

# Screening good borrowers: Evidence from the small business community

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## ABSTRACT

The current collapse of credit markets has left small and medium enterprises (SMEs) facing severe credit rationing. The practice of screening borrowers by risk level has become a paramount consideration for both lenders and firms. This paper represents the first empirical test of the screening role of loan contracts that consider collateral-interest margins simultaneously. For our empirical analysis, we use a unique data set composed of bank loans granted by 28 Spanish banks to SMEs. Our results suggest that by combining collateral appropriately with interest rate, borrowers with different risk levels are separated: high-risk borrowers accept loans without collateral and with high interest rates, whereas low-risk borrowers accept loans with real estate collateral and with low interest rates. Hence, we provide the first empirical evidence of the effectiveness of collateral as a screening mechanism, when it is adequately combined with interest rates.

**KEYWORDS:** Asymmetric Information, Collateral, Credit Risk, Incentive-Compatible Contracts, Screening Mechanisms

**JEL CLASSIFICATION:** D82, G21, G32, L26.

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## 1. INTRODUCTION

The current collapse of credit markets has left small and medium firms (SMEs) facing severe credit rationing, which erodes working capital and strongly influences the viability of investment projects. With credit markets frozen and borrowers competing for credit, the ability to screen borrowers by their risk level has become a paramount pursuit for both lenders and firms. From the lender side, mechanisms are needed to observationally sort equivalent loan applicants, and to mitigate adverse selection and moral hazard inefficiencies generated by imperfect information. From the borrower side, proper screening mechanisms reduce credit rationing, thus increasing good borrowers' access to credit.

Among the extant screening mechanisms, lenders may employ collateral requirements to achieve a separating equilibrium that reveals information that can resolve credit rationing.<sup>1</sup> In particular, Bester 1985b shows that lenders may offer a menu of contracts with different interest rates and collateral combinations that act as a firm self-selection mechanism. Applicants with lower-risk projects are willing to accept higher collateral at a lower premium, while those with higher-risk projects select unsecured debt at a higher premium. At such equilibrium, lenders are capable of indirectly distinguishing between borrowers of different risk levels, despite the imperfect information setting.<sup>2</sup>

Notwithstanding the relevance of the screening-mechanism implications, these models have never been empirically tested. We fill this gap by providing the first empirical test of the Bester (1985b) model, which also represents the first empirical test on the screening role of loan contracts that consider collateral-interest margins simultaneously. So far, the empirical literature has focused on the relationship between collateral and borrower risk, never on the relationship: collateral-interest margin and borrower risk. The literature<sup>3</sup> shows that secured lending is associated with risky borrowers (Orgler 1970; Hester 1979; Scott and Smith 1986; Leeth and

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<sup>1</sup> Much of the theoretical work on collateral and asymmetric information focuses on "outside" collateral, i.e., assets not owned by the firm; assets which the lender might otherwise not claim (see Chan and Kanatas 1985, Besanko and Thakor 1987, Chan and Thakor 1987, Deshons and Freixas 1987, Igawa and Kanatas 1990, Stiglitz and Weiss 1992). Only a very small number of papers deals with the role of "inside" collateral, i.e., assets of the business itself (see Smith and Warner (1979), Stulz and Johnson (1985), Swary and Udell (1988), and Gorton and Kahn (2000)). Here, we concentrate exclusively on outside collateral.

<sup>2</sup> A more detailed discussion of the theoretical literature can be found in Coco (2000).

<sup>3</sup> Berger and Udell (1998) offers a comprehensive review of the empirical literature.

Scott 1989; Berger and Udell 1990 and Berger and Udell 1992; Booth 1992; Jimenez and Saurina 2004). Only Cressy (1996), Machauer and Weber (1998), and Burke and Hanley (2006) find the opposite relationship, all on samples of SMEs.

The small business community's relationship with banks is strongly characterized by *ex ante* asymmetric information, leading to credit rationing and higher interest charges for small businesses, as compared to larger firms<sup>4</sup>. We thus concentrate on the small-firm credit market, differing from most of the empirical literature. We use a unique data set composed of bank loans to SMEs granted by 28 Spanish banks, which have the common attribute of being backed by the Spanish mutual guarantee institution (MGI),<sup>5</sup> Sociedad de Garantia Reciproca (SGR) Comunidad Valenciana.

Also, our unique data set on bank loans to SMEs gives us information, on a loan-by-loan basis, about the kind of collateral, the interest rate, the loan volume, the loan term, and more importantly, the *ex post* loan performance (e.g., whether the loan is repaid or defaults). Therefore, this data set allows us to use a more direct approximation for each borrower risk level (privately known to the borrower and, consequently, *ex ante* unobservable). The *ex ante* borrower risk is a difficult concept to measure in any empirical setting, precisely because it is privately known by the borrower. Some literature has used interest-rate premiums as proxies for borrower risk (Berger and Udell, 1990; Burke and Hanley, 2006), or "company age" or experience (Leeth and Scott, 1989; Cressy 1996), and some has concentrated on borrower credit rating (Hester, 1979; Machauer and Weber, 1998). Berger and Udell (1990), as a novelty in this kind of research, used loan performance on an *ex post* basis to corroborate their previous results; however, as the required data were not individually reported, they used aggregate data. Jimenez and Saurina, 2004, following Berger and Udell, 1990, also used a measure of *ex post* loan performance.

Thus, our second innovation comes from our data set. This data set allows us to focus on SMEs and to use the *ex post* loan performance on a loan-by-loan basis to proxy the *ex ante* borrower risk. We follow Berger and Udell (1990), who support the use of *ex post* loan performance since it is not affected by the monitoring cost of collateral. However, we use individualized rather than aggregate *ex post* performance measures. Only Berger and Udell (1990) and Jimenez and Saurina (2004) have had access to the *ex post* loan performance, but on loans to larger firms.

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<sup>4</sup> Small firms do not typically have audited financial statements, and are unlikely to be monitored by rating agencies or the financial press. Further, the evaluation of small borrower creditworthiness does involve fixed costs that turn out to generally be high.

<sup>5</sup> MGI stands for mutual guarantee institution. We use Zecchini and Ventura (2009) notation.

Further, the sample period covers an entire economic cycle (from 1982 to 1998), which includes both recessions and growth periods (it even captures the last years of the oil crisis and the subsequent period), which allows us to ensure the robustness of our results despite the effects of trends in interest rates, economic growth, and credit rationing.

Another important issue regarding SMEs and the screening models is overconfidence. Businesspersons may tend to overestimate their own probability of success or their own entrepreneurial skills and experience (see, for instance, De Meza and Southey, 1996; Camerer and Lovo, 1999; Arenius and Minniti, 2005). However, an implicit assumption of the theoretical models we test is that borrowers can correctly assess their *ex ante* (project) risk while choosing a particular contract type. If there are optimistic borrowers who underestimate their chances of going bankrupt, they will borrow at the higher collateral and lower premium contract, but they will probably default. Subsequently, no screening would be found in our analysis, as we use *ex post* loan performance (e.g., whether the loan is repaid or defaults) as borrower risk proxy. However, if screening does occur, overconfidence will be found not to be strong enough to rule out the screening mechanism of contracts combining appropriate pairs of collateral and interest rates.

Empirical testing, thus far, has not addressed this question. Therefore, as our third innovation, we provide empirical evidence on the robustness of this screening mechanism against SMEs overconfidence. We are able to test whether overconfidence affects screening as a result of the use of the *ex post* loan performance proxy.

To empirically test the Bester model, we run a logit model where the dependent variable is defined as the type of contract, and the independent variable is the *ex ante* unobservable borrower risk. We also control for factors such as firm size, firm legal form, loan term, and loan maturity. Our dependent variable is a binary variable that incorporates two types of contracts: one with real estate “outside” collateral and a low interest rate, and the other with no collateral and a high interest rate. The hypothesis to be tested is whether this menu of contracts allows screening of borrowers with respect to their *ex ante* unobservable risk.

Our results suggest that by combining collateral appropriately with interest rate, borrowers with different risk levels are separated; and the high-risk borrowers accept loans without collateral and with high interest rates. On the other hand, the low-risk borrowers accept loans with strong collateral and low interest rates. This constitutes the first empirical evidence on the effectiveness of collateral as a separating mechanism when it is adequately combined with interest rates.

The evidence does not contradict the existence of adverse selection or moral hazard effects triggered by collateral, as described by Stiglitz and

Weiss (1981) and Wette (1983), but it indicates that when collateral is appropriately combined with interest rate, it proves to be an excellent screening mechanism for borrowers characterized by differing risk levels.

Our results also suggest that overconfidence among SME entrepreneurs is not strong enough to overcome the screening mechanism of contracts combining appropriate pairings of collateral and interest rates.

In the next section, our theoretical model and hypotheses are presented. In Section 3, the database and methodology are described. We present our results in Section 4. Section 5 summarizes our main conclusions.

## 2. THEORETICAL MODEL AND CONTRAST HYPOTHESIS

Our analysis follows the Bester (1985b) model. It considers a credit market with  $N_i$  risk neutral firms, which can either be type  $i = a$  or  $b$ , according to their project risk level. Each firm has the possibility of starting a project that requires an initial fixed investment  $I$ . The return on the project for firm  $i$  is given by the random variable  $\tilde{R}_i$ , with  $0 \leq \tilde{R}_i \leq R_i$  and a distribution function  $F_i(R) > 0$  for all  $R > 0$ . As in Rostchild and Stiglitz (1970) and Stiglitz and Weiss (1981),  $\tilde{R}_b$  has a greater risk than  $\tilde{R}_a$  according to the second order stochastic dominance criterion. The firms have initial wealth  $W < I$ , which together with a loan  $B = I - W$ , finances the project. Given the size of the loan,  $B$ , a credit contract  $\gamma = (r, C)$  is specified by interest rate  $r$  and collateral  $C$ . Potential borrowers may face collateralization costs assumed to be proportional to the amount of collateral. When  $C > (1+r)B$ , the firm does not admit project failure. Therefore, only contracts with  $C \leq (1+r)B$  are considered. It is assumed that firm  $i$ 's project fails if  $C + R_i < (1+r)B$ ; this becomes observable only after a firm declares project failure. If this happens, the bank becomes the owner of the investment project and its returns. Thus, the expected profit from the project for firm  $i$  and a credit contract  $\gamma$  is given by:

$$\Pi_i(\gamma) = E\{\max[\tilde{R}_i - (1+r)B - kC, -(1+k)C]\}. \quad [1]$$

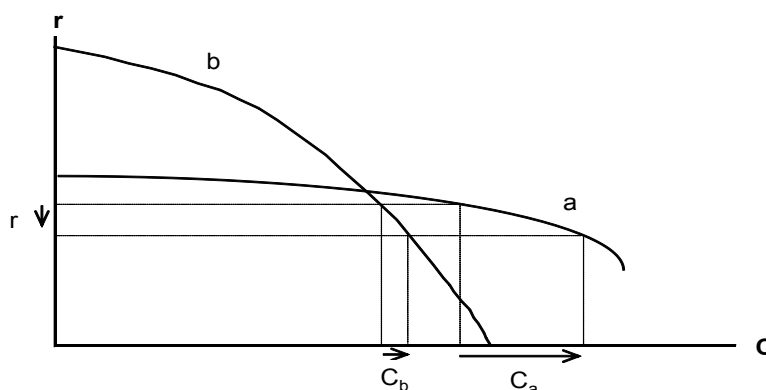
Banks cannot screen borrowers by risk; however, they can screen them by offering a pair of contracts  $(\gamma_\alpha, \gamma_\beta)$  that are incentive-compatible and act as self-selecting mechanisms. The pair  $(\gamma_\alpha, \gamma_\beta)$  is incentive-compatible if:

$$\Pi_a(\gamma_\alpha) \geq \Pi_a(\gamma_\beta); \quad \Pi_b(\gamma_\beta) \geq \Pi_b(\gamma_\alpha) \quad [2]$$

Firm  $i$  will invest only if it receives a loan  $\gamma$  such that  $\Pi_i(\gamma) > (1 + \pi)W$ . So long as a pair of contracts  $(\gamma_\alpha, \gamma_\beta)$  is offered, the firm prefers a contract that maximizes its expected profits. Thus, if preferences of potential borrowers depend systematically on their risk levels, banks can utilize a menu of contracts with different collateral requirements as self-selection mechanisms. In order to solve the problem of adverse selection, Bester (1985) concludes that low-risk firms try to differentiate themselves from high-risk firms by accepting higher collateral, as collateral is costly. Thus, collateral serves to reveal the riskiness of an entrepreneur's project.

The isoprofit curves for the two types of loan applicants are depicted in Figure 1. Applicant  $b$ 's isoprofit curve has a steeper slope than applicant  $a$ 's, because applicant  $b$ 's project is riskier and, by stochastic dominance of second degree, profits are a convex function of realized returns ( $R$ ). This means that type  $a$  firms are inclined to accept a higher increment in collateral for a given reduction in interest rates than type  $b$  firms. This fact makes it possible for the bank to offer different pairs of incentive-compatible contracts.<sup>6</sup>

**Figure 1. Separating Equilibrium for  $(\gamma_\alpha, \gamma_\beta)$**



More specifically, Bester states that low-risk firms are more inclined to accept an increase in collateral requirements for a given reduction in interest rate than are high-risk firms, since banks decide upon the interest rate and the collateral of their contracts simultaneously rather than separately.

In accordance with this framework, a menu of two incentive-compatible contracts could be defined. One contract would be characterized by a combination of low collateral and a high interest rate, and the second would be characterized by a combination of high collateral and a low interest rate. Bester states that between two such contracts, lower-risk borrowers tend to accept the second contract, and higher-risk borrowers tend to accept the first one.

The hypothesis to be tested is thus whether rewarding high “outside” collateral with a lower interest rate enables screening for lower-risk borrowers.

### **3. EMPIRICAL ANALYSIS—SAMPLE AND METHODOLOGY**

To empirically test the Bester (1985b) model and to gauge the screening capability of loans characterized by a particular combination of collateral

<sup>6</sup> In Bester (1985b), self-selection results from stronger assumptions than in Stiglitz and Weiss (1981). To produce a separating equilibrium, the additional assumption that  $F_1(R) > 0$  for all  $R > 0$  is needed. With this assumption, it is possible to have a monotonic relationship between risk and borrower preferences.

and interest rate, we run a logit model where the dependent variable is defined as the menu of contracts analyzed in Bester and the independent variable is borrower risk level.

To depict the menu of contracts, we define two contract types: Contract  $C_1$ , characterized by a combination of no collateral and a high interest rate spread, and Contract  $C_2$  characterized by a combination of real state “outside” collateral and a low interest rate spread. We define interest rate spread as the difference between each loan initial interest rate and the legal interest rate in that period as disclosed in the Bank of Spain Bulletin. High and low interest rate spread are defined, respectively, as spreads whose variations are at least  $\pm 2\%$  from the legal interest rate. Loans with an intermediate rate of interest and those with surety guarantee are excluded since our aim is to address theoretically incentive-compatible contracts. If the Bester model applies, lower-risk borrowers will accept  $C_2$  contracts more frequently, and higher-risk borrowers will accept  $C_1$  contracts.

We use data on 323 anonymous bank-loan contracts granted by 28 Spanish banks to SMEs for the period 1982–1998. Thus, the sample period covers an entire economic cycle (from 1982 to 1998) with both recession and growth periods (it even captures the last years of the oil crisis and the subsequent period), which allows us to ensure the robustness of our results despite the effects of trends in interest rates, economic growth, and credit rationing. Data are provided by SGR Comunidad Valenciana, an MGI that provides banks with guarantees against their loans to SMEs. All loans correspond to PLCs, limited liability companies, and sole proprietors. Among the loans, there are 172 that combine real state collateral with a low rate of interest (Contract  $C_2$ ) and 151 that combine no collateral with a higher interest rate (Contract  $C_1$ ).

To test the Bester model, we define our dependent variable, contract type, as a binary variable that takes the value 1 for Contract  $C_1$ , and the value 0 for Contract  $C_2$ . To proxy the *ex ante*, i.e., privately known, borrower risk we use the known *ex post* loan performance, which is available in our data set. Thus, the explanatory variable, *ex post* loan performance, is measured by *Risk*, a dummy variable that takes the value 1 for non-defaulted loans, and 0 for defaulted ones. Our definition of defaulted loans includes any non-performing loan, not only legal insolvency, i.e., non-performing loans (90 days), and doubtful loans.

The *ex ante* borrower risk is a difficult concept to measure in any empirical setting, precisely because it is privately known by the borrower. However, as Berger and Udell (1990) point out, the advantage of using the *ex post* loan performance as a proxy (instead of interest rate premium) is that it is not affected by the monitoring cost of collateral.

We also control for factors such as loan size (*Lsize*), loan maturity (*Lterm*), loan destination (*Ldest*), firm size (*Fsize*), and firm legal form (*Firmtype*(1))

and *Firmtype(2)*). All these factors have been found to affect the level of *ex ante* borrower risk (Hester 1979; Leeth and Scott 1989; Berger and Udell 1990; Machauer and Weber 1998).

Therefore, our proposed model is defined as:

$$\begin{aligned} \text{Contract}_{it} = & \beta_0 + \beta_1 \text{Risk}_{it} + \beta_2 \text{Lsize}_{it} + \beta_3 \text{Lterm}_{it} + \beta_4 \text{Ldest}_{it} + \\ & + \beta_5 \text{Fsize}_{it} + \beta_6 \text{Firmtype}(1)_{it} + \beta_7 \text{Firmtype}(2)_{it} + \varepsilon_{it} \end{aligned} \quad [3]$$

where *Contract<sub>it</sub>* and *Risk<sub>it</sub>* stand for the type of contract and project risk (as defined above), *Lsize<sub>it</sub>* is measured by local currency, *Lterm<sub>it</sub>* is measured in months, *Ldest<sub>it</sub>* is measured by a binary variable that takes the value 0 when the loan is used to start a new business, and 1 otherwise; *Fsize<sub>it</sub>* is measured by the number of employees in the firm, and firm legal form is defined by three different dummy variables, *Firmtype*, *Firmtype(1)* and *Firmtype(2)*, as follows: *Firmtype(1)* is a binary variable that is given the value 1 for sole proprietors, and 0 for limited liability companies and for PLCs; *Firmtype(2)* stands for a binary variable that is given the value 1 for limited liability companies, and 0 for sole proprietors and for PLCs; and *Firmtype* is defined as a dummy variable that takes the value 0 for sole proprietors, 1 for limited liability companies, and 2 for PLCs, and is used strictly for the analysis of variance.

Finally, to test whether the logit function is robust against a change in the sample, the total sample is disaggregated into estimation and validation subsamples. The estimation subsample is composed of formalized loans from January 1, 1983 to May 31, 1998 and consists of 172 loans of Contract *C<sub>2</sub>* and 131 loans of Contract *C<sub>1</sub>*. The validation subsample is composed of 20 loans formalized in 1982, all characterized by no collateral and high interest rate. The choice of estimation subsample was determined by the convenience of using a balanced sample in terms of the number of each contract type.

#### 4. EMPIRICAL RESULTS

Our results are conclusive. By appropriately combining collateral with interest rate, borrowers with different risk levels are disaggregated: high-risk borrowers accept loans without collateral and with high interest rates; low-risk borrowers accept loans with real state asset collateral and with low interest rates. Hence, we provide the first empirical evidence on the effectiveness of collateral as a disaggregating screening mechanism when it is adequately combined with interest rate, as modeled in Bester (1985b). The results of the logit estimation, as shown in Table 1, clearly highlight the efficacy of the screening mechanism, since the selected menu of contracts allows screening borrowers according to their *ex ante* unobservable risk. The coefficient of *Risk* clearly shows that Contract *C<sub>2</sub>* loans have no default problems, despite the higher observed risk. This



result is also shown in the analysis of variance (see Table 2). In contrast, loans without collateral and with high interest rates have a high probability of default.

However, in line with the empirical literature, strong collateral is related to loans with higher *ex ante* observed risk: When loan characteristics cause lenders to expect a higher default risk, loans are formalized with real state asset collateral.

**Table 1. Test of the combination collateral-interest rate; logit results.**

The estimation sample consists of 303 loans to SMEs guaranteed by Spanish SGRs from 1983 to 1998 (1982 is used only for the validation subsample). *Contract* is the endogenous variable, which takes the value 1 for a loan contract formalized with no collateral and high interest rate, which is labeled  $C_1$  (172 observations), and takes the value 0 for a contract combining real state asset collateral with a low rate of interest, which is labeled contract  $C_2$  (131 observations). The exogenous dummy variables *Ftype(1)*, *Ftype(2)*, *Aim* and *Risk* are given the value 1 in the case of sole proprietors and PLCs, investments not corresponding to the set-up of a new company, and in cases of non-repayment, respectively. Variable *Fsize* is firm size, measured as number of employees, *Lsize* and *Lterm* represent loan size (in euros) and loan term (in months), respectively. The table shows coefficient values and Wald statistics (in parentheses). \*\*\* indicates significance at the 1% level.

Variable	Coefficient and Wald Test
Const.	6.2632*** (25.7214)
<i>Ftype(1)</i>	-1.8117*** (9.2702)
<i>Ftype(2)</i>	-2.3273*** (19.9488)
<i>Fsize</i>	0.0285*** (18.5548)
<i>Lsize</i>	-7.2E-08*** (12.8514)
<i>Lterm</i>	-0.0697*** (39.8156)
<i>Aim</i>	2.2157*** (9.0362)
<i>Risk</i>	-2.5857*** (9.6724)
Likelihood Test	238.690***
Cox-Snell $R^2$	0.545
Nagelkerke $R^2$	0.7341
Correct classification	89.11% of estimation sample 100% of validation sample

**Table 2. Test of the combination collateral-interest rate.**

Results of the normality and homoskedasticity tests and analysis of the variance are shown for both kinds of contract. *P*-values in parentheses. *Ftype*(1), *Ftype*(2), *Aim* and *Risk* are dummy variables that are given the value 1 in the case of sole proprietors, PLCs, investments not corresponding to the set-up of a new company, and in cases of non-repayment, respectively. *Fsize* is firm size, and is measured by number of employees, *Lsize* and *Lterm* represent loan size (in euros) and loan term (in months), respectively. \* Correction of the significance of Lilliefors. \*\*Standard deviations are in parentheses. \*\*\*Level of significance is in parentheses.

Exogenous variables	1.1. Normality and Homoskedasticity Test			1.2. Analysis of Variance		
	Kolmogorov-Smirnov* Contract C <sub>2</sub>	Kolmogorov-Smirnov* Contract C <sub>1</sub>	Levene's Test	Mean** Contract C <sub>2</sub>	Mean** Contract C <sub>1</sub>	F***
<i>Ftype</i>	0.277 (0.000)	0.332 (0.000)	37.681 (0.000)	0.86 (0.67)	1.25 (0.86)	20.181 (0.000)
<i>Ftype</i> (1)	0.439 (0.000)	0.454 (0.000)	1.398 (0.238)	0.31 (0.46)	0.28 (0.45)	0.347 (0.556)
<i>Ftype</i> (2)	0.353 (0.000)	0.491 (0.000)	95.316 (0.000)	0.52 (0.50)	0.20 (0.40)	40.61 (0.000)
<i>Fsize</i>	0.270 (0.000)	0.197 (0.000)	46.940 (0.000)	17.39 (28.31)	40.39 (43.61)	32.08 (0.000)
<i>Lsize</i>	0.152 (0.000)	0.209 (0.000)	11.066 (0.001)	20,314.76 (14,756.79)	11,666.12 (12,481.,76)	31.712 (0.000)
<i>Lterm</i>	0.318 (0.000)	0.154 (0.000)	27.274 (0.00)	80.51 (18.8)	46.99 (22.0)	213.944 (0.000)
<i>Aim</i>	0.520 (0.000)	0.541 (0.000)	36.775 (0.000)	0.87 (0.34)	0.96 (0.20)	8.234 (0.004)
<i>Risk</i>	0.536 (0.000)	0.434 (0.000)	573.073 (0.000)	0.98 (0.13)	0.68 (0.47)	64.432 (0.000)

Our results also suggest that overconfidence among SME entrepreneurs is not strong enough to overcome the screening mechanism of contracts that combine appropriate pairs of collateral and interest rates, since the separation of borrowers into two different contracts is clear-cut.

With respect to goodness of fit, Table 1 shows that all the coefficients are significantly different from zero. The joint significance of the model is high when determining the probability of providing collateral combined with a low rate of interest, as shown by the value of the Chi-square statistic. As to

the robustness check, the validation of the model is very high, as shown by the high percentage of loans correctly classified according to estimated probability (89.11%). The model correctly classified 270 of 303 analyzed loans.<sup>7</sup> Hence, this menu of contracts enables correct screening of borrowers by risk level, clustering those with lower risk in Contract  $C_2$ .

Other insights on the characterization of firms by contract type can be drawn. Table 1 shows that a loan with real state collateral and low interest rate is more likely the longer the loan term ( $Lterm$ ), the larger the loan size ( $Lsize$ ), and the lower the number of employees in the firm ( $Fsize$ ). This happens particularly when the borrower is a sole proprietor or a company (PLC) and when the money is invested in a start up business. All these results are reinforced by the analysis of variance shown in Table 2.<sup>8</sup>

Table 2 shows that each of the exogenous variables clearly differentiates the two types of contract, except  $Firmtype(1)$ . Interestingly, the  $Risk$  coefficient shows that 98% of Contract  $C_2$  borrowers repay their loans (only 2% of loans defaulted), whereas loans without collateral and with high interest rate show a much higher default rate, 32%.

Most of the SMEs willing to borrow at Contract  $C_2$  (real state external collateral and low interest rate) are limited companies and sole proprietors. PLCs have a greater presence in the Contract  $C_1$  group (no collateral and higher interest rate), as shown by the mean values of the variables  $Firmtype$ ,  $Firmtype(1)$  and  $Firmtype(2)$ . Moreover, Contract  $C_2$  is held by SMEs with smaller numbers of employees, higher mean loan terms and higher loan sizes than SMEs with Contract  $C_1$ . Regarding loan destination, the weight of loans for business start-ups is higher in Contract  $C_2$  (13% of total loans in this group, whereas they represent only 4% of Contract  $C_1$  loans).

Additionally, Table 2 shows the low impact of overconfidence on our results. This is another advantage of using *ex post* loan performance as a proxy for *ex ante* borrower risk. An implicit assumption of the theoretical models we are testing is that borrowers can correctly assess their *ex ante* risk while choosing a particular contract type. However, borrowers might overestimate their probability of success or their entrepreneurial skills and experience (see for instance De Meza and Southey, 1996; Camerer and Lovo, 1999; Arenius and Minniti, 2005). If there were optimistic SME entrepreneurs who underestimated their chances of going bankrupt and who

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<sup>7</sup> A 100% correct classification in the validation sample was obtained. In addition, there is a low correlation among the variables in the final solution. Results are available from the authors upon request.

<sup>8</sup> Implicit hypotheses of the analysis of variance with one factor were tested, as shown in Table 2. Only  $Firmtype(1)$  presents equal variance in the two types of loans. However, the lack of homogeneity of variance affects the F statistics if the ratio of the larger sample size to the smaller one is above 2; in this case it is 1.13.  $Firmtype$ ,  $Firmtype(1)$ ,  $Firmtype(2)$ ,  $Ldest$  and  $Risk$  are categorical, which requires caution in the interpretation of the F statistics.

were willing to provide the required collateral, they would choose Contract  $C_2$ , but they would be very likely to default. This would negatively impact the screening results. However, as these two contracts screen borrowers of different risk level, overconfidence is found to be non-significant in this screening model.

## 5. CONCLUSIONS

Inspired by the theoretical models on credit markets with asymmetric information that show that borrower preferences among different interest-collateral combinations systematically depend on their risk levels, we have conducted the first empirical test on the screening role of collateral-interest rate combinations in bank-loan contracts.

We have analyzed a unique data set on bank loans to Spanish SMEs backed by a Spanish MGI. Consistent with the screening theory, our results suggest that by combining collateral appropriately with interest rate, borrowers with different risk levels are separated and the higher-risk borrowers are clustered in unsecured loans (no-collateral) with high interest rates. On the other hand, lower-risk borrowers tend to accept loans characterized by high real state external collateral and low interest rates. Hence, we provide the first empirical evidence on the effectiveness of collateral as a screening mechanism when it is adequately combined with interest rates. Our results support the theoretical conclusions with respect to collateral of Bester (1985b, 1987), Chan and Kanatas (1985), Besanko and Thakor (1987), Deshons and Freixas (1987), Igawa and Kanatas (1990), and Stiglitz and Weiss (1986, 1992).

Also, the *ex post* loan performance proxy used has allowed us to observe that overconfidence does not overcome the screening mechanism of contracts combining appropriate pairs of collateral-interest rates.

Our evidence does not contradict the existence of adverse selection or moral hazard effects triggered by collateral, as described by Stiglitz and Weiss (1981) and Wette (1983), but it does indicate that when collateral is appropriately combined with interest rate, it becomes an excellent screening mechanism for borrowers characterized by different risk levels. Though our sample is only composed of Spanish data, our results are easily applicable to most credit markets.

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