Loan Characteristics and Credit Risk

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1. Introduction

The aim of this study is to analyse the impact that certain characteristics of loans (i.e. collateral, maturity, size, type of lender and closeness of the customer-bank relationship) have on default rates. The aim is to compare the alternative hypotheses proposed by the various theoretical models, given that there is only scant empirical evidence relating to them, and that it tends to be limited primarily to the case of the United States[1]. This study uses information on the more than three million loans entered into by Spanish credit institutions over a complete business cycle (1988 to 2000) collected by the Bank of Spain's Credit Register (*Central de Información de Riesgos*, CIR). In addition to its academic interest, the result of this study may be of use to banking supervisors interested in monitoring institutions' credit risk and banking regulators that wish to link capital requirements and provisions more closely to the risk actually incurred by institutions.

The impact of collateral on credit risk is a subject that has raised a good deal of debate. From the theoretical perspective there are two alternative interpretations that lead to different empirical predictions. On the one hand, the collateral pledged by borrowers may help attenuate the problem of adverse selection and of moral hazard faced by the bank when lending (Stiglitz and Weiss (1981), Bester (1985), Chan and Kanatas (1985), Besanko and Thakor (1987a, b) and Chan and Thakor (1987)). Lower risk borrowers are willing to pledge more and better collateral, given that their lower risk means they are less likely to lose it. Thus, collateral acts as a signal enabling the bank to mitigate or eliminate the adverse selection problem caused by the existence of information asymmetries between the bank and the borrower. Freixas and Rochet (1997) find that high risk borrowers do not need to post collateral, whereas low risk ones do, in exchange for lower interest rates. Similarly, the collateral pledged helps align the interests of both lenders and borrowers, avoiding a situation in which the borrower makes less effort to ensure the success of the project for which finance was given. Thus, collateral makes it possible to limit the problem of the moral hazard faced by all banks when they lend money. Collateral can therefore be seen as an instrument ensuring good behaviour on the part of borrowers, given the existence of a credible threat (Aghion and Bolton (1992), Gorton and Khan (1993) and La Porta et al (1998)). On the basis of the two arguments outlined above, on the empirical level one would expect to see a negative relationship between collateral and default such that the lowest risk borrowers are those that provide most collateral.

Nevertheless, the situation described above seems to be contrary to the general perception among bankers, who tend to associate the requirement for collateral with greater risk[2]. Saunders (1997) claims that the best lenders do not need to post collateral as their credit risk is small. There are also theoretical arguments (Manove and Padilla (1999, 2001)) supporting the possibility that more collateral entails more non-performing loans (*ex post* credit risk) or greater probability of default (PD or *ex ante* credit risk). Firstly, if banks are protected by a high level of collateral they have less incentive to undertake adequate screening and monitoring of borrowers. Secondly, there are optimistic businessmen who underestimate their chances of going bankrupt and who are willing to provide all the collateral they are asked for in order to obtain finance for their projects. The empirical prediction in this case is that there

[1] Although the corporate finance literature on the impact of the characteristics of corporate bonds is extensive, bank credit has received much less attention.

[2] This study focuses on credit risk analysis in companies. It is possible that default in the case of lending to households may depend inversely on the existence of collateral due to the fact that mortgage lending generally has lower default rates and constitutes a very large proportion of borrowing by households.

should be a positive relationship between the pledging of collateral and default by borrowers[3].

The empirical evidence shows collateralised loans to be subject to greater risk (Orgler (1970), Hester (1979), Scott and Smith (1986), Berger and Udell (1990, 1992), Booth (1992), Booth and Chua (1996), Angbazo et al (1998) and Klapper (1998)). All these studies were limited to the US loan market.

The maturity of the loan can also affect the likelihood of default (PD). The longer the maturity, *ceteris paribus*, the greater the risk of the borrower's encountering problems (Jackson and Perraudin (1999)). Flannery (1986) argues that maturity is an alternative mechanism for solving the problems of adverse selection and moral hazard in credit relationships. Thus, in a situation of asymmetric information, an insider who knows that his company has high credit quality prefers to borrow short term rather than be penalized for long-term borrowing, where outsiders' uncertainties are greater and consequently the risk premium is higher. Lower risk borrowers will therefore choose short-term finance, signalling that they are good risks. Thus, the shorter the maturity the lower the risk.

Additionally, on the theoretical level the loan maturity may be considered to be a feature providing a solution to information problems and enabling the lender to impose greater discipline on the borrower. Berger and Udell (1998) view the loan maturity as an extreme type of covenant. In this way if the time horizon is short, the bank can renegotiate the conditions of the loan. In a similar vein to Manove and Padilla's argument (2001), that there is a substitutability between collateral and the thoroughness of the screening, this trade-off may also be considered to hold in the case of the maturity: shorter term loans receive less thorough screening or, on the contrary, longer-term ones will be lower risk, *ex post*, as they will have been evaluated in more detail.

As in the case of collateral, the theoretical arguments are not conclusive. The empirical evidence is ambiguous. The credit risk and maturity have been found to be negatively related (Berger and Udell (1990)), to have no significant relationship (Booth (1992)) and to be positively related (Angbazo et al (1998)).

The size of the loan, which in most cases is directly related to the size of the borrower, the age of the company, or the age of the length of the bank-borrower relationship, can also be an indicator of credit risk. Smaller loans tend to involve small or newly created companies, whose risk is greater and, therefore, whose loans will be subject to higher rates of default. By contrast, loans to large companies tend to be lower risk due to their generally greater financial solidity. Additionally, large scale loans tend to undergo much more rigorous screening, thus resulting in a lower level of credit risk. The available evidence (Berger and Udell (1990) and Booth (1992) supports these arguments.

It is possible that there are interactions between several characteristics of loans. Indeed, empirical evidence (Berger and Udell (1995), Leeth and Scott (1989) and Harhoff and Korting (1997)) shows that small companies, which are more opaque in information terms than large ones, provide more collateral to secure their loans. In this case the effect of size is

[3] In the context of moral hazard, Boot et al (1991) also find that riskier borrowers pledge more collateral. Rajan and Winton (1995) predict that the amount of collateral pledged is directly proportional to the borrower's difficulties with repayment.

added to the effect of the collateral to obtain a positive empirical relationship between collateral and the credit risk, and a negative relationship between size and default.

What role is played by different types of institution in the credit risk incurred by borrowers? Carey et al. (1998) find that specialist finance firms are more willing than banks to lend to riskier borrowers. There is considerable literature on the incentives of savings banks to adopt credit policies that differ from those of banks in terms of levels of risk. In general, what has been found is that institutions controlled by shareholders have greater incentives to take on more risk than those controlled by managers due to the fact that the latter have invested specific human capital or that they can appropriate private profits (Saunders et al (1990), Esty (1997a and b) and Leonard and Biswas (1998), Gorton and Rosen (1995) being an exception). The information available allows us to compare the differences between credit risk in loans involving private banks, savings banks, which we can assimilate to institutions in which managers have full control, credit cooperatives, which are closer in structure to mutual societies, and finally, credit finance establishments, which provide special-purpose credit (for example car purchase finance, consumer credit, leasing, factoring, etc.) but do not take deposits from the public.

Finally, another issue, which has aroused a considerable amount of interest in the literature, is the role of the bank-customer relationship in credit risk. A close relationship between the bank and the borrower enables the bank to obtain extremely valuable information about the latter's economic and financial situation. Non-financial companies can benefit from close relationships with banks through easier access to credit, in terms of both the amount of credit they can obtain and how much it costs them, the protection they have during recession and even an implicit insurance of the cost of finance (Petersen and Rajan (1994) and Berger and Udell (1995)). The close bank-customer relationship may produce informational rents for the bank (Sharpe (1990) and Rajan (1992)) enabling it to exercise a certain degree of market power in the future, provided the environment is not excessively competitive (Petersen and Rajan (1995)). In this context, banks may be prepared to finance riskier borrowers (with higher default rates *ex post*) if they can subsequently offset this higher default rate by applying higher interest rates to the surviving companies.

Empirically, one might expect that the more a bank develops its relationship lending strategy the greater the rate of default on its lending to firms. The closer the relationship between the bank and the borrower, the greater the likelihood of default. By contrast, when a firm has a relationship with several banks, none of them can monopolize their information on the borrower's quality, and so they cannot extract rents, thus considerably diminishing the incentives to finance higher-risk borrowers[4]. The strength of the customer-bank relationship can be approximated by the number of institutions providing finance for the borrower, the percentage of the borrower's finance that each institution provides, or the duration of the relationship.

This study analyses the impact of the characteristics of credit loans on default rates by seeking to distinguish between a number of theoretical possibilities. The international empirical literature has largely focused on the US case. It is therefore of interest to examine whether the results obtained also apply to Spain, a country whose financial system is dominated by credit institutions, and where retail banking predominates and savings banks play an important and increasing role.

[4] However, in the case of Italy, Foglia et al. (1998) find that relationships with multiple banks is associated with greater borrower risk, and D'Auria et al. (1999) find it to be associated with higher rates of interest.

The Credit Register information used here is based exclusively at the transaction or loan level, not at that of borrowers. The approach used is the same as that of Hester (1979), Scott and Smith (1986), and Berger and Udell (1990 and 1992). A given borrower may enter into several loans with the same bank or with different banks. As some characteristics of the loans cannot readily be aggregated for a given borrower (maturity, collateral, type of instrument), to distinguish their impact it is essential to perform the analysis at the level of each loan. As well as being problematic, aggregation of loan characteristics of a single borrower might distort the conclusions.

The CIR's information on the characteristics of each loan may be used to construct approximate measures of the probability of default (PD) on each loan. These characteristics include the amount or size of the loan, the borrower (including the business sector to which the borrower belongs and the region in which it is located), the instrument used, the currency, maturity, collateral, and finally, the quality of the asset (defaulting or unimpaired). It is therefore possible to model the probability of default of loans using only the CIR's information such that it is possible to obtain a measure of the risk on each loan. In this way, it is possible to isolate the contribution of each characteristic to the default rate and see the interactions between the variables. The model obtained permits the simulation of PD for any change in the characteristics of the loan and to establish, at any time, the average PD of the loan portfolio of each institution.

Therefore, in addition to the academic interest of this study, the results are of use to supervisors who wish to monitor the quality of financial institutions' loan portfolios. Once the characteristics of a new loan are known it is possible to estimate its PD. By aggregating the PDs of all the loans the average PD of the new loans portfolio can be obtained. By comparing it with the traditional portfolio of each institution it is possible to see whether its credit risk has increased. This enables continuous monitoring of the portfolio quality and expected losses.

This paper is structured as follows: section 2 describes the database used and the econometric specifications, while the main results are shown in section 3, together with an analysis of their robustness. Section 4 analyses the role of collateral in more depth and looks at its interaction with other characteristics. Section 5 centres on the simulation of changes in the characteristics of the loan in order to see their impact on PD and, finally, section 6 contains the main conclusions of the study.

2. Database and econometric specifications

As stated above, the database used for this study is the Credit Register of the Bank of Spain (*Central de Información de Riesgos del Banco de España*, CIR). This database records monthly information on all loans granted by credit institutions (banks, savings banks, cooperatives and credit finance establishments) in Spain for a value of over one million pesetas (around 6,000 euros). The CIR's data distinguishes between companies (legal persons) and individuals (natural persons). Among the latter it is possible to identify those undertaking business activities (individual businessmen). The characteristic defining such individuals is that although they are natural persons they are assigned a business sector code referring to their business activity. There is a clear separation between the characteristics of the loans involving legal persons (mainly in terms of the size of the loan, maturity, collateral,

and default rates) and of loans involving natural persons and individual businessmen. This difference makes it appropriate to treat each of the two groups separately.

The CIR includes information on the characteristics of each loan (instrument, currency, maturity, collateral, situation and amount drawn or available) and of each borrower (province in which they operate their business and the sector of business in the case of legal persons and individual businessmen)[5]. The analysis here is loan by loan, monitoring geographical area and the business sector of the person in whose name the loan has been taken out. The empirical literature alluded to in the introduction mainly takes a similar approach. The difference lies in the fact that most studies rely on an often small sample of loans, whereas we have used data on all lending transactions carried out by Spanish credit institutions on the dates studied.

This study focuses on legal persons, and in order to encompass an entire economic cycle we have used data from the month of December in five years, namely 1987, 1990, 1993, 1997 and 2000[6]. The data used have been subjected to various filters. To summarize, all loans declared by banks, savings banks, credit cooperatives and credit finance establishments have been taken into account; loans with an amount of less than 4 million pesetas (around 24,000 euros) have been ignored as prior to 1996 there was no obligation to declare them, although many institutions did; only loans with Spanish residents in the private sector have been included (hence loans with non-residents and the public sector have been excluded). The information on loan characteristics is numerical (amount of risk) or alphabetical (instruments, currencies, collateral, etc.) The analysis has been limited to legal persons (companies), and individuals (including businessmen) have been excluded due to the difference in their characteristics in terms of both loans and risk levels. We have opted to discretize all the variables by constructing dummy variables (the appendix offers more details on this point).

This study models the probability of default (PD) on each loan. In our case, default on payment (i.e. the event we wish to model) is considered to have occurred when, three months after the date of maturity, the debt balance remains unpaid or when there are reasonable doubts as to its repayment. A filter has been established in order to avoid distortion of the analysis by insignificant non-payment. Specifically, if the unpaid amount is less than 5% of the total credit drawn down it is not considered to be unpaid.

2.1. Descriptive analysis of the population

Table 1 gives a descriptive analysis of the data used for each of the years in terms of numbers of loans. As can be seen in the table, the number of observations available is large and has grown continually throughout the period studied. Overall, there are data on over 3 million loans for the five dates analysed. This number of observations ensures the consistency of the econometric estimates presented in the following section.

In terms of type of instrument, financial credit predominates, followed at some distance by commercial credit (financing purchases or the provision of services). This latter type of finance has come to account for a smaller share of credit transactions involving legal persons. Around 10% are leasing operations, with other items (fixed income, factoring and documentary credit) representing only a small share.

[5] For more detailed information on the CIR see Bank of Spain Circular 3/1995 and its subsequent modifications.
[6] Given the existence of problems with the December 1987 data in the database, January 1988 data has been used instead.

In terms of the currencies used, the majority of the loans are denominated in pesetas (euros).

The maturity structure is fairly balanced. In general, a shift may be observed from shorter terms to longer ones over the period studied. This shift is related, in part, with the loss of relative weight of commercial loans, and probably, with the increase in loans secured by collateral.

The majority of companies' loans are not secured by collateral, or in other words, have only a personal guarantee. Thus, on average, almost 85% of loans have no collateral. Loans that do have collateral have doubled their relative weight over the time horizon analysed. Collateral in the form of real property usual provides full or 100% cover of the loan, i.e. its value covers 100% of the risk. This type of collateral may take the form of public bonds, cash deposits, property or shipping mortgages, listed shares, merchandise or receipts of deposit of merchandise. More detailed information is not available on these types of guarantee, which may have differing degrees of effectiveness and, above all, have different costs of realization. In addition to 100% guarantees, there are partial guarantees that do not reach 100% of the value of the loan, but which cover more than 50%. Obviously, these are less effective guarantees, although their relative weight is almost negligible. Finally, we consider all other types of guarantee: public sector, CESCE (a government-owned export insurer) or resident or non-resident credit institutions; that, again, account for a relatively small proportion of loans.

Loan amounts have been divided into 10 size categories. As might be expected, the lower amount categories are those containing the largest number of loans, such that around 90% of the total number of loans are concentrated in the first three (from 24 to 150 thousand euros), although, clearly the percentage is smaller in terms of values lent. The relative weight of each category has been very stable over time. The 24 thousand euro (four million pesetas) limit was put in place, as mentioned before, because before 1996 this was the minimum amount that institutions were obliged to report. Prior to 1996 some institutions also declared operations over six thousand euros (one million pesetas), but the lack of uniformity between institutions makes it advisable to concentrate only on loans above the 24,000 euro limit. The ten scales enable analysis of the whole range of loans, from those providing finance to very small companies, credit for SMEs of various sizes, through to large loans to major corporations.

In terms of business sectors, loans to companies in manufacturing industry, commerce and construction (including property developers) stand out. The regional distribution is in line with the relative weights of the economies of the regions in the national economy as a whole.

Finally, commercial and savings banks are responsible for providing around 90% of the loans. However, the way this situation has evolved over time is significant. Commercial banks have gone from controlling four fifths of total loans to close to a half. This loss of market share in the business finance market is the result of the market penetration of the savings banks, which have practically doubled their relative weight over the period under analysis. Financial credit establishments also have a significant market share (almost 10%).

As mentioned in the previous section, one important characteristic of this study is the modelling of PD on a loan-by-loan basis rather than grouping together all the loans belonging to the same borrower. Grouping loans in this way is difficult on account of some of their intrinsic characteristics. For example, if a company obtains finance from a bank via

commercial discounting, financial credit (or five year loans) and through a leasing arrangement, how can the information on each type of instrument be characterized at the overall borrower level? Should the variable be discretized and averaged? This difficulty can be extended to the currency, maturity and collateral. If all a borrower's loans with various different banks are grouped together it also becomes impossible to distinguish differences in behaviour between groups of institutions. All in all, this leads us to the view that it is necessary to determine the influence of these variables at the level of the individual loan in order to obtain a point of reference for any subsequent aggregate analysis undertaken.

These problems do not arise if there is only one loan registered for each borrower. Table 2 shows that this is not the case in the years studied. Around half of all records (loans) belonging to each borrower in the CIR database correspond to only one loan (in terms of volume of exposure these account for around 10%). Almost 20% of borrowers have two loans and 10% have three. In the case of at least half of all loans difficulties arise in aggregating a borrower's characteristics. Therefore, in order to get around the difficulties that aggregate analysis would entail, without having to reduce the information, it would seem to be logical to explore the factors determining PD on a loan-by-loan basis, without prejudice to the analysis that may be carried out at the borrower level. Moreover, our focus coincides with the empirical work already mentioned, which has been applied to the case of the United States.

Note that we are not arguing that an analysis of PD by borrower would not be significant. On the contrary, the use of information about borrower characteristics can help improve the predictive capacity of the models. Moreover, this is the approach taken by Basel 2 given its view that credit risk is primarily determined by the economic/financial capacity of the borrower. However, as mentioned, a borrower focus prevents the direct impact of some of the characteristics of credit contracts from being seen, and at both the academic and supervisory levels, this is important unless the analysis centres on those borrowers that only have one loan or if borrowers are selected that do not have loans of different types. This would, however, presumably again reduce the sample size considerably, and hence the significance of the conclusions.

2.2. Econometric specification

The aim of this study is to obtain a model of the probability of default (PD) using CIR data, and thus to ascertain the influence that various factors have on it and so enable a comparison of the various alternative hypotheses that have been formulated in the literature.

The endogenous variable, y_{it}, is dichotomous, where $y_{it} = 1$ if the loan is doubtful and 0 otherwise. To the extent that this variable is related to another latent non-observable random variable, y^*_{it}, which takes the form:

$$y^*_{it} = a + x'_{it}\,ß + z'_t\,? + e_{it}$$

where $-e_{it}$ conditional upon (x_{it}, z_t) follows a logistic distribution, i.e., $F(a) = 1/(1+exp(-a))$, and if also, the relationship is of the type: $y_{it} = 1$ if $y^*_{it} > 0$, and zero otherwise; we obtain:

$$\text{Prob}(y_{it} = 1 / (x_{it}, z_t)) = \text{Prob}(y^*_{it} > 0 / (x_{it}, z_t)) = F(a + x'_{it}\,ß + z'_t\,?).$$

Where, therefore, $Prob(y_{it} = 1 / (x_i, z_t))$ is the probability of default of the loan *i*. This PD is considered to be a function of the type of instrument, currency, maturity, collateral, amount lent, business sector, region, type of financing institution, all of which are variables that vary between loans and over time (x_{it}). In order to control macroeconomic elements common to all borrowers and all loans, but which vary over time, a dummy variable for the year has been included (z_t).

The variable y^*_{it} can be understood as a function of the company's losses, such that if this function is greater than zero (or if the losses exceed a given threshold) the only option for the company is to default. Along the same lines, default could also arise out of a company's assessment of the various options it faces, thus turning it into a business decision.

Thus, another way of understanding y^*_{it} is to see it as the expected difference between the utility of defaulting on the loan and that of not defaulting, given a series of variables in the context of the information on the company and other macroeconomic factors. From this point of view, a company will default if the utility it obtains thereby is greater than that which it would obtain if it did not, in terms of its expectations. In other words, the company will default if $y^*_{it} > 0$.

In short, we are working with a binomial logistic model, and the estimates of the parameters in question have been obtained by maximizing the log-likelihood function of y_{it}.

For the purposes of our study this analysis has been performed both using a pool of five dates (a total of 3,167,326 observations) and each year in isolation.

3. The determinants of loan's PD

In this section we present the results of the empirical estimates. In the first subsection the results of the basic model are discussed and the following section subjects this model to various different analyses of robustness (changes in the explanatory variables). The results of the base model are very robust to most changes in the variables.

3.1. Basic model

The first column of Table 3 (Model 1) shows the results of the maximum likelihood estimate of the logistic model applied previously to the pool of data from over the five year period studied[7]. The model includes a constant forcing a variable to be left out of each block of characteristics to avoid perfect multicolinearity from occurring. The characteristics of the excluded loan are: financial credit, in pesetas (euros), long term (over five years), unsecured, 1993, small amount (between 24 and 60 thousand euros), construction sector and lent by a bank. Obviously, the interpretation of the sign of the parameters estimated in the model is in relation to the omitted variables. The explanatory capacity of the model is high, with a percentage of concordant observations of 69.5%[8] while the significance of the majority of the parameters is around 1%.

[7] Note that the number of observations is extremely large (over three million), which makes the estimates extremely difficult to calculate due to the processing requirements. In particular, it would not be possible to add further years without using sampling techniques. Nevertheless, this large number of observations guarantees the reliability of the estimates.

[8] In order to measure the predictive capacity of the model, the relationship between the predicted probabilities and the responses observed was analysed. The tables of predicted response frequencies are highly dependent on

As regards collateral, the pledging of collateral (money, real estate, etc.) increases the PD when compared with unsecured lending. Within secured loans, the PD of those that are 100% secured is lower than that of those secured to a value of over 50% but not to a full 100%, although the latter account for only a small percentage of the sample. Finally, loans guaranteed by a credit institution or the public sector have a lower likelihood of default, less even than in the case of unsecured loans. Note that this latter class of loan is subject to a double evaluation, i.e. by the bank giving credit and by the bank or public body guaranteeing it.

The foregoing finding makes a significant contribution to clarifying the debate surrounding the role of collateral as a borrower risk signalling mechanism. In the case of loans to companies in Spain, it may be concluded that banks demand collateral in the case of those loans that present a greater risk of default. This empirical evidence coincides with that found by other authors (Berger and Udell (1990 and 1992) and Booth (1992)) for the US credit market. At the same time, this evidence runs counter to the theoretical view which conceives of collateral as a mechanism for controlling borrowers' incentives (i.e. controlling moral hazard) or as a tool with which to limit the problem of adverse selection. By contrast it strengthens the arguments of Manove and Padilla (1999 and 2001) that the existence of collateral can weaken the adequate selection of borrowers and confirm the importance of screening as an intrinsic task of banks (Diamond (1984)).

As regards the maturity, very short-term loans (under three months), indeterminate maturity transactions and those with maturities between 1 and 5 years (medium term) have a greater probability of default than long-term transactions (i.e. those with a maturity of over 5 years). Between 3 months and 1 year (short term) the PD is lower. The value of the coefficients reveals that very short-term finance, and in particular, that for an indeterminate maturity (related with growing financial difficulties of companies, manifested through current account overdrafts and excess borrowing on credit accounts) is the highest risk, whereas the fact that short-term lending carries the lowest risk could support the arguments of Flannery (1986) on credit quality signalling.

Moreover, the lower PD on long-term loans than that on medium-term ones (between 1 and 5 years) shows the importance of screening. Given the time horizon of the loan, the bank examines the application with greater care given that the borrower's financial health could change significantly over such a long period. A maturity structure in which PD is continuously increasing is not obtained (of the type obtained by Jackson and Perraudin (1999) using bond data), rather there is a fall in PD in the case of the longest term. In bank credit operations selection therefore seems to be very careful in the case of the longest terms. This finding is in line with that obtained by Berger and Udell (1990), although their maturity variable was continuous. Unlike Booth (1992), maturity is a significant variable when explaining credit risk.

The results in Table 3 show that there is a decreasing monotonic relationship between the size of the loan and the probability of default on payment, although it is only significant in the case of large loans (over 3 million euros). Above this threshold, the higher the amount of the loan, the lower its PD. The screening argument can again be used here. Institutions study

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the cut off probability point selected. Thus, the method presented is a measure of the correlation between ranges for different pairs of values of the dependent variable and their estimated probabilities. They are classified as being concordant, if their values move in the same direction, and tied.

loans implying a higher level of risk much more carefully. As the absolute amount of the loan increases, the authority to delegate responsibility for it is more limited and the decision is made further up the management hierarchy of the bank. The involvement of a larger number of individuals and their greater experience in the granting of credit could also be a factor in this result. At the same time, this finding also reflects the fact that large exposures correspond to large companies with a much lower PD[9].

The absence of significant differences in the PD of loans up to 3 million euros as compared with very small exposures (between 24 and 60 thousand euros) seems to indicate the existence of only slight differentiation of PD for Spanish SMEs, and even, for very small companies. This would be consistent with one of the constant capital requirements, as stated in the proposal of the Basel Committee on Banking Supervision for the standard approach, although with an exposure limit, set in July, which could fall somewhat short.[10]

Default rates among financial credit establishments are significantly higher than among banks. This result coincides with that obtained by Carey et al (1998) for the US case, although the credit establishments considered here also include those that are subsidiaries of banking institutions. What is clear is that certain types of finance (consumer durables in particular) and certain types of borrower (those without access to bank credit) are riskier. The fact that credit establishments specialize in a small number of operations could deprive their credit portfolios of the benefits of greater risk diversification. In fact, a decrease over time in the credit establishments that are bank subsidiaries has been observed, suggesting that banks have decided not to manage loans of this kind separately.

Loans granted by savings banks to companies are riskier than those by commercial banks. Given that the institutional characteristics of savings banks in Spain[11] are such that they can be considered to be companies in which the managers have a broad field of manoeuvre, this result seems to contradict the US findings that show that the presence of shareholders (and deposit insurance) makes institutions riskier. The explanation for this difference in the case of Spain could lie in the lesser historical specialization of the savings banks in providing loans to companies and their aggressive entry into this market in the late eighties and early nineties[12]. The lack of knowledge of the business segment and the desire to increase market share quickly provided fertile ground for adverse selection to manifest itself. Moreover, many savings banks, which had previously been concentrated in regional or even local markets, implemented ambitious geographical expansion plans outside of the area they traditionally knew well and in which they had always operated. Shaffer (1998) demonstrates that adverse selection has a powerful and lasting impact on new entrants. Although the subject requires investigation in greater depth, on account of both its implications for corporate governance and for credit risk supervision, it seems to be clear that the substantial and significantly higher default rates of the savings banks in the case of loans to firms is the result of adverse selection. Once this factor has been neutralized, it is possible that the empirical evidence will be more like that obtained in the US case.

[9] As shown by the capital requirements curve for corporate borrowing proposed by the Basel Committee for Banking Supervision.

[10] The robustness analysis in the following section nuances this statement.

[11] See, for example, Salas and Saurina (2002a) for a summary. This paper also found differences in the levels of credit risk of Spanish commercial and savings banks, although the methodology used was different.

[12] The entry of savings banks in the loan to business segment was accompanied, symmetrically, by the entry of banks in the individual borrower market, in particular mortgage lending for homebuyers, which had previously been the main credit product offered by savings banks.

Credit cooperatives, which do not have shareholders but do have owner/partners, are somewhat riskier in their credit operations than banks, but much lower risk than savings banks and credit finance establishments. In general, these organizations are highly localized and tend to be concentrated in rural areas. In their case also, the lack of diversification of their credit portfolio could explain their difference from banks, which are much larger and more diversified. Moreover, the proximity of the banks to the average PD of their operations is consistent with the greater similarity of their structure of ownership and corporate governance, making, if possible, the case of Spanish savings banks more interesting still.

Finally, the paper will briefly examine the impact on PD of the remaining loan characteristics. By type of instrument, credit finance is the highest risk. Following it is commercial credit, leasing arrangements, then loan transfers, fixed income securities and documentary credit. Last in the list comes factoring. As can be seen in Table 1, these last four types of loan account for only a small proportion of the total. Commercial credit tends to be short term (less than one year) and is closely linked company turnover and business type and is basically used to provide circulating capital. By contrast, financial credit tends to be used for longer term investments whose results take longer to materialize.

The PD of loans in foreign currencies is substantially and significantly lower than that of loans in the national currency. It should be borne in mind that such loans account for a very small proportion of the total and that, given their characteristics, they are probably scrutinized more closely by the financial institutions involved.

Significant differences exist between economic sectors. The construction industry (omitted variable) appears to be the riskiest, after the hotel and restaurants sector (which is both seasonal and cyclical). This industry also includes the property development business, whether of first or second homes, and also the construction of rental property and commercial premises. This result is consistent with the evidence seen in other countries and with the interest of banking supervisors in monitoring the construction cycle. Construction is followed by agriculture, and at a distance, by transport, mining and commerce. Finally, the lowest risk sector is that of the production and distribution of electricity, gas and water, which is a sector dominated by large companies, many of which have high credit ratings. Significant differences also exist between regions[13].

Both the sector variable and the region variable should be considered here to be control variables permitting unbiased estimated to be obtained of the parameters associated with the rest of the explanatory variables on the basis of sectorial or geographical criteria. Nevertheless, it is clear that they have implications in terms of credit policy for institutions (in terms of risk premiums) and for supervisors (in terms of monitoring).

The temporary dummy variables play a similar role as control variables. Note that the parameters of these variables faithfully reflect the cyclical profile of the Spanish economy over the period 1988 to 2000, with a deep recession in 1993. Note the large difference between the PD associated with 2000 compared with the other years, in particular 1988. In both years the Spanish economy underwent rapid rates of annual growth (around 4-5% of real GDP) but the average PD is almost half in 2000. In addition to the structural changes undergone by the Spanish economy between these dates, part of the explanation could be an

[13] Although the specific values of the parameters are not shown in Table 3, all the estimates include the dummy region variables as omitting them could skew the results.

improvement in credit risk management by financial institutions, resulting from better measurement and management of risk.

The high value of the temporary dummy parameters reveals the procyclical nature of credit risk (Borio et al. (2001)) and the Basel Committee on Banking Supervision's concern that the new capital requirements take this factor into account[14].

In short, the empirical evidence for the case of Spain shows that collateral pledged to secure companies' loans is associated with greater credit risk, in line with the results found in other countries; that shorter terms imply lower credit risk, except in the case of long term lending (over five years), contrary to the increasing monotonic relationship between maturity and risk found in international bond markets; that the larger the loan, the lower the credit risk, although this relationship is only significant at exposures of over 3 million euros; and that savings banks, which have no shareholders or owners, have higher levels of credit risk than banks, contrary to most empirical evidence from abroad, but very probably explained by adverse selection; credit institutions that do not take deposits are the riskiest, in line with the evidence from other countries. This study shows the importance for credit institutions of an adequate policy for granting credit (i.e. screening) in order to obtain a healthy loan portfolio. The estimated parameters show that, on average, institutions appear to have adopted a cautious policy towards long term, unsecured and large volume loans.

3.2. Analysis of robustness

The second column of Table 3 (Model 2) is the base model with an additional variable acting as a control for loan size relative to the borrower's total exposure. This variable is segmented into four dichotomous variables: a single record that takes the value 1 if this is the only loan granted to the borrower and 0 otherwise; relative weight of between 0.6 and 1 that is worth 1 if the weight of the operation in question is situated above 60% but does not account for 100%, 0 otherwise; relative weight between 0.3 and 0.6 with a value of 1 if the loan represents between 30% and 60% and 0 otherwise, and finally, the last variable (omitted in the regression analysis to avoid perfect multicolinearity) which is set to 1 if the relative weight of the loan is below 30% and 0 otherwise. Over half of all loans fall in this latter category, with a relatively even split between the other three. One might expect smaller borrowers to account for a lower number of loans, and therefore that they should largely fall into the groups defined by the first three variables. Thus, it is highly likely that the borrowers in those groups would have a close relationship with a credit institution. In the first of these groups this is obviously the case.

As may be observed, the sign is positive and significant, indicating a greater PD for those borrowers that, presumably, have a close relationship with a credit institution[15]. In other words, credit institutions are willing to finance higher risk loans if they have a close relationship with the borrower, either because they are the sole provider of finance or because they provide a large percentage of the borrower's finance. It would seem obvious that banks

[14] Some supervisors feel that not only capital but also insolvency provisions should recognize, from a prudential point of view, the procyclical behaviour of credit risk. Dynamic insolvency provision could be an appropriate mechanism for achieving this (Banque de France (2001), Borio and Lowe (2001), Crockett (2001) and Fernández de Lis et al. (2001)).

[15] This is an initial exploration of the CIR data to evaluate the impact of relationship lending. These are very much preliminary results which are the start of a much more ambitious empirical research project which will not only be limited to bank-company relationships.

are willing to finance operations that are, on average, riskier in the case of customers with which there is a greater degree of commitment if, in return, they can recoup the greater expected losses by charging their other surviving exclusive or nearly exclusive customers higher interest rates. Therefore, the results of Model 2 indirectly support the existence of informational rents for the bank by developing a close relationship with the customer (Sharpe (1990) and Rajan (1992)). The company obtains finance despite the fact that its risk profile is worse. This advantage of relationship lending is in addition to those already found by Petersen and Rajan (1994) regarding the greater availability of funds at lower cost[16].

The introduction of these new variables has a very slight impact on the sign, the significance or the value of the estimated parameters in Model 1 of the previous sub-section. The only noteworthy feature is the impact of short-term loans (between 3 months and 1 year), which although negative is not significant, perhaps because the close bank-customer relationship has a longer-term time horizon or, equivalently, finance through several creditors is largely provided short term. Medium-low amount loans (between 60 and 600 thousand euros) now show a lower PD than very small loans (up to 60 thousand euros), the non-significance profile being maintained between 600 thousand and 3 million euros and the descending profile above 3 million euros. Nevertheless, the value of the parameters between 60 and 600 thousand euros is close to zero. This result may be due to the fact that a large part of relationship lending concentrates on medium-low amount loans (up to 600 thousand euros). By introducing this as an explanatory variable, the sizes cease to be a proxy and reveal that very small transactions (up to 60 thousand euros) are riskiest. Finally, many of the sectorial variables, although they remain of the same sign, cease to be significant, perhaps indicating which sectors tend to have closest bank-industry relationships.

The third column of Table 3 (Model 3) aims to examine in more detail the issue of relationship banking and includes on the single record variable, i.e. those borrowers for whom the loan in question is the only one registered in the database. This is an extreme measure of the bank-company relationship, not only does the borrower only have a relationship with one bank, but at the moment in question, it only does so through one loan. This eliminates a degree of uncertainty that exists regarding the other variables, given that we do not know if the remainder of the loans (for example, those representing 40% for the variable above 60% but below 100%) have also been entered into with the same institution or with a different one. As may be observed, the extreme measure of relationship banking is also positive and significant, reinforcing the previous conclusions that there is a greater willingness to finance riskier operations when there is an exclusive relationship with the customer.

The difference with Model 1 is now reduced even further as the short-term loans again have a greater PD (to a significance of 10%) and the sectorial parameters resemble one another more. On the other hand, for amounts up to 3 million euros the PD is greater than for the small loans. Very probably, by eliminating the high dependency (but not exclusivity) variables (over 30% and less than 100%), the size parameters act as a proxy. In other words, in the case of amounts between 0.06 and 3 million euros there is a considerable presence of close relationships between banks and companies, although the relationship is not 100% exclusive.

[16] Note that we, unlike Petersen and Rajan (1994), have evaluated the impact of bank relationships on the *ex post* risk of the transaction, not on the interest rate or availability of funds for the company.

Model 4 (the fourth column of Table 3) allows a different approximation to the question of the size of the operations and their interaction with bank-company relationships. As may be observed, the dichotomous size variables have been eliminated and replaced by a continuous variable for the size of the borrower's debt (the sum of all the borrower's loans). This variable can be seen to have a negative effect on risk, i.e. the greater the size the lower the PD, which is also the result obtained by Berger and Udell (1990). The variable that measures the exclusivity of the bank-customer relationship in its extreme form continues to be positive and significant, although of lower magnitude, again revealing the importance of informational rents when financing particular high-risk borrowers.

In addition, Model 4 incorporates the variable number of the borrower's banking relationships with credit institutions. Obviously, given that our study has focused on a loan-by-loan analysis, the value of the variable will be the same for all a given borrower's loans. It can be seen that the more widespread multiple lending is, the lower the value of PD. In other words, when a borrower's loans are spread across several or many institutions there is less of an incentive to finance riskier borrowers. Again, results in line with those of Petersen and Rajan (1994) have been obtained, where the endogenous variable is the credit risk of the loans[17].

As regards the stability of the remainder of the parameters in comparison with Model 1, the conclusions are very favourable. Non-significance only reappears in the case of short-term loans, with a certain degree of instability in the sectorial parameters.

Model 5 substitutes the temporary control variables with the growth of real GDP contemporary and lagged one period. As we would expect, the fifth column of Table 3 shows how the slowing of the economy translates into a higher PD, although the greatest impact is not on the contemporary PD but in that lagged one year. There are very few changes in the remainder of the parameters (except in short term finance and some intermediate size groups). The explanatory capacity of the model is somewhat reduced with respect to Model 1.

Finally, the last column of Table 3 (Model 6) shows the impact of eliminating the temporary dummy variables without replacing them with any macroeconomic variables. Firstly, a substantial fall may be observed (almost 10 percentage points) in the explanatory capacity of the model. Secondly, the parameters associated with the sectorial variables change substantially, most probably showing that the cyclical behaviour of the sectors is not the same. Instability reappears in medium and low value and short-term lending. This model is clearly inadequate.

In short, the robustness analysis to which we have subjected the base model described in the previous subsection is, in general, highly satisfactory and has enabled us to highlight the importance of a close relationship between credit institutions and the companies to which they lend (in terms of total exclusivity, partial exclusivity, and the number of banking relationships) when financing high risk projects, in line with the theoretical predictions and empirical evidence found at the international level.

A further robustness analysis was performed to estimate the five dates separately. It may be observed that, in general (Table 4), the explanatory capacity decreases. This decrease in the number of concordants is greater in those years, such as 2000, where the ratio of default is

[17] The advantages in terms of access to finance for riskier borrowers would seem to be offsetting the drawbacks indicated in Detragiache et al. (2000).

very low. The main results remain, in particular those relating to collateral and the type of institution, which do not show any noteworthy exceptions from Model 1 in any of the years. There are some differences in the maturity, in particular, for short-term lending, the last years, and for medium-term lending in the early years of the study. There are also a few differences in the size of the loans, especially in the early years. Oddly, a monotonically decreasing relationship may be observed between size and risk in 2000. The remainder of the characteristics (instrument, currency and region) do not show significant variations with respect to Model 1, while there is a certain degree of instability in the sectorial parameters, as was indicated during the robustness analysis of Table 3.

4. More detailed analysis of the role of collateral

In the introduction we mentioned the possibility of there being interactions between the different characteristics of the loans. In this section we will explore in further detail the role of collateral and its relationship with other variables.

As regards collateral, the previous section has shown how, consistent with the empirical literature available on this question, and contrary to many of the theoretical arguments, collateralised loans are associated with a higher credit risk. The objective of this section is to look in more depth at this dimension of collateral in order to ascertain whether there is a difference in the impact of guarantees depending on the amount of the loan, maturity, and type of lender or instrument. Berger and Udell (1995) find that younger companies (which are therefore higher risk) pledge more collateral. Berger and Udell (1998) also indicate that smaller companies pledge more collateral.

Table 5 shows the distribution of fully secured loans and of the remainder loans. One point that stands out is that collateralised lending mainly takes the form of long-term credit or loans of which a large proportion are provided by savings banks.

The two columns of Table 6 analyse the interaction between collateral and other characteristics of the loan. The study focuses on collateral covering 100% of the loan, as these constitute the majority of secured loans (92% on average, according to Table 1). In the first column (Model 7) it may be seen that small and medium size loans collateralised at the 100% have the highest risk. These loans, given their volume, are characteristic of small and medium-sized businesses in Spain. It is interesting to note the pattern followed by the parameters: increasing with size up to 6 million euros. It may also be seen that the non-significance of size remains (by comparison with Model 1 of Table 3) up to exposures of 3 million euros, as does the lower risk of large loans associated with big companies, in the general size estimates, without any interaction with collateral. When the overall impact coefficients are added to those for the interaction between guarantees and amounts, 100% collateralised loans become higher risk as the value grows up to 15 million euros, an amount of risk only reached by 1.5% of loans (i.e. the major Spanish companies). In short, the results of the previous section, whereby a higher level of guarantees is associated with a greater level of risk, are reinforced. However, it is somewhat surprising that the risk increases with the size of the collateralised loan[18].

[18] It is possible that this relationship conceals differences in behaviour between commercial banks and savings banks due to the former's greater knowledge of the market and the aggressive entry of the latter, thus confronting them with an adverse selection problem.

The same column of Table 6 shows the interaction between collateral and instrument type. This makes it clear that collateral is associated with higher risk operations as commercial credit, fixed income, leasing and factoring are generally lower risk than credit finance (omitted variable). However, by interacting them with collateral they appear to be higher risk. Nevertheless, Table 5 shows that these loans account for a very small percentage of the sample.

The second column of Table 6 (Model 8) shows the interaction between collateral and type of lender. Fully secured lending (100%) by savings banks turns out to be lower risk than the remainder of the unsecured loans. Despite this, savings banks are still higher risk than commercial banks. Savings banks may perhaps have a tendency, given their recent entry into this market, to ask for collateral across the board, regardless of the customer's risk profile. This idea is supported by comparing Tables 1 and 5: savings banks represent, on average, 26% of total loans but 49% of collateralised loans. Something similar happens in the case of financial credit establishments. Perhaps for certain consumer finance loans the pledging of collateral is an efficient mechanism of selection and ensuring borrower discipline[19]. However, for credit cooperatives, collateralised loans imply additional risk, reinforcing the general conclusion that the greater the risk, the greater the collateral demanded.

Finally, the second column of Table 6 contains the interaction between 100% collateral and loan maturity. Again, the existence of collateral implies a higher PD for all the maturities considered. Given that most collateral is required for long-term loans (69% of the total for maturities of over five years), if institutions perceive greater levels of risk in short-term operations they demand more collateral. When collateral is used as a control, the parameters associated with maturity (for loans not fully collateralised) an increasing monotonic curve is again seen (except for the very short term), which is more consistent with that obtained in the bond market. At all events, these results confirm the greater instability of the parameters associated with the maturity, as described in the previous sub-section, and above all, the need to consider the interactions between all the characteristics of the variables. Unifactorial analysis of credit risk may lead to conclusions which overlook some of the finer details.

In short, the analysis of the interactions between collateral and the remainder of the loan's characteristics generally supports the conclusions already obtained. The existence of collateral is related with a higher level of credit risk. However, for savings banks a different conclusion is reached, perhaps because collateral is demanded on the basis of other criteria, in addition to the borrower's risk. By loan size, the somewhat surprising result is obtained that the impact of collateral on credit risk increases with the size of the loan in a continuous way, reversing only in the case of extremely large loans.

5. Analysis of predicted PDs

From the point of view of banking supervisors concerned with the quality of loans, it is of interest to obtain an evaluation of the marginal impact of each characteristic associated with a loan. In this way, for example, supervisors can better guide their inspection visits (on-site monitoring) or perform detailed follow up of new transactions registered by the CIR (off-site monitoring). Alert systems could be designed to detect if an institution approves an increasing number of loans whose characteristics signal greater credit risk. For supervisors, a concentration of loans with these characteristics signals a shift in credit policy, perhaps

[19] Unfortunately we do not have any information about the type of collateral pledged. Such information could prove enlightening.

because the institution has decided to follow a higher risk strategy given a decline in profitability or solvency[20]. In extreme cases it may indicate a dangerous rush into the unknown.

Table 7 shows the predicted PD for the reference loan (credit finance, in pesetas (euros), over more than five years, unsecured, for a value of between 24 and 60 thousand euros, property sector borrower, lent by a bank). We see that the PD behaves, as may be expected, in a highly cyclical way, reaching a maximum in 1993 (a year in which the Spanish economy was in a pronounced recession). In 2000 the level of the estimated PD was very low, which is consistent with an improvement in the position on the cycle. As mentioned, the differences in PD between the first two years of the sample, and the last year, correspond approximately to the same point in the cycle (strong economic expansion) and could indicate an improvement in risk management by Spanish institutions over the course of the last decade.

By changing just one of the characteristics of the reference loan cited in the previous paragraph it is possible to calculate the new PD measuring the marginal impact on the probability of default of the characteristic in question. Thus, for 1997, if the reference operation is fully collateralised (100%) rather than unsecured, the PD goes from 5.71% to 8.10%. Obviously, the results of Table 7 are no more than another way of presenting the year-by-year results of Table 4. Nevertheless, it is worth noting, given its importance for supervisors, the greater credit risk associated with very short term loans (less than three months) and those with collateral, and by contrast, the lower PD of big loans granted by banks. It is worth recalling that we are only dealing with credit risk on lending to companies here.

Note that for all the characteristics PD retains its cyclical profile, with a maximum in 1993, i.e. independently from whether the PD is higher or lower than the reference, its time course follows the economic cycle. In particular, we see that, in general, the highest risk sectors or regions during a recession are also highest risk during the expansive part of the cycle. It should be noted that the period analysed is sufficiently long for this result to indicate the existence of structural factors underlying these differences.

The points mentioned in the previous paragraph have consequences for institutions' credit policy. If, *ceteris paribus*, one region's PD is higher than that of another, the risk premium should also be different so that the higher risk borrowers pay more for their credit. To do otherwise, i.e. to charge a risk insensitive premium, would in effect be a cross subsidy between regions and therefore introduce inefficiencies in the credit system by distorting the allocation of funds. Clearly this could run counter to institutions' commercial policy. At all events, the variation of capital requirements based on the risks assumed (Basel 2) could contribute to eliminating these cross subsidies should they arise[21].

From the estimated PDs it is possible to determine their sample distribution. In Figure 1 sample density functions have been obtained for each year included in the study. Three characteristics common to them all can be seen. Firstly, there is a clear asymmetry towards the right which produces long tails, it being noted that as the economy went into recession the

[20] Keeley (1990), in the US case, and Salas and Saurina (2002b), in the Spanish case, find a greater predisposition to taking on higher credit risk when the competition has eroded an institution's market power and therefore the value of its banking licence.

[21] We do not have any information that would allow us to evaluate the existence of this phenomenon or its scope.

distribution of the PDs gradually shifted towards the right, and then returned to the left as the cycle progressed. Secondly, the distributions are unimodal, i.e. they have a single maximum. Moreover the kurtosis (a measure of how pointed the curve is) is lower during the troughs in the cycle, and it peaked in 2000 when the PDs were at their lowest value in the period. Finally, the variability of the distribution is countercyclical, reaching a minimum in 2000, where the concentration is greatest.

Similarly, the distribution of the drawn credit in terms of the PDs of each loan has been calculated (Figure 2). The characteristics of the densities are those already described, with a greater uniformity than that seen in the previous case.

6. Conclusions

This paper has analysed the role certain characteristics of loans have on credit risk. We have focused on the collateral, maturity, amount, type of lender institution and, finally, the degree of relationship between the bank and the company it is financing. The data come from the Bank of Spain's Credit Register (CIR) and refer to all lending by Spanish credit institutions on five specific dates, taking in a complete cycle of the Spanish economy. The results enable differences to be discerned between the various theoretical approaches regarding the relationship between loan characteristics and credit risk, and are generally in line with the scarce empirical evidence there is at international level. However, in some cases (particularly, savings banks) there are substantial differences that may have their origin in certain specific features of the Spanish financial system. Numerous robustness exercises have been performed, which with only a few specific exceptions, have confirmed the results of the base model. From these results we can deduce practical implications for banking supervisors, which may enable better monitoring of the credit risk incurred by financial institutions.

On the theoretical level there are arguments (adverse selection and moral hazard) that would lead one to think that the higher the risk of a borrower the less collateral it is willing to pledge in order to secure the finance provided by the bank. However, some authors (Manove and Padilla (1999, 2001)) argue that excessive optimism on the part of business people or excessive reliance upon collateral hinder the application of appropriate levels of screening by banks, with the result that there is a positive relationship between the pledging of collateral and credit risk. The existing empirical evidence (Berger and Udell (1990 and 1992) and Booth (1992)), which is somewhat scant and is limited to the case of the United States, finds clear evidence of a positive and significant relationship between credit risk and the pledging of collateral. The results of this study are very clear on the role of collateral, namely that secured credit operations have a higher PD (probability of default). Subsequent robustness analysis confirms this result. Therefore, the conclusions drawn by the former empirical studies are not exclusive to the US credit market but can be generalized to other credit markets with a very different institutional set up and characteristics.

The results of this study as regards the maturity and size of loans reveals the importance of the screening process carried out by institutions. Long-term lending (over five years) implies a lower credit risk than medium-term lending (1 to 5 years) or very short-term lending (less than 3 months). This highlights the fact that such loans receive more careful analysis on account of the potential risk of lending over such a long period. Similarly, large loans are lower risk, probably because the borrower is normally a large company and the operation has been studied in greater detail.

Published empirical studies, which mainly focus on the US case, find that credit institutions controlled by bank management staff have a lower risk profile than those with a greater degree of shareholder control over their management (Saunders et al. (1990) and Esty (1997a and b)). The Spanish case is something of an exception, as is shown by Spanish savings banks, which have no owners or shareholders, thus suggesting that their managers have maximum discretion. Savings banks' lending to companies entails greater credit risk than that of the commercial banks. Like Carey et al. (1998), we have found credit institutions which do not take deposits from the public to be the highest risk lenders in Spain.

In this study we find evidence to support the importance of relationship banking. A close bank-customer relationship, and in particular when the customer depends solely on one bank and is a small company, translates into greater credit risk. In other words, when there is an exclusive or very close relationship between the bank and its borrowers, the bank is more willing to finance higher risk projects. This finding supports the conclusions of the studies by Petersen and Rajan (1994 and 1995) and Berger and Udell (1995) although we use PD as a measure of bank credit risk and not the interest rate paid. Therefore, the potential advantages of relationship banking are not limited to the US market.

Finally, our study shows the marginal impact of each characteristic of a credit operation on PD, highlighting the utility that this can have for a banking supervisor interested in off-site monitoring of credit risk or in an improved allocation of scarce resources when carrying out the necessary on-site monitoring.

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Appendix. Sources and definitions

Source: Bank of Spain's Credit Register (Central de Información de Riesgos del Banco de España, CIR).

Dates: 1998:01, 1990:12, 1993:12, 1997:12 and 2000:12.

All variables are binary, and equal to one for the letters indicated and 0 other wise.

- Default on payment: C, D, E, F, G, H, I and L from the fifth record of risk.

- In terms of type of instrument: Commercial credit: A. Financial credit: B. Documentary credits: F. Fixed income: G. Leasing: K. Factoring: L o M. Loan or credit transferred to a third party: Q.

- Currencies: Peseta (euro for 2000): A. Other currencies: other letters.

- Maturity: < 3 moths: A. 3 moths-1 year: B. 1 year-3 years: C. 3 years-5 years: D. Over 5 years: E. Indeterminate maturity: F.

- Guarantees: 100% guarantees (collateral): A o B. Partial guarantees (>50%): C. Loans guaranteed by the public sector or by a credit institution (>75%): D, E, F o H. Unsecured loans: V.

- Size of the loan: 24-60 thousand €. 60-150 thousand €. 150-300 thousand €. 300-600 thousand €. 0.6-1.5 mio. €. 1.5-3 mio. €. 3-6 mio. €. 6-15 mio. €. 15-30 mio. €. >=30 mio. €.

- Economic sectors: Farming and fishing: NACE: 01, 02 or 03. Mining: NACE: 10, 11, 12, 13 or 14. Manufacturing: NACE: 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36 or 37. Electrical services, gas and water: NACE: 40 or 41. Construction an real estate: NACE: 45 or 70. Trade: NACE: 50, 51 or 52. Hotels and catering: NACE: 55. Transport: NACE: 60, 61, 62, 63 or 64. Financial intermediation: NACE: 65, 66 or 67. Computing, R&D: 71, 72, 73 or 74. Other services: other NACE. Before 1993 the necessary equivalences has been made.

- Region variables: País Vasco. Castilla la Mancha. Comunidad Valenciana. Andalucía. Castilla León. Extremadura. Baleares. Cataluña. Galicia. Aragón. La Rioja. Madrid. Murcia. Navarra. Asturias. Canarias. Cantabria. Ceuta and Melilla.

- Credit institutions: Banks. Saving banks. Credit cooperatives. Credit finance establishments.

Table 1. Time distribution of the sample

Legal Persons	1988		1990		1993		1997		2000		Pool	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
No. observations	334,384		608,379		582,706		746,344		895,513		3,167,326	
Defaults	11,271	3.37	23,335	3.84	59,936	10.29	33,497	4.49	14,704	1.64	142,743	4.51
Commercial credit	141,824	42.41	195,100	32.07	171,567	29.44	198,226	26.56	202,936	22.66	909,652	28.72
Financial credit	185,374	55.44	332,875	54.72	359,335	61.67	463,519	62.11	574,677	64.17	1,915,779	60.49
Documentary credit	5,030	1.50	6,698	1.10	5,074	0.87	7,635	1.02	6,938	0.77	31,376	0.99
Fixed income	2,156	0.64	1,278	0.21	785	0.13	507	0.07	516	0.06	5,242	0.17
Leasing	0	0.00	71,790	11.80	45,031	7.73	73,280	9.82	96,394	10.76	286,495	9.05
Factoring	0	0.00	638	0.10	914	0.16	2,947	0.39	6,929	0.77	11,428	0.36
Loans or cred. transf. to a third party	0	0.00	0	0.00	0	0.00	230	0.03	7,124	0.80	7,354	0.23
Curency: pesetas or euros	325,114	97.23	590,017	96.98	564,720	96.91	725,642	97.23	873,080	97.50	3,078,573	97.20
Other currencies	9,270	2.77	18,362	3.02	17,986	3.09	20,702	2.77	22,433	2.51	88,753	2.80
Maturity <3 moths	137,357	41.08	197,686	32.49	172,188	29.55	172,321	23.09	168,820	18.85	848,372	26.79
Maturity 3 months-1 year	94,042	28.12	174,003	28.60	165,640	28.43	209,961	28.13	220,001	24.57	863,647	27.27
Maturity 1 year-3 years	45,371	13.57	111,854	18.39	91,665	15.73	138,253	18.52	184,798	20.64	571,941	18.06
Maturity 3 years-5 years	13,375	4.00	35,315	5.80	39,151	6.72	65,872	8.83	93,831	10.48	247,544	7.82
Maturity >5 years	20,440	6.11	51,620	8.48	71,204	12.22	107,165	14.36	164,391	18.36	414,821	13.10
Indeterminate maturity	23,799	7.12	37,900	6.23	42,858	7.36	52,772	7.07	63,672	7.11	221,001	6.98
100% guarantees (collateral)	24,232	7.25	49,213	8.09	67,419	11.57	100,299	13.44	134,232	14.99	375,395	11.85
Partial guarantees (>50%)	1,721	0.51	1,968	0.32	1,919	0.33	2,174	0.29	4,074	0.45	11,856	0.37
Other guarantees	1,742	0.52	5,637	0.93	5,796	0.99	3,533	0.47	4,699	0.52	21,408	0.68
Unsecured	306,689	91.72	551,561	90.66	507,572	87.11	640,338	85.80	752,509	84.03	2,758,667	87.10
1988-01											334,384	10.56
1990-12											608,379	19.21
1993-12											582,706	18.40
1997-12											746,344	23.56
2000-12											895,513	28.27
Size 24-60 thousand €	134,480	40.22	264,742	43.52	245,676	42.16	353,404	47.35	336,893	37.62	1,335,196	42.16
Size 60-150 thousand €	102,639	30.69	173,819	28.57	179,733	30.84	223,176	29.90	314,935	35.17	994,302	31.39
Size 150-300 thousand €	47,824	14.30	84,927	13.96	76,699	13.16	87,284	11.69	121,846	13.61	418,581	13.22
Size 300-600 thousand €	25,167	7.53	43,113	7.09	41,376	7.10	44,380	5.95	62,038	6.93	216,073	6.82
Size 0.6-1.5 mio. €	14,759	4.41	25,937	4.26	24,612	4.22	24,891	3.34	37,200	4.15	127,399	4.02
Size 1.5-3 mio. €	4,850	1.45	8,743	1.44	7,723	1.33	7,287	0.98	12,497	1.40	41,100	1.30
Size 3-6 mio. €	2,412	0.72	4,034	0.66	3,823	0.66	3,363	0.45	5,646	0.63	19,278	0.61
Size 6-15 mio. €	1,497	0.45	2,169	0.36	2,140	0.37	1,827	0.24	3,190	0.36	10,823	0.34
Size 15-30 mio. €	449	0.13	576	0.09	564	0.10	436	0.06	782	0.09	2,807	0.09
Size >30 mio. €	307	0.09	319	0.05	359	0.06	295	0.04	487	0.05	1,767	0.06
Farming and fishing	14,247	4.26	24,016	3.95	20,426	3.51	29,895	4.01	40,044	4.47	128,628	4.06
Mining	3,780	1.13	5,749	0.95	4,961	0.85	6,096	0.82	6,912	0.77	27,498	0.87
Manufacturing	148,857	44.52	222,420	36.56	195,607	33.57	225,343	30.19	238,654	26.65	1,030,881	32.55
Electrical services, gas and water	3,570	1.07	3,622	0.60	4,103	0.70	4,648	0.62	5,137	0.57	21,080	0.67
Construction and real estate	44,427	13.29	97,673	16.05	100,988	17.33	132,991	17.82	189,792	21.19	565,872	17.87
Trade	77,340	23.13	137,524	22.61	127,431	21.87	161,627	21.66	182,913	20.43	686,835	21.69
Hotels and catering	4,640	1.39	10,629	1.75	10,981	1.88	16,791	2.25	23,010	2.57	66,051	2.09
Transport	11,334	3.39	26,963	4.43	43,714	7.50	39,234	5.26	48,672	5.44	169,917	5.36
Financial intermediation	2,377	0.71	3,835	0.63	3,291	0.56	3,733	0.50	4,826	0.54	18,063	0.57
Computing, R&D	9,203	2.75	26,138	4.30	34,645	5.95	66,768	8.95	89,152	9.96	225,905	7.13
Other services	14,609	4.37	49,810	8.19	36,559	6.27	59,218	7.93	66,401	7.41	226,597	7.15
País Vasco	26,642	7.97	38,985	6.41	37,075	6.36	43,431	5.82	48,351	5.40	194,485	6.14
Castilla la Mancha	8,412	2.52	17,530	2.88	19,386	3.33	24,230	3.25	29,520	3.30	99,078	3.13
Comunidad Valenciana	40,821	12.21	74,640	12.27	69,916	12.00	96,869	12.98	119,260	13.32	401,506	12.68
Andalucía	29,834	8.92	64,262	10.56	67,406	11.57	91,928	12.32	121,016	13.51	374,446	11.82
Castilla León	12,357	3.70	23,399	3.85	26,553	4.56	36,120	4.84	44,625	4.98	143,054	4.52
Extremadura	2,551	0.76	5,639	0.93	8,149	1.40	15,784	2.11	18,866	2.11	50,989	1.61
Baleares	9,100	2.72	17,393	2.86	14,723	2.53	19,027	2.55	23,605	2.64	83,848	2.65
Cataluña	91,308	27.31	156,136	25.66	131,973	22.65	156,947	21.03	175,144	19.56	711,509	22.46
Galicia	14,198	4.25	27,320	4.49	29,050	4.99	37,973	5.09	47,087	5.26	155,628	4.91
Aragón	11,659	3.49	21,697	3.57	20,861	3.58	24,657	3.30	28,018	3.13	106,892	3.37
Rioja	3,048	0.91	5,197	0.85	4,937	0.85	6,597	0.88	7,725	0.86	27,504	0.87
Madrid	50,255	15.03	93,130	15.31	91,310	15.67	102,666	13.76	116,293	12.99	453,654	14.32
Murcia	9,008	2.69	17,150	2.82	18,117	3.11	26,742	3.58	33,369	3.73	104,386	3.30
Navarra	5,347	1.60	9,197	1.51	8,866	1.52	16,269	2.18	21,790	2.43	61,468	1.94
Asturias	6,145	1.84	10,909	1.79	10,927	1.88	13,431	1.80	15,048	1.68	56,460	1.78
Canarias	10,706	3.20	19,924	3.27	17,648	3.03	26,095	3.50	36,920	4.12	111,293	3.51
Cantabria	2,993	0.90	5,871	0.97	5,809	1.00	7,488	1.00	8,609	0.96	30,770	0.97
Ceuta and Melilla	0	0.00	0	0.00	0	0.00	89	0.01	268	0.03	357	0.01
Banks	268,041	80.16	401,051	65.92	370,475	63.58	442,232	59.25	483,103	53.95	1,964,903	62.04
Saving banks	58,973	17.64	114,624	18.84	149,498	25.66	213,576	28.62	295,389	32.99	832,060	26.27
Credit cooperatives	7,370	2.20	12,057	1.98	17,041	2.92	30,816	4.13	45,228	5.05	112,512	3.55
Credit finance establishments	0	0.00	80,647	13.26	45,692	7.84	59,720	8.00	71,792	8.02	257,851	8.14

Table 2. Time distribution of the sample by the number of transactions of each borrower, in terms of number of credits and the amount drawn (%)

	1998		1990		1993		1997		2000		Pool	
	Number	Size	Number	Size	Number	Size	Number	Size	Number	Size	Number	Size
1	48.73	8.35	47.42	9.44	50.95	10.59	55.99	13.15	57.22	11.80	53.60	11.23
2	19.82	6.46	19.81	8.28	19.74	9.48	18.65	9.16	17.96	8.97	18.89	8.78
3	10.43	5.78	10.55	6.96	10.17	8.09	8.92	7.09	8.69	9.84	9.44	8.14
4	6.02	4.51	6.52	6.27	5.95	6.29	5.01	6.31	4.81	5.51	5.42	5.85
5	3.94	3.82	4.13	5.19	3.75	5.32	3.13	6.53	3.00	4.64	3.42	5.18
6	2.62	3.16	2.84	4.31	2.54	4.68	2.08	4.15	2.02	3.95	2.30	4.11
7	1.84	2.85	1.96	3.79	1.68	3.79	1.41	3.27	1.39	3.41	1.57	3.45
8	1.29	2.49	1.45	3.40	1.22	4.15	1.02	2.80	1.03	2.86	1.15	3.12
9	1.00	4.28	1.06	3.21	0.86	2.86	0.74	2.83	0.76	2.56	0.83	2.92
10	0.75	1.87	0.77	2.42	0.62	2.39	0.57	2.33	0.56	2.32	0.62	2.31
11-15	1.97	7.49	2.03	9.59	1.52	9.33	1.40	8.15	1.46	9.29	1.59	8.93
16-20	0.75	5.42	0.72	6.34	0.52	5.76	0.51	7.63	0.55	5.42	0.58	6.10
21-25	0.36	3.37	0.32	4.10	0.20	3.60	0.23	3.15	0.24	3.44	0.25	3.50
26-50	0.43	11.93	0.35	10.38	0.23	9.06	0.28	10.00	0.28	11.73	0.29	10.70
>50	0.08	28.22	0.05	16.32	0.03	14.63	0.05	13.44	0.05	14.26	0.05	15.69

Table 3. Estimation of the PD equations using pooled cross-sections (1988:01, 1990:12, 1993:12, 1997:12 and 2000:12)

Legal Persons	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
Variables	Coefficient	S.D.	Coefficient	S.D.	Coefficient	S.D.	Coefficient	S.D.	Coefficient	S.D.	Coefficient	S.D.
Constant	-2.001 ***	(0.015)	-2.402 ***	(0.015)	-2.181 ***	(0.015)	-1.334 ***	(0.018)	-2.176 ***	(0.016)	-3.165 ***	(0.014)
Commercial credit	-0.230 ***	(0.008)	-0.220 ***	(0.008)	-0.242 ***	(0.008)	-0.238 ***	(0.008)	-0.233 ***	(0.008)	-0.274 ***	(0.008)
Documentary credit	-0.996 ***	(0.067)	-0.956 ***	(0.067)	-0.970 ***	(0.067)	-1.004 ***	(0.068)	-0.949 ***	(0.067)	-1.032 ***	(0.067)
Fixed income	-0.962 ***	(0.117)	-0.692 ***	(0.117)	-0.900 ***	(0.117)	0.776 ***	(0.120)	-0.704 ***	(0.117)	-0.853 ***	(0.117)
Leasing	-0.208 ***	(0.016)	-0.196 ***	(0.016)	-0.190 ***	(0.016)	-0.211 ***	(0.016)	-0.230 ***	(0.016)	-0.271 ***	(0.015)
Factoring	-1.370 ***	(0.090)	-1.212 ***	(0.090)	-1.329 ***	(0.090)	-0.928 ***	(0.090)	-1.616 ***	(0.089)	-1.839 ***	(0.089)
Loans or cred. transf. to a third party	-0.847 ***	(0.132)	-0.857 ***	(0.132)	-0.855 ***	(0.132)	-0.874 ***	(0.132)	-1.403 ***	(0.132)	-1.824 ***	(0.132)
Currency different from euros	-1.239 ***	(0.034)	-1.071 ***	(0.034)	-1.188 ***	(0.034)	-0.847 ***	(0.034)	-1.210 ***	(0.034)	-1.169 ***	(0.034)
Maturity <3 moths	0.359 ***	(0.012)	0.383 ***	(0.013)	0.383 ***	(0.013)	0.386 ***	(0.013)	0.480 ***	(0.013)	0.558 ***	(0.013)
Maturity 3 moths-1 year	-0.058 ***	(0.012)	-0.012	(0.012)	-0.023 *	(0.012)	-0.011	(0.012)	0.051 ***	(0.012)	0.101 ***	(0.012)
Maturity 1 year-3 years	0.040 ***	(0.012)	0.060 ***	(0.012)	0.064 ***	(0.012)	0.056 ***	(0.012)	0.107 ***	(0.012)	0.096 ***	(0.012)
Maturity 3 years-5 years	0.082 ***	(0.013)	0.101 ***	(0.013)	0.100 ***	(0.013)	0.098 ***	(0.014)	0.114 ***	(0.013)	0.109 ***	(0.013)
Indeterminate maturity	0.655 ***	(0.013)	0.699 ***	(0.013)	0.712 ***	(0.013)	0.740 ***	(0.013)	0.766 ***	(0.013)	0.798 ***	(0.013)
100% guarantees (collateral)	0.282 ***	(0,010)	0.267 ***	(0.010)	0.250 ***	(0.010)	0.236 ***	(0.010)	0.267 ***	(0.010)	0.292 ***	(0.010)
Partial guarantees (>50%)	0.450 ***	(0.039)	0.471 ***	(0.040)	0.451 ***	(0.039)	0.457 ***	(0.040)	0.448 ***	(0.039)	0.394 ***	(0.039)
Other guarantees	-0.094 ***	(0.035)	-0.018	(0.035)	-0.071 **	(0.035)	0.020	(0.035)	-0.026	(0.035)	0.121 ***	(0.034)
1988-01	-1.146 ***	(0.011)	-1.133 ***	(0.011)	-1.139 ***	(0.011)	-1.119 ***	(0.011)				
1990-12	-1.032 ***	(0.008)	-1.009 ***	(0.008)	-1.029 ***	(0.008)	-1.011 ***	(0.008)				
1997-12	-0.900 ***	(0.007)	-0.917 ***	(0.007)	-0.913 ***	(0.007)	-0.931 ***	(0.007)				
2000-12	-1.956 ***	(0.009)	-1.978 ***	(0.009)	-1.979 ***	(0.010)	-1.960 ***	(0.010)				
GDP_t growth									-0.129 ***	(0.002)		
GDP_{t-1} growth									-0.215 ***	(0.003)		
Size 60-150 thousand €	-0.010	(0.007)	-0.018 ***	(0.007)	0.011 *	(0.007)			-0.023 ***	(0.007)	-0.042 ***	(0.006)
Size 150-300 thousand €	-0.017 *	(0.009)	-0.030 ***	(0.009)	0.024 ***	(0.009)			0.006	(0.009)	-0.016 ***	(0.009)
Size 300-600 thousand €	-0.004	(0.011)	-0.025 **	(0.011)	0.048 ***	(0.011)			0.030 ***	(0.011)	0.021 ***	(0.011)
Size 0.6-1.5 mio. €	0.019	(0.014)	-0.012	(0.014)	0.080 ***	(0.014)			0.063 ***	(0.014)	0.051 ***	(0.014)
Size 1.5-3 mio. €	0.024	(0.024)	-0.010	(0.025)	0.097 ***	(0.024)			0.079 ***	(0.024)	0.050 ***	(0.024)
Size 3-6 mio. €	-0.140 ***	(0.038)	-0.153 ***	(0.038)	-0.059	(0.038)			-0.076 **	(0.038)	-0.089 ***	(0.038)
Size 6-15 mio. €	-0.377 ***	(0.058)	-0.367 ***	(0.058)	-0.290 ***	(0.058)			-0.313 ***	(0.058)	-0.329 ***	(0.057)
Size 15-30 mio. €	-0.531 ***	(0.126)	-0.525 ***	(0.127)	-0.450 ***	(0.126)			-0.467 ***	(0.126)	-0.501 ***	(0.125)
Size >30 mio. €	-0.887 ***	(0.192)	-0.899 ***	(0.193)	-0.819 ***	(0.192)			-0.836 ***	(0.192)	-0.859 ***	(0.191)
Farming and fishing	-0.019	(0.015)	0.025	(0.015)	0.010	(0.015)	0.014	(0.015)	0.046 ***	(0.015)	0.019 ***	(0.015)
Mining	-0.066 **	(0.031)	0.061 *	(0.031)	0.000	(0.031)	0.073 **	(0.031)	0.028	(0.031)	0.031 ***	(0.031)
Manufacturing	-0.123 ***	(0.008)	0.010	(0.008)	-0.050 ***	(0.008)	0.021 **	(0.008)	-0.017 **	(0.008)	0.000 ***	(0.008)
Electrical services, gas and water	-0.545 ***	(0.046)	-0.398 ***	(0.046)	-0.491 ***	(0.046)	-0.092 **	(0.046)	-0.470 ***	(0.046)	-0.425 ***	(0.045)
Trade	-0.082 ***	(0.009)	-0.012	(0.009)	-0.033 ***	(0.009)	-0.043 ***	(0.009)	-0.015 *	(0.009)	0.001 ***	(0.009)
Hotels and catering	0.068 ***	(0.019)	0.023	(0.019)	0.060 ***	(0.019)	-0.003	(0.019)	0.056 ***	(0.019)	0.050 ***	(0.019)
Transport	-0.058 ***	(0.013)	-0.007	(0.013)	-0.023 *	(0.013)	-0.041 ***	(0.013)	-0.025 *	(0.013)	0.125 ***	(0.013)
Financial intermediation	-0.024	(0.037)	0.010	(0.037)	-0.019	(0.037)	0.093 **	(0.037)	0.008	(0.037)	0.008 ***	(0.036)
Computing, R&D	-0.068 ***	(0.012)	-0.085 ***	(0.012)	-0.072 ***	(0.012)	-0.123 ***	(0.012)	-0.118 ***	(0.012)	-0.130 ***	(0.012)
Other services	0.012	(0.012)	0.015	(0.012)	0.019	(0.012)	-0.013	(0.012)	0.042 ***	(0.012)	0.015 ***	(0.012)
Saving banks	0.198 ***	(0.007)	0.189 ***	(0.007)	0.215 ***	(0.007)	0.165 ***	(0.007)	0.170 ***	(0.006)	0.173 ***	(0.006)
Credit cooperatives	0.096 ***	(0.016)	0.076 ***	(0.016)	0.120 ***	(0.016)	0.043 ***	(0.016)	0.045 ***	(0.016)	0.022 ***	(0.015)
Credit finance establishments	0.248 ***	(0.016)	0.266 ***	(0.016)	0.279 ***	(0.016)	0.248 ***	(0.016)	0.350 ***	(0.015)	0.377 ***	(0.015)
Single record			0.791 ***	(0.007)	0.584 ***	(0.007)	0.184 ***	(0.008)	0.559 ***	(0.007)		
Relative weigth between 0.6 and 1			0.580 ***	(0.009)							0.538 ***	(0.007)
Relative weight between 0.3 and 0.6			0.462 ***	(0.007)								
Size of the borrower							-0.1705 ***	(0.003)				
No. of borrower's banking relationships							-0.0143 ***	(0.001)				
Chi-square / (p-value)	74,913 /	(0.0001)	87,802 /	(0.0001)	81,276 /	(0.0001)	93,228 /	(0.0001)	70,532 /	(0.0001)	23,138 /	(0.0001)
-2*Log-likelihood	1,088,933		1,076,042		1,082,569		1,070,618		1,093,314		1,140,707	
No. observations / Defaults	3,167,326 /	4.51%	3,167,326 /	4.51%	3,167,326 /	4.51%	3,167,326 /	4.51%	3,167,326 /	4.51%	3,167,326 /	4.51%
Association of predicted probabilities and observed responses												
Concordant	69.5%		71.6%		70.7%		72.3%		68.5%		60.0%	
Tied	1.9%		1.6%		1.7%		1.5%		2.3%		3.7%	

Notes: 1. The constant term will determine the probability of default for the reference group (Model 1), for credits with the following characteristics: credit finance, in pesetas (euros), over more than five years, unsecured, for a value of between 24 and 60 thousand euros, property sector borrower, lent by a bank in Andalucía.
2. Standard deviations of the coefficients (S.D.) in brackets *** variable significant at the 1%, ** at the 5%, and * at the 10%.

Table 4. Cross-section estimation of the PD equation (1988:01, 1990:12, 1993:12, 1997:12 and 2000:12)

Legal Persons	1988		1990		1993		1997		2000	
Variables	Coefficient	S.D.	Coefficient	S.D.	Coefficient	S.D.	Coefficient	S.D.	Coefficient	S.D.
Constant	-3.297 ***	(0.057)	-3.064 ***	(0.036)	-1.937 ***	(0.022)	-2.805 ***	(0.028)	-4.094 ***	(0.042)
Commercial credit	-0.205 ***	(0.025)	-0.112 ***	(0.019)	-0.291 ***	(0.012)	-0.248 ***	(0.017)	-0.157 ***	(0.025)
Documentary credit	-1.151 ***	(0.200)	-0.821 ***	(0.160)	-0.975 ***	(0.107)	-1.145 ***	(0.147)	-0.885 ***	(0.209)
Fixed income	-0.958 ***	(0.199)	-0.846 ***	(0.227)	-1.509 ***	(0.263)	-0.561 *	(0.324)	-0.304	(0.585)
Leasing	–	–	-0.384 ***	(0.057)	0.022	(0.027)	-0.264 ***	(0.028)	-0.473 ***	(0.040)
Factoring	–	–	-0.988 ***	(0.309)	-1.132 ***	(0.151)	-1.636 ***	(0.175)	-1.585 ***	(0.166)
Loans or cred. transf. to a third party	–	–	--	--	--	--	-0.726 *	(0.415)	-0.780 ***	(0.140)
Currency different from euros	-0.845 ***	(0.117)	-1.587 ***	(0.098)	-1.265 ***	(0.049)	-1.213 ***	(0.070)	-1.043 ***	(0.099)
Maturity <3 moths	0.144 ***	(0.046)	0.090 ***	(0.031)	0.380 ***	(0.019)	0.444 ***	(0.027)	0.523 ***	(0.038)
Maturity 3 moths-1 year	-0.317 ***	(0.046)	-0.270 ***	(0.030)	-0.076 ***	(0.018)	0.006	(0.024)	0.206 ***	(0.035)
Maturity 1 year-3 years	-0.324 ***	(0.049)	-0.047	(0.031)	0.042 **	(0.019)	0.111 ***	(0.024)	0.146 ***	(0.036)
Maturity 3 years-5 years	0.018	(0.055)	0.048	(0.034)	0.099 ***	(0.021)	0.047 *	(0.026)	0.065 *	(0.039)
Indeterminate maturity	0.433 ***	(0.049)	0.422 ***	(0.034)	0.649 ***	(0.020)	0.705 ***	(0.026)	0.870 ***	(0.037)
100% guarantees (collateral)	0.493 ***	(0.036)	0.215 ***	(0.027)	0.238 ***	(0.016)	0.376 ***	(0.021)	0.164 ***	(0.032)
Partial guarantees (>50%)	0.652 ***	(0.105)	0.430 ***	(0.093)	0.335 ***	(0.068)	0.631 ***	(0.083)	0.285 **	(0.114)
Other guarantees	0.106	(0.130)	-0.180 **	(0.081)	-0.698 ***	(0.058)	0.572 ***	(0.070)	0.781 ***	(0.089)
Size 60-150 thousand €	0.063 ***	(0.023)	0.092 ***	(0.016)	0.019 *	(0.010)	-0.059 ***	(0.013)	-0.210 ***	(0.019)
Size 150-300 thousand €	0.098 ***	(0.030)	0.052 **	(0.021)	0.019	(0.014)	-0.068 ***	(0.019)	-0.257 ***	(0.027)
Size 300-600 thousand €	0.172 ***	(0.037)	0.069 **	(0.027)	0.027	(0.018)	-0.053 **	(0.025)	-0.315 ***	(0.036)
Size 0.6-1.5 mio. €	0.168 ***	(0.047)	0.033	(0.034)	0.070 ***	(0.022)	0.016	(0.031)	-0.331 ***	(0.046)
Size 1.5-3 mio. €	0.348 ***	(0.075)	0.061	(0.057)	0.087 **	(0.038)	-0.014	(0.056)	-0.503 ***	(0.082)
Size 3-6 mio. €	0.331 ***	(0.111)	0.066	(0.085)	-0.010	(0.056)	-0.509 ***	(0.103)	-0.944 ***	(0.149)
Size 6-15 mio. €	0.246	(0.157)	0.091	(0.119)	-0.316 ***	(0.087)	-1.011 ***	(0.177)	-1.132 ***	(0.220)
Size 15-30 mio. €	0.549 **	(0.260)	-0.209	(0.273)	-0.605 ***	(0.203)	-0.936 ***	(0.358)	-2.088 ***	(0.709)
Size >30 mio. €	0.550 *	(0.328)	-0.165	(0.385)	-1.310 ***	(0.360)	-1.625 ***	(0.582)	-9.012 ***	(0.379)
Farming and fishing	0.015	(0.049)	0.290 ***	(0.034)	-0.137 ***	(0.025)	-0.147 ***	(0.032)	0.023	(0.044)
Mining	0.036	(0.086)	0.012	(0.074)	-0.103 **	(0.049)	-0.200 ***	(0.069)	-0.007	(0.100)
Manufacturing	-0.153 ***	(0.030)	0.008	(0.021)	-0.207 ***	(0.013)	-0.133 ***	(0.017)	0.030	(0.026)
Electrical services, gas and water	-1.274 ***	(0.173)	-0.731 ***	(0.134)	-0.630 ***	(0.071)	-0.462 ***	(0.092)	0.070	(0.116)
Trade	-0.246 ***	(0.033)	-0.039 *	(0.022)	-0.140 ***	(0.014)	-0.060 ***	(0.018)	0.132 ***	(0.026)
Hotels and catering	-0.128	(0.083)	0.263 ***	(0.047)	-0.008	(0.031)	0.064 *	(0.037)	0.182 ***	(0.053)
Transport	-0.262 ***	(0.061)	0.013	(0.037)	-0.067 ***	(0.018)	-0.097 ***	(0.028)	-0.080 *	(0.043)
Financial intermediation	-0.323 **	(0.127)	-0.078	(0.094)	-0.213 ***	(0.062)	0.307 ***	(0.067)	0.145	(0.112)
Computing, R&D	-0.043	(0.061)	-0.018	(0.037)	-0.133 ***	(0.020)	-0.045 **	(0.022)	0.018	(0.033)
Other services	0.043	(0.048)	0.157 ***	(0.027)	-0.021	(0.019)	-0.050 **	(0.023)	0.021	(0.036)
Saving banks	0.177 ***	(0.025)	0.397 ***	(0.017)	0.210 ***	(0.010)	0.088 ***	(0.013)	0.111 ***	(0.019)
Credit cooperatives	0.079	(0.065)	0.163 ***	(0.046)	0.070 ***	(0.027)	0.017	(0.029)	0.236 ***	(0.037)
Credit finance establishments	–	–	0.203 ***	(0.053)	0.309 ***	(0.026)	0.070 **	(0.028)	0.366 ***	(0.039)
Chi-square / (p-value)	2,147 /	(0.0001)	4,343 /	(0.0001)	8,480 /	(0.0001)	5,113 /	(0.0001)	2,089 /	(0.0001)
-2*Log-likelihood	96,430		193,603		377,641		268,286		147,922	
No. observations / Defaults	334,384 /	3.37%	608,379 /	3.84%	582,706 /	10.29%	746,344 /	4.49%	895,513 /	1.64%
Association of predicted probabilities and observed responses										
Concordant	59.8%		59.3%		60.4%		59.1%		55.1%	
Tied	4.5%		4.2%		1.7%		3.7%		10.2%	

Notes: 1. The constant term will determine the probability of default for the reference group, for credits with the following characteristics: credit finance, in pesetas (euros), over more than five years, unsecured, for a value of between 24 and 60 thousand euros, property sector borrower, lent by a bank in Andalucía.
2. Standard deviations of the coefficients (S.D.) in brackets *** variable significant at the 1%, ** at the 5%, and * at the 10%.

Table 5. Distribution by guarantees (pool)

Legal Persons	100% Guarantees (%)	Unsecured (%)
Commercial credit	1.50	32.64
Financial credit	96.37	55.58
Documentary credit	0.15	1.11
Fixed income	0.29	0.14
Leasing	1.12	9.93
Factoring	0.00	0.41
Loans or cred. transf. to a third party	0.56	0.19
Maturity <3 moths	3.49	30.19
Maturity 3 months-1 year	5.29	30.39
Maturity 1 year-3 years	7.78	19.31
Maturity 3 years-5 years	10.70	7.28
Maturity >5 years	69.21	5.35
Indeterminate maturity	3.53	7.48
1988-01	6.46	11.10
1990-12	13.11	19.97
1993-12	17.94	18.44
1997-12	26.72	23.21
2000-12	35.76	27.28
Size 24-60 thousand €	42.88	49.71
Size 60-150 thousand €	32.16	35.91
Size 150-300 thousand €	12.51	15.26
Size 300-600 thousand €	6.36	7.89
Size 0.6-1.5 mio. €	3.92	4.62
Size 1.5-3 mio. €	1.27	0.15
Size 3-6 mio. €	0.55	0.70
Size 6-15 mio. €	0.26	0.40
Size 15-30 mio. €	0.06	0.10
Size >30 mio. €	0.03	0.07
Banks	42.90	64.93
Saving banks	48.92	23.08
Credit cooperatives	4.65	3.40
Credit finance establishments	3.53	8.59

Table 6. The role of collateral. Estimation of the PD equations using pooled cross-sections (1988:01, 1990:12, 1993:12, 1997:12 and 2000:12)

Legal Persons	Model 7		Model 8	
Variables	Coefficient	S.D.	Coefficient	S.D.
Constant	-2.142 ***	(0.015)	-2.090 ***	(0.017)
Commercial credit	-0.248 ***	(0.008)	-0.241 ***	(0.008)
Documentary credit	-0.975 ***	(0.068)	-0.966 ***	(0.067)
Fixed income	-1.268 ***	(0.161)	-0.961 ***	(0.117)
Leasing	-0.218 ***	(0.016)	-0.198 ***	(0.017)
Factoring	-1.336 ***	(0.090)	-1.361 ***	(0.090)
Loans or cred. transf. to a third party	-0.968 ***	(0.184)	-0.792 ***	(0.132)
100% guarantees *Commercial credit	0.139 **	(0.062)		
100% guarantees *Documentary credit	0.108	(0.345)		
100% guarantees *Fixed income	0.920 ***	(0.233)		
100% guarantees *Leasing	0.699 ***	(0.057)		
100% guarantees *Factoring	1.584 **	(0.778)		
100% guarantees *Loans	0.268	(0.265)		
Currency different from euros	-1.184 ***	(0.034)	-1.191 ***	(0.034)
Maturity <3 moths	0.360 ***	(0.013)	0.287 ***	(0.015)
Maturity 3 moths-1 year	-0.047 ***	(0.012)	-0.127 ***	(0.015)
Maturity 1 year-3 years	0.041 ***	(0.012)	-0.058 ***	(0.015)
Maturity 3 years-5 years	0.079 ***	(0.014)	-0.011	(0.017)
Indeterminate maturity	0.693 ***	(0.013)	0.620 ***	(0.016)
100% guarantees *Maturity <3m.			0.079 **	(0.037)
100% guarantees *Maturity 3m.-1y.			0.256 ***	(0.035)
100% guarantees *Maturity 1y.-3y.			0.343 ***	(0.029)
100% guarantees *Maturity 3y.-5y.			0.145 ***	(0.029)
100% guarantees *Indet. Maturity			0.033	(0.037)
100% guarantees (collateral)	0.108 ***	(0.014)	0.198 ***	(0.021)
Partial guarantees (>50%)	0.442 ***	(0.039)	0.415 ***	(0.040)
Other guarantees	-0.061 *	(0.035)	-0.078 **	(0.035)
1988-01	-1.139 ***	(0.011)	-1.172 ***	(0.011)
1990-12	-1.032 ***	(0.008)	-1.039 ***	(0.009)
1997-12	-0.910 ***	(0.007)	-0.916 ***	(0.008)
2000-12	-1.977 ***	(0.010)	-1.919 ***	(0.010)
100% guarantees *1988-01			0.320 ***	(0.032)
100% guarantees *1990-12			0.101 ***	(0.024)
100% guarantees *1997-12			0.024	(0.019)
100% guarantees *2000-12			-0.333 ***	(0.026)
Size 60-150 thousand €	0.000	(0.007)	0.011 *	(0.007)
Size 150-300 thousand €	-0.012	(0.010)	0.022 **	(0.009)
Size 300-600 thousand €	-0.016	(0.013)	0.045 ***	(0.011)
Size 0.6-1.5 mio. €	0.018	(0.016)	0.076 ***	(0.014)
Size 1.5-3 mio. €	0.033	(0.027)	0.090 ***	(0.024)
Size 3-6 mio. €	-0.125 ***	(0.042)	-0.066 *	(0.038)
Size 6-15 mio. €	-0.444 ***	(0.066)	-0.298 ***	(0.058)
Size 15-30 mio. €	-0.506 ***	(0.136)	-0.460 ***	(0.126)
Size >30 mio. €	-0.904 ***	(0.207)	-0.828 ***	(0.192)
100% guarantees *Size 60-150	0.073 ***	(0.019)		
100% guarantees *Size 150-300	0.244 ***	(0.024)		
100% guarantees *Size 300-600	0.415 ***	(0.031)		
100% guarantees *Size 0.6-1.5	0.396 ***	(0.038)		
100% guarantees *Size 1.5-3	0.399 ***	(0.064)		
100% guarantees *Size 3-6	0.424 ***	(0.101)		
100% guarantees *Size 6-15	0.932 ***	(0.141)		
100% guarantees *Size 15-30	0.454	(0.372)		
100% guarantees *Size >30	0.723	(0.558)		
Farming and fishing	0.009	(0.015)	0.002	(0.015)
Mining	0.002	(0.031)	-0.003	(0.031)
Manufacturing	-0.049 ***	(0.008)	-0.053 ***	(0.008)
Electrical services, gas and water	-0.482 ***	(0.046)	-0.503 ***	(0.046)
Trade	-0.033 ***	(0.009)	-0.036 ***	(0.009)
Hotels and catering	0.060 ***	(0.019)	0.055 ***	(0.019)
Transport	-0.023 *	(0.013)	-0.028 **	(0.013)
Financial intermediation	-0.015	(0.037)	-0.024	(0.037)
Computing, R&D	-0.073 ***	(0.012)	-0.077 ***	(0.012)
Other services	0.018	(0.012)	0.013	(0.012)
Saving banks	0.216 ***	(0.007)	0.241 ***	(0.007)
Credit cooperatives	0.119 ***	(0.016)	0.092 ***	(0.017)
Credit finance establishments	0.286 ***	(0.016)	0.306 ***	(0.017)
100% guarantees *Saving banks			-0.151 ***	(0.017)
100% guarantees *Credit cooperatives			0.118 ***	(0.039)
100% guarantees *Credit Finance S.			-0.179 ***	(0.041)
Single record	0.590 ***	(0.007)	0.590 ***	(0.007)
Chi-square / (p-value)	81,795 /	(0.0001)	81,970 /	(0.0001)
-2*Log-likelihood	1,082,050		1,081,875	
No. observations / Defaults	3,167,326 /	4.51%	3,167,326 /	4.51%
Association of predicted probabilities and observed responses				
Concordant		70.7%	70.8%	
Tied		1.7%	1.7%	

Notes: 1. The constant term will determine the probability of default for the reference group for credits with the following characteristics: credit finance, in pesetas (euros), over more than five years, unsecured, for a value of between 24 and 60 thousand euros, property sector borrower, lent by a bank in Andalucía.

2. Standard deviations of the coefficients (S.D.) in brackets *** variable significant at the 1%, ** at the 5%, and * at the 10%.

Table 7. Predicted probabilities (%)

Legal Persons	Predicted Probabilities (%)				
	1988	1990	1993	1997	2000
Standard	3.57	4.46	12.59	5.71	1.64
BUT					
Commercial credit	2.92	4.01	9.72	4.51	1.41
Documentary credit	1.16	2.01	5.16	1.89	0.68
Fixed income	1.40	1.97	3.09	3.34	1.22
Leasing	--	3.08	12.83	4.44	1.03
Factoring	--	1.71	4.44	1.17	0.34
Loans or cred. transf. to a third party	--	--	--	2.84	0.76
Currency different from euros	1.57	0.95	3.91	1.77	0.58
Maturity <3 moths	4.10	4.86	17.40	8.62	2.73
Maturity 3 moths-1 year	2.62	3.44	11.78	5.74	2.01
Maturity 1 year-3 years	2.61	4.27	13.06	6.33	1.89
Maturity 3 years-5 years	3.63	4.67	13.72	5.97	1.75
Indeterminate maturity	5.40	6.65	21.62	10.91	3.82
100% guarantees (collateral)	5.71	5.48	15.46	8.10	1.93
Partial guarantees (>50%)	6.63	6.70	16.77	10.21	2.17
Other guarantees	3.95	3.75	6.69	9.68	3.51
Size 60-150 thousand €	3.79	4.87	12.81	5.40	1.33
Size 150-300 thousand €	3.92	4.69	12.80	5.35	1.27
Size 300-600 thousand €	4.21	4.76	12.89	5.42	1.20
Size 0.6-1.5 mio. €	4.19	4.60	13.38	5.79	1.18
Size 1.5-3 mio. €	3.79	4.73	13.58	5.63	1.00
Size 3-6 mio. €	3.92	4.75	12.49	3.51	0.64
Size 6-15 mio. €	4.21	4.87	9.51	2.16	0.53
Size 15-30 mio. €	4.19	3.65	7.30	2.32	0.21
Size >30 mio. €	4.98	3.81	3.74	1.18	0.00
Farming and fishing	4.52	5.88	11.17	4.96	1.68
Mining	6.02	4.52	11.50	4.72	1.63
Manufacturing	6.02	4.50	10.48	5.03	1.69
Electrical services, gas and water	3.57	2.20	7.13	3.67	1.76
Trade	3.62	4.30	11.13	5.39	1.87
Hotels and catering	3.69	5.73	12.51	6.06	1.96
Transport	3.08	4.52	11.88	5.21	1.51
Financial intermediation	1.02	4.14	10.43	7.60	1.89
Computing, R&D	2.81	4.39	11.21	5.47	1.67
Other services	3.15	5.18	12.37	5.44	1.67
Saving banks	4.04	6.49	15.09	6.20	1.83
Credit cooperatives	3.84	5.21	13.39	5.80	2.07
Credit finance establishments	--	5.41	16.40	6.09	2.35

Note: Standard: credit finance, in pesetas (euros), over more than five years, unsecured, for a value of between 24 and 60 thousand euros, property sector borrower, lent by a bank in Andalucía.

Figure 1. Density functions estimated for the predicted probabilities (1988, 1990, 1993, 1997 and 2000). Number of credits

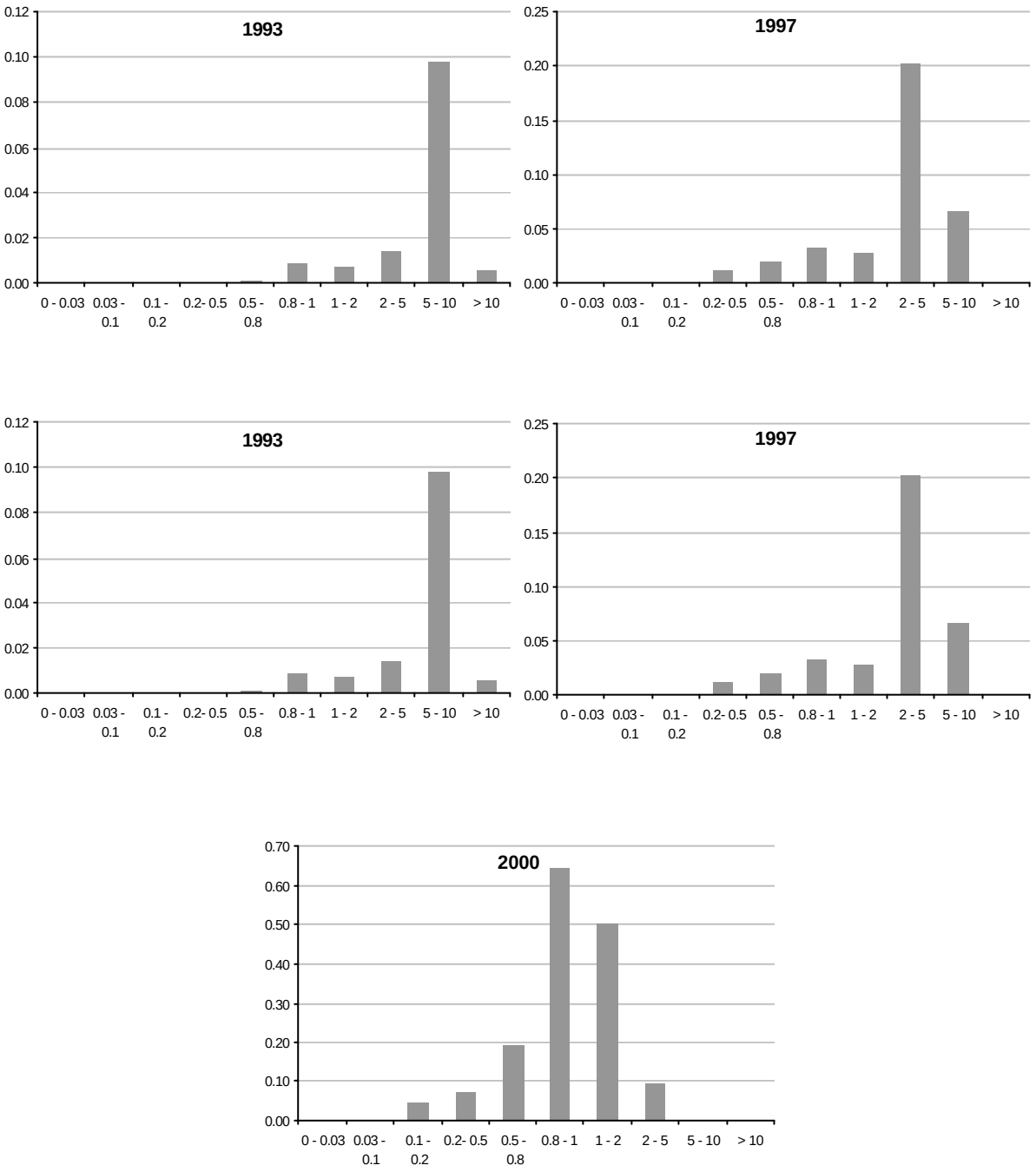

Figure 2. Density functions estimated for the predicted probabilities (1988, 1990, 1993, 1997 and 2000). Credit drawn