-	-0.263
	(2.52)	(2.85)		(1.13)
Accounting Standards	-	-	0.785	0.769
			(1.22)	(1.06)
Creditor Rights	2.383	3.954	-0.235	-4.756*
	(0.95)	(1.52)	(0.10)	(1.72)
Rule of Law	-45.066***	-49.252***	-44.480***	18.104
	(12.61)	(5.81)	(6.84)	(1.48)
Bank Costs	955.301***	874.504***	921.210***	1082.382***
	(4.92)	(4.13)	(4.64)	(5.18)
Adjusted R^2	0.1526	0.1533	0.1652	0.1749
N	5843	5843	4724	4724

Table 4
Regressions with interaction variables for information sharing and its components

Definitions of variables appear in the Appendix. The dependent variable is Risk Premium. Table reports coefficients with t-statistics 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	Key variable					
	Information Sharing		Public Registry		Private Bureau	
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	235.284***	230.672***	242.284***	139.538**	241.677***	115.515*
	(6.80)	(3.18)	(7.63)	(2.06)	(7.71)	(1.70)
Collateral	-17.393	-17.112	43.227***	44.689***	32.590***	27.407***
	(0.80)	(0.79)	(7.91)	(8.13)	(3.91)	(3.22)
Collateral × KeyVariable	62.800***	63.030***	2.088	-1.825	14.354	21.220**
	(2.85)	(2.86)	(0.23)	(0.20)	(1.51)	(2.17)
Maturity	0.142***	0.141***	0.141***	0.142***	0.136***	0.136***
	(3.57)	(3.54)	(3.55)	(3.55)	(3.41)	(3.41)
Number of Lenders	-24.669***	-24.681***	-24.358***	-24.643***	-24.445***	-24.732***
	(10.80)	(10.79)	(10.62)	(10.73)	(10.70)	(10.81)
Loan Type	3.437	3.025	2.440	2.731	2.501	2.931
	(0.82)	(0.72)	(0.58)	(0.65)	(0.60)	(0.70)
Loan Size	-0.790	-0.197	-0.719	-0.183	-0.736	0.025
	(0.46)	(0.11)	(0.42)	(0.10)	(0.43)	(0.01)
Covenants	19.403***	20.433***	19.054***	20.585***	18.938***	20.835***
	(3.26)	(3.41)	(3.19)	(3.43)	(3.18)	(3.48)
Economic Development	-	1.114	-	12.094*	-	15.682**
		(0.13)		(1.66)		(2.14)
Financial Development	-	2.572	-	5.788	-	8.715
		(0.33)		(0.76)		(1.15)
Information Sharing	-0.136	2.082	-	-	-	-
	(0.01)	(0.12)				
Public Registry	-	-	-7.881	-4.687	-	-
			(0.92)	(0.52)		
Private Bureau	-	-	-	-	-12.681	-26.086***
					(1.41)	(2.64)
Trust	-	-0.397**	-	-0.353*	-	-0.556***
		(2.20)		(1.88)		(2.85)
Accounting Standards	-	-	-	-	-	-
Creditor Rights	2.916	4.603*	1.043	3.297	-12.681	5.254**
	(1.20)	(1.78)	(0.41)	(1.20)	(1.41)	(1.96)
Rule of Law	-45.199***	-49.764***	-45.245***	-59.949***	1.630	-58.193***
	(13.24)	(5.87)	(11.86)	(7.35)	(0.67)	(7.52)
Bank Costs	980.003	848.496	1019.943	840.984	1078.116	904.264
	***(5.27)	***(4.01)	***(5.46)	***(3.93)	***(5.48)	***(4.18)
Adjusted R^2	0.1537	0.1540	0.1518	0.1523	0.1520	0.1532
N	5843	5843	5843	5843	5843	5843

Table 5
Regressions with interaction variables for economic and financial development

Definitions of variables appear in the Appendix. The dependent variable is Risk Premium. Table reports coefficients with t-statistics 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.

	Key variable			
Explanatory variables	**Economic development**		**Financial development**	
	(1)	(2)	(3)	(4)
Intercept	224.571***	279.223***	256.508***	188.765***
	(3.27)	(3.74)	(8.04)	(2.63)
Collateral	-132.709***	-140.687***	-23.106**	-23.967**
	(2.78)	(2.94)	(2.20)	(2.28)
Collateral × KeyVariable	18.774***	19.679***	79.953***	81.154***
	(3.70)	(3.87)	(7.06)	(7.14)
Maturity	0.134***	0.135***	0.137***	0.135***
	(3.37)	(3.39)	(3.43)	(3.41)
Number of Lenders	-24.415***	-24.257***	-24.054***	-24.327***
	(10.67)	(10.69)	(10.56)	(10.67)
Loan Type	2.496	2.223	2.773	3.174
	(0.60)	(0.53)	(0.67)	(0.76)
Loan Size	-0.405	0.263	-0.741	-0.064
	(0.24)	(0.15)	(0.43)	(0.04)
Covenants	19.878***	20.127***	17.506***	18.998***
	(3.33)	(3.36)	(2.95)	(3.18)
Economic Development	0.861	-8.579	-	6.492
	(0.12)	(0.98)		(0.77)
Financial Development	-	3.114	-28.233***	-31.038***
		(0.40)	(3.32)	(3.41)
Information Sharing	-	33.714**	-	25.115*
		(2.28)		(1.71)
Trust	-	-0.410**	-	-0.441**
		(2.27)		(2.45)
Accounting Standards	-	-	-	-
Creditor Rights	3.115	5.193**	-0.661	2.373
	(1.27)	(2.01)	(0.27)	(0.92)
Rule of Law	-54.330***	-51.744***	-45.251***	-55.732***
	(7.55)	(6.10)	(12.58)	(6.57)
Bank Costs	963.619***	864.314***	1183.824***	924.120***
	(4.98)	(4.09)	(6.20)	(4.38)
Adjusted R^2	0.1539	0.1550	0.1590	0.1602
N	5843	5843	5843	5843

Table 6
Robustness tests with alternative country-level variables

Definitions of variables appear in the Appendix. The dependent variable is *Risk Premium*. Table reports coefficients with t-statistics 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. All estimations are performed with the full conditioning set of country-level variables (*Economic Development, Financial Development, Information Sharing, Trust, Accounting Standards, Creditor Rights, Rule of Law, Bank Costs*) except where indicated. Standard estimations are a reminder of the results displayed in tables 2, 3 and 4. Estimations with legal origin add dummy variables whether the legal origin is Common Law, French origin, German origin, or Socialist origin (dummy variable for Scandinavian origin is dropped) to the full conditioning set of variables, and exclude the variables *Creditor Rights* and *Rule of Law*. Estimations with religion variables add dummy variables whether the religion practiced by the largest fraction of the population is Catholic, Protestant, Muslim, or Buddhist religion (dummy variable for other religion is dropped) to the full conditioning information set of variables. Estimations with *Legal Formalism* replace *Rule of Law* by this variable in the full conditioning information set of variables. Estimations with *Corruption* replace *Rule of Law* by this variable in the full conditioning set of variables.

	Key variable				
Explanatory variables	**Economic Develop.**	**Financial Develop.**	**Trust**	**Information Sharing**	**Accounting Standards**
Standard estimations					
Collateral	-140.687***	-23.967**	21.232*	-17.112	-61.326
	(2.94)	(2.28)	(1.65)	(0.79)	(1.28)
Collateral × Key Variable	19.679***	81.154***	0.578*	63.030***	1.497**
	(3.87)	(7.14)	(1.85)	(2.86)	(2.29)
Adjusted R^2	0.1550	0.1602	0.1533	0.1540	0.1749
With Legal Origin					
Collateral	-147.819***	-11.326	36.638***	-66.231	-17.616
	(3.09)	(1.08)	(2.83)	(1.37)	(0.81)
Collateral × Key Variable	20.211***	63.758***	0.115	1.556**	61.044***
	(3.96)	(5.58)	(0.36)	(2.36)	(2.78)
Adjusted R^2	0.1635	0.1657	0.1613	0.1745	0.1624
With Religion					
Collateral	-162.269***	-24.193**	24.097*	-18.717	-67.368
	(3.38)	(2.26)	(1.86)	(0.87)	(1.39)
Collateral × Key Variable	21.655***	77.866***	0.419	61.368***	1.578**
	(4.24)	(6.68)	(1.33)	(2.80)	(2.38)
Adjusted R^2	0.1648	0.1686	0.1625	0.1634	0.1747
With Legal Formalism					
Collateral	-126.648***	-16.344	19.049	-15.506	-67.641
	(2.64)	(1.56)	(1.45)	(0.71)	(1.42)
Collateral × Key Variable	18.297***	73.322***	0.662**	62.438***	1.597**
	(3.59)	(6.46)	(2.11)	(2.82)	(2.45)
Adjusted R^2	0.1500	0.1542	0.1488	0.1493	0.1755
With Corruption					
Collateral	-123.621***	-20.242*	20.818	-15.365	-67.104
	(2.57)	(1.90)	(1.61)	(0.71)	(1.39)
Collateral × Key Variable	17.978***	78.691***	0.614**	62.271***	1.566**
	(3.52)	(6.75)	(1.96)	(2.81)	(2.37)
Adjusted R^2	0.1497	0.1545	0.1484	0.1490	0.1749

Table 7
Probit estimation of the Collateral equation for 3SLS regressions

Definitions of variables appear in the Appendix. The dependent variable is *Collateral*. 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.

	Estimation
Explanatory variables	
Intercept	3.657***
	(160.46)
Loan Type	0.168***
	(20.04)
Loan Amount	-0.168***
	(124.59)
Number of Lenders	0.123***
	(33.51)
Distribution Method	0.365***
	(46.97)
Seniority	0.693***
	(179.76)
LR	1290.33***
Percent Concordant	75.1
N	5843

Table 8
3SLS estimation for benchmark regressions

*Collateral** is the fitted value of *Collateral*, estimated with a probit model. Instruments for the 3SLS regression are taken from equations (2). Definitions of variables appear in the Appendix. The dependent variables in the equations system are *Risk Premium* and *Collateral*. Results for the *Risk Premium* estimation are provided. Table reports coefficients with t-statistics 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.

	Estimations	
Explanatory variables	(1)	(2)
Intercept	416.61***	812.125***
	(5.06)	(7.84)
Collateral*	-79.33***	-36.506*
	(3.45)	(1.65)
Maturity	0.124***	0.072*
	(3.17)	(1.91)
Number of lenders	-17.43***	-16.308***
	(6.54)	(5.92)
Loan Type	13.51***	22.431***
	(2.90)	(4.78)
Loan Size	-7.02***	-6.458***
	(3.25)	(3.04)
Covenants	28.409***	29.251***
	(4.62)	(4.97)
Economic Development	0.268	-70.124***
	(0.03)	(6.47)
Financial Development	4.607	10.883
	(0.59)	(4.25)
Information Sharing	26.223*	72.437***
	(1.78)	(4.25)
Trust	-0.208	-0.104
	(1.13)	(0.44)
Accounting Standards	-	1.756***
		(3.42)
Creditor Rights	2.365	-5.887**
	(0.91)	(2.12)
Rule of Law	-42.507***	17.683
	(4.97)	(1.46)
Banking Costs	1308.324***	1378.086***
	(5.80)	(6.23)
Country dummy variables	No	No
Adjusted R^2	0.1417	0.1571
N	5843	4724

Table 9
3SLS estimation for regressions with interaction variables for trust and accounting standards

*Collateral** is the fitted value of *Collateral*, estimated with a probit model. Instruments for the 3SLS are taken from equations (2). Definitions of variables appear in the Appendix. The dependent variables in the equations system are *Risk Premium* and *Collateral*. Results for the *Risk Premium* estimation are provided. Table reports coefficients with t-statistics 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.

	Key variable				
Explanatory variables	**Trust**	**Accounting Standards**	**Information Sharing**	**Economic development**	**Financial development**
	(1)	(2)	(3)	(4)	(5)
Intercept	423.433***	815.189***	426.943***	879.141***	462.1***
	(5.15)	(6.56)	(4.89)	(8.03)	(5.63)
Collateral*	-164.935***	-41.43	-100.992	-952.255***	-250.339***
	(4.46)	(0.37)	(1.55)	(6.87)	(7.65)
Collateral* × KeyVariable	2.359***	0.067	22.227	90.703***	190.41***
	(2.95)	(0.04)	(0.36)	(6.38)	(7.3)
Maturity	0.124***	0.072*	0.124***	0.122***	0.103***
	(3.19)	(1.92)	(3.17)	(3.13)	(2.65)
Number of Lenders	-17.546***	-16.303***	-17.401***	-15.909***	-16.047***
	(6.59)	(5.91)	(6.53)	(5.97)	(6.04)
Loan Type	13.184***	22.434***	13.514***	15.724***	14. 148***
	(2.83)	(4.77)	(2.9)	(3.38)	(3.05)
Loan Size	-6.84***	-6.459***	-7.048***	-7.453***	-6.836***
	(3.17)	(3.04)	(3.26)	(3.46)	(3.18)
Covenants	28.356***	29.256***	28.454***	30.526***	28.962***
	(4.61)	(4.97)	(4.63)	(4.97)	(4.73)
Economic Development	5.21	-70.097***	0.301	-49.023***	6.564
	(0.61)	(6.45)	(0.04)	(4.31)	(0.78)
Financial Development	3.833	10.736	4.649	2.614	-102.154***
	(0.49)	(1.26)	(0.59)	(0.33)	(6.17)
Information Sharing	22.531	72.577***	15.754	35.768**	27.721*
	(1.52)	(4.19)	(0.48)	(2.42)	(1.89)
Trust	-1.516***	-0.103	-0.208	-0.269	-0.299
	(3.16)	(0.44)	(1.14)	(1.47)	(1.63)
Accounting Standards	-	1.709	-	-	-
		(1.45)			
Creditor Rights	1.568	-5.892**	2.394	2.79	-0.618
	(0.6)	(2.12)	(0.92)	(1.07)	(0.24)
Rule of Law	-47.559***	17.781	-42.585***	-39.465***	-46.033***
	(5.46)	(1.45)	(4.98)	(4.62)	(5.4)
Bank Costs	1289.829***	1378.186***	1306.092***	1322.207***	1247.902***
	(5.72)	(6.23)	(5.78)	(5.88)	(5.55)
Adjusted R^2	0.143	0.157	0.1415	0.148	0.1501
N	5843	4724	5843	5843	5843

Appendix: Brief description of all variables and their sources

Variable	Description	Source
Loan contract characteristics		
Risk Premium	Risk premium in basic points	Dealscan
Collateral	=1 if the loan is secured by a collateral	Dealscan
Loan Size	Logarithm of the size of the loan in thousand dollars	Dealscan
Maturity	Maturity of the loan in months	Dealscan
Loan Type	=1 if the loan is a term loan	Dealscan
Number of Lenders	Logarithm of the number of lenders	Dealscan
Distribution Method	= 1 if the loan is syndicated	Dealscan
Seniority	= 1 if the debitor is senior	Dealscan
Country characteristics		
Trust	Weighted average normalized to scale 0 to 100 of survey responses to question: "Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people ?" (0=can't be too careful, 1=most people can be trusted).	World Values Survey
Information Sharing	=1 if either a public registry or a private bureau operates in the country. or a private registry	Japelli and Pagano (2002)
Accounting Standards	Index created by examining and rating companies'1995 annual reports on their inclusion or omission of 90 items.	CIFAR (Center for International Financial Analysis and Research)
Economic Development	Mean logarithm of GDP per capita in PPP for the period 1992-2000.	World Penn Tables 6.2
Financial Development	Mean ratio of the volume of credit to private companies to GDP for the period 1995-1997.	Beck, Demirgüc-Kunt and Levine (2000).
Creditor rights	An index aggregating four aspects of creditor rights. The index ranges from zero (weak creditor rights) to four (strong creditor rights).	La Porta et al. (1998)
Rule of Law	This indicator refers to "the extent to which agents have confidence in and abide by the rules of society".	Kaufmann et al. (1999a, b)
Bank costs	Total bank overhead costs as a share of total bank assets in 1999.	Barth, Caprio and Levine (2004)
Legal Origin	Four dummy variables that identify legal origin, for Common, French, German, Socialist legal origin.	La Porta et al. (1997a)
Religion	Four dummy variables depending on the primary religion (Catholic, Protestant, Muslim, Buddhist).	Stulz and Williamson (2003), CIA Factbook (2003).
Legal Formalism	A measure of costs of enforcing contracts through courts, based on surveys of lawyers and judges.	Djankov et al. (2003)
Corruption	A composite index of corruption which aggregates indicators of corruption obtained from experts surveys and some resting on residents surveys. The index is rescaled from zero (low corruption) to ten (high corruption).	Kauffmann, Kraay and Zoido-Lobaton (1999a, b)