

# Why Do Banks Ask for Collateral ?<sup>1</sup>

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## **Abstract:**

In spite of the massive use of collateral, there exist only few studies on the reasons of the use of collateral. This paper aims at testing empirically the three major theoretical reasons for using collateral: reduction of loan loss in the event of default, adverse selection, and moral hazard. We use a dataset of 735 bank loans on French distressed firms, which contains the full information on debt contract characteristics including collaterals. This dataset allows providing a complete empirical framework to test the three theoretical arguments in connection with the type and the value of collaterals.

Our conclusions are: (a) Collateral contributes to reduce loan loss in the event of default, with differences among types of collaterals in terms of the recovered value for a given initial value. (b) Collateral does not solve adverse selection problems, as there is a positive relationship between collateral and risk premium. (c) Collateral does not solve moral hazard, as secured loans are not associated with a lower probability of moral hazard behavior. Therefore, our work suggests that information asymmetries are not of prime importance in the decision of the bank to secure a loan, while the reduction of the loan loss and the observed-risk hypothesis may explain the use of collateral.

*Keywords:* bank, collateral, credit risk.

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## 1. Introduction

There is widespread evidence regarding the massive use of collateral. In European countries, Davydenko and Franks (2004) observe that 75.7% of firm loans in France and 88.5% in Germany are secured, whereas Gonas et al. (2004) point out that 73% of loans are secured for US firm loans, which is similar to the order of magnitude provided by Berger and Udell (1990).

It is therefore of interest to know why banks use collateral. Theoretical literature on this topic can be broadly summarized in three arguments, as observed by Greenbaum and Thakor (1995). First, collateral allows a reduction of the loan loss for the bank in the event of the default of the loan. Indeed it provides to the bank a prior title on specific assets. Second, collateral helps to solve the problem of adverse selection borne by the bank when lending, as it constitutes a signalling instrument providing some valuable information to the bank. Indeed, collateral helps the bank to obtain private information owned by the borrower, as high-quality borrowers are more induced to accept to provide collateral in compensation of a low loan rate than low-quality borrowers. Third, collateral helps to solve the problem of moral hazard after the loan is granted: namely, the borrower is not inclined to provide the optimal effort or the optimal level of investment. This mechanism is rooted in the binding role of collateral on the borrower which favors the alignment of his interests on the bank's ones.

We can however question about the empirical relevance of these theoretical arguments. Indeed, collateral incurs monitoring and legal costs, which might be large enough to offset the advantages of requiring a collateral for a bank. More important, while both arguments based on information asymmetries suggest a negative relationship between risk of default and collateral, there is a commonly accepted view among bankers that riskier loans would be associated with more collateral. 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 higher loan rates to riskier borrowers and require higher collateral from these borrowers. Theories on the use of collateral would then fail to explain the widespread use of collateral.

The empirical validation of the theories of the use of collateral is therefore a major issue for the understanding of the use of collateral in lending decisions.

However, only a few empirical studies have provided some evidence regarding the relevance of these arguments. Berger and Udell (1990) focused on the role of collateral as a signalling instrument in an investigation of the link between the presence of collateral and the risk premium on US loans. Jimenez and Saurina (2004) analyzed the influence on the collateral of the probability of default on Spanish bank loans. Finally, several works tested determinants of collateralization to study firm and loan characteristics with which the presence of a collateral is associated (e.g. Leeth and Scott, 1989; Gonas et al., 2004).

However these studies suffer from several drawbacks which result from the availability of data. First, they do not provide a broad framework to test the three theoretical arguments on the same sample. Moreover, only few studies directly measure these arguments. Second, almost all studies on this topic only test the fact that the loan is secured or not. This binary approach is imperfect as it neglects the role of the type and the value of collaterals. It seems notably intuitive that an outside collateral – namely an asset outside of the borrowing firm – is more binding than an inside collateral. Jimenez and Saurina (2004) extend the binary approach by considering the proportion of the loan which is secured, but they also do not take the type of collateral into account.

The aim of this paper is to provide empirical evidence to test the three theoretical reasons of the use of collateral by banks. This evidence is based on a dataset of 735 bank loans from French distressed firms, which provides detailed information on the type and the value of each collateral, but also the reasons of the default. This impressive dataset allows major additions to the empirical literature on the theories of the use of collateral.

The first contribution is a complete empirical framework to test on a common sample the three theoretical arguments regarding the causes of the use of collateral by banks. The second contribution aims at testing the influence of the type and the value of the collateral. Indeed, as mentioned above, the type of the collateral is notably expected to exert an impact on the results.

Third, a major contribution of our paper is to provide a satisfactory investigation of the role of collateral on moral hazard problems. Our database on loans from distressed companies includes qualitative information on the causes of default, which allows proxying moral hazard according to these causes.

The paper is organized as follows. Section 2 presents the theoretical and empirical background on the use of collateral by banks. Section 3 describes the data and variables. In section 4, we develop the empirical results. We finally provide some concluding remarks in section 5.

## **2. Background**

### **2.1 Theoretical background**

Broadly speaking, theoretical literature provides three major reasons for the use of collateral by banks (Greenbaum and Thakor, 1995). This subsection is designed to develop each of them. We first must define what an inside and an outside collateral are, as some of the theoretical arguments on the role of collateral are based on this definition. An inside collateral is an asset owned by the firm to which the loan is granted. It can notably be account receivables, inventories or fixed assets. In opposition, an outside collateral is an asset which is not owned by the firm. It is typically a guarantee from firm owners or from the firm group.

First, a bank is inclined to ask for collateral as it reduces loan loss in the event of the default. Indeed collateral grants the bank a title on specific assets. An inside collateral is useful for the bank as it increases priority if the firm defaults. An outside collateral suspends the limited liability of the firm, as it gives the bank property on an asset outside of the firm. It has to be stressed that this intuitive reason is independent of information asymmetries between the borrower and the bank. This is a major difference with both other reasons for the use of collateral.

Second, collateral may solve the problem of adverse selection resulting from 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, meaning a signal that can not be provided by low-quality borrowers. Collateral constitutes such a signal, as it is more costly for low-quality

borrowers since they have a higher chance of defaulting and then of losing the collateral (Bester, 1985; Chan and Kanatas, 1985; Besanko and Thakor, 1987).

Consequently, as collateral acts a signalling device, it conveys valuable information on the borrower to the bank which helps to solve credit rationing and allows a better pricing of borrowers according to their quality. A bank can then screen borrowers by offering the choice between a secured loan with a low loan rate and an unsecured loan with a high loan rate. A high-quality borrower will be inclined to choose the loan with a collateral as its low risk of default means a low probability to lose collateral and a high probability to repay interest.

This argument is particularly relevant in the case of outside collaterals, since the cost for the borrower of providing such collaterals is obvious. However, it also plays a role for inside collaterals because of their costs. Indeed, an inside collateral is costly for a borrower as its use makes subsequent loans more expensive since it reduces the assets available for collateral to the lenders of these loans.

Third, collateral can reduce the problem of moral hazard after that the borrower has obtained the loan by reducing the incentives of the borrower to invest in riskier projects or to minimize its effort to ensure the success of the project for which loan was granted (Boot, Thakor and Udell, 1991). Indeed the bank can align the borrower's interest with its own using collateral, as it imposes a greater loss on the borrower in case of default. This argument is particularly relevant in the case of outside collaterals, since these collaterals extend the limited liability of the borrower to external assets.

Therefore, both latter arguments suggest a negative link between collateral and credit risk, as a secured loan would be associated with a higher quality of borrowers and a lower probability of ex post moral hazard behavior. However, some counterarguments exist in favor of a positive relationship between collateral and credit risk. On the one hand, there is a commonly accepted view among bankers that collateral is associated with greater credit risk, as mentioned by Berger and Udell (1990) and Jimenez and Saurida (2004). The rationale underlying this argument is that banks can sort the borrowers from information they have on their quality. Consequently they charge a higher loan rate to riskier borrowers, and simultaneously require more collateral from these borrowers following the first theoretical reason for the use of collateral: since collateral reduces its loss, the bank would be more inclined

ceteris paribus to ask for collateral to clients with a higher credit risk. This argument is commonly called the observed-risk hypothesis in the literature.

On the other hand, some theoretical papers provide some additional arguments on this issue. First, a high level of collateral can induce the bank to become “lazy” and therefore to undertake an insufficient screening of the borrower when loan is granted (Manove and Padilla, 1999). Second, even if borrowers are fully sincere, they may suffer from an excessive optimism making them underestimate their probability of default. Consequently, they would be willing to provide any requested amount of collateral as they undervalue the cost of collateral (Manove and Padilla, 2001).

In summary, theoretical literature provides three major arguments in favor of the use of collateral by banks, showing that collateral would reduce the loss and the credit risk of the bank. Counterarguments also exist in favor of a positive relationship between collateral and credit risk. We turn now to the question to know whether these reasons are empirically validated, by keeping counterarguments in mind.

## **2.2. Empirical background**

In spite of the large amount of empirical literature devoted to banking issues, it is worth mentioning that studies devoted to the reasons of the use of collateral are impressively scarce. A likely reason for this deficit seems the difficulties to find loan-level data on collaterals.

Furthermore, it must be emphasized that only a very limited set of these studies have directly tested some of the three theoretical arguments regarding the use of collateral. Other works focus on the determinants of the collateralization of loans, basing their reasoning on the link between the use of collateral and the perceived risk by the bank.

Berger and Udell (1990) investigate the relationship between collateral and credit risk on a sample of 1 million loans from US banks. In a first part, these authors 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 collateralized 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 result may be explained by the

fact that banks require more collateral from riskier borrowers who are also charged higher loan rates, in accordance with the observed-risk hypothesis.

In a second part, several ex post measures of risk, including net charge-offs to loans and loan payments past due to loans, are regressed on a set of borrower characteristics aggregating information by loan, so that this regression is performed at the borrower's level. They observe that collateral is associated with credit risk. As a consequence, this work concludes in favor of a positive relationship between collateral and credit risk, which incites banks to ask more collateral from riskier companies, and consequently charged them with higher loan rates.

Jimenez and Saurina (2004) focus on the determinants of the probability of default of bank loans on a wide set of 3 million loans provided by Spanish banks. Probability of default is considered as an ex post credit risk. Therefore they test whether both arguments of the use of collateral based on information asymmetries are validated, namely whether the presence of collateral reduces the probability of default. The probability of default is explained by a set of loan characteristics including some information on the collateral. Three dummy variables depending on the collateralized share of the loan are jointly taken into account in the model: they are respectively equal to one if this share is 100%, if it ranges between 50% and 100%, and if it is below 50%. They find that the probability of default is greater for loans with collateral. Thus, this study also supports the observed-risk hypothesis.

We now turn to the studies investigating the determinants of collateralization. Most of these studies explain whether the loan is secured or not with loan-based data. The seminal paper on this topic is Leeth and Scott (1989). This work tests several determinants of the binary decision of the bank to secure the collateral or not on a sample of 2000 US loans. Notable results are the negative influence of age on the presence of a collateral and the non-significance of size. Similarly, Cowling (1999) tests the determinants of collateralization on a sample of 272 firm loans in the United Kingdom. The tested hypothesis is the link between risk and collateral, and consequently tested determinants proxy risk (age, size, limited liability). The author concludes to a positive effect of risk on loan collateralization.

In a broader perspective, Gonas et al. (2004) investigate the determinants of collateralization on a sample of 7600 US loans by proxying each of the three theoretical reasons of the use of collateral. The presence of adverse selection problems is expected to be lower when the firm has a rating, is listed, is larger, or

when the firm is domestic. Moral hazard problems are assumed to increase with the loan maturity. Finally, credit risk should be inversely related to the quality of the firm rating. The nature of the proxies for each theoretical argument needs to be stressed, given the interpretations of the paper. However, the conclusions of the paper are rather mixed with some evidence in favor of each theory, with the expected sign for all variables related to adverse selection, moral hazard and risk reduction of the loan loss, even if there are some ambiguous elements.

Hulburt and Scherr (2003) also analyze the determinants of the collateralization, with a notable exception: the dependent variable is defined by the ratio of secured debt to total debt at the firm level. The work is performed on a sample of two yearly samples of about 4000 small companies each. The tested explaining variables are then defined also as firm characteristics which constitute a major limitation to the study for our focus. Most notable results include the positive sign of age and the negative sign of size. As both variables proxy the risk of the company, these results show mixed evidence regarding the link between risk and collateralization.

Finally, Berger and Udell (1995) focus on a closely related issue, relationship lending. This work is remarkable as it constitutes the only one to our knowledge taking the type of collateral into account. Namely, several dummy variables are included for receivables and inventories, other firm assets or outside collaterals. This work analyzes the associations among collateral, banking relationship and risk premium. It provides some support on the positive association between collateral and risk premium, and clear evidence that firms with longer banking relationships are less likely to pledge collateral. Consequently, this work tends to support the view that collateral is associated with greater risk, in accordance with the observed-risk hypothesis.

This brief survey on the empirical literature on the motives of the use of collateral can be summarized in three points for our investigation. First, it appears that empirical evidence is rather in favor of the observed-risk hypothesis according to which riskier borrowers are required to provide more often collateral, in accordance with the common opinion of bankers. This element tends to invalidate the theoretical arguments on the use of collateral.

Second, most evidence is however based on studies which do not directly analyze these arguments, considering rather proxies. Furthermore, no study provides a complete framework allowing to test the three theoretical assumptions on the same

sample of loans. Third, all works only consider the fact that the loan is secured or not, if we except two works considering in a limited way the type and the value of collateral (Berger and Udell, 1995; Jimenez and Saurida, 2004). This is a major limitation of these works, as the characteristics of the collateral can likely influence the results. Our empirical work is fitted to improve the former literature relative to these both drawbacks.

### **3. Data and variables**

We collect a sample of 735 credit lines attached to 386 French distressed firms, whose debt exposure exceeds 100 K€ The year of default is between 1993 and 2003. Loans were granted from 1984 to 2001. The sample comes from a larger database we collected between 2004 and 2005 under S&P Risk Solution supervision. The “default” event follows the Basel II definition: a firm defaults as soon as delays on its financial commitments exceed 90 days.

Data come from three major French commercial banks, and were collected manually from their internal recovery unit. When the client defaults, these units face the following alternative: some of these companies subsequently go to formal bankruptcy (1985 French Law) and others undergo a workout (this one may be either a private renegotiation with the Bank or a “Règlement Amiable” procedure, monitored by a legal supervisor, following the 1984 French Law). Formal bankruptcy implies a stay of claims and may induce significant violations of priority of claims, depending on the final issue: liquidation, sale as a going concern and continuation. The issue is decided by the Court: creditors do not vote in France. This legal intervention creates incentive to postpone bankruptcy because both managers and creditors fear a loss of control in case of default: as a consequence, bankruptcy triggering is frequently delayed, which leads to a relatively high proportion of liquidation procedures. On the other hand, distressed firms can privately renegotiate with creditors. A French specification is that actors can choose to be monitored by a legal mandatory, whose mission is to facilitate financial renegotiation and restructuring efforts.

Table 1: Descriptive statistics by firm

	Mean or frequency	Standard Deviation
Age (years) (1)	15.06	17.28
Nb. Employees (2)	144.4	656.4027
Total balance sheet (K€) (3)	10488.3	36155.5
Turnover (K€) (3)	11970.9	32116.4
Limited Liability (1)	88.22%	32.29%
Group (1)	38.67%	48.77%
IssueRI (1)	13.90%	34.64%
IssueRA (1)	6.04%	23.86%
IssueCE (1)	13.90%	34.64%
IssueCO (1)	9.67%	29.60%
IssueLJ (1)	56.50%	49.86%
Relationship Length (years) (1)	665.21%	692.79%
Moral hazard (1)	26.59%	44.25%
Unknown rating (1)	27.19%	44.56%
Good rating (1)	32.63%	46.96%
Bad rating (1)	40.18%	49.10%

(1) 331 remaining obs. on relevant sample; (2) 90 obs.; (3) 176 obs.

Our templates collect two types of data. The first group of data deals with the main characteristics of the firms, the causes of the default, and analyses the successive stages of the resolution of financial distress. The second part of the template focuses on each credit lines: we collect information on the loan size, the type and the term, the risk premium, and recovered amounts. On this last point, we analyze useful information on collaterals, depending of their type (internal or external), their initial market value, and their final realized value.

Tables 1 and 2 summarize our sample structure, focusing respectively on firms and on credit lines. The sample is composed of a majority of small and medium units with small corporate governance issues, and whose managers are protected by limited liability. This feature partially explain the relative high level of liquidations, whereas private renegotiations are less numerous. An interesting point is the relatively high proportion of pure private renegotiations, whereas monitored renegotiation is the less used resolution mode. As a matter of fact, this non flexible solution may induce a reputation loss effect, even if legal interventions can reduce the occurrence of bargaining blockages because of free-riding incentives.

Table 2: Descriptive statistics by credit line

Credit lines:	Mean or frequency	Standard Deviation
Overdraft (4)	20.92%	40.71%
STFixed (4)	6.56%	24.78%
STVariable (4)	4.26%	20.20%
LTFixed (4)	37.23%	48.39%
LTVVariable (4)	8.16%	27.39%
Discount (4)	13.65%	34.36%
Other credit lines (4)	9.22%	28.96%
LoanSize (K€) (4)	436.3	1367.9
LossRatio (4)	55.07%	83.97%
EAD (K€) (4)	325.0	851.4
Exces (4)	117.10%	196.01%
Pemium risk (5)	1.62%	1.41%
Collateral (4)	74.5%	43.6%
GuaranteesIndividuals (4)	43.6%	49.6%
GuaranteesCompanies (4)	13.7%	34.4%
OtherCollaterals (4)	8.7%	28.2%
CollateralsSTAssets (4)	14.4%	35.1%
CollateralsLTAssets (4)	15.2%	36.0%
Mortgage (4)	18.6%	39.0%
GuaranteesIndividualsValue (K€) (6)	131.5	260.4
GuaranteesCompaniesValue (K€) (6)	79.4	571.7
OtherCollateralsValue (K€) (6)	42.8	318.9
CollateralsSTAssetsValue (K€) (7)	167.5	1492.8
CollateralsLTAssetsValue (K€) (8)	62.7	233.6
MortgageValue (K€) (9)	120.4	470.9
GuaranteesIndividualRecoveredValue (K€) (10)	10.6	45.4
GuaranteesCompaniesRecoveredValue (K€) (11)	14.1	83.7
OtherCollateralsRecoveredValue (K€) (12)	17.6	193.6
CollateralsSTAssetsRecoveredValue (K€) (13)	8.5	65.2
CollateralsLTAssetsRecoveredValue (K€) (14)	4.0	33.7
MortgageRecoveredValue (K€) (15)	27.7	140.2
Recovery rate on GuaranteesIndividuals (7)	10%	25%
Recovery rate on GuaranteesCompanies (8)	39%	45%
Recovery rate on OtherCollaterals (9)	32%	41%
Recovery rate on STAssets (10)	21%	37%
Recovery rate on LTAssets (11)	11%	32%
Recovery rate on Mortgage (12)	21%	34%

(4) 564 obs.; (5) 328 obs.; (6) 420 obs.; (7) 246 obs.; (8) 77 obs.; (9) 49 obs.; (10) 81 obs.; (11) 86 obs.; (12) 105 obs.

French firms massively use overdraft, and discount for their short term financial needs. Investment relies on long term fixed interest rates. Notice that the level of collateralization is rather high (74%) whereas final recovered amounts on such collaterals never exceed 40%. Moreover, banks concentrate their collateralization policy on few types of collateral: individual guarantees (44%) and mortgage (19%). Collaterals on long term (15%) and short term (14%) assets are of second importance. We shall see later that such a behavior may traduce inappropriate choices: personal guarantees and mortgages are associated to a higher individual risk and are less

efficient, taking into account the legal environment and the volatility of some economic assets which support the collateral.

The list of all used variables is described in the Appendix.

## **4. Results**

This section is organized so as to investigate each cause of default in turn. Namely the first subsection analyzes the role of collateral to reduce loan loss in the event of default, while the second and third subsections respectively study the influence of collateral to solve the adverse selection and moral hazard problems.

### **4.1 Does collateral reduce loan loss in the event of default?**

An intuitive motivation for the use of collateral in the loan contracts is that it permits a reduction of the loan loss in the event of the default of the loan. However, one can wonder whether the presence of collateral significantly reduces loan loss. Furthermore, the impact of collateral in terms of reduction of the loan loss is likely to be influenced by the type and value of collateral. Namely all collaterals do not provide the same titles to the bank.

We therefore provide several estimations to investigate the assumed impact of collateral on the loan loss. We include several control variables: a dummy variable equal to one if the legal status of the borrower includes limited liability (*LimitedLiability*), a dummy variable equal to one if the borrower is part of a group (*Group*), a dummy variable equal to one if the last internal rating estimated by the bank before the default of the borrower is unknown because of the lack of satisfactory information (*UnknownRating*), a dummy variable equal to one if the last internal rating estimated by the bank before the default considers the borrower as solvent (*GoodRating*). We also include four dummy variables to account for the alternative ways of resolving the default: private renegotiation (*IssueRI*), monitored renegotiation (French “règlement amiable”) (*IssueRA*), firm sale as a going concern (*IssueCE*), continuation (*IssueCO*). The dummy variable for the last possibility, liquidation, is dropped in order to avoid collinearity issues. Exposure at default is also considered,

including all the due amounts plus the discounted commitments (*lnEAD*).<sup>4</sup> A measure of the excessive use of the credit line is also included: the ratio of used amount to the initial granted amount (*Excess*).

Finally, we include some dummy variables for the type of loan: *Overdraft*, *STFixed*, *STVariable*, *LTFixed*, *LTVariable*, *Discount* represent dummy variables equal to one respectively if the loan is an overdraft, a short-term loan with fixed rate, a short-term loan with variable rate, a long-term loan with fixed rate, a long-term loan with variable rate, a discount. The dummy variable for the last possibility, *Overdraft*, is dropped.

We first explain the loan loss ratio, defined as loan loss divided by loan amount. Namely, we test whether the presence of collaterals reduces significantly this ratio. In this aim, we provide two regressions of this ratio displayed in tables 3 and 4. Based upon the value of the adjusted R<sup>2</sup> statistic, the fit of the equations is rather satisfactory. We used the condition index of Besley, Kuh and Welsch (1980) to assess the collinearity of the model.<sup>5</sup> The multicollinearity of the regressions appears satisfactory with values below 17.

The first regression contains a dummy variable (*Collateral*) equal to one whether the loan is secured or to zero else. The results are described in table 3. We observe a negative coefficient for *Collateral* which is significant at the 1% level. This intuitive result supports the expectation that a secured loan reduces the loan loss in the event of default of the company.

The second regression takes the type of collateral into account: it includes dummy variables for each type of collateral (*GuaranteesIndividuals*, *GuaranteesCompanies*, *OtherCollaterals*, *CollateralsSTAssets*, *CollateralsLTAssets*, *Mortgage*). The results are displayed in table 4. We point out some differences between collaterals: the presence of guarantees from companies, collaterals based on short-term assets, and mortgage, significantly reduces loan loss, while there is no significant influence of the three other types of collaterals.

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<sup>4</sup> The discount rate varies with the maturity and date of lending.

<sup>5</sup> According to these authors, the multicollinearity is considered as very weak for an index below 10, moderate when the index ranges from 10 and 30, excessive and biasing the estimations if the index is above 30.

Table 3: collateral and reduction of loan loss: secured or not (OLS)

Variable	Coefficient	t-statistic
Intercept	0.988***	7.27
Collateral	-0.163***	-2.69
LimitedLiability	0.133	1.57
Group	0.037	0.71
UnknownRating	0.014	0.22
GoodRating	0.044	0.67
IssueRI	-0.196**	-2.46
IssueRA	-0.186	-1.53
IssueCE	0.092	1.26
IssueCO	-0.163	-1.54
STFixed	0.281**	2.48
STVariable	0.386***	2.86
LTFixed	0.237***	3.51
LTVVariable	0.178	1.71
Discount	0.114	1.36
LnEAD	-0.057***	-3.10
Excess	-0.275***	-20.34
Adjusted R <sup>2</sup>	0.4967	
Condition Index	15.67	

Dependent variable is the loan loss ratio. \*, \*\*, \*\*\* denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

The lack of significance of guarantees from individuals can be explained by the fact that these guarantees can cover several bank loans. As a consequence, the recovered amount on these collaterals is not significant to reduce the loan loss. Another argument is that a distressed firm may have already contributed to reduce the personal wealth of its managers, as the increasing difficulties of the firm incite managers or other possible providers of guarantees to increase their invested funds in the firm. Regarding the lack of significance of long-term assets other than mortgage, this result may come from the poor recovered value of intangible fixed assets.

Turning to the other control variables, it is of interest to point out the significant and negative sign of *LnEAD* and *Excess*. These results suggest the role of the effort of the bank in the recovery process. Namely, the bank supplies a greater effort in this process when the exposure at default and the excessive use of the credit line are greater.

Concerning the ways of resolving the default, loan loss is significantly reduced under renegotiation (whatever its type: purely informal, *IssueRI*, or legally monitored, *IssueRA*). This result can be relied with the French bankruptcy code efficiency issue. Article 1 of the French bankruptcy code specifies that the first priority of the court should be the continuation of activity and the protection of employees. As a matter of fact, creditors bargaining position is reduced to nearly zero under the French

bankruptcy law, so that every time financial distress is resolved outside bankruptcy, banks recover higher amounts. Notice here that the liquidation issue is excluded from regressions in order to avoid collinearity with other issues: all retained solutions (*IssueRI*, *IssueRA*, *IssueCE*, *IssueCO*) must be interpreted in reference to the liquidation event.

Table 4: Collateral and reduction of loan loss: types of collateral (OLS)

Variable	Coefficient	t-statistic
Intercept	0.969***	7.24
GuaranteesIndividuals	-0.054	-1.02
GuaranteesCompanies	-0.178**	-2.29
OtherCollaterals	-0.120	-1.27
CollateralsSTAssets	-0.225***	-3.02
CollateralsLTAssets	-0.001	-0.02
Mortgage	-0.228***	-3.23
LimitedLiability	0.081	0.93
Group	0.040	0.74
UnknownRating	0.016	0.25
GoodRating	0.032	0.48
IssueRI	-0.204**	-2.54
IssueRA	-0.225*	-1.85
IssueCE	0.083	1.14
IssueCO	-0.135	-1.27
STFixed	0.308***	2.72
STVariable	0.409***	3.05
LTFixed	0.245***	3.58
LTVVariable	0.208*	1.95
Discount	0.135	1.61
LnEAD	-0.041**	-2.19
Excess	-0.277***	-20.61
Adjusted R <sup>2</sup>	0.5058	
Condition Index	16.34	

Dependent variable is the loan loss ratio. \*, \*\*, \*\*\* denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

These estimations have then shown that the presence of collaterals reduces the loan loss of the bank in the event of default. However a major issue for a bank is also to know how much it can recover from each type of collateral. In this aim, we have to provide a model linking the recovered value of a collateral to its initial value. Consequently, we now present a model on secured loans explaining the recovered value of each collateral. As we want to take into account simultaneous effects between recovered amounts on every collateral, we model six simultaneous equations so that we have one equation per collateral. The explained variable is the logarithm of the recovered value for each collateral (*LnGuarIndivRecovered* for guarantees for individuals and so on), while the main explaining variable is the logarithm of the

initial value of the collateral at the time of the lending decision (*LnGuarIndivInitial* for guarantees for individuals and so on). We use a Three-Stage Least Squares estimation method for the global estimation of the model.<sup>6</sup>

The results of this model are displayed in tables 5 and 6. Based upon the value of the adjusted  $R^2$  statistic (0.3441), the fit of the model is quite satisfactory. As expected, the initial value of collateral has a significantly positive influence on the recovered value of collateral, whatever the type of collateral. When we consider the level of the coefficient of the initial value so as to measure the sensitivity of the recovered value to the initial value, a hierarchy of the collaterals emerges. In descending order, the “best” collateral is guarantees from companies with a coefficient of 0.382. This can be explained by the fact that this collateral is based on the wealth of other companies than the distressed one. The other collaterals have a coefficient of 0.355, which may result from the high legal protection associated with leasing and the French-specific “*privilège de prêteur de deniers immobilier*”. This latter collateral deals with the real estate loans. It gives a higher position in the absolute priority order and is based on the complete assets of the company. Leasing guarantees to the bank that there is no property transfer until the bank is fully repaid.

Then, the third “best” collateral is mortgage, namely a collateral on a non-volatile asset. The following collateral is short-term assets, which includes volatile assets such as receivables and stocks but also the non-volatile cash. Finally, the two “worst” collaterals in terms of the recovered value in comparison to the initial value are guarantees from individuals and long-term assets other than mortgage, namely both collaterals which are not significantly linked to the loan loss ratio shown above. Their relatively weak power of recovery takes some arguments mentioned above regarding the loan loss ratio. Even if a guarantee from an individual is an outside collateral which appears particularly satisfactory for a bank, it can be provided to cover several bank loans. Consequently the wealth of the guarantor can be shared between several banks. Moreover, we can consider that a distressed firm has in many cases already reduced considerably the personal wealth of its guarantors. The

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<sup>6</sup> Following the Three-Stage OLS method, we first use a Double-Stage OLS method (i.e. we use the reduced form of the model to regress exogenous instruments on endogenous variables : predicted values are taken back to the right side of the initial model, which can be estimated using simple OLS method). Then, first-stage residuals are used for the estimation of the relationship between random effects attached to each equation. Then, we use GLS method for the estimation of the whole model.

relatively weak of the coefficient of long-term assets other than mortgage can be explained by the poor recovered value on intangible fixed assets.

Table 5: collateral and reduction of loan loss: types and values of collateral (1/2) (Three-stage OLS)

	LnGuarIndivRecovered	LnGuarCompRecovered	LnOtherCollRecovered
Intercept	0.066 (0.16)	0.481 (1.62)	0.224 (0.50)
LnGuarIndivInitial	0.102** (2.46)		
LnGuarCompInitial		0.382*** (6.14)	
LnOtherCollInitial			0.355*** (5.46)
LnSTAssetsInitial			
LnLTAssetsInitial			
LnMortgageInitial			
LnGuarIndivRecovered		-0.217 (-0.79)	-0.653* (-1.79)
LnGuarCompRecovered	-0.258* (-1.88)		-0.334* (-1.71)
LnOtherCollRecovered	-0.146 (-1.14)	-0.066 (-0.57)	
LnSTAssetsRecovered	-0.360* (-1.65)	-0.247 (-1.14)	-0.489 (-1.59)
LnLTAssetsRecovered	-0.418 (-1.14)	-0.298 (-0.92)	-0.799* (-1.83)
LnMortgageRecovered	-0.263** (-1.89)	-0.047 (-0.29)	-0.374* (-1.92)
LimitedLiability	-0.254 (-1.01)	-0.339* (-1.72)	-0.410 (-1.40)
Group	-0.075 (-0.47)	-0.175 (-1.45)	-0.131 (-0.73)
UnknownRating	-0.052 (-0.30)	-0.221* (-1.70)	-0.064 (-0.32)
GoodRating	0.306 (-1.59)	0.131 (0.77)	0.424* (1.82)
IssueRI	-0.418* (-1.68)	-0.365* (-1.67)	-0.564* (-1.73)
IssueRA	-1.015** (-2.32)	-0.399 (-0.81)	-0.847 (-1.20)
IssueCE	0.101 (0.45)	0.266 (1.63)	0.253 (1.03)
IssueCO	-0.297 (-1.03)	0.162 (0.66)	-0.526 (-1.63)
STFixed	-0.355 (-1.11)	0.228 (0.78)	-0.394 (-1.03)
STVariable	-0.615 (-1.38)	-0.870** (-2.47)	-0.855 (-1.51)
LTFixed	-0.235 (-1.22)	-0.045 (-0.27)	-0.374 (-1.62)
LTVVariable	0.093 (0.32)	0.467** (2.25)	-0.084 (-0.25)
Discount	-0.788** (-2.51)	-0.454 (-1.31)	-0.843* (-1.70)
LnEAD	0.233** (2.26)	0.058 (0.46)	0.320** (2.09)
Excess	-0.032 (-0.93)	0.020 (0.65)	-0.054 (-1.38)

Adjusted R<sup>2</sup>=0.3441. t-statistic is in brackets. \*, \*\*, \*\*\* denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

When we analyze the coefficients of the recovered values of the other collaterals, we observe negative signs which are significant in many cases. Two explanations may be provided on this result. On the one hand, the presence of a collateral tends to reduce the presence and therefore the recovered value of the other collaterals. On the other hand, a greater value of one collateral incites the bank to concentrate its efforts in the recovery of this collateral to the detriment of other collaterals.

Focusing on the variables for the rival ways of default resolution, it appears that, even if global loss is reduced with outside bankruptcy as we mentioned above, banks do not use their collateralized rights under private renegotiation, so that their

recoveries on collaterals are significantly reduced when events *IssueRA* and *IssueRI* happen.

Table 6: collateral and reduction of loan loss: types and values of collateral (2/2) (Three-stage OLS)

	LnSTAssetsRecovered	LnLTAssetsRecovered	LnMortgageRecovered
Intercept	0.543** (2.05)	0.163 (0.60)	0.175 (0.34)
LnGuarIndivInitial			
LnGuarCompInitial			
LnOtherCollInitial			
LnSTAssetsInitial	0.211*** (4.35)		
LnLTAssetsInitial		0.093*** (3.07)	
LnMortgageInitial			0.222*** (3.51)
LnGuarIndivRecovered	-0.226 (-0.95)	-0.353* (-1.79)	-0.779** (-2.27)
LnGuarCompRecovered	-0.080 (-0.59)	-0.241*** (-2.61)	-0.408** (-2.17)
LnOtherCollRecovered	0.027 (0.22)	-0.122 (-1.39)	-0.286* (-1.81)
LnSTAssetsRecovered		-0.244 (-1.44)	-0.670** (-2.45)
LnLTAssetsRecovered	-0.086 (-0.27)		-0.790* (-1.74)
LnMortgageRecovered	-0.125 (-0.97)	-0.176 (-1.64)	
LimitedLiability	-0.257 (-1.45)	-0.218 (-1.24)	-0.496 (-1.60)
Group	-0.215** (-2.06)	-0.038 (-0.34)	-0.117 (-0.57)
UnknownRating	-0.145 (-1.22)	-0.019 (-0.16)	-0.103 (-0.46)
GoodRating	-0.061 (-0.35)	0.264** (2.08)	0.411 (1.58)
IssueRI	-0.216 (-1.06)	-0.277 (-1.54)	-0.760** (-2.48)
IssueRA	-0.773** (-2.08)	-0.682** (-1.99)	-1.426** (-2.24)
IssueCE	-0.075 (-0.45)	0.228* (1.68)	0.048 (0.16)
IssueCO	0.070 (0.31)	-0.100 (-0.49)	-0.249 (-0.65)
STFixed	-0.076 (-0.31)	-0.246 (-1.12)	-0.678 (-1.62)
STVariable	-0.539 (-1.64)	-0.623** (-2.11)	-1.037* (-1.76)
LTFixed	-0.184 (-1.30)	-0.248* (-1.86)	-0.428* (-1.69)
LTVVariable	-0.329 (-1.39)	0.128 (0.68)	0.208 (0.56)
Discount	-0.626** (-2.33)	-0.537** (-2.17)	-1.177*** (-2.62)
LnEAD	0.081 (0.75)	0.158* (1.93)	0.412*** (3.25)
Excess	-0.015 (-0.60)	-0.029 (-1.22)	-0.061 (-1.40)

Adjusted R<sup>2</sup>=0.3441. t-statistic is in brackets. \*, \*\*, \*\*\* denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

We conclude here that collaterals exert a positive and significant role to reduce the loan loss of the bank in the event of the default of the loan. However there are important differences between the types of collaterals in terms of the recovered value for a given initial value. Namely, guarantees from companies, other collaterals, and mortgage are in descending order the collaterals which provide the greatest recovered value. It has to be stressed that the differences between collaterals do not follow the distinction between outside and inside collaterals. This results notably from the legal differences among collaterals.

## 4.2 Does collateral solve adverse selection problems?

This subsection aims at analyzing the role of collateral to solve adverse selection problems. Theoretical literature suggests that collateral may constitute a signalling instrument and consequently it may help the bank to obtain private information owned by the borrower. According to this argument, we should observe a negative link between the presence of collateral and the risk premium, as high-quality firms would be inclined to provide a collateral in exchange of a lower risk premium. To test this hypothesis, we perform several regressions of the risk premium on a set of variables including collateral variables.

Risk premium is defined as the difference between the loan rate and a prime rate. The definition of prime rates is debatable. A first choice would be the use of all the available prime rates for all maturities, and then to consider that the prime rate of a loan would be the one corresponding to the maturity of this loan. However practical evidence suggests that this view does not correspond to the reality of French bankers. Indeed, it is notably argued that bankers use some reference rates for short-term and long-term loans, and notably the TBB (“taux de base bancaire”) for short-term loans during the period of our study as pointed out by practitioners (Les Echos, 2004; Galesne, 1999). Therefore, we choose to use as prime rate either the rate provided by the database, when the loan is based on a variable rate, or a reference rate depending on the maturity of the loan: the TBB (“taux de base bancaire”) for short-term loans, the TME (“taux mensuel des emprunts d’Etat”) for long-term loans.

These latter variables include information on loan size (*LnLoanSize*), on the length of the relationship between the bank and the borrower (*LnRelationshipLength*), the duration of the loan (*LnDuration*), and dummy variables for the type of loan (we drop the dummy variable for Overdraft). Based upon the value of the adjusted R<sup>2</sup> statistic, we conclude that the fit of the equations is quite satisfactory. The multicollinearity of the regressions appears also satisfactory, following the condition index of Besley, Kuh and Welsch (1980) with values below 18.

We first regress the risk premium on a dummy variable (*Collateral*) equal to one whether the loan is secured or to zero else. The results are described in table 7. The coefficient for *Collateral* is positive and significant at the 1% level. Therefore, we observe that risk premium increases when the loan is secured. This evidence does not support the theoretical argument according to which collateral helps to solve the

problem of adverse selection. In contrast, it is in favor of 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 the empirical evidence provided by Berger and Udell (1990), who also observe a positive link between the presence of collateral and risk premium on US companies. Turning to the control variables, a striking result is the negative and significant coefficient of *LnRelationshipLength* which shows that a longer length of the relationship between the bank and the borrower allows the borrower to benefit from a lower risk premium.

Table 7: collateral and risk premium: secured or not (OLS)

Variable	Coefficient	t-statistic
Intercept	0.038***	8.85
Collateral	0.005***	2.94
LnLoanSize	-0.768E-3	-1.21
LnRelationshipLength	-0.002***	-2.63
LnDuration	-0.880 <sup>E</sup> -3	-1.04
STFixed	-0.020***	-5.13
STVariable	-0.017***	-4.38
LTFixed	-0.018***	-5.93
LTVVariable	-0.019***	-5.09
Discount	-0.019***	-4.55
Adjusted R <sup>2</sup>	0.1524	
Condition Index	15.97	

Dependent variable is the risk premium. \*, \*\*, \*\*\* denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

It is also of utmost interest to investigate the type and the value of collateral as the loan characteristics may influence the link with risk premium. We then perform a second regression including dummy variables for each type of collateral. We observe the results in table 8, showing that three types of collateral are significant: guarantees from individuals, long-term assets other than mortgages, mortgages. Before commenting these results, one may wonder whether the inclusion of the value of the collateral is also linked to the risk premium. As a consequence, we also perform a third regression taking both type and value of collateral into account in table 8. We then consider the ratio of the initial value of each collateral on the loan amount (*GuaranteesIndividualsValue* and so on). The results support the second regression, as three variables are significantly positive: the ratios of guarantees from individuals, long-term assets other than mortgages, and mortgages to the loan amount.

How to explain this result? Our arguments are as follows. Following the observed-risk hypothesis, the bank is able to observe the risk of the borrower. As a

consequence, information asymmetries in favor of the borrower do not play a significant role in the decision of the bank to secure a loan. However, when a bank considers a borrower as risky, it requires from this borrower a greater loan rate and a collateral. Which collaterals to ask for? Collaterals appearing the most attractive for the bank are in descending order guarantees from individuals, mortgage, and to a lesser degree long-term asserts. Indeed these collaterals notably have the lowest volatility. The exception is guarantees from companies, which are also an attractive collateral for a bank. However this collateral can not be provided by the firm in many cases, while for instance a personal guarantee can always be provided. Consequently, banks ask for the most attractive collaterals from riskier companies, which are also charged with greater loan rates.

A striking observation is that we showed above that the most requested collaterals from riskier borrowers are not those which provide the greater recovered value for a given initial value. Therefore, bank behavior may seem somewhat “schizophrenic”. However, we argue that effective bank behavior is not based on the reality of the recovered value for each collateral, which is not known by the bank employees granting loans to SMEs, but is rather based on routine-minded behavior of these employees. This behavior may also come from the organizational structure of French banks in which commercial and recovery units are splitted.

In summary, our tests do not support the hypothesis of a collateral helping banks to solve adverse selection problems. They rather provide evidence in favor of the observed-risk hypothesis according to which banks charge greater loan rates and ask for collateral to riskier companies. It must be emphasized that these results are in accordance with Berger and Udell (1990), being the only work to our knowledge on this topic.

Table 8: collateral and risk premium: types of collateral (OLS)

Variable	Coefficient	t-statistic
Intercept	0.038***	8.90
GuaranteesIndividuals	0.005***	3.50
GuaranteesCompanies	0.203E-3	0.10
OtherCollaterals	0.002	0.82
CollateralsSTAssets	0.002	0.65
CollateralsLTAssets	0.004**	2.11
Mortgage	0.004**	2.21
LnLoanSize	-0.991E-3	-1.55
LnRelationshipLength	-0.002**	-2.10
Duration	-0.889 <sup>E</sup> -3	-1.07
STFixed	-0.018***	-4.69
STVariable	-0.017***	-4.39
LTFixed	-0.019***	-6.00
LTVVariable	-0.020***	-5.06
Discount	-0.019***	-4.59
Adjusted R <sup>2</sup>	0.1866	
Condition Index	17.54	

Dependent variable is the risk premium. \*, \*\*, \*\*\* denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

Table 9: collateral and risk premium: types and values of collateral (OLS)

Variable	Coefficient	t-statistic
Intercept	0.036***	8.90
GuaranteesIndividualsValue	0.004***	3.50
GuaranteesCompaniesValue	0.610 <sup>E</sup> -3	0.10
OtherCollateralsValue	0.145 <sup>E</sup> -3	0.82
CollateralsSTAssetsValue	0.002	0.65
CollateralsLTAssetsValue	0.004**	2.11
MortgageValue	0.003**	2.21
LnLoanSize	-0.458 <sup>E</sup> -3	-1.55
LnRelationshipLength	-0.002**	-2.10
LnDuration	-0.890 <sup>E</sup> -3	-1.07
STFixed	-0.018***	-4.69
STVariable	-0.017***	-4.39
LTFixed	-0.018***	-6.00
LTVVariable	-0.018***	-5.06
Discount	-0.020***	-4.59
Adjusted R <sup>2</sup>	0.1793	
Condition Index	17.03	

Dependent variable is the risk premium. \*, \*\*, \*\*\* denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

### 4.3 Does collateral solve moral hazard?

In this subsection, we concentrate on the possible role of collateral to alleviate moral hazard problems. The reasoning behind this theoretical argument is that collateral favors the alignment of the interests of the borrower on the interests of the bank. Our dataset allows us to have very sharp information on the presence of moral hazard. Indeed, it includes only distressed firms and provides exhaustive information on the causes of default. Consequently, we do not need to use some uncertain proxies for moral hazard but we rather define the occurrence of moral hazard according to the real causes of default.

To test the role of collaterals to reduce the probability of moral hazard, we rely on a binomial logit model. The explained variable is a dummy variable equal to one if the presence of moral hazard among the causes of default, and zero else. This variable is built from full information on the causes of default. Our database includes full descriptive information of the events which have led to default. Following theoretical literature on moral hazard, this debatable definition includes underinvestment, asset substitution and weak managerial effort. Consequently, we consider all the causes linked to these three items as a moral hazard case. Namely, we then take all the causes connected to the internal reasons of faulty management. These causes include fraud, firm strategy, and managerial underperformance. It has to be stressed that this argument is particularly relevant in the case of outside collaterals, since these collaterals extend the limited liability of the borrower to assets outside the firm.

The estimations are performed at the firm level, unlike former tests at the loan level, since we explain the causes of default of the firms. We include several control variables defined before. *LnRelationshipLength*, *LimitedLiability*, *UnknownRating*, *GoodRating*. We also include some variables for the type of loans. As we focus now on the firm level rather than on the loan level, we consider the share of each type of loan in the total of loans of the company. Namely *ShareOverdraft*, *ShareSTFixed*, *ShareSTVariable*, *ShareLTFixed*, *ShareLTVariable*, *ShareDiscount* respectively represent dummy variables equal to one if overdrafts, short-term loans with fixed rate, short-term loans with variable rate, long-term loans with fixed rate, long-term loans with variable rate, discounts, represent more than 50% of the total loans of the company.

In a similar approach than in the previous subsection, we present here three models testing respectively the presence, the type, and finally the type and the value of collateral. The explanatory power of the three logit models estimated here is quite satisfactory, with a percentage of concordant observations between 66.8% and 71.1%.

The first model tests whether a secured loan reduces the probability of moral hazard, by including a dummy variable (*Collateral*) equal to one whether the loan is secured or zero else. The results displayed in table 10 show no significant sign for *Collateral*, meaning that there is no significant impact on the occurrence of moral hazard when the loan is secured. This conclusion supports the role of both opposing arguments with respect to the relationship between moral hazard and the use of collateral. On the one hand, collateral is expected to reduce the problem of moral hazard by aligning borrower's interest on bank's interest. On the other hand, banks can sort borrowers from information they have on their quality and consequently they require higher collateral from the borrowers considered as risky. Moral hazard and observed-risk effects would then cancel each other out.

Table 10: collateral and moral hazard: secured or not (Logit)

Variable	Coefficient	Chi-Square
Intercept	-2.987***	6.91
Collateral	0.539	0.93
LnRelationshipLength	-0.010	0.01
LimitedLiability	1.563**	5.63
UnknownRating	0.705*	2.90
GoodRating	0.082	0.03
ShareOverdraft	0.056	0.01
ShareSTFixed	-5.534	2.51
ShareSTVariable	0.333	0.17
ShareLTFixed	0.064	0.01
ShareLTVariable	-0.419	0.30
ShareDiscount	-0.656	0.52
-2 log likelihood	209.550	
Association of prediction probabilities and observed responses		
Concordant	66.8	
Tied	1.6	

Dependent variable is a dummy variable taking the value of 1 when moral hazard is one of the causes of default, and 0 else. \*, \*\*, \*\*\* denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

The second model takes the type of collateral into account in table 11, by including dummy variables for each type of collateral. No collateral is not significant, except *GuaranteesIndividuals*, which is positive. It might appear as a surprising result, as we could have expected that the moral hazard effect would dominate the

observed-risk effect for outside collaterals. However, we showed above in the model explaining risk premium that only three types of collaterals are positively linked to risk premium, including guarantees from individuals. This result was in favor of the observed-risk hypothesis, supporting the view that banks request the most attractive collaterals from the riskiest borrowers to cover its risk. Therefore, following this line of reasoning, it is no surprise that if the presence of guarantees from individuals is positively associated to riskier borrowers, it is also linked with a greater probability of moral hazard.

Table 11: collateral and moral hazard: types of collateral (Logit)

Variable	Coefficient	Chi-Square
Intercept	-2.581**	5.46
GuaranteesIndividuals	0.640*	3.09
GuaranteesCompanies	-0.152	0.10
OtherCollaterals	0.026	0.01
CollateralsSTAssets	-0.665	1.40
CollateralsLTAssets	0.048	0.01
Mortgage	0.027	0.01
LnRelationshipLength	0.008	0.01
LimitedLiability	1.498**	4.57
UnknownRating	0.830*	3.70
GoodRating	0.109	0.05
ShareOverdraft	-0.314	0.11
ShareSTFixed	-5.652	2.37
ShareSTVariable	0.214	0.07
ShareLTFixed	-0.218	0.10
ShareLTVVariable	-0.627	0.60
ShareDiscount	-0.790	0.72
-2 log likelihood	204.832	
Association of prediction probabilities and observed responses		
Concordant	71.0	
Tied	0.5	

Dependent variable is a dummy variable taking the value of 1 when moral hazard is one of the causes of default, and 0 else. \*, \*\*, \*\*\* denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

Finally, the third model in table 12 considers the type and the nature of collaterals. As estimations take now place at the firm level, we sum collaterals per type for each firm (*LnTotalGuaranteesIndividualsValue...*). We find similar results than with the second model, as only the variable accounting for guarantees from individuals is positive and significant.

Turning to the control variables, we observe only two significant variables in all three models. First, *LimitedLiability* has a positive and significant sign, which result not surprisingly from the fact that firms with limited liability have more incentives to

adopt moral hazard behavior. Second, the sign of *UnknownRating* is significantly positive, which is unsurprising as a borrower considering that their bank is short of information on him is more inclined to adopt moral hazard behavior.

Furthermore, the lack of any significant sign for *LnRelationshipLength* is an interesting result, as it suggests that a longer length of the relationship between the bank and the borrower does not reduce the probability of moral hazard. This does not corroborate the view according to which a borrower with a longer length of the relationship with its bank would have fewer incentives to adopt a moral hazard behavior, because of his greater costs in terms of losing good lending conditions.

Table 12: collateral and moral hazard: types of collateral (Logit)

Variable	Coefficient	Chi-Square
Intercept	-2.703**	5.88
LnTotalGuaranteesIndividualsValue	0.118*	2.95
LnTotalGuaranteesCompaniesValue	0.013	0.02
LnTotalOtherCollateralsValue	-0.027	0.08
LnTotalCollateralsSTAssetsValue	-0.155	1.88
LnTotalCollateralsLTAssetsValue	-0.002	0.01
LnTotalMortgageValue	0.036	0.23
LnRelationshipLength	0.030	0.02
LimitedLiability	1.605**	5.25
UnknownRating	0.823*	3.63
GoodRating	0.130	0.07
ShareOverdraft	-0.223	0.06
ShareSTFixed	-5.901	2.43
ShareSTVariable	0.135	0.03
ShareLTFixed	-0.228	0.11
ShareLTVariable	-0.648	0.63
ShareDiscount	-0.875	0.86
-2 log likelihood	204.013	
Association of prediction probabilities and observed responses		
Concordant	71.1	
Tied	0.4	

Dependent variable is a dummy variable taking the value of 1 when moral hazard is one of the causes of default, and 0 else. \*, \*\*, \*\*\* denote an estimate significantly different from 0 at the 10%, 5% or 1% level.

Therefore, our estimations do not tend to support the role of collateral to solve the moral hazard problems. Indeed secured loans are not associated with a lower probability of moral hazard. Furthermore, moral hazard behavior is positively linked with loans secured with guarantees from individuals. The fact that moral hazard behavior is not positively associated with secured loans suggests nonetheless that an influence partly offset the observed-risk effect. We can not compare precisely these results to any other study, as we are not aware of any work on this specific topic.

Nevertheless, on a closely related issue, Jimenez and Saurina (2004) observed a greater probability of default for secured loans, supporting the observed-risk hypothesis.

## **5. Concluding remarks**

This research has analyzed empirically the motives of the use of collateral by banks provided by the theoretical literature. It is indeed of utmost importance to assess these motives, as there is a notable opposition between the effects expected by the theories based on information asymmetries and the common opinion of the bankers. Furthermore, there exists a lack of empirical evidence on this topic notably because of the deficit of satisfactory data. We used an impressive dataset of loans of distressed firms with exhaustive information on collaterals to provide new empirical evidence on this topic. Our main conclusions are as follows.

Does collateral reduce loan loss in the event of default? As expected, the answer is undoubtedly positive. Nonetheless, we show differences between the types of collaterals in terms of the recovered value for a given initial value. Namely, guarantees from companies, other collaterals, and mortgage are in descending order the collaterals which provide the greatest recovered value.

Does collateral solve adverse selection problems? Our answer is negative, in opposition with the theoretical argument of the collateral as a signalling instrument (Bester, 1985; Besanko and Thakor, 1987). Indeed, while this latter argument suggests a trade-off between risk premium and collateral, we show a positive relationship between collateral and risk premium. This supports the observed-risk hypothesis according to which banks can sort borrowers from information they have on their quality. As a consequence, banks would charge greater loan rates and ask more often for collateral to riskier companies.

Does collateral solve moral hazard? Our answer is rather negative. Secured loans are associated neither positively nor negatively with moral hazard behavior, suggesting that moral hazard and observed-risk effects cancel each other out. However the presence of outside collaterals does not reduce the probability of moral hazard behavior. It must be emphasized that the analysis by type of collateral shows

similarities in the types of collaterals requested by banks on loans with risky borrowers, proxied either by risk premium or moral hazard behavior.

In summary, our work provides two major conclusions. The first one is that two reasons motivate the request of banks for collateral: to reduce loan loss in the event of default, to secure loans granted to risky borrowers following the observed-risk hypothesis. The second one is that information asymmetries in favor of the borrower do not play a significant role in the decision of the bank to secure a loan. This latter conclusion may seem strong as it contrasts with the results of many theoretical works on the use of collateral (e.g. Bester, 1985; Chan and Kanatas, 1985; Besanko and Thakor, 1987, Boot, Thakor and Udell, 1991).

We can however provide three arguments in favor of our thesis. First, it is in accordance with the rare former works on this topic. Indeed while Berger and Udell (1990) also found that secured loans are associated with a greater risk premium, Jimenez and Saurina (2004) observed a higher probability of default for secured loans. Second, as notably mentioned by these both works, the perception of bankers tends to link the requirement of collateral with greater credit risk. Third, there exists a few theoretical works in favor of our results (Manove and Padilla, 1999; Manove and Padilla, 2001). Our results should however be considered with care as this issue needs further analysis.

## REFERENCES

- Berger A. and Udell G. (1990). "Collateral, Loan Quality, and Bank Risk", *Journal of Monetary Economics* 25, 21-42.
- Berger A. and Udell G. (1995). "Relationship Lending and Lines of Credit in Small Firm Finance", *Journal of Business* 68, 351-382.
- Besanko D. and Thakor A. (1987). "Collateral and Rationing: Sorting Equilibria in Monopolistic and Competitive Credit Markets", *International Economic Review* 28, 671-689.
- Besley, D., Kuh E. and Welsch, R. (1980). *Regression Diagnostics: Identifying Influential Data and Sources of Collinearity*, Wiley, New York.
- Bester H. (1985). "Screening vs. Rationing in Credit Markets with Imperfect Information", *American Economic Review* 25, 21-42.
- Boot A., Thakor A. and Udell G. (1991). "Secured Lending and Default Risk: Equilibrium Analysis, Policy Implications and Empirical Results", *Economic Journal* 101, 458-472.
- Chan Y. and Kanatas G. (1985). "Asymmetric Valuation and the Role of Collateral in Loan Agreements", *Journal of Money, Credit and Banking* 17, 85-95.
- Cowling M. (1999). "The Incidence of Loan Collateralization in Small Business Lending Contracts", *Applied Economics Letters* 6, 291-293.

- Davydenko S. and Franks J. (2004). "Do Bankruptcy Codes Matter? A Study of Defaults in France, Germany and the UK", Working Paper, London Business School.
- Galesne A. (1999). *Le Diagnostic Financier de l'Entreprise*, CEREFIA, Rennes.
- Gonas J., Highfield M. and Mullineaux D. (2004). "When are Commercial Loans Secured", *The Financial Review* 39, 79-99.
- Greenbaum S. and Thakor A. (1995). *Contemporary Financial Intermediation*. Dryden Press, Orlando.
- Hulburt H. and Scherr F. (2003). "Determinants of the Collateralization of Credit by Small Firms", *Managerial and Decision Economics* 24, 483-501.
- Jimenez G. and Saurina J. (2004). "Collateral, Type of Lender and Relationship Banking as Determinants of Credit Risk", *Journal of Banking and Finance* 28, 2191-2212.
- Leeth J. and Scott J. (1989). "The Incidence of Secured Debt: Evidence from the Small Business Community", *Journal of Financial and Quantitative Analysis* 24, 3, 379-393.
- Les Echos (2004). "Crédit: Le Retour en Grâce des PME", p.33, 25 october.
- Manove M. and Padilla A. (1999). "Banking (Conservatively) with Optimists", *Rand Journal of Economics* 30, 324-350.
- Manove M. and Padilla A. (2001). "Collateral versus Project Screening: A Model of Lazy Banks", *Rand Journal of Economics* 32, 726-744.

## APPENDIX: List of variables

Variable	Description
<b>Dependent variables</b>	
Loan loss ratio	Loan loss divided by loan amount
Risk premium	Risk premium, defined as the difference between the loan rate and a prime rate
Moral hazard	Dummy variable equal to 1 if moral hazard is one of the causes of default
<b>Collateral variables</b>	
Collateral	Dummy variable equal to 1 if the loan is secured
GuaranteesIndividuals	Dummy variable equal to 1 if the loan is secured with guarantees from individuals
GuaranteesCompanies	Dummy variable equal to 1 if the loan is secured with guarantees from companies
OtherCollaterals	Dummy variable equal to 1 if the loan is secured with other collaterals
CollateralsSTAssets	Dummy variable equal to 1 if the loan is secured with short-term assets
CollateralsLTAssets	Dummy variable equal to 1 if the loan is secured with long-term assets other than mortgage
Mortgage	Dummy variable equal to 1 if the loan is secured with a mortgage
GuaranteesIndividualsValue	Ratio of the initial value of guarantees from individuals on the loan amount
GuaranteesCompaniesValue	Ratio of the initial value of guarantees from companies on the loan amount
OtherCollateralsValue	Ratio of the initial value of other collaterals on the loan amount
CollateralsSTAssetsValue	Ratio of the initial value of short-term assets on the loan amount
CollateralsLTAssetsValue	Ratio of the initial value of long-term assets other than mortgage on the loan amount
MortgageValue	Ratio of the initial value of mortgage on the loan amount
LnGuarIndivInitial	Log of the initial value of guarantees from individuals
LnGuarCompInitial	Log of the initial value of guarantees from companies
LnOtherCollateralsInitial	Log of the initial value of other collaterals
LnSTAssetsInitial	Log of the initial value of short-term assets
LnLTAssetsInitial	Log of the initial value of long-term assets other than mortgage
LnMortgageInitial	Log of the initial value of mortgage
LnGuarIndivRecovered	Log of the recovered value of guarantees from individuals
LnGuarCompRecovered	Log of the recovered value of guarantees from companies
LnOtherCollateralsRecovered	Log of the recovered value of other collaterals
LnSTAssetsRecovered	Log of the recovered value of short-term assets
LnLTAssetsRecovered	Log of the recovered value of long-term assets other than mortgage
LnMortgageRecovered	Log of the recovered value of mortgage
LnTotalGuaranteesIndividualsValue	Log of the initial value of total guarantees from individuals
LnTotalGuaranteesCompaniesValue	Log of the initial value of total guarantees from companies
LnTotalOtherCollateralsValue	Log of the initial value of total guarantees from other collaterals
LnTotalCollateralsSTAssetsValue	Log of the initial value of total guarantees from short-term assets
LnTotalCollateralsLTAssetsValue	Log of the initial value of total guarantees from long-term assets other than mortgage
LnTotalMortgageValue	Log of the initial value of total guarantees from mortgage

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<b>Control variables</b>	
LnAge	Log of Age
LnRelationshipLength	Log of the length of the relationship bank-borrower
LnDuration	Log of the duration of the loan
LimitedLiability	Dummy variable equal to 1 if
Excess	Used amount to the initial granted amount of loan
lnEAD	Exposure at default (all the due amounts plus the discounted commitments)
LimitedLiability	Dummy variable equal to 1 if the legal status of the borrower includes limited liability
Group	Dummy variable equal to 1 if
UnknownRating	Dummy variable equal to 1 if the last internal rating estimated by the bank before the default of the borrower is unknown because of the lack of satisfactory information
GoodRating	Dummy variable equal to 1 if the last internal rating estimated by the bank before the default of the borrower considers the borrower as solvent
IssueRI	Dummy variable equal to 1 if the way of resolving the default is private renegotiation
IssueRA	Dummy variable equal to 1 if the way of resolving the default is monitored renegotiation
IssueCE	Dummy variable equal to 1 if the way of resolving the default is firm sale as a going concern
IssueCO	Dummy variable equal to 1 if the way of resolving the default is continuation
Overdraft	Dummy variable equal to 1 if
STFixed	Dummy variable equal to 1 if
STVariable	Dummy variable equal to 1 if
LTFixed	Dummy variable equal to 1 if
LTVVariable	Dummy variable equal to 1 if
Discount	Dummy variable equal to 1 if
FixedRate	Dummy variable equal to 1 if
ShareOverdraft	Share of overdrafts in the total of loans of the company
ShareSTFixed	Share of short-term loans with fixed rate in the total of loans of the company
ShareSTVariable	Share of short-term loans with variable rate in the total of loans of the company
ShareLTFixed	Share of long-term loans with fixed rate in the total of loans of the company
ShareLTVVariable	Share of long-term loans with variable rate in the total of loans of the company
ShareDiscount	Share of discounts in the total of loans of the company

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