



## Credit granting to small firms: A Brazilian case

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### ABSTRACT

Transaction costs limit the supply of credit to small and medium-sized firms (SMEs). From a sample of 65,535 SME credit proposals submitted to a large Brazilian bank between January 2004 and September 2006, this research analyzes credit granting decisions. Results suggest that small firms face credit rationing and that low risk credit contracts with liquid collateral are their primary source of credit. Also, the bank captures private information through its lending relationships with borrowers, which affects its credit granting decisions. The findings reveal that the bank under study faces difficulties in expanding the supply of credit to small firms mainly because of cost, collateral-dependency and constraints due to asymmetric information.

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### 1. Introduction

Because of the argument that small firms' access to credit is crucial due to their potential for market development and entrepreneurial innovation (Schumpeter, 1961), many researchers devote efforts to understanding the effects of credit on small business prosperity (e.g., Audretsch and Elston, 2002; Hutchinson and Xavier, 2006; Hyttinen and Väänänen, 2006;). Among these efforts is the postulation by 1995 Nobel Prize recipient Robert Lucas that the marginal outcomes of capital are very significant for the performance of small firms (Lucas, 1988). The subject achieves acknowledged relevance, especially because of the fact that restrictions on credit to small business are a global phenomenon (Baas and Schrooten, 2006).

Even though economists elaborate a substantial theory about the functioning and dynamics of credit rationing (e.g., Jaffee and Russell, 1976; Stiglitz and Weiss, 1981), researchers conduct only a limited amount of empirical studies about the origins of financial constraints (Hyttinen and Väänänen, 2006). Literature addresses asymmetric information and transaction costs as the main drivers of credit rationing (Rauch and Hendrickson, 2004), but studies do not jointly assess their effects on credit granting decisions.

In order to contribute to the understanding of financial restrictions on small firms, this paper presents a quantitative study of the decision making process of a bank when providing credit to this population segment in Brazil, a country where the credit market imposes severe

credit constraints to small entrepreneurs (Najberg et al., 2000; Pinheiro and Moura, 2001; Tasic, 2005).

#### 1.1. Research questions

The research questions in this paper focus on the transaction costs of supplying credit to small and medium-sized enterprises (SMEs). Here, transaction costs mean the costs inherent in maintaining a credit portfolio, in accordance with the study of Rauch and Hendrickson (2004), who relate loan characteristics – such as loan size, collateral and interest rate – and information asymmetry to the cost of monitoring credit contracts. For these authors, lending techniques – transactional or relational – and loan securitization relate to the cost of dealing with information asymmetry concerning borrowers. Accordingly, Hernández-Cánovas and Martínez-Solano (2007) introduce an evidence of the costs of producing information about SMEs as effects of choices between relationship and transactional lending, and Ashton and Keasey (2005) recognize the costs implicit in monitoring the quality of collateral; in case of default, debt-holders can realize recovery only to the degree to which they can redeploy assets (Williamson, 1991).

Jaffee and Russell (1976) and Stiglitz and Weiss (1981) develop the main theoretical contributions about credit rationing and suggest that imperfect issues of information concerning borrowers' behavior are the greatest limitations on productive credit granting. Empirical studies (Detragiache et al., 2000; Hernández-Cánovas and Martínez-Solano, 2007; Hyttinen and Väänänen, 2006; Rauch and Hendrickson, 2004; Strahan and Weston, 1998;) state that the availability and use of information about SMEs leads to expansion of the amount of credit

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supplied to these firms. However, none of these studies considers the mutual interaction of theoretically relevant variables to credit granting – such as collateral and loan size (see Ray, 1998; Stiglitz and Weiss, 1981; Tasic, 2005) – and lending techniques, which depend on relationships with customers and/or external information (see Baas and Schrooten, 2006; Berger and Udell, 1995, 1996; Diamond, 1989; Rauch and Hendrickson, 2004; Sharpe, 1990). Also, many of these studies employ data from developed countries, and none of them refer to Latin American markets; therefore, most of their findings do not explain credit granting in transition economies with very particular financial conditions and property rights characteristics, like Brazil. Credit restrictions in Brazil are so severe that only about 14 to 19% of micro and small firms – which total nearly 6 million formal enterprises in the country (SEBRAE, 2005) – use bank loans to fund their investments or to obtain cash flow (SEBRAE, 2007). This study aims to establish how the interaction of information asymmetry, loan size, collateralization and lending techniques can impact small business lending in a transition economy.

### 1.2. Relevance

Hutchinson and Xavier (2006) state that access to finance for SMEs in transition economies demands diversification in the range of financial products to this segment and represents one of the main obstacles to small business development and growth.

Feakins (2004) points out the relevance of bringing decision-making and processing structures into academic analysis of commercial bank lending and into discussions about the nature of SMEs financing. Hartarska and Gonzalez-Vega (2006) argue that providers of formal finance lack ability to solve problems resulting from asymmetric information in lending to small firms. Financiers need to develop innovative lending practices to meet the demand of small businesses for credit, which is particularly true in Brazil (Pinheiro and Moura, 2001). Banks and other financial institutions should acquire information processing capabilities and lending techniques that overcome asymmetric information with cost-effective financial services to small firms.

Advances in credit granting processes impact directly on the survival and performance of numerous SMEs in transition economies. Brazilian financial institutions intend to better structure their strategy to expand their supply to the small business segment (Billi and Vieira, 2007). A large market potential on the supply side and the need for resources to enable small business prosperity on the demand side motivate interest in studying the SME credit market (Tasic, 2005). Serviço de Apoio às Micro e Pequenas Empresas – SEBRAE conducts a survey (SEBRAE, 2007) that shows that 22% of the Brazilian micro and small firms end their activities before reaching two years of operation, significantly because of a shortage of resources to manage their cash flow.

The substantive contribution of this research is in verifying and quantifying the relationships between transaction costs and credit granting in a productive credit market which deals with imperfect information.

## 2. Literature review

### 2.1. Credit rationing

Credit rationing is the situation in which a potential borrower lacks access to credit, even though she/he agrees to pay a higher price (interest rate) for money than the price prevailing in the market (Jaffee and Russell, 1976). Stiglitz and Weiss (1981) state that high interest rates tend to attract higher-risk borrowers, whose projects probably do not prosper enough to cover the cost of money. When interest rates become higher, the average risk to projects increases, threatening the expectation of return of the lender, which is optimal

when interest rates are lower than the rate which balances the market in terms of supply and demand. If firms do not behave diligently, credit rationing may be the best solution to lenders (Bester and Hellwig, 1987).

Also according to Stiglitz and Weiss (1981), interest rates are not the only relevant terms in credit contracts. The loan size also affects credit risk, since a loan tends to become riskier as its size becomes larger (Stiglitz and Weiss, 1981; Tasic, 2005). Collateral is also very relevant to credit granting decisions as an instrument of risk management (Ray, 1998; Tasic, 2005).

Financiers take various factors into account when making a decision about a credit transaction with a small firm. These factors result from attempts to opportunistically charge high interest rates that borrowers accept to pay in situations of credit rationing, but without increasing the risk of default implicit in expensive loans. These attempts include banking techniques that deal with information asymmetry when trying to expand credit activities and to obtain economies of scale with a pool of small business loans (Rauch and Hendrickson, 2004), such as screening of borrower's credit behavior (Baas and Schrooten, 2006) or management of credit contracts by means of loan collateralization (Bomfim, 2005) and securitization (Mester, 1997).

### 2.2. Lending techniques

The literature distinguishes between two types of lending decision processes: relationship banking and statement – or ratio – lending. A relationship loan depends on both objective and subjective information about borrowers, which the bank obtains through its relationships with customers (Diamond, 1989), while a ratio loan relies on objective procedures such as credit score and loan securitization (Rauch and Hendrickson, 2004).

Diamond (1989) states that exclusive banking relationships arise as a way to channel resources when small firms get close to banks because the amount of information from these relationships increases when the borrower uses a wide range of banking services. Relationship banking may increase credit availability to small firms dealing with one bank and gives banks informational advantage over competitors since their customers' credit behavior remains private. Such information allows the bank to discriminate in price among customers. But financial institutions may informationally capture companies which borrow exclusively from them, as no other lender knows these customers' real risk. So a monopolistic relationship may arise and lenders can charge high interest rates (Besanko and Thakor, 1987; Hernández-Cánovas and Martínez-Solano, 2006; Sharpe, 1990).

Despite the benefits of relationship banking, alternative lending techniques with automatic procedures may reduce screening costs and avoid default. Banks willing to supply credit massively may rely on the automation of lending processes of credit scoring and on contractual terms such as collateralization and securitization; these are statement – or ratio – lending techniques (Rauch and Hendrickson, 2004). Ratio borrowers usually establish their credit reputation and encounter standard underwriting procedures for obtaining credit (Berger and Udell, 1996). Nevertheless, according to Mester (1997), because information about a customer's credit history may be relatively unavailable, ratio lending frequently implies significant limitations.

Besides credit scoring, statement – or ratio – lending may use loan securitization (Rauch and Hendrickson, 2004), which involves pooling together a group of loans and using their cash flows to back securities for which the loans serve as collateral (Kimber, 2004). Collateral works out mainly as an incentive to solvency, but with a ceiling limit that a bank should require to maximize its return, because risky borrowers tend to commit larger amounts of collateral in credit contracts, since they are not risk averse (Stiglitz and Weiss, 1981).

Ray (1998) defines two types of collateral: 1) collateral which is highly valuable to both lender and borrower; and 2) collateral which is highly valuable to the borrower but not to the lender. Collateral valuable to both parties has the advantage of better covering the lender's position

against default and is an incentive to borrower payback. According to the financial literature, collateral that best covers risk is of liquid nature, such as credit derivatives, monetary receivables (Bomfim, 2005), checks, or credit card receivables. Non-liquid collateral instruments, such as mortgages and machinery, are less effective with lenders and more valuable to borrowers.

Since credit scoring may be inefficient (Baas and Schrooten, 2006), the covering of loans by means of liquid collateral (Bomfim, 2005; Kimber, 2004) may bring more effective results in terms of risk reduction (Mester, 1997). The liquidity of receivables is usually not very risky because suppliers have an advantage in collecting information about their non-financial customers, accessing their credit worthiness and controlling their actions. This informational advantage allows suppliers to discriminate between their safer and riskier customers better than banks (Wilner, 2000).

### 2.3. Small business financing

Diamond (1989) proposes that adverse selection and moral hazard relate inversely to the age and size of firms. Hartarska and Gonzalez-Vega (2006) and Hyytinen and Väänänen (2006) find empirical results that corroborate that assertion. The limitation of public available information about SMEs – due mainly to the poor quality of their legal accounting records and low incentives to operate formally – is a specific reason why small businesses face insufficient access to credit (Baas and Schrooten, 2006). Small firms are more informationally opaque and, therefore, have less access to external funding than larger firms; financiers are unable to solve problems of asymmetric information and to adequately fund small business expansion (Hartarska and Gonzalez-Vega, 2006).

Baas and Schrooten (2006) attest that information about small and medium-sized enterprises is rare and costly for financial intermediaries, leading to high interest rates even in a long-term relationship between borrower and bank. Rating agencies and the financial press seldom monitor small firms, which makes information asymmetry between these companies and moneylenders significant (Petersen and Rajan, 1995). Also, young and small firms typically do not establish reputation regarding their competence and honesty, nor about the risk of projects they may undertake. For small businesses, which are not very transparent from an informational point of view, adverse selection can be severe enough to prevent them from getting financing outside their most frequent banking relationships (Hernández-Cánovas and Martínez-Solano, 2007).

### 2.4. The Brazilian context

Pinheiro and Moura (2001) state that the Brazilian financiers classify the credit market according to loan size and availability of information about borrowers, thus generating the following three segments: 1) the retail market, with many credit proposals, small loans, high interest rates, and decision processes relying on negative information; 2) the middle market, in which banks make lending decisions using internal information of their relationships with borrowers (information in these borrowers' balance sheets is usually unreliable due to off-the-books activities and poor accounting practices); and 3) the large corporation market, in which companies can provide better accounting records and thus alleviate information asymmetry (a small segment in number of companies, but in which loan size tends to be larger and interest rates lower).

Small businesses usually belong to the retail market, often operating with very elastic demand and facing high levels of competition. Survival is a crucial challenge for these firms, which lack managerial and investment resources to reach operational sustainability in the long term (Najberg et al., 2000). Due to their fragile financial situation and elastic demand, many small businesses need external monetary resources to obtain cash flows in the short term (Tasic, 2005).

Small and medium-sized Brazilian firms usually keep a debt relationship with only one bank, so their credit information tends to remain private with one institution (Pinheiro and Moura, 2001). Furthermore, Brazilian credit bureaus traditionally keep negative information about borrowers, normally putting emphasis on default records but not on positive indications of the borrower's payment behavior (Pinheiro and Moura, 2001).

## 3. Method

This research addresses the comparative utility of two alternatives to the bank under study – whether or not to offer a credit contract to an entrepreneur – as a latent score. A probit function transforms the probabilities of the event of interest into scores without boundaries. A hierarchical probit model captures the effect of private knowledge of the bank concerning the credit behavior of its customers; the success probability depends on contextual level effects – credit proposals (level-one), customers (level-two) and branch location (level-three). So a probit random intercept model estimates scores convertible to the probability of credit granting as a function of some explanatory variables and random deviations attributable to each customer and to each branch location.

Classical estimation in generalized hierarchical models relies on asymptotic normality to provide the densities of parameters, which may not hold for non-linear relationships (Rossi et al., 2006). A Bayesian procedure for discrete data with no constraints about asymptotic normality, on its turn, can generate more reliable inference about parameters (Gameran and Lopes, 2006). Specifically in this paper, a Gibbs sampler computes the posterior distribution of the latent parameter in a process which can recognize its separation into two natural groups (Rossi et al., 2006). Another benefit of Bayesian methods to hierarchical models is their better shrinkage effects, balancing the estimation of different level parameters according to the information in a specific group and the information of the entire data set (Raudenbush and Bryk, 2002). Despite the fact that Bayesian inferences depend on the assumptions of prior parameter distributions, these assumptions are irrelevant for results involving very large data sets, because observations actually determine the posterior distributions of parameters (Congdon, 2006; Raudenbush and Bryk, 2002). In this study, which employs a very large sample, prior distributions are not informative; they are flat priors.

### 3.1. Research Universe and Object

Small and medium-sized businesses credit proposals in the Brazilian private financial market characterize the research universe. SEBRAE published a study in 2005 revealing that, in 2003, micro enterprises totaled 5,464,849 in Brazil, while small firms totaled 261,919 and medium-sized firms totaled 29,486 in the country. The study registers only formal enterprises.

In this paper, the small business credit segment refers to operations with small loans for borrowers with low annual revenues. Assuming that Brazilian financiers usually classify their portfolio according to loan size, characteristics of lending process and the opacity of borrowers (Pinheiro and Moura, 2001), the credit proposals in this work are those which the bank under study classifies as belonging to the small business segment. At the time of the study, the bank faced the challenge of expanding its small loan supply and struggled to gain market share in the small business segment.

A total of 17,445 different customers submitted to the bank 65,535 credit proposals that constitute the random sample of this study. The bank analyzed these proposals between January 2004 and September 2006. The sample represents a subset of the universe of small business credit proposals of the bank's portfolio in the period.

### 3.2. Model

A preliminary qualitative interview (see Feakins, 2004; Weiss, 1994) with a director of the bank reveals its credit granting decision process, which the research team did not know previously. The process goes as follows. An account manager prospects a credit transaction with a customer and together they elaborate a credit proposal; then a credit scoring system analyzes the proposal automatically. If the credit scoring system rejects the proposal, the account manager may submit the proposal to a credit committee, which may or may not offer a credit contract to the customer – with basis on a more subjective judgment – or submit the decision to another committee. The bank can repeat the process indefinitely to take a final decision. The interview brings insights into key variables and their importance in the credit granting process, representing an expert's view of the lending decision. The following hierarchical probit model results from the theoretical review and from the interview findings:

$$y_{ijk} \sim \text{Binomial}(n_{ijk}, \pi_{ijk})$$

$$\text{probit}(\pi_{ijk}) = \beta_{0jk}x_0 + \sum_{h=1}^{14} \beta_h x_{hijk} + \beta_{15} x_{15jk}$$

$$\beta_{0jk} = \beta_0 + u_{0j} + v_{0k}$$

$$[u_{0jk}] \sim N(0, \Omega_u) : \Omega_u = [\sigma_{u0}^2]$$

$$[v_{0k}] \sim N(0, \Omega_v) : \Omega_v = [\sigma_{v0}^2]$$

$$\text{var}(y_{ijk} | \pi_{ijk}) = \pi_{ijk}(1 - \pi_{ijk}) / n_{ijk}$$

The variables' definitions are next.

Y is the bank decision to offer a credit contract (1), or not (0).

$\pi$  is the probability of success of the event of interest (1).

$x_0$  is a constant vector.

$x_1$  is a dummy which states if the proposal demands a single credit operation (1) or a credit limit to several operations (0).

$x_2$  is a first-order lag dummy which states whether the bank rejected the customer's last proposal (1) or not (0).

$x_3$  is a first-order lag dummy which states whether the bank approved the customer's last proposal (1) or not (0).

$x_4$  is a dummy variable which states if the bank takes the decision at the first level of approval (1) or not (0).

$x_5$  is the age of the firm at the moment of the decision, centered.

$x_6$  is the percentage of the loan's principal value which illiquid collateral covers in the proposal.

$x_7$  is the percentage of the loan's principal value which liquid collateral covers in the proposal.

$x_8$  is the squared percentage of the loan's principal value which illiquid collateral covers in the proposal.

$x_9$  is the squared percentage of the loan's principal value which liquid collateral covers in the proposal.

$x_{10}$  is the natural logarithm of the loan size (R\$) of the proposal, centered.

$x_{11}$  is the natural logarithm of the loan size (R\$) of a proposal with illiquid collateral, centered (zero for other types of proposals).

$x_{12}$  is the natural logarithm of the loan size (R\$) of a proposal with liquid collateral, centered (zero for other types of proposals).

$x_{13}$  is the natural logarithm of the customer's annual revenue of a proposal with illiquid collateral, centered (zero for other types of proposals).

$x_{14}$  is the natural logarithm of the customer's annual revenue of a proposal with liquid collateral, centered (zero for other types of proposals).

$x_{15}$  is the natural logarithm of the customer's annual revenue, centered.

$u_{0jk}$  is the variance component of the intercept due to level-two (customer) hierarchical effect.

$v_{0k}$  is the variance component of the intercept due to level-three (branch location) hierarchical effect.

A few comments about the model and its variables are necessary. The third-level (regional) effect in the model controls for regional variations in the response variable; branches belong to 19 different locations. *Annual\_revenue* ( $x_{15}$ ) is an estimate by the bank of its customers' revenues on an annual basis and is the only level-two variable in the model. The *loan\_size* ( $x_{10}$ ) variable is an inflation updated value of the loan amount in each proposal (the month of reference is September 2006). The centered variables provide a better interpretation of the regression intercept and improve the performance of parameter estimation in the hierarchical model. The model quantifies the effects of the natural logarithms of some variables (annual revenue, loan size, and their interaction terms with other variables) instead of their original values, and interpretation should consider that information. *First-order lag (rejected)* ( $x_2$ ) and *First-order lag (approved)* ( $x_3$ ) are not mutually exclusive, because when a customer submits a proposal to the bank for the first time, both variables equal to zero. So  $x_2$  captures the effect of a previous rejection of a customer's proposal on the bank's decision in reference to a proposal from a customer for the first time. Similarly,  $x_3$  captures the effect of a previous approval of a proposal on the current credit decision in reference to a proposal from a first-time borrower. *Approval level (branch)* ( $x_4$ ) indicates whether the bank takes the decision at the first approval level (1) – meaning that the decision employs credit scoring – or not (0).

### 3.3. Data

The bank approved approximately 63% of the 65,535 proposals in the sample. The annual revenue of the 17,445 customers varies between R\$ 438,000.00 and R\$ 17,959,000.00 (US\$ 186,383.00 and US\$ 7,642,128.00 at the time), with an average of R\$ 3,722,477.00 (US\$ 1,584,033.00); the median is R\$ 2,940,000.00 (US\$ 1,251,064.00). Firms with revenues between R\$ 438,000.00 and R\$ 10,000,000.00 (US\$ 186,383.00 and US\$ 4,255,319.00) are in the majority, representing more than 97% of the sample. The average loan size for the proposals is R\$ 77,470.00 (US\$ 32,966.00) and the median is R\$ 45,000.00 (US\$ 19,149.00). Loan sizes range from R\$ 10,025.00 to R\$ 1,926,600.00 (US\$ 4,266.00 to US\$ 819,830.00), but concentrate mainly between R\$ 10,025.00 and R\$ 250,000.00 (US\$ 4,266.00 and US\$ 106,383.00), with approximately 95% of the observations in that interval.

Although the sample includes outliers which are potentially medium-sized enterprises, these observations are of interest in this research since the bank considers them as belonging to the small business segment. Also, medium-sized firms are useful in the analysis, because they are at the boundary of size classification by the bank and may bring more variance to the study. Finally, the employment of natural logarithms instead of the original variables usually reduces the effects of outliers in regression analysis, and the same happens with the employment of hierarchical models (Raudenbush and Bryk, 2002) and with the use of Bayesian estimations (Congdon, 2006); all of the observations remain in the analysis.

### 4. Results

The hierarchical probit analysis uses the statistical package *MLWin 2.02, 2005*. The monitoring chain length size is of 30,000 iterations after a burn-in period of 1000 iterations. Second-order penalized-quasi-likelihood (PQL) estimation previously generates the parameters' initial values with the same package.

A suggestion by Snijders and Bosker (1999) to check for the stability of parameters in generalized hierarchical models is running the model with a subsample of observations and comparing the resulting parameters from an estimation using the whole sample. A random subsample of 32,723 proposals from the data set under analysis generates parameters approximately equivalent to the estimations of the model with the whole sample.

The variance component estimation of the intercept due to the level-two (customer) hierarchical effect (parameter  $\sigma_{\mu}^2$ ) is zero, demonstrating to be redundant (Congdon, 2006). Therefore, the model does not further include this parameter for reasons of parsimony. Actually, when the research team runs the model without dummies  $X_2$  (which states the rejection of the customer's last proposal) and  $X_3$  (which states the approval of the customer's last proposal), significant variance appears at the second hierarchical level (customer); that indicates that the bank's last decision totally explains variance at the customer level, possibly meaning that the bank's previous information about borrowers explains repeated decisions on credit proposals. So parsimony leads to the following hierarchical probit model (the variables are the same as those of the Method section):

$$y_{ik} \sim \text{Binomial}(n_{ik}, \pi_{ik})$$

$$\text{probit}(\pi_{ijk}) = \beta_0 x_0 + \sum_{h=1}^{14} \beta_h x_{hijk} + \beta_{15} x_{15jk}$$

$$\beta_{0k} = \beta_0 + v_{0k}$$

$$[v_{0k}] \sim N(0, \Omega_v) : \Omega_v = [\sigma_{v0}^2]$$

$$\text{var}(y_{ik} | \pi_{ik}) = \pi_{ik}(1 - \pi_{ik}) / i_k$$

Table 1 displays the model results.

The model generally classifies correctly 84.25% of the decisions (75.48% of the rejections and 85.25% of the approvals). The classification criterion is that, for scores equal to or less than zero, the bank's decision is not to perform the credit transaction and, for scores greater than zero, the bank decides to perform the transaction. The reason for the cutting point is that zero represents a 50% probability that the event of interest occurs.

At the mean probability of the dependent variable, the probability of approval of a proposal in the customer's branch (by means of credit scoring) is about 3% higher than the probability of approval at another level. Decisions that take place out of branches, which depend on subjective and relational evaluation, are less likely to approve proposals. The probability of approval for a proposal from a borrower whose last proposal resulted in rejection is 54.7% less than the probability of approval for a credit proposal from a new customer, so customers with recent rejections significantly face more credit rationing than new customers. On the other hand, recently approvals of customers' proposals do not present significant difference in the probability of obtaining credit in comparison to decisions concerning new customers. This result might reveal a restrictive aspect of the Brazilian credit market, due to the fact that the bank is reluctant to provide credit to customers who faced credit rationing recently.

The effects of  $\beta_6$  (illiquid collateral) and  $\beta_8$  (squared illiquid collateral) may indicate together the existence of an optimal level of illiquid collateral that determines the bank's decision. The same may apply to liquid collateral, according to coefficients  $\beta_7$  (liquid collateral) and  $\beta_9$  (squared liquid collateral). However, the optimal levels of illiquid and liquid collateral present different slopes. The satiety effect of liquid collateral is smoother to the bank than the satiety effect of illiquid collateral, revealing greater utility of liquid collateral to the bank. Fig. 1 demonstrates the effects of both illiquid and liquid collaterals according to the model predictions.

Table 1  
Model parameters.

Effect	Parameter	Parameter estimate	Parameter standard error	Significance	Effects on predicted probabilities at $\bar{y}$
Constant	$\beta_0$	0.69	0.04	0.00	
Credit type (single operation)	$\beta_1$	0.55	0.02	0.00	0.18
First-order lag (rejected)	$\beta_2$	-1.71	0.02	0.00	-0.55
First-order lag (approved)	$\beta_3$	-0.01	0.02	0.28	-0.00
Approval_level (branch)	$\beta_4$	0.08	0.01	0.00	0.03
Firm's age	$\beta_5$	0.01	0.00	0.02	0.00
Illiquid collateral	$\beta_6$	0.83	0.03	0.00	0.25
Liquid collateral	$\beta_7$	0.76	0.08	0.00	0.23
Squared illiquid collateral	$\beta_8$	-0.28	0.02	0.00	-0.11
Squared liquid collateral	$\beta_9$	-0.17	0.08	0.01	-0.06
Loan_size	$\beta_{10}$	-0.57	0.01	0.00	-0.22
Loan size illiquid collateral	$\beta_{11}$	0.41	0.02	0.00	0.14
Loan size liquid collateral	$\beta_{12}$	0.47	0.01	0.00	0.16
Annual revenue illiquid collateral	$\beta_{13}$	-0.23	0.02	0.00	-0.09
Annual revenue liquid collateral	$\beta_{14}$	-0.27	0.02	0.00	-0.11
Annual revenue	$\beta_{15}$	0.25	0.01	0.00	0.09
Branch location variance of the intercept	$\sigma_{v0}^2$	0.03	0.01	0.01	

Parameter  $\beta_{15}$  (annual revenue) shows that the smallest businesses face more credit rationing. Ceteris paribus, the model predicts that larger firms are more able to contract debt without collateral than small firms, probably because they demonstrate better solvency capacity. However, parameters  $\beta_{13}$  (annual revenue illiquid collateral) and  $\beta_{14}$  (annual revenue liquid collateral) reveal that collateral neutralizes the effect of annual revenue (see Fig. 2).

The firm's age coefficient, although positive, theoretically coherent and statistically significant at the level of 5%, presents a very small effect on the probability that the bank decides to perform a credit transaction with a small firm. The research team keeps the firm's age coefficient in the model, however, to support the proposition that new firms face more credit rationing than older firms.

Finally, the loan size effect is negative, probably because large loans tend to be more risky. Nevertheless, collateral significantly softens the impact of the loan size, since the regression effect drops from minus 0.57 ( $\beta_{10}$ ) to minus 0.16 ( $\beta_{10} - \beta_{11}$ ) in case of illiquid collateral and to minus 0.1 ( $\beta_{10} - \beta_{12}$ ) in case of liquid collateral.

### 5. Concluding remarks

The results of this study reinforce the existence of an optimal amount of collateral to lenders in a credit contract, and that small business borrowers face credit rationing. Also, liquid collateral credit products seem to fit with the small business segment, reducing risk; an eventual optimal ceiling to the bank of liquid collateral in a contract seems to be higher than the optimal ceiling of illiquid collateral. Furthermore, customers with a rejection in their last credit proposal count on very low probabilities of obtaining credit, indicating the use of restrictive internal information by the bank.

This study offers insights into particular aspects of credit granting in Brazil, specifically about products with liquid collateral, which may be innovative to other markets. However, the bank's supply of credit

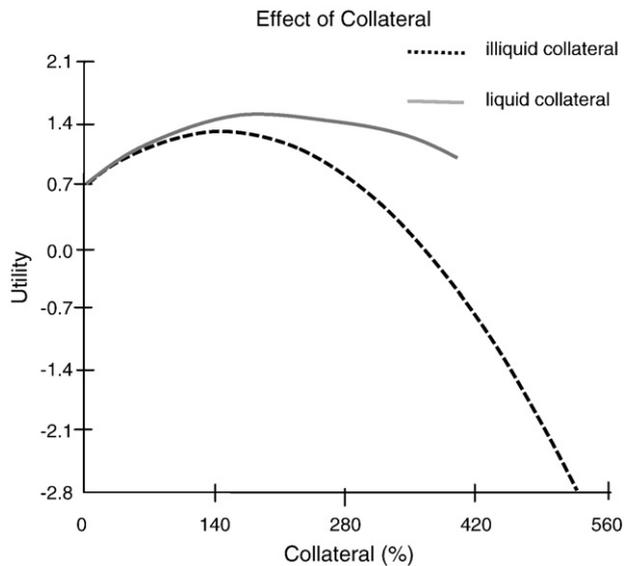


Fig. 1. Fixed effects estimations of collateral on the bank's utility in credit proposals for illiquid collateral (%) and liquid collateral (%).

seems to depend on liquid collateral, which does not necessarily eliminate informational opacity of borrowers; dependency on operations involving the discount of receivables may limit the expansion of the supply of credit.

Also, the use of relationship banking information may inhibit a massive expansion of the supply of credit to small firms, because the process depends on specialists in credit committees responsible for making subjective decisions about credit. Granting credit with basis on relationship banking particularly inhibits the supply of large banks, which may have to create complex, hierarchical, and costly structures to provide relationship lending on a large scale (Berger and Udell, 1996).

Because the bank under study seems to have limitations on supplying SMEs' requests for credit as a consequence of transaction costs and asymmetric information, this work may motivate an agenda to foster the credit market in Brazil for private banks, the public sector, credit bureaus, and small and medium-sized enterprises.

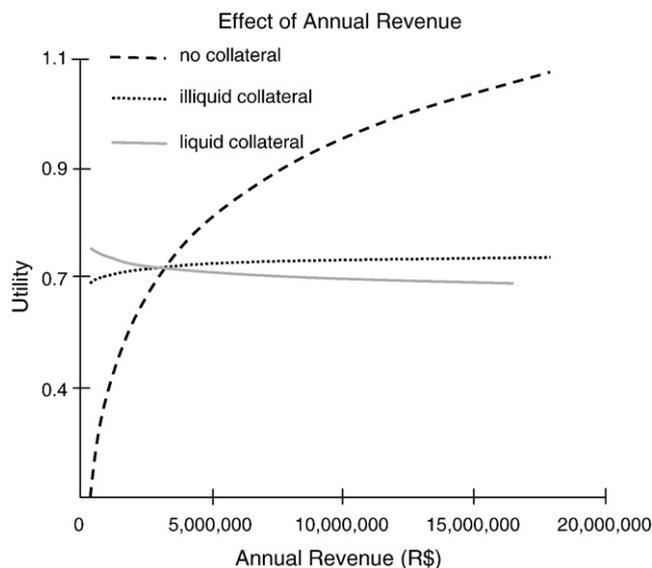


Fig. 2. Fixed effects estimations of customer's annual revenue (R\$) on the bank's utility for clean proposals, proposals with illiquid collateral, and proposals with liquid collateral.

For private financial institutions, the challenge of expanding credit operations relates to the growth of loans to micro, small and medium-sized firms, which constitute the vast majority of enterprises in Brazil (SEBRAE, 2005). In such a context, financial institutions may benefit from the availability of positive public information about borrowers.

The public sector may find in this study empirical evidence to support the offering of positive information about SMEs. The transfer of property rights of positive information from private institutions to the market may accelerate competition among private banks. Fiscal incentives to formalization of SMEs could aim to similar purposes. Under these circumstances, the role of credit bureaus may be crucial in providing positive records concerning borrowers instead of the negative information they usually offer to the market (Pinheiro and Moura, 2001).

Small and medium-sized firms may find evidence motivating higher levels of formalization in order to obtain greater access to credit. These firms can also benefit from entering into relationships with more than one bank to avoid a single bank capturing them informationally.

### 5.1. Limitations and future studies

Because the context of the bank under study and its risk averseness limit the results of the present research, the internal validity of this paper is greater than its external validity. However, the bank presents significant activity and growth in the small business credit market throughout Brazil, and its lending practices represent market standards prevailing in the country. 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.

Also, results in this work relate to formal credit operations in the private financial sector, and do not apply to operations of public banks, trade credit, or the informal credit sector. Furthermore, the sample includes only proposals for productive credit; however, many Brazilian entrepreneurs undertake credit operations in the retail market in order to fulfill the needs for external funding of their enterprises, and not for personal consumption (Pinheiro and Moura, 2001).

Other obstacles challenge the prosperity of SMEs besides credit access, among the most relevant of which are taxation and lack of capabilities of entrepreneurs and their collaborators (Tasic, 2005), subjects that are surely of interest for future studies.

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