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Does Innovation Affect Credit Access? New Empirical Evidence from Italian Small Business Lending

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DOES INNOVATION AFFECT CREDIT ACCESS? NEW EMPIRICAL EVIDENCE FROM ITALIAN SMALL BUSINESS LENDING.

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Abstract

In this paper we analyze the access to credit of innovative firms on the *price* and *non-price* dimensions of bank lending. Using information from two datasets, we use a propensity score matching procedure to estimate the impact of the innovative nature of firms on: (a) loan interest rates; (b) the probability of having to post collateral; and (c) the probability of overdrawing. Our analysis reveals that banks trade off higher interest rates and lower collateral requirements for firms involved in innovative processes. Further, innovative firms have a lower probability of being credit rationed than their non-innovative peers.

JEL Classification: D82, E43, D40, G21.
Keywords: innovative firms, interest rate, firm's financing, relationship lending.

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1. Introduction

Does innovation affect credit access? Recently, this question has been attracting attention in the economic literature, broadly limited to the issue of credit access from a firm's perspective. By contrast, the credit costs for firms with an innovative activity, i.e. the question of whether banks' lending behaviors reflect more or less prudential preferences toward the nature of these firms, and how these lending behaviors influence the pricing and supply of bank loans, remains an open question. This is especially true where small- and medium-sized innovative firms are concerned.

Due to the importance of small firms' technological activities and their dynamic role on economic growth (Solow, 1957; Act and Audretsch, 1988, 2002), in the last decade important advancements have been made in public policies to stimulate and subsidize research and development activities (R&D) (OECD, 2011). However, despite the role played by public institutions and financial systems to implement and foster investments in start-ups and development of innovative activities with the adoption of various mechanisms of evaluation and screening technologies, the R&D projects of small and medium-sized enterprises (SMEs) remain substantially difficult to finance in a freely competitive loan market. Furthermore, European SMEs, compared to large-sized firms, mainly rely on banks, while market-based financing is quantitatively small (ECB, 2009). Meanwhile, small-sized firms also usually experience access problems to bank loans as they suffer informational opaqueness problems more heavily than large-sized firms (Berger and Udell, 1998).

In the case of innovative SMEs, informational opaqueness and risk may exacerbate difficulties in the access to bank financing. In fact, for established SMEs the provision of bank financing for their R&D activities remains - in qualitative and quantitative terms - largely inefficient and constrained due to their inherent riskiness and weaknesses. For innovative firms, credit access and credit conditions may be worse for many reasons: R&D returns are intrinsically more uncertain and less predictable (Carpenter and Petersen 2002, Hall 2002); R&D appropriability (Levine et al. 2005); firms are reluctant to share information (Himmelberg and Petersen 1994); intangible capital is hardly re-deployable (Mocnik, 2001). Finally, in terms of output and consequently of expected returns, the systematic R&D undertaken by large firms is more effective in product innovation compared to the occasional R&D carried out by SMEs (Santarelli and Sterlacchini, 1990).

Furthermore, as a consequence of the recent financial crisis, the banking system has experienced a structural reform in terms of more stringent capital requirements that may further reduce the banks' propensity to engage in riskier investments, especially in a scenario involving increasingly short-term focus by investors.

Indeed, there is solid evidence emphasizing that internal and equity financing have advantages over debt (Hellmann and Stiglitz, 2000); furthermore demonstrated is how bank debt remains a less suitable source of financing for investment in innovative activities than other internal sources of financing

innovative small-sized firms. Moreover an important source of banks' debt substitute is the financial support of the investments of entrepreneurial start-ups and younger innovative enterprises by venture capitalists (Robb, 2010; Brierley, 2001).

Notwithstanding this, only recently have several empirical works pointed out the importance of the role played by financial intermediation in terms the screening expertise of lenders for the provision of funds for R&D activities and, consequently, the outcomes of innovative firms' investments (Brown et al., 2012; Chava et al., 2013).

However, there is new evidence attesting to the centrality of external finance for people in the process of starting new ventures. Audretsch et all. (2009), using data on 900 nascent entrepreneurs, found that firms use their patents and prototypes in order to signal the project's feasibility and their ability to appropriate the returns from their innovation. Thus, in the case in which the financier perceives the project´s signal to be credible, innovation could impact positively on external financing. They also find that the relation between finance and innovation depends on the specific stage of a start-up lifecycle. Examining the link between liquidity constraints and investment behavior for German firms of different sizes, Audretsch and Elston (2002) find that medium-sized firms appear to be more liquidity-constrained in their investment behavior than either larger or smaller sized firms suggesting that German funding infrastructures succeeded in alleviating liquidity constraints for SBEs.

In general, the aspects that may negatively affect the financing conditions of small and medium innovators, and consequently their opportunities to undertake new investments in R&D activities prevalently originate in two facts.

The first fact depends on the presence of an information gap between entrepreneurs asking for a loan and the bank managers supplying them. The informational opaqueness of small- and medium-sized innovative firms increases the uncertainty between contracting parties, reducing the lender's ability to obtain and screen the private soft information, and consequently the banks' ability of evaluating them.

Soft information, directly gathered during banks' relationship lending or indirectly through interactions with the social context of the borrower, is crucial for both contracting parties. Firstly, for the local bank managers to use the set of information on the proposed borrower's quality and/or ability to undertake the innovative project, with the aim of better discerning the nature of the riskiness involved and the possible success of the innovative investment activities proposed (Berger and Udell, 1998).

Secondly, for SMEs, which rely on the quality of this information to reduce their informational opaqueness, and increase the probability that their investments in innovative activities will be financed. Moreover, while a long lending relationship may reduce the asymmetric information problems facilitating the credit conditions for SMEs, new established firms may not have yet built such relationships (Petersen and Rajan 1995; Berger and Udell 2001), and thus suffer more from

informational opaqueness. In addition, bank financing may be limited for the R&D projects of young firms because of the higher default risk of young companies (Fritsch *et al.* 2006). [4]

This problem may become even more severe as the "Basle II Capital Accord" requires banks to conduct detailed risk assessment based on standardized rating systems (Czarnitzki and Hottenrott, 2011). Moreover, established firms can innovate by building on their previous inventions, e.g., product variation or improvement, while younger firms may need to conduct more fundamental R&D, which requires more resources and is much more uncertain.

The second fact that may negatively affect the lending conditions and compromise the financing of potential R&D investment refers to the risky nature of the activity of innovative firms. Like any investment, R&D "innovative" projects require a considerable amount of financial resources but, with respect to "traditional" ones, it is characterized by higher specific sunk costs for firms (which are never refundable) and by the lower availability of collateral (Hall, 2010). In addition, these fixed costs are independent of the size of the market for innovation, and consequently require a certain amount of collateralization.

Furthermore, the credit access substantially depends on a firm's characteristics and size, and many reasons explain that financing constraints may be particularly binding for smaller innovative firms. Indeed, on one side, SMEs may be disadvantaged because they cannot exploit scale economies and have fewer overall physical assets that could serve as collateral, compared to large capital-intensive companies. On the other, SMEs have to provide a higher level of collateral compared to large innovators or traditional firms, in order to mitigate moral hazard and/or adverse selection problems (Holmstrom, 1989) and attempt to get R&D investments financed. Hence, small and medium sized firms may face different conditions than more established firms.

In addition, innovative firms may be subject to negative cash flows or high return volatility, and this is especially true in the case of small innovative firms, which may have fewer possibilities to diversify their innovative projects and obtain more stable cash flows compared to large innovative firms. Indeed, small businesses generally operate with limited resources (Giudici and Paleari, 2000) and tend to redirect their efforts towards the development of a single research project that requires considerable funding relative to the turnover base. The consequence is a higher degree of project risk, in the face of uncertain returns, rendering innovative firms basically riskier than traditional firms. Another aspect refers to the fact that innovative firms typically base their activity on intellectual capital and intangible assets that amplify the problem of financial opaqueness i.e. investors find it more difficult to evaluate the profitability of their investment projects and, therefore, firms' current and future market value (Hall, 2010).

[4] However, the regulatory reforms introduced in the Italian banking sector in the 90s fostered a pre-entry selection process with firms better equipped to reduce the "try and see" mechanism, applications. This consequently resulted in less informational opaqueness (Santarelli, 2000).

Both information opaqueness and the riskiness of innovative firm activities, by exacerbating the problem of asymmetric information between the contracting parties, increase the bank managers' efforts to assess the quality, investment riskiness and profitability of firm investments. As a consequence, such increased efforts are expected to raise the cost of obtaining financing for SMEs or limit their loan access in quantitative terms, lowering their opportunities to undertake new investments in R&D activities.

To the best of our knowledge, our work is the first to address the problem of the credit access of innovative SMEs undertaking innovative investments in price and non-price terms from a bank's side perspective, overcoming some problems of supply shock. From the point of view of firms recent literature provides evidence of financial constraints for younger and SME innovators (Petersen and Rajan, 1995; Berger and Udell, 2002; Carpenter and Petersen, 2002; Czarnitzki, 2006).

In addition, some studies using innovation survey data stressed the importance of firm innovation activity to have access to loan markets. Freel (2007) is concerned with the extent to which 'innovativeness' is associated with a lower level of loan application success by means of a sample extracted from the "Survey of Enterprise in Northern Britain" over the period 1998-2001. In general, results suggest that the most innovative firms are less successful in loan markets than their less innovative peers – though there is some variation by proxy. Moreover, there is tentative evidence that 'a little innovation may be a good thing'. Testing for financial constraints on R&D investment and how they differ from capital investment, Czarnitzki and Hottenrott (2011) show that internal constraints, measured by mark-ups, are more decisive for R&D than for capital investment. For external constraints, they find a monotonic relationship between the level of constriction and firm size for both types of investment. Using a simultaneous model and a large sample of French firms Savignac (2008) and Hajivassiliou and Savignac (2008) do not find evidence that binding financing constraints discourage innovation. With a sample of UK firms, Canepa and Stoneman (2008) find that for innovation the cost and availability of credit particularly matters for high-tech and small-sized firms.

Data on Italy suggest that the financial structure of innovative firms is oriented more toward internal sources than equity or debt (Colombo and Grilli, 2007; Magri, 2013). Calcagnini et al. (2011) analyzing financial models of innovative firms find that only a small number of the Italian firms interviewed faced problems in raising external funds for innovation, even during the period of the economic and financial crisis. Summing up the aforesaid, empirical findings concerning innovative firms' access to credit are not unique; a prevalence of empirical literature suggests that R&D investment in small or young firms may face higher capital costs and mainly be subject to binding financial constraints than larger or older firms (Czarnitzki and Hottenrott 2011).

In this study we contribute to advancing the previous empirical literature by looking at the context of small business lending to innovative firms from the point of view of the bank, and addressing two important questions.

First, our analysis aims to test whether the innovative nature of firm activities is a key variable in accessing credit markets, i.e. whether banks apply different loan conditions to innovative firms in *price* and *non-price* terms. To address this research question, we estimate two models: (i) a simultaneous-equation model for the interest rate and the collateral requirements; (ii) a Probit model for the likelihood that borrowers will draw more credit than that made available by the bank. However, as argued above, tighter contract terms could be due to the higher opaqueness of innovative firms, to their higher risk, or both.

Thus, in the second part of our analysis, in order to substantiate the two arguments about the nature of differences in credit access of innovative firms – risk and informational opaqueness - we categorize the loans in our sample by dividing them into sub-samples intended to offer cross-sectional variation in the degree of borrower transparency and information asymmetry.

To analyze the credit access of small and medium-sized innovative firms we use a combination of information obtained from two datasets on firms operating in an Italian context. The first dataset contains the entire bank portfolio on more than 15,000 credit lines granted to SMEs by a major inter-regional Italian bank (hereafter, simply *the bank*) in two distinct years. The second dataset identifies innovative firms that carry out a narrow set of innovative activities, signaled for example, by the registration of patents with the Italian Patent Office (IPO), the European Patent Office (EPO), the United States Patent and Trademark Office (USPTO), or participation in national research projects. Eventually, we identified 95 innovative SMEs in 2004 and 109 in 2006, respectively, out of a total of more than 8000 firms.

Innovative and non-innovative firms in the dataset turn out to be different along some dimension which also explains innovation itself and, consequently, the outcome of our models, i.e. bank behaviors in terms of interest rate, collateral requirements and overdraw. Indeed, most innovative firms, for example, are larger sized, while non-innovative ones tend to be smaller, or the former businesses tend to be set up in more highly structured legal forms than the latter. This aspect is known as the 'common support problem': due to the selection processes carried out by the banks that decide how to grant credit among firms, the group of innovative firms is a special and selective one. Thus, to precisely identify the impact of innovation on loan terms, we opted to use propensity score matching (PSM). Specifically, under the matching assumptions, the only observable difference between the treated and the control group on observables is the innovative activity, and hence one can evaluate the effect of innovation on bank contract characteristics by estimating the difference in interest rates, collateral and overdraw between the treated group (innovative firms) and the matched control group (non-innovative firms).

To the best of our knowledge, this paper is the first one to empirically analyze the access to credit by innovative firms in price and non-price terms and from a bank perspective. We improve on the existing literature in two ways. First, our findings confirm theoretical arguments according to which innovative

firms have more difficulty accessing credit, finding a positive association between innovation and interest rates. This result is consistent both with an argument for information-based frictions and with the riskier nature of innovative firms compared to traditional ones. Secondly, we also find that innovative firms face less binding credit limits and thus are less likely to overdraw funds than the others. These findings together suggest that, on one hand, banks evaluate innovative firms to be riskier, and then charge them a higher price. On the other hand, however, banks also recognize that innovative firms are more profitable than other firms, and reward them with less binding credit limits (Freel, 2007).

Our analysis also shows that innovation is a key determinant for the probability that a firm will experience binding credit limits for those firms that are more likely to suffer from problems of information asymmetry. Among them, banks evaluate positively, in term of credit availability, the presence of an innovative activity carried out by the firm. Meanwhile, for those firms who are well known by the bank and for which the loan officers may rely on additional information, being innovative is not a key determinant. These findings seem to suggest that innovation may reduce the presence of credit constraints among those firms that, typically, may suffer more from financing constraints. For these firms, innovation may help to avoid the costly option of overdrawing expensive funds.

The paper is organized as follows. Section 2 describes the dataset employed, while Section 3 analyzes the model specifications. Section 4 discusses our identification strategy. Section 5 shows our empirical findings, and Section 6 concludes.

2. Data and variables

To analyze innovative firms' access to credit we combine information from two datasets. The first proprietary dataset collects information on credit lines granted to small- and medium-sized enterprises (SMEs) by a large Italian bank (hereafter, simply *the bank*). The bank belongs to a major Italian banking group quoted on the Milan Stock Exchange. One of the bank's core businesses is the provision of financing to SMEs, making this dataset ideal for the purposes of our analysis. The sample includes the bank's entire portfolio of credit lines as of September 2004 and 2006, which was mainly concentrated in two Italian provinces.[5] The provinces are also representative of the Italian economic structure, characterized by the presence of a large number of SMEs.[6] Approximately 42.8% of the borrowing firms are *Sole Proprietorships*, accounting for more than 18% of the loans granted by the bank. Other legal business profiles are *Partnerships* (27.6%) and *Corporations* (26.7%) accounting for 27,7% and 43,2%

[5] Less than 4% of the credit lines are granted to firms located in other two neighboring provinces.
[6] Using GDP per capita in Italy in 2006 as a base of 100, both provinces are slightly richer than the average Italian province (110.3 and 101.2, respectively). In both provinces, the manufacturing sector contributes 30% of overall value added, services contribute 68%, and agriculture only 2% (for the aggregate Italian economy, these figures are 27%, 71% and 2%, respectively).

respectively of the total loans granted by the bank. The remaining 2.9% of borrowing firms take the form of *Cooperatives*. Firms operate in more than 23 industry sectors defined at the 2-digit level according to the Italian National Institute of Statistics (ISTAT).

During the timeframe of our study, the bank had more than 60 branches in both provinces. The dataset contains information on loan contract terms (e.g. credit limits, interest rates), bank-borrower relationship (e.g. length and exclusivity, whether the borrower uses other services offered by the bank, rating, collateral, portfolio, the decisional level, etc.), borrower characteristics (e.g. address, sales, industry sector, juridical form, etc.), and characteristics of the local credit market and lending branch (e.g. concentration, province, etc.). Many of these variables permit us to verify whether the relative advantage between innovative and traditional firms is determined by market concentration, by the extent of entry barriers, or by the composition of firm size within the industry (Acs and Audretsch, 1987).

The latter dataset above combines information on firm innovative activities collected by the Regional Government Agency, which aims to promote the collaboration between firms in R&D projects, facilitating their access to technological consultation and improving the knowledge of the regional innovation system. We identify the *innovative firms* within the dataset through a series of innovation activity processes in which they participated in 2004 and 2006. Examples include the registration of patents, projects funded and the involvement and development of R&D projects. A firm is defined as innovative or, more precisely, a "firm that innovates" if it pursued at least one of the activities listed in Table 1 during this period of time. Then, we construct an indicator "*Innov*", which assumes the value of 1 if the firm pursued at least one of the activities reported in Table 1, and 0 otherwise.

Following the above-mentioned criteria, overall we identify 301 innovative firms operating in these provinces. By matching information on the bank's portfolio and firm innovation activities, we identify 234 bank-innovative firm relationships, 110 in 2004 and 124 in 2006, respectively. In 2006 almost 53% of the existing innovative firms borrowed from this bank. As our focus is on small business lending, we follow the EU definition of Small Business Enterprises and exclude 15 innovative borrowers with sales exceeding €50,000,000 from our dataset[7]. Generally, most of the firms that carried out an innovative project in 2004 were also involved in these activities in 2006. However, in the last year available we can observe 14 firms not previously involved in innovative projects. Thus, our final sample contains 95 innovative firms in 2004 and 109 innovative ones in 2006, respectively, showing an increase of about 15%. [8]

[7] The European Commission adopted the definition of Small Business Enterprises in its Recommendation of 6 May 2003 (GUCE L 124/36 del 20/05/2003).

[8] A previous research project on innovation identified 346 innovative firms located in this region in the year 2007. Results showed that in 2007 these firms carried out at least one of the innovative activities listed in Table 1 and constituted a large share of all innovative firms located in this Region. Indeed, they represented around 58% of all residents registered in the

Table 2 reports the descriptive statistics of firms – innovative and traditional - detected in the financial dataset. Definitions and construction of the variables are described in the next section and summarized in the Appendix.

A. Dependent Variables

We analyze the role of innovation on price and non-price terms of the loan contract, i.e.: *Interest rates, Overdraw* and *Collateral.*

The first dependent variable is the interest rate actually paid by the borrower for the utilized amount of credit. The average rate is 7.043%. The difference in the interest rate between innovative and traditional borrowers is, on average, statistically significant: innovative borrowers pay approximately 46 basis points more than traditional ones (6.59 vs. 7.05).

The second dependent variable we consider is *Overdraw*, a dichotomous variable taking the value of 1 if a borrower draws more credit than what is actually granted by the bank in its loan contract and 0 if he/she uses up or utilizes strictly less than the available credit line. In Italy, credit lines provide borrowers with a certain degree of flexibility by either allowing them to not fully utilize the committed credit, free of any charge, or overdraw up to a certain amount, subject to payment of fees and penalty interest rates by the overdrawing customer. Credit availability is tighter for overdrawing firms in the sense that they may count on a lower credit buffer. On average, 22% of borrowers face tight credit limits, i.e. overdraw funds. Furthermore, the frequency with which traditional firms overdraw is significantly higher with respect to innovative ones (6% vs. 22%).

The average credit limit of the contracts in our sample is €117,234 with considerable variation across legal business forms (€49,209 for Sole Proprietorships vs. €189,931 for Corporations). The average amount of credit that is actually used is €72,992, equivalent to 62.26% of the credit limit allowed by the bank (€39,091 for Sole Proprietorships vs. €112,468 for Corporations – equivalent to 79.44% and 59.21%, respectively, of the credit limits set by the bank). Again, overdrawing borrowers are more likely to be located outside the local credit market (24.65% vs. 20.89%) and outside an industrial cluster (23.70% vs. 20.75%).

The third dependent variable of interest we consider is *Collateral.* It is and indicator variable, that takes the value of 1 if the credit line is secured by real collateral, and 0 otherwise. On average, 30 percent of our borrowers are required to provide collateral. This share remains stable if we consider traditional firms, while form innovative firms it decreases to 17.5 percent.

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national register of research projects (universities and state-owned laboratories of research were the remaining 42%) and 50% of all patents registered with the United States Patent and Trademark Office (USPTO) between 1991 and 2007 by residents in this region (Favaretto and Zanfei, 2007). According to Favaretto and Zanfei (2007) firms were concentrated in a few and often non-front-rank innovative activities. Most of the firms (192 over 346, that is 55% of all firms) were included in the sample because they were registered with the national register of research projects.

B. Control Variables

The cost of credit also depends on various borrower and lender characteristics. In order to ensure that our measure of innovation does not capture factors other than innovative activity, we introduced a rich set of control variables related to borrower and lending branch characteristics and the nature of the bank-customer relationship.

Firm Size is measured by the borrower's total sales. As the bank only provides sales categories rather than exact sales amounts, we construct a step variable considering six categories of sales. Construction of the variable is described and summarized in the Appendix. In terms of turnover innovative firms have significantly higher figures than the traditional ones, (on average 4,88 vs. 2,22 million euro). The average borrower in our sample falls into the second category, while the innovative borrower falls into the fourth one. The expected impact of *Firm Size* is an improvement in firms' access to credit, by lowering interest rates and the likelihood of experiencing credit tightness, particularly if innovative firms are involved.

Another borrower characteristic we also consider is the legal business form of the firm. *Corporation* is an indicator that takes the value of 1 if the loan recipient is a corporation and 0 otherwise. In our dataset almost 34% of the borrowers were set up with a corporate form, but only 7.7% of innovative firms are not corporations. The univariate results reported in Table 2 show that innovative firms generally have a more highly structured legal business form and are mainly organized as Limited Liability companies (92% vs. 33% of traditional firms). In our sample firms that innovate have a slightly more highly structured legal business profile compared to traditional firms. This fact could be due to the industrial sector in which they operate (i.e. the secondary sector and manufacturing in particular), by the firm's size and/or by the firm's activity seniority. In the latter case it is possible that younger firms tend to be less structured (Berger and Udell, 1998). To take into consideration differences in the specialization of the borrower, we introduce a dummy variable *Industrial district* that takes the value of 1 if the borrower is located in an industrial cluster and 0 otherwise. From Table 2 we note that 58.5% of our borrowers are located in such clusters but on average the presence of innovative firms is higher than traditional ones (78.5% vs. 58.2% respectively). We also control for sectoral differences in the cost of credit by adding a set of industry indicators based on the ISTAT classification discussed earlier. In particular we build 23 dummies at the 2-digit ISTAT level, which roughly corresponds to the 2-digit SIC classification in the U.S.

We furthermore introduce three measures intended to capture the nature of the bank-borrower lending relationship. First, *Relationship Length* is the number of days since the firm first borrowed from our bank. On average, the firms included in the sample have been clients of the bank for 3,380 days. The average length is 3,353 days for innovative and 5,089 days for traditional firms, respectively. These figures are comparable to findings by Cole (1998), Degryse and Van Cayseele (2000) and in Italy with Gambini and Zazzaro (2012). The latter authors document the fact that firms with fewer than 50

employees maintain credit relationships with their main bank for 12 years on average. In the multivariate analysis, we take a logarithmic transformation of this variable. Second, *Multiple Lending* is a dummy variable designed to capture the exclusivity of the relationship. The variable takes the value of 1 if the firm borrows from multiple banks and 0 if the borrower has an exclusive relationship with our bank. In our sample, only 4% of the firms have an exclusive lending relationship with the bank and we do not notice differences between innovative and traditional firms. Lastly, *Other Services* considers the scope of the bank-borrower interaction (Cole and Wolken, 1995). The variable takes the value of 1 if the firm uses additional services provided by the bank and 0 otherwise. 91,1% of firms utile other financial services from this bank. However, innovative firms tend to use more of these services from the bank respect to their traditional counterparts (97,4% vs. 91%).

To take in account the organizational structure and decision making process of the bank (e.g., Liberti and Mian 2009), we include the variable *Portfolio,* that identifies the operating segment of the bank into which the borrower falls. Specifically, the variable takes the value of 1 if the bank considers the credit line to be part of its *small business market* and 0 if it is part of its *corporate market*. The small business market represents more than 90% of the bank's loan portfolio. It is important to note that the bank might consider a firm with a corporate organizational form to be part of the *small business market* because of the firm's characteristics and services it requires. This distinction has implications for the riskiness of the subset of the loan portfolio and for the internal division that manages the credit line. In our sample innovative firms fall, on average, inside corporate portfolios in 59% of the cases.

We also take into account the hierarchical level of the lending branch in the bank's organizational structure. Therefore, we construct a dummy variable, *Decisional level* that takes the value of 1 if the credit line is managed at the headquarters level and 0 if this happens at a local bank branch. In our sample only the 18% of the credit lines are managed at the headquarters level. This proportion is maintained for traditional firms, whereas the credit lines of innovative firms are managed at the headquarters level, on average, in the 58% of cases.

We also include a branch-based Herfindahl Hirschman Index (HHI), to capture local credit market conditions and competition, calculated in September 2004 and 2006. On average branches are located in contestable markets with an HHI close to 0.21. Moreover, in our formal analysis, time-invariant heterogeneity across bank branches is absorbed through branch fixed effects, while year effects account for differences in the aggregate economic conditions between 2004 and 2006.

Lastly, in order to measure the degree of collateralization of the credit line we construct a step variable *Amount Collateral* that takes the value of 1 if the credit line is not collateralized, 2 if it is collateralized up to 75% of the credit limit, and 3 if the collateral amount exceeds that 75% level. In the multivariate analysis, we use indicator variables for each category of collateralization. Specifically, *D(Collateral i)* takes the value of 1 if the collateralization of a credit line falls into the *i*-th category. Note

that 70% of the credit lines are not covered by collateral, i.e. fall into category 1. The fraction of credit lines in the 2nd and 3rd category is 19% and 11%, respectively.

In case of innovative firms the figures for category 1 and fixed assets and equipment are 82% and 3% respectively.

3. Empirical Models

Our analysis aims to test whether the innovative nature of firms' activities is a key variable in accessing credit markets, and whether the riskiness of their activities may be reflected in the cost of credit - in *price* and *non-price* terms. As argued above, innovative firms are usually characterized by a higher level of opaqueness and more severe asymmetric information problems that could result in costly external funds. However innovative firms, as opposed to traditional ones, tend to experience rapid growth rates and the need to attract increasing amounts of external funds. Thus, in terms of access to credit, innovative firms may or may not face more difficulties than traditional ones, according to whether their weaknesses prevail over their strengths or *vice versa*.

To address our research question, we estimate two models: (i) a simultaneous-equation model for the interest rate and the collateral requirements; (ii) a Probit model for the likelihood of borrowers drawing more credit than that made available by the bank.

3.1 Interest rates and Collateral: Simultaneous-equation model

The first part of our analysis aims at testing whether borrowers' innovative activities influence the loan contract in terms of interest rate and guarantee requirements. We utilize a simultaneous-equation specification that considers the relationship between the presence of collateral, interest rates and innovation. We opted for this framework because, as financial theory suggests, lenders' required return should be positively related to default risk but borrowers could compensate lenders through various combinations of interest rates and collateral (Brick and Palia, 2007 Calcagnini et al., 2014). Hence, it is possible that interest rates and collateral requirements are determined simultaneously in the contracting process. Therefore, we investigate the relationship between innovation, collateral and interest rate by estimating a set of regression equations – one for interest rate and one for collateral – in which the endogenous explanatory variable of one equation is the dependent variable for the other equation in the system. The specification of our system is outlined in equations (1A) and (1B):

$$Rate_{ijt} = c + \alpha\, Innov_{it} + \beta Collateral_{ijt} + \gamma\, Market_{jt} + \delta\, Bank_{it} + \eta\, Firm_{it} + \varepsilon_{ijt} \quad (1A)$$

$$Collateral_{ijt} = c + \alpha\, Innov_{it} + \beta Rate_{ijt} + \gamma\, Market_{jt} + \delta\, Bank_{it} + \eta\, Firm_{it} + \varepsilon_{ijt} \quad (1B)$$

where *Rate* is the interest rate in percentage terms paid by firm *i* in market *j* at time *t* and *Collateral* is a binary dummy variable that takes the value of 1 if firm *i* posts collateral and 0 otherwise. *Innov* is the dummy variable capturing the innovative firms. *Market*, *Bank* and *Firm* are vectors of characteristics related to the local credit market (concentration, industrial district, population, etc.), the bank-firm relationship (credit limit, services, exclusivity of relationship, length, riskiness, rating, portfolio, decisional level, etc.), and firm profile (sales, activity sector, organizational form, etc.). We also include industry, branch and year-specific effects.

If banks evaluate the innovative nature of firm activities to be riskier, interest rates should be higher for innovative firms. In contrast, if banks consider innovative firms more profitable than traditional ones, then the interest rates charged to innovative firms could be lower than those charged to the other firms. Finally, interest rates should be the same for both firms (e.g. innovative and traditional ones) if banks do not evaluate innovative projects or activities. A positive point estimate of a in equation (1A) above would be consistent with the hypothesis that lending to innovative firm is riskier. Tighter contract terms on loans to innovative firms could also be reflected in a higher likelihood of having to pledge collateral compared to traditional firms. In this case, the estimated coefficient of *Innov* in model (1B) below should be positive ($a > 0$). Alternatively, banks may ask for lower collateral requirements to offset higher interest rates, and in this case the estimated coefficient of *Innov* in model (1B) below should be negative ($a < 0$).

Equations (1A) and (1B) explicitly show that *Collateral* and *I_Rate* are determined simultaneously, i.e.: we explain interest rates with collateral but collateral is also explained by interest rates and other variables, and is not exogenous anymore. This result in endogeneity, i.e. *Collateral* (*I_Rate*) is correlated with the error-term, and therefore OLS will lead to biased and inconsistent estimates. Thus, we estimate the system of equations (1A)-(1B) by means of a Three Stage Least Square regression (3-SLS). Differently from 2-SLS, 3-SLS uses the additional information that these equations could be related through their error-terms, thus, increasing the efficiency of the results (Zellner and Theil ,1962). Specifically, we adopt *I_Rate* and *Collateral* as endogenous variables and we use the *Rival Distance*, *Rating*, and *Overdraw* as additional exogenous variables; the latter are not included in any of the system equations (1A)-(1B) - These variables will be added to the exogenous variables in the system and used in the first stage as instruments for the endogenous variables.

3.2 Innovation and credit availability

Lastly, as banks may trade off easier access in exchange for higher credit prices, we focus on the quantity dimension of the loan contract. However, our dataset does not provide information on access, and all firms received LCs. Thus, as explained, we focus on over-drafting after receiving credit. [9]

The underlying rationale is that tighter contract terms on loans for the activities of innovative enterprises would indicate that innovative borrowers are on average riskier, and consequently there could also be implications in terms of credit rationing and availability, and for the likelihood of overdrawing. To investigate, we estimate a Probit model for the probability that a borrower used credit in excess of what is made available by the bank, i.e. overdrew funds, as follows:

$$\Pr(Overdraw=1)_{ijt} = F\left(c + \alpha\, Innov_{it} + \gamma\, Market_{jt} + \delta\, Bank_{it} + \eta\, Firm_{it} + \varepsilon_{ijt}\right) \qquad (2)$$

where *Overdraw* is an indicator that takes the value of 1 if a borrower exceeds the credit limit on the loan contract, and 0 otherwise. *F*(.) is the cdf of the standard normal distribution. The innovation variable *Innov*, and the vectors of controls for market conditions, bank-firm relationship, and firm characteristics (*Market*, *Bank*, and *Firm*, respectively) are the same as those outlined in model (1).

If innovation proxies for riskiness, borrowers dealing with innovation activities should face more binding credit limits and thus should be more likely to overdraw funds. Hence, a positive coefficient ($\alpha > 0$) on the measure of innovation would be consistent with lending practices of constraint. By contrast, a negative coefficient ($\alpha < 0$) on the innovation variable should reflect the fact that banks evaluate the innovation activity pursued positively.

4. Identification: propensity score matching results

The aim of this study is to verify whether innovation is a key variable of interest for lenders, and whether banks apply different conditions on loans granted to innovative and non-innovative firms, i.e. we would like to identify the effect of innovation on loan contract characteristics. Ideally, one should need innovative and non-innovative firms to be identical along every possible dimension other than innovation. Unfortunately, this assumption does not hold in our dataset, as very different types of firm are included in both groups, and innovative and non-innovative firms turn out to be significantly

[9] A concern in using overdraw regards the fact that it is different from not receiving credit at all, but our dataset contains information on interest rates and contract terms only for successful firms: denied firms are excluded, as are firms that chose not to apply. As a consequence, there might be a survivorship bias involved. Indeed, no credit leads to firm failure (Cole, 1998). Analysis of U.S. firms using 2003 SSBF by Cole (2010) shows that denial rate for renewals is an order of magnitude less than for new LCs, suggesting that is it likely that loan terms also differ across new LCs vs. renewals of LCs.

different, as shown from the descriptive statistics in Table 2. Indeed, there were 95 innovative SMEs in 2004 and 109 in 2006, respectively, out of a total of more than 8000 firms.

Thus, we need a method to solve the problem that innovative and non-innovative firms are different along some dimension, which also explains innovation itself and, consequently, the outcome of our models, i.e. bank behaviors in terms of interest rate, collateral requirements and overdraw. Indeed, for example, most innovative firms are larger while non-innovative ones tend to be smaller, or the former tend to be organized in a more highly structured business legal form than the latter. This aspect is known as the 'common support problem': due to selection processes on the part of the banks that decide how to grant credit among firms, the group of innovative firms is a special and selective one.

Thus, we opted to use propensity score matching (PSM), as has been done by, e.g. Almus and Czarnitzki (2003) or Gorg and Strobl (2007), whose research specifically deals with the potential common support problem in analyzing the impact of R&D subsidies on innovation. Under the matching assumptions, the only difference between the treated and the control group on observables is innovative activity, and hence one can evaluate the effect of innovation on bank contract characteristics by estimating the difference in interest rates, collateral and overdraw between the treated group (innovative firms) and the matched control group (non-innovative firms).

One crucial assumption of this approach, though, is unconfoundedness or conditional independence, i.e. that, controlling for observables, the outcomes of the non-treated? control group are independent of innovation (Rosenbaum and Rubin, 1983; Rubin, 2008). Under unconfoundedness, the basic idea is to find in a large group of non-innovative firms similar to the innovative firms in all relevant pre-treatment characteristics X.[10] The match should be based on variables that (i) simultaneously influence the treatment status and the outcome variables (see e.g., Sianesi, 2004; Smith and Todd, 2005); (ii) are unaffected by treatment. Furthermore, over-parameterized models should be avoided (see Bryson et al., 2002) for two reasons, i.e.: (i) including extraneous variables in the propensity score model exacerbates the support problem; (ii) although the inclusion of non-significant variables in the propensity score specification will not bias the propensity score estimates or make them inconsistent, it can increase their variance.

Thus, our final PSM is performed on the following characteristics: *Firm Size*, *Firm Location*, *Governance*, and *Portfolio*. While the first three measures represent exogenous firm characteristics, the latter captures the bank evaluation of the firm, as represented by the operating segment into which the firm falls (*Small Business market* or *Corporate market*). Thus, the logistic equation is as follows:

$$\Pr(Innov=1)_{ijt} = F\left(c + \alpha\, Firm\,Size_{it} + \beta\, Firm\,Location_{it} + \gamma Governance_{it} + \delta\, Portfolio_{it} + \varepsilon_{ijt}\right) \quad (3)$$

[10] Grilli and Rampichini (2011) provide a detailed overview of the most common PSM techniques.

Estimates of the propensity score are shown in Table 3. Then, we match observations on the odds ratio of the propensity score, and once each innovative firm is matched with a non-innovative one, the difference between the outcome of the treated units and the outcome of the matched control units is computed, and the Average Treatment effect on Treated (ATT) of interest is then obtained by averaging these differences. The resulting PSM sample contains 199 innovative and 199 non-innovative firms. As shown in Table 4, the outcome variables (*I_Rate*, *Collateral* and *Overdraw*) do not show statistically significant differences after the PSM; therefore, unconfoundedness or a conditional independence assumption turns out to be satisfied, i.e. controlling for observables, the outcomes of the non-treated control group are independent of innovation itself.

5. Results

5.1 Interest rates and Collateral: Simultaneous-equation model

We begin the discussion of our results with the analysis of the results of the simultaneous-equation model (1A)-(1B) shown in Table 5. We discuss findings in columns (1) and (2) that show the estimated coefficients for the PSM sample, while columns (3) and (4) show estimates for the whole sample for comparative purposes.

We note that the coefficient on the variable that captures the innovative firm, namely *Innov*, is positive and statistically significant in columns (1) and negative in column (2). Thus, our preliminary analysis of the impact of innovation on the cost of credit shows that borrowing firms that innovate pay higher interest rates relative to their counterparts supply-dominated firms. This finding is consistent with the part of the theory according to which innovative firms have more difficulty accessing external sources of funds due to riskier activity and more severe asymmetric information problems. Meanwhile, innovative firms usually rely more on intangible assets and therefore, have less tangible assets to use as collateral (Hall, 2010). Further, estimates are in line with previous empirical studies that found that guarantees have a positive impact on interest rates, supporting the idea that observably riskier borrowers are asked to pledge more guarantees to mitigate the moral hazard problem, i.e. interest rates on secured loans are on average higher than those on unsecured loans, and guarantees are most often associated with riskier borrowers and riskier loans (Berger and Udell, 1990 and 1995; Casolaro et al., 2008; Ono and Uesugi, 2009; Ogawa et al., 2010). Indeed, as long as interest rates increase there is an incentive for riskier borrowers to apply for credit (Stiglitz and Weiss, 1981). Therefore, the impact of a high level of collateral on interest rates may be positive if collateral does not counterbalance the higher borrower risk (Calcagnini et al., 2014).

Local market conditions such as competition (*HHI*) and clusters of economic activity (*Industrial District*) do not have a statistically significant effect either on the interest rate charged by the bank, nor

on collateral (Table 5, column (1) and (2), respectively). This finding could be motivated by the slow-changing nature of these economic measures and the simultaneous inclusion of bank branch fixed effects (Bellucci *et al.*, 2013).

The legal organization of firms influences both interest rates and collateral requirements. Indeed, we find that firms organized as *Corporations* trade off a higher interest rate against lower collateral requirements. The same finding holds for firms belonging to the bank *corporate market:* the estimated coefficients on *Portfolio* show that credit lines, as part of the bank *corporate market,* have higher interest rates and a lower probability of collateral requirements compared to those that are part of the bank's *small business market*.

Further, larger loans pay a lower price for credit, as they are typically associated with larger firms and they also generate economies of scale (Table 5 column (1)). However, as expected, they have a higher probability of being secured, as shown by the estimated coefficient of the variable *Tot. Accorded* in Table 5, Column (2).

Concerning the variables that aim to capture the bank-borrower relationship, we find that borrowers with longer and exclusive lending relationships do not seem to benefit in terms of price, or collateral requirements, or that the use of other bank services is associated with lower interest rates or collateral. Finally, the *Decisional Level* negatively affects the *price* of credit and positively affects the *non-price* term of the loan contract, suggesting that the Headquarters decisional level prefers to trade off a lower interest rate with higher collateral requirements.

In short, the positive association between innovation and interest rates is consistent both with an argument for information-based frictions and with the riskier nature of the innovative firm reflected in the *Innov* variable. On the other side, the fact that innovative firms face fewer collateral requirements seems to suggest that in the case of innovative firms banks trade off higher interests rates with lower collateral, likely because of the nature of this type of firms, typically characterized by higher volatility and lower tangible assets than their non-innovative peers.

5.2 Innovation and credit availability

In Table 6 we examine the relation between innovation and credit availability formalized in Equation (2) above. In the first specification (column 1) we estimate a baseline Probit model that includes only our innovative variable, along with industry, year and branch-specific effects. Industry effects are particularly important as some the most critical variables for evaluating the availability of credit are measures of firm risk as leverage or credit score, and Cole (FM, 2013) finds that industry leverage is highly correlated with firm leverage.

In column (2) we augment the baseline specification including a full set of control variables for firm, loan and bank characteristics. In column (3) we exploit the longitudinal dimension of our dataset using panel data estimators to control for unobserved individual effects, which could systematically

differ among entrepreneurs. To this end, we re-estimate our augmented specification from column (2), including random effects. Indeed, our variable of interest, *Innov*, is nearly time-invariant and we cannot use the Within estimator. Lastly, in column (4) we estimate model (1) by using the Hausman and Taylor (1981) estimator (hereinafter, HT). In this procedure, some explanatory variables are allowed to be correlated with the individual effects, and instrumented with the exogenous regressors, the average across time of the exogenous time-variant regressors and the difference between the endogenous time-variant variable and its individual average. Thus, in column (4) *Tot accorded*, *Relationship Length* and *Multiple Lending* are assumed to be endogenous covariates.[11]

The analysis in Table 6 reveals that borrowers that carry out innovative activities are less likely to overdraw funds, as the coefficient of *Innov* is negative and statistically significant in columns (1) and (2). Specifically, the marginal non-tabulated effect of this variable is equal to -0.08, i.e.: being innovative firms reduces the probability of having to face binding credit limits by 8%. Furthermore, we note that our panel estimators – random effects model in column (3) and Hausman-Taylor model in column (4) where *Tot accorded, Relationship Length* and *Multiple Lending* are assumed to be endogenous covariates – generate results that confirm the negative association between overdraw and innovation.

Thus, our findings suggest a strong association between firms' innovation activities and credit tightness, and this association seems to be in favor of innovation. Indeed, innovative firms are less likely to overdraw funds, and thus face less binding credit limits than their non-innovative peers.

This finding suggests a dual explanation. First, banks gain the advantage of evaluating the riskier innovative firms, charging them a higher price and lower collateral requirements. Secondly, banks also recognize that innovative firms are more profitable than traditional firms, and "repay" them with less binding credit limits.

While the positive association between interest rates and innovative firms is not new to the empirical literature, to the best of our knowledge, we provide the first comprehensive evidence on the fact that the ability of firms to innovate reduces the probability of overdrawing funds. Thus, firms that innovate have better access to the credit market in *non-price* terms; furthermore banks seem to recognize the opportunity of evaluating the potential high growth and profitability of innovative firms positively.

Turning the analysis of the control variables on the availability of credit (Table 6), we find that local market concentration, as measured by *HHI* reduces the probability of overdrawing. This result is also in line with Audretsch and Elston (2002), in which emerging competition has improved access to capital for some groups of firms. Furthermore, firms organized in more structured legal forms, i.e. *Corporations*, have a lower probability of experiencing binding credit limits, in line with the theory according to which more solid firms have better access to credit markets. Finally, collateralized credit lines present a higher probability of overdrawing funds than unsecured ones.

[11] For comparative purposes, Table 7 shows estimates for the full sample.

Table 7 shows estimated coefficients of equation (2) for the full sample, and findings on the impact of innovation on overdraw are confirmed. Furthermore, this Table also shows that the length of the lending relationship has a positive effect on the quantity dimension of the loan contract. Indeed, a long-term banking relationship may benefit the borrowers by helping to build trust between borrowers and lenders (Boot and Thakor, 1994). However, a longer lending relationship might also generate an information monopoly that enables banks to extract rents from firms. Our estimates suggest that the former effect prevails on the latter, i.e.: borrowers with longer bank relationships benefit in terms of credit availability as they are less likely to overdraw costly funds from the bank. Moreover, we find that the use of other bank services is associated with lower probability of overdrawing. Indeed, the scope of the relationship allows banks to accumulate soft information that enhances banks' ability to assess and monitor their customers, and thus to offer better contract terms than other firms. Firms experience a lower probability of overdrawing when their credit lines are managed at the headquarters level, as the indicator *Decisional Level* is negative and statistically significant. Collateralized credit lines continue to present a higher probability of overdrawing funds than unsecured ones. As expected, the amount of credit reduces the probability of binding credit limits (as shown from the estimated coefficient of *Tot. Accorded* in columns (2) to (4) in Table 7), credit lines of the *corporate market* portfolios seem to experience a higher probability of overdraw. The same finding is confirmed for large-sized firms.

To summarize, the positive association between innovation and interest rates is consistent both with an argument for information-based frictions and with the riskier nature of the innovative firm reflected in the *Innov* variable. On the other hand, the fact that innovative firms face less binding credit limits and thus are less likely to overdraw funds seems to be justified by the high levels of profitability and rate of growth that typically are associated with these firms. As we believe that this finding is new and could have interesting policy implications, in the next paragraphs we provide additional evidence on the links between innovation and credit availability.

5.3 Innovation as a Signal: Sub-sample Analyses

The motivation for this study is the recognition that, in terms of access to credit, innovative firms may or may not face more difficulties than traditional ones according whether their weaknesses prevail over their strengths or *vice versa*. On one hand, the innovative nature of their activity implies a higher level of opaqueness and more severe asymmetric information problems. Then, external funds become particularly costly. On the other, innovative firms, as opposed to traditional ones, tend to experience rapid growth rates and the need to attract increasing amounts of external funds, especially risk capital. Our analysis shows that innovative firms pay higher prices than other firms, likely due to their riskiness, and because banks trade off higher interest rates with lower collateral requirements. However, they also face less binding constraints than traditional ones, i.e.: banks consider innovative firms riskier than traditional ones, but assign positive evaluations to the innovative activity they carry out.

As we argue that this finding depends on bank evaluation, in this section we categorize the firms in our sample into sub-samples from a supply-side perspective intended to identify cross-sectional differences in terms of firm transparency. We re-estimate the model of credit availability specified in Model (2) for each sub-sample and draw inferences from these sub-sample analyses shown in Table 8. In each estimation we include the full set of controls used in the estimation of the augmented Probit model in Table 7, column (2).[12]

The first sub-sample categorization considers a measure of the informational advantage of the lending bank for a firm relative to other firms of this bank, i.e. the operating segment type. The sample is divided into two sub-groups: firms that are in the small business portfolio and firms that are in the corporate portfolio. Usually, decisions about the small business portfolio are taken through traditional banking channels at branch premises. By contrast, for firms that fall in the corporate portfolio, bank loan officers usually visit the firm's premises and negotiate the contract terms directly (Bellucci *et al.*, 2013). This sub-sample analysis shows that the coefficient on *Innov* is negative and significant only for firms in the small business portfolio, column (1) of Table 8. Hence, banks evaluate *small businesses* that innovate positively. Meanwhile, when the lender deals with firms in the corporate portfolio, credit availability is not affected by innovation, the decision relies on other firm characteristics.

The second sub-sample division classifies firms according to whether the bank has assigned a credit rating to the firm or not. In the first case, banks rely on additional information about the credit risk of the firm. The findings reveal that firms that innovate face less binding constraints than other firms in the case of they are not rated (4). It follows that, when ratings are available, banks base their decisions on them and are not influenced by the presence or lack of an innovative activity carried out by the firm.

The third part of the sample considers whether the credit line is approved and managed at the local bank branch. In this case, loan officers operating at the branch level may not have enough instruments to evaluate the projects of innovative firms and their potential growth. Hence, one should observe that the importance of innovation in the availability of credit is less pronounced when decisions are taken at a local bank branch. Consistent with this argument, we find that the coefficient on *Innov* is negative and statistically significant only for the sub-sample of firms whose credit lines are managed at the headquarters level (column (5)). These innovative firms are less likely to overdraw funds and exceed their credit limits than traditional ones.

The last sub-sample categorization uses the variable *Relationship Length* to split the sample in two sub-groups: *Short* relationship length (if less than the sample median) and *Long* relationship length (if it exceeds the sample median). The rationale for this partition is that as long as the firm maintains a long-lasting relationship with its bank, loan officers usually base their decisions on soft information accumulated during the years. Diversely, if the firm is a new client or the lending relationship has been

[12] Unfortunately, we cannot perform this analysis on the PSM sample because of the poor number of observations we had in each sub sample.

brief, banks may evaluate the information concerning the innovative nature of the firm in a positive manner. Thus, among firms without a well-established lending relationship, those who are considered innovative may face less binding constraints. As expected, the coefficient on *Innov* is negative and statistically significant only for firms who do not have a long-lasting lending relationship, as shown in column (7).

Overall, our sub-sample analyses reveal that innovation is a key determinant for the probability that a firm will experience binding credit limits for those firms that are more likely to suffer from information asymmetry. Among them, banks evaluate positively, in term of credit availability, the presence of an innovative activity carried out by the firm. Meanwhile, for those firms which are well known by the bank and for which the loan officers may rely on additional information, being innovative is not a key determinant. These findings seem to suggest that innovation may reduce the presence of credit constraints among those firms that, typically, may suffer more from financing constraints.

6. Conclusions

This article carried out an empirical analysis of the access to credit by innovative firms compared to traditional ones in *price* and *non-price* terms. Innovative firms may or may not face more difficulties in credit access than traditional ones, according to whether their weaknesses or strengths prevail. In the first case, innovative firms could incur in higher financing costs, and have a higher probability of being credit rationed than traditional firms. In the second case, the situation could be reversed, and innovative firms could get better credit conditions than traditional ones.

Our findings reveal a positive association between innovation and interest rates, and are consistent both with an argument for information-based frictions and with the riskier nature of innovative firms compared to traditional ones. However, we also find that innovative firms face less binding credit limits and thus are less likely to overdraw funds than the others. These findings together suggest that, on one hand, banks evaluate innovative firms to be riskier, and then charge them a higher price.

At the same time, on the other hand, banks also recognize that innovative firms are more profitable than other firms, and reward them with less binding credit limits (Freel, 2007). Our analysis also shows that innovation is a key determinant for the probability that a firm will experience binding credit limits for those firms that are more likely to suffer from problems of information asymmetry. Among them, banks evaluate positively, in term of credit availability, the presence of an innovative activity carried out by the firm. Meanwhile, for those firms which are well known by the bank and for which the loan officers may rely on additional information, being innovative is not a key determinant. These findings seem to suggest that innovation may reduce the presence of credit constraints among

those firms that, typically, may suffer more from financing constraints. For these firms, innovation may help to avoid the costly option of overdrawing expensive funds.

In terms of policy implications our findings offer many points of interest. Indeed, one of the motivations for this study was the current economic crisis and the critique made of the Italian banking system as being unable to respond to firms' demand for credit. This is especially true for small firms, that are the ones which suffer most from the crisis (Bank of Italy, 2013). This study reveals that firms that innovate could face lower binding constraints. Therefore, a way to overcome the difficulties of credit access should be to undertake proactive behaviors intended to convert the firm's activity from the perspective of innovation.

Further, the importance of innovative firms for economic growth suggests that all economic and institutional actors should cooperate to increase the number of innovative firms. According to this paradigm banks should financially sustain dynamic and efficient firms, and the public sector should promote industrial policies oriented to growth (Rey, 2012).

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TABLE 1 - ACTIVITIES OF R&D

ACTIVITY	DESCRIPTION
CORDIS PROJECTS	Community Research and Development Information Service (Cordis) projects that firms located in these provinces participated in this lapse of time.
USPTO PATENTS	Patents registered to United States Patent and Trademark Office (USPTO) by firms located in our referred provinces.
EPO PATENTS	Patents registered to Europena Patent Office (EPO) by firms located in our referred provinces.
UIB PATENTS	Patents registered to Italian Patent Office (UIB) by firms located in our referred provinces.
NATIONAL REGISTRY OFFICE	Firms registered at "Anagrafe Nazionale delle Ricerche" (ANR). ANR is a national registry office where firms registration' is mandatory obtaining public funds for R&D.
FAR PROJECTS	Projects funded by the Ministry of Education, University and Research (MIUR) through the "Fondo Agevolazioni alla Ricerca" (FAR). FAR is a public national fund supporting firms national projects' in R&D following the laws 299/97, 488, ex l.46.
REGISTER OF LABORATORIES	Register of Laboratories managed by the Ministry of Education, University and Research (MIUR). Firms are registered only after a selective evaluation of activities by a specific departmental office.
REGIONAL PROJECTS	Firms projects' financed by regional funds to incentive R&D with regional law 73°, 73b/2003.

TABLE 2 - SUMMARY STATISTICS: INNOVATIVE VS. TRADITIONAL FIRMS

	All firms		Innovative Firms		Traditional Firms		Means differences
	Mean	*St. dev.*	*Mean*	*St. dev.*	*Mean*	*St. dev.*	p-values
Dependent variables							
Interest rate	7.043	(2.470)	6.588	(2.445)	7.050	(2.470)	0.004***
Overdraw	0.220	(0.414)	0.061	(0.240)	0.222	(0.416)	0.000***
Collateral	0.301	(0.459)	0.175	(0.381)	0.303	(0.459)	0.000***
Innovation variables							
Innov	0.015	(0.123)					
Control variables							
Industrial district	0.585	(0.493)	0.795	(0.405)	0.582	(0.493)	0.000 ***
HHI	0.213	(0.155)	0.165	(0.116)	0.213	(0.155)	0.000 ***
Sales	2.256	(1.673)	4.876	(1.735)	2.215	(1.639)	0.000 ***
Corporation	0.339	(0.473)	0.923	(0.267)	0.330	(0.470)	0.000 ***
Multiple Lending	0.960	(0.195)	0.961	(0.193)	0.960	(0.195)	0.917
Other Services	0.911	(0.284)	0.974	(0.158)	0.910	(0.286)	0.001 ***
Relationship Length	3380	(2724)	5089	(3219)	3353	(3708)	0.000 ***
Portfolio	0.103	(0.304)	0.594	(0.492)	0.095	(0.293)	0.000 ***
Decisional Level	0.178	(0.383)	0.581	(0.494)	0.172	(0.377)	0.000 ***
Credit Limit	117,234	(595,432)	1,008,559	(2,805,378)	103,538	(476,641)	0.000 ***
Credit Used	80,120	(392,907)	542,707	(1,710,773)	72,992	(329,393)	0.000 ***
Rating	5.675	(1.512)	4.923	(2.104)	5.704	(1.478)	0.000 ***

TABLE 3 - PROPENSITY SCORE MATCHING: LOGISTIC ESTIMATION

Dependent variable: *Innov*	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
Portfolio	0.55	0.22	2.53	0.01	0.12	0.98
D (Governance 2)	2.39	0.46	5.22	0.00	1.50	3.29
D (Governance 3)	1.09	0.51	2.12	0.03	0.08	2.09
D (Governance 4)	1.49	0.55	2.69	0.01	0.41	2.58
D (Governance 5)	3.08	0.50	6.12	0.00	2.09	4.07
Province	-2.37	0.42	-5.67	0.00	-3.18	-1.55
D (Sales 2)	0.42	0.51	0.82	0.42	-0.58	1.42
D (Sales 3)	0.96	0.39	2.48	0.01	0.20	1.71
D (Sales 4)	1.79	0.36	5.04	0.00	1.10	2.49
D (Sales 5)	1.94	0.39	5.02	0.00	1.18	2.70
D (Sales 6)	2.13	0.43	4.93	0.00	1.28	2.97
Constant	-7.07	0.44	-16.13	0.00	-7.92	-6.21
Observations		14376				
LR Chi2(12) p value		0.00				
Pseudo R2		0.2632				

Note: The table presents results from the PSM logistic regression (3). PSM is performed by using the psmatch2 (Leuven and Sianesi 2003) Stata command. We used the option nearest neighbor (within caliper, without replacement), and imposing common support. The definition and construction of the variables is provided in the Appendix. * p<0.1, ** p<0.05, *** p<0.01.

TABLE 4 – PROPENSITY SCORE MATCHING: OUTCOME VARIABLES

Outcome Variable	Sample	Treated (*Innov*=1)	Controls (*Innov*=0)	Difference	S.E.	T-stat
I_rate	Unmatched	6.87	7.07	-0.20	0.17	-1.15
	ATT	6.87	6.64	0.24	0.23	1.03
Collateral	Unmatched	0.20	0.31	-0.12	0.03	-3.51
	ATT	0.20	0.22	-0.02	0.04	-0.49
Overdraw	Unmatched	0.06	0.23	-0.17	0.03	-5.56
	ATT	0.06	0.11	-0.05	0.03	-1.80

Note: The table presents outcomes (*I_Rate, Collateral,* and *Overdraw*) before and after the PSM computed according to equation (3). The "unmatched sample" refers to the mean value of outcome variables before the match. The "ATT" represents the mean value of outcome variables after the match.

TABLE 5 – INNOVATION, INTEREST RATE AND COLLATERAL: SIMULTANEOUS-EQUATION ESTIMATES

	Matched sample		Full sample	
VARIABLES	*I_Rate*	*Collateral*	*I_Rate*	*Collateral*
Innov	0.62*	-0.09*	0.37*	-0.10*
	(0.371)	(0.050)	(0.205)	(0.056)
I_Rate		0.14***		0.27***
		(0.041)		(0.003)
Collateral	6.78***		3.65***	
	(2.044)		(0.034)	
Industrial District	0.17	-0.02	0.17*	-0.05*
	(0.539)	(0.080)	(0.091)	(0.025)
HHI	1.83	-0.27	0.37	-0.10
	(2.322)	(0.339)	(0.368)	(0.101)
Corporation	1.28*	-0.18*	0.93***	-0.25***
	(0.688)	(0.105)	(0.059)	(0.016)
Distance	0.13	-0.02	0.06***	-0.02***
	(0.134)	(0.019)	(0.017)	(0.005)
Multiple Lending	0.77	-0.11	0.02	-0.01
	(1.029)	(0.146)	(0.132)	(0.036)
Other Services	0.33	-0.05	0.21**	-0.06***
	(0.996)	(0.145)	(0.083)	(0.023)
Relationship Length	0.02	-0.00	-0.02	0.00
	(0.173)	(0.025)	(0.025)	(0.007)
Portfolio	1.44**	-0.21***	0.13	-0.04
	(0.605)	(0.073)	(0.123)	(0.034)
Decisional Level	-1.23**	0.18**	0.01	-0.00
	(0.568)	(0.078)	(0.085)	(0.023)
Total accorded	-0.70***	0.10***	-0.66***	0.18***
	(0.217)	(0.026)	(0.025)	(0.007)
Province	0.49	-0.08	0.38	-0.10
	(2.979)	(0.429)	(0.284)	(0.078)
D (Sales 2)	-0.94	0.14	0.08	-0.02
	(1.102)	(0.160)	(0.081)	(0.022)
D (Sales 3)	1.09	-0.16	0.45***	-0.12***
	(0.932)	(0.130)	(0.078)	(0.021)
D (Sales 4)	2.36**	-0.34***	1.05***	-0.29***
	(0.944)	(0.125)	(0.093)	(0.025)
D (Sales 5)	0.54	-0.08	1.00***	-0.28***
	(0.883)	(0.124)	(0.131)	(0.036)
D (Sales 6)	0.18	-0.03	0.89***	-0.24***
	(0.944)	(0.136)	(0.206)	(0.056)
Constant	10.84***	-1.56***	11.87***	-3.26***
	(3.472)	(0.600)	(0.426)	(0.119)
Branch effects	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Observations	390	390	14,501	14,501
R-squared	-0.22	-0.82	-1.61	-0.25
Hansen-Sargan overid. Statistic (p-value)	0.72		0.82	

Note: The table presents simultaneous-equation analysis of the impact of innovation on *Interest Rate* and *Collateral* (equations (1A-1B)) by using the reg3 Stata command. Columns (1) and (2) show results from from PSM sample, while columns (3) and (4) show estimates the whole sample. Endogenous variables are instrumented by *Rival Distance*, *Rating*, and *Overdraw* in the first step estimates. Instrument validity is tested by using the overid Stata command after estimation. The table reports point estimates of the coefficients, followed in parentheses by t-statistics, based on robust standard errors. The definition and construction of the variables is provided in the Appendix. * p<0.1, ** p<0.05, *** p<0.01

TABEL 6 – INNOVATION AND OVERDRAW: PSM SAMPLE

VARIABLES	Overdraw (1)	Overdraw (2)	Overdraw (3)	Overdraw (4)
Innov	-0.40**	-0.59***	-0.07**	-0.08*
	(0.172)	(0.192)	(0.031)	(0.044)
Industrial District		0.47	0.04	0.03
		(0.502)	(0.050)	(0.068)
HHI		-9.75***	-0.36*	-0.37*
		(2.744)	(0.185)	(0.196)
Corporation		-1.22**	-0.17	-0.16*
		(0.574)	(0.105)	(0.086)
Multiple Lending		-0.76*	-0.07	0.00
		(0.432)	(0.078)	(0.116)
Other Services		0.53	0.11	0.00
		(0.775)	(0.099)	(0.139)
Relationship Length		-0.11	-0.01	0.05
		(0.160)	(0.025)	(0.045)
Portfolio		0.06	0.00	-0.03
		(0.271)	(0.059)	(0.069)
Decisional Level		0.20	-0.01	-0.07
		(0.495)	(0.090)	(0.078)
Tot. Accorded		-0.19	-0.03	0.00
		(0.188)	(0.027)	(0.041)
Distance		0.08	0.00	-0.01
		(0.155)	(0.015)	(0.014)
D (Collateral 2)		0.20	0.07*	0.04
		(0.287)	(0.039)	(0.048)
D (Collateral 3)		1.77**	0.34*	0.29***
		(0.751)	(0.183)	(0.091)
D (Sales 2)		0.46	-0.01	-0.06
		(0.880)	(0.179)	(0.139)
D (Sales 3)		0.06	0.03	-0.03
		(0.603)	(0.109)	(0.115)
D (Sales 4)		0.58	0.08	0.01
		(0.568)	(0.109)	(0.108)
D (Sales 5)		0.38	0.07	0.01
		(0.537)	(0.104)	(0.109)
D (Sales 6)		0.06	0.02	-0.05
		(0.712)	(0.111)	(0.118)
Province		1.52*	-0.05	-0.12
		(0.904)	(0.133)	(0.328)
Constant	-1.39***	3.64	0.51	0.09
	(0.189)	(2.883)	(0.371)	(0.641)
Branch effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Observations	283	283	396	396

Note: The table presents multivariate analysis of the impact of innovation on *Overdraw* (Model (2)). Column (1) shows results from a baseline Probit model with dependent variable *Overdraw* which takes the value of 1 if the firm exceeds the amount granted on the credit line by the bank and 0 otherwise. Column (2) shows results from an augmented Probit model. Column (3) shows results from a Random Effects model, while column (4) shows estimates from the Hausman and Taylor (1981) estimator with *Relationship Length, Multiple Lending*, and *Tot. Accorded* as endogenous variables. The table reports point estimates of the coefficients, followed in parentheses by t-statistics, based on robust standard errors. The definition and construction of the variables is provided in the Appendix. * p<0.1, ** p<0.05, *** p<0.01

TABLE 7 INNOVATION AND CREDIT AVAILABILITY – FULL SAMPLE ANALYSIS

VARIABLES	Overdraw (1)	Overdraw (2)	Overdraw (3)	Overdraw (4)
Innov	-0.58***	-0.30**	-0.03	-0.03
	(0.126)	(0.133)	(0.019)	(0.036)
Industrial District		0.05	0.02	0.02
		(0.056)	(0.015)	(0.016)
HHI		-0.06	-0.03	-0.03
		(0.109)	(0.029)	(0.042)
Corporation		-0.05	-0.02	-0.01
		(0.040)	(0.010)	(0.010)
Distance		0.02	0.01*	0.01**
		(0.011)	(0.003)	(0.003)
Multiple Lending		-0.05	-0.00	0.01
		(0.072)	(0.017)	(0.022)
Other Services		-0.12***	-0.05***	-0.06***
		(0.045)	(0.016)	(0.014)
Relationship Length		-0.11***	-0.03***	-0.02***
		(0.014)	(0.004)	(0.007)
Portfolio		0.21**	0.06***	0.06***
		(0.089)	(0.020)	(0.021)
Decisional Level		-0.11***	-0.02**	-0.02
		(0.039)	(0.010)	(0.013)
Tot. Accorded		-0.19***	-0.05***	-0.05***
		(0.013)	(0.004)	(0.004)
D (Collateral 2)		0.23***	0.05***	0.05***
		(0.028)	(0.008)	(0.009)
D (Collateral 3)		0.59***	0.17***	0.16***
		(0.045)	(0.014)	(0.012)
D (Sales 2)		0.14***	0.03***	0.03**
		(0.041)	(0.011)	(0.014)
D (Sales 3)		0.11**	0.03**	0.03*
		(0.051)	(0.012)	(0.013)
D (Sales 4)		0.23***	0.06***	0.06***
		(0.056)	(0.014)	(0.016)
D (Sales 5)		0.15	0.04**	0.04*
		(0.096)	(0.020)	(0.023)
D (Sales 6)		-0.12	0.00	0.00
		(0.130)	(0.025)	(0.036)
Province		0.21***	0.07***	0.07
		(0.050)	(0.017)	(0.049)
Constant	-0.77***	2.03***	0.97***	0.91***
	(0.067)	(0.234)	(0.061)	(0.075)
Branch effects	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes
Observations	14,756	14,695	14,695	14,695
(Pseudo) R-squared	0.03	0.08	0.08	

Note: The table presents multivariate analysis of the impact of innovation on *Overdraw* (Model (2)). Column (1) shows results from a baseline Probit model with dependent variable *Overdraw* which takes the value of 1 if the firm exceeds the amount granted on the credit line by the bank and 0 otherwise. Column (2) shows results from an augmented Probit model. Column (3) shows results from a Random Effects model, while column (4) shows estimates from the Hausman and Taylor (1981) estimator. The table reports point estimates of the coefficients, followed in parentheses by t-statistics, based on robust standard errors. The definition and construction of the variables is provided in the Appendix. * p<0.1, ** p<0.05, *** p<0.01

TABLE 8 INNOVATION AND OVERDRAW – SUB-SAMPLE ANALYSIS

	Portfolio		Rating		Decisional Level		Relationship Length	
	SBs	Corporate	Rating	No Rating	HQs	Branch	Short	Long
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Innov	-0.36*	-0.20	0.01	-0.40***	-0.39*	-0.28	-0.46**	-0.02
	(0.202)	(0.298)	(0.316)	(0.144)	(0.224)	(0.181)	(0.227)	(0.227)
Industrial District	0.06	0.04	0.22	0.05	-0.09	0.07	0.07	-0.02
	(0.059)	(0.111)	(0.215)	(0.063)	(0.173)	(0.060)	(0.059)	(0.123)
HHI	-0.04	-0.46	-56.84***	-0.09	-0.10	-0.05	-0.18	0.22
	(0.116)	(0.604)	(6.478)	(0.105)	(0.436)	(0.125)	(0.132)	(0.204)
Corporation	-0.03	-0.39*	-0.12	-0.06	-0.00	-0.05	-0.02	-0.24**
	(0.035)	(0.210)	(0.116)	(0.041)	(0.123)	(0.042)	(0.045)	(0.094)
Distance	0.02	-0.01	-0.06**	0.02**	-0.00	0.02	0.02*	-0.00
	(0.012)	(0.061)	(0.025)	(0.012)	(0.031)	(0.012)	(0.011)	(0.024)
Multiple Lending	-0.08	0.48*	0.16	-0.08	-0.12	-0.04	0.04	-0.21*
	(0.077)	(0.282)	(0.174)	(0.079)	(0.111)	(0.096)	(0.097)	(0.114)
Other Services	-0.12**	-0.12	0.25	-0.13***	0.10	-0.13***	-0.15***	0.02
	(0.046)	(0.213)	(0.316)	(0.044)	(0.157)	(0.047)	(0.047)	(0.162)
Relationship Length	-0.12***	-0.02	-0.08	-0.11***	-0.09*	-0.11***		
	(0.014)	(0.055)	(0.101)	(0.014)	(0.047)	(0.012)		
Portfolio			0.09	0.25**	-0.18	0.36***	0.15	0.46***
			(0.172)	(0.109)	(0.131)	(0.080)	(0.111)	(0.163)
Decisional Level	-0.06	-0.20	-0.33*	-0.07*			-0.08*	-0.24***
	(0.041)	(0.267)	(0.175)	(0.041)			(0.046)	(0.088)
Tot. Accorded	-0.20***	-0.20***	-0.18***	-0.20***	0.02	-0.21***	-0.20***	-0.17***
	(0.012)	(0.075)	(0.054)	(0.013)	(0.057)	(0.013)	(0.013)	(0.034)
D (Collateral 2)	0.24***	0.10	0.14	0.26***	0.20**	0.25***	0.21***	0.23***
	(0.031)	(0.249)	(0.088)	(0.029)	(0.083)	(0.029)	(0.037)	(0.070)
D (Collateral 3)	0.60***	0.28	0.96***	0.59***	0.52***	0.61***	0.56***	0.80***
	(0.046)	(0.249)	(0.202)	(0.047)	(0.126)	(0.047)	(0.053)	(0.087)
Province	0.23***	-0.22**	5.63***	0.16***	-0.11	0.22***	0.24***	0.13
	(0.069)	(0.113)	(0.412)	(0.053)	(0.305)	(0.077)	(0.068)	(0.105)
Constant	2.11***	1.63	10.27***	2.13***	-0.95	2.13***	1.26***	0.94*
	(0.217)	(1.410)	(1.341)	(0.232)	(1.134)	(0.234)	(0.224)	(0.520)
Branch effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Size effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	13,363	1,107	1,314	13,339	2,323	12,304	11,008	3,718
Pseudo R-squared	0.08	0.16	0.13	0.08	0.08	0.07	0.07	0.09

Note: The table presents multivariate analysis of the impact of innovation on *Overdraw* (Model (3)). Columns (1) and (2) show results for the sub-samples of firms considered as part of the Small Business portfolio and Corporate portfolio, respectively. Columns (3) and (4) show results for the sub-samples of firms that are rated or not by the bank, respectively. Columns (5) and (6) show results for the sub-samples of cases where the credit line is managed at the headquarters and at the branch level, respectively. Columns (7) and (8) show results for the sub-samples of firms with relationships shorter and longer, respectively, than the 75th percentile of the bank-firm relationships in the sample. Each regression uses the entire sample period and includes industry, time and bank branch effects. The table reports point estimates of the coefficients, followed in parentheses by t-statistics, based on robust standard errors. The definition and construction of the variables is provided in the Appendix. * p<0.1, ** p<0.05, *** p<0.01

Appendix: List of Variables

Variable	*Definition*
Innovative	A dichotomous variable that take the value of 1 if the firm is involved in many of innovative activities following the classification specified in Table 1, and 0 otherwise.
Interest Rate	The interest rate charged by the bank, expressed as a percentage.
Overdraw	A dichotomous variable that takes the value of 1 if the borrower uses more than the amount granted on the credit line by the bank and 0 otherwise.
Collateral	A dichotomous variable that takes the value of 1 if the borrower's credit line is collateralized by real guarantees and 0 otherwise.
Sales	A step variable that takes the value of: It takes the value of 1 if sales are less than €250,000; 2 for sales between €250,000 and €500,000; 3 for sales between €500,000 and €1,500,000; 4 for sales between €1,500,000 and €5,000,000, 5 for sales between €5,000,000 and €25,000,000; 6 for sales between €25,000,000 and €50,000,000.
D(Sales i)	An indicator variable that takes the value of 1 if the firm's sales fall in the *i*-th category (1 through 6) and 0 otherwise.
Multiple lending	A dichotomous variable that takes the value of 1 if the borrower has multiple bank-borrower relationships and 0 if the borrower has an exclusive relationship with this bank.
Other services	A dichotomous variable that takes the value of 1 if the bank branch provides other (besides the credit line) services to the borrower and 0 otherwise.
Relationship Length	A continuous variable that measures the length of the bank-borrower relationship: constructed as the natural logarithm of 1 + the length of the bank-borrower relationship expressed in days.
Decisional Level	A dichotomous variable that takes the value of 1 if the credit line is managed at the headquarters level and 0 if this happens at a local bank branch.
Amount Collateral	A step variable that takes the value of 1 if the credit line is not secured with collateral, 2 if the line is secured with collateral of less than 80% of the credit line (*Medium collateral*), and 3 if the collateralization is higher than 80% (*High collateral*). Indicator for each collateralization category is used in the multivariate analysis.
D(Collateral i)	An indicator variable that takes the value of 1 if the collateralization of the credit line is in the *i*-th category (1 through 3) and 0 otherwise.
Portfolio	A dichotomous variable that takes the value of 1 if the bank considers the credit line as part of its *small business market* and 0 if it is part of its *corporate market*.
Industrial District	A dichotomous variable that takes the value of 1 if the firm is located within an industrial district area and 0 otherwise.
Corporate	A dichotomous variable that takes the value of 1 if the loan recipient is a corporation and 0 otherwise
Rating	A dichotomous variable that takes the value of 1 if the firm is rated by the bank; 0 if the firm has no rating evaluation.
HHI	A branch-based Herfindahl-Hirschman Index of market concentration. The relevant market for each bank branch is determined by the postal area code where the branch is located.
Tot. Accorded	A continuous variable that measures the total amount accorded: constructed as the natural logarithm of 1+ total amount accorded to the firm.
Governance	This variable stores the firm legal structure into classes. It takes the value of 1 if the firm is organized as Sole proprietorship; the value of 2 if the firm is a Limited liability company; the value of 3 if it is a Partnership; the value of 4 if it is a Limited partnership; the value of 5 if it is a Limited company.
D (Governace i)	An indicator variable that takes the value of 1 if the firm's governance falls in the *i*-th category (1 through 5) and 0 otherwise.

Distance	A continuous variable that measures the bank-borrower distance: constructed as the natural logarithm of 1 + the length of the bank-borrower distance in meters.
Rival distance	Natural logarithm of the 25th percentile of the metric distances between borrower and bank branches of competing banks in the local credit market

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