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Credit Constraints and Small Business Credit Availability

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Dedication

I dedicate this dissertation to my husband Nuno and my daughter Maria who have been my safe harbour in all my adventures. Above all, for the invaluable family support that overcame the several flaws I committed due to the circumstances, and for the patience and understanding revealed.

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"It is very important that man has ideas. Without them we will go nowhere"

Dalai Lama

I also thank my friends for having understood my absence during the required time spent on this project.

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Resumo

Este estudo analisa efeito dos modelos de informação privada ex ante versus ex post nos quais as garantias (colateral) são usadas para mitigar a assimetria de informação entre mutuários e credores. O estudo analisa empiricamente as diferenças entre informação privada e pública para testar as duas teorias. Utilizando dados de um grande banco comercial português relativamente a 38 639 contractos de créditos concedidos a PME durante o período de Janeiro de 2007 a Fevereiro de 2012, os resultados mostram que os mutuários que apresentam um menor nível de risco são mais susceptíveis de aceitar contratos com prestação de garantias adicionais por forma a obter uma redução na taxa de juro. Estes resultados sustentam empiricamente o modelo ex ante. Os resultados também mostram que a teoria ex post é dominante nos mutuários que no passado estiveram em incumprimento. Dado que a um terço dos créditos está associado uma garantia mútua, os resultados mostram que os mutuários que outrora registaram incumprimento e/ou restrições em apresentar garantias adicionais vêem a sua possibilidade de financiamento reduzida. Os resultados são robustos quando controlamos o montante das garantias prestadas e as condições macroeconómicas. Concluísse-se assim que em períodos de recessão económica e com a desvalorização dos activos, os credores solicitam cada vez mais garantias adicionais.

Palavras-chave

Colateral, Assimetria de Informação, Racionamento de Crédito, Relacionamento Bancário, PME.

Abstract

This study investigates the effect of the ex ante private information versus ex post model in which collateral is used to overcome incentive conflicts between borrowers and lenders, and thus mitigating credit rationing. The study empirically examines differences in private and public information to test the two set of theories. Using a database of 38 639 SME credit approvals from a large Portuguese commercial bank between January 2007 to February 2012, the results show that less risky borrowers are more likely to accept an increase in collateral requirements for certain reduction in the interest rate. These results support the ex ante theory. The results also indicate that the ex post theory dominate for borrowers who had default on a loan in the past. Moreover, because one third of the loans have associated a mutual guarantee, the findings suggest that borrowers that default or are not able to provide additional guarantees are credit rationed. Furthermore, the results are robust when we control the amount of collateral pledge and the macroeconomic conditions. Therefore, in periods of economic contraction and declining in asset values lenders are more likely to require collateral.

Keywords

Collateral, Asymmetric Information, Credit Rationing, Relationship Lending, SMEs.

Contents

List of tables

List of Acronyms

Basel II	New Basel Capital Accord
BCE	European Central Bank
BP	Banco de Portugal
CAE	Economic Activity Code
CGD	Caixa Geral de Depósitos
GDP	Gross Domestic Product
IMF	International Monetary Fund
OLS	Ordinary Least Squares
SME	Small and Medium-sized Enterprise
UE	European Union
US	United States
VIF	Variance Inflation Factor

1. Introduction

In industrialized countries, small and medium-sized enterprises (SMEs) represent more than 90% of all firms. They employ about two-thirds of the workforce and contribute to nearly 50% of the value added in non-agricultural production. They are often considered to play an important role in growth promotion and poverty reduction (World Bank, 1994; 2002; 2004; Beck et al., 2003; Wagenvoort, 2003).

Nevertheless, and it seems to be a global phenomenon, SMEs are confronted with relatively harsh credit constraints (Beck and Maksimovic, 2002; European Commission, 2002; Beck et al., 2003).

The deepening crisis of sovereign debt in the euro area and the consequent increase of systemic risk in European countries have contributed to deepen the problem of financing by domestic banks. These effects, together with the increased credit risk associated with national economic agents, resulted in a tightening of the credit supply.

According to the survey, the Portuguese credit market conducted by the Bank of Portugal (BP) (2012), the tightening in credit policy is a consequence of an increase in the banks funding costs, balance sheet constraints and an increase in their portfolio risk. As a result, currently, Portuguese banks apply more stringent contractual terms, which resulted in an increase in spreads (with special emphasis on higher risk loans), but also the application of other terms slightly more restrictive, in particular, in the case of small companies, the reduction of the maturity of the loans, contractual non-monetary conditions (covenants) and the reinforcement of guarantees required. The role of collateral in loan contracts reflects the incentive and signaling effects, which determine moral hazard and adverse selection problems under asymmetric information. Moreover, collateralization may induce a borrower to reveal its otherwise hidden risks (Lehmann and Neuberger,2001).

The pledging of collateral to secure loans is a widespread and important feature of the credit acquisition process (e.g., Berger and Udell, 1990), particularly in small business credit contracts. The question why some loans are granted without collateral and other loans require collateral and the pledge assets tendency to be heterogeneous remains an open issue. Moreover, the recent financial crisis and the recent research that suggest that the significant decline in real estate collateral value in Japan in the early 1990s (Gan, 2007), and the more recent procyclical effect that occurred in the US and other nations triggered in 2007 by the collapse in real estate collateral values (Berger et al., 2011) have raised significant academic and policy interest in understanding the role of collateral in debt contracts (Berger et al. 2011).

The theoretical literature offers two broad classes of theories about why borrowers pledge collateral. The first set of theories motivates collateral as a way for good borrowers to signal their quality under conditions of ex ante private information. The second set of theories explains collateral as an optimal response to ex post contract frictions such as moral hazard. Although the extensive theoretical and empirical literature on evidence about secured debt contracts (e.g., Brick et al. 2007; Petersen and Rajan, 1994; Berger and Udell, 1995), the existing empirical literature has been unable to isolate the effect of these two theories. Thus, the objective of this paper is to test empirically the ex ante private information/signal models and ex post models in which collateral is used to overcome the credit constraints faced by SMEs.

Using a large data set of 38 639 loans granted by Caixa Geral de Depósitos (CGD), the main findings of the study can be summarized as follows. In line with the ex ante theory, the results show that less risky borrowers are more likely to accept an increase in collateral requirements for certain reduction in the interest rate. The findings also indicate that the ex post theory dominate in borrowers who had default on a loan any time, suggesting that borrowers that default or are not able to provide additional guarantees are credit rationed. The results are robust when we control the amount of collateral pledge and the macroeconomic conditions.

The paper is structured as follows. Section 2 discusses theoretical background about credit rationing, lending techniques and a literature review about the role of collateral in debt term contracts. Section 3 provides a description of dataset, variables and method. Section 4 presents and discusses the results. Section 5 concludes with a summary of the main findings and the limitations of the study as well as prospects for further investigations.

2.Literature Review

2.1. Credit Rationing

The relationship between SMEs and banks is characterized by asymmetric information, adverse selection and moral hazard, which may lead to the problem of credit rationing. Credit rationing occurs if a potential borrower lacks access to credit, even though she/he agrees to pay a higher interest rate for money than the price prevailing in the market (Jaffee and Russell, 1976). In this context, high interest rates tend to attract higher-risk borrowers, whose projects probably do not prosper enough to cover the cost of money (Stiglitz and Weiss, 1981). Consequently, when interest rates become higher, the average risks of the projects increases, threatening the expectation of return of the lender. Thus, if firms do not behave diligently, credit rationing may be the best solution to lenders (Bester and Hellwig, 1987). Therefore, as stated by Zambaldi et al. (2011) small business borrowers face credit rationing and it is one of the most important examples of market failure in our modern economy.

Financiers such as banks take various factors into account when making a decision about a credit transaction with SME's (Zambaldi et al. 2011). The uncertainty surrounding the investment project and the borrower's ability are the most relevant issues in a financial contract because of information asymmetry. Information asymmetry is prevalent if a firm knows the expected risk and return of its project, while the bank only knows the average expected return and risk of an average project in the economy (Steijvers, 2008) and according to Bebcuzk (2003) can adopt the following types: adverse selection and moral hazard.

Adverse selection is a term used to refer to a market process in which bad results occur when buyers and sellers have access to different information. This phenomenon arises because the set of information about the credit applicant is incomplete and/or uncertain. Adverse selection is the bank's impossibility to distinguish between proponents of credit with low credit risk and proponents with high levels of risk (Stiglitz and Weiss, 1981). That means that a lender suffers adverse selection when it is not capable of distinguishing between projects with different credit risk when allocating credit which gives the firm an unfair advantage (Bebczuk, 2003; Besanko and Thankor, 1987 a, b).

By moral hazard we mean the borrower's ability to apply the funds to different uses then those agreed upon with the lender (Bebczuk, 2003). They can opt for a different project once in possession of the funds, thus it is difficult to the bank to control the borrower's credit after the formalization of the contract. Accordingly, the moral hazard implies a change in behaviour by one (or more) of the parties, contrary to what one would expect to the

agreement reached in order to obtain an advantage/benefit (e.g., the underinvestment problem – Jensen and Meckling, 1976). When the creditors realize these problems, they will demand higher interest rates without increasing the risk of default implicit in expensive loans (Zambaldi et al., 2011), management of credit contracts by means of loan collateralization and securitization (Mester, 1997) and screening of borrower's credit behaviour (Baas and Schrooten, 2006).

2.2. Lending Techniques

The expected return to the bank depends obviously on the probability of repayment, hence the bank would like to be able to identify borrowers who are more likely to reimburse. But it is difficult to identify such borrowers (Craig et al., 2007). Thus, banks develop banking techniques that deal with information asymmetry when trying to expand credit activities to small business loans.

The literature distinguishes between two types of lending decision processes: banking relationship and statement – or ratio – lending. A relationship lending depends on both objective and subjective information about borrowers, which the bank obtains through its relationships with customers (Diamond, 1989). It is often considered as the most appropriate lending technique for collecting information on SMEs, since reliable information on these type of firms is rare and costly (Elsas and Krahnen, 1998). Due to the insufficiency of accounting information for SMEs on the process of credit decision and the efforts to reduce asymmetries (and opacity) of the existent information between banks and SME'S, the banking relationship seems to have been assuming a key role in the process of evaluation of the credit risk. This relationship between lenders and borrowers is often considered as the most appropriate lending techniques for collecting information on SME's (Boot and Milbourn, 2002) and contribute to reduce asymmetries. As a consequence, relationship lending should improve the bank's knowledge of the characteristics of both the firm and its projects, making it less risky for the bank to grant a loan. The proximity between the bank and the borrower has been proved to facilitate the monitoring and the screening and can overcome problems of asymmetric information. Screening techniques in the pre-contract stage enables the selection process of the proponents to be more efficient, on the other hand monitoring techniques (supervision and control) allow us to put in practice a set of mechanisms to sanction in case of failure by the borrower's credit at the same time minimizing the costs of the agency. For the borrower, this should translate into an increased availability of debt and a lower cost of capital (Petersen and Rajan 1994; Boot and Thakor 1994). Therefore, this lending technology addresses the problem of SMEs' information opacity (Neuberger et al., 2008; Steijvers and Voordeckers 2009; Wu et al., 2008) and, thus solving the credit rationing problem (Ogawa and

Suzuki 2000; Jacobson et al., 2005; Baas and Schrooten 2006; Steijvers and Voordeckers 2009).

Beyond relationship lending the bank customer relationship can be also characterized by transaction lending which is based primarily on "hard" quantitative data and is focused on transparent information borrowers (Neuberger et al., 2008; Wu et al., 2008). In line with Berger and Udell (2002) transactions lending technologies are distinguished primarily by the source and type of information used like financial ratios for financial statement lending; the quantity and quality of the available collateral; usually accounts receivable and inventory for asset-based lending; and the financial condition and history of the main owner of the firm for small business credit scoring.

The use of a transactional lending technology like credit scoring models is relatively new, but it is a growing practice in the area of SMEs lending. Therefore, generally only SMEs with sufficient solid information available receive transactions credit from banks (Berger and Udell, 2006). Similar to capital market investors that rely on external credit ratings provided by rating agencies, banks assign internal credit ratings to evaluate the creditworthiness of their borrowers. In both cases, ratings can be interpreted as a screening technology that is applied to lessen asymmetric information problems between borrowers and lenders. Transaction lending is viewed as arms-length finance focusing on that particular transaction rather than being aimed at an intensive-information relationship with a customer (Boot and Thakor, 2000).

The transaction lending technologies are an important issue, not only for external credit ratings but also as an internal tool for banks because of the introduction of the New Basel Capital Accord (Basel II) (Butera and Faff, 2006). The adoption of scoring models as management tools has significantly altered the way banks deal with their SMEs loan portfolio. Consequently, concerns have been raised that the Basel II will change the way banks analyse credits, introducing new credit risk management techniques, like credit scoring models, and possibly reducing the lending activity toward SMEs (Altman and Sabato, 2005).

Basel II is a regulatory framework for the banking sector, whose objective is to align the regulation with best practices in managing credit risk (Haber, 2007). Two important consequences of the Impact of Basel II on SMEs happened: first, banks were increasingly focused on risk assessment – or rating- of SMEs, even if they asked for small loans. Second, SMEs faced a wider range of prices and conditions of credit by banks (Comissão Europeia, 2007). The cost of financing for SMEs is reflected in the spread that is charged by the bank and relates to the same quality and quantity of information requested, from which we analyze the risk involved in the transaction. The spread is set based on the cost associated with return on capital consumed in the operation, on the probability of default and to cover the operating costs.

Currently, another relevant issue is the global financial crisis and the "collapse" of financial system which took place in the second half of 2008. The deepening crisis of sovereign debt in the euro area and the consequent increase of systemic risk at European level have contributed to deepen the problem of financing of domestic banks, which, together with the increased credit risk associated with national economic agents, resulted in a tightening of the supply of credit. Hence, this crisis can have an adverse effect on SMEs access to bank financing (Audretsch et al., 2009). The firms with the weakest financial structure and lower credit rating, like SMEs, suffer the most. Only submitted collateral decreases the risk of a given loan, since it gives the lender a specific claim on an asset without reducing his/her general claim against the borrower.

2.3. The role of collateral in debt contracts

The use of collateral is a widespread feature of credit contracts between firms and financial institutions (Steijvers and Voordeckers, 2009). Credit markets research explains the use of collateral as a consequence of the problems of adverse selection (Besanko and Thakor, 1987 a,b; Chan and Kanatas, 1985; Bester, 1985), and/or the problems of moral hazard (Boot et al., 1991). Therefore collateral can be viewed as a solution to overcome credit rationing under asymmetric information (e.g., Menkhoff et al., 2006).

Reviewing current theoretical work about the role of collateral, the theory explains collateral either as an attempt to compensate for ex ante asymmetric information or as a method of reducing ex post incentive problems. Accordingly, one group of models explains collateral as arising from ex ante information gaps between borrowers and lenders due to adverse selection and credit rationing in the line of Stiglitz and Weiss (1981). Therefore, the use of collateral allows lenders to sort observationally equivalent loan applicants through signaling. More specifically, lenders offer a menu of loan contract terms which allows that observationally equivalent applicants with higher quality projects choose secured debt with lower risk premiums, while those with lower quality projects self-select into unsecured debt with higher risk premiums (e.g., Bester, 1985; 1987; Besanko and Thakor, 1987a, b; Boot et al., 1991). In this case, collateral serves as a positive signal about borrower quality that is known to firm managers, but is unobservable to lenders (see, e.g., Besanko and Thakor, 1987a,b; Chan and Kanatas, 1985; Bester, 1985). A higher availability of collateral is expected to increase the supply of bank debt since collateral can mitigate the informational asymmetries between borrower and lender (Steijvers and Voordeckers 2009). Thus collateral is considered as an attempt to compensate for ex ante asymmetric information. Accordingly, unobservable riskier borrowers are less likely to pledge collateral.

The second group of theoretical models explains the use of collateral as part of an optimal debt contract by invoking ex post frictions. These friction include moral hazard concerns (e.g., Boot et al., 1991; Boot and Thakor, 1994; Aghion and Bolton, 1997); difficulties in enforcing contracts (e.g, Cooley et al., 2004); and expensive state verification (e.g., Boyd and Smith, 1993). Therefore, these ex post models predict that observably riskier borrowers are more likely to be required to pledge collateral.

Regarding empirical literature, the majority of the studies focus on how collateral incidence relates to measures of borrower risk and proxies for private information. Concerning the ex post theories, several studies find that observably riskier borrowers are more likely to pledge collateral by showing positive associations between collateral and past observed repayment problems (e.g., Harhoff and Korting, 1998; Chakraborty and Hu, 2006; Jimenez et al., 2006; Brick et al., 2007). Others show that firms with better public ratings are less likely to pledge collateral (e.g., Gonas et al., 2004) and Brick et al. (2007) found a positive association between financial leverage and collateral.

In relation to the ex ante theories that predict that unobservable safer borrowers pledge collateral, the results from empirical studies are less conclusive. The majority of studies examine the effect of lender–borrower relation strength on collateral incidence. According to the theory of relationship lending, stronger relations (e.g., in terms of length) will result in private information being revealed about the firm as lenders gather private information about the borrower's character, reliability, and project choice over time (e.g., Petersen and Rajan, 1994; Berger and Udell, 1995; Degryse and Cayseele, 2000). The main drawback of the effect of access to private information on collateral pledges is ambiguous because this information could be favourable or unfavorable. Thus, it is not surprisingly that empirical results are mixed. For instance, while Berger and Udell (1995) and Brick et al. (2007) found that stronger relations are inversely related to the incidence of collateral for loans drawn under lines of credit, Elsas and Krahnen, (2000); Degryse and Cayseele, (2000) Lehmann and Neuberger (2001), Menkhoff et al., (2006) report that the incidence of collateral is positively related to an indicator ''main bank'' or ''house bank'' status. More recent studies attempt to find other proxies for private information (others than the length of the relation, the scope). For example, Gonas et al. (2004) find that large exchange-listed firms and those with public debt ratings are less likely to pledge collateral for bank loans and Berger et al. (2011) by examining differences in informational opacity across borrowers, finding that more transparent firms are less likely to pledge collateral. Appendix I provide an overview of the key findings of the empirical studies, focusing on collateral.

Because small firms are more informational opaque - due mainly to the poor quality of their legal accounting records and low incentives to operate formally - they have less access to external funding than larger firms. As Baas and Schrooten (2006) argue information about SMEs is rare and expensive for financial intermediaries, leading to high interest rates even in

a long-term relationship between borrower and bank. Furthermore, rating agencies and the financial press scarcely monitor small firms, the information asymmetry between these companies and lenders are significant (Petersen and Rajan, 1995). Therefore, this paper aims to extend empirical literature by testing the effect of the ex ante private information versus ex post model in which collateral is used to overcome incentive conflicts between borrowers and lenders. By using data from bank-level data on loan contracts to Portuguese SMEs the study empirically test differences in private and public information to test the two set of theories.

3. Data, Variables and Method

3.1. Database and information environment

This study uses a database of credit files of one the biggest Portuguese commercial bank –CGD from January 2007 to February 2012. During the 2007- 2012 period the Portuguese economy slowed down markedly due to economic and financial shocks. The first shock occurred during the year of 2007 and took the form of a significant increase in prices in the international markets for commodities (e.g., oil, food and metals) resulting in a real demand shock. The second shock took the form of high risk mortgage in United States (US) in the summer of 2007 giving rise to a global financial crisis, which has generated a widespread turbulence in financial markets under the impulse of a profound reassessment of risk conditions and the breakdown of the level of investor confidence. Characterized by a unique combination of rapid reduction in liquidity with the tightening of access to credit, the final of 2008 brings the collapse of relevant commercial and investment banks (e.g., the bankruptcy of the Lehman Brothers bank). The recession consummated during 2009 and 2010, as well as the adoption of a broad range of measures to support entrepreneurship and implementation of measures to reform financial systems already during the year of 2011 still does not represent the "out of the crisis". As a consequence the result of the Group CGD in 2011 was heavily penalized, which led to the registration of Impairment of items of Credit and Securities.

The Portuguese State is the major shareholder of CGD. On December 31st 2011 the state approved a capital increase of 100 million euros raising it to 5,150 million euros. CGD, while leading institution and reference in the Portuguese financial system has an increased responsibility at this level, due to its history and values, positioning itself at the forefront in providing credit to the economy, consequently to SMEs. CGD constituted an active partner of Portuguese companies, continuing to contribute solidly to the economic development, enhancing competitiveness, innovation capacity, export and internationalization of Portuguese companies.

Currently, CGD operates in all segments of the banking business, namely: Investment Banking, Brokerage and Risk Capital, Real Estate, Insurance, Asset Management, Specialized Credit, E-Commerce and Cultural Activities. On December 31st 2011, the commercial consisted of 861 branches and 38 offices Box Enterprises. In 2011, CGD consolidated its leadership position in Customer Deposits, with a market share of 27.5% with the particular segment registered a market share of 32% and the corporate segment a market share of 11.2%. The consolidated net assets (group CGD) amounted to 120,600 million at the end of December 2011.The Overdue ratio to over 90 days was 3.6% and the degree of coverage of loans stood at 116.5%. The ratio of Credit Risk increased from 4.2% to 6.9%. The solvency ratio on a consolidated

basis and including retained earnings reached 11.6% in December 2011. The Transformation ratio measured by net credit in relation to deposits from customers amounted to 122.2%, standing close to the values already set for 2014 under the Programme of Economic and Financial Assistance (120%). Despite the weakened macroeconomic and banking environment in Portugal during our sample period, CGD concluded the year of 2011 with a Core Tier 1 ratio of 9.5%, comfortably exceeding the limit of 9% required by the Memorandum of Understanding, and demonstrating a strength that has always been one of the characteristic elements of the Group CGD.

Several types of commercial credit contracts are in the data set, including credit cards, overdrafts, installment loans, discount loans, leases, factoring operations and lines of credit. Because previous studies show that loan term contracts can differ depending on the type of operation, even if the transactions are between the same borrowers and lender (e.g., Berger and Udell, 1995), this study focus exclusively on financial contracts and refer to these as standard debt contracts. These contracts account for 85.20% of the total value of commercial loans during the sample period and are denominated in Euros, thus we use only these loans in our analysis.

For each loan, the database has information on the date of origination, maturity date, contract terms, and ex post performance through the sample period. Regarding each borrower the data set has information about its Economic Activity Code (CAE) and whether he/she has been delinquent or defaulted on a loan in the recent past.

The BP requires that some loan information is shared among the participating institutions to ease the otherwise pervasive information asymmetries in the Portuguese credit markets. Thus, after written an authorization from a potential customer, a lender can access the registry and obtain a credit report, which contains information on all outstanding loans of the customer for the previous two months. Entries include, loan amount, type of loan, value of overdue payments. Loans with overdue payments remain in the registry until they are paid off, even if they are past maturity. This implies that delinquencies in the past two months and past defaults from any previous period are observable to other lenders through the registry system.

By having access to the entire credit registry, this information-sharing regime allows us to construct our indicators of observed and unobserved borrower risk, our independent key variables for testing the two collateral theories.

After removing cases with missing values and outliers, we ended up with a final sample of 38 639 loans made to corporations, that is, companies in which all the partners have limited liability. The majority of the cases are from 2010 (26.43%) and 2009 (24.88%).

3.2. Variables

Dependent variables

The dependent variables are *Collateral* and *Risk Premium*. *Collateral* is defined as a dummy that takes value 1 if collateral was pledged at loan origination and zero otherwise. *Risk Premium* is the difference between the contractual interest rate and the prime rate – Euribor six months.

Independent variables

Because the main objective of this study is to test empirically the ex ante versus ex post theories, in which collateral is used to overcome the conflicts between lender and borrowers, the independent key variables are those capturing Observed and Unobserved borrower risk. To measure Observed risk, we create a dummy variable (*Default*) that equals one if the borrower had defaulted on a loan anytime with any lender, zero otherwise. Because rating agencies and the financial press seldom monitor small firms, which makes information asymmetry between these companies and moneylenders significant, to measure the unobserved risk we use the internal rating defined for each loan by CGD. This information is not known by the borrower until the loan is approved. Hence, we define three dummy variables: *Internal Rating 1*, *Internal Rating 2* and *Internal Rating 3* if the loan risk is lower, medium and high, respectively, zero otherwise.

Loan characteristics account for differences in the individual loan contracts. *Loan amount* is measured as the natural logarithm of the loan amount at the origin in Euros. *Maturity* is a natural logarithm of the number of months between loan origin and maturity. *Mutual Guarantee* is a dummy variable that takes the value one if the loan contract has a mutual guarantee. Control variables include *leverage* and *collateralization*. *Leverage* is the ratio between the credit used to the credit granted by CGD to the borrower. *Collateralization* is the ratio between the amounts of collateral pledged to the loan contracted.

Macroeconomic variables account for the business cycle and monetary policy. Hence, we include in the analysis the gross domestic product (*GDP*) per capita and *industry default risk* measured as the ratio between the loan defaults to total loans by industry (CAE). Table 1 provides the definitions of all the variables used in the analyses.

3.3. Method

This study conducts two empirical tests. The first empirical test relate the incidence of collateral to measures of observed and unobserved borrower risk, loan characteristics, control variables and macroeconomic variables. The study estimates this model using probit method. The model is as follows:

P(Collateral)it=

f (observed riskit, unobserved riskit, loan characteristicsit, control variablesit, macroeconomic variablesit).

Where p(.) indicates the probability, Collateral is a dummy variable that takes the value one if the loan is secured, and i and t index the loan and time, respectively.

The second empirical test examines the determinants of the risk premium by using ordinary least squares (OLS). The model is defined as:

Risk premium it=

f(observed riskit, unobserved riskit, collateralit, loan characteristicsit, control variablesit, macroeconomic variablesit)

Where i and t index the loan and time, respectively. The definition of independent variables appears in table 1.

Table 1: Variable definitions

Variable	Definition
Dependent variables	
Collateral	Dummy that takes value 1 if collateral was pledged at loan origination, 0 otherwise
Risk Premium	The difference between the contractual interest rate and the prime rate
Independent variables	
Observed risk	
Default	Equals 1 if the borrower had defaulted on a loan anytime with any lender and 0 otherwise
Unobserved risk	
Internal Rating 1	Equals 1 if the loan risk is lower, and 0 otherwise
Internal Rating 2	Equals 1 if the loan risk is medium, and 0 otherwise
Internal Rating 3	Equals 1 if the loan risk is higher, and 0 otherwise
Loan characteristics	
Loan Amount	Natural logarithm of the loan amount at the origin in Euros
Maturity	Natural logarithm of the number of months between loan origin and maturity
Mutual Guarantee	Dummy that takes value 1 if the loan contract has a mutual guarantee
Control variables	
Leverage	Ratio between the credit used to the credit granted by CGD to the borrower
Collateralization	Ratio between the amounts of collateral pledged to the loan contracted
Macroeconomic Variables	
Industry Default Risk	Ratio between the loan defaults to total loans by Industry.
GDP p.c.	GDP per capita by year

4. Results

4.1. Univariate analysis

Table 2 presents the descriptive statistics of the variables used in this study. The percentage of firms that pledged collateral is 73.7%. The mean firms pay a mean (median) risk premium of 3.29% (3.375%). Regarding the observed risk – Default - 20% had defaulted on a loan. The data also shows that 41% of loan report a low risk. The percentage of loan with a medium risk is about 37% and only 7% reports a high risk. These results suggested that the lender only grants credit to borrowers with low risk. Recall that the rating is defined by the lender. The average loan size is € 571.132,00 with a maturity of 49 months. Almost one third of the loans have a mutual guarantee. Turning to the control variables, the mean of leverage of each borrower is 68.8%. Moreover, the collateral pledged covers about 65.8% of the credit granted.

Table 3 shows the mean test results from secured and unsecured loans. As expected, secured and unsecured loans have different contract terms. Secured loans have lower risk premium, 3.194% compared to 3.574% for unsecured loans. Loans with a good internal rating, which proxy for unobserved risk for other lenders provide more collateral, suggesting that these borrowers provide more collateral to obtain lower interest rates, in line with the ex ante theories. The result for the observed risk variable is unexpected because firms that have defaulted any time report low collateral. This result suggests some noise regarding the definition of this variable. In other words the data does not allow us to define when the loan had overdue the payment. Furthermore, secured loans have loan maturities and these borrowers report high level of leverage. The industry default risk is also higher for secured loans.

4.2. Determinants of collateral

Table 4 reports probit regressions for Collateral, a dummy variable that equals one if the loan is secured and is equal to zero otherwise. Column 1 shows the benchmark specification without loan characteristics because under ex ante theories show that these contracts terms could be simultaneously determined with collateral, hence they are potentially endogenous. Column 2 reports the results when these variables are included in the model. Under the heading ‘‘Probit coefficients’’ we report the estimated coefficients of the two probit specifications. Under the heading ‘‘Marginal effects’’ we report the change in probability of pledging collateral for each one of the independent variables. The correlation values for independent variables are less than 0.5 (Gujarati and Porter 2010), which indicates that multicollinearity was not a problem. Appendix 2 reports the correlation values.

In both specifications the internal rating 1 (i.e., borrowers with low risk, which is defined by the lender) is positive and statistically significant. These findings sustain the ex ante theory, which predicts that less risk borrowers are more inclined to accept an increase in collateral requirements for a certain reduction in the interest rate than those with a high probability of default. The variable internal rating 3 (i.e., highest risk borrowers) reports contradicted results, but this variable is not statistically significant in both specifications. The variable Internal rating 2 is the omitted category. The results reported by the variable risk premium sustain these predictions, because the coefficient of this variable is negative and statistically significant at 1% level in both estimations. Furthermore, the economic impact is significant as the marginal effects of these variables are statically significant at 1% level.

Regarding the variable Default, this indicates borrowers who had default on a loan anytime with any lender reports a negative and statistically significant at 1% level. The negative coefficient suggests that borrowers with high probability of default choose a contract with lower collateral opposed to borrowers with low probability of default. The main drawback of this result is that according to ex post theories riskier borrower are more likely to be required to pledge collateral. Beside the main concerns regarding the going concern of these borrowers, they obtained a loan because one third of the loans have a mutual guarantee associated. This reasoning is confirmed by the positive coefficient reported by the variable mutual guarantee in model 2. This finding is economically significant given that the marginal effect associated to this variable is higher compared to other loans characteristics variables. In addition, the probability of pledging collateral is much higher for borrowers with high leverage ratio. The coefficient of this variable is positively related with the probability to pledge collateral and statistically significant at 1% level in both estimations.

For vector loan characteristics, the collateral is lower for large loans but increase with longer maturities. This result could be due the necessity to prevent the problem of assets substitution (Jensen and Meckling, 1976). The asset substitution problem arises when a borrower has the possibility to switch to a higher risk investment project than the original one. This phenomenon is great in contracts with long maturities, because in case of success, the potential profit gains of this behaviour benefits the borrower; lenders do not receive any additional gain in case of success, but they bear the potential losses in case of failure.

The macroeconomic variables confirm that when the industry risk increases the incidence of collateral is higher. Note that beside the industry default risk variable is not statistically significant in estimation 2, its marginal effect is statistically significant. The results of the variable GDP show that periods when the macroeconomic conditions weakened are more likely to be associated with collateral pledged.

4.3. Determinants of risk premium

Because empirical literature relates measures of borrower risk, such as the loan risk premium to whether or not collateral was pledged for a given loan (e.g., Brick et al., 2007; Jimenez et al., 2006), table 5 shows the determinants of risk premium. Column 1 reports the benchmark estimation without the loan characteristics variables. Column 2 includes the loan characteristics and column 3 controls the amount of collateral provided, by adding the variable collateralization. Under the heading "OLS coefficients" the table shows the estimated coefficients of the three OLS specifications. Under the heading "VIF" (variance inflation factor) table values present the VIF values. In line with the results reported in the correlation matrix (see appendix 2), because the values of VIF statistics are around one, the multicollinearty is not a problem.

The results of unobserved risk variables confirm that low risk borrowers (i.e., borrowers with an internal rating 1) obtain a low interest rate compared to more risky borrowers. The coefficient of the variable internal rating 3 reports a negative and statistically significant coefficient while the variable internal rating 1 show a positive coefficient, also statistically significant at 1% level. The internal rating 2 is the omitted category. These results sustain the ex ante theory. Concerning the variable observed risk – default –, and in line with the ex post theory, in the three specifications the coefficients are positive and significant at 1% level, indicating that riskier borrowers are more likely to pay higher interest rates. Furthermore, the results indicate a strong negative association (significant at 1% level) between loan risk premium and the incidence of collateral. Consistent with ex ante theory, this finding suggests that borrowers pledging collateral receive a lower interest rate. Moreover, the results remain unchanged if equation 3, when the variable collateral is replaced by the variable collateralization, and thus control to the amount of collateral pledged. In addition, the variable Mutual Guarantee also reports a negative and statistically significant indicating a substitution effect between the incidence of collateral and risk premium.

Concerning the loan characteristics variables, the results are similar to those reported in table 4. Hence, large loans pay lower average risk premium but the risk premium increases with maturities. These results are consistent with long maturities, which are generally being associated with the assets substitution problem.

The macroeconomic variables that account for macroeconomic conditions, show that the risk premium increase with the industry default risk and when the GDP decrease, suggesting that in period of monetary tightening the risk premium increase. This phenomenon is relevant in our data set because it covers the period of financial assistance from International Monetary Fund (IMF), European Central Bank (BCE) and European Union (UE).

Table 2: Descriptive statistics

	N	Mean	Median	Standard Deviation	Min.	Max.
Dependent variables						
Collateral	38639	0.737	1	0.440	0	20
Risk Premium	38639	3.294	3.375	1.596	0	1
Independent variables						
Observed risk						
Default	38639	0.202	0	0.401	0	1
Unobserved risk						
Internal Rating 1	38639	0.413	0	0.492	0	1
Internal Rating 2	38639	0.368	0	0.482	0	1
Internal Rating 3	38639	0.074	0	0.261	0	1
Loan characteristics						
Loan Amount	38076	571 132	50 000	360 513	5000	100 000 000
Maturity	38638	48.923	48	39.302	0.033	600
Mutual Guarantee	38639	0.297	0	0.457	0	1
Control variables						
Leverage	38635	0.688	1	0.456	0	1
Collateralization	38639	0.658	1	0.437	0	1
Macroeconomic variables						
Industry Default Risk	36786	4.446	3.975	2.203	0.05	9,825
GDP p.c.	30023	19962,01	19785,7	398,985	19574,19	20550,73

Table 3: Mean differences between secured and unsecured loans

	Mean Values		
	Secured loans	Unsecured loans	t-test
Risk Premium	3.194	3.574	20.737***
Default	0.192	0.230	8.323***
Internal Rating 1	0.427	0.374	-9.364***
Internal Rating 2	0.174	0.202	6.239***
Internal Rating 3	0.070	0.086	5.399***
Loan Amount	415135.2	1020304	14.366***
Maturity	52.890	37.810	-33.693***
Mutual Guarantee	0.368	0.099	-52.656***
Leverage	0.861	0.204	-2.536***
Industry Default Risk	4.548	4.164	-14.803***
GDP p.c	19916.6	20090.02	33.732***

Notes: *** indicates significant at 1% level.

Table 4: Determinants of collateral

	Probit coefficients		Marginal Effects	
Variables	(1)	(2)	(1)	(3)
Risk Premium	-0.099***	-0.142***	0.002***	0.002***
	(0.006)	(0.009)		
Observed risk				
Default	-0.142***	-0.078***	0.006***	0.006***
	(0.022)	(0.027)		
Unobserved risk				
Internal Rating 1	0.072***	0.065***	0.005***	0.005***
	(0.019)	(0.024)		
Internal Rating 3	-0.035	0.037	0.009	0.008
	(0.033)	(0.039)		
Loan characteristics				
Loan Amount		-0.072***		0.001***
		(0.007)		
Maturity		0.128***		0.002***
		(0.009)		
Mutual Guarantee		0.371***		0.006***
		(0.029)		
Control variables				
Leverage	1.980***	2.130***	0.005***	0.006***
	(0.017)	(0.023)		
Macroeconomic Variables				
Industry Default Risk	0.136***	0.089	0.003***	0.004***
	(0.013)	(0.018)		
GDP p.c		-4.330***		
		(0.645)		0.135***
Log-Likelihood	-13438.832	-8389.109	-13391.158	-8394.72
Pseudo R^2	0.369	0.493	0.371	0.492
N	36782	28892	36782	28892

Notes*** indicates significant at 1% level.

Table 5: Determinants of risk premium

	OLS coefficients			VIF		
Variables	(1)	(2)	(3)	(1)	(2)	(3)
Collateral	-0.434***	-0.556***		1.74	2.13	
	(0.027)	(0.028)				
Observed risk						
Default	0.081***	0.228***	0.233***	1.07	1.14	1.14
	(0.022)	(0.020)	(0.020)			
Unobserved risk						
Internal Rating 1	-0.484***	-0.244***	-0.244***	1.12	1.18	1.18
	(0.016)	(0.015)	(0.015)			
Internal Rating 3	0.365***	0.338***	0.338***	1.07	1.10	1.10
	(0.042)	(0.039)	(0.039)			
Loan characteristics						
Loan Amount		-0.143***	-0.153***		1.12	1.13
		(0.006)	(0.006)			
Maturity		0.150***	0.147***		1.28	1.28
		(0.009)	(0.009)			
Mutual Guarantee		-0.681***	-0.746***		1.39	1.39
		(0.017)	(0.017)			
Control Variables						
Leverage	0.033	-0.149***	-0.217***	1.73	2.19	1.88
	(0.025)	(0.027)	(0.024)			
Collateralization			-0.496***			
			(0.025)			1.70
Macroeconomic variables						
Industry Default Risk	0.427***	0.138***	0.135***	1.02	1.38	1.38
	(0.012)	(0.013)	(0.013)			
GDP p.c.		-10.700***	-10.800***		1.51	1.51
		(0.474)	(0.475)			
N	36782	28892	28892			
R squared	0.076	0.157	0.157			

Notes: *** indicates significant at 1% level.

5. Concluding Remarks

The theoretical literature offers two broad classes of theories about why borrowers pledge collateral. The first set of theories motivates collateral as a way for good borrowers to signal their quality under conditions of ex ante private information. The second set of theories explains collateral as an optimal response to ex post contract frictions such as moral hazard.

The recent financial crisis raised the academic and policy interest in understanding the role of collateral in debt contracts to overcome the conflicts between borrowers and lenders, and thus mitigate credit rationing. For decades the determinants of collateral have intrigued scholars. This paper extends the empirical literature by using data from Portuguese market data.

Using a large data set of 38 639 loans granted by CGD, this paper aims to explore risk information about borrowers that is known only to the lender (e.g., information provided by BP), to construct measures of both observed and unobserved risk, and thus, test the two sets of collateral theories to overcome borrower and lenders agency conflicts.

The results show that less risky borrowers are more likely to accept an increase in collateral requirements for certain reduction in the interest rate. In other words, borrowers who show good signals (e.g., a good rating) enjoy better contract terms than those with high risk. These results support the ex ante theory, which predicts that low quality borrowers are less likely to pledge collateral. The results also indicate that the ex post theory dominate for borrowers who had default on a loan any time. Moreover, because one third of the loans have associated a mutual guarantee, the findings suggest that borrowers that default or are not able to provide additional guarantees are credit rationed. Furthermore, the results are robust when we control for the amount of collateral pledge and when we control for macroeconomic conditions. Therefore, in periods of economic contraction and declining in asset values lenders are more likely to require collateral.

This paper makes an important contribution to the literature seeking to understanding the role of collateral in debt contracts. Nowadays, this issue is relevant because (a) the recent decline in real estate collateral value in Japan in the early 1990s and the collapse in real estate collateral values triggered in 2007 a financial crisis that played an important role in contraction of the investment and debt capacity in world economy, especially in Europe and US, (b) the consolidation of the banking industry and the introduction of the Basel II Capital Accord, predict that collateral will become even more important in the future. Therefore, providing collateral is a relevant tool to mitigate informational asymmetries and thus solving the credit-rationing problem particularly in the context of SME due to their opacity.

Nevertheless, replication of the model with data from other credit providers and other economies is necessary to confirm and improve the findings of this paper. Future research including other proxies to measure the informational asymmetry (e.g., relationship lending in all its dimensions) may enhance the picture we currently have on the role of collateral as a remedy to solve credit rationing indirectly, by reducing the asymmetric information problem, or directly, by increasing the supply of bank debt.

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Appendix

Appendix 1: Empirical studies on Collateral as a remedy to solve the credit rationing problem

Paper	Data Set	Method	Key variables	Type and size of the loan	Incidence of collateral (%)	Main findings
Lehmann and Neuberger (2001)	A survey of German banks in 1997. The survey was addressed to the bank loan managers. The respondents were asked to refer to loan applications of SMEs with a loan volume ranging between DM 100 and 10 millions.	Two-limit Tobit regression to determine the amount of collateralization varying from 0% to 100%.	Relationship, firm, loan and risk characteristics.	Different loan types, loan size 50,000–5 m.€.	Firms with extended credit provide 88% of collateral given the loan amount requested.	High –risk borrowers seem to pledge less collateral. When obtaining loans from a housebank, more collateral has to be provided.
Menkhoff et al.(2006)	Credit files of a Thai bank over the period 1992-1996.	Probit and Tobit regression with the incidence and amount of collateral pledged as dependent variables.	Risk, Relationship and firm characteristics.	Loan size in extreme 10 % percentiles: 570,000–36 m.$, mean: 9.6 m.$.	72% of loans are made on a secured basis, and the mean collateral value is 53% of the total loan volume.	Collateral is used to reduce the higher credit risks of small and rather young firms.

Brick et al. (2007)	Survey data from National Survey of Business Finances (1993 and 1998).	Simultaneous equation estimation (2SLS) consisting of three equations with loan rate premium, business and personal collateral as dependent variables.	Loan, firm and relationship characteristics.	Receivable loans, inventory loans (such as chattel mortgages, trust receipts and warehouse receipts), and equipment, plant and commercial real-estate loans.	Collateral pledging has a significant impact on a loan interest rates suggesting a jointness in debt terms. The paper reveals a significant positive correlation between the observable firm risk and the pledging of collateral.	Not found a significant correlation between explicit loan interest rates and the length of the borrower-lender relationship, but importantly find a positive correlation between loan interest rates, collateral and fees.
Steijvers and Voordeckers (2008)	Credit files of a large Belgian Bank over the period 2000-2003.	Ordered Probit and continuation Ratio Logit estimation with the collateralization decision and the type of collateral decision as dependent variables.	Relationship, loan, firm and lender characteristics.	Different loan types.	The probability of providing collateral is high 57.26 percent.	Reveals differences in determinants of the collateralization decision and determinants of the type of collateral.

Cánovas and Solano (2010)	Survey data from Spanish SME'S in the period 1999-2000.	Probit regression with the decision to pledge personal guarantees as a dependent variable.	Relationship, Risk and firm characteristics.	Short-term loans (renewal).	The probability of providing personal guarantees (collateral) is high for 42.86 percent (26.37 percent) of the firms.	Larger and hold firms incur a lower probability of having to provide personal guarantees. The coefficient of the variable Personal Guarantees is statistically significant and has a positive sign, indicating that secured loans are riskier than unsecured ones.
Berger et al. (2011)	Three sources: Federal Reserve's Survey of Terms of Bank Lending; Survey of Small Business Credit Scoring conducted by the Federal Reserve Bank of Atlanta (Jan 1998); Summary of Deposits, and the National Information Center.	Base the test on a Logit model of whether collateral was pledged on the individual loans.	Collateral, credit scoring, loan and bank characteristics.	13,973 loans made by 37 different large banks.	80% of the sample loans have collateral pledged.	Findings are consistent with the central prediction of the private-information models that a reduction in ex ante asymmetric information lowers the probability that collateral is pledged.

Appendix 2: Correlation Matrix

		Mean	Median	1	2	3	4	5	6	7	8	9	10	11	12
Risk Premium	1	3.294	3.375	1											
Collateral	2	0.737	1	-0.105***	1										
Collateralization	3	0.658	1	-0.068***	0.898***	1									
Leverage	4	0.688	1	-0.078***	0.634***	0.556***	1								
Internal Rating 1	5	0.413	0	-0.159***	0.048***	0.020***	0.017***	1							
Internal Rating 3	6	0.074	0	0.084***	-0.027***	-0.011**	-0.006	-0.237***	1						
Default	7	0.202	0	0.052***	-0.042***	-0.019***	-0.003	-0.237***	0.108***	1					
Industry Default Risk	8	4.446	3.975	0.161***	0.081***	0.058***	0.071***	0.048***	-0.101	-0.009**	1				
Mutual Guarantee	9	0.297	0	-0.235***	0.259***	0.115***	0.227***	0.214***	-0.135***	-0.152***	0.195***	1			
Loan Amount	10	571,132	50,000	-0.161***	-0.086***	-0.125***	-0.080***	0.008**	-0.009**	0.002***	-0.130 ***	-0.144***	1		
Maturity	11	48.923	48	-0.107***	0.309***	0.254***	0.254***	0.032***	0.022***	-0.123***	-0.133***	0.216***	0.181***	1	
GDP p.c.	12	19,962.01	19,785.7	-0.077***	-0.191***	-0.148***	-0.180***	-0.054***	0.103***	0.114***	-0.495***	-0.392***	0.165***	-0.047***	1

Notes: *** indicates significant at 1% level.