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ECONOMICS OF BANKRUPTCY EXEMPTION: SIGNALING VALUE OF COLLATERAL, COST OF CREDIT AND ACCESS TO CREDIT

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WORKING PAPERS

2013/02

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Title: ECONOMICS OF BANKRUPTCY EXEMPTION: SIGNALING VALUE OF COLLATERAL COST OF CREDIT AND ACCESS TO CREDIT

ISBN: 978 88 84 67 870 6

First Edition: February 2013
Second Edition: April 2014

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09123 Cagliari
Tel./Fax 070 291201
www.cuec.it

Economics of bankruptcy exemption: Signaling value of collateral, cost of credit and access to credit*

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Very preliminary and incomplete

Abstract

We analyze the effect of a bankruptcy law according to which some of the borrower's assets are exempt from liquidation in the event of default in the context of a competitive credit market characterized either by moral hazard (MH) or by adverse selection (AS). In particular, we study how the level of such exemption affects the role of collateral depending on the dominant source of asymmetric information. Under MH, conditional on the level of exemption, the cost of credit is higher for borrowers who are requested to post collateral. Moreover, conditional on posting collateral, the cost of credit does not change with the level of asset exemption. Differently, in the case of AS, the decision to post collateral results in a lower cost of credit, whenever the equilibrium is separating. Finally, under AS, a higher level of exemption is generally associated with a lower level of credit rationing. Similarly, credit rationing either stays unchanged or goes down with exemption in the case of MH. We exploit cross State variability in the level of asset exemption from liquidation – according to personal bankruptcy US State laws prior to 2005 federal reform – in order to identify the signaling role played by collateral in a sample of american small business taken from the SBFF data.

Keywords: Bankruptcy, Collateral, Exemption levels, Moral hazard, Signal, Screening

JEL-Codes: D82, G32, G33, and K35.

1 Background

Personal bankruptcy law in the US allows individuals to choose between two different bankruptcy procedures: Chapter 7 and Chapter 13.[1] If an individual files under Chapter 7, her unsecured debt would be mostly discharged. At the same time, the trustee will liquidate individual's

*We thank Francesco Lippi for useful insights, and seminar participants at the Università di Sassari and Università di Cagliari for comments. Part of this paper has been written while Gianfranco Atzeni was visiting the Departmento de Estadistica de la Universidad Carlos III, Madrid, and Luca Deidda was visiting the department of Economics of European University Institute in Florence. Gianfranco Atzeni and Luca Deidda gratefully acknowledge financial support by the Italian Ministero dell'Università e Ricerca (PRIN), by the Regione Autonoma Della Sardegna (Legge n. 7), and Fondazione Banco di Sardegna. Corresponding author: Luca Deidda, Università di Sassari, Dipartimento di Economia, Impresa, Regolamentazione, via Torre Tonda n. 34, 07100, Italy, Tel.: +39-079-2017333, Fax: +39-079-2017312, E-mail: deidda@uniss.it.

[1]Whenever it might be relevant, please note that we refer to the bankruptcy law in place prior to the reform which took place in 2005, since the data we use in the empirical analysis are from 2002.

non-exempt assets to repay creditors Crucially, secured creditors can still fully seize the assets pledged as collateral.[2] Types of exempt assets and levels of exemption are decided by individual States. There exists a widely variation across states. Exemptions can be classified on the basis of the type of asset they apply to. Homestead exemption is the exemption on the individual's equity in owner-occupied principal residence. Differently, non-homestead exemption includes individual's equity in cars, cash, and other goods such as furniture, clothing, cooking utensils, farm implements, family bibles, and tools for trade, etc. In most States, the level of homstead exemption is larger that of the non-homestead one. Furthermore, non-homestead exemption is generally low across states. Finally, homestead-exemption is unlimited in some State, and zero in some others.

Unlike Chapter 7, Chapter 13 is more like debt-repayment plan. No debt is discharged. Agents can keep their assets, and they have to use future earnings to repay part or all of their debt.

According to chapter 7, bankrupt individuals could benefit from a fresh start opportunity to the extent that they will keep some assets, while their debt obligation will be partially redeemed. This has a number of potential consequences on the functioning of credit markets.

In this paper we concentrate our attention on two aspects. First, we study the effect of such asset exemption on the cost of credit and on access to credit in credit market subject either to adverse selection or moral hazard. Unlike previous literature, in our theoretical analysis we take explicitly into account the fact that borrowers can undo the effects of exemption by posting collateral to secure debt. Second, we use the results from the theoretical analysis, in order to test for the signaling effect of collateral in sample of small businesses in the US based on 2002 SSBF data.

2 Exemption and the role of collateral

Consider a standard adverse selection (AS) framework characterized by a competitive credit market populated by (1) Entrepreneurs who are endowed with one asset each, and to borrow to finance their business; and (2) Competitive lenders who face an opportunity cost equal to zero, and make zero profits in equilibrium. Entrepreneurs are of two types: risky (with a high probability of default) and safe (with a low probability of default). As usual, while each entrepreneur knows her type, lenders only know the distribution of types.

In a pooling equilibrium where all entrepreneurs are financed, safe entrepreneurs would be subsidizing risky ones. Hence, they could benefit from separation by means of a signaling

[2] [...] Although a debtor is not personally liable for discharged debts, a valid lien (i.e., a charge upon specific property to secure payment of a debt) that has not been avoided (i.e., made unenforceable) in the bankruptcy case will remain after the bankruptcy case. Therefore, a secured creditor may enforce the lien to recover the property secured by the lien. [...], (http://www.uscourts.gov/FederalCourts/Bankruptcy/BankruptcyBasics/DischargeInBankruptcy.aspx). As a clarifying example of the fact that exemption does not protect assets voluntarily posted as collateral, read about the case of Minnesota: http://www.legalconsumer.com/bankruptcy/bankruptcy-law.php?ST=MN.)

device. Collateral could be such device.

There are two identical credit markets, one located in State 1, and the other located in State 2, where,

1. in State 2's, no assets are exempt from liquidation in the event of bankruptcy;

2. in State 1's, all uncollateralized assets are exempt in the case of default.

Consider first the case of State 1. In the event of bankruptcy, entrepreneurs' assets are liquidated anyway; independently of whether they were posted as collateral or not. Therefore, posting collateral plays no role as a signal. Neither the cost of credit nor access to credit can be affected by the decision to post collateral. Accordingly, in State 1, the prevailing equilibrium should be a pooling equilibrium where, if financial exchange takes place, the same contract applies to all entrepreneurs, independently of whether they post any collateral.

Consider now State 2. In the event of bankruptcy, entrepreneurs' assets will be liquidated if and only if they were posted as collateral. Hence, if going bankrupt, an entrepreneur who has posted collateral suffers a greater loss than an entrepreneur who has not. Posting collateral has now an opportunity cost. Crucially, such opportunity cost is, in expected terms, type-dependent. Risky entrepreneurs have a higher probability to fail than safe entrepreneurs, so that their expected opportunity cost from posting collateral is higher than that of safe entrepreneurs. This provides the sorting condition for a separating equilibrium in which safe entrepreneurs self-select into contracts characterized by higher collateral requirements. In such equilibrium, posting collateral results in a lower interest rate for two reasons:

1. Posting collateral increases the cash flow available to financiers (Direct effect);

2. Posting collateral signals a lower probability of default (Signaling effect).

Consider now a moral hazard (MH) framework, whereby entrepreneurs' access to credit depends on whether they have the right incentives to put effort in the conduct of their business. In this setup, access to credit could depend upon the amount of wealth pledged by the entrepreneur as guarantee, as pleadging wealth increases entrepreneurial loss in the event of default, thereby giving entrepreneurs incentives to put effort. Consider first, State 1. Suppose MH is biting so that entrepreneurs are requested to pleadge their asset. Posting collateral has no role to play, since the lender can liquidate the entrepreneur's asset in the event of bankruptcy, independently the asset was posted as collateral or not. In other words, by demanding credit, entrepreneurs are automatically pledging their wealth independently of whether they post their asset as collateral. Consider now, State 2. Suppose that MH is biting so that entrepreneurs are requested to pledge their asset to be extended credit. Then the entrepreneur will have to post the asset as collateral. Accordingly, the decision to post collateral affects positively access to credit similarly to what happens under AS. However, the effects on the cost of credit are quite different. In fact, in both states the cost of credit will be the same. More generally, if we consider the case of a State where the level of exemption is not unlimited, borrowers who are requested to pledge collateral are the weaker ones, who do not have enough non exempt assets, and are therefore more prone to MH. Accordingly, in such State the cost of financing will be higher for those borrowers who are asked to pledge collateral, than for those who are not. In other words, those who are not requested collateral, have enough non exempt wealth to secure the loan, and because of that they face a lower cost of credit than those who do not have enough non exempt wealth, and, because of that, are requested to post collateral.

We develop the above intuitions by means of numerical examples (section 4), and then provide a model of the credit market to fully analyze the role of collateral on cost of credit and access to credit depending on whether MH or AS is the source of asymmetric information(section 5). Then, we use the theoretical predictions for the AS case, to identify the signaling role of collateral using data on the Survey of Small Business Finance (SSBF) prior to the 2005 Bankruptcy reform.

3 Related literature

Cross-State variability in exemption levels associated with US State bankruptcy laws prior to the 2005 reform, is key to most empirical investigations on the effects of exemption. Various papers have examined the effects of exemption rates on interest rates and credit rationing. Gropp, Scholz and White (1997) found that interest rates on car loans where higher in states with higher exemption levels. Lin and White (2001) found that potential borrowers are more likely to be turned down by banks the higher is the level of exemption. Berkowitz and White (2004) found that small businesses borrow less and pay higher interest rates in states with higher exemption levels. In a similar vein, Berger, Cerqueiro and Penas (2011) find that borrowers have lower access to credit in states with more debtor-friendly levels of exemption. They also find that in such states borrowers are more likely to pledge collateral and have generally tighter loan terms.

Fan and White (2003) investigate the effects of the bankruptcy system on entrepreneurial behavior. States with unlimited homestead exemption are found to have one-third more entrepreneurs than states with low exemptions. Armour and Cummings (2005) find that countries in which the post-bankruptcy period for which filers are obliged to repay from earnings is shorter have more entrepreneurs.

Fay, Hurst and White (2003) tested where pro-debtor bankruptcy laws encourage borrowers' opportunistic behavior. Their evidence is that for every \$1000 increase in debtors' potential gain from bankruptcy, the filing rate raises by 7%.

Finally, Grant and Koeniger (2005) investigate the insurance effects. They find that the variance of consumption over time is lower in states with higher exemption levels.

4 Exemption and the cost of credit: Examples

4.1 Moral hazard

Consider the case of an entrepreneur who owns a house worth \$110 to him, whose liquid value is \$100. The entrepreneur has access to an investment project of size \$100 and has no financial resources. Lenders' opportunity cost of lending is normalized to zero. The entrepreneur can operate either in State 1 or in State 2. While in State 1, there is no homestead exemption from liquidation in the event of bankruptcy, in State 2, homestead exemption is unlimited. If financed, the entrepreneur faces the following private decision:

1. Make proper use of funds: Manage an enterprise that generates a return of \$360 with probability 1/2 and zero otherwise;

2. Mismanage the funds: Gain private benefits equal to \$110 at the expenses of the lenders. The probability of success of the enterprise in this case equals zero.

While lenders cannot observe entrepreneurs' behavior, they are clearly interested in it. More precisely, they would lend the money to the entrepreneur if and only if they were convinced that the entrepreneur would not misbehave.

Suppose first the entrepreneur operates in State 1. Conditional on the fact that the entrepreneur does not misbehave, given the cost of credit R_L, lenders' expected profits are

$$\frac{1}{2} \times R_L \times \$100 + \frac{1}{2} \times \$100. \tag{1}$$

If we assume that lenders earn zero profits in equilibrium, then $R_L = 1$ holds. The crucial question is: Given the equilibrium value of R_L, will the entrepreneur behave? If behaving his expected payoff would be

$$\frac{1}{2} \times (\$360 - \$100) - \frac{1}{2} \times \$110 = \$75. \tag{2}$$

If misbehaving, his expected payoff would be: $\$100 - \$100 = \$0$. Hence, the entrepreneur will behave. Hence, independently of whether the entrepreneur will be asked to post the house as collateral or not, she will be financed, and in any case the cost of credit will be $R_L = 1$.

Suppose now the entrepreneur operates in State 2. Consider first the case in which the entrepreneur does not post the house as collateral. Conditional on the entrepreneur not misbehaving, lenders' zero profits condition is

$$\frac{1}{2} R_L \times \$100 = \$100, \tag{3}$$

which implies $R_L = 2$.

Will the entrepreneur behave, given the value of R_L? If behaving he would get an expected payoff

$$\frac{1}{2} \times (\$360 - \$200) = \$80. \quad (4)$$

If misbehaving the entrepreneur will get \$110. Hence the entrepreneur will misbehave. Therefore, if the entrepreneur does not post the house as collateral he will be not financed.

Consider now the case in which the entrepreneur posts the house as collateral. Conditional on the entrepreneur not misbehaving, lenders' zero profits condition is

$$\frac{1}{2} R_L \times \$100 + \frac{1}{2}\$100 = \$100, \quad (5)$$

which implies $R_L = 1$

Will the entrepreneur behave? If behaving his expected payoff will be

$$\frac{1}{2} \times (\$360 - \$100) - \frac{1}{2} \times \$110 = \$75. \quad (6)$$

If misbehaving, his expected payoff would be, \$110 − \$110 = \$0. Hence the entrepreneur will behave. Therefore, if posting the house as collateral, the entrepreneur will be financed and the cost of credit will be $R_L = 1$.

Summing up,

- Depending on the level of exemption, collateral might become necessary to obtain credit;
- Yet, conditional on being financed, the cost of credit is the same independently of whether there is no exemption at all or unlimited exemption.

4.2 Adverse selection

Consider now a different setup, in which entrepreneur's type is decided by nature. An entrepreneur can either be risky, R, or safe, S. S-type entrepreneurs are endowed with a project that requires 100 units of finance and delivers 360 with probability 1 and zero otherwise. R-type entrepreneurs are endowed with a project that requires 100 and delivers 360 with probability 1/2 and zero otherwise. An entrepreneur is of type $i = R, S$ with probability 0.5. Each entrepreneur is endowed with a house which is worth \$110 dollars to him and whose liquid value is \$100. Lenders are not informed about types, and their certain opportunity cost of lending is normalized to zero. As before, the entrepreneur can either operate in State 1 with no exemption, or in State 2 with unlimited exemption.

Let us assume that lenders issue contracts specified in terms of cost of credit, R_L and collateral, C. Let us analyze the case of an entrepreneur operating in State 1. Consider first candidate pooling equilibria (PE). Since there is no exemption, and the liquid value of the house is less than the value of debt, the entrepreneur's asset will be liquidated entirely in the event of bankruptcy, independently of whether the asset had been posted as collateral or not by the entrepreneur. Therefore, the guarantees offered by an entrepreneur is $max(100, C) = 100$. Given lenders' participation constraint, the value of R_L associated with the contract must satisfy:

$$\frac{3}{4}R_L \times \$100 + \frac{1}{4}\$100 = \$100 \Rightarrow R_L = 1. \tag{7}$$

Borrowers' participation constraint is satisfied:

$$type - S \quad : \qquad \$260 > 0, \tag{8}$$

$$type - R \quad : \qquad \frac{1}{2}\$260 - \frac{1}{2}\$110 > 0. \tag{9}$$

Hence a PE always exists.

Consider now a candidate separating equilibrium (SE) whereby type-S entrepreneurs signal themselves by posting their house as collateral, $C = 100$ while type-R do not. Then, by observing collateral, lenders infer an entrepreneur is safe with probability one. The values of the cost of credit, R_i, associated with the contract designed for entrepreneurs of type i, with $i = R, S$, satisfy:

$$R_S : R_S \times \$100 = \$100 \quad \Rightarrow \quad R_S = 1 \tag{10}$$

$$R_R : \frac{1}{2}R_R \times \$100 + \frac{1}{2}100 = \$100 \quad \Rightarrow \quad R_R = 1 \tag{11}$$

Note that if type-R entrepreneurs mimic type-S ones, they get the same payoff. The same result holds starting from a pooling equilibrium. Hence, pooling and separating yield the same equilibrium outcome in terms of cost of credit.

Consider now the case of an entrepreneur who operates in State 2. Let us focus on SE whereby S type self-select themselves into a lending contract that requires collateral, $C = 100$, while risky self-select into a contract with no collateral. Then, by observing an entrepreneur posting collateral, lenders infer an entrepreneur is safe. Correspondingly, the cost of credit for safe and risky are respectively given by :

$$R_S \times \$100 = \$100 \quad \Rightarrow \quad R_S = 1, \tag{12}$$

$$\frac{1}{2}R_R \times \$100 = \$100 \quad \Rightarrow \quad R_R = 2. \tag{13}$$

The payoff of type-R entrepreneurs who are not posting collateral is:

$$\frac{1}{2}\$160 = \$80. \tag{14}$$

If they were to mimic type-S entrepreneurs they would be worse off:

$$\frac{1}{2}\$260 - \frac{1}{2}110 = \$75. \tag{15}$$

Hence, the SE exists.

Summarizing the results,

- With no exemption, collateral has no effect on the cost of credit;
- With unlimited exemption, posting collateral might results in a lower cost of credit.

Comparing the results from the two examples, we have the following. While, under MH, the cost of credit conditional on posting collateral is independent of the exemption level, the same is not true under AS. In this case, the decision to post collateral has no effect on the cost of credit under no exemption, and results in a lower cost of credit under unlimited exemption.

5 A model with Moral Hazard

We consider a competitive market populated by a large number E of entrepreneurs and a large number L of lenders. The set of entrepreneurs, $\mathcal{E}$, and that of lenders, $\mathcal{L}$, are indexed by $e = 1, ..., E$, and $l = 1, ..., L$, respectively. Both entrepreneurs and lenders are risk-neutral. Lenders are endowed with one unit of financial resources, each, and face an opportunity cost of capital, $r > 0$. Each entrepreneur, e, is endowed with an investment opportunity of fixed size one and an amount of pledgeable wealth, $w_e \in [0, \overline{w}]$. With no loss of generality, we set $L/E > 1$, so that financial resources are abundant. For any given level of wealth, w, we define $\mathcal{E}_w \subseteq \mathcal{E}$ the subset of entrepreneurs endowed with wealth w, and $E(w) = |\mathcal{E}_w|$ the corresponding number of entrepreneurs.

Investment lasts one period and deliver an overall $R > 0$ with probability p and 0 otherwise. The probability of success p is a function of effort, q, which can take two values, high (H) and low (L):

$$p = \begin{cases} p_H \, if & q = H \\ p_L \, if & q = L \end{cases} \tag{16}$$

If exerting low effort, entrepreneurs gain private benefits, $B > 0$, while private benefits equal zero if the entrepreneur exerts high effort. We impose $p_L R - (1 + r) < 0$ so that the possibility of moral hazard emerges. Finally, we assume that the value of an amount of entrepreneurial wealth w to the lender is βw, with $\beta < 1$. Hence, liquidating wealth to pay for debt is inefficient.

Ex ante, information about individual effort, q and wealth, w, is private. However, entrepreneurs can credibly disclose information about the true value of their wealth at zero cost if they want to. Ex post, in the event of default, wealth is observable and verifiable.

The market functions as follows:

Stage 0: Entrepreneurs and lenders meet in the credit market. Lenders simultaneously offer credit contracts; entrepreneurs decide whether to disclose information about their wealth or not, whether to demand credit or not, and under which contract;

Stage 1: Financed entrepreneurs, if there are any, privately choose effort;

Stage 2: Payoff are realized.

5.1 Supply side: Real guarantees and collateral necessary to access credit

In principle, contract between lender and borrower is defined as a triple $(R_L; I, C)$ where R_L is the overall cost of credit (to be paid in case of success), I is the size of the loan, and $C \geq 0$ is collateral. Since the size of the investment opportunity available to each entrepreneur is equals one, whenever the entrepreneur is financed, it is immediate that the amount of the loan must be equal to one. Hence, with no loss of generality, we define a contract $\mathcal{C}$ as a pair (R_L, C), i.e. $\mathcal{C} \equiv (R_L, C)$. Given a contract $\mathcal{C}$, and a level of exemption η, the value of entrepreneurial wealth that the lender is entitled to in the case of default – which we refer to as real guarantees – is given by[3]

$$G = \min(\max(w - \eta, C), \max(\frac{R_L}{\beta}, C)). \tag{17}$$

Given a contract, $\mathcal{C}$, and the associated value of G, the expected payoff for a lender who finances an entrepreneur is $p_q R_L + (1 - p_q)\beta G$. The expected payoff of a financed entrepreneur is $p_H(R - R_L) - (1 - p_H)G$ if the entrepreneur exerts high effort and $p_L(R - R_L) - (1 - p_L)G + B$ if the entrepreneur exerts low effort.

A contract should satisfy lender's participation (LPC) constraint, and borrower's incentive compatibility constraints (BICC) as follows:

$$\begin{aligned} LPC &: \quad R_L + (1 - p_H)\beta G \geq I(1 + r) && (18) \\ BICC &: \quad R - R_L \geq \frac{B}{\triangle p} - G, && (19) \end{aligned}$$

where, $\Delta_p = p_H - p_L$. Given the above constraints, a necessary condition for lenders to be willing to finance an entrepreneur is:

$$P + p_H G + (1 - p_H)\beta G \geq (1 + r), \tag{20}$$

where $P \equiv p_H R - p_H \frac{B}{\triangle p}$ is pledgeable income. By solving (20) for G, we find the minimum amount of real guarantees, $G_{\min}$, necessary in order for an entrepreneur to be financed,

$$G_{\min} = \max\left(\frac{(1 + r) - P}{p_H + (1 - p_H)\beta}, 0\right). \tag{21}$$

[3]We are assuming that, in the event of default, non-collateralized entrepreneurs' assets are liquidated up to R_L/β – that is up to the value of debt at date 1, R_L.

Correspondingly, we find that entrepreneurs are never financed if they are not able to provide a minimum amount of collateral equal to

$$C_{\min} = \begin{cases} 0\, if & \max(w-\eta, 0) \geq G_{\min} \\ G_{\min}\, if & \max(w-\eta, 0) < G_{\min} \end{cases} \tag{22}$$

Comment We note that the minimum level of real guarantees demanded by the lender, $G_{\min}$, is independent of exemption. Differently, the level of collateral demanded by the lender depends on the level of exemption. More precisely, the minimum amount of collateral necessary in order to be financed, $C_{\min}$, is weakly increasing in the level of exemption. We now turn to borrowers' willingness to offer real guarantees.

5.2 Demand side: Willingness to offer real guarantees and collateral

Given the level of guarantees G associated with a contract $\mathcal{C}$, an entrepreneur's payoff is

$$U_B = p_H(R - R_L) + w - (1 - p_H)G. \tag{23}$$

Given the LPC, the equilibrium value of R_L satisfies,

$$p_H R_L = (1 + r) - (1 - p_H)\beta G. \tag{24}$$

Substituting back into (23) we find the equilibrium value of U_B as a function of G:

$$U_B^E(G) = p_H R - (1 - p_H)(1 - \beta)G - (1 + r) + w. \tag{25}$$

A necessary condition for an entrepreneur to undertake borrowing is

$$U_B^E \geq w \Rightarrow p_H R - (1 + r) \geq (1 - p_H)(1 - \beta)G, \tag{26}$$

where w is the value of entrepreneur's payoff when she choses not to undertake the project. Given the above inequality, we find the maximum amount of wealth that an entrepreneur is willing to loose in the event of default:

$$G_{\max} : p_H R - (1 + r) = (1 - p_H)(1 - \beta)G_{\max} \Rightarrow G_{\max} = \frac{p_H R - (1 + r)}{(1 - p_H)(1 - \beta)} \tag{27}$$

Comment. Independently of the exemption level, the maximum amount of guarantees that entrepreneurs are willing to supply in order to obtain credit is $G_{\max}$. This is also the maximum amount of collateral that they are willing to post, that is $C_{\max} = G_{\max}$.

5.3 Equilibrium characterization and existence

We base our equilibrium analysis on the concept of Subgame Perfect Nash Equilibrium (SPNE), focusing on symmetric equilibria in pure strategies. An equilibrium is defined as two strategy profiles, one common to all entrepreneurs, and one common to all lenders, that constitute best replies at all stages.

In order to rule out uninteresting equilibria in which no financial exchange takes place, we assume that there is a non-empty set of entrepreneurs for whom, $G_{\min} = 0$, and $P - B/\Delta_p > 1 + r$. We start our analysis with four preliminary observations.

1. In any equilibrium with financial exchange, lenders must be making zero profits. Consider a candidate equilibrium, with financial exchange, according to the equilibrium contract, $\mathcal{C}' = (R_L^{'}, C')$, lenders make positive expected profits when financing an entrepreneur. Given $L > E$, there must be some lenders who are not financing any entrepreneur. These lenders are making zero profits. Therefore, they would be strictly better off by deviating and undercutting their competitors by offering a contract $\mathcal{C}'' = (R_L^{''}, C')$, where $R_L^{''} = R_L^{'} - \epsilon$, with $\epsilon \to 0^+$. Borrowers strictly prefer this contract to C'. Given $\epsilon \to 0^+$, continuity then implies that lenders will make strictly positive profits by offering C'', which destroys the candidate equilibrium we started with.

2. In any equilibrium, financial exchange takes place. Consider a candidate equilibrium in which supply of loans equals zero. Given that there exist a non empty set of entrepreneurs such that $P - B/\Delta_p > 1 + r$, any lender would be able offer a contract that would attract such borrowers and guarantee strictly positive profits.

3. In any equilibrium, information about individual wealth of a financed entrepreneur is revealed, whenever lenders need such information in order to know the level of guarantees offered by that entrepreneur. It is immediate to verify that lenders require information about individual wealth w_e of entrepreneur e, in order to know the level of guarantees offered by e, whenever $w_e - \eta \geq C$ and $C \leq R_L/\beta$ hold. Suppose, $w_e - \eta \leq C$. Then, $G = C$ – in which case whether e discloses her level of wealth w_e or not does not make a difference. Similarly, if $C \geq R_L/\beta$, lenders appropriate C in case of default, i.e. $G = C$. Differently, if $w_e - \eta > C$ and $C < R_L/\beta$, then $G = \min(w_e - \eta, R_L/\beta))$ – in which case the lender might need to be informed about w_e in order to evaluate G. Consider an equilibrium where a set $\mathcal{E}'$ of entrepreneurs heterogeneous with respect to wealth are not disclosing their wealth, and, for each of these entrepreneurs, $w_e - \eta > C$ and $C < R_L/\beta$, so that $G = \min(w_e - \eta, R_L/\beta))$. $\mu(w_e | e \in \mathcal{E}')$ will be the equilibrium expected value of wealth for an entrepreneur who is not disclosing her wealth, with, $\mu(w_e | e \in \mathcal{E}') < \sup(W(\mathcal{E}'))$, where $\sup(W(\mathcal{E}'))$ is the level of wealth of the richest entrepreneur who is not disclosing her wealth. Accordingly, the equilibrium contract, $C' = (R_L^{'}, C')$, for any entrepreneur

who is not disclosing her wealth will satisfy,

$$p_H R_L^{'} + (1 - p_H)\beta G' = 1 + r \tag{28}$$

where, $G' = \mu(w|e \in \mathcal{E}') - \eta$. It is then immediate to verify that if disclosing her wealth, the richest entrepreneur who is not disclosing it, would be better off. By doing so, she will increase the level of expected guarantees he is offering the lenders to $G'' = \sup(w(\mathcal{E}')) - \eta$, thereby reducing the cost of credit. Given that, ex post, her true wealth will be observable and verifiable anyway, the advantage of disclosing the information ex ante is clear. It follows that, in any equilibrium, information about entrepreneurial wealth is revealed, whenever such information is needed in order to evaluate guarantees. In other words, in any equilibrium, for any entrepreneur who is not disclosing her wealth, $C > w_e - \eta$ or $C > R_L/\beta$ must hold so that $G = C$; all other entrepreneurs, for whom $G = \min(w - \eta, R_L/\beta)$, must be disclosing their wealth.

Based upon the above observations, with no loss of generality, we focus on characterizing – thereby showing its existence – the unique equilibrium where: (i) Financial exchange takes place, and (ii) All entrepreneurs are disclosing their wealth.[4]

Competition among lenders not only implies that they make zero profits in equilibrium, but also that - subject to that zero profits constraint- they offer the contract that maximizes borrowers' payoff. Otherwise, there would be an extra-profit opportunity. Moreover, in equilibrium, the loan contract(s) must satisfy entrepreneurs' ICC whenever an entrepreneur is financed. Accordingly, any equilibrium contract $\mathcal{C}^* = (R_L^*, C^*)$ that guarantees financing solves the following problem:

$$\max_{\{R_L, C\}} U^B = p_H(R - R_L) + (1 - p_H)(w - G), \tag{29}$$

$$s.to: \tag{30}$$

$$LPC: p_H R_L + (1 - p_H)\beta G = 1 + r \tag{31}$$

$$ICC: R - R_L \geq \frac{B}{\Delta_p} - G, \tag{32}$$

$$G = \min(\max(W - \eta, C), \max(\frac{R_L}{\beta}, C)). \tag{33}$$

Given $\beta < 1$, liquidation of assets constitutes an inefficient (more costly) mean of repayment for debt. Hence, other things equal, the optimal contract minimizes G. Accordingly, $C^* = 0$ whenever – given the optimal level of the gross interest rate, R_L^* associated with it, $\min(\max(w - \eta, 0), \max(\frac{R_L^*}{\beta}, 0)) \geq G_{\min}$ is satisfied, and $C^* = G_{\min} - \min(\max(W - \eta, 0), \max(\frac{R_L^*}{\beta}, 0))$ other-

[4]There are other equilibria, in which some of the entrepreneurs for whom $w_e - \eta \leq C$ are not disclosing their wealth. However, it should be clear from the above discussion that the outcome of such equilibria is the same as the one of the equilibrium on which we focus our attention.

wise.[5] The equilibrium contract, $\mathcal{C}^*$ is uniquely determined as follows.

Case 1. If $w \geq (1+r)/\beta + \eta$ holds, then,

$$R_L^* = 1 + r \tag{34}$$
$$C^* = 0, \tag{35}$$

so that, debt is a safe asset.

Case 2. If $w < (1+r)/\beta + \eta$, then,

$$R_L^* = \frac{(1+r) - (1-p_H)\beta \max(W-\eta, C^*)}{p_H}, \tag{36}$$

where[6]

$$C^* = \begin{cases} 0 \; if & \max(w-\eta, 0) \geq G_{\min} \\ G_{\min} \; if & \max(w-\eta, 0) < G_{\min} \end{cases} \tag{37}$$

It is important to note that, whenever, $C^* > 0$, $G^* = G_{\min}$.

The fraction of entrepreneurs who demand credit is given by,

$$d_L = \sum_{w:G^E \leq G_{\max}} \frac{E(w)}{E} \tag{38}$$

The fraction of entrepreneurs who are rationed – taken conditional on demanding credit – is given by

$$cr = \frac{\sum_{w:G^* \leq G_{\max},, w<G_{\min}} E(w)}{\sum_{w:G^* \leq G_{\max}} E(w)} = \frac{\sum_{w:G_{\min} \leq G_{\max},, w<G_{\min}} E(w)}{\sum_{W:G^E \leq G_{\max}} E(w)} \tag{39}$$

5.4 Empirical implications

We now analyze the model's implication as far as how the level of exemption, η, affects impact of collateral on (i) Cost of credit and (ii) Access to credit.

i. Collateral, exemption, and the cost of credit. Consider two entrepreneurs, 1 and 2, who operate in two different States characterized by levels of exemption, η_1, η_2 with $\eta_1 > \eta_2$, respectively. Assume that the two entrepreneurs are endowed with amounts of wealth w_1 and w_2, such that $w_1 - \eta_1 = w_2 - \eta_2$. Suppose that the value of $G_{\min}$ is the same for both entrepreneurs, and that $\max(w_1 - \eta_1, 0) < G_{\min}$, so that, both entrepreneurs are required to post the same positive level of collateral, C^* , where $C^* = G_{\min} - (w_1 - \eta_1) > 0$, so that for

[5] Note that, given the LPC, for each value of C, there is a unique value of R_L.

[6] Note that, if $w < (1+r)/\beta + \eta$, then debt is a risky asset. Therefore, $R_L^* > 1 + r$ holds, so that $w - \eta < \frac{R_L^*}{\beta}$, which implies $G^* = \max(w - \eta, C^*)$.

both entrepreneurs, $G^* = G_{\min}$. Accordingly,the equilibrium rate of return on loans faced by both entrepreneurs will be:

$$R_L^* = \frac{(1+r) - (1-p_H)\beta G_{\min}}{p_H}. \tag{40}$$

That is, whenever borrowers are requested to post collateral, the cost of credit conditional on posting collateral is the same irrespectively of the level of exemption. In other words, the decision to post collateral in response to lenders' request results in the same cost of credit independently of the level of exemption. This is due to the fact that whenever an entrepreneur is requested to post collateral, she will post the minimum amount of collateral necessary in order to reach a level of guarantees equal to $G_{\min}$.

Consider a variant of the above example, in which both entrepreneurs operate in the same State, which is characterized by a level of exemption η, and $w_1 - \eta > G_{\min} > w_2 - \eta$ so that only entrepreneur 2 will be requested to post collateral. The cost of credit for borrower 2 will be still given by equation (40), while the cost of credit for borrower 1, who is not requested to post collateral, will be

$$R_L^E = \frac{(1+r) - (1-p_H)\beta \min(w_1 - \eta, (1+r)/\beta)}{p_H}, \tag{41}$$

which is strictly lower than (40), since $w_1 - \eta > G_{\min}$. Hence, for a given level of exemption, η, the cost of credit faced by a borrower who is requested to post collateral is higher than that faced by a borrower who is not requested to post any collateral. In other words, posting collateral – given that borrowers are posting collateral only if requested – is associated with a higher cost of credit.

Moreover, we note that (41) is increasing in η, which means that such effect decreases with exemption: the cost of credit for borrowers who are not requested to post collateral and yet have not enough non-exempt wealth to secure the loan increases with exemption. Moreover, this also implies that the higher the exemption, the smaller the increase in the cost of credit as we move from an entrepreneur who is not posting collateral to one who is posting it being requested to do so.

ii. Collateral, exemption, and access to credit. If $w < G_{\min}$, the level of guarantees that the entrepreneur needs to post in order to be financed, would be equal to $G_{\min}$, i.e. $G^* = G_{\min}$. Therefore, the numerator of equation (39) does not depend on η. As for the denominator, higher levels of η result in lower values of G^* for wealthy borrowers. Hence, if any, the only effect of an increase in η is to increase the denominator of equation (39) by increasing the number of entrepreneurs who apply for credit. Therefore, an increase in the level of exemption has either no impact, or reduces the fraction of entrepreneurs who are rationed conditional on demanding credit. The intuition is that as η goes up, more entrepreneurs are demanding credit, while the increase in η has no impact on those who are going to be rationed.

Summarizing, the empirical implications of the model are as follows:

i. Whenever lenders request collateral, the cost of credit conditional on posting collateral does not change with the exemption level, η;

ii. For a given level of exemption, η, borrowers who post collateral face a higher cost of credit than borrowers who do not. Hence, posting collateral is associated with an increase in the cost of credit. This effect is weaker the higher the exemption level;

iii. The cost of credit for borrowers who are not requested to post collateral and yet have not enough non-exempt wealth to secure the loan increases with the exemption level, η.

iv. Credit rationing, defined as the ratio between the number of entrepreneurs who are denied credit and those who apply for it, is either not affected or affected negatively by an increase in the exemption level, η.

6 Model with adverse selection

Consider now a different version of the above market, characterized by the following new assumptions. Entrepreneurial investment delivers an overall R with probability of success p and 0 otherwise (with probability $1-p$), where p is now a function of entrepreneur's type, q

$$p = \begin{cases} p_H \, if & q = H \\ p_L \, if & q = L \end{cases}, \tag{42}$$

rather than effort, with $p_H > p_L$. A fraction λ of the population of entrepreneurs is of type H (safe) and a fraction $1-\lambda$ is of type L (risky). We assume $p_L R > (1+r)$, which means that both safe and risky entrepreneurs are worth financing.

Ex ante, entrepreneurs' quality is private information and so is information about wealth. In other words, individual wealth is not observable ex ante. However, entrepreneurs can credibly disclose information about its true value at zero cost if they want to. Ex post, in the event of default, wealth is observable and verifiable. All other assumptions are unchanged.

6.1 Contracts, sorting condition and signaling role of collateral

Following Besanko and Thakor (1987), we define a lending contract, $\mathcal{C}$, as a triplet, (R_L, C, π), where R_L is the cost of credit, C is the amount of collateral, and π is the probability to be financed; that is, $\mathcal{C} = (R_L, C, \pi)$.[7] As in the model with MH, given borrower's wealth, w, and exemption level of the State where the entrepreneur operates, η, a contract is the level of real guarantees associated with the contract $\mathcal{C} = (R_L, C, \pi)$ is

[7]As in the case of moral hazard, we neglect the amount of financing, which is necessarily equal to one if financial exchange takes place.

$$G = \min(\max(w - \eta, C), \max(\frac{R_L}{\beta}, C)). \quad (43)$$

It is important to note that, other things equal, G is weakly increasing in C, and decreasing in η.

Sorting condition. The expected payoff for an entrepreneur of type q signing a generic contract, $\mathcal{C}$ is, $p_q(R - R_L) - (1 - p_q)G$. Let $\mathcal{C}_1$ and $\mathcal{C}_2$ two contracts with $\pi_1 = \pi_2 = 1$, $C_1 > C_2$ and $R_{L,1} < R_{L,2}$ such that $G_1 > G_2$. Note that $C_1 > C_2$ implies $G_1 > G_2$, if η is sufficiently high and β is sufficiently low, relative to the other parameters' values. Then, if

$$p_L(R - R_{L,1}) - (1 - p_L)G_1 \geq p_L(R - R_{L,2}) - (1 - p_L)G_2, \quad (44)$$

$$p_H(R - R_{L,1}) - (1 - p_H)G_1 > p_H(R - R_{L,2}) - (1 - p_H)G_2, \quad (45)$$

holds. This follows directly from $p_H > p_L$. That is whenever entrepreneurs of type L prefer the contract characterized by more real guarantees, entrepreneurs of type H strictly prefer such contract. This implies, in principle, that entrepreneurs of type H could signal their type by self-selecting into a contract characterized by a level of guarantees sufficiently high. In turns, since guarantees are a weakly increasing function of collateral, this means that collateral has a potential role as sorting/signaling device.

Signaling role of collateral as a function of exemption, η. The effectiveness of collateral as a signaling/sorting mechanism depends upon the level of exemption, η. Under no exemption, i.e. if $\eta = 0$, independently of whether they post collateral or not, entrepreneurs' wealth is liquidated in the event of default. Hence, posting collateral does not provide any meaningful signal. In the opposite extreme case of unlimited exemption, i.e. if $\eta \to \infty$, entrepreneurs' wealth is liquidated in the event of default if and only if they post it as collateral. Hence, the opportunity cost of posting collateral increases with exemption. But then, since such cost of capital is type dependent, this implies that the signaling power of collateral is enhanced.

6.2 Equilibrium analysis

The sequence of actions is as follows:

Stage 0: Entrepreneurs and lenders meet in the credit market. Lenders simultaneously offer credit contracts; Entrepreneurs decide whether to disclose information about their wealth or not,[8] whether to demand credit or not, and under which contract;

Stage 1: Contracts are signed (if any), and payoffs are realized.

[8]Another way of saying it is that banks decide whether to ask entrepreneurs to disclose information by offering contracts that require entrepreneurs to do so, or not.

We focus on symmetric Subgame Perfect Nash Equilibria (SPBE) in pure strategies. We define an equilibrium as set of strategies for entrepreneurs and lenders, such that:

1. Lenders and entrepreneurs' strategies constitute best replies at all stages given, other agents' strategies, and the belief function;

2. The belief function is consistent with agents' strategies;

3. Lenders' make zero profits.

We characterize the set of equilibrium contracts in two steps. First, we consider the simple case in which all borrowers have the same level of wealth w. Then we generalize the result to any borrower's wealth distribution.

6.2.1 Borrowers homogeneous with respect to wealth, w

For convenience, let us re-define contracts, in terms of guarantees, G, rather than collateral, C.[9] We will characterize the equilibrium in the general case in which exemption is strictly positive, $\eta > 0$, and then briefly characterize the equilibrium the special case in which $\eta = 0$. We start our equilibrium analysis with three preliminary results.

1. In any equilibrium, lenders must be making zero profits. Consider an equilibrium in which lenders offer $\mathcal{C}^L \equiv (R_L^L, G^L, \pi_L)$, and $\mathcal{C}^H \equiv (R_L^H, G^H, \pi_H)$ to risky and safe borrowers respectively, such that those lenders who are able to lend make positive profits.[10] Since we assume $E < L$, there will be lenders not able to lend, who make zero profits. Then, one of these lenders could deviate and offer a contract $\mathcal{C}^{L'}$, characterized by a cost of credit, $R_L^{L'} = R_L^L - \epsilon$. Clearly, borrowers of type L strictly prefer this contract compared to the equilibrium ones. Moreover, since ϵ can be chosen arbitrarily close to zero, profits of the deviating lender will be strictly positive. Hence, the described deviation is profitable, which destroys the equilibrium. Hence, in any equilibrium, lenders who are offering a contract $\mathcal{C}^L$ must be making zero profits. This also implies that in any separating equilibrium, where $\mathcal{C}^L \neq \mathcal{C}^H$, lenders must be making zero profits on each of the equilibrium contracts.

2. So long as $\eta > 0$, the standard result of models with competitive screening applies according to which, no pooling equilibrium exists. Consider a candidate pooling equilibrium characterized by a contract $\mathcal{C}^P = (R_L^P, G^P, \pi^P)$. The equilibrium contract satisfies lenders' zero profits' condition:
$$\mathcal{C}^p : p_M R_L^P + (1 - p_M)\beta G^P = 0 \tag{46}$$
where $p_M \equiv \lambda p_H + (1-\lambda)p_L$. Suppose first that the level of guarantees equals the level of collateral, $G^P = C^P > 0$. Consider a deviation, $\mathcal{C}' = (R', G', \pi_P)$ where, $R' = R^P + \Delta R$,

[9] Once we derive the equilibrium contracts in terms of G, we can recover the equilibrium values of C.
[10] Note that in a pooling equilibrium, $\mathcal{C}^L = \mathcal{C}^H$ holds.

and $G' = C' = C^P - \Delta C$ where $\Delta R = \beta(1 - p_L)/p_L \Delta C + \epsilon$, so that such deviation will be always strictly profitable to lenders so long it attracts borrowers. Borrowers of type L strictly prefer a contract characterized by a higher interest rate and a lower collateral compared to the equilibrium contract $\mathcal{C}^P$ so long as $\Delta R \leq (1 - p_L)p_L \Delta C$. It is then immediate to verify that for $\epsilon \to 0^+$, the above deviation will attract at least borrowers of type L, which destroys the candidate equilibrium. Suppose now that $G^P > C^P$. In this case, a deviation characterized by a lower level of collateral has no effect. Consider, instead, a deviation, $\mathcal{C}' = (R', C', \pi_M)$ where, $R' = R^P - \Delta R$, and $C' = \Delta C + G^P$ where $\Delta R = -\beta(1 - pH)/p_H \Delta C + \epsilon$, so that such deviation will be always strictly profitable to lenders so long it attracts borrowers of type H. Borrowers of type H strictly prefer a contract characterized by a higher interest rate and a lower collateral compared to the equilibrium contract C^P so long as $|\Delta R| > (1 - p_H)p_H \Delta C$. Differently, borrowers of type L will prefer the new contract if $|\Delta R| > (1 - pL)p_L \Delta C$. Given $p_L < p_H$, $(1 - p_L)p_L \Delta C > (1 - p_H)p_H \Delta C$. It then follows that, for $\epsilon \to 0^+$, the above deviation will attract only borrowers of type H, and it would be strictly profitable for both lenders and borrowers of type H, which destroys the equilibrium.

Given points 1-2 above, with no loss of generality, we focus on separating equilibria (SE), which by definition, are equilibria where safe types separate from risky types. We disregard the existence problem and focus on equilibrium characterization.[11] We analyze first the special case in which all borrowers are homogeneous in wealth, w, and information about individual wealth is common knowledge. Then, we deal with the more general case in which borrowers are heterogeneous with respect to wealth, and information about individual wealth is private albeit disclosable at no cost.

Consider a candidate SE equilibrium where lenders offer contracts, $\mathcal{C}_H = (R_L^H, G_H, \pi_H)$ and $\mathcal{C}_L = (R_L^L, G_L, \pi_L)$, such that, rich and safe self-select into contract $\mathcal{C}_H$ and risky select into contract $\mathcal{C}_L$. These contracts should satisfy the following constraints:

1. Borrowers' incentive compatibility constraints

$$(ICC_H) : \pi_H[p_H(R - R_L^H) - (1 - p_H)G_H] \geq \pi_L[p_H(R - R_L^L) - (1 - p_H)G_L], \tag{47}$$

$$(ICC_L) : \pi_L[p_L(R - R_L^L) - (1 - p_L)G_L] \geq \pi_H[p_L(R - R_L^H) - (1 - p_L)G_H]; \tag{48}$$

2. Feasibility constraints

$$G_i \leq w, \tag{49}$$

$$G_i \geq \max(w - \eta, 0), \tag{50}$$

$$\pi_i \leq 1 \tag{51}$$

[11] The standard argument applies according to which there is no guarantee that a competitive equilibrium exists. Having said that, there exist parameter configurations such that the equilibrium exist. We characterize the unique equilibrium (outcome) under parameter configurations that guarantee existence.

$$\pi_i \geq 0 \tag{52}$$

with $i = L, H$;

3. Borrowers' participation constraints:

$$p_H(R - R_L^H) - (1 - p_H)G_H \geq 0, \tag{53}$$

$$p_L(R - R_L^L) - (1 - p_L)G_L \geq 0; \tag{54}$$

4. Lenders' zero-profits constraints:

$$p_H R_L^H + (1 - p_H)G_H\beta = (1 + r) \Rightarrow R_L^H = \frac{(1 + r)}{p_H} - \frac{(1 - p_H)\beta G_H}{p_H}; \tag{55}$$

$$p_L R_L^L + (1 - p_L)\beta G_L = (1 + r) \Rightarrow R_L^L = \frac{1 + r}{p_L} - \frac{(1 - p_L)\beta G_L}{p_L}. \tag{56}$$

Our first observation is that –since liquidation of borrowers' asset is an inefficient way of corresponding cash flows to lenders, due to $\beta < 1$ – in any equilibrium, the level of guarantees played by risky types should be minimum. Accordingly, in any SE, $C_L^* \leq \min(w - \eta, R_L/\beta)$ must hold (no distortion at the bottom), so that,

$$G_L^* = \min(w - \eta, \frac{1 + r}{\beta}), \tag{57}$$

and R_L^* is determined accordingly by the zero profit constraint, (56).[12] In order to prove that $C_L^* \leq \min(w - \eta, R_L/\beta)$ must hold, consider a candidate SE such that the contract designed for L-type entrepreneurs is characterized by $C_L > \max(w - \eta, R_L/\beta)$, so that $G_L = C_L$. Consider a deviation to a contract such that $G' = C' = C_L - \Delta C$ and $R' = R_L + \Delta R$, where $\Delta R = \beta(1 - p_L)/p_L \Delta C + \epsilon$. It is immediate to verify that such contract will be strictly profitable to lenders if it can attract any borrower. In fact, L-type borrower would strictly prefer this contract if $\Delta R \leq (1 - p_L)p_L \Delta C$. This condition is satisfied for $\epsilon \to 0^+$, so that there exist a strictly profitable deviation, which destroys the equilibrium.

Imposing the $G_L = G_L^*$ and $R_L^L = R_L^{L*}$ and substituting for R_L^H using (55), the values of π_H and G_H associated with the optimal contract for safe types, and the value of π_L associated with the optimal contract for risky types solve

$$\max_{\{\pi_L, \pi_H, G_H\}} \lambda\{\pi_H[p_H R - (1+r) - (1-p_H)(1-\beta)G_H\} + (1-\lambda)\{\pi_L p_L(R - R_L^{L*}) - (1-p_L)G_L^*\} + w \tag{58}$$

subject to the constraints 1-4. The Lagrangean associated with the problem is

[12]If $R_L = (1 + r)/\beta$ the loan is safe as the borrower has enough non-exempt wealth to repay the loan even in the event of default.

$$
\begin{aligned}
\mathcal{L} =&\lambda\{\pi_H[p_H R-(1+r)-(1-p_H)(1-\beta)G_H\}+\\
&+(1-\lambda)\{\pi_L[p_L(R-R_L^{L*})-(1-p_L)G_L^*]\}+w\\
&+\tau_H(1-\pi_H)+\tau_L(1-\pi_L)+\gamma_H\pi_H+\gamma_L\pi_L+\theta_H(W-G_H)+\delta_H(G_H-\max(w-\eta,0))\\
&+\mu_H\{\pi_H[p_H R-(1+r)-(1-p_H)(1-\beta)G_H]-\pi_L[p_H(R-R_L^{L*})-(1-p_H)G_L^*]\}\\
&+\mu_L\{\pi_L[p_L(R-R_L^{L*})-(1-p_L)\overline{G}_L^*]-\pi_H[p_L(R-(1+r)+\frac{p_L}{p_H}(1-p_H)\beta G_H-(1-p_L)G_H]\},
\end{aligned}
\tag{59}
$$

where, τ_i, μ_i, with $i=L,H$, and δ_H, θ_H, are the lagrangean multipliers. The first order conditions are:

$$
\frac{\partial\mathcal{L}}{\partial\pi_L} = (1-\lambda)[p_L(R-R_L^{L*})-(1-p_L)G_L^*]+\mu_L[p_L(R-R_L^{L*})-(1-p_L)G_L^*] \tag{60}
$$

$$
-\mu_H[p_H(R-R_L^{L*})-(1-p_H)G_L^*]+\gamma_L-\tau_L=0,
$$

$$
\frac{\partial\mathcal{L}}{\partial\pi_H} = \lambda\{p_H R-(1+r)-(1-p_H)(1-\beta)G_H\}+\mu_H[p_H R-(1+r)-(1-p_H)(1-\beta)G_H] \tag{61}
$$

$$
\mu_L[p_L(R-(1+r)+\frac{p_L}{p_H}(1-p_H)\beta G_H-(1-p_L)G_H]+\gamma_H-\tau_H=0,
$$

$$
\frac{\partial\mathcal{L}}{\partial G_H} = -\pi_H(\mu_H+\lambda)(1-p_H)(1-\beta)-\pi_H\mu_L[\frac{p_L}{p_H}(1-p_H)\beta-(1-p_L)]+\theta_H-\delta_H=0. \tag{62}
$$

We solve for the optimal contracts under two cases: that in which borrowers are rich in the sense that they are endowed with a level of wealth that exceeds the level of guarantees associated with the optimal contract for type-H borrowers; and that in which they are poor in the sense that wealth constraint is binding for those borrowers who self-select into the contract designed for type-H borrowers.

Case a: Sorting rich and safe borrowers from risky one. Consider first the case in which $G_H^* \leq w$ is not binding. We solve the maximization problem under the hypothesis that $G_H^* \in (w, \max(w-\eta,0))$ and then verify the necessary and sufficient condition for that to hold. Given $G_H^* \in (0,w)$, $\delta_H=\theta_H=0$. Accordingly, it follows from the FOC relative to G_H that, $\mu_L>0$,[13] which means that the ICC_L is binding,

[13] $\pi_H[\frac{p_L}{p_H}(1-p_H)\beta-(1-p_L)]$ is positive and $\pi_H(\mu_H+\lambda)(1-p_H)(1-\beta)$ is strictly negative so that, if $\theta_H=\theta_L=0$, $\mu_L>0$ must follow.

$$\pi_L[p_L(R - R_L^{L*}) - (1-p_L)G_L^*] = \pi_H[p_L R - \frac{p_L}{p_H}(1+r) + \frac{p_L}{p_H}(1-p_H)\beta G_H^* - (1-p_L)G_H^*]. \quad (63)$$

It is easy to verify that, if the ICC_L is binding, then the ICC_H is slack, so that $\mu_H = 0$ holds. In turns, the FOC relative to the choice of π_L reduces to:

$$(1 - \lambda + \mu_L)[p_L(R - R_L^{L*}) - (1-p_L)G_L^* + w] + \gamma_L - \tau_L \geq 0. \quad (64)$$

It can be immediately verified that the only possibility is $\tau_L = 1$, which means $\pi_L^* = 1$. As for π_H^*, it follows directly from the relevant FOC that the only possibility is $\tau_H = 1$, which means $\pi_H^* = 1$.[14]

The optimal value of G_H is then found imposing, $\pi_L^* = \pi_H^* = 1$, and solving equation (63),

$$G_H^* = \frac{(1+r)(\frac{p_H}{p_L} - 1) + (1-p_L)(1-\beta)G_L^*}{(1-p_L)(1 - \frac{p_L}{p_H}\frac{1-p_H}{1-p_L}\beta)}, \quad (66)$$

where easy to verify that $G_H^* > G_L^*$ holds, so long as $G_L^* = w - \eta < (1+r)/\beta$, and $G_H^* = G_L^*$ otherwise.[15] Note that $G_H^* > \min(w - \eta, 0)$, directly implies $C_H^* = G_H^* > C_L^*$. Other things equal, there will be always values of w such $G_L^* = w - \eta$, so that $G_H^* > G_L^*$, and $G_H^* < w$, so that the identified solution is coherent with the starting hypothesis that the constraint $G_H^* \leq w$ were not binding.

Finally let us look at the participation constraints. Equivalent to the case of MH, a borrower type $i = H, L$ will apply for credit if and only if

$$G_i^* \leq \frac{p_i R - (1+r)}{(1-p_i)(1-\beta)} = G_i^{\max} \quad (67)$$

There always exists parameter configurations such that the above constraints are satisfied. In particular, other things equal, such constraints are always satisfied for R big enough.

Case b: Sorting poor and safe borrowers from risky ones. Consider now the case in which $G_H^* > w$ so that the constraint $G_H \leq w$ will be binding at the optimal contract. In this case, the optimal values of G_H and G_L, which we call G_H^{**}, and G_L^{**} respectively, satisfy $G_H^{**} = C_H^{**} = w$, and $G_L^{**} = G_L^* = G_L^* = \min(w - \eta, \frac{1+r}{\beta})$ hold, with $C_L^{**} = C_L^* \leq G_L^*$.

We derive the other elements of the optimal contracts under the assumption that that ICC_H is not binding, so that $\mu_H = 0$, and then verify that indeed the ICC_H is not binding. Given $\mu_H = 0$, the FOC relative to the choice of π_L implies $\pi_L^* = 1$ as in the previous case. Then, given

[14]This is also confirmed if we substitute for G_H^* using (63) in the expression for safe borrowers to obtain,

$$\pi_H(p_H R - (1+r)) - \pi_H(1-p_H)(1-\beta)\frac{(1+r)(\frac{p_H}{p_L} - 1) + (1-p_L)(1-\beta)G_L^*}{(1-p_L)(1 - \frac{p_L}{p_H}\frac{1-p_H}{1-p_L}\beta)} \quad (65)$$

which is increasing in π_H whenever safe borrowers are willing to demand credit.

[15]This follows directly from $1 + r > \beta$.

$G_H^{**} < G_H^*$, $\pi_H^{**} < 1$, otherwise the ICC_L would be violated. Furthermore, the FOC relative to the choice of π_H implies that the ICC_L must be binding, so that $\mu_L = 1$. Accordingly, we find the value of π_H^{**} by solving the ICC_L,

$$\pi_H^{**} = \frac{p_L R - (1+r) - (1-p_L)G_L^*]}{[p_L R - \frac{p_L}{p_H}(1+r) + \frac{p_L}{p_H}(1-p_H)\beta w - (1-p_L)w]} \tag{68}$$

where it is immediate to verify that $\pi_H^{**} < 1$.

Characterization of the equilibrium. We are now able to characterize the equilibrium for the case in which borrowers are homogeneous in wealth. Risky borrowers (independently of whether they are rich or poor) self-select into the contract $\mathcal{C}_L^* = \{R_L^{L*}, C_L^*, 1\}$, with $C_L^* \leq G_L^* = \min(w - \eta, \frac{1+r}{\beta})$, so that they are always able to borrow and are never rationed; safe and rich borrowers self-select into the loan contract $\mathcal{C}_H^* = \{R_L^{H*}, C_H^*, \pi_H^*\}$, where $\pi_H^* = 1$, and $C_H^* > C_L^*$, and, $R_L^{H*} < R_L^{L*}$; and, finally safe borrowers self-select into the loan contract, $\mathcal{C}_H^{**} = \{R_L^{H**}, w, \pi_H^{**}\}$, with $\pi_H^{**} < 1$ if they are poor.

6.2.2 Generalization to any wealth distribution

Let us now extend the above characterization to the case in which borrowers are heterogeneous with respect to pledgeable wealth $w \in [0, \overline{w}]$ they are endowed with, and information about individual wealth is private and disclosable at no cost. The key point here is to show that in any SE both risky and safe borrowers have the incentive to disclose their wealth. This is crucial, because then banks can sort risky and safe borrowers conditional on wealth so that the structure of the optimal contracts derived above will hold in equilibrium, as borrowers with wealth w will have access only to contracts specified for borrowers with that level of wealth.

Let us first analyze the incentives that safe borrowers have to disclose their wealth. In any SE, the ICC of borrowers of type L must be satisfied as strict equality. Otherwise, lenders can make extra profits by offering a new contract to safe borrowers, characterized by slightly lower interest rate or guarantees or both. Hence,

$$\pi_L[p_L(R - R_L^L) - (1-p_L)G_L] \geq \pi_H[p_L(R - R_L^H) - (1-p_L)G_H]; \tag{69}$$

must hold for any risky borrower. We note that the LHS of the above constraint is decreasing in G_L . As G_L is increasing in w so long as $w - \eta \leq (1+r)/\beta$, for any borrower of type H, are not disclosing their wealth, the contract offered to them must satisfy,

$$\pi_L[p_L(R - R_L^L) - (1-p_L)\min(\overline{w} - \eta, (1+r)/\beta] \geq \pi_H[p_L(R - R_L^H) - (1-p_L)G_H]; \tag{70}$$

Crucially, for a risky borrower with wealth, w_1, such that $G_{L,1} = \min(w_1 - \eta, (1+r)/\beta) < \min(\overline{w} - \eta, (1+r)/\beta$ the above constraint is satisfied as a strict inequality. Hence, borrowers of type H with the same level of wealth equal to w_1, have the incentive to disclose their wealth because in that case they can be offered a contract conditional on the wealth level, which needs to satisfy only the ICC_L for risky borrowers endowed with that level of wealth, that is

$$\pi_L[p_L(R - R_L^L) - (1 - p_L)(w_1 - \eta) \geq \pi_H[p_L(R - R_L^H) - (1 - p_L)G_H]; \tag{71}$$

which is less strict than the above.

In other words, given a SE in which safe borrowers with wealth w such that $w-\eta < (1+r)/\beta$ are not disclosing their wealth, lenders have the incentive to propose contracts that require safe borrowers to disclose their wealth, as by doing so they can make extra profits and surely attract borrowers.Let us now turn to the incentives of risky borrowers to disclose their wealth. Note that, the above argument does not hold for safe borrowers endowed with levels of wealth such that $w - \eta \geq (1 + r)/\beta$. However, whether these borrowers disclose their wealth or not does not make a difference in terms of the equilibrium outcome.

Consider now incentives of risky borrowers. Consider a candidate equilibrium characterized by the fact that there is a non-empty subset $\mathcal{E}'$ of entrepreneurs heterogeneous with respect to wealth who are not disclosing their wealth, w, for whom $w - \eta > C$ and $C < R^L/\beta$. $\mu(w|e \in \mathcal{E}'$ will be the equilibrium expected value of wealth for an entrepreneur who is not disclosing her wealth, with, $\mu(w|e \in \mathcal{E}') < \sup(w(\mathcal{E}'))$, where $\sup(w(\mathcal{E}'))$ is the level of wealth of the richest entrepreneur who is not disclosing her wealth. In equilibrium, lenders should breakeven in expected terms, given the information available. Hence, for each borrower e with $e \in \mathcal{E}'$, the equilibrium contract satisfies,

$$p_H R_L^{'} + (1 - p_H)\beta G' = 1 + r \tag{72}$$

where, $G' = \min(\mu(w|e \in E') - \eta, \frac{R_L}{\beta})$. It is then immediate to verify that if disclosing her wealth, the richest entrepreneur who is not disclosing it, would be better off by doing so, she will increase the level of expected guarantees she is offering the lenders, thereby reducing the cost of credit, which destroys the candidate equilibrium.[16]

Define, $\overline{G}_L^* \equiv \min(\overline{w} - \eta, \frac{R_L}{\beta})$ the level of guarantees associated with the equilibrium contract for the risky and wealthiest borrowers who are posting collateral, $\overline{C}_L^* \leq \overline{w} - \eta$. Note that, according to the above discussion, these entrepreneurs are disclosing their wealth. Correspondingly,

$$\overline{G}_H^* \equiv \frac{(1 + r)(\frac{p_L}{p_H} - 1) + (1 - p_L)(1 - \beta)\overline{G}_L^*}{(1 - p_L)(1 - \frac{p_L}{p_H}\frac{1-p_H}{1-p_L}\beta)} \tag{73}$$

defines the level of real guarantees that a safe borrower need to offer in order to self-select into

[16] As in the case of MH, by doing so, she will increase the level of expected guarantees she is offering the lenders to $G'' = \sup(w(\mathcal{E}')) - \eta$, thereby reducing the cost of credit. Given that, ex post, her true wealth will be observable and verifiable anyway, the advantage of disclosing the information ex ante is clear.

the debt contract characterized by $\pi^*_H = 1$. Then, all safe borrowers with wealth $w < \overline{G}^*_H$ cannot self-select into the debt contract characterized by $\overline{G}^*_H$. These borrowers will post collateral $C^{**}_H = w$, thereby offering guarantees $G^{**}_H = w$ (Note that these entrepreneurs might disclose their wealth or not). These borrowers will be rationed with positive probability $1-\pi^{**}_H$. All risky borrowers will self-select into contracts characterized by collateral $C^*_L \leq w - \eta$, and guarantees equal to $G^*_L = \min(w - \eta, R_L/\beta)$, and will never be rationed (note that these borrowers will be disclosing their wealth).

Hence, the fraction of rationed borrowers will be

$$cr = \frac{\sum_{w<\min(\overline{G}^*_H, G^{\max}_H)} \pi^{**}_H(w)E(w)}{\lambda \sum_{W:G^{**}_H, G^*_H \leq G^{\max}_L} E(w) + (1-\lambda) \sum_{W:G^*_L \leq G^{\max}_L} E(w)} \tag{74}$$

6.3 Empirical implications

The empirical implication of the adverse selection model are as follows.

i. Exemption, collateral and cost of credit Consider two borrowers, one risky and one safe, homogeneous in wealth, w. Suppose borrowers are rich, in the sense that $w > G^*_H$. For a given level of exemption, η, the difference in the cost of credit faced by risky and safe borrowers, respectively, is as follows:

$$\Delta R_L = \frac{1+r}{p_L} - \frac{(1+r)}{p_H} + \frac{(1-p_H)G^*_H\beta}{p_H} - \frac{(1-p_L)\beta G^*_L}{p_L}, \tag{75}$$

where $G^*_L = \min(w - \eta, R^{L*}_L/\beta)$.

The marginal effect on G^*_H induced by an increase in G^*_L is,

$$\frac{dG^*_H}{dG^*_L} = \frac{(1-\beta)}{1 - \frac{p_L}{p_H}\frac{1-p_H}{1-p_L}\beta} < 1. \tag{76}$$

The overall effect on the differential between the cost of credit of rich and safe and risky is

$$\frac{d\Delta R_L}{dG^*_L} = \frac{(1-p_H)\beta}{p_H}\frac{dG^*_H}{dG^*_L} - \frac{(1-p_L)\beta}{p_L} \tag{77}$$

Since, $\frac{dG^*_H}{dG^*_L} < 1$ and $p_H > p_L$ hold, this finally implies,

-

$$\frac{d\Delta R_L}{dG^*_L} < 0 \tag{78}$$

We know that $G^*_L = \min(w-\eta, R^{L*}_L/\beta)$ is a generally a weakly decreasing function of exemption, that is $dG^*_L/d\eta \leq 0$. Furthermore,G^*_L is strictly decreasing η for sufficiently high levels of η. Therefore, given that marginal effect of G^*_L on ΔR_L is negative, we can conclude that the interest rate differential conditional on posting collateral, goes up (down) as the level of exemption goes up (down). In other words, the effect of collateral on the interest rate goes up with the level of exemption.

Consider now the case of poor borrowers, ie. $w < G_H^*$. In the case such difference is equal to:

$$\Delta R_L|_{G_H^*=w} = \frac{1+r}{p_L} - \frac{(1+r)}{p_H} + \frac{(1-p_H)w\beta}{p_H} - \frac{(1-p_L)\beta G_L}{p_L} \tag{79}$$

We note that as the level of exemption decreases (increase), this will eventually result in an increase (reduction) of the level of guarantees offered by risky borrowers, $G_L^* = \min(w-\eta, \frac{R_L}{\beta})$, while the guarantees offered by safe borrowers stay unchanged. This will reduce (increase) the cost of credit faced by risky borrowers compared to safe and poor borrowers. Hence, also for safe and poor borrowers, the effect of posting collateral on the cost of credit they face, compared to risky borrowers, increases with the level of exemption.

ii. Exemption, collateral, and access to credit Notably as the level of exemption decreases the amount of collateral that a safe borrowers need to post in order to be not rationed increases. Hence, given a wealth distribution, more safe borrowers fall in the poor category, and will be rationed. Hence, we should observe a negative correlation between exemption level and rationing. Furthermore, as in the moral hazard model, a reduction of the level of exemption might discourage entrepreneurs from applying for credit. This effect reinforces the conclusion that a reduction in exemption should result in more credit rationing.

Summarizing,

i. Other things equal, for a given level of exemption, the decision to post collateral results in a lower cost of credit

ii. The reduction in the interest rate associated the decision to post collateral goes up with exemption

iii. The fraction of rationed individuals over total number of individuals demanding credit goes down with exemption (The probability of a safe borrower being rationed goes down with exemption).

7 Empirical analysis

7.1 The empirical model of the loan contract

We model the firm-bank relationship as a two dimensional contract in which the interest rate and the probability of posting collateral are jointly determined. The contract stems from a selection process in which firms that need credit can be either denied the loan, discouraged from applying or are financed by the bank. This selection process may give rise to a selectivity bias that we will consider later.

The estimation strategy of the contract has to appropriately take into account the endogeneity that arises because of the simultaneous determination of the elements of the loan contract. In fact, the interest rate on the loan and the probability of posting collateral are likely to be simultaneously determined in the bargaining between the firm and the bank. The level of collateral is an unobserved continuos variable, while the observed variable is the dichotomous dummy equal one if the firm posts collateral. The financing contract can be represented by a system of two simultaneous equations, one for the interest rate and the other for the probability of posting collateral. The estimation procedure and the identification problem that arises in such cases is discussed in Maddala and Lee (1976), and it is referred in the literature as 'two stage probit least square'. To show the nature of the problem we start from the following generic model:

$$R_L^* = \gamma_1 C^* + \beta_1^{'} X_1 + \varepsilon_1 \tag{80}$$

$$C^* = \gamma_2 R_L^* + \beta_2^{'} X_2 + \varepsilon_2 \tag{81}$$

in which R_L^* and C^* are observed as follows:
$R_L = R_L^*$
$C = 1 \ if \ C^* > 0$
$C = 0$ otherwise
and γ_1 and γ_2 are both different form zero.
The simultaneous equation model arising from above is then:

$$R_{L_i} = \gamma_1 C_i + \beta_1^{'} X_{1,i} + \varepsilon_{1,i} \tag{82}$$

$$C_i = \gamma_2 R_{L_i} + \beta_2^{'} X_{2,i} + \varepsilon_{2,i} \tag{83}$$

where R_L is a continuos endogenous variable (interest rate),

C is a dichotomous endogenous variable (dummy equal 1 if firm posted collateral), which is observed only if $C^* > 0$, i.e. if firm has posted a positive amount of collateral, and zero otherwise,

X_1 and X_2 are matrices of exogenous variables,

β_1 and β_2 are vectors of parameters of the exogenous variables,

γ_1 and γ_2 are the parameters of the endogenous variables,

ε_1 and ε_2 are the error term and i subscript denotes cross sections.

We estimate the system of the two simultaneous equations in which R_L is the interest rate and C a dummy equal one if the firm posted collateral in order to be financed, and a set X_1 and X_2 of control variables. The method of estimation for the model and the routine used to implement a two stage probit least square are presented in Keshk (2003).

7.2 Data

The data in this paper have been obtained from the Survey of Small Business Finances (SSBF), which has been conducted in 2004-2005 for the Board of Governors of the Federal Reserve System. The public data set provides information for a sample of 4240 firms, selected from the target population of all for-profit, non-financial, non-farm, non-subsidiary business enterprises that had fewer than 500 employees and were in operation as of year-end 2003 and on the date of the interview. The Survey collected information on the availability and use of credit and other financial services along with information on firm demographic characteristics for up to three individual owners, and other information on the number of workers, organizational form, location, credit history, income statement and balance sheet data.

The survey asks the respondents to provide information whether the firm applied for credit during the last three years (from 2001 to 2003) and, in that case, whether the most recent application for credit was denied. Moreover, the survey reports information on whether in the same period the firm, though it needed credit, did not apply for loans fearing rejection. As in Berkowitz and White (2004) we use these information to define a dummy variable that equals one if the firm either was discouraged form applying for loans or the application was turned down by the bank. These firms are considered credit rationed.

For all the firm that in the same period have been always or sometimes financed the survey provides some information on the most recent loan contract. In particular, we use information on the interest rate applied to the loan and whether the firm had to post some collateral to secure the loan. The firm-bank relationship is measured along three dimensions: the probability of being credit rationed, the percentage points of the interest rate on the loan and the probability of posting collateral.

7.3 Regressors and descriptive statistics

We include some controls for firm-bank relationship and various firm, entrepreneur and loan characteristics as control variables in the interest rate and collateral equations.

Sorensen and Chang (2006) provide wide evidence of the positive relationship between entrepreneur experience and firm profit. To catch the managing experience effect we include the number of years of the principal owner's managing experience. We expect a negative effect on interest rate as we expect that a greater experience is positively correlated to higher profit and hence generating a higher probability of success for the venture.

Belonging to a minority group has been found to reduce the probability of obtaining a loan (Cavalluzo and Wolken, 2005; Berkowitz and White, 2002), while Cerqueiro and Penas (2011) found evidence that owners belonging to a minority group rely more heavily on their own funds to finance a start up. We include two dummies: the first is equal one if the principal owner is black, the other is equal one if the owner belongs to other minority groups (asian, hispanic, asian pacific, native american). We include also a dummy indicating whether the owner is female, to verify possible discrimination effects on the loan price. Firm's proprietorship characteristic may have some effect to credit availability and loan contract due to different agency costs compared to those of non-family owned firms. Anderson et al (2003) argue that debt holders often establish informed relationships with managers, and the family's presence may foster these relationships to build over successive generations. Niskanen et al (2010) found some evidence of less credit availability in small Finnish firms when family ownership increases and evidence of less collateral requirement associated with managerial ownership. On the contrary no proprietorship effect on the loan interest rate has been found, suggesting the presence of more relevant agency cost for family ownership.

Firm bank relationship can be represented by several variables, such as firm distance from the bank, previous relationships (e.g. if the firm holds a checking account with the bank or the duration of in years of the relationship with the lender), method of application for the loan, number of banks from which the firm borrows. Local credit market characteristics may also have a role in explaining the loan pricing decision. To consider possible bank local market power we include a dummy equal one if the Herfindahl–Hirschman bank deposit index of local banking market concentration is greater than 1800 (i.e. highly concentrated). Number of credit applications in the previous three years may represent a proxy of the firm need for financial resources. Given other firm characteristics many or frequent applications may signal the bank the existence of financial distress or greater investment opportunities. Credit score can be used to signal quality to the bank and may have an effect on interest rate. To measure this effect we include a dummy equal one if firm credit score is in the top 25% of the distribution.

Loan characteristics may affect loan price in several ways. Larger amount granted are associated to lower interest rates, as well as longer loan maturity or loan with fixed interest rate. The type of loan granted may also affect loan price. In order to assess differences in price, we consider three dummies equal one if the loan is a line of credit, it is a mortgage or if it is with fixed interest rate.

Finally we include the logs of sales to account for dimensional effects and a measure of firm financial structure, the ratio of debt on total asset, to catch for the impact of leverage on the loan contract.

The level of bankruptcy homestead and personal property exemptions are also included in the dataset according to firm geographical location. The public version of the SSBF reports firm location only for nine census divisions (New England; Middle Atlantic; East North Central; West North Central; South Atlantic; East South Central; West South Central; Mountain; Pacific). For States with unlimited homestead exemption we set it to the average dollar value of firms' assets in the sample. Average exemption is then computed for each census division and included in the dataset.

In tables 1 to 3 are displayed the descriptive statistics for the variables included in the regression, for the whole sample and for the two subgroups of firms that post or not collateral.

The sample of 3480 firms reduces to 1699 when we consider those that received a new loan during the period of the survey. Among these, more than half are required to give collateral to secure their loans. On average the cost of credit for firms posting collateral is 0.6% higher compared to the ones that don't give guarantees. Firms posting collateral more likely operate in a more concentrated credit market, apply for a longer maturity and have a lower credit score.

7.4 Empirical Results

The two theoretical models have the following empirical predictions regarding the relationship between the cost of credit (R_L) and collateral (C):

i. Moral Hazard

a. For a given level of η, borrowers posting $C > 0$ face a higher cost of credit than borrowers who do not;

b. The value of R_L conditional on posting $C > 0$ does not change with exemption (η).

ii. Adverse Selection

a. For a given level of η borrowers posting $C > 0$ face a lower cost of credit than borrowers who do not;

b. Increasing η results in a lower R_L conditional on posting $C > 0$.

In table 4 and 5 we report the estimation results of the simultaneous equation model for the whole sample. We find a negative relationship between $R_L$and C. Other things equal, the decision of posting collateral is associated with an average reduction in the cost of credit by 37 base points. Consistently, a higher interest rate results in a lower probability of posting collateral. Both results support the prediction from the adverse selection model against the moral hazard one.

In table 6 to 9 we report the results obtained dividing the sample in two subsamples, one including firms located in groups of states with average homestead and personal property exemption level below the mean (low exemption), and the other including firms located in group of states with exemption level above the mean. The two ways negative relationship between collateral and cost of credit which is stronger and statistically significant only in the group of the high exempt firms. This offer further support to the adverse selection model, and to the role of collateral as signal device.

7.5 Selection process

Until now we have not considered that we observe a loan contract only for those firms that have been selected by the bank. This may give rise to a selection bias in the estimation.

We model access to credit as a decision tree in three steps (see Fig. 1). In the first stage the firm decides if additional credit is needed. If so, in the second step the potential borrower can be financed or rationed (e.g. turned down or discouraged). Finally, in the third stage a loan contract is realized. Hence, the contract elements, namely interest rate, collateral, maturity and amount granted are observed in the subsample of financed firms, which is a non random sample, being the result of a selection process.

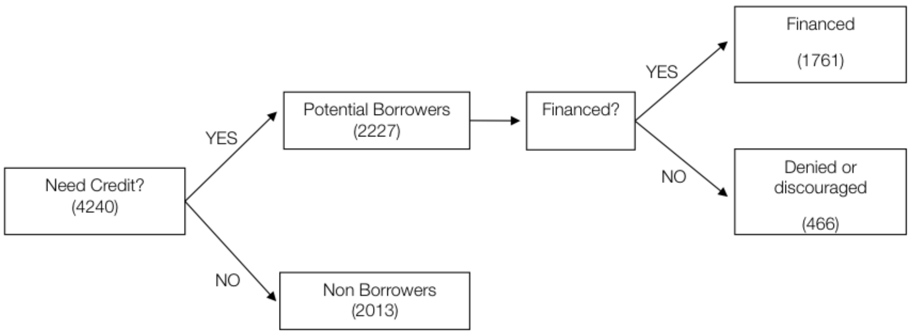

Figure 1:

Formally, the equation of the cost of credit (82):

$$R_{L_i} = \gamma_1 C_i + \beta_1^{'} X_{1,i} + \varepsilon_{1,i} \tag{84}$$

is observed depending on a latent model F^* that may be identified as the bank 'propensity to finance' firm i:

$$F^*{}_i = \alpha_1' Z_{1,i} + u_{1,i} \tag{85}$$

where $Z_{1,i}$ is a set of publicly known variables that affects bank's propensity to finance;

α_1' is a vector of parameters;

ϵ_1, u_1 are $\sim N(0, 0, \sigma_1, 1, \rho)$, where ρ is the correlation between ϵ_1 and u_1; $\sigma_2 = 1$ is the same normalization used to identify a probit model.

The continuos variable F_i^* is not observable, we observe a dichotomous variable F_i that takes on two values:

$$F_i = \begin{cases} = 1\, if & \alpha_1' Z_{1,i} + u_{1,i} > 0 \\ = 0\, if & \alpha_1' Z_{1,i} + u_{1,i} \leq 0 \end{cases} \tag{86}$$

Taking expectation we obtain the regression model for R_L:

$$E(R_{Li} \mid F_i^* > 0) = E(R_{Li} \mid u_{1.i} > -\alpha_1' Z_{1,i}) = \gamma_1 C_i + \beta_1' X_{1,i} + \rho\sigma \frac{\phi(\alpha_1' Z_{1,i})}{\Phi(\alpha_1' Z_{1,i})} \tag{87}$$

As we model selection (i.e. only loan contracts for financed firms are observed) $\lambda_i(-\alpha_1' Z_{1,i}) = \frac{\phi(\alpha_1' Z_{1,i})}{\Phi(\alpha_1' Z_{1,i})}$ represents the non selection hazard, or the inverse Mill's ratio.

We obtain the vector $\lambda_i(\cdot)$ estimating a bivariate probit with selection for F_i. Firms are financed or rationed by the bank provided they apply for a loan. Thus the bank's willingness to finance is observed only for the selected sample of applicants. The selection equation models the firm's decision to apply, while the second equation estimates the probability it is financed by the bank. From the linear prediction of this second equation we obtain the inverse Mill's ratio $\lambda_i(\cdot)$ to be used int the equation for the cost of credit.

We employ maximum-likelihood to estimate the following simultaneous probit model:

$$NC_i = \alpha_0 Z_{0,i} + u_{0,i} \tag{88}$$

$$F_i = \alpha_1 Z_{1,i} + u_{1,i} \tag{89}$$

where NC_i is a dichotomous variable equal 1 if a firm need additional credit (i.e it is a potential borrower);

Z_0 are a set of determinants of firm's need for a loan;

and $u_{0,i}$ and $u_{1,i}$ are the correlated error terms.

Equation 88 is the selection equation, while equation 89 estimates firms' probability to receive a loan. The ML estimation results are reported in table 10. We reject the null hypotheses of independence of the two equations.

In tables 11 to 15 are reported the estimation of the simultaneous model of equations (82) and (83) augmented by the inverse Mill's ratio. In the whole sample the non selection hazard is significant. The marginal effect of posting collateral on the cost of credit remain substantially unchanged (-0.378) and so are almost all the other parameters. The two exceptions are the effect of a good credit score and of being black on interest rate which are reduced once we control for selection bias. For low homestead exemption subsample our variable of interest (posting collateral) remain not significant after plugging the inverse Mill's ratio in the equation. In the high exemption level sample the effect of posting collateral on the cost of credit is reduced by two base points. However the inverse Mill's ratio is not significant. One possible explanation for these results is that the lower is the level of exemption the less the collateral works as a signal and the more important is the chance of being/not being financed in determining the cost of credit. However this issue need to be further analyzed.

8 Conclusions

We analyzed the effects of bankruptcy exemption in a competitive credit market characterized either by adverse selection or moral hazard. Differently from the existing literature, we explicitly allow for the fact that borrowers can undo the effects of bankruptcy exemption by posting collateral. We find that, under moral hazard, (i) For a given level of exemption, the cost of credit is in general higher for those borrowers who (are requested to) post collateral than for those who do not post collateral; (ii) The cost of credit conditional on posting collateral does not change with the exemption level; (iii) Exemption has either no effect on credit rationing or reduces it. Differently, under adverse selection, (i) For a given level of exemption, borrowers posting collateral face a lower cost of credit than those who do not post collateral, and; (ii) This effect is stronger the higher is the level of exemption; (iii) Exemption has either no effect on credit rationing or reduces it. We test the simultaneous relationship between the decision to post collateral and the cost of credit in a sample of US small businesses. The empirical result offers support for the adverse selection mechanism.

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Table 1: Summary statistics: whole sample

Variable	Mean	Std. Dev.	Min.	Max.	N
Interest rate on loan (%)	2.821	3.435	0	30	3480
Dummy=1 if firm posted collateral	0.556	0.497	0	1	1699
Homestead and personal property exemption* ($)	522801.085	828016.856	25660	2228878	3480
Dummy=1 if Fixed interest rate	0.442	0.497	0	1	1699
Dummy=1 if lending was a new line of credit	0.082	0.274	0	1	3480
Dummy=1 if lending was a mortgage	0.047	0.211	0	1	3480
Dummy=1 if firm's Credit score is top 25%	0.365	0.481	0	1	3480
Number of credit applications	0.714	2.011	0	50	3480
Natural log of total sales	13.635	2.182	3.989	19.167	3436
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.489	0.5	0	1	3480
Owner managing experience (n. of years)	21.813	11.365	0	65	3423
Dummy=1 if Owner is female	0.2	0.4	0	1	3398
Dummy=1 if Owner is black	0.026	0.159	0	1	3398
Dummy=1 if Owner belongs to an ethnic minority other than black	0.077	0.267	0	1	3480
Years of firm bank relationship	11.467	10.644	0	96.333	3440
Distance of firm from bank (miles)	14.882	99.935	0	2650	3440
Debt on total asset	1.582	11.729	0	460.789	3408
Dummy=1 if firm is family owned	0.811	0.392	0	1	3480
Dummy=1 if lending was a new line of credit	0.082	0.274	0	1	3480
Dummy=1 if firm's Credit score is top 25%	0.365	0.481	0	1	3480
Loan original maturity (n. of months)	44.968	58.924	0	576	1613
Amount granted over total applied	1.11	1.236	0.054	40.313	1699
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.489	0.5	0	1	3480
Dummy=1 if firm has limited liability	0.715	0.452	0	1	3480
Dummy=1 if firm has been rationed sometimes	0.039	0.193	0	1	1699
Dummy=1 if Owner is female	0.2	0.4	0	1	3398
Years of firm bank relationship	11.467	10.644	0	96.333	3440
Dummy=1 if firm is family owned	0.811	0.392	0	1	3480

*Homestead unlimited exemption is set to the average dollar value of firms' assets in the sample

Table 2: Summary statistics: firms not posting collateral

Variable	Mean	Std. Dev.	Min.	Max.	N
Interest rate on loan (%)	6.134	3.177	0	30	754
Homestead and personal property exemption* ($)	506506.596	824641.855	25660	2228878	754
Dummy=1 if Fixed interest rate	0.459	0.499	0	1	754
Dummy=1 if lending was a new line of credit	0.184	0.388	0	1	754
Dummy=1 if lending was a mortgage	0.023	0.149	0	1	754
Dummy=1 if firm's Credit score is top 25%	0.405	0.491	0	1	754
Number of credit applications	1.017	1.852	0	20	754
Natural log of total sales	14.173	1.902	6.586	19.081	752
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.448	0.498	0	1	754
Owner managing experience (n. of years)	21.891	10.884	0	55	740
Dummy=1 if Owner is female	0.174	0.38	0	1	734
Dummy=1 if Owner is black	0.019	0.137	0	1	734
Dummy=1 if Owner belongs to an ethnic minority other than black	0.061	0.24	0	1	754
Years of firm bank relationship	12.034	11.016	0.167	96.333	754
Distance of firm from bank (miles)	9.028	37.667	0	500	754
Debt on total asset	1.005	3.007	0	53.42	751
Dummy=1 if firm is family owned	0.779	0.416	0	1	754
Dummy=1 if lending was a new line of credit	0.184	0.388	0	1	754
Dummy=1 if firm's Credit score is top 25%	0.405	0.491	0	1	754
Loan original maturity (n. of months)	33.524	42.889	0	576	698
Amount granted over total applied	1.207	1.777	0.054	40.313	754
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.448	0.498	0	1	754
Dummy=1 if firm has limited liability	0.781	0.414	0	1	754
Dummy=1 if firm has been rationed sometimes	0.032	0.176	0	1	754
Dummy=1 if Owner is female	0.174	0.38	0	1	734
Years of firm bank relationship	12.034	11.016	0.167	96.333	754
Dummy=1 if firm is family owned	0.779	0.416	0	1	754

*Homestead unlimited exemption is set to the average dollar value of firms' assets in the sample

Table 3: Summary statistics: firms posting collateral

Variable	Mean	Std. Dev.	Min.	Max.	N
Interest rate on loan (%)	5.493	2.125	0	16	945
Homestead and personal property exemption* ($)	514105.25	821793.320	25660	2228878	945
Dummy=1 if Fixed interest rate	0.429	0.495	0	1	945
Dummy=1 if lending was a new line of credit	0.154	0.362	0	1	945
Dummy=1 if lending was a mortgage	0.154	0.362	0	1	945
Dummy=1 if firm's Credit score is top 25%	0.362	0.481	0	1	945
Number of credit applications	1.526	3.081	0	50	945
Natural log of total sales	14.844	1.948	8.516	19.167	939
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.493	0.5	0	1	945
Owner managing experience (n. of years)	23.369	10.805	1	65	918
Dummy=1 if Owner is female	0.136	0.343	0	1	912
Dummy=1 if Owner is black	0.01	0.099	0	1	912
Dummy=1 if Owner belongs to an ethnic minority other than black	0.065	0.246	0	1	945
Years of firm bank relationship	11.363	10.931	0.083	80	945
Distance of firm from bank (miles)	15.469	72.058	0	1110	945
Debt on total asset	1.123	4.43	0.002	116.667	938
Dummy=1 if firm is family owned	0.738	0.44	0	1	945
Dummy=1 if lending was a new line of credit	0.154	0.362	0	1	945
Dummy=1 if firm's Credit score is top 25%	0.362	0.481	0	1	945
Loan original maturity (n. of months)	53.697	67.413	0	432	915
Amount granted over total applied	1.033	0.464	0.1	12	945
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.493	0.5	0	1	945
Dummy=1 if firm has limited liability	0.836	0.37	0	1	945
Dummy=1 if firm has been rationed sometimes	0.044	0.206	0	1	945
Dummy=1 if Owner is female	0.136	0.343	0	1	912
Years of firm bank relationship	11.363	10.931	0.083	80	945
Dummy=1 if firm is family owned	0.738	0.44	0	1	945

*Homestead unlimited exemption is set to the average dollar value of firms' assets in the sample

Estimation results

All estimations are performed employing the number of observations indicated in the tables. The SSBF data set includes 5 implicates. Each implicate includes 4,240 firms. In total, the entire data set contains 21,200 observations. Implicates are used only for those values that were missing and that have been calculated.

Table 4: Simultaneous model: interest rate (whole sample)

Variable	**Coefficient**	**(Std. Err.)**
Dichotomous first stage instrumental variable.	-0.3740**	(0.1099)
Dummy=1 if Fixed interest rate	0.9090**	(0.0605)
Dummy=1 if lending was a new line of credit	-0.2521**	(0.0782)
Dummy=1 if lending was a mortgage	0.5582**	(0.1756)
Dummy=1 if firm's Credit score is top 25%	-0.1767**	(0.0592)
Number of credit applications	0.0282*	(0.0119)
Natural log of total sales	-0.2806**	(0.0209)
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.2466**	(0.0561)
Owner managing experience (n. of years)	-0.0144**	(0.0028)
Dummy=1 if Owner is female	-0.0298	(0.0775)
Dummy=1 if Owner is black	0.8245**	(0.2246)
Dummy=1 if Owner belongs to an ethnic minority other than black	0.6618**	(0.1103)
Years of firm bank relationship	-0.0102**	(0.0027)
Distance of firm from bank (miles)	0.0008†	(0.0004)
Debt on total asset	0.0280**	(0.0071)
Dummy=1 if firm is family owned	-0.2821**	(0.0677)
Intercept	9.9222**	(0.3204)
N	1598	
R^2	0.16	
$F_{(16,7962)}$	82.4057	

Significance levels : † : 10% * : 5% ** : 1%

Table 5: Simultaneous model: prob. of posting collateral (whole sample)

Variable	Coefficient	(Std. Err.)
Continous predicted variable from first stage OLS	-0.2251**	(0.0181)
Dummy=1 if lending was a new line of credit	-0.1556**	(0.0444)
Dummy=1 if firm's Credit score is top 25%	-0.1495**	(0.0330)
Loan original maturity (n. of months)	0.0050**	(0.0003)
Amount granted over total applied	-0.1970**	(0.0339)
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.1613**	(0.0320)
Dummy=1 if firm has limited liability	0.0954*	(0.0439)
Dummy=1 if firm has been rationed sometimes	0.4750**	(0.0901)
Dummy=1 if Owner is female	-0.1328**	(0.0450)
Years of firm bank relationship	-0.0080**	(0.0015)
Dummy=1 if firm is family owned	-0.1160**	(0.0386)
Intercept	1.5446**	(0.1358)
N	1598	
Log-likelihood	-5129.5	
$\chi^2_{(11)}$	1075.1334	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

Table 6: Simultaneous model: interest rate (States with average Low homestead and personal property exemption)

Variable	Coefficient	(Std. Err.)
Dichotomous first stage instrumental variable for Collateral	-0.1403	(0.1055)
Dummy=1 if Fixed interest rate	0.9497**	(0.0686)
Dummy=1 if lending was a new line of credit	-0.0841	(0.0887)
Dummy=1 if lending was a mortgage	0.5519**	(0.1806)
Dummy=1 if firm's Credit score is top 25%	-0.0332	(0.0655)
Number of credit applications	0.0214†	(0.0130)
Natural log of total sales	-0.2714**	(0.0227)
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.0689	(0.0630)
Owner managing experience (n. of years)	-0.0189**	(0.0031)
Dummy=1 if Owner is female	-0.0467	(0.0903)
Dummy=1 if Owner is black	0.9193**	(0.2661)
Dummy=1 if Owner belongs to an ethnic minority other than black	0.2619*	(0.1266)
Years of firm bank relationship	-0.0053†	(0.0031)
Distance of firm from bank (miles)	0.0010†	(0.0005)
Debt on total asset	0.0254†	(0.0150)
Dummy=1 if firm is family owned	-0.3013**	(0.0760)
Intercept	9.8376**	(0.3544)
N	399	
R^2	0.15	
$F_{(16,5978)}$	55.8935	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

Table 7: Simultaneous model: prob. of posting collateral (States with average Low homestead and personal property exemption)

Variable	Coefficient	(Std. Err.)
Continous predicted variable for Interest Rate	-0.2178**	(0.0220)
Dummy=1 if lending was a new line of credit	-0.0798	(0.0515)
Dummy=1 if firm's Credit score is top 25%	-0.0840*	(0.0380)
Loan original maturity (n. of months)	0.0050**	(0.0004)
Amount granted over total applied	-0.1935**	(0.0387)
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.1419**	(0.0369)
Dummy=1 if firm has limited liability	0.1141*	(0.0504)
Dummy=1 if firm has been rationed sometimes	0.8383**	(0.1181)
Dummy=1 if Owner is female	-0.1976**	(0.0538)
Years of firm bank relationship	-0.0091**	(0.0018)
Dummy=1 if firm is family owned	-0.0620	(0.0449)
Intercept	1.4230**	(0.1621)
N	399	
Log-likelihood	-3867.3	
$\chi^2_{(11)}$	829.9239	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

Table 8: Simultaneous model: interest rate (States with average Low homestead and personal property exemption)

Variable	Coefficient	(Std. Err.)
Dichotomous first stage instrumental variable for Collateral	-0.7271**	(0.2478)
Dummy=1 if Fixed interest rate	0.8188**	(0.1294)
Dummy=1 if lending was a new line of credit	-0.8367**	(0.1729)
Dummy=1 if lending was a mortgage	0.4320	(0.3742)
Dummy=1 if firm's Credit score is top 25%	-0.6961**	(0.1364)
Number of credit applications	0.0315	(0.0265)
Natural log of total sales	-0.3224**	(0.0432)
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.6980**	(0.1186)
Owner managing experience (n. of years)	-0.0064	(0.0062)
Dummy=1 if Owner is female	0.1756	(0.1513)
Dummy=1 if Owner is black	1.1179*	(0.4410)
Dummy=1 if Owner belongs to an ethnic minority other than black	1.5802**	(0.2248)
Years of firm bank relationship	-0.0202**	(0.0056)
Distance of firm from bank (miles)	-0.0003	(0.0009)
Debt on total asset	0.0233**	(0.0084)
Dummy=1 if firm is family owned	-0.3452*	(0.1608)
Intercept	10.8895**	(0.6195)
N	1199	
R^2	0.24	
$F_{(17,1966)}$	32.9924	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

Table 9: Simultaneous model: prob. of posting collateral (States with average High homestead and personal property exemption)

Variable	Coefficient	(Std. Err.)
Continous predicted variable for Interest rate	-0.1919**	(0.0303)
Dummy=1 if lending was a new line of credit	-0.3660**	(0.0907)
Dummy=1 if firm's Credit score is top 25%	-0.3690**	(0.0709)
Loan original maturity (n. of months)	0.0055**	(0.0006)
Amount granted over total applied	-0.1971**	(0.0723)
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.1906**	(0.0672)
Dummy=1 if firm has limited liability	0.0653	(0.0930)
Dummy=1 if firm has been rationed sometimes	-0.2538†	(0.1476)
Dummy=1 if Owner is female	0.0277	(0.0841)
Years of firm bank relationship	-0.0022	(0.0031)
Dummy=1 if firm is family owned	-0.3038**	(0.0789)
Intercept	1.6712**	(0.2612)
N	1199	
Log-likelihood	-1236.9	
$\chi^2_{(12)}$	310.3729	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

Table 10: Prob. of being Financed | need credit: Dependent variable Dummy=1 if firm has been financed

Variable	Coefficient	(Std. Err.)
Prob. of being Credit worthy		
Debts on equity	-0.0023*	(0.0010)
Dummy=1 if firm has delinquency records	-0.1574**	(0.0116)
Dummy=1 if firm has limited liability	0.1963**	(0.0318)
Firm's Age	0.0193**	(0.0015)
Dummy=1 if Owner belongs to ethinc minority	-0.3375**	(0.0405)
Owner total personal wealth	0.0000**	(0.0000)
Dummy=1 if Owner has delinquency records	-0.6064**	(0.0404)
Dummy=1 if Owner is female	-0.1762**	(0.0327)
Intercept	1.1641**	(0.0389)
Selection Equation : Prob. to need credit		
Natural log of total sales	0.1962**	(0.0053)
Financial debts on total liabilities	0.5805**	(0.0260)
Liquidity on total assets	-0.9561**	(0.0425)
Dummy=1 if sales increased wrt last year	0.0833**	(0.0205)
Owner managing experience (n. of years)	-0.0133**	(0.0009)
Intercept	-2.2954**	(0.0735)
athrho	-1.2914**	(0.1026)
N. of obs.	3304	
Censored obs.	1315	
Uncensored obs.	1989	
Log-likelihood	-13285.75	
LR test of indep. eqns. (rho = 0): $\chi^2_{(1)}$	317.68	

Table 11: Simultaneous model: interest rate (Whole sample)

Variable	Coefficient	(Std. Err.)
Dichotomous first stage instrumental variable for Collateral	-0.3788**	(0.1102)
Dummy=1 if Fixed interest rate	0.8968**	(0.0606)
Dummy=1 if lending was a new line of credit	-0.2685**	(0.0783)
Dummy=1 if lending was a mortgage	0.5578**	(0.1757)
Dummy=1 if firm's Credit score is top 25%	-0.1249*	(0.0597)
Number of credit applications	0.0278*	(0.0119)
Natural log of total sales	-0.2524**	(0.0216)
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.2413**	(0.0561)
Owner managing experience (n. of years)	-0.0091**	(0.0030)
Dummy=1 if Owner is female	-0.1273	(0.0794)
Dummy=1 if Owner is black	0.6151**	(0.2279)
Dummy=1 if Owner belongs to an ethnic minority other than black	0.5053**	(0.1136)
Years of firm bank relationship	-0.0093**	(0.0027)
Distance of firm from bank (miles)	0.0009*	(0.0004)
Debt on total asset	0.0273**	(0.0071)
Dummy=1 if firm is family owned	-0.2825**	(0.0678)
Hazard ratio of being financed (Inv.Mill's Ratio)	1.5505**	(0.2746)
Intercept	9.1518**	(0.3522)
N	1596	
R^2	0.16	
$F_{(17,7951)}$	90.72	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

Table 12: Simultaneous model: prob. of posting collateral (Whole sample)

Variable	Coefficient	(Std. Err.)
Continous predicted variable for interest rate	-0.2164**	(0.0178)
Dummy=1 if lending was a new line of credit	-0.1472**	(0.0443)
Dummy=1 if firm's Credit score is top 25%	-0.1470**	(0.0329)
Loan original maturity (n. of months)	0.0050**	(0.0003)
Amount granted over total applied	-0.1981**	(0.0339)
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.1597**	(0.0318)
Dummy=1 if firm has limited liability	0.1047*	(0.0436)
Dummy=1 if firm has been rationed sometimes	0.4616**	(0.0896)
Dummy=1 if Owner is female	-0.1381**	(0.0447)
Years of firm bank relationship	-0.0078**	(0.0015)
Dummy=1 if firm is family owned	-0.1177**	(0.0384)
Intercept	1.4891**	(0.1341)
N	1596	
Log-likelihood	-5126.79	
$\chi^2_{(11)}$	685.71	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

Table 13: Simultaneous model: interest rate (States with average Low homestead and personal property exemption)

Variable	Coefficient	(Std. Err.)
Dichotomous first stage instrumental variable for collateral	-0.1655	(0.1063)
Dummy=1 if Fixed interest rate	0.9350**	(0.0686)
Dummy=1 if lending was a new line of credit	-0.0989	(0.0889)
Dummy=1 if lending was a mortgage	0.5765**	(0.1811)
Dummy=1 if firm's Credit score is top 25%	0.0170	(0.0659)
Number of credit applications	0.0209	(0.0130)
Natural log of total sales	-0.2322**	(0.0237)
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.0628	(0.0631)
Owner managing experience (n. of years)	-0.0119**	(0.0033)
Dummy=1 if Owner is female	-0.1783†	(0.0928)
Dummy=1 if Owner is black	0.6824*	(0.2692)
Dummy=1 if Owner belongs to an ethnic minority other than black	0.0609	(0.1307)
Years of firm bank relationship	-0.0037	(0.0031)
Distance of firm from bank (miles)	0.0010*	(0.0005)
Debt on total asset	0.0222	(0.0150)
Dummy=1 if firm is family owned	-0.2979**	(0.0760)
Hazard ratio of being financed (Inv.Mill's Ratio)	1.9181**	(0.3113)
Intercept	8.8098**	(0.3950)
N	1197	
R^2	0.14	
$F_{(17,5967)}$	66.66	

Significance levels : † : 10% * : 5% ** : 1%

Table 14: Simultaneous model: prob. of posting collateral (States with average Low homestead and personal property exemption)

Variable	Coefficient	(Std. Err.)
Continous predicted variable for interest rate	-0.2047**	(0.0215)
Dummy=1 if lending was a new line of credit	-0.0696	(0.0512)
Dummy=1 if firm's Credit score is top 25%	-0.0820*	(0.0377)
Loan original maturity (n. of months)	0.0050**	(0.0004)
Amount granted over total applied	-0.1956**	(0.0388)
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.1407**	(0.0366)
Dummy=1 if firm has limited liability	0.1273*	(0.0498)
Dummy=1 if firm has been rationed sometimes	0.8181**	(0.1170)
Dummy=1 if Owner is female	-0.2055**	(0.0533)
Years of firm bank relationship	-0.0089**	(0.0017)
Dummy=1 if firm is family owned	-0.0624	(0.0446)
Intercept	1.3408**	(0.1586)
N	1197	
Log-likelihood	-3864.29	
$\chi^2_{(11)}$	825.0821	

Significance levels : † : 10% * : 5% ** : 1%

Table 15: Simultaneous model: interest rate (States with average High homestead and personal property exemption)

Variable	Coefficient	(Std. Err.)
Dichotomous first stage instrumental variable for collateral	-0.7036**	(0.2456)
Dummy=1 if Fixed interest rate	0.8202**	(0.1291)
Dummy=1 if lending was a new line of credit	-0.8144**	(0.1717)
Dummy=1 if lending was a mortgage	0.4182	(0.3720)
Dummy=1 if firm's Credit score is top 25%	-0.6444**	(0.1390)
Number of credit applications	0.0284	(0.0263)
Natural log of total sales	-0.3296**	(0.0429)
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.7825**	(0.1171)
Owner managing experience (n. of years)	-0.0024	(0.0063)
Dummy=1 if Owner is female	0.1410	(0.1536)
Dummy=1 if Owner is black	0.8807†	(0.4523)
Dummy=1 if Owner belongs to an ethnic minority other than black	1.5578**	(0.2309)
Years of firm bank relationship	-0.0221**	(0.0056)
Distance of firm from bank (miles)	0.0000	(0.0009)
Debt on total asset	0.0230**	(0.0084)
Dummy=1 if firm is family owned	-0.3677*	(0.1606)
Hazard ratio of being financed (Inv.Mill's Ratio)	0.4742	(0.5882)
Intercept	10.4906**	(0.6636)
N	399	
R^2	0.24	
$F_{(17,1966)}$	37.78	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

Table 16: Simultaneous model: prob. of posting collateral (States with average High homestead and personal property exemption)

Variable	Coefficient	(Std. Err.)
Continous predicted variable from first stage OLS	-0.1874**	(0.0298)
Dummy=1 if lending was a new line of credit	-0.3531**	(0.0900)
Dummy=1 if firm's Credit score is top 25%	-0.3589**	(0.0703)
Loan original maturity (n. of months)	0.0055**	(0.0006)
Amount granted over total applied	-0.1979**	(0.0713)
Banking market concentration: Dummy=1 if Herfindahl index> 1800	0.2233**	(0.0666)
Dummy=1 if firm has limited liability	0.0768	(0.0923)
Dummy=1 if firm has been rationed sometimes	-0.2761†	(0.1470)
Dummy=1 if Owner is female	0.0170	(0.0836)
Years of firm bank relationship	-0.0026	(0.0031)
Dummy=1 if firm is family owned	-0.3051**	(0.0785)
Intercept	1.5031**	(0.2412)
N	399	
Log-likelihood	-1238.17	
$\chi^2_{(11)}$	236.11	

Significance levels : † : 10% ∗ : 5% ∗∗ : 1%

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Finito di stampare nel mese di Giugno 2014
Presso Centro Stampa dell'Università degli Studi di Cagliari
Via Università 40
09125 Cagliari

www.crenos.it

ISBN 978-88-84-67-870-6

9788884678706